FRANZ ENVIRONMENTAL INC.

◆ CONSULTING ◆ ENGINEERING ◆ TECHNOLOGIES ◆

Long Term Monitoring, 2012
SWMF Landfill, Roberts Bay, Nunavut

FINAL REPORT

Prepared for:

Aboriginal Affairs and Northern Development Canada
Contaminated Sites Directorate
Nunavut Regional Office
P.O. Box 2200
Iqaluit, Nunavut X0A 0H0

Prepared by:

Franz Environmental Inc.
329 Churchill Avenue, Suite 200
Ottawa, Ontario K1Z 5B8
Tel. (613) 721-0555
Fax: (613) 721-0029

Project No. 1697-1201
January 2013

EXECUTIVE SUMMARY

FRANZ Environmental Inc. (FRANZ) was retained by Aboriginal and Northern Affairs Canada (AANDC) to conduct the second long-term monitoring site visit to the remediated abandoned silver mine site ("the Site") at Roberts Bay, Nunavut, as prescribed by AANDC's Roberts Bay and Ida Bay Long-Term Monitoring Plan. This project was completed under AANDC standing offer number 01-11-6001/5, call-up number 02, and file number 1632-11/01-11-6001/5.

The Site is located on crown land approximately 115 km southwest of the hamlet of Cambridge Bay, south of Melville Sound on the north coast of mainland Nunavut, and approximately 1 km north of Roberts Lake. Access to the Site is by rotary wing aircraft, fixed wing aircraft equipped with floats or by barge. The Roberts Bay site was an active silver mine in the early 1970s and was again the subject of exploration in the 1980s and 1990s. Remedial activity was conducted between 2008 and 2010, remediation consisted of disposal of non-hazardous waste and contaminated soils in on-site facility, the Solid Waste Management Facility landfill (SWMF). The first year of monitoring activities were completed in 2010.

The Site visit to complete the second long term monitoring event was conducted on August 9, 2012 while based out of the nearby hamlet of Cambridge Bay. The Site visit was originally scheduled to take place over two days; however, due to availability of aircraft equipped with floats the Site visit was limited to a single day.

The chemical data obtained through the investigation were compared to historic Site data as well as established guidelines. Site-specific guidelines were used preferentially, although federal guidelines from the Canadian Council of Ministers of the Environment (CCME) were used where necessary. For parameters not covered by CCME guidelines, provincial authorities were consulted.

Based on chemical and ground temperature data analysis as well as visual and photographic investigations, it was determined that the Site and its SWMF continue to operate as designed, and the Site poses no present threat to the natural environment.

This executive summary should be read in conjunction with the main report and is subject to the same limitations described in Section 8.0.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

(in text)

(in appendices)

LIST OF APPENDICES

1.0 INTRODUCTION

FRANZ Environmental Inc. (FRANZ) was retained by Aboriginal Affairs and Northern Development Canada (AANDC) to complete the second monitoring event of the Roberts Bay mine long-term monitoring plan. This project was completed under AANDC standing offer number 01-09-6038, call-up number 02; file number 1632-11/01-11-6001/5.

This report describes the monitoring activities completed in 2012 at the former Roberts Bay silver mine, located on crown land approximately 115 km southwest of the Hamlet of Cambridge Bay, south of Melville Sound in the central Kitikmeot Region of Nunavut (Figure A-1, Appendix A). It was prepared in accordance with the AANDC Request for Proposal (RFP) dated May 14, 2012, FRANZ Proposal No. P-4178, dated June 7, 2012, the Call-up Details, dated June 18, 2012 and the Project Initiating Meeting held on July 12, 2012.

Throughout this report the abandoned silver mine site at Roberts Bay, Nunavut, will be referenced as “the Site.”

1.1 Project Objectives

The overall objective of the Roberts Bay mine long-term monitoring plan is to determine whether the Solid Waste Management Facility (SWMF) landfill constructed at the Site is performing as designed and continues to contain the waste placed within it during the remediation. To achieve this overall objective, visual observation, surface water samples and thermal monitoring were conducted at the Site.

1.2 Scope of Work

The scope of long term monitoring work as described in the Roberts Bay and Ida Bay Long-Term Monitoring Plan (INAC, 2009) was as follows:

1. Visual monitoring of the SWMF, including:
    - Checking the physical integrity of the SWMF and observing any evidence of erosion, ponding, frost action, settlement and lateral movement and completing a visual monitoring checklist.
    - Taking photographs to document the condition of the SWMF and substantiate the recorded observations.
2. Monitoring of surface water in the vicinity of the SWMF, including:
    - Collection of samples from the designated downgradient surface water sampling points.
    - Examination and analyses of the samples for colour, odour, hardness, pH, conductivity, temperature, total and dissolved metals, polychlorinated biphenyls

(PCBs), petroleum hydrocarbon (PHCs), major ions, total dissolved solids (TDS) and total suspended solids (TSS).

3. Soil monitoring in the area around the SWMF, including:
    - The collection of soil samples near the SWMF, if any physical evidence of compromise in landfill integrity is observed (e.g., staining, slumping, erosion).
    - Analyses of the soil samples for inorganic elements (arsenic, cadmium, chromium, cobalt, copper, lead, nickel, and zinc), PCBs and petroleum hydrocarbon (PHCs).
4. Thermal monitoring of the SWMF, including:
    - Collection of data from automatic dataloggers attached to each of the three thermistor strings installed at the SWMF.
    - Analysis of the thermal data to provide ground temperature profiles at various locations within the SWMF.
    - Servicing the dataloggers, as required.
5. Natural environment monitoring
    - Documentation of observations and evidence of humans and wildlife activity present at the Site.
    - Interview with member(s) of the local Hunters and Trappers Organization or other persons knowledgeable of the Site; collection of anecdotal information.
6. Preparation of a report documenting the 2012 monitoring program.

To fulfill the scope of work as described above, Franz along with AANDC, devised a work plan that included the following tasks:

a) Preparation of a health and safety plan;
b) Preparation of a sampling plan for soil and surface water;
c) Excavation of test pits if any physical evidence of compromise in landfill was observed;
d) Collection of soil samples for chemical analysis;
e) Obtaining surface water samples for chemical analysis;
f) Inspection of thermistor installations and collection of datalogger information;
g) Interpretation of analytical data;
h) Visual inspection and photo documentation of the Site;
i) Observing and investigating land use and wildlife trends; and
j) Reporting.

The work plan for the 2012 Site visit was based on information contained within the following documents:

- Roberts Bay and Ida Bay Long-Term Monitoring Plan (INAC, 2009);
- Nunavut Water Board's Water License issued to INAC (NWB, 2008);
- SENES report on the remedial activities program (SENES, 2010); and
- Franz Environmental Inc., 2010 Monitoring Program SWMF Landfill, Roberts Bay, Nunavut (FRANZ, 2010)

1.3 Report Format

The long-term monitoring report is structured as follows:

Section 1 – Introduction: Provides general background information and outlines the scope and objectives of this study.

Section 2 – Background Information: Describes the history and the regional and physical setting of the Site and its general characteristics.

Section 3 – Regulatory Guidelines: Presents the evaluation guidelines used for the assessment of chemical impacts and provides context for the use of certain environmental quality guidelines to assess impacts and screen chemicals of concern.

Section 4 – Investigative Methodology: Presents the methodology, level of effort and details of the field investigations.

Sections 5 – Summary of SWMF Conditions: Describes the physical characteristics and the chemical impacts and distribution above applicable regulatory guidelines of the SWMF.

Section 6 – Surrounding Areas and Natural Environment: Describes the physical conditions of the remainder of the study area, including flora and fauna.

Section 7 – Conclusions and Recommendations: Presents main findings and conclusions as well as recommendations for the next Site visit.

Section 8 – Limitations

Section 9 – References

Section 10 – Closure

2.0 BACKGROUND INFORMATION

2.1 Site Description

Roberts Bay and nearby Ida Bay are two abandoned silver mines located approximately 115 kilometres southwest of Cambridge Bay on the north coast of mainland Nunavut in the central Kitikmeot region of the territory. The Roberts Bay site is located approximately 1 km north of Roberts Lake while the Ida Bay mine site is located adjacent to Melville Sound about 6 km north of the Roberts Bay site.

These two sites were explored between 1965 and 1972 and operated from 1972 to 1975, after which, they were abandoned. Further explorations continued throughout the 1980s and 1990s. Evidence of recent mineral exploration (abandoned drilling equipment and empty drums) was observed near the dock at Roberts Lake during the 2012 monitoring visit (see Photo 35, Appendix A, F).

A remediation project was conducted at the sites between 2008 and 2010. The remediation involved the demolition and disposal of buildings, structures and other debris, as well as the cleanup of hazardous materials. Contaminated soil was excavated and either shipped off site or placed in the SWMF landfill constructed at the Roberts Bay site. All impacted materials were removed from Ida Bay, and no remediation infrastructure requiring monitoring was constructed there. Site visits to Ida Bay are thus not a part of the Roberts Bay long term monitoring program.

The Roberts Bay mine site had been in a state of abandonment for nearly 30 years when remediation activities commenced in 2008. Residual mine-related infrastructure present at the Site prior to remediation included a tailings pond, waste rock piles, abandoned equipment and buildings, non-hazardous wastes and debris (e.g. scrap metal, wood, mill equipment, appliances and burlap bags), hazardous wastes (e.g. petroleum products, batteries, propane tanks, assay lab reagents and some unknown chemicals) and petroleum and metals impacted soil.

The Site also contained two mine openings (one adit and one vertical shaft) and a capped vent raise. The fully-flooded adit was surrounded by a chain-link security fence which had deteriorated over time. The vertical shaft was located on the side of a basaltic ridge and was accessible by climbing the ridge. The shaft was open with partially caved-in walls. A security fence surrounded 2/3 of the perimeter of the shaft, allowing access to the shaft opening. Stability problems surrounding the collar and the vent raise had been addressed with a concrete cap. The two former mine openings and vent raise were fully sealed and re-graded during the remediation; they are no longer visible from the surface.

Geochemical assessment conducted on the waste rock and the tailings at the Site suggested that these materials are non-acid generating.

Constructed during remediation in the summer of 2009, the SWMF is a non-hazardous waste landfill built over the former tailings pond, as seen on Figures A-1 and A-2, Appendix A (also refer to Photos 1 to 3, Appendix F). Monitoring procedures adopted by AANDC for this site are similar to those defined in the AANDC Abandoned Military Site Remediation Protocol, AMSRP, with some modifications as applicable to mine sites.

The SWMF was designed to contain non-hazardous contaminated soils and debris, and to encapsulate and stabilize tailings water remaining at the Site. The design was based on the characteristics of the contaminants in the soil and the local geothermal and permafrost properties. The design uses permafrost as the primary containment barrier with both the contents and perimeter berms remaining in a frozen state. It was projected that the SWMF would reach a frozen state within a few years of construction. To monitor the freeze back of the contents and berms, three ground temperature sensor strings (thermistors) and dataloggers were installed along a transect of the facility. The thickness of the cover material was calculated to exceed the maximum depth of active layer thawing using modeled climate data; this is to ensure impacted materials within the SWMF remain frozen throughout the year.

The SWMF was designed to contain non-hazardous materials only, and due to the small amounts of metals and PCB contaminated soils (defined as “Tier II” by AANDC Abandoned Military Site Remediation Protocol) on site, there was no need for construction of a Tier II, Secure Soil Disposal Facility. The SWMF was constructed over the former tailings pond, covered by a woven geotextile and then covered with 2 m of compacted waste rock which had been assessed as non-metal leaching and non-acid generating. The waste was placed in lifts and sequentially covered with granular fill. On the basis of survey work, a total of 109 m^3 of debris and 742 m^3 of debris and waste rock intermediate cover were placed into the SWMF. A final cover of coarse fill was used to cap the landfill. Shortly after the capping of the landfill in August, 2009, the final construction steps were completed, which included grading to promote drainage and installing the thermistor strings and datalogger housings.

2.2 Previous Monitoring Programs

Prior to the field program, FRANZ reviewed the following reports pertaining to the Roberts Bay abandoned mine site, some of which include previous site investigations and remedial activities:

- Franz Environmental Inc., November 19, 2010, *2010 Monitoring Program SWMF Landfill, Roberts Bay, Nunavut.*
- Indian and Northern Affairs Canada. February 9, 2009. *Roberts Bay and Ida Bay Long-Term Monitoring Plan*.

- Nunavut Water Board (NWB)'s Water License, August 8, 2008. *License No. 1BR-ROB0813* issued to Indian and Northern Affairs Canada.
- SENES Consultants Limited, February, 2010. *2009 Inter-Seasonal Report for Roberts Bay and Ida Bay Mine Sites Site Remediation Program, Nunavut*.
- AMEC Earth & Environmental for Public Works and Government Services Canada, January 2007, *Roberts Bay and Ida Bay Abandoned Mine Sites Remediation Plan.*
- Indian and Northern Affairs Canada, Contaminated Sites Program, March 2009, *Abandoned Military Site Remediation Protocol*.

The 2012 monitoring program was the second of eight scheduled over a 25 year period for the Site. Information from previous investigations was incorporated into this year's sampling plan. Data collected in subsequent years will be combined with the complete data set, as well as that from pre-landfill construction in 2008 and 2009, and analyzed.

As part of the investigation, information regarding land use by both humans and wildlife was gathered though interviews with members of the Ekaluktutiak Hunters and Trappers Association in the nearby community of Cambridge Bay.

3.0 REGULATORY GUIDELINES

3.1 Guideline Review

Where guidelines were developed, criteria presented in the Nunavut Water Board (NWB)'s Water Licence (NWB, 2008) were used to compare both soil and surface water analytical results. These criteria were developed during a human health and ecological risk assessment which determined site-specific remedial objectives prior to remediation of the Site.

The Roberts Bay abandoned mine site is a federal site, and is therefore exempt from territorial regulation; however, the possibility of future disposition of the Site may make it subject to territorial environmental guidelines. Because the Nunavut environmental guidelines are based on the work of the CCME, the federal and territorial guidelines often coincide.

The governing guideline for soil at contaminated sites in Nunavut is the *Environmental Guideline for Contaminated Site Remediation* (EGCSR), published by the Government of Nunavut in March, 2009. The criteria for Petroleum Hydrocarbons (PHC) in soil are found in Section 2.4, and are adapted from the CCME's CWS-PHC. The criteria for other compounds in soil are found in Table A-4 of Appendix 4 of the EGCSR, and are obtained from the CSQGs, published in the *Canadian Environmental Quality Guidelines* (CCME, 1999, updated 2007). The criteria are numerical limits intended to maintain, improve or protect environmental quality and human health at contaminated sites. Because the EGCSR is based on federal standards and has been updated recently, FRANZ does not expect that there are any discrepancies between the federal standards applied to the site and the Nunavut guidelines.

3.2 Soil

The soil standards or guidelines adopted for this evaluation are as follows:

- Nunavut Water Board's Water License, August 8, 2008. License No. 1BR-ROB0813 issued to Indian and Northern Affairs Canada. Used where criteria exist.
- *Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health* (CCME, 1999, with updates) for residential/parkland use, including fact sheets for benzene, toluene, ethylbenzene, and xylenes. Non-potable groundwater is stipulated and coarse grain material is assumed based on field observations during sample collection (generally sandy material).
- *Canada-Wide Standards for Petroleum Hydrocarbons in Soil* (CCME, 2008a) - Tier 1 residential/parkland land use, coarse-grained soil, non-potable groundwater.

If obtained, soil analytical results were compared with the Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines, specifically the *Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health* (CSQGs) and the

Canada-Wide Standards for Petroleum Hydrocarbons in Soil (CWS-PHC). These guidelines are applied to most federal contaminated sites. The guidelines are numerical limits intended to maintain, improve or protect environmental quality and human health at contaminated sites. They are derived using toxicological data and aesthetic considerations.

The CSQGs (CCME, 1999) are a subsection of the Canadian Environmental Quality Guidelines. The CSQGs are derived to approximate a no- to low- effect level (or threshold level) based on scientific data, including toxicology, fate, and behaviour. The CSQGs are based on direct contact, ingestion, and inhalation toxicity data, and were developed to protect receptors exposed directly and indirectly to contaminants of concern. Fact sheets are provided for 32 compounds. The benzene, toluene, ethylbenzene and xylenes fact sheets were used to obtain regulatory criteria for this report.

The CWS-PHC (CCME, 2008a) present criteria for petroleum hydrocarbons in soil. These numerical standards are based on the assessment and consistent management of risks posed to humans, plants, animals and environmental processes under four common land uses (agricultural, residential/parkland, commercial and industrial). Under Tier 1 of the CWS, specific numerical levels are presented for the four land uses, two soil textures (coarse and fine) and the four defined petroleum hydrocarbon fractions (F1 (nC_6-nC_{10}); F2 (nC_{10}-nC_{16}); F3 (nC_{16}-nC_{34}); F4 (nC_{34}+)).

The CWS-PHC also include the option to generate Tier 2 levels where site-specific information indicates that site conditions exist that modify human or ecological exposure to PHC contamination. Such conditions may alter risks significantly relative to the generic conditions that were used to derive Tier 1 levels. A third tier in the CWS-PHC involves developing site-specific cleanup levels and management options using general and site-specific information in conducting a risk assessment.

As a preliminary and conservative determination of protection of human health and the environment at the Site, Tier 1 levels of the CWS are applied to all analytical results where site-specific values are not specified. The appropriate levels are presented with the laboratory analytical data in tables. The rationale for the selection of the appropriate criteria is discussed below.

BTEX Compounds

For the BTEX compounds specifically, the CSQGs were used to determine the appropriate pathway-specific guidelines. For benzene, for example, the 2004 update was used, with the following assumptions:

- Residential/Parkland land use

- Coarse-grained soils
- 10^{-5} acceptable incremental risk
- With applicable guidelines the most conservative of:
  - Soil dermal contact guideline
  - Soil ingestion guideline
  - Eco soil contact

The groundwater check (drinking water) pathway was excluded, at 0.03 mg/kg, as groundwater in the area of the Roberts Bay site is not used as a source of potable water. With its exclusion, the most conservative guideline for benzene applicable at the Site is related to the protection of the pathway for the inhalation of indoor air (slab on grade), at 0.095 mg/kg; however, there are no buildings remaining on this Site and therefore nothing to be affected by vapour intrusion. The most conservative remaining guideline is therefore the ecological soil contact guideline, at 31 mg/kg. A similar process was used to determine the most conservative applicable guideline value for toluene, ethylbenzene and xylenes.

Petroleum Hydrocarbons

For petroleum hydrocarbons, the CWS-PHC was used to determine the appropriate pathway-specific guidelines. Pathway-specific guidelines can be found in the CWS-PHC Technical Supplement (CCME, 2008c).

3.3 Surface Water

There are no surface water guidelines provided in the Roberts Bay long term monitoring plan. In the absence of site-specific guidelines, the AMSRP guidance on post-construction landfill monitoring indicates that “comparison to background and baseline values is recommended.” The AMSRP provides the following table (Table 1) for the assessment of analytical data in groundwater; a similar approach has been used for the assessment of surface water analytical data.

Table 1: Groundwater Chemical Assessment Approach

Geochemical Assessment	Acceptable	Marginal	Significant	Unacceptable
Groundwater concentrations within average ± three standard deviations or within analytical variability	Performing as expected			
Increasing trend in contaminant data over 2 or more successive monitoring events (variation in excess of average ± three standard deviations or analytical variability)		Low risk of failure		

Geochemical Assessment	Acceptable	Marginal	Significant	Unacceptable
Groundwater concentrations in excess of three times average baseline concentrations in more than one monitoring event			Moderate risk of failure	
Where applicable, surface water concentrations in excess of surface water quality guidelines for the protection of aquatic life				Failure
Required Actions	Monitor as per schedule	Increase monitoring frequency. Monitor surface water quality, if applicable, in downgradient water bodies within 300 m.	Assess causes of increasing contaminant concentrations. Evaluate whether remediation is required.	Assess cause of contaminant concentrations. Develop remedial plan. Implement remedial plan.

This table is reproduced from AMSRP Chapter 11, Table 4.2

FRANZ has used historical data presented in a previous report to obtain mean and standard deviation of analytical results from monitoring activities conducted in 2010 in order to establish statistical upper limits of acceptability. These limits are calculated as mean plus three standard deviations, and are used for comparison with analytical results from the 2012 field program. The calculated upper limit of acceptability values are included in surface water analytical tables presented in Appendix B. This is a very limited data set and therefore standard deviations for some parameters are quite high; additional data will help to create more realistic limits.

For some parameters, sufficient data to calculate mean and standard deviation were not available. This is primarily due to the high frequency of results reported to be below the laboratory reportable detection limit (RDL).

In these instances, and for purposes of comparison with the calculated upper limits of acceptability, the following CCME guidelines are included in this report:

- *Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life (FWAL) Update 7.0* (CCME, 2007), Summary Table.

Canadian water quality guidelines are intended to provide protection of freshwater and marine life from anthropogenic stressors such as chemical inputs or changes to physical conditions

At the Site, neither surface water nor groundwater is used for drinking water or agricultural uses. The landfill is greater than one kilometre from the nearest water body, Roberts Lake. Where

upper limits of acceptability were not calculated, the CCME Freshwater Aquatic Life (FWAL) water quality guidelines were applied to the surface waters at the Site.

4.0 INVESTIGATIVE METHODOLOGY

The Site visit to Roberts Bay was carried out on August 9, 2012. During the field investigations, weather conditions were mostly cloudy with temperatures ranging from approximately 12°C to 16°C. The monitoring program included the following tasks:

- Completing a Health and Safety Plan;
- Visually observing and photographically documenting the physical integrity of the landfill and the reporting on the observable conditions over the rest of the Site;
- Natural environment monitoring and gathering information from knowledgeable persons regarding local wildlife and human activity;
- Collecting landfill temperature data from previously installed thermistor strings;
- Measuring various physical parameters in the water samples; and
- Submission of soil (if required) and surface water samples, including duplicates, for applicable laboratory analysis.

The field investigation procedures are described below.

4.1 Health and Safety Plan

Before commencing with Site activities, a site-specific health and safety plan (HASP) was developed. The HASP identified and provided mitigative actions for potential physical and chemical hazards associated with the work required to complete the Site monitoring program. Emergency provisions such as extra food and shelter were included given the site's remoteness. A wildlife monitor with a valid firearm license was also hired and constantly present on Site. The HASP contained a listing of emergency contact numbers and provided protocols to follow in the event of an emergency.

A copy of the HASP was presented to AANDC for their review and approval before activities at the Site began. Prior to conducting any work at the Site, the HASP was distributed and discussed with all personnel involved in the monitoring program. A copy of the HASP has been retained on file with AANDC and FRANZ.

4.2 Visual Inspections

The SWMF and immediate surrounding area were visually inspected to assess the landfill's physical integrity, including evidence for erosion, ponding, frost action, settlement and lateral movement. Using the format provided in the Roberts Bay and Ida Bay Long Term Monitoring Plan (INAC, 2009), a visual monitoring checklist was completed for the landfill (refer to Table 4, Section 5.3). Photographs were taken from the viewpoints indicated on Figures A-1 and A-2, Appendix A.

4.3 Wildlife Survey

FRANZ recorded observations of the natural environment made during the Site visit including direct sightings of wildlife; other evidence of wildlife (e.g., droppings, tracks, feathers/fur); wildlife activities (migrating, nesting, etc.); numerical estimates of wildlife; and vegetation.

As part of the investigation, information regarding land use by both humans and wildlife at the Site was gathered though the wildlife monitor, Mr. Elvin Kanakyok, a member of the Ekaluktutiak Hunters and Trappers Organization. Additional information was gathered from other persons from the nearby community of Cambridge Bay knowledgeable of the Site and surrounding area.

A discussion of the recorded observations and information obtained is presented in Section 6.0 of this report.

4.4 Thermal Monitoring

Three thermistor strings were installed along a transect of the SWMF in the late summer of 2009. Thermistor installation records with details concerning the number of beads and bead depths were not available to FRANZ staff. Based on the data collected in August, 2010, it was concluded that the number of beads at Thermistors A, B and C is 9, 11 and 9, respectively. Assumptions regarding bead depth are discussed in detail in Section 5.4. Each thermistor string is connected to a Lakewood Systems UltraLogger datalogger that is programmed to record values twice daily – at 0h00 and 12h00 – on a continual basis.

At the time of the 2012 Site visit, all thermistor strings were determined to be functioning well. The resistance at each bead was measured manually at each thermistor string. This data was converted to temperature values which were compared to the values logged by the dataloggers. The manual resistance check confirms the functionality of each bead, and the comparison with the logged data confirms that the analog data channels of the datalogger are operating correctly. The beads of all three thermistor strings and the dataloggers at string A and C were performing well. The manually collected data had close agreement with the data collected by the dataloggers. Manual resistance check data is presented in Table H-2, Appendix H.

During the previous Site visit in 2010, it was determined that the datalogger installed at string B was malfunctioning and it was recommended to be replaced. Although the datalogger on string B was malfunctioning, the temperature sensing beads of string B are functioning correctly, as determined by the manual resistance check. The datalogger at string B was replaced with a spare datalogger supplied by AANDC during the 2012 Site visit.

Thermistor data for the period from August 2010 to August 2012 were downloaded from the dataloggers installed at string A and string C using a laptop with Lakewood Systems' Prolog

(v.1.198) software; the data contained in the faulty datalogger installed at string B was not able to be retrieved in the field. Datasets from each datalogger were inspected to ensure completeness and data validity prior to resetting the datalogger units. Datalogger battery voltages, memory usage, and programming were noted and a visual inspection of the housing equipment was performed. Each datalogger, including the replacement unit installed at string B, was then restarted to begin collecting temperature information. Thermistor inspection records are presented in Table H-1, Appendix H.

The malfunctioning datalogger at string B was removed from the Site and sent to the manufacturer, Lakewood Systems Inc., in Edmonton to attempt data retrieval and for servicing. Lakewood was able to retrieve some of the data; however, as in 2010, six of the eleven analog channels in use did not collect useable data due to a faulty multiplexor card within the unit. The available data for string B is presented in Figures H-3 and H-4, Appendix H. Determination of the maximum depth to permafrost at the string B location was not possible due to the missing data.

The SWMF ground temperature record was compiled and trends were highlighted. A discussion, along with plots of temperature versus depth and time, is presented in Section 5.4. The annual maintenance report, which also contains a basic description of the datalogger systems, can be found in Table H-1, Appendix H. Raw data is provided in the attached CD-ROM.

4.5 Surface Water and Soil Sampling

The surface water and soil sampling methodology conformed to guidance provided in the following documents:

- CCME EPC-NCS62E *Guidance Manual on Sampling, Analysis, and Data Management for Contaminated Sites - Volume I: Main Report*, Dec 93 (CCME catalogue - http://www.ccme.ca/assets/pdf/pn_1101_e.pdf);
- CCME EPC-NCS66E *Guidance Manual on Sampling, Analysis, and Data Management for Contaminated Sites - Volume II: Analytical Method Summaries*, Dec 93 (CCME catalogue - http://www.ccme.ca/assets/pdf/pn_1103_e.pdf);
- INAC *Roberts Bay and Ida Bay Long-Term Monitoring Plan* (INAC, 2009); and
- INAC *Abandoned Military Site Remediation Protocol*, Contaminated Sites Program (INAC, 2009).

4.5.1 Surface Water Sampling

Surface water was sampled at four predetermined locations: three in proximity to the SWMF and one distant, background reading collected from Roberts Lake. In accordance with the

established protocol at similar sites managed by AANDC, water samples submitted for metals analyses were not field-filtered.

If surface water was present, it was sampled from the surface water monitoring point locations established during the previous Site visit. Conditions were less wet during the 2012 Site visit than in 2010. No surface water was present at monitoring point ROB-7, and no sample was collected. Samples were successfully collected from previously established surface water monitoring points ROB-6, ROB-8 and ROB-10. The sample at ROB-8 was collected in duplicate, and a background sample was collected from Roberts Lake (surface water monitoring point ROB-9). A summary of the samples that were collected and submitted for laboratory analysis during the surface water sampling activities is provided in Table 2, below. Additional information is provided in the surface water sampling field notes included in Appendix C.

Table 2: Summary of surface water sample collection near the SWMF

SWMF Area	Sample	Description	Analytical Parameters
Downgradient	ROB-6	Surface water to southeast of landfill that may at times flow South to Roberts Lake	- total and dissolved metals - PCBs - petroleum hydrocarbon fractions F1-F4 and BTEX - inorganics (major ions, TDS, TSS, colour, pH, conductivity, hardness)
	ROB-8	Northeast of landfill (to detect possible leachate and runoff)	
	DUP-1*		
	ROB-10	Southeast of landfill (to detect possible leachate and runoff)	
Background	ROB-9	Roberts Lake (for background and control)	

Note: * indicates a blind field duplicate of the sample listed directly above.

All samples were stored immediately in laboratory prepared sample bottles. Water samples for laboratory analysis were stored in laboratory supplied coolers. As soon as was possible, samples were placed on ice and remained chilled until delivery to the laboratory.

4.5.2 Test Pitting and Soil Sampling

If required, soil sampling was to be completed by manual test pitting. Baseline soil data was collected in during the 2010 Site visit. Subsequent soil samples are only to be collected should physical or other chemical evidence of landfill deterioration be observed. No such evidence was observed during the 2012 Site visit, therefore no test pits were advanced and no soil samples were collected.

4.6 Quality Assurance and Quality Control

Field personnel employed FRANZ's established Quality Assurance/Quality Control (QA/QC) protocols, including appropriate techniques for sampling, sample storage, shipping and handling, as well as collection of duplicates.

4.6.1 Field

Surface water samples were collected and placed in a variety of appropriately sized and prepared laboratory vessels. Sample numbers were clearly marked on the containers. The water bottles were filled to capacity with minimum headspace and stored in coolers to moderate temperature fluctuations during transport from Site. Once available, ice was added to the coolers to keep the samples chilled until they were delivered to the laboratory.

As a quality control measure, a surface water blind field duplicate sample was collected and analyzed for PHC fractions F1-F4, BTEX, inorganic parameters, total and dissolved metals, and PCBs. Additional quality assurance field and travel blanks were also submitted to the laboratory for analysis of the parameters listed above.

FRANZ personnel collected the duplicate samples by alternately placing approximately 50 percent of the sample volume into the primary sample container and then placing the same amount into the duplicate container. The field staff continued placing aliquots of approximately 50 percent of the remaining container volume into each container until both containers were filled.

The samples were transported to the project laboratory accompanied by a Chain of Custody form. Copies of the Chain of Custody forms are attached in Appendix D.

4.6.2 Laboratory

To assess the reliability of the laboratory data, duplicate samples were taken for at least every five samples collected by FRANZ. One blind field duplicate was collected in the surface water sampling program.

Analytical data quality was assessed by submission of the following:

- Surface water samples ROB-8 (primary) and DUP-1 (corresponding water duplicate), were analyzed for CCME PHCs F1-F4/BTEX, PCBs, and metals (total and dissolved). Major ions, hardness, conductivity, pH, TDS, TSS and colour were also analysed and duplication was compared.

Sampling procedures and laboratory analytical precision are evaluated by calculating the relative percent difference (RPD) for a sample and duplicate pair according the following equation:

$$RPD = | X_1 - X_2 | / X_{avg} \times 100$$

where: X_1 and X_2 are the duplicate concentrations and X_{avg} is the mean of these two values. The duplicate results were evaluated using criteria developed by Zeiner (1994), which draws from several data validation guidelines developed by the United States Environmental Protection Agency (USEPA). According to these criteria, the RPD for duplicate samples should be less than 20% for aqueous samples, and less than 40% for solid samples. RPDs can only be calculated when the compound is detected in both the original and the duplicate sample at a concentration five times above the reportable detection limit (or method detection limit - MDL). Alternative criteria are used to evaluate duplicate pairs where one or both of the results are less than five times the MDL, or where one or both of the results is less than the MDL (i.e. nd or 'not-detected'). The alternative criteria used for the evaluation of the data, adapted from Zeiner (1994), are presented in the table below. When both concentrations are less than the MDL, no calculation/evaluation criterion is required.

Table 3: Criteria for the Evaluation of Blind and Duplicate Sample Results

Scenario	Result A	Result B	Criteria for Acceptance
			Aqueous (water)
A	Nd	nd	Acceptable precision; no evaluation required
B	Nd	positive	result B – 0.5 x MDL < MDL
C	positive and > 5 x MDL	Positive and > 5 x MDL	RPD < 20%
D	positive and < or = 5 x MDL	positive	|result B – result A| < MDL[1]

Source: Zeiner, S.T., Realistic Criteria for the Evaluation of Field Duplicate Sample Results, Proceedings of Superfund XV, November 29-December 1, 1994, Sheraton Washington Hotel, Washington, D.C. – modified to use Method Detection Limit (MDL) or Reportable Detection Limit (RDL) in lieu of the Quantitation Limit (QL), the Instrument Detection Limit (IDL) and/or Laboratory Reporting Limit (LRL).

Notes:

nd – not detected

RPD – relative percent difference, |result A - result B| / |(result A + result B)/2|

1. When result reported was less than half the quantitation limit, half the limit was used in the equation.

The precision is considered acceptable when the evaluation criteria are met or when both results are below the MDL. When the evaluation criteria are not satisfied, the following apply:

- nd vs. positive – unacceptable precision: the positive result is considered an estimate and the nd result is considered inconclusive.
- Positive vs. positive – unacceptable precision: the results are considered an estimate.

Refer to Appendix E for a discussion on QA/QC results.

4.7 Laboratory Analytical Program

Surface water samples were sent to Maxxam Analytics in Edmonton, Alberta for chemical analyses of the target compounds previously identified. Maxxam is certified by the Canadian Association for Laboratory Accreditation, Inc. (CALA) and has an internal QA/QC protocol. The laboratory QA/QC documentation is provided with the analytical report and was reviewed by FRANZ as part of the QA/QC protocol. The laboratory results and chain of custody forms are presented in Appendix D.

5.0 SUMMARY OF SWMF CONDITIONS

5.1 Area Summary

The SWMF, composed of both a dry and a wet cell, is located to the west of the two former adits, and is built on the same location as the former mine tailings pond. Monitoring of the SWMF consisted in part of a visual inspection to assess its physical integrity by collecting evidence of erosion, ponding, frost action, settlement and lateral movement. Surface water samples were also collected at locations downgradient of the SWMF, all of which were collected over 200 metres beyond the landfill perimeter. A background surface water sample was collected from Roberts Lake.

The SWMF surface water sample locations and photographic viewpoints can be seen on Figure A-1 and on Figure A-2 in Appendix A. The visual inspection report, including supporting photos and figures, is presented in Sections 5.2 and 5.3 below.

5.2 Photographic Record

The photographic record of the SWMF was completed as per Call Up Details for the monitoring program. It is presented in Appendix F, where photograph captions provide the landfill viewpoint numbers (as seen on Figure A-2, Appendix A). Full resolution digital copies of the photographs are contained in the attached CD-ROM.

5.3 Visual Inspection Report

The visual inspection of the SWMF and surrounding area was conducted on August 9, 2012. The visual monitoring checklist was completed using the format provided in the *Roberts Bay and Ida Bay Long-Term Monitoring Plan* (INAC, 2009) and is presented as Table 4 of this report. Field notes relating to the visual inspection are included in Appendix G.

Settlement

Four areas of possible settlement were identified on the top of the SWMF during the 2010 Site visit (refer to Figure A-2, Appendix A). These isolated areas were reported to be small (less than a few square metres) and shallow (less than 30 cm). There was no evidence of water infiltration reported and no ponding was observed on top of the landfill.

With the exception of the northernmost area of possible settlement identified in 2010, which was not observed in the 2012 Site visit, the areas reported as possible minor settlement in 2010 were identified. Though these areas were identified, they were not observed to be of a large enough magnitude to be confirmed as settling. These areas may simply represent minor variation in the final grading and compaction of the surface of the landfill.

As in 2010, no ponded water was observed in the immediate vicinity of the SWMF during the 2012 Site visit. Surface water was present to the east (sampling points ROB-6, ROB-8 and ROB-10) of the landfill (refer to Figure A-2, Appendix A).

Erosion

As in 2010, no evidence of erosion or preferred drainage channels was observed during the 2012 Site visit.

Frost Action

As in 2010, no evidence of heaving or cracking was observed on the top or berms of the SWMF, and no frost action was observed at any of the thermistor housing units during the 2012 Site visit.

Evidence of Burrowing Animals

No animal burrows were observed on the SWMF during the 2012 Site visit. As in the previous Site visit, indications of burrowing animals (ground squirrels) were prevalent throughout the undisturbed areas of the Site.

Staining

No evidence of staining was observed on or near the SWMF during the 2012 Site visit.

Seepage Points

There was no evidence of seepage from the SWMF observed during the 2012 Site visit.

Debris

No exposed debris was observed at the SWMF during the 2012 Site visit. Abandoned exploration drilling equipment (drill rods, empty fuel drums, pallets, hydraulic hose, etc.) was observed near the shore of Roberts Lake (photo references 34 and 35, Appendix F and Figure A-1, Appendix A). A functional floating dock was also present at the beaching area of Roberts Lake. The dock was used to secure the aircraft and transfer equipment and samples in and out of the aircraft during the Site visit.

Discussion

Based on the minimal to non-existent erosion, settlement, frost action, burrowing, staining and seepage observed, the performance of the SWMF, with respect to containment, was rated as satisfactory. The evidence observed suggests the structure is performing as designed. The visual inspection report is presented in Table 4 below.

Table 4: Roberts Bay Abandoned Mine – Landfill Visual Inspection

Date:	August 9,2012
Landfill:	Solid Waste Management Facility Landfill (SWMF)

1. Erosion	**Answer**
a) Is erosion occurring on the surface or berms of the landfill?	No
i) Are there preferred drainage channels?	No
ii) Is there sloughing of material?	No
b) What is the extent of the erosion? *(percentage of surface area)*	–
i) Is it localized or continuous?	–
c) Where is the erosion occurring? N/A	
d) Explanation: N/A.	

2. Settlement	**Answer**
a) Is there differential settlement occurring on the surface?	No
i) Are there low areas or depressions?	Yes
ii) Are voids forming?	No
b) What is the extent of the settlement? *(percentage of surface area)*	< 1%
i) Is it localized or continuous?	Localized
ii) How deep is it?	< 0.3 m
c) Where is the settlement occurring? Very small areas at a few locations on the landfill top (refer to viewpoint numbers 27 to 32 on Figure A-2, Appendix A).	
d) Explanation: No obvious cause. Settlement areas are small enough that it is possible that they are simply artefacts of the construction process.	

3. Frost Action	**Answer**
a) Is there frost action/damage to the landfill?	No
i) Is there exposed debris due to uplift?	No
ii) Is there tension cracking along the berms?	No
iii) Is there sorting of granular fill?	No
b) What is the extent of the frost action? *(percentage of surface area)*	–
i) Is it localized or continuous?	–
c) Where is the heaving/cracking occurring? None visible on the any surface of the SWMF.	
d) Explanation: No apparent signs of frost action on any surface of the SWMF.	

4. Monitoring Instruments
a) What is the condition of the monitoring wells and thermistor strings? No monitoring wells present at this Site. Thermistor housing units were in good condition. It was determined that the three sets of thermistor beads were operating correctly, but that one of the dataloggers (on string-B) was malfunctioning. This datalogger was replaced with a spare datalogger provided by AANDC. Each thermistor casing was locked with Guard, 40 mm universal-key padlocks, No. 834 (key number 102). Thermistor batteries will require replacement during the next Site visit, scheduled for summer of 2014.
5. Others
Animal Burrows: no animal burrows were observed in or on the SWMF. **Vegetation**: no vegetation was observed on the SWMF. Due to elevation, drainage, regional climate, and the type of material (large angular cobble) used to cap the SWMF, the establishment of vegetation is not anticipated. No significant re-growth was observed in any of the worked areas of the Site. **Staining**: no staining was observed at the SWMF. **Vegetation stress**: none observed. **Seepage points**: none observed. **Exposed debris**: no debris was exposed from the SWMF.
6. Sketch
See Figure A-2, Appendix A
7. General Comments
The physical condition of the SWMF is acceptable and appears to be performing as designed.

5.4 Thermal Monitoring Data

As generally described in the Site remediation report (SENES, 2010), three thermistor strings: A, B and C were installed in the SWMF. Thermistor string installation records were not available; however, Site remediation specifications (INAC Project No. 416829) recommended that temperature sensing beads be placed at 500 mm intervals from thermistor bore bottoms to the landfill surface. Based on the elevations of the thermistor borehole bottoms, casing tops and the landfill surface provided by the SWMF construction drawings, it was assumed that thermistor beads were placed from the borehole bottom to the top at the recommended 500 mm spacing. The top bead appears to coincide with the landfill surface in the case of thermistor

string A. Thermistor string B has the top bead positioned above the ground surface, while string C has the top two beads positioned above the ground surface. These conclusions are drawn based on observation of the thermistor string cables within the housings, and are supported by the magnitude of diurnal temperature fluctuations observed at the upper beads. Larger diurnal temperature fluctuations are apparent when the bead is positioned above the ground surface and is measuring air temperature. The inferred bead depths are presented in Table H-2, Appendix H.

A complete memory transfer was successfully performed on the dataloggers installed at string A and string C. Data could not be retrieved from the datalogger installed at string B in the field. The string B datalogger was removed from the Site and sent to the manufacturer, Lakewood Systems Inc., for repairs. Lakewood was able to retrieve the data from the faulty datalogger, however data from only five of the eleven beads installed at string B was useable. Lakewood determined that the errors were due to a faulty multiplexor card within the datalogger. The faulty component was replaced and the datalogger is now available to AANDC as a spare datalogger for future use.

A manual verification of the data downloaded from the dataloggers was performed in the field using a sensitive resistance meter available from the datalogger manufacturer. Results indicate that all temperature sensing beads of the three thermistor strings are functional. Though half of the data channels on the datalogger at string B were not recording data correctly, all of the temperature-sensing beads of string B were functional. A comparison of manually recorded temperatures with the automatically logged values indicated good agreement between the two for strings A and C, and for those beads with operational channels on the string B datalogger.

All thermistor beads positioned below the ground surface were found to yield temperatures within the standard ± 0.2 ºC margin of error, with the exception of bead 3 on string A, bead 1 on string B, (both with discrepancies of 0.3 ºC) and bead 3 on string C (discrepancy of 0.6 ºC). The discrepancy of 0.3 ºC at the third bead of string A is very close to the acceptable margin of error; the data from this bead was considered useable and was retained. A larger margin of error between manually and automatically recorded temperatures is considered acceptable for beads positioned above or near the ground surface, as is the case for beads 1 of string B and beads 1, 2 and 3 of string C. The larger margin of error is attributable to fluctuation in atmospheric temperature over the duration of the test period. The largest discrepancy between logged and manually recorded values of beads measuring atmospheric temperature was 1.1 ºC at string C; this is considered to be acceptable. Additional details of the manual verification test are presented in Table H-2, Appendix H.

The position of the 0°C isotherm was calculated at each location from ground temperatures recorded by the dataloggers on the day of the Site visit (Table 5). Plots of depth versus temperature (at each thermistor bead) for a day at the end of each month and temperature versus time over the previous two years are presented on Figure H-1 through Figure H-6, Appendix H.

Table 5: Summary of SWMF Active Layer Thickness

	Thermistor String		
	A	**B**	**C**
Depth to 0º isotherm (m) on Aug 9, 2010	2.43	N/A*	1.88
Depth to 0º isotherm (m) on Aug 9, 2011	2.12	N/A*	1.85
Depth to 0º isotherm (m) on Aug 9, 2012	1.88	1.79**	1.64
Maximum depth to permafrost 2009-2010 (m) (yyyy/mm/dd)	Permafrost not yet established		
Maximum depth to permafrost 2010-2011 (m) (yyyy/mm/dd)	2.95 (2010/09/22)	N/A*	2.31 (2010/09/16)
Maximum depth to permafrost 2011-2012 (m) (yyyy/mm/dd)	2.46 (2011/09/11)	N/A*	2.07 (2011/09/12)

*insufficient data to calculate a depth

**Interpolated from manually recorded temperature data

Because of the malfunctioning datalogger at thermistor string B, only half of the temperature sensing bead channels recorded useful information. Unfortunately, not enough information was available to calculate a reasonable value for maximum depth of the active layer at this location. At the locations of thermistor string A and C thermal monitoring indicates that, as expected, the active layer has progressively decreased in thickness over the past two years.

In general, it can be concluded that the SWMF is getting colder, and the waste contained within the SWMF, reported to be at a depth of ≥ 3 mbgs has remained frozen year round since the fall of 2010.

Thermistor details can be found in the annual maintenance monitoring report (Table H-1, Appendix H). Field notes relating to the thermistor inspection are included in Appendix G.

5.5 Analytical Results – Surface Water Samples

As described in Section 4.5.1, a total of five surface water samples (four samples plus one blind duplicate) were submitted to Maxxam Analytics in Edmonton, Alberta for analyses of PHCs, metals, PCBs and inorganic parameters. Obtained analytical results are discussed below.

PHCs

Laboratory analytical results and the selected federal guidelines—the CCME guidelines for the protection of freshwater aquatic life (FWAL)—for PHCs are presented in Table B-1, Appendix B. As shown in the table, concentrations of all PHC parameters were below laboratory reportable detection limits (RDLs) and thus satisfy the guidelines applied to the Site. No upper limits of acceptability were calculated for PHCs in surface water.

Metals

Laboratory analytical results, selected federal (CCME FWAL) and calculated site-specific upper limits of acceptability for dissolved and total metals are presented in Table B-2, Appendix B. Site-specific upper limits of acceptability were calculated for total and dissolved metals parameters as detailed above in Section 3.3. None of the surface water samples submitted for metals analysis exceeded the calculated upper limits of acceptability for any of the parameters analyzed.

In addition, only two exceedances were observed in comparing analytical results to the CCME FWAL guidelines: concentrations of total copper in ROB-06 and ROB-10 were 0.006 mg/L and 0.0063 mg/L respectively, marginally exceeding the CCME FWAL guideline of 0.004 mg/L. At ROB-8, where the duplicate sample was collected, the detection limit for chromium was elevated as the samples required dilution. There is no CCME FWAL guideline for total chromium; however, guidelines are provided the two most commonly observed oxidation states, Cr(III) and Cr(VI). Cr(VI) is considered to be the more toxic of the two states and is the dominant species in surface water; therefore, the guideline for Cr(VI) was selected as the most conservative approach. The detection limit for chromium is above the guideline for Cr(VI) in both the primary and duplicate samples collected at ROB-8. Chromium has not previously been detected in surface water at this location, nor is there a known source of chromium at the site. As a result, these exceedences are noted for reference only. The calculated upper limit of acceptability remains the standard to which the 2012 monitoring results are compared to determine acceptability.

PCBs

Laboratory analytical results for PCBs are shown in Table B-3, Appendix B. A CCME guideline was not available for PCBs in surface water, nor was a site-specific upper limit of acceptability able to be calculated for PCBs, this due to the fact that all analytical results were reported as less than the RDL. Results are thus acceptable and indicative of no risk associated with PCBs at the Site.

Inorganic Parameters

Laboratory analytical results for inorganic parameters are presented in Table B-4, Appendix B. CCME FWAL guidelines exist for some of the parameters under this heading; these are noted in Table B-4 for reference purposes. Using the methodology detailed in Section 3.3, site-specific upper limits of acceptability were successfully calculated for all of the parameters under this heading. These site-specific limits are used to determine the acceptability of the 2012 surface water monitoring analytical results. As indicated in the Table B-4, results for two parameters in sample ROB-10 (dissolved nitrate and orthophosphate) exceeded their respective calculated upper limits of acceptability. It was noted that the result for dissolved nitrate in sample ROB-10 was 14 mg/L, which is less than three times the calculated upper limit, and only 1 mg/L greater than the CCME FWAL guideline. The concentration of 0.013 mg/L of orthophosphate reported for ROB-10 is less than five times the RDL (0.0030 mg/L). The magnitudes of these two exceedances are thus not considered to be significant or indicative of deterioration of the SWMF integrity.

Laboratory certificates of analyses for the 2012 surface water samples are provided in Appendix D.

5.6 Analytical Results – Soil Samples

No physical evidence of deterioration to the SWMF was observed during the 2012 Site visit; no soil samples were collected or submitted for chemical analysis.

6.0 SURROUNDING AREAS AND NATURAL ENVIRONMENT

The surrounding areas of the SWMF at Roberts Bay, including the borrow areas, locations of former adits and re-graded areas were also briefly inspected. As in the previous monitoring visit in 2010, the area surrounding the SWMF was found to be clean and in good order, with no significant change observed.

Long-term monitoring plans for other, similarly managed AANDC sites recommend monitoring the following parameters to better understand the presence and temporal changes to wildlife and the natural environment:

- Wildlife sightings
- Other evidence of recent presence of wildlife (e.g. droppings, tracks)
- Wildlife activity (e.g. nesting, migration)
- Qualitative assessment of relative numbers versus previous years
- Re-vegetation of disturbed areas versus previous years

Information regarding these parameters was either gathered directly, through personal observation while on Site or indirectly, through the wildlife monitor, a member of the Ekaluktutiak Hunters and Trappers Association in the nearest community of Cambridge Bay, NU.

Wildlife and Human Activity

During the 2012 Site visit, the following signs of wildlife were observed on Site between late morning and late afternoon of August 9, 2012:

- Many ground squirrels were observed at the Site;
- Several small sparrow-like birds were observed in the dense willow growth directly south west of the SWMF;
- Two arctic swans were spotted from the air on a small lake several kilometres north of the Site;
- Many snow geese were observed flying overhead and droppings were ubiquitous at the Site.

From information gathered in Cambridge Bay, the Site was reported to be used for hunting and fishing. Evidence of recent human activity was present near the Site and included:

- A functional floating dock was installed on the north shore of Roberts Lake, near the path leading to the SWMF.
- Two persons were observed working near the Site; they were conducting a fish survey using the fish weir installed in the nearby creek flowing into Roberts Lake, (see photo viewpoint 33-34, Figure A-1, Appendix A);

- These persons relayed that they were finding many arctic char and lake trout in the weir;
- They also reported bears were in the area, and they had seen a grizzly at the Site on August 8, 2012.
- Abandoned exploration drilling equipment including drill rods, hydraulic hoses, empty fuel drums and pallets, were observed (see photo viewpoint 35, Figure A-1, Appendix A).

Re-establishment of Vegetation

Major Site remedial work, which comprised excavation and construction activities, was completed in the summer of 2009. Little to no sign of re-vegetation was observed in the worked areas during the 2012 Site visit. Given the regional setting of the Roberts Bay SWMF landfill and growth observed at other, similar sites in the Nunavut region, it is reasonable to assume that it will take some time for native vegetation to become re-established at the Site. Due to the type of material used to cap the landfill (large angular cobble), re-vegetation of the surface of the SWMF it is considered to be very minimal within the time-frame of the long-term monitoring program at the Site.

7.0 CONCLUSIONS AND RECOMMENDATIONS

FRANZ conducted the field activities for the second Site visit of the Roberts Bay long term monitoring program on August 9, 2012, while based in the nearby community of Cambridge Bay.

Physical observations from the 2012 field activities suggest that there has been little significant change at the Site since the previous Site visit in 2010. The SWMF is performing as designed and continues to contain the enclosed waste. Thermal monitoring data indicates that the temperature below ground surface at the SWMF has decreased each year since the previous Site visit, and that permafrost was established within the waste at the SWMF in the fall of 2011. Although there is inadequate data to determine the maximum depth of the active layer at thermistor string B over the past two years, thermal monitoring data from thermistor strings A and C indicate that the maximum depth of the active layer has remained less than the depth to the waste material contained within the SWMF from August 2010 to August 2012.

In addition to physical and temperature observations, FRANZ collected surface water samples to assess the performance of the SWMF. With the exception of two nutrient results (dissolved nitrate and orthophosphate) reported in one sample (ROB-10), all chemical parameters were measured at concentrations either below the laboratory RDL or below the calculated upper limits of acceptability. The two exceedances noted above were minimal and are not considered indicative of any deterioration in the integrity of the SWMF.

The faulty datalogger noted in the previous monitoring report at string B was replaced with a functional datalogger. The thermal monitoring infrastructure installed at the SWMF is now performing well, and data should be available for string B during the next Site visit. The faulty datalogger was removed from the Site and was serviced by the manufacturer, Lakewood Systems Inc.; it is now ready for future deployment should the need arise. During the next scheduled monitoring event all of the batteries should be changed in all of the dataloggers. Two fresh desiccant cartridges should also be installed in each datalogger unit. To avoid a gap in the thermal monitoring data due to insufficient memory storage space for three years of 12hr data, the dataloggers will have to be reprogrammed during the 2014 monitoring event. Datalogger sampling frequency will have to be reduced (suggested to once per day at noon). Lakewood Systems is available for assistance with the re-programming.

As a result of the physical and thermal observations and analytical results of the 2012 field program, FRANZ believes that the Site is little changed from the last monitoring event, in August 2010, that the SWMF continues to operate as designed, and that the Site poses no present threat to human health or the natural environment.

8.0 LIMITATIONS

This report has been prepared exclusively for Aboriginal Affairs and Northern Development Canada. Any other person or entity may not rely upon the report without the express written consent from FRANZ Environmental Inc. and Aboriginal Affairs and Northern Development Canada.

Any use, which a third party makes of this report, or any reliance on decisions made based on it, is the responsibility of such third parties. FRANZ Environmental Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Some of the information presented in this report was provided through existing documents and interviews. Although attempts were made, whenever possible, to obtain a minimum of two confirmatory sources of information, FRANZ Environmental Inc., in certain instances, has been required to assume that the information provided is accurate.

The conclusions presented represent the best judgment of the assessors based on current environmental standards and on the Site conditions observed on August 9, 2012. Due to the nature of the investigation and the limited data available, the assessors cannot warrant against undiscovered environmental liabilities.

Should additional information become available, FRANZ Environmental Inc. requests that this information be brought to our attention so that we may re-assess the conclusions presented herein.

There is no warranty, expressed or implied that the work reported herein has uncovered all potential environmental liabilities, nor does the report preclude the possibility of contamination outside of the areas of investigation. The findings of this report were developed in a manner consistent with a level of care and skill normally exercised by members of the environmental science and engineering profession currently practicing under similar conditions in the area.

A potential remains for the presence of unknown, unidentified, or unforeseen surface and sub-surface contamination. Any evidence of such potential site contamination would require appropriate surface and sub-surface exploration and testing.

If new information is developed in future work (which may include excavations, borings, or other studies), FRANZ Environmental Inc. should be requested to re-evaluate the conclusions of this report, and to provide amendments as required.

9.0 REFERENCES

AMEC Earth & Environmental, January 2007. *Roberts Bay and Ida Bay Abandoned Mine Sites Remediation Plan.*

Canadian Council of Ministers of the Environment. 2007. *Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health.*

Canadian Council of Ministers of the Environment, 2007. *Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life (FWAL) Update 7.0*

Canadian Council of Ministers of the Environment. 2008a. *Canada-Wide Standards for Petroleum Hydrocarbons in Soil.*

Canadian Council of Ministers of the Environment. 2008b. *Canada-Wide Standard for Petroleum Hydrocarbons (PHC) in Soil: Scientific Rationale Supporting Technical Document.*

Canadian Council of Ministers of the Environment. 2008c. *Canada-Wide Standard for Petroleum Hydrocarbons (PHC) in Soil: User Guidance.*

Franz Environmental Inc., 2010. *Monitoring Program Solid Waste management Facility Landfill Roberts Bay, Nunavut, Final Report.*

Indian and Northern Affairs Canada. March 2009. *Abandoned Military Site Remediation Protocol*, Contaminated Sites Program.

Indian and Northern Affairs Canada. February 9, 2009. *Roberts Bay and Ida Bay Long-Term Monitoring Plan*.

Indian and Northern Affairs Canada, Specification, Project No. 416829, Roberts Bay/Ida Bay, Section 31 70 02 Site Remediation.

Ministry of the Environment, Ontario, 1994. *Water Management - Policies, Guidelines, Provincial Water Quality Objectives.*

Nunavut Water Board (NWB)'s Water Licence, August 8, 2008. License No. 1BR-ROB0813 issued to Indian and Northern Affairs Canada.

SENES Consultants Limited. February, 2010. *2009 Inter-Seasonal Report for Roberts Bay and Ida Bay Mine Sites Site Remediation Program, Nunavut*.

Zeiner, S*.T., Realistic Criteria for the Evaluation of Field Duplicate Sample Results,* Proceedings of Superfund XV, November 29-December 1, 1994, Sheraton Washington Hotel, Washington, D.C.

10.0 CLOSURE

We trust that this information satisfies your present requirements. Should you have any questions or require additional information, please do not hesitate to contact the undersigned.

Yours truly,

FRANZ Environmental Inc.

Dave Kiar, C. Tech
Field Assessor

Andrew Henderson, B.Eng., P.Eng.
Environmental Engineer

Kevin McKenna, B.Sc.
Project Manager/Field Assessor

Steve Livingstone, M.Sc., P. Geol
Principal/Senior Reviewer

Distribution: Addressee (2 paper, 2 electronic)
FRANZ (1 paper, 1 electronic)

Z:\Projects\2012\1697-1201 AANDC DEW Lines\Reporting\Robert's Bay\Text\FINAL\Final Report Roberts Bay.docx

APPENDIX A

Figures

N

ROB-8

ROB-8

LANDFILL

ROB-10

ROB-7

ROB-10

ROB-6

ROB-6

70m

Trail from Robert's Lake
Dock to the SWMFL

33

FISH WEIR AND
STUDY AREA

ABANDONED EXPLORATION
DRILLING EQUIPMENT

34

35

SMALL
FLOATING
DOCK

ROB-9

ROBERT'S
LAKE

20m

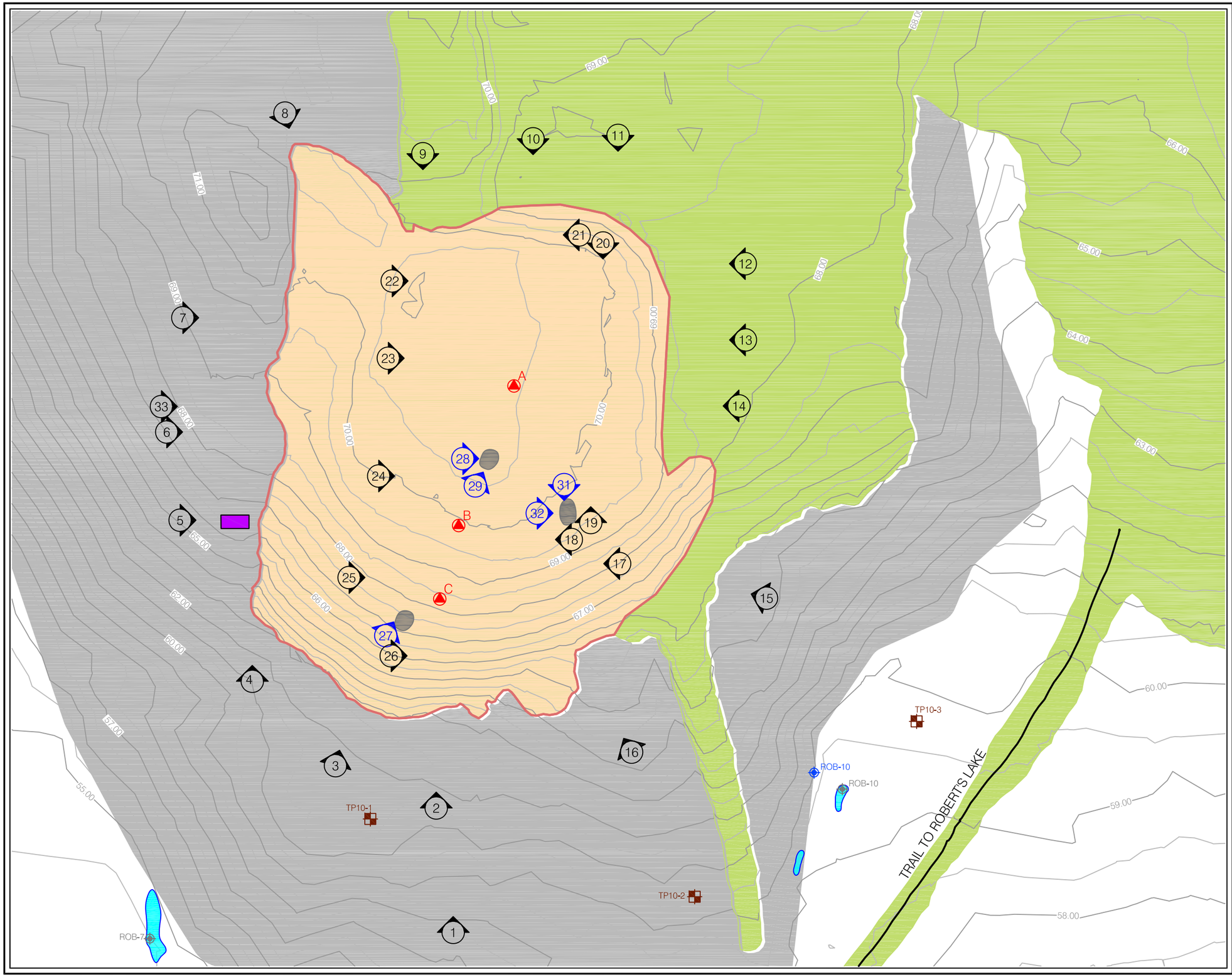
100m

LEGEND

- Pond/Surfacewater
- Solid Waste Management Facility Landfill
- Trail
- Surfacewater Sample Location (FRANZ, 2010)
- Surfacewater Sample Location (FRANZ, 2010)
- 1 - Picture Viewpoint Number

Title: SITE PLAN	
FRANZ ENVIRONMENTAL INC. ♦ CONSULTING ♦ ENGINEERING ♦ TECHNOLOGIES ♦	Project: LONG TERM MONITORING PROGRAM, SWMF LANDFIL, ROBERTS BAY, NUNAVUT
Date: October 2010 Updated: January, 2013	Client: ABORIGINAL AFFAIRS AND NORTHERN DEVELOPMENT CANADA
SCALE: 1:3250	FIGURE A–1

Z:\Projects\2012\1697-1201 AANDC DEW Lines\Reporting\Robert's Bay\Figures\CAD\Figures 2010



N

LEGEND

- 68.00 - Ground surface Contour
- Outcrop
- Waste Rock Area
- Pond/Surface water
- Blast Hole (2 m deep)
- Solid Waste Management Facility Landfill
- Trail
- Possible Settlement Area
- 1 - Picture Viewpoint Number
- 27 - Picture Viewpoint Number (Settlement Area)
- Thermistor
- Surfacewater Sample Location (FRANZ, 2012)
- Surfacewater Sample Location (FRANZ, 2010)
- Soil Sample Location (FRANZ, 2010)

REFERENCE:

1. PUBLIC WORKS AND GOVERNMENT SERVICES CANADA, PROJECT N° : 416829, SHEET 2 of 2
2. FIGURE BASED ON AMEC LAND SURVEYS LIMITED DRAWINGS: ROBERTS BAY AND IDA BAY MINE SITE REMEDIATION, SHEETS 1-4, SEPTEMBER 2005

NOTE:

1. SEE ATTACHED CD-ROM FOR VIEWPOINT PICTURES

Scale 1:500

10 7.5 5.0 2.5 0 metres 10 20

Title: SOLID WASTE MANAGEMENT FACILITY LANDFILL

Project: LONG TERM MONITORING PROGRAM, SWMF LANDFIL, ROBERTS BAY, NUNAVUT

Client: ABORIGINAL AFFAIRS AND NORTHERN DEVELOPMENT CANADA

FRANZ ENVIRONMENTAL INC.
♦ CONSULTING ♦ ENGINEERING ♦ TECHNOLOGIES ♦

Date: October 2010

Updated: January 2013

FIGURE A–2

1967-1001/xxx/MZ/Roberts_Bay_MineSite.dwg

APPENDIX B

Analytical Results Tables

Table B-1
Surface Water Chemical Concentrations - PHCs

PARAMETER / Sample ID / Date	Units	Guidelines		RDL	ROB-06	ROB-08	DUP-1	Duplicate Evaluation			ROB-10	ROB-09 (ROBERTS LAKE)
		CCME FWAL[1]	Upper Limit of Acceptability[2]					Scenario*	RPD (%)	Acceptable		
Date					09/08/2012	09/08/2012	09/08/2012				09/08/2012	09/08/2012
BTEX & F1 Hydrocarbons												
Benzene	ug/L	370	Not Available	0.4	<0.40	<0.40	<0.40	A	---	Y	<0.40	<0.40
Toluene	ug/L	2	Not Available	0.4	<0.40	<0.40	<0.40	A	---	Y	<0.40	<0.40
Ethylbenzene	ug/L	90	Not Available	0.4	<0.40	<0.40	<0.40	A	---	Y	<0.40	<0.40
o-Xylene	ug/L	NC	Not Available	0.4	<0.40	<0.40	<0.40	A	---	Y	<0.40	<0.40
p+m-Xylene	ug/L	NC	Not Available	0.8	<0.80	<0.80	<0.80	A	---	Y	<0.80	<0.80
Total Xylenes	ug/L	NC	Not Available	0.8	<0.80	<0.80	<0.80	A	---	Y	<0.80	<0.80
F1 (C6-C10)	ug/L	NC	Not Available	100	<100	<100	<100	A	---	Y	<100	<100
F1 (C6-C10) - BTEX	ug/L	NC	Not Available	100	<100	<100	<100	A	---	Y	<100	<100
F2-F4 Hydrocarbons												
F2 (C10-C16 Hydrocarbons)	mg/L	NC	Not Available	0.1	<0.10	<0.10	<0.10	A	---	Y	<0.10	<0.10
F3 (C16-C34 Hydrocarbons)	mg/L	NC	Not Available	0.1	<0.10	<0.10	<0.10	A	---	Y	<0.10	<0.10
F4 (C34-C50 Hydrocarbons)	mg/L	NC	Not Available	0.1	<0.10	<0.10	<0.10	A	---	Y	<0.10	<0.10
Reached Baseline at C50	mg/L	NC	Not Available	N/A	Yes	Yes	Yes	NC	NC	NC	Yes	Yes

Notes:

1 = CCME (2007) Canadian Environmental Quality Guidelines Summary Table. Canadian Water Quality Guidelines for the protection of Freshwater Aquatic Life (FWAL).

2 = Upper Limit of Acceptability is determined as described in Report Section 3.2. Upper limits of acceptability are calculated using mean of previous sampling rounds +3 standard deviations.

* = See Quality Assurance and Quality Control section for scenario rationale.

NC = No Criteria

RDL= Reportable Detection Limit

20 = Exceeds selected guideline.

PARAMETER		Guidelines			Lowest RDL	ROB-06		ROB-08		DUP-1		Duplicate Evaluation**			ROB-10		ROB-09 (ROBERTS LAKE)	
Sample ID		CCME FWAL[1]	Upper Limit of Acceptability[2]									Scenario*	RPD (%)	Acceptable				
Date						09/08/2012		09/08/2012		09/08/2012					09/08/2012		09/08/2012	
Metals	**Units**	Total	Dissolved	Total		Dissolved	Total	Dissolved	Total	Dissolved	Total				Dissolved	Total	Dissolved	Total
Cadmium (Cd)	ug/L	0.095ˇ	0.065	0.15	0.0050	0.0072	<0.0050	<0.013	0.017	<0.013	<0.013	B	---	N	0.0069	0.0093	<0.0050	<0.0050
Arsenic (As)	mg/L	0.005	0.017	0.08	0.00020	0.00041	0.00048	0.0017	0.0015	0.0016	0.0019	C	24	Y	0.0012	0.0012	<0.00020	0.00031
Chromium (Cr)	mg/L	0.001	NC	0.004	0.0010	<0.0010	<0.0010	<0.0025	<0.0025	<0.0025	<0.0025	A	---	Y	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt (Co)	mg/L	NC	NC	0.008	0.00030	<0.00030	<0.00030	0.00097	0.001	0.0011	0.0011	D	---	Y	<0.00030	<0.00030	<0.00030	<0.00030
Copper (Cu)	mg/L	0.004ˇ	0.006	0.028	0.00020	0.005	0.006	0.00053	<0.00050	0.00051	0.00084	B	---	N	0.0057	0.0063	0.0016	0.0013
Lead (Pb)	mg/L	0.007ˇ	0.001	0.012	0.00020	<0.00020	<0.00020	<0.00050	<0.00050	<0.00050	<0.00050	A	---	Y	<0.00020	0.00023	<0.00020	<0.00020
Nickel (Ni)	mg/L	0.15ˇ	0.008	0.016	0.00050	0.00065	0.00057	<0.0013	0.0015	<0.0013	<0.0013	B	---	N	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)	mg/L	0.03	0.012	0.034	0.0030	<0.0030	<0.0030	<0.0075	<0.0075	<0.0075	<0.0075	A	---	Y	<0.0030	<0.0030	<0.0030	<0.0030

Notes:

1 = CCME (2007) Canadian Environmental Quality Guidelines Summary Table. Canadian Water Quality Guidelines for the protection of Freshwater Aquatic Life (FWAL).

2 = Upper Limit of Acceptability is determined as described in Report Section 3.2. Upper limits of acceptability are calculated using mean of previous sampling rounds +3 standard deviations.

3 = The CCME guideline for chromium is the Cr(VI) guideline as it is the more stringent of the available chromium guidelines for the protection of freshwater aquatic life

ˇ = Used average water hardness to calculate CCME guideline

* = See Quality Assurance and Quality Control section for scenario rationale.

** = Total metal values used for the Duplicate Evaluation

NC = No Criteria

- Not Analyzed

RDL= Reportable Detection Limit

20 = Exceeds selected guideline.

20 = Detection limit exceeds selected guideline

Table B-3
Surface Water Chemical Concentrations - PCBs

PARAMETER	Guidelines		RDL	ROB-06	ROB-08	DUP-1	Duplicate Evaluation			ROB-10	ROB-09 (ROBERTS LAKE)
Sample ID	CCME FWAL[1]	Upper Limit of Acceptability[2]					Scenario*	RPD (%)	Acceptable		
Date				09/08/2012	09/08/2012	09/08/2012				09/08/2012	09/08/2012
PCBs (mg/L)											
Aroclor 1016	NC	Not Available	0.000050	<0.000050	<0.000050	<0.000050	A	---	Y	<0.000050	<0.000050
Aroclor 1221	NC	Not Available	0.000050	<0.000050	<0.000050	<0.000050	A	---	Y	<0.000050	<0.000050
Aroclor 1232	NC	Not Available	0.000050	<0.000050	<0.000050	<0.000050	A	---	Y	<0.000050	<0.000050
Aroclor 1242	NC	Not Available	0.000050	<0.000050	<0.000050	<0.000050	A	---	Y	<0.000050	<0.000050
Aroclor 1248	NC	Not Available	0.000050	<0.000050	<0.000050	<0.000050	A	---	Y	<0.000050	<0.000050
Aroclor 1254	NC	Not Available	0.000050	<0.000050	<0.000050	<0.000050	A	---	Y	<0.000050	<0.000050
Aroclor 1260	NC	Not Available	0.000050	<0.000050	<0.000050	<0.000050	A	---	Y	<0.000050	<0.000050
Aroclor 1262	NC	Not Available	0.000050	<0.000050	<0.000050	<0.000050	A	---	Y	<0.000050	<0.000050
Aroclor 1268	NC	Not Available	0.000050	<0.000050	<0.000050	<0.000050	A	---	Y	<0.000050	<0.000050
Total PCB	NC	Not Available	0.000050	<0.000050	<0.000050	<0.000050	A	---	Y	<0.000050	<0.000050

Notes:

1 = CCME (2007) Canadian Environmental Quality Guidelines Summary Table. Canadian Water Quality Guidelines for the protection of Freshwater Aquatic Life (FWAL)

2 = Upper Limit of Acceptability is determined as described in Report Section 3.2. Upper limits of acceptability are calculated using mean of previous sampling rounds +3 standard deviations.

* = See Quality Assurance and Quality Control section for scenario rationale.

NC = No Criteria

RDL= Reportable Detection Limit

20 = Exceeds selected guideline.

Table B-4
Surface Water Chemical Concentrations - Inorganic Parameters

PARAMETER		Guidelines		Lowest RDL	ROB-06	ROB-08	DUP-1	Duplicate Evaluation			ROB-10	ROB-09 (ROBERTS LAKE)
Sample ID		CCME FWAL[1]	Upper Limit of Acceptability[2]					Scenario*	RPD (%)	Acceptable		
Date					09/08/2012	09/08/2012	09/08/2012				09/08/2012	09/08/2012
Inorganics	**Units**											
Calculated Parameters												
Hardness (CaCO3)	mg/L	NC	1330	0.50	260	780	730	C	7	Y	290	40
Dissolved Nitrate (NO3)	mg/L	13	4.8	0.013	3.2	0.022	<0.013	B	---	Y	14	0.035
Nitrate plus Nitrite (N)	mg/L	NC	NC	0.0030	0.73	0.005	<0.0030	B	---	Y	3.1	0.008
Dissolved Nitrite (NO2)	mg/L	0.06	NC	0.0099	<0.0099	<0.0099	<0.0099	A	---	Y	<0.0099	<0.0099
Misc. Inorganics												
Conductivity	uS/cm	NC	5300	1.0	590	4100	4100	C	0	Y	850	240
pH	N/A	6.5-9.0	7.21 < 8.01	0	7.97	7.74	7.74	C	0	Y	7.74	7.64
Total Dissolved Solids	mg/L	NC	4580	10	370	2400	2300	C	4	Y	490	130
Total Suspended Solids	mg/L	NC	550	1.0	<1.0	<1.0	<1.0	A	---	Y	<1.0	1
Anions												
Dissolved Fluoride (F)	mg/L	0.12	0.16	0.050	0.072	0.15	0.15	D	---	Y	0.06	0.055
Dissolved Sulphate (SO4)	mg/L	NC	370	1.0	61	130	130	C	0	Y	110	5.2
Dissolved Chloride (Cl)	mg/L	120	1300	1.0	59	1100 (1)	1100 (1)	A	---	Y	100	58
Nutrients												
Orthophosphate (P)	mg/L	NC	0.007	0.0030	0.007	0.005	0.004	D	---	Y	0.013	0.003
Dissolved Nitrite (N)	mg/L	13	NC	0.0030	<0.0030	<0.0030	<0.0030	A	---	Y	<0.0030	<0.0030
Dissolved Nitrate (N)	mg/L	0.06	4.8	0.0030	0.73	0.005	<0.0030	B	---	Y	3.1	0.008
Physical Properties												
True Colour	PtCo units	NC	76	2.0	41	74	73	C	1	Y	10	8.8

Notes:

1 = CCME (2007) Canadian Environmental Quality Guidelines Summary Table. Canadian Water Quality Guidelines for the protection of Freshwater Aquatic Life (FWAL).

2 = Upper Limit of Acceptability is determined as described in Report Section 3.2. Upper limits of acceptability are calculated using mean of previous sampling rounds +3 standard deviations; significant figures of results are factored in the calculation.

* = See Quality Assurance and Quality Control section for scenario rationale.

NC = No Criteria

RDL= Reportable Detection Limit

20 = Exceeds selected guideline.

Table B-5
Historical Surface Water Chemical Concentrations
Upper Limits of Acceptability - PHCs, PCBs, Inorganic Parameters

Sample #	Location	Date	PCBs [ug/L]	TPH Identity								Inorganic Parameters											
				Benzene [ug/L]	Toluene [ug/L]	Ethyl-benzene [ug/L]	Total Xylene [ug/L]	F1 [ug/L]	F2 [ug/L]	F3 [ug/L]	F4 [ug/L]	Conductivity [µmho/cm]	pH	Colour [PtCo]	Hardness [mg/L]	Total Dissolved Solids [mg/L]	Total Suspended Solids [mg/L]	Dissolved Fluoride [mg/L]	Dissolved sulphate [mg/L]	Dissolved Chloride [mg/L]	Ortho-phosphate [mg/L]	Nitrite [mg/L]	Nitrate [mg/L]
Surface Water Samples																							
ROB-6	SE of SWMF	2010	<0.05	<0.2	<0.2	<0.2	<0.4	<100	<100	<100	<100	1500	7.66	34	590	1500	420	0.060	150	280	<0.003	<0.003	1.4
ROB-7	W of SWMF	2010	<0.05	<0.2	<0.2	<0.2	<0.4	<100	<100	<100	<100	950	7.60	20	415	970	80	0.060	120	90	<0.003	<0.003	<0.003
DUP-1	W of SWMF	2010	<0.05	<0.2	<0.2	<0.2	<0.4	<100	<100	<100	<100	950	7.62	20	424	980	160	0.060	130	90	<0.003	<0.003	<0.003
ROB-8	NE of SMWF	2010	<0.05	<0.2	<0.2	<0.2	<0.4	<100	<100	<100	<100	4000	7.84	59	871	3400	11	0.140	230	1000	0.004	<0.003	<0.003
ROB-9	Robert's Lake	2010	<0.05	<0.2	<0.2	<0.2	<0.4	<100	<100	<100	<100	250	7.45	11	40.3	180	11	0.070	5	58	0.004	<0.003	<0.003
DUP-2	Robert's Lake	2010	<0.05	<0.2	<0.2	<0.2	<0.4	<25	<100	<100	<100	250	7.45	10	40.1	190	8	0.070	5	56	0.006	<0.003	<0.003
ROB-10	E of SWMF	2010	<0.05	<0.2	<0.2	<0.2	<0.4	<25	<100	<100	<100	1900	7.62	15	582	1700	57	0.050	170	380	<0.003	<0.003	3.6
ROB-6	SE of SWMF	2012	<0.05	<0.2	<0.2	<0.2	<0.4	<25	<100	<100	<100	590	7.97	41	260	370	<1.0	0.072	61	59	0.007	<0.003	0.73
ROB-8	NE of SMWF	2012	<0.05	<0.2	<0.2	<0.2	<0.4	<25	<100	<100	<100	4100	7.74	74	780	2400	<1.0	0.150	130	1100	0.005	<0.003	0.005
DUP-1	NE of SMWF	2012	<0.05	<0.4	<0.4	<0.4	<0.8	<100	<100	<100	<100	4100	7.74	73	730	2300	<1.0	0.150	130	1100	0.004	<0.003	<0.003
ROB-9	Robert's Lake	2012	<0.05	<0.4	<0.4	<0.4	<0.8	<100	<100	<100	<100	240	7.64	8.8	40	130	1.0	0.055	5	58	0.003	<0.003	0.008
ROB-10	E of SWMF	2012	<0.05	<0.4	<0.4	<0.4	<0.8	<100	<100	<100	<100	850	7.74	10	290	490	<1.0	0.060	110	100	0.013	<0.003	3.1
Statistics																							
N Value			12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
N Value [2010 only]			7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Average			<0.05	<0.4	<0.4	<0.4	<0.8	<100	<100	<100	<100	1640	7.67	31	422	1218	63	0	104	364	0.0048	<0.003	0.738
Average [2010 only]			<0.05	<0.2	<0.2	<0.2	<0.4	<100	<100	<100	<100	1400	7.61	24	423	1274	107	0	116	279	0.0037	<0.003	0.716
Minimum			<0.05	<0.2	<0.2	<0.2	<0.4	<25	<100	<100	<100	250	7.45	10	40.1	180	8	0.05	5	56	0.003	<0.003	0.003
Maximum			<0.05	<0.2	<0.2	<0.2	<0.4	<100	<100	<100	<100	4000	7.84	59	871	3400	420	0.14	230	1000	0.006	<0.003	3.6
Standard Deviation (s)* [2010 only]			NC	NC	NC	NC	NC	NC	NC	NC	NC	1296	0.13	17	302	1103	148	0	84	342	0	NC	1
Acceptable Range (Average +/- 3s) [2006-2011 only]			NC	NC	NC	NC	NC	NC	NC	NC	NC	0 < 5300	7.21 < 8.01	0 < 76	0 < 1330	0 < 4580	0 < 550	0 < 0.16	0 < 370	0 < 1300	0 < 0.007	NC	0 < 4.8

Sample duplicates underlined (primary sample listed above duplicate)
Detection limits are converted to results to calculate average and standard deviation
Zero is substituted for negative values where average minus 3s is less than zero
NC: Not calculated. Where there are no values other than "non-detect," no standard deviation is calculated. The acceptable range for these samples should be close to the detection limit.

Table B-6
Historical Surface Water Chemical Concentrations
Upper Limits of Acceptability - Metals

Sample #	Location	Date	Diss. As [mg/L]	As [mg/L]	Diss. Cd [ug/l]	Cd [ug/l]	Diss. Co [mg/L]	Co [mg/L]	Diss. Cr [mg/L]	Cr [mg/L]	Diss. Cu [mg/L]	Cu [mg/L]	Diss. Ni [mg/L]	Ni [mg/L]	Diss. Pb [mg/L]	Pb [mg/L]	Diss. Zn [mg/L]	Zn [mg/L]	Diss. Hg [mg/L]	Hg [ug/l]
Surface Water Samples																				
ROB-6	SE of SWMF	2010	0.0005	0.0023	0.012	0.079	<0.0003	0.0047	<0.001	0.003	0.0042	0.0220	0.0008	0.0045	<0.0002	0.0092	0.005	0.017	0.002	0.008
ROB-7	W of SWMF	2010	0.01	0.050	0.008	0.087	<0.0003	0.0041	<0.001	<0.001	0.001	0.0048	0.0047	0.01	<0.0002	0.014	<0.003	0.021	<0.002	0.003
DUP-1	W of SWMF	2010	0.0097	0.043	0.013	0.065	<0.0003	0.0033	<0.001	<0.001	0.001	0.0038	0.0049	0.0095	<0.0002	0.0087	0.004	0.015	<0.002	0.007
ROB-8	NE of SMWF	2010	0.002	0.005	<0.005	0.05	<0.0003	<0.0003	<0.001	<0.001	<0.001	0.0020	<0.0005	<0.0005	<0.0002	<0.0002	<0.003	<0.003	0.003	0.009
ROB-9	Robert's Lake	2010	0.0002	0.0003	0.005	<0.005	<0.0003	<0.0003	<0.001	<0.001	0.001	0.0020	<0.0005	0.0008	<0.0002	<0.0002	<0.003	<0.003	<0.002	0.007
DUP-2	Robert's Lake	2010	<0.0002	0.0007	<0.005	<0.005	<0.0003	<0.0003	<0.001	<0.001	0.001	0.0017	<0.0005	0.0007	<0.0002	<0.0002	<0.003	<0.003	<0.002	0.004
ROB-10	E of SWMF	2010	0.0016	0.0022	0.052	0.048	<0.0003	0.0005	<0.001	<0.001	0.0027	0.0051	0.0019	0.0032	0.0008	0.0048	0.010	0.014	<0.002	0.006
ROB-6	SE of SWMF	2012	0.00041	0.00048	0.0072	<0.005	<0.0003	<0.0003	<0.0010	<0.0010	0.005	0.006	0.00065	0.00057	<0.0002	<0.0002	<0.003	<0.003		
ROB-8	NE of SMWF	2012	0.0017	0.0015	<0.013	0.017	0.00097	0.001	<0.0025	<0.0025	0.00053	<0.00050	<0.0013	0.0015	<0.0005	<0.0005	<0.0075	<0.0075		
DUP-1	NE of SMWF	2012	0.0016	0.0019	<0.013	<0.013	0.0011	0.0011	<0.0025	<0.0025	0.00051	0.00084	<0.0013	<0.0013	<0.0005	<0.0005	<0.0075	<0.0075		
ROB-9	Robert's Lake	2012	<0.0002	0.00031	<0.005	<0.005	<0.0003	<0.0003	<0.001	<0.001	0.0016	0.0013	<0.0005	<0.0005	<0.0002	<0.0002	<0.003	<0.003		
ROB-10	E of SWMF	2012	0.0012	0.0012	0.0069	0.0093	<0.00030	<0.00030	<0.0010	<0.0010	0.0057	0.0063	<0.0005	<0.0005	<0.0002	0.00023	<0.003	<0.003		
Statistics																				
N Value			12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	7	7
N Value [2010 only]			7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Average			0.002	0.009	0.012	0.032	0.0004225	0.001375	<0.0025	0.0014	0.002136667	0.004653	0.0015	0.0028	0.00030	0.0032	0.0046	0.008	0.0021	0.0063
Average [2010 only]			0.003	0.015	0.014	0.048	<0.0003	0.00192857	<0.001	0.0013	0.0017	0.005914	0.0020	0.0042	0.00029	0.0053	0.0044	0.011	0.0021	0.0063
Minimum			0.0002	0.0003	0.005	0.005	0.0003	0.0003	<0.001	0.001	0.00051	0.0005	0.0005	0.0005	0.0002	0.0002	0.003	0.003	0.002	0.003
Maximum			0.01	0.05	0.052	0.087	0.0003	0.0047	<0.001	0.003	0.0042	0.022	0.0049	0.01	0.0008	0.014	0.01	0.021	0.003	0.009
Standard Deviation (s)* [2010 only]			0.0044	0.0218	0.0170	0.0328	NC	0.0020	NC	0.0008	0.0013	0.0072	0.0020	0.0041	0.0002	0.0055	0.0026	0.0077	0.0004	0.0021
Acceptable Range (Average +/- 3s) [2006-2011 only]			0 < 0.017	0 < 0.08	0 < 0.065	0 < 0.15	NC	0 < 0.008	NC	0 < 0.004	0 < 0.006	0 < 0.028	0 < 0.008	0 < 0.016	0 < 0.001	0 < 0.022	0 < 0.012	0 < 0.034	0 < 0.003	0 < 0.013

Sample duplicates underlined (primary sample listed above duplicate)
Detection limits are converted to results to calculate average and standard deviation
Zero is substituted for negative values where average minus 3s is less than zero
NC: Not calculated. Where there are no values other than "non-detect," no standard deviation is calculated. The acceptable range for these samples should be close to the detection limit.

APPENDIX C

Surface Water Sampling Notes

Aug 9/2012
1697-1201

Roberts Bay surface water sampling

- walked around site to locate surface water sampling locations.
- Able to locate Rob-8, Rob-6 and Rob-10. Rob-7 area seems to be dry; no standing water could be identified there. Rob-9 is background location

- each location shot w/ differential GPS.
- photos taken At each surface water Location

- Samples collected through peristaltic pump.

Aug 9/2012
1697-1201

Roberts Bay
Surface water Sampling.

ROB-08

located NE of Landfill, approx 10 m by 2.5 m and 6-10" deep. metallic sheen apparent on surface of water.
- collected sample @ 1:30 BTEX F1-F4, PCBs, metals (total and dissolved) Gen Chem & Solids.
*also collected field duplicate sample (Dup-1).

ROB-10

located SISE of landfill. approx 2.5 m by 0.3 m and 2-4" deep.
- collected sample @ 2:30 BTEX F1-F4, PCBs, metals (total and dissolved) Gen chem and solids.

Rite in the Rain

Aug 9/2012
1697-1201

Roberts Bay Surface Water Sampling

ROB-06

located SE of landfill. approx 1.2 m by 1m and 1-2" deep. Collected sample at 3:15 BTEx F1-F4, PCBs, Metals (total and dissolved) Gen Chem and solids.

Roberts Lake

collected additional sample from Roberts Lake adjacent to Dock. Water at location of sample collection ~ 4-6" deep. BTEx F1-F4, PCBs, Metals (total and dissolved) Gen Chem and solids.

Rite in the Rain

APPENDIX D

Laboratory Certificates of Analyses and Chain of Custody Forms

Your Project #: 1697-1201, DEW LINES (ROBERTS)
Your C.O.C. #: 365645-02-01

Attention: KEVIN MCKENNA
FRANZ ENVIRONMENTAL INC.
329 CHURCHILL AVE NORTH
SUITE 2000
OTTAWA, ON
CANADA K1Z5B8

Report Date: 2012/08/17

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B271116
Received: 2012/08/11, 11:15

Sample Matrix: Water
Samples Received: 5

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
BTEX/F1 in Water by HS GC/MS	5	N/A	2012/08/15	AB SOP-00039	CCME, EPA 8260C
Cadmium - low level CCME - Dissolved	4	N/A	2012/08/16	AB SOP-00043	EPA 200.8
Cadmium - low level CCME - Dissolved	1	N/A	2012/08/17	AB SOP-00043	EPA 200.8
Cadmium - low level CCME (Total)	5	2012/08/13	2012/08/16	AB SOP-00043	EPA 200.8
Chloride by Automated Colourimetry	5	N/A	2012/08/15	AB SOP-00020	EPA 325.2
True Colour	5	N/A	2012/08/15	CAL SOP-00049	SM 2120 C
Conductivity @25C	5	N/A	2012/08/13	AB SOP-00005	SM 2510-B
Fluoride	5	N/A	2012/08/13	AB SOP-00005	SM 4500-F C
CCME Hydrocarbons (F2-F4 in water)	1	2012/08/15	2012/08/15	CAL SOP-00086 AB SOP-00037	EPA3510C/CCME PHCCWS
CCME Hydrocarbons (F2-F4 in water)	4	2012/08/15	2012/08/16	CAL SOP-00086 AB SOP-00037	EPA3510C/CCME PHCCWS
Hardness	4	N/A	2012/08/16	AB WI-00065	SM 2340B
Hardness	1	N/A	2012/08/17	AB WI-00065	SM 2340B
Elements by ICP - Dissolved	4	N/A	2012/08/14	AB SOP-00042	EPA 200.7
Elements by ICP - Dissolved	1	N/A	2012/08/15	AB SOP-00042	EPA 200.7
Elements by ICP - Total	4	2012/08/14	2012/08/14	AB SOP-00042	EPA 200.7
Elements by ICP - Total	1	2012/08/15	2012/08/15	AB SOP-00042	EPA 200.7
Elements by ICPMS - Dissolved	5	N/A	2012/08/15	AB SOP-00043	EPA 200.8
Elements by ICPMS - Total	4	2012/08/14	2012/08/15	AB SOP-00043	EPA 200.8
Elements by ICPMS - Total	1	2012/08/15	2012/08/15	AB SOP-00043	EPA 200.8
Nitrate and Nitrite	5	N/A	2012/08/13	AB SOP-00023	SM4110B
Nitrate + Nitrite-N (calculated)	5	N/A	2012/08/13	AB SOP-00023	SM 4110-B
Nitrogen, (Nitrite, Nitrate) by IC	5	N/A	2012/08/13	AB SOP-00023	SM 4110-B
Polychlorinated Biphenyls	2	2012/08/15	2012/08/16	CAL SOP-00149	EPA 3510C, EPA 8082A
Polychlorinated Biphenyls	3	2012/08/15	2012/08/17	CAL SOP-00149	EPA 3510C, EPA 8082A
pH @25°C (Alkalinity titrator)	5	N/A	2012/08/13	AB SOP-00005	SM 4500-H+B
Orthophosphate by Konelab	5	N/A	2012/08/13	AB SOP-00025	SM 4500-P
Sulphate by Automated Colourimetry	5	N/A	2012/08/15	AB SOP-00018	EPA 375.4
Total Dissolved Solids (Filt. Residue)	5	2012/08/16	2012/08/16	CAL SOP-00074	SM 2540-C
Total Suspended Solids (NFR)	5	2012/08/15	2012/08/15	CAL SOP-00075	SM 2540-D

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
* Results relate only to the items tested.

../2

Maxxam Job #: B271116
Report Date: 2012/08/17

FRANZ ENVIRONMENTAL INC.
Client Project #: 1697-1201, DEW LINES (ROBERTS)

Sampler Initials: DK

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Ioana Stoica, Project Manager
Email: IStoica@maxxam.ca
Phone# (403) 291-3077

==========

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 2

Maxxam Job #: B271116
Report Date: 2012/08/17

FRANZ ENVIRONMENTAL INC.
Client Project #: 1697-1201, DEW LINES (ROBERTS)

Sampler Initials: DK

AT1 BTEX AND F1-F4 IN WATER (WATER)

Maxxam ID		EE3055	EE3116	EE3129	EE3130	EE3131		
Sampling Date		2012/08/09	2012/08/09	2012/08/09	2012/08/09	2012/08/09		
	UNITS	**ROB-O6**	**ROB-08**	**ROB-10**	**ROBERTS LAKE**	**DUP-1**	**RDL**	**QC Batch**
Ext. Pet. Hydrocarbon								
F2 (C10-C16 Hydrocarbons)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	6083257
F3 (C16-C34 Hydrocarbons)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	6083257
F4 (C34-C50 Hydrocarbons)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	6083257
Reached Baseline at C50	mg/L	YES	YES	YES	YES	YES	N/A	6083257
Surrogate Recovery (%)								
O-TERPHENYL (sur.)	%	86	83	94	89	81	N/A	6083257
Volatiles								
Benzene	ug/L	<0.40	<0.40	<0.40	<0.40	<0.40	0.40	6079647
Toluene	ug/L	<0.40	<0.40	<0.40	<0.40	<0.40	0.40	6079647
Ethylbenzene	ug/L	<0.40	<0.40	<0.40	<0.40	<0.40	0.40	6079647
o-Xylene	ug/L	<0.40	<0.40	<0.40	<0.40	<0.40	0.40	6079647
m & p-Xylene	ug/L	<0.80	<0.80	<0.80	<0.80	<0.80	0.80	6079647
Xylenes (Total)	ug/L	<0.80	<0.80	<0.80	<0.80	<0.80	0.80	6079647
F1 (C6-C10) - BTEX	ug/L	<100	<100	<100	<100	<100	100	6079647
(C6-C10)	ug/L	<100	<100	<100	<100	<100	100	6079647
Surrogate Recovery (%)								
1,4-Difluorobenzene (sur.)	%	105	103	104	104	102	N/A	6079647
4-BROMOFLUOROBENZENE (sur.)	%	98	98	96	97	98	N/A	6079647
D4-1,2-DICHLOROETHANE (sur.)	%	88	77	87	85	87	N/A	6079647

N/A = Not Applicable
RDL = Reportable Detection Limit

Maxxam Job #: B271116
Report Date: 2012/08/17

FRANZ ENVIRONMENTAL INC.
Client Project #: 1697-1201, DEW LINES (ROBERTS)

Sampler Initials: DK

REGULATED METALS (CCME/AT1) - DISSOLVED

Maxxam ID		EE3055		EE3116		EE3129	EE3130			EE3131		
Sampling Date		2012/08/09		2012/08/09		2012/08/09	2012/08/09			2012/08/09		
	UNITS	**ROB-O6**	**RDL**	**ROB-08**	**RDL**	**ROB-10**	**ROBERTS LAKE**	**RDL**	**QC Batch**	**DUP-1**	**RDL**	**QC Batch**
Low Level Elements												
Dissolved Cadmium (Cd)	ug/L	0.0072	0.0050	<0.013	0.013	0.0069	<0.0050	0.0050	6077216	<0.013	0.013	6077216
Elements												
Dissolved Aluminum (Al)	mg/L	0.017	0.0010	0.0061(1)	0.0025	0.0044	0.010	0.0010	6082452	0.0040	0.0025	6084223
Dissolved Antimony (Sb)	mg/L	<0.00060	0.00060	<0.0015	0.0015	0.0018	<0.00060	0.00060	6082452	<0.0015	0.0015	6084223
Dissolved Arsenic (As)	mg/L	0.00041	0.00020	0.0017(1)	0.00050	0.0012	<0.00020	0.00020	6082452	0.0016	0.00050	6084223
Dissolved Barium (Ba)	mg/L	0.049(1)	0.010	0.11	0.010	0.045(1)	<0.010	0.010	6079848	0.11(2)	0.010	6084134
Dissolved Beryllium (Be)	mg/L	<0.0010	0.0010	<0.0025	0.0025	<0.0010	<0.0010	0.0010	6082452	<0.0025	0.0025	6084223
Dissolved Boron (B)	mg/L	0.052(1)	0.020	0.044(1)	0.020	0.062	0.022(1)	0.020	6079848	0.040(1)	0.020	6084134
Dissolved Calcium (Ca)	mg/L	64(2)	0.30	170(2)	0.30	73(2)	6.5(2)	0.30	6079848	150(2)	0.30	6084134
Dissolved Chromium (Cr)	mg/L	<0.0010	0.0010	<0.0025	0.0025	<0.0010	<0.0010	0.0010	6082452	<0.0025	0.0025	6084223
Dissolved Cobalt (Co)	mg/L	<0.00030	0.00030	0.00097	0.00075	<0.00030	<0.00030	0.00030	6082452	0.0011	0.00075	6084223
Dissolved Copper (Cu)	mg/L	0.0054	0.00020	0.00053(1)	0.00050	0.0057	0.0016(3)	0.00020	6082452	0.00051	0.00050	6084223
Dissolved Iron (Fe)	mg/L	0.083(1)	0.060	0.60	0.060	<0.060	<0.060	0.060	6079848	0.49	0.060	6084134
Dissolved Lead (Pb)	mg/L	<0.00020	0.00020	<0.00050	0.00050	<0.00020	<0.00020	0.00020	6082452	<0.00050	0.00050	6084223
Dissolved Lithium (Li)	mg/L	<0.020	0.020	<0.020	0.020	<0.020	<0.020	0.020	6079848	<0.020	0.020	6084134
Dissolved Magnesium (Mg)	mg/L	24(2)	0.20	88(2)	0.20	27(2)	5.9(2)	0.20	6079848	83(2)	0.20	6084134
Dissolved Manganese (Mn)	mg/L	<0.0040	0.0040	1.3(2)	0.0040	<0.0040	<0.0040	0.0040	6079848	1.2(2)	0.0040	6084134
Dissolved Molybdenum (Mo)	mg/L	0.00079	0.00020	0.0015	0.00050	0.0019	<0.00020	0.00020	6082452	0.0016	0.00050	6084223
Dissolved Nickel (Ni)	mg/L	0.00065(1)	0.00050	<0.0013	0.0013	<0.00050	<0.00050	0.00050	6082452	<0.0013	0.0013	6084223
Dissolved Phosphorus (P)	mg/L	<0.10	0.10	<0.10	0.10	<0.10	<0.10	0.10	6079848	0.14(1)	0.10	6084134
Dissolved Potassium (K)	mg/L	2.7	0.30	7.1(2)	0.30	4.5(2)	1.9(2)	0.30	6079848	6.7(2)	0.30	6084134
Dissolved Selenium (Se)	mg/L	<0.00020	0.00020	<0.00050	0.00050	0.00048	<0.00020	0.00020	6082452	<0.00050	0.00050	6084223
Dissolved Silicon (Si)	mg/L	3.1(2)	0.10	0.48(1)	0.10	2.4(2)	0.32	0.10	6079848	0.44(1)	0.10	6084134
Dissolved Silver (Ag)	mg/L	<0.00010	0.00010	<0.00025	0.00025	<0.00010	<0.00010	0.00010	6082452	<0.00025	0.00025	6084223
Dissolved Sodium (Na)	mg/L	29(2)	0.50	540(4)	2.5	69(2)	30(2)	0.50	6079848	480(2)	0.50	6084134
Dissolved Strontium (Sr)	mg/L	0.13	0.020	0.78(2)	0.020	0.15	0.036(1)	0.020	6079848	0.71(2)	0.020	6084134
Dissolved Sulphur (S)	mg/L	19	0.20	43(2)	0.20	36(2)	1.5	0.20	6079848	39(2)	0.20	6084134
Dissolved Thallium (Tl)	mg/L	<0.00020	0.00020	<0.00050	0.00050	<0.00020	<0.00020	0.00020	6082452	<0.00050	0.00050	6084223
Dissolved Tin (Sn)	mg/L	<0.0010	0.0010	<0.0025	0.0025	<0.0010	<0.0010	0.0010	6082452	<0.0025	0.0025	6084223
Dissolved Titanium (Ti)	mg/L	<0.0010	0.0010	<0.0025	0.0025	<0.0010	<0.0010	0.0010	6082452	<0.0025	0.0025	6084223
Dissolved Uranium (U)	mg/L	0.0012	0.00010	0.0013(2)	0.00025	0.0027	<0.00010	0.00010	6082452	0.0014	0.00025	6084223

RDL = Reportable Detection Limit
(1) - Dissolved greater than total. Results are within limits of uncertainty(MU).
(2) - Dissolved greater than total. Results within acceptable limits of precision.
(3) - Dissolved greater than total. Reanalysis yields similar results.
(4) - Detection limits raised due to dilution to bring analyte within the calibrated range.

Maxxam Job #: B271116
Report Date: 2012/08/17

FRANZ ENVIRONMENTAL INC.
Client Project #: 1697-1201, DEW LINES (ROBERTS)

Sampler Initials: DK

REGULATED METALS (CCME/AT1) - DISSOLVED

Maxxam ID		EE3055		EE3116		EE3129	EE3130			EE3131		
Sampling Date		2012/08/09		2012/08/09		2012/08/09	2012/08/09			2012/08/09		
	UNITS	**ROB-O6**	**RDL**	**ROB-08**	**RDL**	**ROB-10**	**ROBERTS LAKE**	**RDL**	**QC Batch**	**DUP-1**	**RDL**	**QC Batch**
Dissolved Vanadium (V)	mg/L	<0.0010	0.0010	<0.0025	0.0025	<0.0010	<0.0010	0.0010	6082452	<0.0025	0.0025	6084223
Dissolved Zinc (Zn)	mg/L	<0.0030	0.0030	<0.0075	0.0075	<0.0030	<0.0030	0.0030	6082452	<0.0075	0.0075	6084223
RDL = Reportable Detection Limit												

Maxxam Job #: B271116
Report Date: 2012/08/17

FRANZ ENVIRONMENTAL INC.
Client Project #: 1697-1201, DEW LINES (ROBERTS)

Sampler Initials: DK

REGULATED METALS (CCME/AT1) - TOTAL

Maxxam ID		EE3055		EE3116		EE3129	EE3130			EE3131		
Sampling Date		2012/08/09		2012/08/09		2012/08/09	2012/08/09			2012/08/09		
	UNITS	**ROB-O6**	**RDL**	**ROB-08**	**RDL**	**ROB-10**	**ROBERTS LAKE**	**RDL**	**QC Batch**	**DUP-1**	**RDL**	**QC Batch**
Low Level Elements												
Total Cadmium (Cd)	ug/L	<0.0050	0.0050	0.017	0.013	0.0093	<0.0050	0.0050	6077217	<0.013	0.013	6077217
Elements												
Total Aluminum (Al)	mg/L	0.018	0.0010	0.0055	0.0025	0.0081	0.028	0.0010	6082389	0.0050	0.0025	6084217
Total Antimony (Sb)	mg/L	<0.00060	0.00060	<0.0015	0.0015	0.0021	<0.00060	0.00060	6082389	<0.0015	0.0015	6084217
Total Arsenic (As)	mg/L	0.00048	0.00020	0.0015	0.00050	0.0012	0.00031	0.00020	6082389	0.0019	0.00050	6084217
Total Barium (Ba)	mg/L	0.046	0.010	0.11	0.010	0.043	<0.010	0.010	6079819	0.10	0.010	6084090
Total Beryllium (Be)	mg/L	<0.0010	0.0010	<0.0025	0.0025	<0.0010	<0.0010	0.0010	6082389	<0.0025	0.0025	6084217
Total Boron (B)	mg/L	0.050	0.020	0.042	0.020	0.063	0.021	0.020	6079819	0.039	0.020	6084090
Total Calcium (Ca)	mg/L	61	0.30	160	0.30	69	5.9	0.30	6079819	140	0.30	6084090
Total Chromium (Cr)	mg/L	<0.0010	0.0010	<0.0025	0.0025	<0.0010	<0.0010	0.0010	6082389	<0.0025	0.0025	6084217
Total Cobalt (Co)	mg/L	<0.00030	0.00030	0.0010	0.00075	<0.00030	<0.00030	0.00030	6082389	0.0011	0.00075	6084217
Total Copper (Cu)	mg/L	0.0055	0.00020	<0.00050	0.00050	0.0063	0.0013	0.00020	6082389	0.00084	0.00050	6084217
Total Iron (Fe)	mg/L	0.079	0.060	0.91	0.060	0.061	0.085	0.060	6079819	0.75	0.060	6084090
Total Lead (Pb)	mg/L	<0.00020	0.00020	<0.00050	0.00050	0.00023	<0.00020	0.00020	6082389	<0.00050	0.00050	6084217
Total Lithium (Li)	mg/L	<0.020	0.020	<0.020	0.020	<0.020	<0.020	0.020	6079819	<0.020	0.020	6084090
Total Magnesium (Mg)	mg/L	23	0.20	85	0.20	25	5.5	0.20	6079819	78	0.20	6084090
Total Manganese (Mn)	mg/L	<0.0040	0.0040	1.2	0.0040	<0.0040	0.0063	0.0040	6079819	1.1	0.0040	6084090
Total Molybdenum (Mo)	mg/L	0.00089	0.00020	0.0017	0.00050	0.0020	<0.00020	0.00020	6082389	0.0018	0.00050	6084217
Total Nickel (Ni)	mg/L	0.00057	0.00050	0.0015	0.0013	<0.00050	<0.00050	0.00050	6082389	<0.0013	0.0013	6084217
Total Phosphorus (P)	mg/L	<0.10	0.10	<0.10	0.10	<0.10	<0.10	0.10	6079819	0.13	0.10	6084090
Total Potassium (K)	mg/L	2.7	0.30	6.8	0.30	4.2	1.7	0.30	6079819	6.5	0.30	6084090
Total Selenium (Se)	mg/L	<0.00020	0.00020	<0.00050	0.00050	0.00053	<0.00020	0.00020	6082389	<0.00050	0.00050	6084217
Total Silicon (Si)	mg/L	3.0	0.10	0.47	0.10	2.3	0.38	0.10	6079819	0.42	0.10	6084090
Total Silver (Ag)	mg/L	<0.00010	0.00010	<0.00025	0.00025	<0.00010	<0.00010	0.00010	6082389	<0.00025	0.00025	6084217
Total Sodium (Na)	mg/L	28	0.50	540(1)	2.5	66	29	0.50	6079819	470	0.50	6084090
Total Strontium (Sr)	mg/L	0.13	0.020	0.76	0.020	0.15	0.034	0.020	6079819	0.68	0.020	6084090
Total Sulphur (S)	mg/L	19	0.20	42	0.20	35	1.5	0.20	6079819	37	0.20	6084090
Total Thallium (Tl)	mg/L	<0.00020	0.00020	<0.00050	0.00050	<0.00020	<0.00020	0.00020	6082389	<0.00050	0.00050	6084217
Total Tin (Sn)	mg/L	<0.0010	0.0010	<0.0025	0.0025	<0.0010	<0.0010	0.0010	6082389	<0.0025	0.0025	6084217
Total Titanium (Ti)	mg/L	<0.0010	0.0010	<0.0025	0.0025	<0.0010	0.0020	0.0010	6082389	<0.0025	0.0025	6084217
Total Uranium (U)	mg/L	0.0013	0.00010	0.0012	0.00025	0.0028	<0.00010	0.00010	6082389	0.0014	0.00025	6084217
Total Vanadium (V)	mg/L	<0.0010	0.0010	<0.0025	0.0025	<0.0010	<0.0010	0.0010	6082389	<0.0025	0.0025	6084217
Total Zinc (Zn)	mg/L	<0.0030	0.0030	<0.0075	0.0075	<0.0030	<0.0030	0.0030	6082389	<0.0075	0.0075	6084217

RDL = Reportable Detection Limit
(1) - Detection limits raised due to dilution to bring analyte within the calibrated range.

Maxxam Job #: B271116
Report Date: 2012/08/17

FRANZ ENVIRONMENTAL INC.
Client Project #: 1697-1201, DEW LINES (ROBERTS)

Sampler Initials: DK

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		EE3055		EE3116		EE3129	EE3130		EE3131		
Sampling Date		2012/08/09		2012/08/09		2012/08/09	2012/08/09		2012/08/09		
	UNITS	**ROB-O6**	**RDL**	**ROB-08**	**RDL**	**ROB-10**	**ROBERTS LAKE**	**RDL**	**DUP-1**	**RDL**	**QC Batch**
Calculated Parameters											
Hardness (CaCO3)	mg/L	260	0.50	780	0.50	290	40	0.50	730	0.50	6077218
Dissolved Nitrate (NO3)	mg/L	3.2	0.013	0.022	0.013	14	0.035	0.013	<0.013	0.013	6077221
Nitrate plus Nitrite (N)	mg/L	0.73	0.0030	0.0050	0.0030	3.1	0.0080	0.0030	<0.0030	0.0030	6077222
Dissolved Nitrite (NO2)	mg/L	<0.0099	0.0099	<0.0099	0.0099	<0.0099	<0.0099	0.0099	<0.0099	0.0099	6077221
Misc. Inorganics											
Conductivity	uS/cm	590	1.0	4100	1.0	850	240	1.0	4100	1.0	6077430
pH	N/A	7.97	N/A	7.74	N/A	7.74	7.64	N/A	7.74	N/A	6077441
Total Dissolved Solids	mg/L	370	10	2400	10	490	130	10	2300	10	6086330
Total Suspended Solids	mg/L	<1.0	1.0	<1.0	1.0	<1.0	1.0	1.0	<1.0	1.0	6083145
Anions											
Dissolved Fluoride (F)	mg/L	0.072	0.050	0.15	0.050	0.060	0.055	0.050	0.15	0.050	6077455
Dissolved Sulphate (SO4)	mg/L	61	1.0	130	1.0	110	5.2	1.0	130	1.0	6086270
Dissolved Chloride (Cl)	mg/L	59	1.0	1100(1)	10	100	58	1.0	1100(1)	10	6086269
Nutrients											
Orthophosphate (P)	mg/L	0.0070	0.0030	0.0050	0.0030	0.013	0.0030	0.0030	0.0040	0.0030	6078265
Dissolved Nitrite (N)	mg/L	<0.0030	0.0030	<0.0030	0.0030	<0.0030	<0.0030	0.0030	<0.0030	0.0030	6077481
Dissolved Nitrate (N)	mg/L	0.73	0.0030	0.0050	0.0030	3.1	0.0080	0.0030	<0.0030	0.0030	6077481
Physical Properties											
True Colour	PtCo units	41	2.0	74	2.0	10	8.8	2.0	73	2.0	6084813

N/A = Not Applicable
RDL = Reportable Detection Limit
(1) - Detection limits raised due to dilution to bring analyte within the calibrated range.

Maxxam Job #: B271116
Report Date: 2012/08/17

FRANZ ENVIRONMENTAL INC.
Client Project #: 1697-1201, DEW LINES (ROBERTS)

Sampler Initials: DK

POLYCHLORINATED BIPHENYLS BY GC-ECD (WATER)

Maxxam ID		EE3055	EE3116	EE3129	EE3130	EE3131		
Sampling Date		2012/08/09	2012/08/09	2012/08/09	2012/08/09	2012/08/09		
	UNITS	**ROB-O6**	**ROB-08**	**ROB-10**	**ROBERTS LAKE**	**DUP-1**	**RDL**	**QC Batch**
Polychlorinated Biphenyls								
Aroclor 1016	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000050	6083627
Aroclor 1221	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000050	6083627
Aroclor 1232	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000050	6083627
Aroclor 1242	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000050	6083627
Aroclor 1248	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000050	6083627
Aroclor 1254	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000050	6083627
Aroclor 1260	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000050	6083627
Aroclor 1262	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000050	6083627
Aroclor 1268	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000050	6083627
Total Aroclors	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000050	6083627
Surrogate Recovery (%)								
NONACHLOROBIPHENYL (sur.)	%	111	92	114	82	94	N/A	6083627
N/A = Not Applicable RDL = Reportable Detection Limit								

Maxxam Job #: B271116
Report Date: 2012/08/17

FRANZ ENVIRONMENTAL INC.
Client Project #: 1697-1201, DEW LINES (ROBERTS)

Sampler Initials: DK

Package 1	0.5°C
Package 2	0.2°C

Each temperature is the average of up to three cooler temperatures taken at receipt

REGULATED METALS (CCME/AT1) - DISSOLVED Comments

Sample EE3116-01 Elements by ICPMS - Dissolved: Due to the sample matrix, sample required dilution. Detection limit was adjusted accordingly

Sample EE3131-01 Elements by ICPMS - Dissolved: Due to the sample matrix, sample required dilution. Detection limit was adjusted accordingly

REGULATED METALS (CCME/AT1) - TOTAL Comments

Sample EE3116-01 Elements by ICPMS - Total: Due to the sample matrix, sample required dilution. Detection limit was adjusted accordingly

Sample EE3131-01 Elements by ICPMS - Total: Due to the sample matrix, sample required dilution. Detection limit was adjusted accordingly

Maxxam Job #: B271116
Report Date: 2012/08/17

FRANZ ENVIRONMENTAL INC.
Client Project #: 1697-1201, DEW LINES (ROBERTS)

Sampler Initials: DK

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6077430	Conductivity	2012/08/13			101	90 - 110	<1.0	uS/cm	0.3	20
6077441	pH	2012/08/13			100	97 - 102			0.3	5
6077455	Dissolved Fluoride (F)	2012/08/13	97	80 - 120	101	80 - 120	<0.050	mg/L	NC	20
6077481	Dissolved Nitrite (N)	2012/08/13	103	80 - 120	100	90 - 110	<0.0030	mg/L		
6077481	Dissolved Nitrate (N)	2012/08/13	98	80 - 120	104	90 - 110	<0.0030	mg/L		
6078265	Orthophosphate (P)	2012/08/13	94	80 - 120	97	80 - 120	<0.0030	mg/L	NC	20
6079647	1,4-Difluorobenzene (sur.)	2012/08/15	99	70 - 130	99	70 - 130	104	%		
6079647	4-BROMOFLUOROBENZENE (sur.)	2012/08/15	97	70 - 130	100	70 - 130	98	%		
6079647	D4-1,2-DICHLOROETHANE (sur.)	2012/08/15	76	70 - 130	81	70 - 130	80	%		
6079647	Benzene	2012/08/15	86	70 - 130	84	70 - 130	<0.40	ug/L	NC	40
6079647	Toluene	2012/08/15	96	70 - 130	95	70 - 130	<0.40	ug/L	NC	40
6079647	Ethylbenzene	2012/08/15	95	70 - 130	94	70 - 130	<0.40	ug/L	NC	40
6079647	o-Xylene	2012/08/15	99	70 - 130	97	70 - 130	<0.40	ug/L	NC	40
6079647	m & p-Xylene	2012/08/15	98	70 - 130	97	70 - 130	<0.80	ug/L	NC	40
6079647	(C6-C10)	2012/08/15	89	70 - 130	79	70 - 130	<100	ug/L	NC	40
6079647	Xylenes (Total)	2012/08/15					<0.80	ug/L	NC	40
6079647	F1 (C6-C10) - BTEX	2012/08/15					<100	ug/L	NC	40
6079819	Total Barium (Ba)	2012/08/14	NC	80 - 120	97	80 - 120	<0.010	mg/L	1.4	20
6079819	Total Boron (B)	2012/08/14	NC	80 - 120	103	80 - 120	<0.020	mg/L	1.2	20
6079819	Total Calcium (Ca)	2012/08/14	NC	80 - 120	107	80 - 120	<0.30	mg/L	0.3	20
6079819	Total Iron (Fe)	2012/08/14	NC	80 - 120	102	80 - 120	<0.060	mg/L	NC	20
6079819	Total Lithium (Li)	2012/08/14	NC	80 - 120	100	80 - 120	<0.020	mg/L		
6079819	Total Magnesium (Mg)	2012/08/14	NC	80 - 120	101	80 - 120	<0.20	mg/L		
6079819	Total Manganese (Mn)	2012/08/14	83	80 - 120	98	80 - 120	<0.0040	mg/L	0.6	20
6079819	Total Phosphorus (P)	2012/08/14	108	80 - 120	105	80 - 120	<0.10	mg/L		
6079819	Total Potassium (K)	2012/08/14	NC	80 - 120	98	80 - 120	<0.30	mg/L		
6079819	Total Silicon (Si)	2012/08/14	111	80 - 120	112	80 - 120	<0.10	mg/L		
6079819	Total Sodium (Na)	2012/08/14	NC	80 - 120	101	80 - 120	<0.50	mg/L		
6079819	Total Strontium (Sr)	2012/08/14	NC	80 - 120	100	80 - 120	<0.020	mg/L	1.2	20
6079819	Total Sulphur (S)	2012/08/14					<0.20	mg/L		
6079848	Dissolved Barium (Ba)	2012/08/14	99	80 - 120	103	80 - 120	<0.010	mg/L		
6079848	Dissolved Boron (B)	2012/08/14	98	80 - 120	101	80 - 120	<0.020	mg/L		
6079848	Dissolved Calcium (Ca)	2012/08/14	110	80 - 120	114	80 - 120	<0.30	mg/L	NC	20
6079848	Dissolved Iron (Fe)	2012/08/14	101	80 - 120	104	80 - 120	<0.060	mg/L	NC	20
6079848	Dissolved Lithium (Li)	2012/08/14	96	80 - 120	100	80 - 120	<0.020	mg/L		
6079848	Dissolved Magnesium (Mg)	2012/08/14	102	80 - 120	106	80 - 120	<0.20	mg/L	NC	20
6079848	Dissolved Manganese (Mn)	2012/08/14	100	80 - 120	102	80 - 120	<0.0040	mg/L	NC	20
6079848	Dissolved Phosphorus (P)	2012/08/14	108	80 - 120	111	80 - 120	<0.10	mg/L		
6079848	Dissolved Potassium (K)	2012/08/14	97	80 - 120	101	80 - 120	<0.30	mg/L	NC	20
6079848	Dissolved Silicon (Si)	2012/08/14	96	80 - 120	99	80 - 120	<0.10	mg/L		

Maxxam Job #: B271116
Report Date: 2012/08/17

FRANZ ENVIRONMENTAL INC.
Client Project #: 1697-1201, DEW LINES (ROBERTS)

Sampler Initials: DK

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6079848	Dissolved Sodium (Na)	2012/08/14	94	80 - 120	97	80 - 120	<0.50	mg/L	NC	20
6079848	Dissolved Strontium (Sr)	2012/08/14	98	80 - 120	101	80 - 120	<0.020	mg/L		
6079848	Dissolved Sulphur (S)	2012/08/14					<0.20	mg/L		
6082389	Total Aluminum (Al)	2012/08/15	93	80 - 120	118	80 - 120	0.0015, RDL=0.0010	mg/L	7.2	20
6082389	Total Antimony (Sb)	2012/08/15	110	80 - 120	118	80 - 120	<0.00060	mg/L	NC	20
6082389	Total Arsenic (As)	2012/08/15	104	80 - 120	103	80 - 120	<0.00020	mg/L	NC	20
6082389	Total Beryllium (Be)	2012/08/15	112	80 - 120	102	80 - 120	<0.0010	mg/L	NC	20
6082389	Total Chromium (Cr)	2012/08/15	97	80 - 120	100	80 - 120	<0.0010	mg/L	NC	20
6082389	Total Cobalt (Co)	2012/08/15	97	80 - 120	103	80 - 120	<0.00030	mg/L	NC	20
6082389	Total Copper (Cu)	2012/08/15	97	80 - 120	103	80 - 120	<0.00020	mg/L	1.5	20
6082389	Total Lead (Pb)	2012/08/15	97	80 - 120	102	80 - 120	<0.00020	mg/L	NC	20
6082389	Total Molybdenum (Mo)	2012/08/15	108	80 - 120	107	80 - 120	<0.00020	mg/L	NC	20
6082389	Total Nickel (Ni)	2012/08/15	98	80 - 120	104	80 - 120	<0.00050	mg/L	NC	20
6082389	Total Selenium (Se)	2012/08/15	96	80 - 120	98	80 - 120	<0.00020	mg/L	NC	20
6082389	Total Silver (Ag)	2012/08/15	104	80 - 120	112	80 - 120	<0.00010	mg/L	NC	20
6082389	Total Thallium (Tl)	2012/08/15	94	80 - 120	98	80 - 120	<0.00020	mg/L	NC	20
6082389	Total Tin (Sn)	2012/08/15	105	80 - 120	112	80 - 120	<0.0010	mg/L	NC	20
6082389	Total Titanium (Ti)	2012/08/15	98	80 - 120	97	80 - 120	<0.0010	mg/L	NC	20
6082389	Total Uranium (U)	2012/08/15	95	80 - 120	98	80 - 120	<0.00010	mg/L	5.2	20
6082389	Total Vanadium (V)	2012/08/15	103	80 - 120	101	80 - 120	<0.0010	mg/L	NC	20
6082389	Total Zinc (Zn)	2012/08/15	100	80 - 120	110	80 - 120	<0.0030	mg/L	NC	20
6082452	Dissolved Aluminum (Al)	2012/08/15	84	80 - 120	103	80 - 120	<0.0010	mg/L	1.7	20
6082452	Dissolved Antimony (Sb)	2012/08/15	82	80 - 120	89	80 - 120	<0.00060	mg/L	NC	20
6082452	Dissolved Arsenic (As)	2012/08/15	97	80 - 120	102	80 - 120	<0.00020	mg/L	NC	20
6082452	Dissolved Beryllium (Be)	2012/08/15	98	80 - 120	104	80 - 120	<0.0010	mg/L	NC	20
6082452	Dissolved Chromium (Cr)	2012/08/15	94	80 - 120	103	80 - 120	<0.0010	mg/L	NC	20
6082452	Dissolved Cobalt (Co)	2012/08/15	91	80 - 120	101	80 - 120	<0.00030	mg/L	2.3	20
6082452	Dissolved Copper (Cu)	2012/08/15	93	80 - 120	103	80 - 120	<0.00020	mg/L	1.5	20
6082452	Dissolved Lead (Pb)	2012/08/15	87	80 - 120	102	80 - 120	<0.00020	mg/L	NC	20
6082452	Dissolved Molybdenum (Mo)	2012/08/15	101	80 - 120	101	80 - 120	<0.00020	mg/L	NC	20
6082452	Dissolved Nickel (Ni)	2012/08/15	90	80 - 120	103	80 - 120	<0.00050	mg/L	NC	20
6082452	Dissolved Selenium (Se)	2012/08/15	97	80 - 120	99	80 - 120	<0.00020	mg/L	NC	20
6082452	Dissolved Silver (Ag)	2012/08/15	86	80 - 120	105	80 - 120	<0.00010	mg/L	NC	20
6082452	Dissolved Thallium (Tl)	2012/08/15	86	80 - 120	98	80 - 120	<0.00020	mg/L	NC	20
6082452	Dissolved Tin (Sn)	2012/08/15	90	80 - 120	104	80 - 120	<0.0010	mg/L	NC	20
6082452	Dissolved Titanium (Ti)	2012/08/15	104	80 - 120	90	80 - 120	<0.0010	mg/L	NC	20
6082452	Dissolved Uranium (U)	2012/08/15	89	80 - 120	97	80 - 120	<0.00010	mg/L	NC	20
6082452	Dissolved Vanadium (V)	2012/08/15	101	80 - 120	104	80 - 120	<0.0010	mg/L	NC	20
6082452	Dissolved Zinc (Zn)	2012/08/15	97	80 - 120	108	80 - 120	<0.0030	mg/L	0.9	20
6083145	Total Suspended Solids	2012/08/15			90	80 - 120	<1.0	mg/L	15.4	20

Maxxam Job #: B271116
Report Date: 2012/08/17

FRANZ ENVIRONMENTAL INC.
Client Project #: 1697-1201, DEW LINES (ROBERTS)

Sampler Initials: DK

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6083257	O-TERPHENYL (sur.)	2012/08/15	92	50 - 130	92	50 - 130	86	%		
6083257	F2 (C10-C16 Hydrocarbons)	2012/08/15	102	50 - 130	104	70 - 130	<0.10	mg/L	NC	40
6083257	F3 (C16-C34 Hydrocarbons)	2012/08/15	87	50 - 130	91	70 - 130	<0.10	mg/L	NC	40
6083257	F4 (C34-C50 Hydrocarbons)	2012/08/15	82	50 - 130	75	70 - 130	<0.10	mg/L	NC	40
6083627	NONACHLOROBIPHENYL (sur.)	2012/08/16			112	30 - 130	68	%		
6083627	Aroclor 1260	2012/08/16			75	30 - 130	<0.000050	mg/L		
6083627	Aroclor 1016	2012/08/16					<0.000050	mg/L		
6083627	Aroclor 1221	2012/08/16					<0.000050	mg/L		
6083627	Aroclor 1232	2012/08/16					<0.000050	mg/L		
6083627	Aroclor 1242	2012/08/16					<0.000050	mg/L		
6083627	Aroclor 1248	2012/08/16					<0.000050	mg/L		
6083627	Aroclor 1254	2012/08/16					<0.000050	mg/L		
6083627	Aroclor 1262	2012/08/16					<0.000050	mg/L		
6083627	Aroclor 1268	2012/08/16					<0.000050	mg/L		
6083627	Total Aroclors	2012/08/16					<0.000050	mg/L		
6084090	Total Barium (Ba)	2012/08/15	90	80 - 120	90	80 - 120	<0.010	mg/L	0.3	20
6084090	Total Boron (B)	2012/08/15	95	80 - 120	95	80 - 120	<0.020	mg/L	NC	20
6084090	Total Calcium (Ca)	2012/08/15	NC	80 - 120	101	80 - 120	<0.30	mg/L	0.1	20
6084090	Total Iron (Fe)	2012/08/15	93	80 - 120	94	80 - 120	<0.060	mg/L	NC	20
6084090	Total Lithium (Li)	2012/08/15	94	80 - 120	93	80 - 120	<0.020	mg/L	NC	20
6084090	Total Magnesium (Mg)	2012/08/15	96	80 - 120	95	80 - 120	<0.20	mg/L	0.2	20
6084090	Total Manganese (Mn)	2012/08/15	89	80 - 120	92	80 - 120	<0.0040	mg/L	1.3	20
6084090	Total Phosphorus (P)	2012/08/15	95	80 - 120	95	80 - 120	<0.10	mg/L	NC	20
6084090	Total Potassium (K)	2012/08/15	95	80 - 120	94	80 - 120	<0.30	mg/L	1.3	20
6084090	Total Silicon (Si)	2012/08/15	109	80 - 120	106	80 - 120	<0.10	mg/L	0.2	20
6084090	Total Sodium (Na)	2012/08/15	93	80 - 120	93	80 - 120	<0.50	mg/L	0.5	20
6084090	Total Strontium (Sr)	2012/08/15	92	80 - 120	92	80 - 120	<0.020	mg/L	0.08	20
6084090	Total Sulphur (S)	2012/08/15					<0.20	mg/L	0.3	20
6084134	Dissolved Barium (Ba)	2012/08/15	106	80 - 120	101	80 - 120	<0.010	mg/L		
6084134	Dissolved Boron (B)	2012/08/15	102	80 - 120	97	80 - 120	<0.020	mg/L		
6084134	Dissolved Calcium (Ca)	2012/08/15	117	80 - 120	109	80 - 120	<0.30	mg/L	NC	20
6084134	Dissolved Iron (Fe)	2012/08/15	106	80 - 120	99	80 - 120	<0.060	mg/L	NC	20
6084134	Dissolved Lithium (Li)	2012/08/15	103	80 - 120	100	80 - 120	<0.020	mg/L		
6084134	Dissolved Magnesium (Mg)	2012/08/15	110	80 - 120	104	80 - 120	<0.20	mg/L	NC	20
6084134	Dissolved Manganese (Mn)	2012/08/15	106	80 - 120	99	80 - 120	<0.0040	mg/L	NC	20
6084134	Dissolved Phosphorus (P)	2012/08/15	110	80 - 120	102	80 - 120	<0.10	mg/L		
6084134	Dissolved Potassium (K)	2012/08/15	104	80 - 120	101	80 - 120	<0.30	mg/L	NC	20
6084134	Dissolved Silicon (Si)	2012/08/15	103	80 - 120	97	80 - 120	<0.10	mg/L		
6084134	Dissolved Sodium (Na)	2012/08/15	103	80 - 120	100	80 - 120	<0.50	mg/L	NC	20
6084134	Dissolved Strontium (Sr)	2012/08/15	104	80 - 120	99	80 - 120	<0.020	mg/L		

Maxxam Job #: B271116
Report Date: 2012/08/17

FRANZ ENVIRONMENTAL INC.
Client Project #: 1697-1201, DEW LINES (ROBERTS)

Sampler Initials: DK

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6084134	Dissolved Sulphur (S)	2012/08/15					<0.20	mg/L		
6084217	Total Aluminum (Al)	2012/08/15	NC	80 - 120	103	80 - 120	<0.0010	mg/L	1.8	20
6084217	Total Antimony (Sb)	2012/08/15	105	80 - 120	107	80 - 120	<0.00060	mg/L	NC	20
6084217	Total Arsenic (As)	2012/08/15	102	80 - 120	102	80 - 120	<0.00020	mg/L	0.3	20
6084217	Total Beryllium (Be)	2012/08/15	100	80 - 120	99	80 - 120	<0.0010	mg/L	NC	20
6084217	Total Chromium (Cr)	2012/08/15	98	80 - 120	105	80 - 120	<0.0010	mg/L	NC	20
6084217	Total Cobalt (Co)	2012/08/15	100	80 - 120	103	80 - 120	<0.00030	mg/L	NC	20
6084217	Total Copper (Cu)	2012/08/15	100	80 - 120	105	80 - 120	<0.00020	mg/L	2.1	20
6084217	Total Lead (Pb)	2012/08/15	99	80 - 120	103	80 - 120	<0.00020	mg/L	NC	20
6084217	Total Molybdenum (Mo)	2012/08/15	107	80 - 120	105	80 - 120	<0.00020	mg/L	NC	20
6084217	Total Nickel (Ni)	2012/08/15	100	80 - 120	106	80 - 120	<0.00050	mg/L	NC	20
6084217	Total Selenium (Se)	2012/08/15	90	80 - 120	91	80 - 120	<0.00020	mg/L	NC	20
6084217	Total Silver (Ag)	2012/08/15	106	80 - 120	106	80 - 120	<0.00010	mg/L	NC	20
6084217	Total Thallium (Tl)	2012/08/15	98	80 - 120	99	80 - 120	<0.00020	mg/L	NC	20
6084217	Total Tin (Sn)	2012/08/15	106	80 - 120	105	80 - 120	<0.0010	mg/L	NC	20
6084217	Total Titanium (Ti)	2012/08/15	98	80 - 120	101	80 - 120	<0.0010	mg/L	NC	20
6084217	Total Uranium (U)	2012/08/15	99	80 - 120	100	80 - 120	<0.00010	mg/L	NC	20
6084217	Total Vanadium (V)	2012/08/15	102	80 - 120	103	80 - 120	<0.0010	mg/L	NC	20
6084217	Total Zinc (Zn)	2012/08/15	102	80 - 120	101	80 - 120	<0.0030	mg/L	NC	20
6084223	Dissolved Aluminum (Al)	2012/08/15	81	80 - 120	100	80 - 120	<0.0010	mg/L	NC	20
6084223	Dissolved Antimony (Sb)	2012/08/15	81	80 - 120	102	80 - 120	<0.00060	mg/L	NC	20
6084223	Dissolved Arsenic (As)	2012/08/15	94	80 - 120	100	80 - 120	<0.00020	mg/L	NC	20
6084223	Dissolved Beryllium (Be)	2012/08/15	98	80 - 120	99	80 - 120	<0.0010	mg/L	NC	20
6084223	Dissolved Chromium (Cr)	2012/08/15	92	80 - 120	99	80 - 120	<0.0010	mg/L	NC	20
6084223	Dissolved Cobalt (Co)	2012/08/15	87	80 - 120	98	80 - 120	<0.00030	mg/L	NC	20
6084223	Dissolved Copper (Cu)	2012/08/15	87	80 - 120	101	80 - 120	<0.00020	mg/L	NC	20
6084223	Dissolved Lead (Pb)	2012/08/15	85	80 - 120	98	80 - 120	<0.00020	mg/L	NC	20
6084223	Dissolved Molybdenum (Mo)	2012/08/15	100	80 - 120	97	80 - 120	<0.00020	mg/L	NC	20
6084223	Dissolved Nickel (Ni)	2012/08/15	89	80 - 120	99	80 - 120	<0.00050	mg/L	NC	20
6084223	Dissolved Selenium (Se)	2012/08/15	90	80 - 120	97	80 - 120	<0.00020	mg/L	NC	20
6084223	Dissolved Silver (Ag)	2012/08/15	82	80 - 120	104	80 - 120	<0.00010	mg/L	NC	20
6084223	Dissolved Thallium (Tl)	2012/08/15	85	80 - 120	97	80 - 120	<0.00020	mg/L	NC	20
6084223	Dissolved Tin (Sn)	2012/08/15	101	80 - 120	100	80 - 120	<0.0010	mg/L	NC	20
6084223	Dissolved Titanium (Ti)	2012/08/15	107	80 - 120	104	80 - 120	<0.0010	mg/L	NC	20
6084223	Dissolved Uranium (U)	2012/08/15	90	80 - 120	97	80 - 120	<0.00010	mg/L	5.5	20
6084223	Dissolved Vanadium (V)	2012/08/15	99	80 - 120	101	80 - 120	<0.0010	mg/L	NC	20
6084223	Dissolved Zinc (Zn)	2012/08/15	94	80 - 120	96	80 - 120	<0.0030	mg/L	NC	20
6084813	True Colour	2012/08/15			86	80 - 120	<2.0	PtCo units	NC	20
6086269	Dissolved Chloride (Cl)	2012/08/15	NC	80 - 120	99	80 - 120	<1.0	mg/L	3.6	20

Maxxam Job #: B271116
Report Date: 2012/08/17

FRANZ ENVIRONMENTAL INC.
Client Project #: 1697-1201, DEW LINES (ROBERTS)

Sampler Initials: DK

QUALITY ASSURANCE REPORT

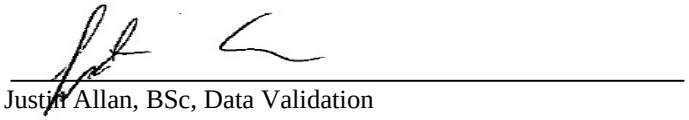
			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6086270	Dissolved Sulphate (SO4)	2012/08/15	NC	80 - 120	109	80 - 120	<1.0	mg/L	0.8	20
6086330	Total Dissolved Solids	2012/08/16			91	80 - 113	<10	mg/L	2.2	20

N/A = Not Applicable
RDL = Reportable Detection Limit
RPD = Relative Percent Difference
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.
NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.
NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.

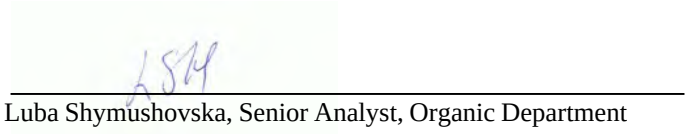
Validation Signature Page

Maxxam Job #: B271116

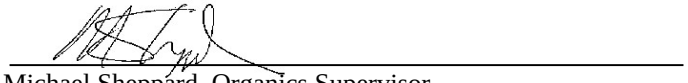
The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Justin Allan, BSc, Data Validation



Luba Shymushovska, Senior Analyst, Organic Department



Michael Sheppard, Organics Supervisor

==========

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Your Project #: 1697-1201
Site Location: CAM-F CAM-D ROBERTS BAY DEW LINE
Your C.O.C. #: 36556401, 365564-01-02

Attention: Kevin McKenna
Franz Environmental Inc
329 Churchill Ave N
Suite 200
Ottawa, ON
K1Z 5B8

Report Date: 2012/08/16

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B2C1257
Received: 2012/08/10, 10:30

Sample Matrix: Water
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
Petroleum Hydro. CCME F1 & BTEX in Water	2	N/A	2012/08/13	OTT SOP-00002	CCME CWS
Petroleum Hydrocarbons F2-F4 in Water	2	2012/08/13	2012/08/13	OTT SOP-00001	CCME Hydrocarbons
Polychlorinated Biphenyl in Water (1)	2	2012/08/13	2012/08/13	CAM SOP-00309	SW846 8082

Remarks:

Maxxam Analytics has performed all analytical testing herein in accordance with ISO 17025 and the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act. All methodologies comply with this document and are validated for use in the laboratory. The methods and techniques employed in this analysis conform to the performance criteria (detection limits, accuracy and precision) as outlined in the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act. Reporting results to two significant figures at the RDL is to permit statistical evaluation and is not intended to be an indication of analytical precision.

The CWS PHC methods employed by Maxxam conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following the 'Alberta Environment Draft Addenda to the CWS-PHC, Appendix 6, Validation of Alternate Methods'. Documentation is available upon request. Maxxam has made the following improvements to the CWS-PHC reference benchmark method: (i) Headspace for F1; and, (ii) Mechanical extraction for F2-F4. Note: F4G cannot be added to the C6 to C50 hydrocarbons. The extraction date for samples field preserved with methanol for F1 and Volatile Organic Compounds is considered to be the date sampled.

Maxxam Analytics is accredited by SCC (Lab ID 97) for all specific parameters as required by Ontario Regulation 153/04. Maxxam Analytics is limited in liability to the actual cost of analysis unless otherwise agreed in writing. There is no other warranty expressed or implied. Samples will be retained at Maxxam Analytics for three weeks from receipt of data or as per contract.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
* Results relate only to the items tested.

(1) This test was performed by Maxxam Analytics Mississauga

../2

Maxxam Job #: B2C1257
Report Date: 2012/08/16

Franz Environmental Inc
Client Project #: 1697-1201
Site Location: CAM-F CAM-D ROBERTS BAY DEW LINE
Sampler Initials: DK

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Julie Clement, Ottawa Customer Service
Email: JClement@maxxam.ca
Phone# (613) 274-3549

==========

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 2

Maxxam Job #: B2C1257
Report Date: 2012/08/16

Franz Environmental Inc
Client Project #: 1697-1201
Site Location: CAM-F CAM-D ROBERTS BAY DEW LINE
Sampler Initials: DK

POLYCHLORINATED BIPHENYLS BY GC-ECD (WATER)

Maxxam ID		OL3689	OL3690		
Sampling Date		2012/08/07	2012/07/25		
	Units	**FIELD BLANK**	**TRIP BLANK**	**RDL**	**QC Batch**
PCBs					
Aroclor 1016	ug/L	<0.05	<0.05	0.05	2936138
Aroclor 1221	ug/L	<0.05	<0.05	0.05	2936138
Aroclor 1232	ug/L	<0.05	<0.05	0.05	2936138
Aroclor 1242	ug/L	<0.05	<0.05	0.05	2936138
Aroclor 1248	ug/L	<0.05	<0.05	0.05	2936138
Aroclor 1254	ug/L	<0.05	<0.05	0.05	2936138
Aroclor 1260	ug/L	<0.05	<0.05	0.05	2936138
Aroclor 1262	ug/L	<0.05	<0.05	0.05	2936138
Aroclor 1268	ug/L	<0.05	<0.05	0.05	2936138
Total PCB	ug/L	<0.05	<0.05	0.05	2936138
Surrogate Recovery (%)					
Decachlorobiphenyl	%	88	93		2936138

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxamanalytics.com

Maxxam Job #: B2C1257
Report Date: 2012/08/16

Franz Environmental Inc
Client Project #: 1697-1201
Site Location: CAM-F CAM-D ROBERTS BAY DEW LINE
Sampler Initials: DK

O'REG 153 PETROLEUM HYDROCARBONS (WATER)

Maxxam ID		OL3689	OL3690		
Sampling Date		2012/08/07	2012/07/17		
	Units	**FIELD BLANK**	**TRIP BLANK**	**RDL**	**QC Batch**
BTEX & F1 Hydrocarbons					
Benzene	ug/L	<0.20	<0.20	0.20	2936396
Toluene	ug/L	<0.20	<0.20	0.20	2936396
Ethylbenzene	ug/L	<0.20	<0.20	0.20	2936396
o-Xylene	ug/L	<0.20	<0.20	0.20	2936396
p+m-Xylene	ug/L	<0.40	<0.40	0.40	2936396
Total Xylenes	ug/L	<0.40	<0.40	0.40	2936396
F1 (C6-C10)	ug/L	<25	<25	25	2936396
F1 (C6-C10) - BTEX	ug/L	<25	<25	25	2936396
F2-F4 Hydrocarbons					
F2 (C10-C16 Hydrocarbons)	ug/L	<100	<100	100	2936322
F3 (C16-C34 Hydrocarbons)	ug/L	<100	<100	100	2936322
F4 (C34-C50 Hydrocarbons)	ug/L	<100	<100	100	2936322
Reached Baseline at C50	ug/L	YES	YES		2936322
Surrogate Recovery (%)					
1,4-Difluorobenzene	%	104	108		2936396
4-Bromofluorobenzene	%	103	107		2936396
D10-Ethylbenzene	%	103	97		2936396
D4-1,2-Dichloroethane	%	99	102		2936396
o-Terphenyl	%	76	75		2936322

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxamanalytics.com

Maxxam Job #: B2C1257
Report Date: 2012/08/16

Franz Environmental Inc
Client Project #: 1697-1201
Site Location: CAM-F CAM-D ROBERTS BAY DEW LINE
Sampler Initials: DK

Test Summary

Maxxam ID OL3689 **Collected** 2012/08/07
Sample ID FIELD BLANK **Shipped**
Matrix Water **Received** 2012/08/10

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Wat	HSGC/MSFD	2936396	N/A	2012/08/13	Steve Roberts
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	2936322	2012/08/13	2012/08/13	Lyndsey Hart
Polychlorinated Biphenyl in Water	GC/ECD	2936138	2012/08/13	2012/08/13	Joy Zhang

Maxxam ID OL3690 **Collected** 2012/07/25
Sample ID TRIP BLANK **Shipped**
Matrix Water **Received** 2012/08/10

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Wat	HSGC/MSFD	2936396	N/A	2012/08/13	Steve Roberts
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	2936322	2012/08/13	2012/08/13	Lyndsey Hart
Polychlorinated Biphenyl in Water	GC/ECD	2936138	2012/08/13	2012/08/13	Joy Zhang

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxamanalytics.com

Maxxam Job #: B2C1257
Report Date: 2012/08/16

Franz Environmental Inc
Client Project #: 1697-1201
Site Location: CAM-F CAM-D ROBERTS BAY DEW LINE
Sampler Initials: DK

Package 1	4.7°C

Each temperature is the average of up to three cooler temperatures taken at receipt

GENERAL COMMENTS

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxamanalytics.com

Maxxam Job #: B2C1257
Report Date: 2012/08/16

Franz Environmental Inc
Client Project #: 1697-1201
Site Location: CAM-F CAM-D ROBERTS BAY DEW LINE
Sampler Initials: DK

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits
2936138	Decachlorobiphenyl	2012/08/13	119	60 - 130	83	60 - 130	83	%		
2936138	Aroclor 1260	2012/08/13	91	60 - 130	76	60 - 130	<0.05	ug/L	NC	30
2936138	Total PCB	2012/08/13	91	60 - 130	76	60 - 130	<0.05	ug/L	NC	40
2936138	Aroclor 1016	2012/08/13					<0.05	ug/L	NC	40
2936138	Aroclor 1221	2012/08/13					<0.05	ug/L	NC	40
2936138	Aroclor 1232	2012/08/13					<0.05	ug/L	NC	40
2936138	Aroclor 1242	2012/08/13					<0.05	ug/L	NC	30
2936138	Aroclor 1248	2012/08/13					<0.05	ug/L	NC	30
2936138	Aroclor 1254	2012/08/13					<0.05	ug/L	NC	30
2936138	Aroclor 1262	2012/08/13					<0.05	ug/L	NC	40
2936138	Aroclor 1268	2012/08/13					<0.05	ug/L	NC	40
2936322	o-Terphenyl	2012/08/13	71	30 - 130	73	30 - 130	75	%		
2936322	F2 (C10-C16 Hydrocarbons)	2012/08/13	73	50 - 130	81	70 - 130	<100	ug/L	NC	50
2936322	F3 (C16-C34 Hydrocarbons)	2012/08/13	73	50 - 130	81	70 - 130	<100	ug/L	NC	50
2936322	F4 (C34-C50 Hydrocarbons)	2012/08/13	73	50 - 130	81	70 - 130	<100	ug/L	NC	50
2936396	1,4-Difluorobenzene	2012/08/13	106	70 - 130	107	70 - 130	108	%		
2936396	4-Bromofluorobenzene	2012/08/13	101	70 - 130	102	70 - 130	103	%		
2936396	D10-Ethylbenzene	2012/08/13	106	70 - 130	113	70 - 130	105	%		
2936396	D4-1,2-Dichloroethane	2012/08/13	101	70 - 130	101	70 - 130	98	%		
2936396	Benzene	2012/08/13	89	70 - 130	88	70 - 130	<0.20	ug/L	NC	40
2936396	Toluene	2012/08/13	86	70 - 130	84	70 - 130	<0.20	ug/L	NC	40
2936396	Ethylbenzene	2012/08/13	90	70 - 130	93	70 - 130	<0.20	ug/L	NC	40
2936396	o-Xylene	2012/08/13	93	70 - 130	93	70 - 130	<0.20	ug/L	NC	40
2936396	p+m-Xylene	2012/08/13	83	70 - 130	84	70 - 130	<0.40	ug/L	NC	40
2936396	F1 (C6-C10)	2012/08/13	90	70 - 130	98	70 - 130	<25	ug/L	NC	40
2936396	Total Xylenes	2012/08/13					<0.40	ug/L	NC	40
2936396	F1 (C6-C10) - BTEX	2012/08/13					<25	ug/L	NC	40

N/A = Not Applicable
RPD = Relative Percent Difference
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.
NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxamanalytics.com

Validation Signature Page

Maxxam Job #: B2C1257

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Charles Ancker, B.Sc., M.Sc., C.Chem, Senior Analyst

Paul Rubinato, Analyst, Maxxam Analytics

==========

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxamanalytics.com

Maxxam

Maxxam Analytics International Corporation o/a Maxxam Analytics

6740 Campobello Road, Mississauga, Ontario Canada L5N 2L8 Tel:(905) 817-5700 Toll-free:800-653-6266 Fax:(905) 817-5779 www.maxxam.ca

CHAIN OF CUSTODY RECORD

Page 1 of 1

INVOICE INFORMATION:		REPORT INFORMATION (if differs from invoice):		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#10988 Franz Environmental Inc	Company Name:		Quotation #:	B23655	MAXXAM JOB #:	BOTTLE ORDER #:
Contact Name:	Invoices, Lillian & Kevin	Contact Name:	Kevin McKenna	P.O. #:			365645
Address:	329 Churchill Ave N Suite 200	Address:		Project #:	1697-1201		
	Ottawa ON K1Z 5B8			Project Name:	DEW Lines (Roberts Bay)	CHAIN OF CUSTODY #:	PROJECT MANAGER:
Phone:	(613)721-0555 Fax: (613)721-0029	Phone:	Fax:	Site #:		C#365645-02-01	Julie Clement
Email:	lellis@franzenvironmental.com, invoicesottawa@fra	Email:	kmckenna@franzenvironmental.com	Sampled By:	D. Kia [illegible]		

Regulation 153 (2011): ☐ Table 1 ☐ Table 2 ☐ Table 3 ☐ Table ___ ☐ Res/Park ☐ Ind/Comm ☐ Agri/Other ☐ Medium/Fine ☐ Coarse ☐ For RSC

Other Regulations: ☒ CCME ☐ Reg. 558 ☐ MISA ☐ PWQO ☐ Other ___ ☐ Sanitary Sewer Bylaw ☐ Storm Sewer Bylaw Municipality ___

SPECIAL INSTRUCTIONS: samples contained in coolers fia-II-1 and Fiant-2

Include Criteria on Certificate of Analysis (Y/N)? N

Note: For MOE regulated drinking water samples - please use the Drinking Water Chain of Custody Form

SAMPLES MUST BE KEPT COOL (< 10ºC) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

TURNAROUND TIME (TAT) REQUIRED:

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Regular (Standard) TAT: ☒

(will be applied if Rush TAT is not specified):

Standard TAT = 5-7 Working days for most tests.

Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)

Date Required: ___ Time Required: ___ ☐

Rush Confirmation Number: ___ *(call lab for #)*

ANALYSIS REQUESTED (Please be specific):

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Regulated Drinking Water ? (Y/N)	Metals Field Filtered ? (Y/N) Dissolved	F1 & BTEX in water	F2-F4 in water	Polychlorinated Biphenyl in Water	CCME Metals (low Level), dissolved	CCME Metals (low Level), total	pH / Colour Conductivity, Hardness	~~Conductivity~~ Major ions NO2, NO3, Cl, SO4, T	~~Hardness~~	Total Suspended Solids	Total Dissolved Solids	# of Bottles	Comments
1		ROB-06	12/08/09	PM	SW	N	Y	X	X	X	X	X	X	X		X	X	11	
2		ROB-08	12/08/09	PM	SW	N	Y	X	X	X	X	X	X	X		X	X	11	
3		ROB-10	12/08/09	PM	SW	N	Y	X	X	X	X	X	X	X		X	X	11	
4		ROBERTS LAKE	12/08/09	PM	SW	N	Y	X	X	X	X	X	X	X		X	X	11	
5		Dup-1	12/08/09	PM	SW	N	Y	X	X	X	X	X	X	X		X	X	11	
6																			
7																			
8																			
9																			
10																			

*RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time:	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time:	# Jars Used and Not Submitted
David Kiar [signature]	12/08/10	11:15				

Laboratory Use Only				
Time Sensitive	Temperature (°C) on Receipt	Custody Seal	Yes	No
		Present		
		Intact		

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

White: Maxxam Yellow: Client

Maxxam Analytics International Corporation o/a Maxxam Analytics

Maxxam

Maxxam Analytics International Corporation o/a Maxxam Analytics
6740 Campobello Road, Mississauga, Ontario Canada L5N 2L8 Tel:(905) 817-5700 Toll-free:800-653-6266 Fax:(905) 817-5779 www.maxxam.ca

CHAIN OF CUSTODY RECORD

Page 1 of 1

INVOICE INFORMATION:		REPORT INFORMATION (if differs from invoice):		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#10988 Franz Environmental Inc	Company Name:		Quotation #:	B23655	MAXXAM JOB #:	BOTTLE ORDER #: 365645
Contact Name:	Invoices, Lillian & Kevin	Contact Name:	Kevin McKenna	P.O. #:			
Address:	329 Churchill Ave N Suite 200	Address:		Project #:	1697-1201		
	Ottawa ON K1Z 5B8			Project Name:	CAM-F, CAM-D, Ruberta Bay DEW Line	CHAIN OF CUSTODY #: C#365645-02-02	PROJECT MANAGER: Julie Clement
Phone:	(613)721-0555 Fax: (613)721-0029	Phone:	Fax:	Site #:			
Email:	lellis@franzenvironmental.com, invoicesottawa@fra	Email:	kmckenna@franzenvironmental.com	Sampled By:	D.Kiar / K. McKenna		

Regulation 153 (2011)
- ☐ Table 1 ☐ Res/Park ☐ Medium/Fine
- ☐ Table 2 ☐ Ind/Comm ☐ Coarse
- ☐ Table 3 ☐ Agri/Other
- ☐ Table ___ ☐ For RSC

Other Regulations
- ☒ CCME ☐ Sanitary Sewer Bylaw
- ☐ Reg. 558 ☐ Storm Sewer Bylaw
- ☐ MISA Municipality ___
- ☐ PWQO
- ☐ Other ___

SPECIAL INSTRUCTIONS
SAMPLES contained in cooler-1

Include Criteria on Certificate of Analysis (Y/N)? ___

Note: For MOE regulated drinking water samples - please use the Drinking Water Chain of Custody Form

SAMPLES MUST BE KEPT COOL (< 10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

TURNAROUND TIME (TAT) REQUIRED:

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Regular (Standard) TAT:
(will be applied if Rush TAT is not specified): ☒
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: _____ Time Required: _____ ☐
Rush Confirmation Number: _____ *(call lab for #)*

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Regulated Drinking Water ? (Y/N)	Metals Field Filtered ? (Y/N)	Major Ions: NO2, NO3, Cl, PO4, SO4, F	F1 / BTEX	F2-F4	PCB's	Dissolved Metals	Total Metals					# of Bottles	Comments
1		Field Blank	12/08/07	PM	H_2O		N	X	X	X	X	X	X					9	
2		TRIP BLANK	*See Note	/	H_2O		N	X	X	X	X	X	X					9	
3											Note:								
4											* TRIP BLANK DATES:								
5											F1/BTEX: 2012/07/17								
6											F2-F4: 2012/07/25								
7											PCBs: 2012/07/25								
8											Dissolved Metals: 2012/07/25								
9											Total Metals: 2012/07/25								
10																			

*RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time:	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time:	# Jars Used and Not Submitted
Kevin McKenna / K McK	12/08/08	8:15	Sumon Nimalunga S.N.	12/08/08	9:15	

Laboratory Use Only				
Time Sensitive	Temperature (°C) on Receipt	Custody Seal	Yes	No
		Present		
		Intact		

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

White: Maxxam Yellow: Client

APPENDIX E

QA/QC Discussion

In order to obtain a minimum of 20% duplicate samples, as stipulated in Long-Term Monitoring Plan, a duplicate surface water sample was collected at the Site in 2012. Analytical results for the submitted sample and its duplicate were compared to provide an indication of the precision of both the field sampling and laboratory analysis methods. Results of the duplicate comparison are presented along with chemical data in Appendix B, while the methodology is discussed in Section 4.6.

Duplicate evaluations of surface water samples for PHCs, dissolved metals, PCBs and inorganic parameters all fell within limits of acceptability. The following total metals did not meet the duplicate evaluations criteria: Cd, Cu, and Ni. These three total metals were not within the acceptable range for "Case B" as outlined in Table 3. This means that:

1) the concentrations of the compounds in the one of the duplicate pairs was above the RDLs, while in the other they were reported below the RDLs; and
2) that half of the numerical value of the lowest RDL, subtracted from the positive result yields a value that remains larger than the RDL.

Detection limits are most often raised in the laboratory due to dilution to bring analyte within a calibrated range of concentrations, or to address other interferences. Comparing analytical results for ROB-8 with DUP-1, it was noted that the RDLs have been raised in DUP-1 for the three metals that failed to pass the duplicate evaluation. For example, the RDL for cadmium was 0.0050 µg/L for sample ROB-8, while it was 0.013 µg/L in DUP-1. The difference in the RDLs of these samples renders the "Case B" duplicate evaluation less meaningful. If the RDLs for DUP-1 were the same as those for ROB-8 it is likely that both would have yielded positive results and a RPD could have been calculated, and would most likely have passed. Alternatively, if the RDL for ROB-8 were the same as those for DUP-1, the duplicate evaluation would have been acceptable. These three instances of unacceptable duplicate evaluation are thus a product of the difference in RDLs and do not necessarily reflect poor duplication.

In addition to the field duplicate, a field blank and a travel blank were submitted to the laboratory for additional QA/QC. Results of analysis on the field and travel blanks are included in Appendix D. Results for all parameters in both field and travel blanks were below the RDLs, demonstrating that no cross-contamination was introduced to the samples from sampling or from transit to the laboratory.

Laboratory quality assurance and quality control was reviewed by FRANZ and is summarized in Table E-1, below.

Table E-1: Laboratory Quality Assurance Analysis

Quality Control Method	**Surface Water**
Blank	PCBs, metals, PHCs and BTEX were not present in the laboratory blank at detectable levels, which is acceptable. Surrogate recovery was within the acceptable range.
Relative Percent Difference	No RPDs were calculated as a result of undetectable concentrations in parent and duplicate sample for BTEX/PHCs or PCBs. RPDs for metals and other physical and inorganic parameters were all within acceptable limits.
Matrix Spike	Percent recoveries for matrix spikes were within acceptable range.
Spiked Blank	Percent recoveries for matrix spikes were within acceptable range

The internal laboratory quality control for analyses meets acceptability criteria; therefore based on both laboratory and field QA/QC results, the data is reliable for its intended use. Laboratory QA/QC results are included in the laboratory certificates of analyses provided in Appendix D.

APPENDIX F

Site Photo Log

South side of Solid Waste Management Facility Landfill (SWMFL). Viewpoint 1 (Figure A-2; Appendix A). Photograph reference RIMG0001. Direction photo taken: N

South side of SWMFL. Viewpoint 2 (Figure A-2; Appendix A). Photograph reference RIMG0002. Direction photo taken: N

South side of SWMFL. Viewpoint 3 (Figure A-2; Appendix A). Photograph reference RIMG0003.
Direction photo taken: N

West edge of SWMFL. Viewpoint 4 (Figure A-2; Appendix A). Photograph reference RIMG0004.
Direction photo taken: N

West side of SWMFL. Viewpoint 5 (Figure A-2; Appendix A). Photograph reference RIMG0005.
Direction photo taken: E

West side of SWMFL. Viewpoint 6 (Figure A-2; Appendix A). Photograph reference RIMG0006.
Direction photo taken: E

West side of SWMFL. Viewpoint 7 (Figure A-2; Appendix A). Photograph reference RIMG0007.
Direction photo taken: E

Northwest corner of SWMFL. Viewpoint 8 (Figure A-2; Appendix A). Photograph reference RIMG0008.
Direction photo taken: E

North side of SWMFL. Viewpoint 9 (Figure A-2; Appendix A). Photograph reference RIMG0009.
Direction photo taken: S

North side of SWMFL. Viewpoint 10 (Figure A-2; Appendix A). Photograph reference RIMG0010.
Direction photo taken: S

North side of SWMFL. Viewpoint 11 (Figure A-2; Appendix A). Photograph reference RIMG0011.
Direction photo taken: S

East side of SWMFL. Viewpoint 12 (Figure A-2; Appendix A). Photograph reference RIMG0012.
Direction photo taken: W

East side of SWMFL. Viewpoint 13 (Figure A-2; Appendix A). Photograph reference RIMG0013.
Direction photo taken: W

East side of SWMFL. Viewpoint 14 (Figure A-2; Appendix A). Photograph reference RIMG0014.
Direction photo taken: W

East side of SWMFL. Viewpoint 15 (Figure A-2; Appendix A). Photograph reference RIMG0015.
Direction photo taken: W

Southeast corner of SWMFL. Viewpoint 16 (Figure A-2; Appendix A). Photograph reference RIMG0016.
Direction photo taken: NW

Top of the SWMFL from the Southeast corner. Viewpoint 17 (Figure A-2; Appendix A). Photograph reference RIMG0017. Direction photo taken: W

Top of the SWMFL from the Southeast corner. Viewpoint 18 (Figure A-2; Appendix A). Photograph reference RIMG0018. Direction photo taken: W

Top of the SWMFL from the Southeast corner. Viewpoint 19 (Figure A-2; Appendix A). Photograph reference RIMG0019. Direction photo taken: N

Top of the SWMFL from the Northeast corner. Viewpoint 20 (Figure A-2; Appendix A). Photograph reference RIMG0020. Direction photo taken: S

Top of the SWMFL from the Northeast corner. Viewpoint 21 (Figure A-2; Appendix A). Photograph reference RIMG0021. Direction photo taken: W

Top of the SWMFL from the Northwest corner. Viewpoint 22 (Figure A-2; Appendix A). Photograph reference RIMG0022. Direction photo taken: E

Top of the SWMFL from the Northwest side. Viewpoint 23 (Figure A-2; Appendix A). Photograph reference RIMG0023. Direction photo taken: E

Top of the SWMFL from the West side. Viewpoint 24 (Figure A-2; Appendix A). Photograph reference RIMG0024. Direction photo taken: E

Top of the SWMFL from the Southwest side. Viewpoint 25 (Figure A-2; Appendix A). Photograph reference RIMG0025. Direction photo taken: E

Top of the SWMFL from the Southwest corner. Viewpoint 26 (Figure A-2; Appendix A). Photograph reference RIMG0026. Direction photo taken: E

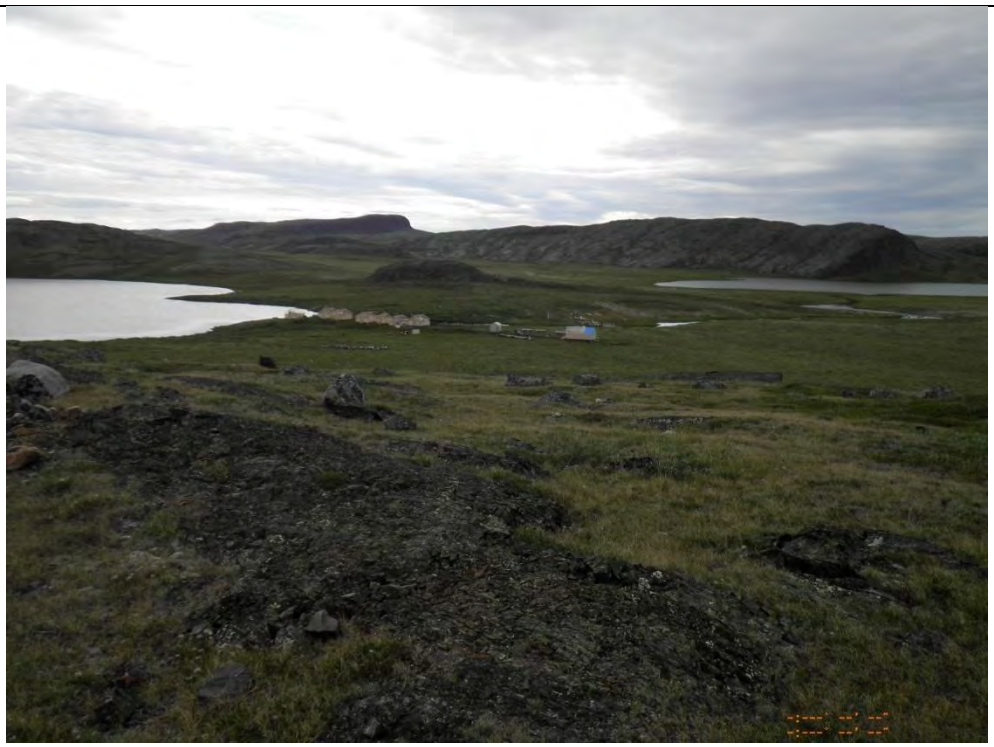
Top of the SWMFL from the Southwest corner. Viewpoint 27 (Figure A-2; Appendix A). Photograph reference RIMG0027. Direction photo taken: NE

Top of the SWMFL from the center. Viewpoint 28 (Figure A-2; Appendix A). Photograph reference RIMG0028. Direction photo taken: E

Top of the SWMFL from the center. Viewpoint 29 (Figure A-2; Appendix A). Photograph reference RIMG0029. Direction photo taken: NE

Top of the SWMFL from the Southeast corner. Viewpoint 31 (Figure A-2; Appendix A). Photograph reference RIMG0031. Direction photo taken: S

Top of the SWMFL from the Southeast corner. Viewpoint 32 (Figure A-2; Appendix A). Photograph reference RIMG0032. Direction photo taken: W



View of the river and fish survey infrastructure. Photograph reference RIMG0033. Direction photo taken: SW

View of the river and fish survey infrastructure. Photograph reference RIMG0034. Direction photo taken: SW

View of the lake. Photograph reference RIMG0035. Direction photo taken: S

APPENDIX G

Field Notes

Roberts Bay Aug 9 2010
1697-1201 (RB) 7:00 AM

· Programed Replaced data Logger.
(Formerly @ CAM-F UT2 ", refurbished
by Lakewood. Serial # 05070003
· Clock set to current time. (MST)
· Batteries: Main 11.34 (Boot)
(V) Aux 13.63 (Boot) Exp. 07/2015
Warm up time 0.035 sec.
· Memory Wrap around disabled.
· Fill time 12/24/2014.
· Dessicant Replaced. · Changed
Description from Serial # to
KOB VT-B (Serial # recorded in
notes)

9:15 AM
In NorthWright Twin Float
take off @ estimate 30 min
to site will look for optimal landing site
Estimate ~ 5 hr of site work.
Cambridge Bay aerodrome. & Float dock.
Weather rain, overcast ~ 10°C

C. Lamontagne A. Dunn / AANDC

1697-1201 Robert's Bay Aug 9 2012
K. McKenna / D. Kian Frame
Elvin Kanayok / Cambay EHTO

Floats down @ Robert's Lake
10:36 AM. After some
searching & conversion of UTM
Coordinates to Lat Long for Pilot's
Navigation System.

Camp site condition @ Dock
is passed.
up goat trail is cat
Reached Landfill @ 11:38

Thermistor A (North most.)
Housing in good condition / Jack
Keyed alike - working

Resistances			
Channel		5	16.277	11
1	8.797	6	17.284	12
2	9.756	7	18.383	13
3	11.323	8	19.365	14
4	14.079	9	20.42	15
		10	131	16

LEVEL

1697-1201 Roberts' Bay Aug 9 2012

Thermistor A Datalogger Serial #
07060503.

String A

Memory 78% full

Battery Power Main: 11.34 V
Aux: 13.38 V.

Programmed to stop logging when memory full

Changed time to MST

Changed Aux Battery
New Voltage @ 13.87 V
(Best)

Done @ 12:38

1697-1201 Roberts Bay Aug 9 2012
12:56.

Data logger #3
Serial # 07060500
String C

Memory 78% full

Batteries: Main: 11.34 V (Best)
Aux: 13.02 V (Best)

- Programmed to stop when memory full
- Changed time to MST
- Changed Aux Battery 07/15 expiry
New Voltage
13.26 (Best)

Aug 9 2012

1697-1201 Robalo's Bay 12:44 pm

Resistance Check String C

Channel	Ω	Channel	Ω
1	7.575	9	18.858
2	8.230	10	~112
3	9.684	11	
4	11.483	12	
5	13.749	13	
6	16.090	14	
7	17.091	15	
8	17.923	16	

Resistance Check for String B

Channel	R	channel	Ω
1	7.685	9	19.072
2	8.162	10	19.92
3	9.529	11	20.62
4	11.461	12	~116.51
5	13.778	13	
6	16.021	14	
7	17.211	15	
8	18.048	16	

1697-1701 Robalo's Bay Aug 9 2012.

1:35 PM Instal Replacement.
Data logger @ String B.
Description ROB VT-B

Clock Sensors - All 11 sensors are functional

Analog 1	(Air temperature)	15.74°C	
Im 2	14.2319	@ ground surface	
3	10.9091		
4	7.1719		
5	3.4718	Freeze back	
6	0.4492	depth est @ N 35m	
7	-0.9217		
8	-1.8846		
9	-2.9596		
10	-3.8077		
11	-4.5000		

LEVEL

1697 - 1201 (RB) Robert's Bay Aug 9 2012

Wildlife Observed
onsite
- Sitsik (ground Squirrel) several
- Sparrows n (many in willows SE of
en route to site - swallows SWDF)
- Snow Geese (many)
- Arctic Swans (2)

Evidence - Goose droppings many
around site - Sitsik burrows
area

Anecdotal from fish study personnel
at Robert's lake docking area
Much Char & Lake trout.
Bears in area (Grizzly)
Several on site Aug 7th 2012

Leave Dock @ Robert's Lake 5:00 pm.
Touch down Cam Bay Aerodrome 5:35

1697 - 1201 (RB) Robert's Bay Aug 9 2012
Refuel in Cam Bay take off 6:15 pm
Land in Kugluktuk 7:56 pm, Refuel (4½ drums)
Depart Kugluktuk 8:25
Down @ Norman Wells @ 11:58 pm

LEVEL

APPENDIX H

Thermistor Data

Table H-1: Thermistor Annual Maintenance Report

Contractor name: Franz Environmental Inc.	**Inspection date:** 2012-08-09
Prepared by: Kevin McKenna	

Thermistor Information

Thermistor Number	**String-A site 1**	**String-B site 2**	**String-C site 3**
Install date	2009	2009	2009
Location	Roberts Bay (SWMF)	Roberts Bay (SWMF)	Roberts Bay (SWMF)
Inclination	Vertical	Vertical	Vertical
Cable length (m)	N/A	N/A	N/A
Cable length (m) above ground	2.5	3.3	3.1
No. of beads*	9	11	9
Bead type	44007	44007	44007
Coordinates (m)	N:7563819 E: 435359	N:7563800 E: 435351	N:7563790 E: 435349
Elevation: casing top (masl)	71.80	71.29	69.53
Elevation: bottom bore (masl)	66.67	65.76	65.11
Serial no.	07060503	07060501 (faulty) replaced with 05070003	07060500
Logger model	Lakewood Systems Ultralogger (RX-16, Revision JC)		

*determined indirectly from thermistor logger data.

Thermistor inspection

Thermistor Number	**String-A site 1**	**String-B site 2**	**String-C site 3**
Casing	Good condition	Good condition	Good condition
Cover	Good condition	Good condition	Good condition
Datalogger	Good condition	Replaced with spare datalogger: Good Condition	Good condition
Cable	Good condition	Good condition	Good condition
Beads	Operational	Operational*	Operational
Memory Used	78%	N/A	78%
Battery installation date	N/A	July 2012	N/A
Battery change date (recommended)	2014	2014	2014
Main battery (V)	11.34	11.34	11.34
Aux battery (V)	13.87	13.63	13.26

*based on reasonable resistance values obtained manually on Aug 9, 2012.

Observations and proposed maintenance

- All locks were functional and were replaced on all three thermistor casings: Guard, 40 mm universal-key padlocks, No. 834 (key number 102).
- Batteries were not replaced in dataloggers at strings A and C. The replacement datalogger installed at string B has fresh batteries; however the main and auxiliary batteries in all three dataloggers should be replaced during the next Site visit scheduled for August 2014.
- A Lakewood resistance meter and switchbox were employed to compare manual (taken directly from thermistor beads) and logged readings. It was determined that all of the beads were functioning correctly.

Table H-2: Manual Thermistor Readings and Inferred Bead Elevations

Analog Channel		Elevation (masl)*	Depth (mbgs)*	Thermistor R (Ohms)	Temperature (ºC)		
					Manual	Logged	Difference
String-A	1	70.5	0	8797	12.5758	12.584	0.0
	2	70.17	0.33	9756	10.4088	10.2455	0.2
	3	69.67	0.83	11323	7.3391	7.0293	0.3
	4	69.17	1.33	14079	2.9519	2.8743	0.1
	5	68.67	1.83	16277	0.0951	0.1177	0.0
	6	68.17	2.33	17284	-1.0723	-1.1081	0.0
	7	67.67	2.83	18383	-2.2624	-2.3148	0.1
	8	67.17	3.33	19365	-3.2603	-3.3944	0.1
	9	66.67	3.83	20420	-4.2711	-4.3442	0.1
				maximum	--	--	***0.3***
String-B	1	70.76	-0.5	7685	15.4502	15.1527	0.3
	2	70.26	0	8162	14.1631	14.0247	0.1
	3	69.76	0.14	9529	10.8993	10.9270	0.0
	4	69.26	0.64	11461	7.0920	1.7364	5.4
	5	68.76	1.14	13778	3.3818	1.7364	1.6
	6	68.26	1.64	16021	0.4048	1.7364	1.3
	7	67.76	2.14	17211	-0.9903	1.7364	2.7
	8	67.26	2.64	18048	-1.9083	-1.9026	0.0
	9	66.76	3.14	19072	-2.9686	1.8519	4.8
	10	66.26	3.64	19920	-3.7995	-3.8286	0.0
	11	65.76	4.14	20620	-4.4561	-4.5132	0.1
				maximum	--	--	***5.4***
String-C	1	68.61	-0.5	7575	15.7599	14.6661	1.1
	2	68.61	-0.41	8230	13.9866	15.052	1.1
	3	68.11	0.09	9684	10.5630	11.1667	0.6
	4	67.61	0.59	11483	7.0529	7.0143	0.0
	5	67.11	1.09	13749	3.4238	3.3743	0.0
	6	66.61	1.59	16090	0.3208	0.3607	0.0
	7	66.11	2.09	17091	-0.8546	-0.8376	0.0
	8	65.61	2.59	17923	-1.7743	-1.8357	0.1
	9	65.11	3.09	18858	-2.7524	-2.7649	0.0
				maximum	--	--	***1.1***

Corrupted channels. Faulty multiplexor card was determined to be the cause.

Temperature difference attributable to greater variability in air temp measured by surface beads and time difference between logging time and manual resistance reading.

Established elevation of borehole bottom (from as-built drawings).

Established elevation of landfill surface (from as-built drawings).

*Inferred elevation and depth based on design recommendations of 500 mm bead spacing from borehole bottom.

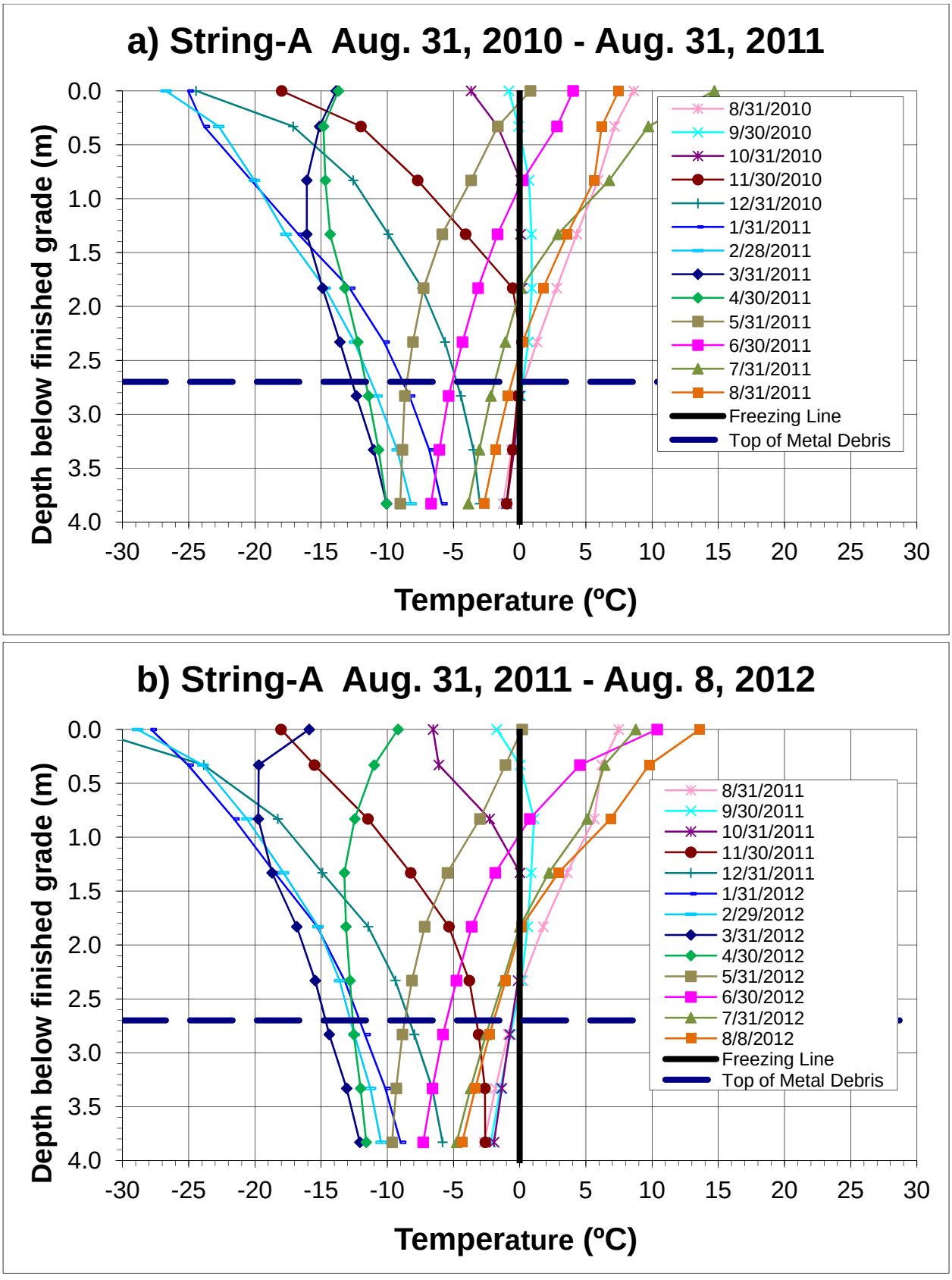


Figure H- 1: Monthly ground temperature profiles at thermistor string A: a) 2010-2011, b) 2011-2012

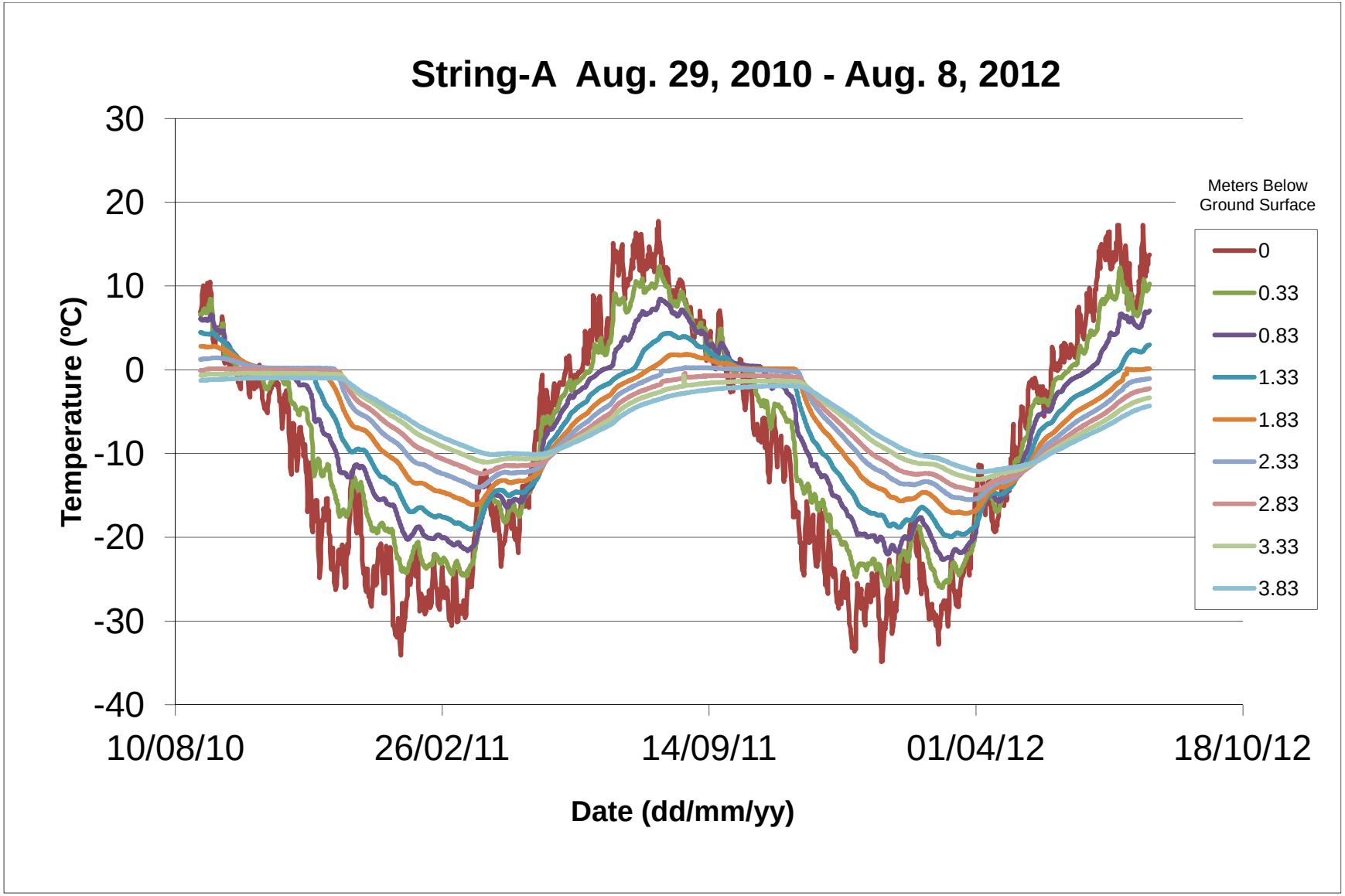


Figure H- 2: Temperature vs. time at thermistor string A: (August 2010-August 2012)

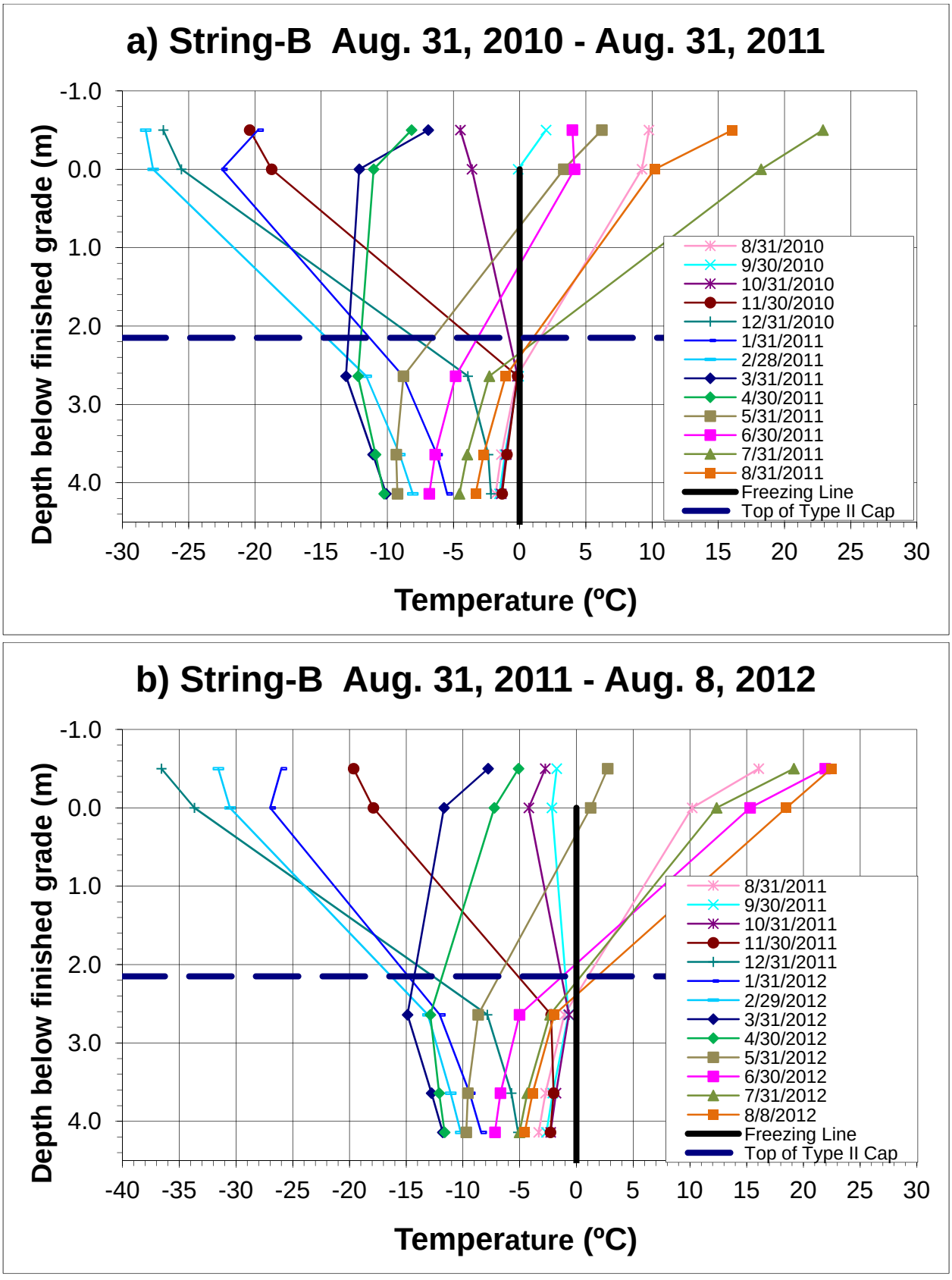


Figure H- 3: Monthly ground temperature profiles at thermistor string B: a) 2010-2011 b) 2011-2012

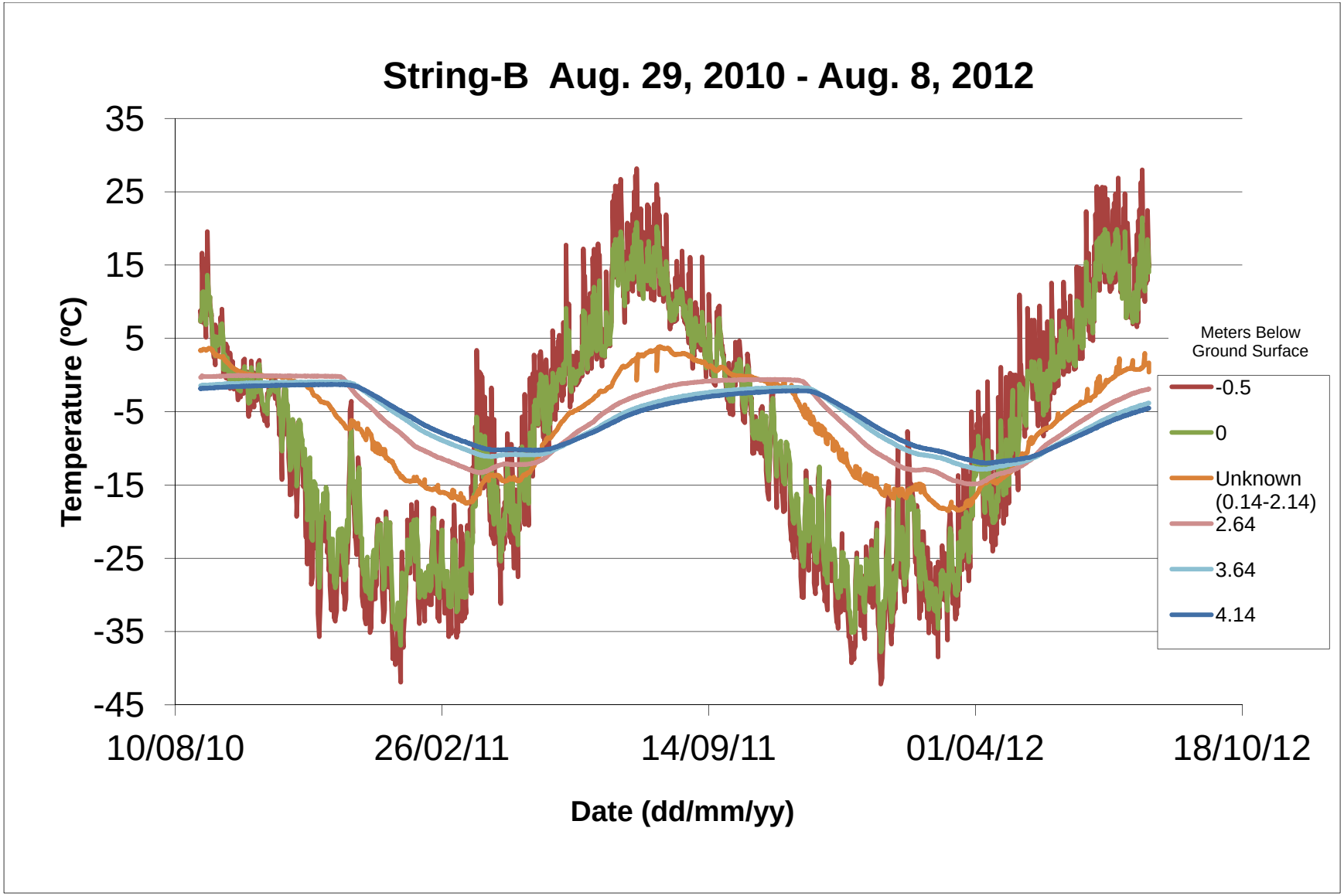
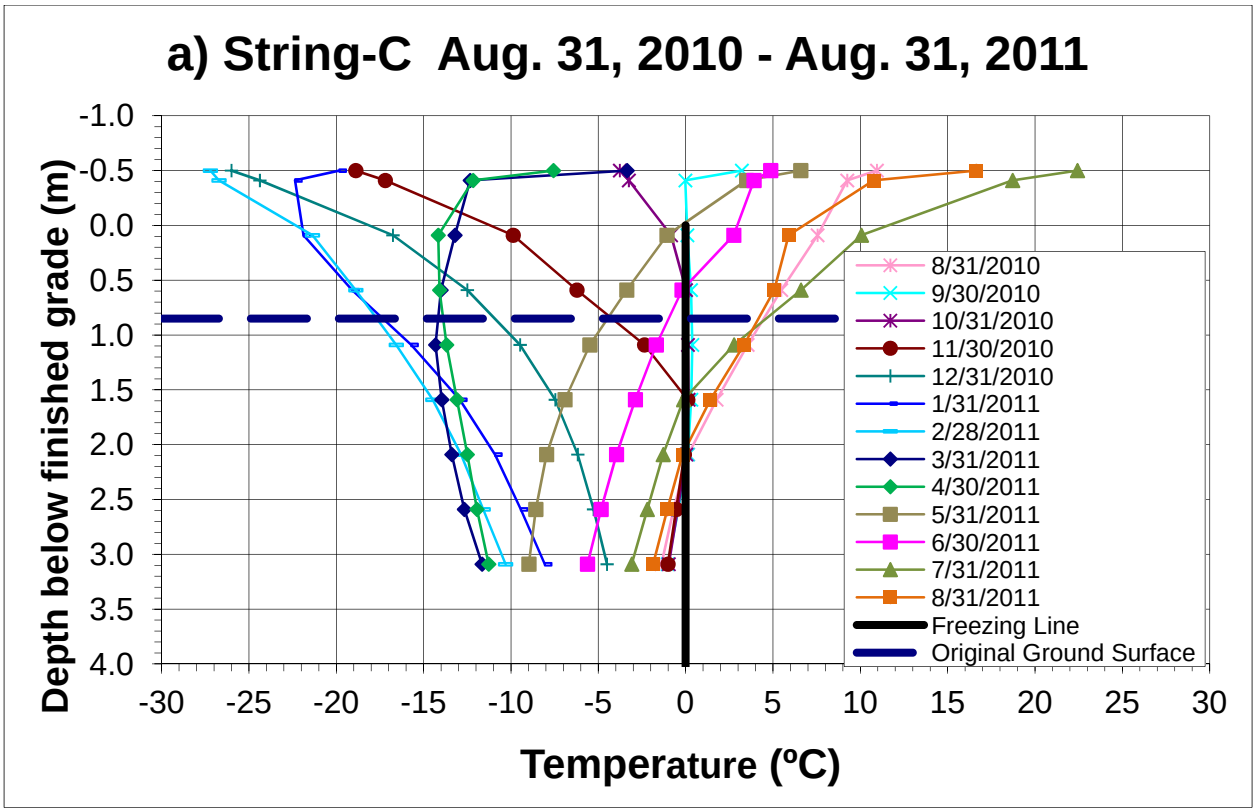


Figure H- 4: Temperature vs. time at thermistor string B (August 2010-August 2012)



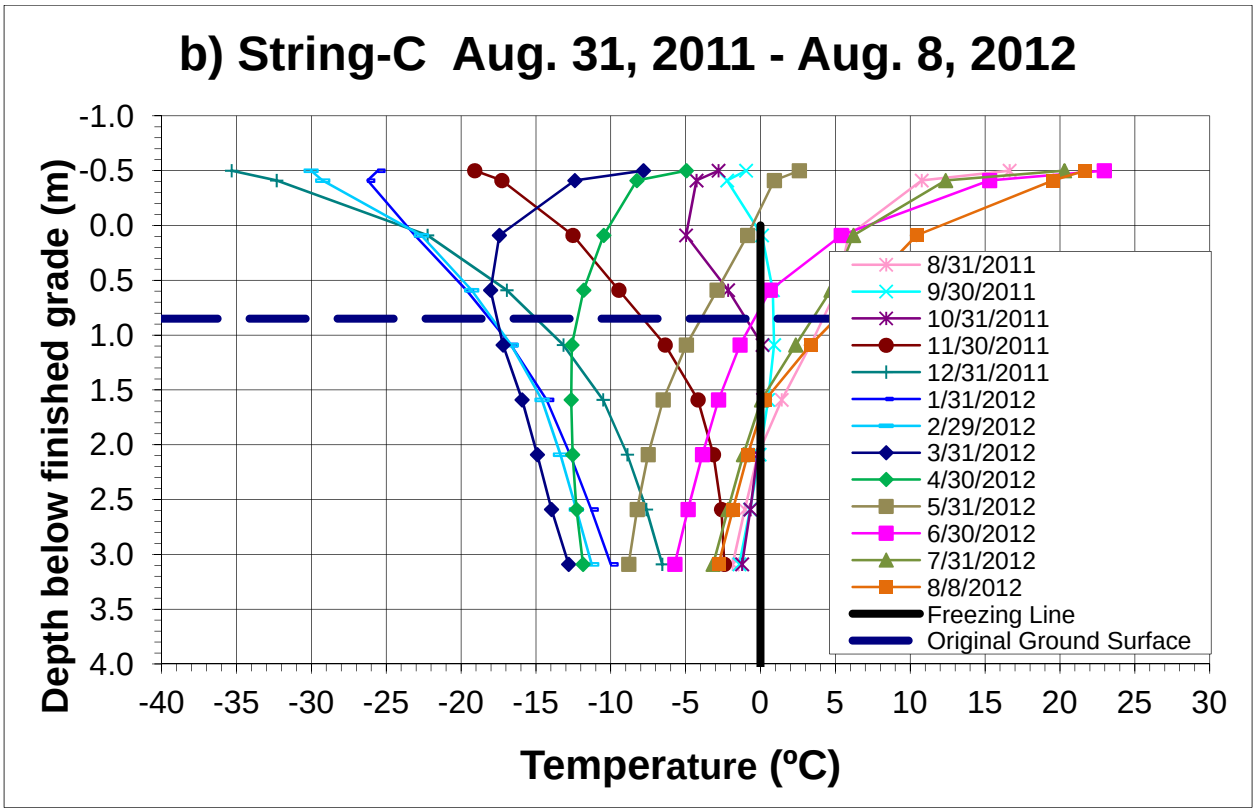


Figure H- 5: Monthly Ground Temperature Profiles at Thermistor String C: a) 2010-2011 b) 2011-2012

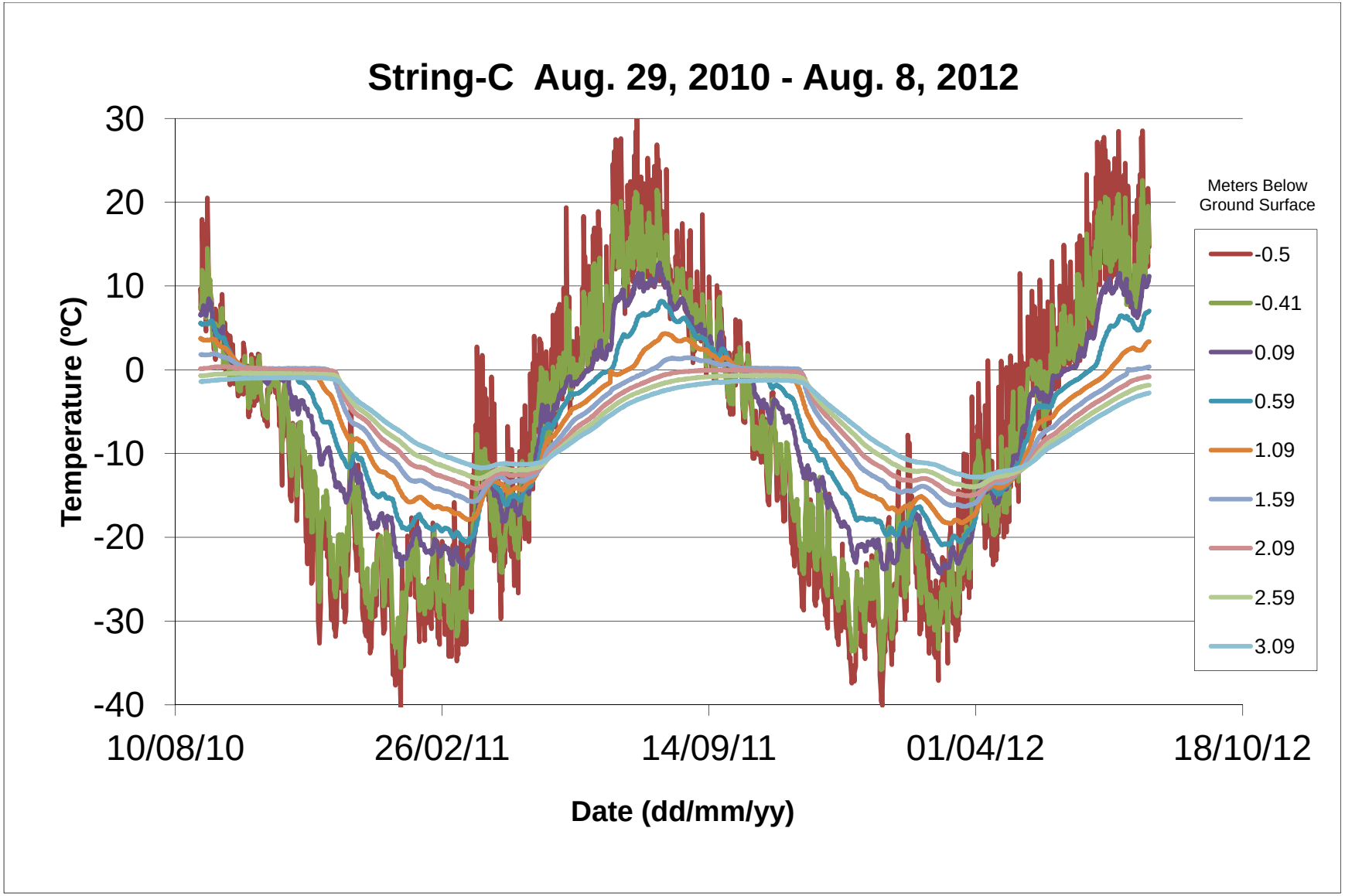


Figure H- 6: Temperature Vs. Time at Thermistor String C (August 2010-August 2012)