March 31, 2016

Project No. 1530908-1000

Department of National Defence Canada
ADM (Infrastructure & Environment)
Ottawa, Ontario
K1A 0K2
ATTN: Laura D'Costa and Cynthia Tremblay

FINAL 2015 FOX-3 MONITORING REPORT

QIKIQ15 BAFFIN REGION DEW LINE SITE MONITORING

Dear Ms. D'Costa and Ms. Tremblay;

Please find attached final report on 2015 monitoring at the FOX-3 DEW Line Site for the QIKIQ15 Baffin Region monitoring contract.

If you wish to discuss any aspect of this report, please do not hesitate to contact the undersigned.

Yours very truly,

GOLDER ASSOCIATES LTD.

Darrin Johnson, P.Eng.
Project Manager

DCJ

Attachments: Final 2015 FOX-3 Monitoring Report

\\golder.gds\gal\ottawa\active\2015\3 proj\1530908 pwgsc dew line\6_1000_2015\9_final reports\r2_fox-3\final version\1530908_fox-3 final report cover letter_31mar2016.docx

Golder Associates Ltd.
1931 Robertson Road, Ottawa, Ontario, Canada, K2H 5B7
Tel: +1 (613) 592 9600 Fax: +1 (613) 592 9601 www.golder.com
Golder Associates: Operations in Africa, Asia, Australasia, Europe, North America and South America

March 2016

QIKIQ15 BAFFIN REGION DEW LINE SITE MONITORING

2015 FOX-3 Monitoring Report

Submitted to:
Department of National Defence
ADM (Infrastructure & Environment)
Ottawa, Ontario
K1A 0K2

ATTN: Laura D'Costa and Cynthia Tremblay

Report Number: 1530908-R2-V3

Distribution:

Department of National Defence - 2 hard copies and 8 electronic copies
Golder Associates Ltd. - 1 hard copy and 1 electronic copy

Executive Summary

Golder Associates Ltd. (Golder) has been contracted by Public Works and Government Services Canada (PWGSC), on behalf of the Department of National Defence (DND), to complete the 2015-2018 Distant Early Warning (DEW) Line Sites Landfill Monitoring Program in the Baffin Region of Nunavut. The four DEW Line sites that were monitored in 2015 as part of the QIKIQ15 contract are DYE-M, FOX-3, FOX-2 and CAM-5. These sites are all now in the Post-Construction Monitoring Phase of their remedial program.

This Monitoring Report presents the 2015 post-construction inspection and monitoring results for four landfills at FOX-3: Station West Landfill, West Landfill, Non-Hazardous Waste Landfill and Tier II Disposal Facility. In addition, visual inspection of the Thermokarst Area was carried out during the 2015 monitoring event. The 2015 monitoring was year 4 for FOX-3; where remediation was completed in 2011. FOX-3 is being monitored annually from 2012 to 2016.

Station West Landfill

Based on the visual inspection, there does not appear to be any significant erosion, settlement, exposed waste or indications of instability at the Station West Landfill. Some shallow ponding of water was observed on the cover surface and ponded/running water was also observed along the toe of the landfill. Red staining was observed on the cover surface in the northeastern corner of Lobe A and some black staining was observed on the south slope of Lobe F. Previously observed minor erosion appears to be self-armouring and has not visibly deteriorated since the last inspection. No exposed waste materials were observed. The Preliminary Stability Assessment conducted based on the visual inspection indicates that the Station West Landfill has an “Acceptable” overall landfill performance.

Concentrations of copper, nickel, lead, zinc, chromium and arsenic were detected in the soil samples above the background/baseline arithmetic mean. Most metal concentrations were highest at downgradient locations F3-4, F3-6 and F3-7, located along the northern toe of Lobe A of the landfill. The red staining was observed near sampling location F3-4. In some cases the 2015 concentrations were slightly higher than in earlier years (e.g., any parameters in the deep samples at F3-6 and F3-7); in most cases they were similar to, or lower than previous monitoring results. No detectable concentrations of PHC or Total PCB were noted in any of the samples in 2015.

Whereas a number of the environmental sampling results are the same or less than in the two previous sampling sessions, elevated and in some cases increases in parameter concentrations (i.e., deep samples from F3-6 and F3-7), may be reflective of ongoing impact from the landfill, however insufficient data is available to determine this.

Collection of additional data should be considered to assess if the F3-4 soil sampling results are related to the observed red staining of the landfill cover. It is recommended that iron be added to the analytical suite for this sample in 2016 to determine if this parameter is elevated.

West Landfill

Based on the visual inspection, there does not appear to be any significant erosion, settlement, exposed waste or indications of instability at the West Landfill. There was some minor self-armouring erosion on the north slope that is not considered a concern. Running water along the north toe and a small pond of water at the south toe does not appear to be impacting landfill stability. Previously observed areas of shallow settlement may be related to construction, rather than landfill performance or permafrost thaw, and are not considered a concern. The Preliminary Stability Assessment conducted based on the visual inspection indicates that the West Landfill has an "Acceptable" overall landfill performance.

Concentrations of copper, nickel, zinc, chromium and arsenic were detected in the soil samples above the background/baseline arithmetic mean. Most metal concentrations were highest at the downgradient location F3-3 (deep sample), located near the northern toe of the landfill. The 2015 concentrations were slightly lower than in earlier years (e.g., many parameters at F3-1 and F3-2. The 2015 concentrations were higher in some cases (e.g., shallow sample from downgradient location F3-3). Ponding of water was observed along the northern and southern toes of the landfill; no staining was observed in these areas. No detectable concentrations of PHC or Total PCB were noted in any of the samples in 2015.

Given that a number of the environmental sampling results are the same or less than in the two previous sampling sessions, there is no evident impact of the landfill on soil quality. Higher concentrations at the downgradient location could, however, be reflective of this location relative to the landfill.

Non-Hazardous Waste Landfill

Based on the visual inspection, there does not appear to be any significant erosion, settlement, cracking, exposed waste or indications of instability at the Non-Hazardous Waste Landfill. Some minor self-armouring erosion on the north and west slopes does not appear to be worsening. Some shallow settlement depressions on the cover surface with ponded water are observed, however they are not considered to be of concern. Shallow ponded water along the west, north and east toe appears to be from recent snow melt and/or precipitation and is not anticipated to have resulted in increased thawing of permafrost. The Preliminary Stability Assessment conducted based on the visual inspection indicates that the Non-Hazardous Waste Landfill has an "Acceptable" overall landfill performance.

Concentrations of copper, nickel, lead, zinc, chromium and arsenic were detected in the soil samples above the background/baseline arithmetic mean at two or more soil sampling locations. Concentrations were highest overall at the shallow sample location MW-07, located cross-gradient of the landfill. At all four locations, the concentrations of most metals were similar to or less than those observed in 2012 and 2014. No detectable concentrations of PHC or PCB were noted in any of the samples in 2015.

Exceedances of the baseline values were reported in the groundwater samples for zinc, chromium and arsenic; these concentrations were generally lower than those reported in 2012 and 2014. No detectable concentrations of PHC or PCB were noted in any of the groundwater samples in 2015.

Based on the results, there does not appear to be significant impact to groundwater quality from the landfill at the four monitoring wells adjacent to the landfill.

Tier II Disposal Facility

Based on the visual inspection, there were no indications of instability at the Tier II Disposal Facility. No erosion, cracks, staining or exposed waste was observed. Five shallow depressions on the cover surface with ponded water were observed, which are not considered to be a concern. Some shallow ponded water was observed along the northwestern and west toe of the landfill, however they are not expected to contribute to increased thawing of permafrost. The Preliminary Stability Assessment conducted based on the visual inspection indicates that the Tier II Disposal Facility has an “Acceptable” overall landfill performance.

Concentrations of copper, nickel, zinc, chromium and arsenic were detected in the soil samples above the background/baseline arithmetic mean at two or more soil sampling locations. Lead was detected at the background and baseline concentrations at the downgradient location MW-04. Most metal concentrations were highest at the upgradient location MW-01. At all four locations, the concentrations of most metals were similar to or less than those observed from 2012 to 2014. No detectable concentrations of PHC or Total PCB were noted in any of the samples in 2015.

Exceedances of the baseline values were reported in the groundwater samples for zinc, chromium and arsenic. At MW-01, MW-03 and MW-04; these concentrations were generally lower than those reported from 2012 to 2014. At MW-02, concentrations were generally lower than those reported in 2014 but greater than those reported in 2012 and 2013. No detectable concentrations of PHC or PCB were noted in any of the groundwater samples in 2015.

Based on the results, there does not appear to be significant impact to groundwater quality from the landfill at the four monitoring wells adjacent to the landfill.

Regraded Thermokarst Area

A visual inspection of the Regraded Thermokarst Area was carried out during the 2015 monitoring event to assess and document the condition of the 2013 remedial works that involved placement and grading of granular fill within the settlement areas and cracks. The Regraded Thermokarst Area is located on the east side of the airstrip along the Macbeth River. It appears that significant additional thaw settlement and cracking has occurred since the Thermokarst Area was regraded in 2013. The Thermokarst Area was observed to have several large tension cracks around the perimeter of the thaw settlement with ponded water in the lowest part of the settlement depression. The Thermokarst Area was assessed to have a “Significant” overall performance because of “Numerous” cracks extending around the perimeter of new thaw settlement. The size and frequency of the tension cracks indicate that the slopes around the settlement area are unstable and at risk of sloughing into the depression.

Table of Contents

TABLES

FIGURES

APPENDICES

APPENDIX A
Report Limitations

APPENDIX B
Field Records

APPENDIX C
Laboratory Certificates of Analysis and QA/QC Reports

APPENDIX D
Photograph Log

APPENDIX E
2015 FOX-3 Thermokast Regrade Visual Inspection Report

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been contracted by Public Works and Government Services Canada (PWGSC), on behalf of the Department of National Defence (DND), to complete the 2015-2018 Distant Early Warning (DEW) Line Sites Landfill Monitoring Program in the Baffin Region of Nunavut (hereafter referred to as the "Project"). The contract number with PWGSC is W6837-151002/001/NCS. The DND file number for the Project is QIKIQ15. The contracted scope of work is in accordance with the project Terms of Reference (TOR) dated April 2015, and Golder Proposal P1530908 dated June 16, 2015 ("Golder Proposal").

The four DEW Line sites that were monitored in 2015 as part of the QIKIQ15 contract are DYE-M, FOX-3, FOX-2 and CAM-5. These sites are all now in the Post-Construction Monitoring Phase of their remedial program. Post-Construction Monitoring was carried out in accordance with the TOR and implemented as per Golder's Logistics and Work Plan (LWP) dated July 30, 2015. Monitoring activities included geotechnical visual inspection, thermal monitoring, soil and groundwater sampling. In addition to the landfill monitoring activities, a visual inspection the regraded thermokarst area at FOX-3 was completed in 2015.

This Monitoring Report presents the 2015 post-construction inspection and monitoring results for FOX-3 (the Site). The 2015 monitoring was year 4 for FOX-3; where remediation was completed in 2011. FOX-3 is being monitored annually from 2012 to 2016.

Appendix A is a summary of the report limitations and forms part of the report.

1.1 Objective of the Study

The objective of the Landfill Monitoring Program is to collect sufficient information to assess the performance, integrity, and stability of the landfills from a geotechnical and environmental perspective for human health and environmental protection. The monitoring program is designed to monitor landfill integrity and to determine in the event of any evident deterioration, if remedial measures are required.

1.2 Scope of Work

The scope of work for this Project includes the following:

1) Project Management including liaison with DND, project team coordination, scope management, cost management, schedule management and resource coordination;

2) Preparation of site-specific Health Safety and Environment Plan and procurement of safety equipment and supplies (e.g., personal protective equipment, first aid kits and satellite phones);

3) Development of a LWP for each field season that outlines the field schedule, travel plans, accommodation, hiring of local Inuit contract workers, All Terrain Vehicle (ATV) and charter aircraft rental;

4) Completion of field work consisting of visual inspection, photographic documentation, thermistor data collection and soil and water sample collection;

5) Preparation of a Field Work Progress Report that summarizes field work activities completed each year (submitted under separate cover);

6) Preparation of a Consultant Inuit Participation Plan and Report (submitted under separate cover); and,

7) Preparation of draft and final Monitoring Reports for each site with visual inspection results, photographic log, thermistor data collection, figures of inspection features and photograph locations, soil and groundwater quality monitoring results, Quality Analysis / Quality Control (QA/QC) and data interpretation.

2.0 BACKGROUND

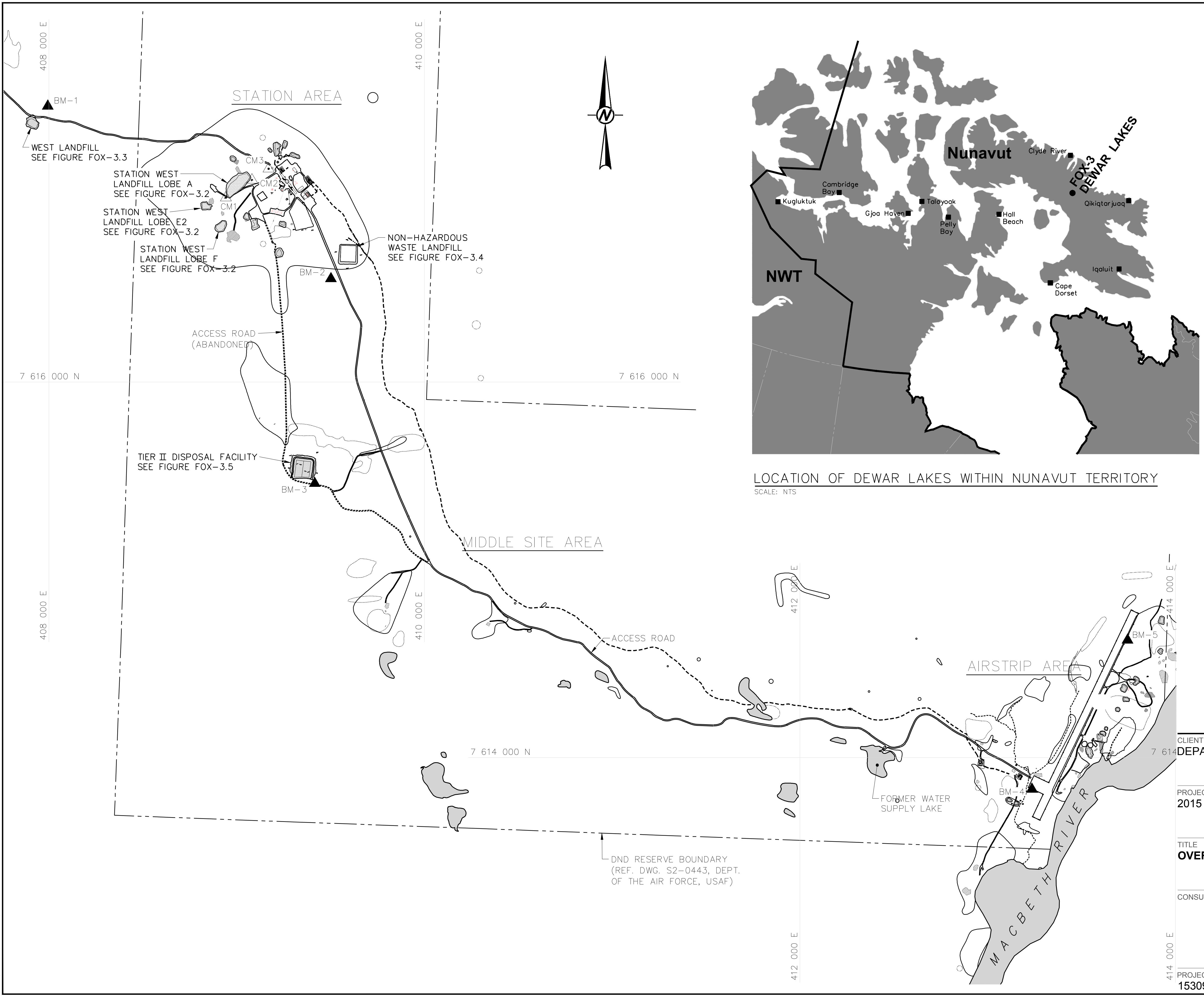
2.1 Site Description

FOX-3 (Dewar Lakes) is a land-locked site located in central Baffin Island, roughly 10 km south of the confluence of the MacBeth River and the Dewar Lakes system. The nearest community is Clyde River, located approximately 220 km to the northeast. For ease of discussion, the site has been classified into three areas: (i) the Station Area, (ii) the Middle Site Area and (iii) the Airstrip Area located adjacent to the MacBeth River. The access road connecting the Station Area and Airstrip Area is approximately six kilometres long.

The FOX-3 site is a former auxiliary radar site on the DEW Line system and was decommissioned in 1993. FOX-3 has been converted to a North Warning System (NWS) Long Range Radar site, and NWS now holds the reserve on the site. Because of ongoing facilities use, most of the infrastructure was not slated for demolition, and no remedial activities were completed within the operational areas. Given that FOX-3 is an active NWS site and the landfills to be monitored are on the current NWS reserve, an escort from the NWS Operations and maintenance contractor (Raytheon) accompanied our field staff during completion of monitoring inspections.

The following four landfills, shown on Figure FOX-3.1, are part of the FOX-3 long-term monitoring program:

- Station West Landfill;
- West Landfill;
- Non-Hazardous Waste Landfill; and,
- Tier II Disposal Facility.



LOCATION OF DEWAR LAKES WITHIN NUNAVUT TERRITORY

SCALE: NTS

LEGEND

– - – DND RESERVE BOUNDARY

△ SURVEY CONTROL MONUMENT

▲ PERMANENT BENCHMARK LOCATION

● BODY OF WATER

NOTE

GRID PROJECTION IS NAD83 ZONE 19N.
ELEVATIONS ARE GEODETIC.

REFERENCE

PREVIOUS INSPECTION FIGURE PROVIDED BY BIOGENIE, A DIVISION OF ENGLOBE CORPORATION, PROJECT NO.CD2655_400_403, DATED JUNE 2015.

0 500 1,000
1:20,000 METRES

CLIENT
DEPARTMENT OF NATIONAL DEFENCE CANADA

PROJECT
2015 FOX-3 MONITORING REPORT

TITLE
OVERALL SITE PLAN

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-03-24
DESIGNED	RM
PREPARED	TDR
REVIEWED	DCJ
APPROVED	DP

PROJECT NO.	PHASE	REV.	FIGURE
1530908	1000	B	FOX-3.1

Path: \\golder.gds\gal\Mississauga\SIM\Clients\Public_Works_Canada\Canada\99_PROJ\1530908_PWGSC_Dew_Line_Mon_Program_2015_2018\40_PROD\0004_Fox_3_Field_Summary_Report\ | File Name: 15309080004-CM-0007.dwg

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25 mm
0

2.2 Site Geology, Hydrogeology and Hydrology

The site is on the northeastern edge of the Precambrian (Canadian) Shield. Most Precambrian bedrock has been metamorphosed (altered by intense heat and pressure) into granite. Surficial soils have been formed by the erosive forces of glaciation and deposited by retreating glaciers. Glacial retreat has deposited glacial till moraine, boulders and talus slopes over the landscape. The landscape is dominated by bedrock outcrops and boulder fields; tundra vegetation is generally limited to valleys.

The groundwater flow processes at the site are expected to be significantly influenced by the presence of continuous permafrost. Annual active thaw layers are typically limited to a few metres below ground surface, depending on ground cover, soil materials and surface water features. Shallow groundwater representing meltwater (both surficial and within the active layer) and infiltration from precipitation during the summer thaw is perched within the active layer during the short summer season. Movement of the groundwater is dictated by soil type, presence of shallow permafrost and hydraulic pressures resulting from topographic differences and distribution (elevation) of the water within the soils. Water elevations are only measured at some wells, and therefore the use of terms upgradient or downgradient may not be truly reflective of the actual flow direction. Nevertheless, for the purposes of this report, upgradient and downgradient are used to maintain consistency with the identification of monitoring locations in previous annual reports.

The landscape is characterized by a broad gently rolling upland flanked by extensively eroded terrain. Elevations range from 400 to 500 metres above sea level (masl) in the uplands, to 100 masl along the MacBeth River. Rugged topography and the presence of permafrost at the site create shallow perched lakes and seasonal streams from drainage of melting snow pack. Smaller, shallow surface water features typically freeze solid during the winter months. Some of the larger, deeper lakes may not freeze solid allowing them to support fish populations.

2.3 Land-Use Description

In the 1950's, DEW Line sites were constructed across a number of locations in the Northern parts of Alaska, Canada and Greenland, between latitudes 65 and 70 degrees to maintain surveillance of the North American Airspace. In 1963, improvements in surveillance technology led to the closure of most of the DEW Line sites and their replacement with the NWS. Since the 1990's, investigations, decommissioning, and clean-up activities have been undertaken. Clean-up and decommissioning activities involved the demolition of surplus buildings and structures, excavation of contaminated soils, and the retrofitting of existing landfills. New engineered landfills were also constructed for the disposal of excavated soils and building materials.

Landfills at DEW Line sites can be categorized as follows:

- **Re-graded:** Existing landfills that were re-graded and capped with gravel;
- **Leachate Contained:** Existing landfills that were capped with gravel and provided with an impermeable membrane keyed into the permafrost (either only on the sides or over the entire surface), to contain leachate;
- **New NH:** New non-hazardous waste landfills; and,
- **New Tier II:** New Tier II disposal facilities (used for the disposal of Tier II soils as described by the DEW Line Cleanup Criteria) have impermeable liners below and above the contaminated soil to encapsulate the contents and contain the leachate. Tier II landfills are designed with a saturated granular perimeter berm keyed into the permafrost and sufficient cover of granular material to promote permafrost aggradation into the landfilled materials.

The four landfills in the monitoring program at FOX-3 fall into the following categories:

- Station West Landfill (Re-graded)
- West Landfill (Re-graded)
- Non-Hazardous Waste Landfill (New NH Landfill)
- Tier II Disposal Facility (New Tier II)

The airstrip at FOX-3 is located adjacent to the MacBeth River, approximately 6 km from the Station area. It is maintained for the purpose of ongoing NWS operations and long-term monitoring.

2.4 Field Program Staff and Schedule

Table 2-1 presents a list of field personnel, roles, responsibilities and dates for the FOX-3 2015 monitoring program.

Table 2-1: Field Personnel and Roles

Name (Affiliation)	Role / Responsibility	Site	Date
Darrin Johnson (Golder)	Sr. Geotechnical. Eng. / Inspections	FOX-3	August 16-20
Reza Moghaddam (Golder)	Field Geotechnical Lead / Inspections	FOX-3	August 16-20
Kevin Rattray (Golder)	Field Environmental Lead / Sampling	FOX-3	August 16-20
Jaypootie Moesesie (Inuit Subcontractor)	Wildlife Monitor	FOX-3	August 16-20
Jeremiah Toomasie (Inuit Subcontractor)	Wildlife Monitor	FOX-3	August 16-20
David Boutilier (Raytheon)	NWS Escort	FOX-3	August 16-20

2.5 Weather Conditions

Table 2-2 presents a summary of weather conditions on each day the FOX-3 monitoring program.

Table 2-2: Summary of Weather Conditions

Date	Weather
August 16	Overcast, 0 to 2ºC
August 17	Overcast, 0 to 2ºC
August 18	Overcast, 0 to 2ºC
August 19	Overcast with periods of clear sky, 0 to 4ºC
August 20	Overcast with periods of clear sky, 1 to º6 C

2.6 Project References

Canadian Council of Ministers of the Environment (CCME, 1993). "*Guidance Manual on Sampling, Analysis and Data Management for Contaminated Sites Guidance Manual on Sampling, Analysis and Data Management for Contaminated Sites – Volumes I and II, Main Report and Analytical Methods*".

Department of National Defence (DND, 2015). "*Terms of Reference, DEW Line Monitoring Program CAM-5, FOX-M, 2, 3, 4, 5, DYE-M*", QIKIQ15 Contract, April 2015.

Golder Associates Ltd. (Golder, 2015a), "Solicitation No. W6837-151002/A Baffin Region Dew Line Sites Monitoring Program", Report P1530908, dated June 16, 2015.

Golder Associates Ltd. (Golder, 2015 b). "*Baffin Region DEW Line Site Monitoring Health Safety and Environment Plan*", Report 1530908-1200-Rev2, dated July 31, 2015.

Golder Associates Ltd. (Golder, 2015c), "2015 Landfill Monitoring for DEW Line Sites: Logistics and Work Plan", Report 1530908-1300-Rev2, dated July 31, 2015.

Golder Associates Ltd. (Golder, 2015d). "*2015 Baffin Region DEW Line Site Landfill Monitoring Field Work Progress Report*", Report 1530908-1300-Rev2, dated October 5, 2015.

2.7 Report Structure

This report describes the monitoring program carried out in August 2015 at FOX-3. Results from visual inspection activities, thermal monitoring, soil sampling and groundwater sampling are presented in accordance with the TOR.

The report is organized into separate sections for each of the landfills (Sections 4.1 to 4.4). Each section contains the following 2015 monitoring information:

- Visual Inspection Checklist;
- Preliminary Stability Assessment Table;
- Table of visual inspection photographs;
- Landfill plan with photograph locations and observed features;
- Summary of thermal monitoring (if applicable for landfill);
- Summary of soil sampling analytical results;
- Summary of groundwater sampling analytical results (if applicable for landfill); and,
- Discussion of overall landfill performance based on available monitoring data.

Appendix A provides a Limitation of Responsibilities and forms part of the report. Thermal and groundwater monitoring field record sheets are included in Appendix B. Laboratory Certificates of Analysis, historical landfill monitoring results and QA/QC Reports are included in Appendix C. A photographic log is included in Appendix D. A visual inspection report on the regraded thermokarst area is included in Appendix E. An electronic version of the report, tables, figures, full resolution photos and Laboratory Certificates of Analysis are saved on a DVD-ROM, which is appended to the hardcopy of the report.

3.0 APPROACH & METHODOLOGY (GENERAL)

3.1 Summary of Work

3.1.1 Health and Safety

Golder developed a Health and Safety Environment Plan (Golder, 2015b) for the QIKIQ15 field program, which describes potential hazards, risks and proposed mitigation measures. Unique health and safety risks included the potential for wildlife encounters, travel by air in light planes and on ATV, long distances to the nearest emergency health care facilities and variable weather conditions. In addition, Golder developed a Logistics and Work Plan (Golder, 2015c) for the field program that contained the detailed schedule and travel plans, contact information, accommodation details, transportation, communications, field equipment and sampling protocols.

3.1.2 Field Program

Table 3-1 provides a summary of the monitoring schedule for the seven DEW Line sites that are part of the QIKIQ15 Project. FOX-3 was monitored in 2015 (Year 4) and will be monitored again in 2016 (Year 5). The field monitoring program consisted of the following activities:

- Visual inspection (of four landfills and thermokarst area) including photographic documentation of observed conditions;
- Thermal monitoring (i.e., datalogger downloading at landfills with thermistors);
- Soil sampling; and,
- Groundwater sampling (at landfills with monitoring wells).

Table 3-2 provides a summary of monitoring activities by landfill.

Table 3-1: Summary of QIKIQ15 Project Monitoring Schedule

DEW Line Site	Year			
	2015	2016	2017	2018
CAM-5 Mackar Inlet	Year 5		Year 7	
FOX-M Hall Beach			Year 10	
FOX-2 Longstaff Bluff	Year 4	Year 5		Year 7
FOX-3 Dewar Lakes	Year 4[(a)]	Year 5		Year 7
FOX-4 Cape Hooper		Year 18		Year 20
FOX-5 Broughton Island		Year 10		
DYE-M Cape Dyer	Year 2	Year 3	Year 4	Year 5

Legend	Phase I Monitoring
	Phase II Monitoring

Note:

a) At FOX-3 in 2015 (Year 4) – Complete a geotechnical inspection of the thermokarst regrade.

Table 3-2: Summary of Monitoring Requirements for Landfills at FOX-3

		Visual Inspection	Soil Sampling[a]	Groundwater Sampling	Thermal Monitoring
Landfill Designation	**Type of Landfill**	**✓ = yes**	**Locations x Samples**	**# of Monitoring Wells**	**# of Thermistors**
FOX-3					
Station West Landfill	Regraded	✓	9 x 2		
West Landfill	Regraded	✓	3 x 2		
Non-Hazardous Landfill	New NH	✓	4 x 2	4	
Tier II Disposal Facility	New Tier II	✓	4 x 2	4	4
	TOTAL	***4***	***40***	***8***	***4***

Notes:

a) (# x #) Indicates the number of sampling points at each landfill. Samples are collected from two depths at each sampling point; from 0-15 cm and from 40-50 cm (or at refusal).

3.1.3 Visual Inspection

At each of the FOX-3 landfill locations and thermokarst area, a visual inspection was conducted to observe whether there were any visual signs of erosion, cracking, seepage, ponded water, stressed vegetation (potentially caused by the landfill) and for physical stability. Photographic records of the landfill (or thermokarst area) were taken to document the observed condition of the landfill and other notable features that were observed. GPS coordinates were recorded of all photograph and feature locations.

Visual inspection information was used to complete a Preliminary Stability Assessment for each landfill (and thermokarst area). Each observed feature was assigned a Severity Rating (Acceptable, Marginal, Significant or Unacceptable) and Extent (Isolated, Occasional, Numerous or Extensive) and then the landfill was assigned an overall Performance Rating (Acceptable, Marginal, Significant or Unacceptable). Definitions of these terms are as follow:

Feature Severity Rating / Landfill Performance Rating	Description
Acceptable	Noted features are of little consequence. The landfill is performing as designed. Minor deviations in environmental or physical performance may be observed, such as isolated areas of erosion, settlement.
Marginal	Physical/environmental performance appears to be deteriorating with time. Observations may include an increase in size or number of features of note, such as differential settlement, erosion or cracking. No significant impact on landfill stability to date, but potential for failure is assessed as low or moderate.
Significant	Significant or potentially significant changes affecting landfill stability, such as significant changes in slope geometry, significant erosion or differential settlement; scarp development. The potential for failure is assessed as imminent.

Feature Severity Rating / Landfill Performance Rating	Description
Unacceptable	Stability of landfill is compromised to the extent that ability to contain waste materials is compromised. Examples may include: • Debris exposed in erosion channels or areas of differential settlement. • Liner exposed. • Slope failure.

Extent	Description
Isolated	Singular feature
Occasional	Features of note occurring at irregular intervals/locations
Numerous	Many features of note, impacted less than 50% of the surface area of the landfill
Extensive	Impacting greater than 50% of the surface area of the landfill

3.1.4 Thermal Monitoring

The landfills that require leachate containment (e.g., Tier II disposal facilities) and rely on permafrost aggradation incorporate ground temperature monitoring systems with vertical thermistor strings that measure temperature at various depths and automated dataloggers that allow for data collection. The data recorded on the dataloggers was downloaded using a laptop computer and Prolog software from Lakewood Systems Ltd. Thermistor inspection and data downloading details were recorded on field record sheets included in Appendix B.

At the FOX-3 site, thermistors and data loggers were installed only at the Tier II Disposal Facility.

3.1.5 Soil Sampling

Soil samples were collected in accordance with the TOR, the Golder Proposal, Logistics and Work Plan and Canadian Council of Ministers of the Environment (CCME) Guidance Manual on Sampling, Analysis and Data Management for Contaminated Sites – Volumes I and II, Main Report and Analytical Methods (CCME, 1993). The only soil sampling procedures that deviated from the TOR are those stated below (*in italics*):

- Soil samples were collected within 2 to 4 metres of monitoring wells (where applicable). Where there was no corresponding monitoring well, soil samples were collected within 2 to 4 metres of the previous sample locations;
- GPS readings of the 2015 soil sampling locations were recorded and confirmed to be consistent with previous/required sampling locations prior to sampling;
- Test pits were dug with a shovel that was washed between sample locations. Soil samples were collected by hand using a single-use disposable nitrile glove and placed into new/clean glass sample jars provided by the laboratory that were labelled with the sample location ID and depth;
- Soil samples were generally collected at depths of 0 to 15 centimetres (cm) and 40 to 50 cm at the locations, in accordance with the TOR. *At some locations, the sample collection depth was adjusted where soil was frozen or refusal on rock was encountered. Where refusal on a large rock(s) was encountered near surface,*

the sampling location was moved slightly to avoid the rock. When rocks were encountered prior to reaching the target sampling depth, the test pit was enlarged and the rock(s) were excavated if possible. If the specified sampling depth could not be reached after expending reasonable effort to enlarge the hole and remove rock(s), a sample was collected at or near the zone of refusal (in accordance with the TOR). If refusal was encountered after the shallow soil sample depth and even with additional effort it was not possible to remove the rock(s) causing refusal, then only one soil sample was collected at that location (noted as "refusal" in summary tables below);

- *At locations where the ground was covered with snow and ice, excavation of the snow was attempted but, in most cases, it was impossible to dig through the ice and frozen ground beneath the snow to collect a soil sample (noted as "frozen" in summary tables below); and,*
- Inter-lab field duplicates were collected for 10% of the total soil samples collected. The field duplicates were collected from relatively homogenous soil material that was mixed either in a stainless steel bowl *or in the test pit*, so that the composition of the two samples was considered to be the same.

3.1.6 Groundwater Sampling

Groundwater samples were collected in accordance with the TOR, the Golder Proposal, Logistics and Work Plan and CCME (1993). Groundwater sampling procedures of note are as follows (*deviations in italics*):

- Water levels in the wells were measured with an interface probe that was decontaminated with soap and water, then methyl hydrate and rinsed with distilled water prior to use;
- *At monitoring well locations where there was snow on the ground surrounding the well and no measurable water level or water that could be pumped with the peristaltic pump, water samples were not collected (noted as "frozen" in the summary tables below);*
- *At monitoring well locations that had no measurable water level or water that could be pumped with the peristaltic pump, water samples were not collected (noted as "dry" in summary tables below);*
- *Because of the limited quantity of water in the wells and/or slow recharge, purging was only carried out until a steady flow was observed* and then sampling was commenced in the priority order outlined in the TOR. *The number of water sample bottles collected and parameters that could not be analyzed are listed in footnotes following the respective summary tables below;*
- Purging and sampling was carried out using a peristaltic pump. Peristaltic pump flexible tubing and nylon tubing extending down the well was single-use and disposed after use at each well (i.e., was not re-used). Sample tubing was removed from the wells after completion of the sampling event and disposed off-site;
- Groundwater samples were pumped directly from the well into analysis-specific glass bottles provided by the laboratory, which were labelled with the sample location ID and date. Groundwater samples were not field filtered and were not field-acidified or preserved, in accordance with the TOR. The low-flow sampling technique used here was to ensure low turbidity which is critical when the samples are not field filtered;
- Where groundwater was insufficient for collection of a complete suite of samples, sampling was prioritized in the following order:
  - Petroleum hydrocarbons (PHC): F1 fraction;
  - Inorganic elements – total concentrations: arsenic, cadmium, chromium, cobalt, copper, lead, nickel, zinc and mercury;

  - PHC: F2, F3 and F4 fractions; and,
  - PCB (polychlorinated biphenyls – Total Aroclor analysis).
- Inter-lab duplicates were collected for 10% of the total groundwater samples collected;
- A field blank was filled in the field and analyzed for all parameters; and,
- Trip blanks were brought to the field and back and analyzed for all parameters.

3.2 Field Notes and Data

Visual inspection photographs, features, locations and notes were recorded in the field with a tablet computer equipped with a camera and Global Positioning System (GPS). Field data and photographs from the tablet were uploaded to an online Geographic Information System (GIS) database that was used to generate the photograph log and figures presented in this report.

Thermistor inspection and monitoring data was recorded on field record sheets included in Appendix B. Thermistor locations were recorded with either the field tablet or a hand-held GPS.

Soil sampling locations were photographed with location identification (ID) cards before test pit excavation, at the maximum depth of the test pit excavation and after backfilling. Soil sampling locations were recorded with either the field tablet or a hand-held GPS.

Groundwater monitoring data was recorded on field record sheets included in Appendix B. Monitoring well locations were recorded with either the field tablet or a hand-held Global Positioning System (GPS).

3.3 QA/QC

Quality Assurance (QA) is the set of procedures which are incorporated into the project's standard operating procedures to ensure that it achieves its quality objectives. Quality control (QC) is the system of checks and validations performed which measure quality in order to determine if the quality objectives have been met.

The QA procedures incorporated into the monitoring program carried out at FOX-3 included:

- Using only ISO 17025 certified environmental labs to perform the soil and groundwater analyses. Golder used Paracel Laboratories Ltd. (Paracel) of Ottawa as the primary lab and AGAT Environmental (AGAT) of Mississauga for the duplicate samples. Both of these laboratories are ISO 17025 certified for the analyses performed. The laboratories also exchanged their "Standard Methods" for the analyses in the program to harmonize their procedures for the duplicate analysis;

- The field sampling for soil and groundwater was completed by a two-person team, which helped to ensure that all of the sampling and field identification procedures were followed in order;

- Duplicate soil samples were prepared in the field by mixing the soil in a stainless steel bowl and taking small portions of soil and alternately filling the sample jars for the two labs. If a duplicate from the lower of the two sample intervals was being prepared, it was sometimes mixed at the bottom of the test pit;

- Duplicate groundwater samples were prepared by alternately filling bottles for each lab for each parameter type; the yield of the wells in some cases prevented filling the whole suite of sample bottles;

- To minimize the possibility of cross contamination, soil samples were collected directly from the test pits with nitrile gloved hands, at the designated depth intervals, and placed into lab-supplied sample jars leaving no headspace. New gloves were used for each sample. The shovel and trowel used to open the test pit were cleaned manually then rinsed with methyl-hydrate and de-ionized water;
- To minimize the risk of cross-contamination, groundwater samples were pumped from the monitoring wells using dedicated tubing inserted into the well and another dedicated length of tubing between the rollers in the peristaltic pump. Staff holding the sample bottles wore Nitrile-gloves. Samples were labelled at the monitoring well with identification, time and date;
- Groundwater samples were neither filtered nor preserved in the field. The low-flow sampling technique was employed to minimize the presence of sediment in the water sample;
- Soil samples were not preserved in the field;
- To minimize the time delay from actual sample collection to receipt at the lab, Golder sent coolers from the site to the staging point every time a resupply flight occurred. From the staging point communities, the coolers were sent via First Air to Ottawa Airport where Golder picked them up and took them to Golder's office in Ottawa, where they were checked for breakage, legibility of the labels and accuracy and completeness of the chain of custody. After being checked in Ottawa, the samples were dispatched to the primary and duplicate labs. The maximum allowable hold times for samples were largely met; where they were exceeded, it was by a maximum of two days due to the logistical limitations of flying in and out of the sites and the long chain of transport from the staging points to the labs.

Quality control was measured by the duplicate analysis and review of the QA/QC data contained in each laboratory certificate of results. In addition to the duplicate analyses, a field blank (consisting of bottles filled with distilled water in the field) was submitted to AGAT for analysis of all specified parameters. Trip blanks consisted of bottles filled with distilled water and sealed at the laboratory. These were brought to the field for the overall 2015 program and back) then submitted back to both Paracel and AGAT for analysis of all specified parameters.

No equipment blanks were prepared because neither the soil samples nor the water samples touched non-dedicated equipment. The water sampling tubing was single-use from well to sample bottle, and soil samples were collected from the test pits into sample jars with gloved hands. This was possible because the texture of the soil samples was generally loose sandy soil.

A discussion of the QA/QC results is provided in Section 5.

4.0 2015 Monitoring Program Results

Photographs 1 through 107 (in Appendix D) document the observed conditions during the visual inspection. Photographs 108 through 113 record the condition of the groundwater monitoring wells. Photographs 114 through 173 illustrate soil sample locations before excavation, after excavation and after backfilling. Photographs 174 through 177 illustrate the condition of the thermistors. A complete log of all photographs are included in Appendix D. Copies of all digital photograph files are included on a DVD attached to this report. Visual inspection photographs taken with the field tablet are identified by an "ATT number" in the file name which are noted in brackets in the visual inspection photograph log tables.

The monitoring program results are listed for each landfill in the sections below. Data in the tables are flagged where they exceed the background data - arithmetic mean (bold) andbaseline data – arithmetic mean (underlined). Soil and groundwater are also compared to their baseline concentration plus three standard deviations (3σ). A modified total petroleum hydrocarbons (TPH) value, calculated as the sum of the PHC F1, F2 and F3 fractions, is discussed throughout this report to allow for comparison to TPH baseline data.

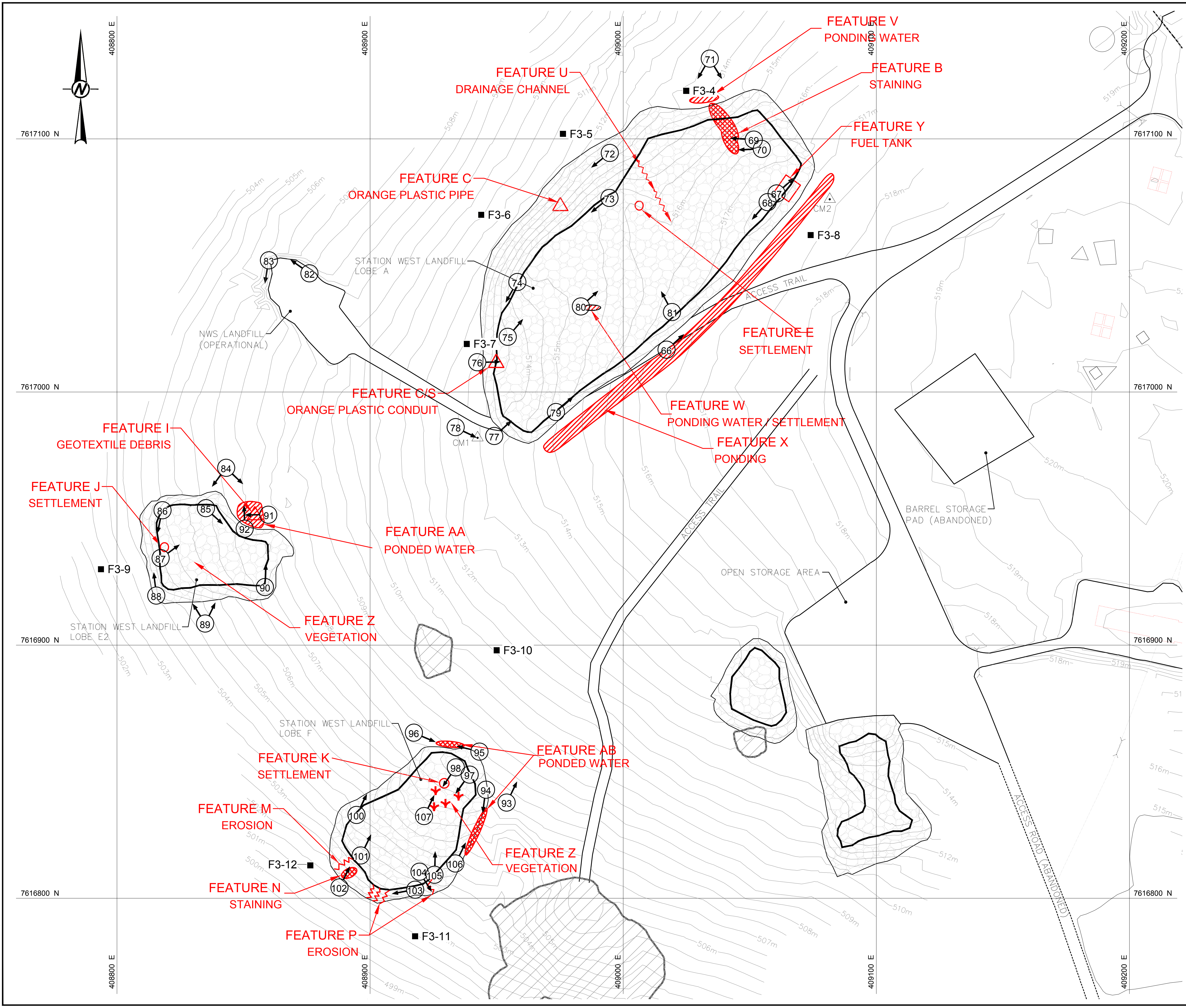
Historical soil and groundwater results and charts are included in Appendix C. It is recommended that seven data points be used at a minimum to identify a soil or groundwater quality trend for these landfills. As of the end of 2015, there are less than seven years of monitoring data available for these landfills, and therefore insufficient information available to establish a reliable trend.

4.1 Station West Landfill

4.1.1 Landfill Description

The Station West landfill is located approximately 150 m west of the main station building northwest and west of the old station access road. The Station West Landfill consists of three individual lobes (A, E2 and F) extending over an area approximately 14,800 m^2 (including sideslopes). The entire landfill area is gently sloping radially (but generally westerly) away from the active NWS buildings, from an elevation of 518 masl immediately southeast of Lobe A, to an elevation of 501 masl southwest of Lobe F. Based on satellite imagery, this area appears to drain to a linear water body located approximately 2 km to the west. The terrain in the area largely consists of boulders, with partially developed frost circles comprised of boulder perimeters with finer grained interiors.

Remediation activities at the Station West landfill consisted of the removal of surface and exposed debris and regrading. The long term monitoring plan consists of visual monitoring, and the periodic collection of soil samples. Approximate locations for the collection of soil samples are identified on Figure FOX - 3.2.



LEGEND

△ CM1	SURVEY CONTROL MONUMENT
■	SOIL SAMPLING LOCATION
○	SETTLEMENT (NTS)
▩	STAINING (NTS)
▨	PONDING (NTS)
△	DEBRIS (NTS)
⩘	DRAINAGE CHANNEL
✢	VEGETATION (NTS)
(78)↘	PHOTOGRAPH VIEWPOINT LOCATION
	TYPE 1 GRANULAR 1

NOTE

GRID PROJECTION IS NAD83 ZONE 19N.
ELEVATIONS ARE GEODETIC.

REFERENCE

PREVIOUS INSPECTION FIGURE PROVIDED BY BIOGENIE, A DIVISION OF ENGLOBE CORPORATION, PROJECT NO.CD2655_400_403, DATED JUNE 2015.

0 25 50
1:1,500 METRES

CLIENT
DEPARTMENT OF NATIONAL DEFENCE CANADA

PROJECT
2015 FOX-3 MONITORING REPORT

TITLE
STATION WEST LANDFILL

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-03-24
DESIGNED	RM
PREPARED	TDR
REVIEWED	DCJ
APPROVED	DP

PROJECT NO.	PHASE	REV.	FIGURE
1530908	1000	B	FOX-3.2

Path: \\golder.gds\gal\Mississauga\SIM\Clients\Public_Works_Canada\Canada\99_PROJ\1530908_PWGSC_Dew_Line_Mon_Program_2015_2018\40_PROD\0004_Fox_3_Field_Summary_Report\ | File Name: 15309080004-CM-0008.dwg

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25 mm

4.1.2 Summary of any Scope Deviations

The field work was conducted as per the TOR. There were no notable exceptions to the scope of work.

4.1.3 Visual Inspection

At the Station West Landfill, there are multiple locations with observed minor settlement, erosion, staining, vegetation and ponded water features. No cracking or exposed waste was observed. Table 4-1 presents a summary of observed visual inspection features; Table 4-2 presents the Preliminary Stability Assessment results. This landfill was assessed to have an "Acceptable" overall landfill performance because all observed features were assessed as "Acceptable". Table 4-3 is a log of photographs taken during the 2015 visual inspection.

A large fuel tank in the northeast corner of Lobe A was previously reported (labelled as "Fuel Tank"), but had not been assigned a Feature ID letter (new Feature Y). Previously observed plastic conduit on the slopes of Lobe A (Features C and C/S) is not buried waste that has become exposed, but instead appears to be road edge safety markers that are used across the site. Previously observed geotextile (Feature I) beyond the northeast toe of Lobe E2 is partially buried with gravel and in an area with ponded water. There does not appear to be buried waste under the geotextile, and therefore the exposed geotextile could be cut and removed at some point in the future. There is a large previously observed red stain on the northeast corner of Lobe A (Feature B) and some black staining on the south slope of Lobe F (Feature N) that was previously reported as seepage.

Ponded and running water was observed to extend along the entire east toe of Lobe A in 2015 (new Feature X). There were small ponds of water at the north toe of Lobe A (previously reported Feature V), the northeast toe of Lobe E2 (new Feature AA) and north and east toes of Lobe F (new Feature AB). There are several depressions on the landfill cover surface that were previously reported as settlement and were filled with water during the 2015 inspection (Features E, J, and K). A new settlement area was also observed (Feature W)   Previously observed shallow drainage channels on the northwest cover surface of Lobe A (Feature U) do not appear to be eroding the cover.

There is some minor self-armouring erosion on the south slope of Lobe F (previously identified as Features M and P) that does not appear to have deteriorated since the last inspection and no exposed waste materials were observed.

Moss and some sparse grass vegetation is becoming established on the cover surface of Lobes E2 and F (new Feature Z).

Table 4-1: Visual Inspection Checklist - Station West Landfill

SITE NAME: FOX-3 Dewar Lakes

LANDFILL DESIGNATION: Station West Landfill

DATE OF INSPECTION: August 17, 2015

DATE OF PREVIOUS INSPECTION: August 23, 2013

INSPECTED BY: Darrin Johnson

REPORT PREPARED BY: Darrin Johnson

MONITORING EVENT NUMBER: 3

The inspector/reporter represents to the best of his/her knowledge that the following statements and observations are true and correct and to the best of the preparer's actual knowledge, no material facts have been suppressed or misstated.

Table 4-1: Visual Inspection Checklist - Station West Landfill

Checklist Item	Present (Y/N)	Feature ID (A, B, etc.)	Location Description	Easting	Northing	Length (m)	Width (m)	Depth (m)	Extent of Landfill Area (%)	Description (Severity Rating)	Comparison to Historical Observations	Photos
Settlement	Y	W	Lobe A, central crest surface	408983	7617034	5	5	0.1	0.17%	Shallow depressions with ponded water (Acceptable)	New observation	80
		E	Lobe A, north crest surface	409006	7617074	2	2	0.1	0.03%	Shallow depressions with ponded water (Acceptable)	Previously observed: Feature has increased in size	81
		J	Lobe E2, west crest	408817	7616934	2	2	0.1	0.03%	Minor settlement (Acceptable)	Previously observed: Feature has increased in size	87
		K	Lobe F, north crest surface	408934	7616852	1	1	0.1	0.01%	shallow depression with ponded water (Acceptable)	Previously observed: Feature has increased in size	98
Erosion	Y	M	Lobe F, southwest slope	408887	7616816	10	5	0.1	0.34%	Minor self armouring erosion (Acceptable)	Previously observed: Expanded area	101
		P	Lobe F, southeast slope	408918	7616803	20	5	0.1	0.68%	Minor self armouring erosion (Acceptable)	Previously observed: Expanded area	103,104
Lateral Movement	N											
Frost Action	N											
Sloughing	N											
Cracking	N											
Animal Burrows	N											
Vegetation	Y	Z	Lobe E2, cover surface	408817	7616934	20	20	-	2.70%	Sparse vegetation (Acceptable)	New observation	87
		Z	Lobe F, cover surface	408939	7616849	20	20	-	2.70%	Moss and sparse grass (Acceptable)	New observation	97

Table 4-1: Visual Inspection Checklist - Station West Landfill

Checklist Item	Present (Y/N)	Feature ID (A, B, etc.)	Location Description	Easting	Northing	Length (m)	Width (m)	Depth (m)	Extent of Landfill Area (%)	Description (Severity Rating)	Comparison to Historical Observations	Photos
Staining	Y	B	Lobe A, north crest edge	409051.6	7617100	20	5	-	0.68%	Red staining (Acceptable)	Previously observed: Unchanged since previous observation	69, 70
		N	Lobe F, south slope	408889.8	7616813	2	2	-	0.03%	Staining (Acceptable)	previously reported as seepage	102
Vegetation Stress	N											
Seepage or Ponded Water	Y	X	Lobe A, east toe	409017	7617017	150	2	0.1	2.03%	Running water along toe (Acceptable)	New observation	66,79
		V	Lobe A, north toe	409034	7617132	20	3	0.1	0.41%	Ponded water along toe (Acceptable)	New observation	71
		AA	Lobe E2, north toe	408835	7616954	20	20	0.1	2.70%	Ponded water along toe (Acceptable)	New observation	85,91,92
		AB	Lobe F, east toe	408934	7616814	15	2	0.1	0.20%	Ponded water along toe (Acceptable)	New observation	94,106
		AB	Lobe F, north toe	408917	7616865	15	2	0.1	0.20%	Ponded water along toe (Acceptable)	New observation	95,96
Debris and/or Liner Exposed	Y	C / S	Lobe A, southwest crest	408948.6	7617011				0.00%	Orange plastic conduit - used as road edge markers - not buried waste - recommend drop from features list. (Acceptable)	Previously observed: Unchanged since previous observation	76
		I	Lobe E2, northeast toe	408859.8	7616952	3	1	-	0.02%	Geotextile surrounded by ponded water (Acceptable)	Previously observed: Unchanged since previous observation	91

Table 4-1: Visual Inspection Checklist - Station West Landfill

Checklist Item	Present (Y/N)	Feature ID (A, B, etc.)	Location Description	Easting	Northing	Length (m)	Width (m)	Depth (m)	Extent of Landfill Area (%)	Description (Severity Rating)	Comparison to Historical Observations	Photos
Presence / Condition of Monitoring Instruments	N											
Features of Note/Other Observations	Y	Y	Lobe A, northeast crest	409060.6	7617078					Fuel tank surrounded by some uneven ground (previous Feature F) and small hydrocarbon stains (previous Feature A). (Acceptable)	Previously observed but no Feature ID letter.	67

Landfill Area = 14,800 m^2.

Table 4-2: Preliminary Stability Assessment - Station West Landfill

Feature	Severity Rating	Extent
Settlement	Acceptable	Occasional
Erosion	Acceptable	Occasional
Lateral Movement	Acceptable	-
Frost Action	Acceptable	-
Sloughing	Acceptable	-
Cracking	Acceptable	-
Animal Burrows	Acceptable	-
Vegetation establishment	Acceptable	Occasional
Staining	Acceptable	Occasional
Vegetation Stress	Acceptable	-
Seepage/Ponded Water	Acceptable	Occasional
Debris and/or liner exposure	Acceptable	Isolated
Other	-	-
Overall Landfill Performance	**Acceptable**	

Table 4-3: Summary Table of Photographic Log - Station West Landfill

Photo	Description (file name)	Easting	Northing	Date
66	Station West Landfill, Lobe A – Southeast slope, facing northeast – Feature A, stream running along toe, fuel tank in background (ATT176_Photo1.jpg)	409017.1129	7617016.706	17-Aug-15
67	Station West Landfill, Lobe A – Feature Y, Fuel tank (ATT177_Photo1.jpg)	409060.5631	7617078.448	17-Aug-15
68	Station West Landfill, Lobe A – Southeast crest edge and toe, facing south (ATT178_Photo2.jpg)	409060.5631	7617078.448	17-Aug-15
69	Station West Landfill, Lobe A – Feature B, red staining (ATT179_Photo1.jpg)	409051.5923	7617099.697	17-Aug-15
70	Station West Landfill, Lobe A – Feature B, red staining (ATT180_Photo2.jpg)	409051.5923	7617099.697	17-Aug-15
71	Station West Landfill, Lobe A – Northeast end facing south (ATT181_Photo1.jpg) (ATT182_Photo2.jpg) (ATT183_Photo3.jpg)	409034.1758	7617131.668	17-Aug-15
72	Station West Landfill, Lobe A – Northwest slope, facing southwest (ATT184_Photo1.jpg)	408994.6813	7617094.424	17-Aug-15
73	Station West Landfill, Lobe A – Northwest crest edge, facing southwest, some small puddles on cover (ATT185_Photo1.jpg)	408994.5548	7617076.63	17-Aug-15

Table 4-3: Summary Table of Photographic Log - Station West Landfill

Photo	Description (file name)	Easting	Northing	Date
74	Station West Landfill, Lobe A – Area of coarser rock fill on northwest slope, facing west (ATT186_Photo1.jpg)	408958.1815	7617043.439	17-Aug-15
75	Station West Landfill, Lobe A – West end of coarse rock fill on northwest slope, facing east (ATT187_Photo1.jpg)	408954.3575	7617021.819	17-Aug-15
76	Station West Landfill, Lobe A – Feature C/S, exposed plastic conduit (ATT188_Photo1.jpg)	408948.6251	7617011.428	17-Aug-15
77	Station West Landfill, Lobe A – South slope and surface, facing station (northeast) (ATT189_Photo1.jpg)	408942.9133	7616980.597	17-Aug-15
78	Station West Landfill, Lobe A – Benchmark (ATT190_Photo2.jpg)	408942.9133	7616980.597	17-Aug-15
79	Station West Landfill, Lobe A – Southeast crest edge, facing station (northeast), stream at toe (Feature X) (ATT191_Photo1.jpg)	408973.4002	7616992.076	17-Aug-15
80	Station West Landfill, Lobe A – Feature W, shallow depressions with ponded water (ATT192_Photo1.jpg)	408983.2292	7617033.804	17-Aug-15
81	Station West Landfill, Lobe A – Cover surface facing northwest, some shallow channelized runoff on cover surface (ATT193_Photo1.jpg)	409019.2533	7617031.561	17-Aug-15
82	Station West Landfill, Lobe A (ATT194_Photo1.jpg)	408876.0309	7617046.844	17-Aug-15
83	Station West Landfill, Lobe A (ATT195_Photo1.jpg)	408859.9831	7617052.023	17-Aug-15
84	Station West Landfill, Lobe E2 – North slope and toe, facing south (ATT196_Photo1.jpg) (ATT197_Photo2.jpg)	408843.1337	7616970.065	17-Aug-15
85	Station West Landfill, Lobe E2 – North crest edge facing east, Feature AA, some pounded water at toe (ATT198_Photo1.jpg)	408835.0831	7616954.104	17-Aug-15
86	Station West Landfill, Lobe E2 – North crest edge, facing southwest (ATT199_Photo1.jpg)	408817.9813	7616953.259	17-Aug-15
87	Station West Landfill, Lobe E2 – Cover surface, facing east, Feature G, sparse vegetation (ATT200_Photo1.jpg)	408817.2098	7616934.355	17-Aug-15
88	Station West Landfill, Lobe E2 – West slope, facing north (ATT201_Photo1.jpg)	408815.4912	7616919.577	17-Aug-15
89	Station West Landfill, Lobe E2 – South slope facing north (ATT202_Photo1.jpg) (ATT203_Photo2.jpg) (ATT204_Photo3.jpg)	408834.7677	7616908.515	17-Aug-15
90	Station West Landfill, Lobe E2 – East crest edge and slope, facing north (ATT205_Photo1.jpg)	408858.4442	7616922.938	17-Aug-15
91	Station West Landfill, Lobe E2 – Feature I, geotextile surrounded by ponded and flowing water (ATT206_Photo1.jpg)	408859.7721	7616951.53	17-Aug-15
92	Station West Landfill, Lobe E2 – Slope at northeast corner, facing north, water at toe (Feature AA) (ATT207_Photo1.jpg)	408850.4078	7616945.994	17-Aug-15

Table 4-3: Summary Table of Photographic Log - Station West Landfill

Photo	Description (file name)	Easting	Northing	Date
93	Station West Landfill, Lobe F – Northeast slope, facing west (ATT217_Photo1.jpg) (ATT218_Photo2.jpg) (ATT219_Photo3.jpg)	408953.9467	7616837.83	17-Aug-15
94	Station West Landfill, Lobe F – East crest edge, facing south, Feature AB, some water running along toe (ATT220_Photo1.jpg)	408945.7687	7616842.908	17-Aug-15
95	Station West Landfill, Lobe F – Northeast edge, facing southeast, Feature AB, ponded water at toe (ATT233_Photo1.jpg)	408943.1706	7616857.899	17-Aug-15
96	Station West Landfill, Lobe F – North end, facing east, Feature AB, water at toe (ATT223_Photo1.jpg	408917.2847	7616865.408	17-Aug-15
97	Station West Landfill, Lobe F – Feature Z, very sparse moss and grasses on cover (ATT221_Photo1.jpg)	408939.2957	7616848.835	17-Aug-15
98	Station West Landfill, Lobe F – Feature K, shallow depression with ponded water (ATT222_Photo1.jpg)	408933.8765	7616851.692	17-Aug-15
99	Station West Landfill, Lobe F – West slope, facing south (ATT224_Photo1.jpg)	408914.858	7616851.269	17-Aug-15
100	Station West Landfill, Lobe F – Cover surface facing station (ATT225_Photo1.jpg)	408894.6295	7616832.907	17-Aug-15
101	Station West Landfill, Lobe F – Feature M, minor self-armouring erosion on southwest slope (ATT226_Photo1.jpg)	408886.8461	7616816.1	17-Aug-15
102	Station West Landfill, Lobe F – Feature N, hydrocarbon staining (ATT227_Photo1.jpg)	408889.8457	7616812.68	17-Aug-15
103	Station West Landfill, Lobe F – Feature P, minor self-armouring erosion from equipment tracks (ATT228_Photo1.jpg)	408917.7754	7616803.404	17-Aug-15
104	Station West Landfill, Lobe F – Feature P, southeast end self-armouring erosion, facing toe (ATT229_Photo1.jpg)	408924.8936	7616808.11	17-Aug-15
105	Station West Landfill, Lobe F – Cover surface facing north, some coarse rock fill in foreground (ATT230_Photo1.jpg)	408925.4311	7616809.281	17-Aug-15
106	Station West Landfill, Lobe F – East slope, facing north, some water running along toe (Feature AB) (ATT231_Photo1.jpg)	408933.6661	7616813.76	17-Aug-15
107	Station West Landfill, Lobe F – Cover surface facing north (ATT232_Photo1.jpg)	408921.2542	7616832.457	17-Aug-15

4.1.4 Soil Sampling

Table 4-4 presents a summary of analytical results for soil samples collected at the Station West Landfill. Sampling locations F3-8 and F3-10 represent upgradient sampling locations of Lobe A and Lobe F, respectively. Sampling locations F3-4 through F3-7 (Lobe A), F3-9 (Lobe E3) and F3-11 and F3-12 (Lobe F) represent downgradient sampling locations.

F3-8

Sampling location F3-8 is located upgradient of Lobe A, approximately 12 m northeast of the toe of the landfill. The estimated elevation of this sampling point is 517.5 masl. As shown in Photograph 144 (Appendix D), the area is covered with loose coarse sand, gravel and stones with some vegetation. A fuel tank is located north of the sampling location. The soil in the area of the sample location consisted of light brown sand and gravel.

The shallow sample at F3-8 (0-15 cm) exhibited elevated concentrations of metals. The concentrations of copper (38.9 mg/kg), nickel (28.8 mg/kg), zinc (64.8 mg/kg), and chromium (70.1 mg/kg) exceeded their background concentrations. In addition, the concentration of arsenic (13.6 mg/kg) exceeded the background (11 mg/kg) and baseline (10 mg/kg) concentrations but was less than baseline concentration plus 3σ (22 mg/kg). Elevated metal concentrations observed in 2012 and 2014 were largely similar. No PHC or PCB were detected from the shallow sample at F3-8 in 2015.

The deep sample at F3-8 (40-50 cm) also exhibited elevated concentrations of metals, at similar concentrations to those in the shallow sample. The concentrations of copper (39.3 mg/kg), nickel (28.2 mg/kg), zinc (64.9 mg/kg), and chromium (68.1 mg/kg) exceeded their background concentrations. In addition, the concentration of arsenic (12 mg/kg) exceeded the background (11 mg/kg) and baseline (10 mg/kg) concentrations but was less than baseline concentration plus 3σ (22 mg/kg). Elevated metal concentrations were similarly observed in 2012 and 2014. No PHC in fractions F1 to F3 was detected, however the soil sample jar was reported as broken upon receipt at Paracel, which could have had an effect of reducing the concentration of the volatile fraction (F1). The concentration of the PHC F4 fraction in 2015 was 7 mg/kg. No PCB were detected from the deep sample at F3-8 in 2015.

F3-10

Sampling location F3-10 is located upgradient of Lobe F, approximately 30 m north of the toe. The estimated elevation of this sampling point is 510 masl. As shown in Photograph 117 (Appendix D), the area is covered with coarse sand, gravel and stones with some vegetation and small linear ponded water features. The soil in the area of the sample location consisted of grey sand and gravel matrix and was moist, with evident seepage occurring through the soil in the walls of the excavation.

In the shallow sample at F3-10 (0-15 cm), the concentration of arsenic (11.3 mg/kg) exceeded the background (11 mg/kg) and baseline (10 mg/kg) concentrations but was less than baseline concentration plus 3σ (22 mg/kg). The concentration of arsenic was similar to those observed in 2012 and 2014. The concentrations of most other metals were also similar to those observed in 2012 and 2014, although it is noted that chromium concentrations at this location were lower than in 2014 (97 mg/kg). No PHC or PCB were detected from the shallow sample at F3-10 in 2015.

A duplicate sample was collected at the deep F3-10 (40-50 cm) sample location, and therefore the average concentrations are discussed relative to background and baseline values. The calculated relative percent difference (RPD) values indicated the original and duplicate sample results differ by less than 19% for all parameters.

In the deep samples at F-10 (40-50 cm), the average concentration of zinc (63 mg/kg) slightly exceeded the background concentration (59 mg/kg). The concentration of zinc was slightly lower than those observed in 2012 (70 mg/kg) and 2014 (67 mg/kg). The concentrations of most other metals were similar to or less than those observed in 2012 and 2014 although it is noted that chromium concentrations at this location were lower than in 2014 (95 mg/kg). No PHC or PCB were detected from the deep samples at F3-10 in 2015.

F3-4

Sampling location F3-4 is located downgradient of the Lobe A of the landfill, approximately 10 m north of the northern toe. The estimated elevation of this sampling point is 513.5 masl. As shown in Photo 69 (Appendix D), some red staining was observed on the northern part of landfill (Feature B). The native soil in the area of the sample location consisted of grey sand and gravel, largely covered with pink and grey igneous gravel, pebbles and stone and sparse vegetation (Photo 132). Standing water was present in the area of the soil sample and the shallow soils were wet.

The shallow sample at F3-4 (0-15 cm) exhibited elevated concentrations of metals. The concentrations of nickel (29.3 mg/kg), zinc (66.3 mg/kg), and chromium (71.6 mg/kg) exceeded their background concentrations. In addition, the concentration of copper (43.3 mg/kg), lead (10.1 mg/kg), arsenic (16.4 mg/kg) exceeded the background and baseline concentrations. Metal concentrations were observed in 2012 and 2014 at similar concentrations, although it is noted that lead and zinc concentrations in 2012 were higher (51 mg/kg and 103 mg/kg, respectively) than in 2015. No exceedances of the baseline concentrations plus 3σ were reported in 2015. No PHC or PCB were detected from the shallow sample at F3-4 in 2015.

The deep sample at F3-4 (40-50 cm) also exhibited elevated concentrations of metals, at similar concentrations to those in the shallow sample. The concentrations of copper (38.4 mg/kg), nickel (28.3 mg/kg), zinc (64.8 mg/kg), and chromium (70.4 mg/kg) exceeded their background concentrations. In addition, the concentration of arsenic (17.7 mg/kg) exceeded the background (11 mg/kg) and baseline (10 mg/kg) concentrations but was less than baseline concentration plus 3σ (22 mg/kg). Metal concentrations observed in 2015 were similar to or less than those observed in 2012 and 2014, although it is noted that lead and zinc concentrations in 2012 were higher (34 mg/kg and 110 mg/kg, respectively) than in 2015. No PHC or PCB were detected from the deep sample at F3-4 in 2015.

Collection of additional data should be considered to assess if the observed soil sampling results are related to the observed red staining of the landfill cover in the area of sample F3-4. It is recommended that iron be added to the analytical suite for this sample in 2016 to determine if this parameter is elevated.

F3-5

Sampling location F3-5 is located downgradient of the Lobe A of the landfill, approximately 12 m northwest of the toe of Lobe A. The estimated elevation of this sampling point is 511.5 masl. Photo 135 (Appendix D) illustrates the conditions in the area of the sample, which consist of weathered boulders surrounded by stony sand and gravel matrix covered with well-established vegetation. The soil in the area of the sample location (Photo 136) consisted of grey sand and gravel matrix.

A duplicate sample was collected at the shallow F3-5 (0-15 cm) sample location, and therefore the average concentrations are discussed relative to background and baseline values. The calculated RPD values indicated the original and duplicate sample results differ by less than 21% for all parameters.

The shallow samples at F3-5 (0-15 cm) exhibited elevated concentrations of metals. The average concentration of nickel (28 mg/kg), zinc (66 mg/kg), and chromium (72 mg/kg) exceeded their background concentrations.

In addition, the concentration of arsenic (13 mg/kg) exceeded the background (11 mg/kg) and baseline (10 mg/kg) concentrations but was less than baseline concentration plus 3σ (22 mg/kg). Metal concentrations observed in 2015 were less than those observed in 2014 and similar to those observed in 2012. No PHC or PCB were detected from the shallow samples at F3-5 in 2015.

The deep sample at F3-5 (40-50 cm) also exhibited elevated concentrations of metals, at slightly higher concentrations than those in the shallow sample. The concentrations of copper (38 mg/kg), nickel (29.5 mg/kg), zinc (61.8 mg/kg), and chromium (72.8 mg/kg) exceeded their background concentrations. In addition, the concentration of arsenic (15.3 mg/kg) exceeded the background (11 mg/kg) and baseline (10 mg/kg) concentrations but was less than baseline concentration plus 3σ (22 mg/kg). Elevated metal concentrations observed in 2012 and 2014 were at similar concentrations. No PHC or PCB were detected from the deep sample at F3-5 in 2015.

F3-6

Sampling location F3-6 is located downgradient of the Lobe A of the landfill, immediately northwest of the toe of the landfill. The estimated elevation of this sampling point is 511.5 masl. Photo 138 (Appendix D) illustrates the conditions in the area of the sample, which consist of weathered boulders surrounded by stony sand and gravel matrix covered with well-established vegetation. The soil in the area of the sample location consisted of grey sand and gravel matrix.

The shallow sample at F3-6 (0-15 cm) exhibited elevated concentrations of metals. The concentrations of copper (37.9 mg/kg), nickel (29.1 mg/kg), zinc (64 mg/kg) and chromium (67.5 mg/kg) exceeded their background concentrations. In addition, the concentration of arsenic (15.3 mg/kg) exceeded the background (11 mg/kg) and baseline (10 mg/kg) concentrations but was less than baseline concentration plus 3σ (22 mg/kg). Elevated metal concentrations were observed in 2012 and 2014 at similar concentrations. No PHC or PCB were detected from the shallow sample at F3-6 in 2015.

The deep sample at F3-6 (40-50 cm) also exhibited elevated concentrations of metals, at slightly higher concentrations than those in the shallow sample. The concentrations of nickel (30.1 mg/kg), zinc (64.5 mg/kg) and chromium (68.4 mg/kg) exceeded their background concentrations. In addition, the concentration of copper (44.7 mg/kg) and arsenic (16.3 mg/kg) exceeded their background and baseline concentrations. Most metal concentrations observed in 2015 were greater than those observed in 2012; a deep sample was not collected at this location in 2014. No exceedances of the baseline concentrations plus 3σ were reported in 2015. No PHC or PCB were detected from the deep sample at F3-6 in 2015.

F3-7

Sampling location F3-7 is located downgradient of Lobe A, approximately 10 m west of the landfill toe. The estimated elevation of this sampling point is 503.5 masl. Photograph 74 (Appendix D) illustrates the area of sample location F3-7. Photo 141 illustrates the conditions in the area of the sample, which consist of weathered boulders surrounded by stony sand and gravel matrix covered with well-established vegetation. The soil in the area of the sample location consisted of grey sand and gravel matrix.

The shallow sample at F3-7 (0-15 cm) exhibited elevated concentrations of metals. The concentrations of copper (34.6 mg/kg), nickel (28.3 mg/kg), zinc (60 mg/kg) and chromium (67.6 mg/kg) exceeded their background concentrations. In addition, the concentration of arsenic (13.5 mg/kg) exceeded the background (11 mg/kg) and baseline (10 mg/kg) concentrations but was less than baseline concentration plus 3σ (22 mg/kg). Metal concentrations observed in 2015 were less than those observed in 2014 but greater than those observed in 2012. No PHC or PCB were detected from the shallow sample at F3-7 in 2015. It is noted that a concentration of 1215 mg/kg TPH was reported for this location in 2014.

The deep sample at F3-7 (40-50 cm) also exhibited elevated concentrations of metals, at slightly higher concentrations than those in the shallow sample. The concentrations of nickel (30.4 mg/kg), zinc (64.9 mg/kg) and chromium (71.9 mg/kg) exceeded their background concentrations. In addition, the concentration of copper (40.1 mg/kg) and arsenic (17.5 mg/kg) exceeded their background and baseline concentrations. Most metal concentrations observed in 2015 were slightly higher than those observed in 2012 and 2014. No exceedances of the baseline concentrations plus 3σ were reported in 2015. No PHC or PCB were detected from the deep sample at F3-7 in 2015. It is noted that a concentration of 275 mg/kg TPH was reported for this location in 2014.

F3-9

Sampling location F3-9 is located downgradient of the Lobe E2 of the landfill, approximately 10 m west of the western toe of Lobe E2. The estimated elevation of this sampling point is 511.5 masl. As shown in Photograph 147 (Appendix D), the area is covered with gravel and stones with some vegetation. The soil in the area of the sample location consisted of grey sand and gravel matrix.

The shallow sample at F3-9 (0-15 cm) exhibited elevated concentrations of metals. The concentrations of copper (38.5 mg/kg), nickel (30.9 mg/kg), zinc (62.9 mg/kg) and chromium (74.5 mg/kg) exceeded their background concentrations. In addition, the concentration of arsenic (16.9 mg/kg) exceeded the background (11 mg/kg) and baseline (10 mg/kg) concentrations but was less than baseline concentration plus 3σ (22 mg/kg). Elevated metal concentrations were observed in 2012 and 2014 at similar concentrations. No PHC or PCB were detected from the shallow sample at F3-9 in 2015.

The deep sample at F3-9 (40-50 cm) also exhibited elevated concentrations of metals, at slightly lower concentrations than those in the shallow sample. The concentrations of copper (36.4 mg/kg) and nickel (28.8 exceeded their background concentrations (32 mg/kg and 27 mg/kg, respectively). In addition, the concentration of arsenic (14.2 mg/kg) exceeded the background (11 mg/kg) and baseline (10 mg/kg) concentrations but was less than baseline concentration plus 3σ (22 mg/kg). Most metal concentrations observed in 2015 were slightly lower than those observed in 2012 and 2014. No PHC or PCB were detected from the deep sample at F3-9 in 2015.

F3-11

Sampling location F3-11 is located downgradient of the Lobe F of the landfill, approximately 6 m south of the toe of the landfill. The estimated elevation of this sampling point is 502.5 masl. As shown in Photograph 120 (Appendix D), the area is covered with boulders, gravel and stones and the sandier areas are covered with well-established vegetation. The soil in the area of the sample location consisted of grey-brown sand and gravel matrix.

The shallow sample at F3-11 (0-15 cm) exhibited elevated concentrations of metals. The concentrations of copper (39 mg/kg), nickel (30.8 mg/kg), zinc (60.4 mg/kg) and chromium (68.3 mg/kg) exceeded their background concentrations. In addition, the concentration of arsenic (18.1 mg/kg) exceeded the background (11 mg/kg) and baseline (10 mg/kg) concentrations but was less than baseline concentration plus 3σ (22 mg/kg).

Metal concentrations observed in 2015 were less than those observed in 2014 and similar to those observed in 2012. No PHC or PCB were detected from the shallow sample at F3-11 in 2015.

The deep sample at F3-11 (40-50 cm) also exhibited elevated concentrations of metals, at slightly higher concentrations than those in the shallow sample. The concentrations of zinc (64.8 mg/kg) and chromium (73 mg/kg) exceeded their background concentrations (59 mg/kg and 67 mg/kg, respectively). In addition, the concentration of copper (39.9 mg/kg), nickel (32.7 mg/kg) and arsenic (18.7 mg/kg) exceeded their background and baseline concentrations. Most metal concentrations observed in 2015 were slightly lower than those observed in 2012 and 2014. No exceedances of the baseline concentrations plus 3σ were reported in 2015. No PHC or PCB were detected from the deep sample at F3-11 in 2015.

F3-12

Sampling location F3-12 is located downgradient of the Lobe F, approximately 8 m west of the western toe of the landfill. The estimated elevation of this sampling point is 502 masl. As shown in Photograph 123 (Appendix D), the area is covered with boulders, gravel and stones and the sandier areas are covered with well-established vegetation. The soil in the area of the sample location consisted of light grey sand and gravel.

A duplicate sample was collected at the shallow F3-12 (0-15 cm) sample location, and therefore the average concentrations are discussed relative to background and baseline values. The calculated RPD values indicated the original and duplicate sample results differ by less than 25% for all parameters.

The shallow samples at F3-12 (0-15 cm) exhibited elevated concentrations of metals. The average concentrations of copper (39 mg/kg), zinc (69 mg/kg) and chromium (76 mg/kg) exceeded their background concentrations. In addition, the average concentrations of nickel (34 mg/kg) and arsenic (16 mg/kg) exceeded their background and baseline concentrations. Metal concentrations observed in 2015 were less than or similar to those observed in 2014 and 2012. No exceedances of the baseline concentrations plus 3σ were reported in 2015. No PHC or PCB were detected from the shallow samples at F3-12 in 2015.

The deep sample at F3-12 (40-50 cm) also exhibited elevated concentrations of metals, at similar concentrations to those in the shallow sample. The concentrations of zinc (65.3 mg/kg) and chromium (75.7 mg/kg) exceeded their background concentrations (59 mg/kg and 67 mg/kg, respectively). In addition, the concentration of nickel (33.5 mg/kg), copper (43.9 mg/kg) and arsenic (18.1 mg/kg) exceeded their background and baseline concentrations. Most metal concentrations observed in 2015 were lower than those observed in 2014 but higher than those observed in 2012. No exceedances of the baseline concentrations plus 3σ were reported in 2015. No PHC or PCB were detected from the deep sample at F3-12 in 2015.

Table 4-4: Soil Chemical Analysis Results - Station West Landfill

ID	Depth (cm)	Cu (mg/kg)	Ni (mg/kg)	Co (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Zn (mg/kg)	Cr (mg/kg)	As (mg/kg)	Hg (mg/kg)	Total PCB (mg/kg)	F1 (mg/kg)	F2 (mg/kg)	F3 (mg/kg)	F4 (mg/kg)
Background Mean		32	27	32	1.0	10	59	67	11	0.10	0.003	NA	NA	NA	NA
Baseline Mean		**40**	**31**	**13**	**1.0**	**10**	**71**	**77**	**10**	**0.10**	**0.10**	**10**	**4.0**	**9.0**	**NA**
Baseline + 3σ		62	43	18	1.0	21	117	104	22	0.10	0.19	10	9.5	19	NA
Upgradient															
F3-8 (0-15)	(0-15)	38.9	28.8	9.6	<0.5	9.4	64.8	70.1	**13.6**	<0.1	<0.05	<7	<4	<8	<6
F3-8 (40-50)	(40-50)	39.3	28.2	9.7	<0.5	8.9	64.9	68.1	**12**	<0.1	<0.05	<7	<4	<8	7
F3-10 (0-15)	(0-15)	31.7	25.9	9.1	<0.5	7.4	55.5	63.2	**11.3**	<0.1	<0.05	<7	<4	<8	<6
F3-10 (40-50)	(40-50)	26.2	25.6	9.1	<0.5	7	56.2	63.1	9.7	<0.1	<0.05	<7	<4	<8	<6
F3-10 (40-50) (Duplicate)	(40-50)	30	29	9.9	<0.5	6	70	69	10	<0.10	<0.1	<5	<4	<8	<6
F3-10 (40-50) (Dup Avg)	(40-50)	28	27	9.5	<0.5	7	63	66	10	<0.1	<0.1	<6	<4	<8	<6
Downgradient															
F3-4 (0-15)	(0-15)	**43.3**	29.3	10	<0.5	**10.1**	66.3	71.6	**16.4**	<0.1	<0.05	<7	<4	<8	<6
F3-4 (40-50)	(40-50)	38.4	28.3	9.8	<0.5	9.3	64.8	70.4	**17.7**	<0.1	<0.05	<7	<4	<8	<6
F3-5 (0-15)	(0-15)	29.3	27.3	9.4	<0.5	7.4	59.6	70.7	**13.2**	<0.1	<0.05	<7	<4	<8	<6
F3-5 (0-15) (Duplicate)	(0-15)	29	29	9.3	<0.5	6	72	73	**13**	<0.10	<0.1	<5	<4	<8	<6

Table 4-4: Soil Chemical Analysis Results - Station West Landfill

ID	Depth (cm)	Cu (mg/kg)	Ni (mg/kg)	Co (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Zn (mg/kg)	Cr (mg/kg)	As (mg/kg)	Hg (mg/kg)	Total PCB (mg/kg)	F1 (mg/kg)	F2 (mg/kg)	F3 (mg/kg)	F4 (mg/kg)
Background Mean		32	27	32	1.0	10	59	67	11	0.10	0.003	NA	NA	NA	NA
Baseline Mean		**40**	**31**	**13**	**1.0**	**10**	**71**	**77**	**10**	**0.10**	**0.10**	**10**	**4.0**	**9.0**	**NA**
Baseline + 3σ		62	43	18	1.0	21	117	104	22	0.10	0.19	10	9.5	19	NA
F3-5 (0-15) (Dup Avg)	(0-15)	29	28	9.4	<0.5	7	66	72	**13**	<0.1	<0.1	<6	<4	<8	<6
F3-5 (40-50)	(40-50)	38	29.5	10.3	<0.5	8.9	61.8	72.8	**15.3**	<0.1	<0.05	<7	<4	<8	<6
F3-6 (0-15)	(0-15)	37.9	29.1	9.8	<0.5	8.9	64	67.5	**15.3**	<0.1	<0.05	<7	<4	<8	<6
F3-6 (40-50)	(40-50)	**44.7**	30.1	10	<0.5	9.3	64.5	68.4	**16.3**	<0.1	<0.05	<7	<4	<8	<6
F3-7 (0-15)	(0-15)	34.6	28.3	9.5	<0.5	8.5	60	67.6	**13.5**	<0.1	<0.05	<7	<4	<8	<6
F3-7 (40-50)	(40-50)	**40.1**	30.4	10.4	<0.5	8.8	64.9	71.9	**17.5**	<0.1	<0.05	<7	<4	<8	<6
F3-9 (0-15)	(0-15)	38.5	30.9	10.9	<0.5	8.4	62.9	74.5	**16.9**	<0.1	<0.05	<7	<4	<8	<6
F3-9 (40-50)	(40-50)	36.4	28.8	10.1	<0.5	8.2	58.1	64.5	**14.2**	<0.1	<0.05	<7	<4	<8	<6
F3-11 (0-15)	(0-15)	39	30.8	10.5	<0.5	8.8	60.4	68.3	**18.1**	<0.1	<0.05	<7	<4	<8	<6
F3-11 (40-50)	(40-50)	**39.9**	**32.7**	10.9	<0.5	8.5	64.8	73	**18.7**	<0.1	<0.05	<7	<4	<8	<6
F3-12 (0-15)	(0-15)	39.5	**32.1**	10.7	<0.5	9	63	73.4	**15.9**	<0.1	<0.05	<7	<4	<8	<6

Table 4-4: Soil Chemical Analysis Results - Station West Landfill

ID	Depth (cm)	Cu (mg/kg)	Ni (mg/kg)	Co (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Zn (mg/kg)	Cr (mg/kg)	As (mg/kg)	Hg (mg/kg)	Total PCB (mg/kg)	F1 (mg/kg)	F2 (mg/kg)	F3 (mg/kg)	F4 (mg/kg)
Background Mean		32	27	32	1.0	10	59	67	11	0.10	0.003	NA	NA	NA	NA
Baseline Mean		**40**	**31**	**13**	**1.0**	**10**	**71**	**77**	**10**	**0.10**	**0.10**	**10**	**4.0**	**9.0**	**NA**
Baseline + 3σ		62	43	18	1.0	21	117	104	22	0.10	0.19	10	9.5	19	NA
F3-12 (0-15) (Duplicate)	(0-15)	39	**35**	11.7	<0.5	7	**75**	**78**	**16**	<0.10	<0.1	<5	<4	<8	<6
F3-12 (0-15) (Dup Avg)	(0-15)	39	**34**	11.2	<0.5	8	69	76	**16**	<0.1	<0.1	<6	<4	<8	<8
F3-12 (40-50)	(40-50)	**43.9**	**33.5**	10.9	<0.5	9.1	65.3	75.7	**18.1**	<0.1	<0.05	<7	<4	<8	<6

Notes:

NA: Not available

Underlined values: Results exceed Background arithmetic mean.

Bold Values: Results exceed Baseline arithmetic mean.

4.1.5 Conclusions and Overall Performance of the Station West Landfill

Based on the visual inspection, there does not appear to be any significant erosion, settlement, exposed waste or indications of instability at the Station West Landfill. There was some shallow ponding of water on the cover surface and ponded/running water along the toe of the landfill. Red staining was observed on the cover surface in the northeastern corner of Lobe A and some black staining (previously reported as seepage) was observed on the south slope of Lobe F. Previously observed minor erosion appears to be self-armouring and has not deteriorated since the last inspection. No exposed waste materials were observed.

Soil samples were collected at all designated locations in 2015; two soil samples (shallow and deep) were collected at all of the locations. Concentrations of copper, nickel, lead zinc, chromium and arsenic were detected above the background/baseline arithmetic mean. Most metal concentrations were highest at F3-4, F3-6 and F3-7, located along the northern toe of Lobe A of the landfill. The red staining was observed near sampling location F3-4. In some cases, the 2015 concentrations were slightly higher than in earlier years (e.g., many parameters in the deep samples at F3-6 and F3-7); however in most cases they were similar to or lower than previous monitoring results. No detectable concentrations of PHC or Total PCB were noted in any of the samples in 2015.

Whereas a number of the environmental sampling results are the same or less than in the two previous sampling sessions, elevated parameters and increases in some cases (i.e., deep samples from F3-6 and F3-7) may be reflective of an ongoing impact from the landfill, however insufficient data is available to determine this.

4.1.6 Recommendations for Station West Landfill

Collection of additional data should be considered to assess if the F3-4 soil sampling results are related to the observed red staining of the landfill cover. It is also recommended that iron be added to the analytical suite for this sample in 2016 to determine if this parameter is elevated. No other modifications to the ongoing monitoring program at this landfill are recommended.

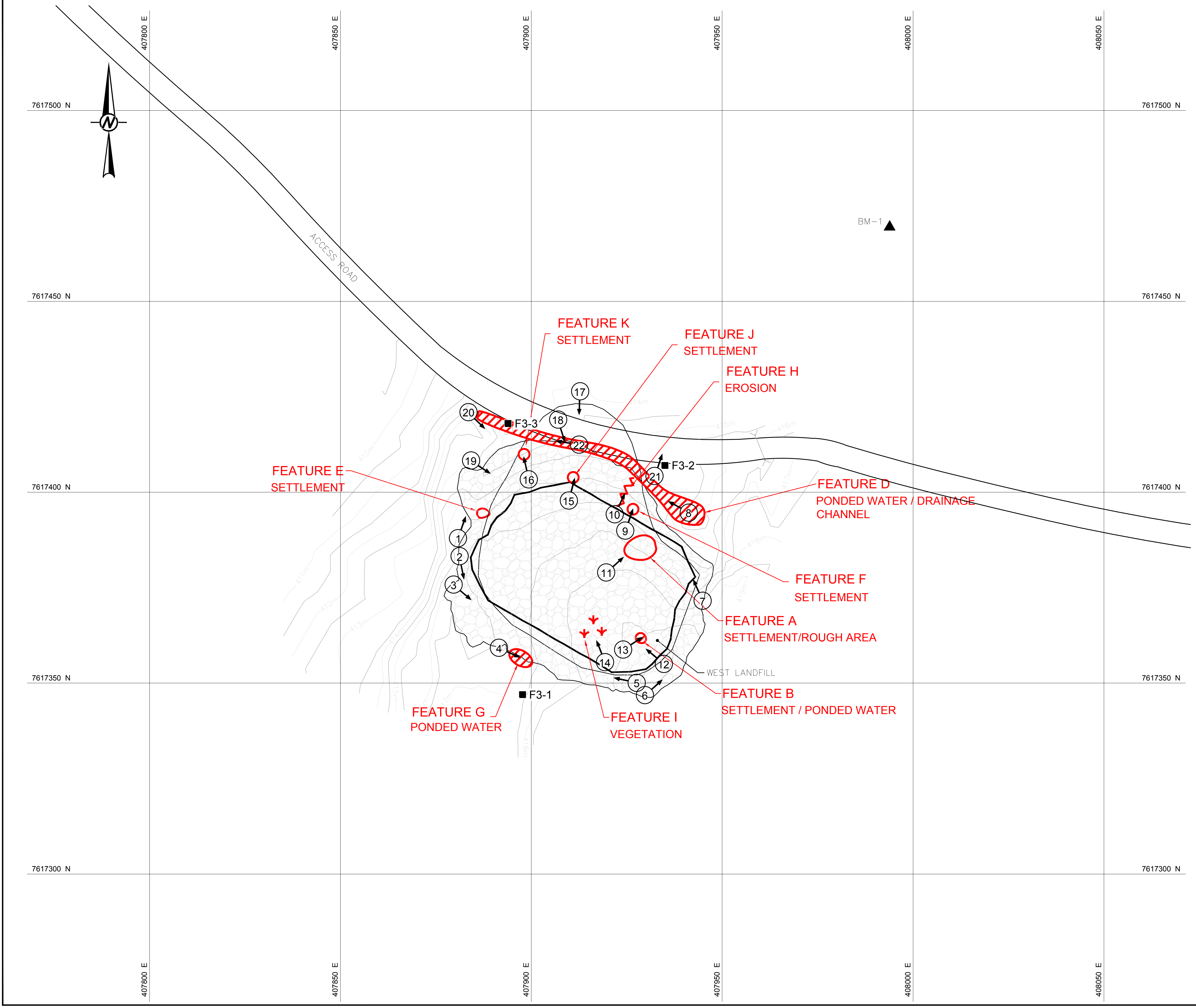
There does not appear to be buried waste under the previously observed geotextile (Feature I) located beyond the northeast toe of Lobe E2 at the Station West Landfill therefore it could be cut and removed in the future, if desired.

4.2 West Landfill

4.2.1 Landfill Description

The West Landfill is located approximately 1.3 km west of the station, and 0.5 km beyond the DEW Line Reserve boundary, in a former granular borrow area. There is an old access road leading to the area from the north end of the module train. The terrain in the vicinity of the landfill slopes to the northwest, from an elevation of 419 masl immediately east of the landfill, to an elevation of 411 masl to the west. Based on satellite imagery, this area appears to drain to adjacent small surface water channels, leading to a linear water body located approximately 2 km to the southwest.

The West Landfill is a regraded landfill extending over an area of approximately 3,350 m^2 (including sideslopes). The long term monitoring plan consists of visual inspection, and the periodic collection of soil samples. Approximate locations for the collection of soil samples are identified in Figure FOX-3.3.



LEGEND

▲ PERMANENT BENCHMARK LOCATION
■ SOIL SAMPLING LOCATION (2015)
○ SETTLEMENT (NTS)
⑪ PHOTOGRAPH VIEWPOINT LOCATION
▨ PONDED WATER (NTS)
〰 EROSION (NTS)
✢ VEGETATION (NTS)
TYPE 1 GRANULAR A

NOTES

GRID PROJECTION IS NAD83 ZONE 19N.
ELEVATIONS ARE GEODETIC.

REFERENCE

PREVIOUS INSPECTION FIGURE PROVIDED BY BIOGENIE, A DIVISION OF ENGLOBE CORPORATION, PROJECT NO.CD2655_400_403, DATED JUNE 2015.

0 25 50
1:1,000 METRES

CLIENT
DEPARTMENT OF NATIONAL DEFENCE CANADA

PROJECT
2015 FOX-3 MONITORING REPORT

TITLE
WEST LANDFILL

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-03-24
DESIGNED	RM
PREPARED	TDR
REVIEWED	DCJ
APPROVED	DP

PROJECT NO.	PHASE	REV.	FIGURE
1530908	1000	B	FOX-3.3

Path: \\golder.gds\gal\Mississauga\SIM\Clients\Public_Works_Canada\Canada\99_PROJ\1530908_PWGSC_Dew_Line_Mon_Program_2015_2018\40_PROD\0004_Fox_3_Field_Summary_Report\ | File Name: 15309080004-CM-0009.dwg

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25 mm

4.2.2 Summary of any Scope Deviations

The field work was conducted as per the TOR. There were no notable exceptions to the scope of work.

4.2.3 Visual Inspection

The West Landfill has some observed minor settlement, erosion and ponded water features. No cracking or exposed waste was observed. Table 4-5 presents a summary of observed visual inspection features and Table 4-6 presents the Preliminary Stability Assessment results. This landfill was assessed to have an “Acceptable” overall landfill performance because all observed features were assessed as “Acceptable”. Table 4-7 is a log of photographs taken during the 2015 visual inspection.

There were three previously observed areas of minor settlement (Features A, E and F) and two new observed areas of minor settlement (Features J and K). The observed settlement is all shallow and may be related to construction rather than landfill performance or permafrost thaw. These minor settlement areas are not considered a concern.

Ponded and running water was observed to extend along the entire north toe (Feature D). There was a small pond of water at the south toe (new Feature G). A small, shallow depression on the landfill cover surface that was previously reported as settlement was filled with water during the 2015 inspection (Feature B).

There was some minor self-armouring erosion on the north slope (new Feature H) that is not considered a concern.

Moss and sparse grass vegetation is becoming established in the southeast corner of the cover surface (new Feature I).

Table 4-5: Visual Inspection Checklist - West Landfill

SITE NAME: FOX-3 Dewar Lakes
LANDFILL DESIGNATION: West Landfill
DATE OF INSPECTION: August 17, 2015
DATE OF PREVIOUS INSPECTION: August 23, 2013
INSPECTED BY: Reza Moghaddam
REPORT PREPARED BY: Reza Moghaddam
MONITORING EVENT NUMBER: 3
The inspector/reporter represents to the best of his/her knowledge that the following statements and observations are true and correct and to the best of the preparer's actual knowledge, no material facts have been suppressed or misstated.

Table 4-5: Visual Inspection Checklist - West Landfill

Checklist Item	Present (Y/N)	Feature ID (A, B, etc.)	Location Description	Easting	Northing	Length (m)	Width (m)	Depth (m)	Extent of Landfill Area (%)	Description	Comparison to Historical Observations	Photos
Settlement	Y	E	West slope	407881	7617388	3	3	0.1	0.27%	Minor settlement (Acceptable)	-New observation	1
		F	North slope	407925	7617391	3	2	0.2	0.18%	Minor settlement (Acceptable)	New observation	9
		A	Cover surface	407920	7617379	3	3	0.1	0.27%	Minor settlement and rough area (Acceptable)	Previously observed: Unchanged since previous inspection	11
		J	North slope	407910	7617398	1	0.5	0.1	0.01%	Minor settlement (Acceptable)	New observation	15
		K	Northwest slope	407899	7617403	1	0.5	0.1	0.01%	Minor settlement (Acceptable)	New observation	16
Erosion	Y	H	North slope	407922	7617394	10	1	0.1	0.30%	minor self-armouring erosion (Acceptable)	New observation	10
Lateral Movement	N											
Frost Action	N											
Sloughing	N											
Cracking	N											
Animal Burrows	N											
Vegetation	Y	I	Crest surface	407919	7617355	20	20	-	11.94%	Moss and sparse vegetation (Acceptable)	New observation	14

Table 4-5: Visual Inspection Checklist - West Landfill

Checklist Item	Present (Y/N)	Feature ID (A, B, etc.)	Location Description	Easting	Northing	Length (m)	Width (m)	Depth (m)	Extent of Landfill Area (%)	Description	Comparison to Historical Observations	Photos
Staining	N											
Vegetation Stress	N											
Seepage or Ponded Water	Y	G	South toe	407891	7617359	10	2	0.2	0.60%	Ponded water (Acceptable)	New	4
		B	Cover surface	407924	7617359	1	1	0.1	0.03%	Ponded water. (Acceptable)	Previously reported as settlement.	13
		D	North toe, east end	407941	7617395	50	3	0.2	4.48%	Ponded water at toe (Acceptable)	Previously observed. Extends across full north toe.	8
			North toe along road	407907	7617419					Drainage channel along road (Acceptable)		18
				407884	7617421					Running water along toe (Acceptable)		20-22
Debris and/or Liner Exposed	N											
Presence / Condition of Monitoring Instruments	N											
Features of Note/Other Observations	N											

Landfill Area = 3,350 m^2.

Table 4-6: Preliminary Stability Assessment - West Landfill

Feature	Severity Rating	Extent
Settlement	Acceptable	Occasional
Erosion	Acceptable	Isolated
Lateral Movement	Acceptable	-
Frost Action	Acceptable	-
Sloughing	Acceptable	-
Cracking	Acceptable	-
Animal Burrows	Acceptable	-
Vegetation establishment	Acceptable	Isolated
Staining	Acceptable	-
Vegetation Stress	Acceptable	-
Seepage/Ponded Water	Acceptable	Occasional
Debris and/or liner exposure	Acceptable	-
Other	-	-
Overall Landfill Performance	**Acceptable**	

Table 4-7: Summary Table of Photographic Log - West Landfill

Photo	Description (file name)	Easting	Northing	Date
1	West Landfill – West crest and slope, looking north, previously reported settlement (Feature E) (ATT8_Photo1.jpg)	407880.7715	7617387.932	17-Aug-15
2	West Landfill – West crest and slope looking south (ATT7_Photo1.jpg)	407880.4093	7617387.666	17-Aug-15
3	West Landfill – South crest and slope, looking east from southwest corner (ATT9_Photo1.jpg)	407879.6251	7617375.774	17-Aug-15
4	West Landfill – Feature G, ponded water at south toe (ATT10_Photo1.jpg)	407891.4961	7617359.23	17-Aug-15
5	West Landfill – South crest and slope, looking west (ATT11_Photo1.jpg)	407927.5996	7617350.069	17-Aug-15
6	West Landfill – East slope and toe, looking north (ATT12_Photo1.jpg)	407929.7643	7617346.846	17-Aug-15
7	West Landfill – North slope, looking west (ATT13_Photo1.jpg)	407944.8773	7617371.545	17-Aug-15
8	West Landfill – Feature D, ponded water at north toe, looking west (ATT14_Photo1.jpg)	407941.2087	7617394.63	17-Aug-15

Table 4-7: Summary Table of Photographic Log - West Landfill

Photo	Description (file name)	Easting	Northing	Date
9	West Landfill – Feature F, previously observed settlement on north slope (ATT15_Photo1.jpg)	407925.0399	7617390.911	17-Aug-15
10	West Landfill – Feature H, minor self-armouring erosion channel on north slope, looking north (ATT18_Photo1.jpg)	407921.8278	7617394.21	17-Aug-15
11	West Landfill – Feature A, minor settlement and rough area on the cover surface (ATT19_Photo1.jpg)	407919.5915	7617378.949	17-Aug-15
12	West Landfill – Cover surface overview, looking west from east crest (ATT20_Photo1.jpg) (ATT21_Photo2.jpg)	407934.6867	7617355.015	17-Aug-15
13	West Landfill – Feature B, ponded water, previously reported as settlement, 1 x 1 m (ATT22_Photo1.jpg)	407924.0386	7617358.793	17-Aug-15
14	West Landfill – Feature I, sparse vegetation (ATT23_Photo1.jpg)	407919.3152	7617355.47	17-Aug-15
15	West Landfill – Feature J, minor settlement on north slope (ATT25_Photo2.jpg)	407909.7973	7617397.797	17-Aug-15
16	West Landfill – Feature K, minor settlement on northwest slope (ATT26_Photo1.jpg)	407899.3296	7617403.334	17-Aug-15
17	West Landfill – north slope and toe overview, looking south (ATT27_Photo1.jpg) (ATT28_Photo2.jpg)	407912.763	7617426.402	17-Aug-15
18	West Landfill – Feature D, ponded water and drainage channel along access road (ATT29_Photo1.jpg)	407907.0358	7617419.007	17-Aug-15
19	West Landfill – North slope and crest, looking east from northwest corner (ATT6_Photo1.jpg)	407884.1919	7617408.282	17-Aug-15
20	West Landfill – Feature D, running water along the north toe and road, looking east (ATT5_Photo1.jpg)	407883.5209	7617420.953	17-Aug-15
21	West Landfill – Feature D, running water along the north toe and road, looking west (ATT3_Photo1.jpg)	407933.6552	7617406.067	17-Aug-15
22	West Landfill – Feature D, running water along the north toe and road, looking west (ATT4_Photo1.jpg)	407912.461	7617412.434	17-Aug-15

4.2.4 Soil Sampling

Table 4-8 presents a summary of analytical results for soil samples collected at the West Landfill. Sample location F3-1 represents an upgradient sampling location, whereas locations F3-2 and F3-3 represent downgradient sampling locations.

F3-1

Sampling location F3-1 is located approximately 10 m south of the toe of the landfill. The estimated elevation of this sampling point is 417.5 masl. As shown in Photo 4 (Appendix D), some ponding of water was observed near the toe of the landfill in this area, however not in the area of the soil sample (Photo 114). The soil in the area of the sample location consisted of sand, gravel and stone. The soil in the test hole consisted of brown sand matrix.

In the shallow sample at F3-1 (0-15 cm), the concentration of arsenic (12 mg/kg) exceeded the background (11 mg/kg) and baseline (8.7 mg/kg) concentrations but was less than baseline concentration plus 3σ (16 mg/kg). Concentrations of arsenic were observed in 2012 (11 mg/kg) and 2014 (10 mg/kg) at similar concentrations. The concentrations of most other metals, including copper (24.2 mg/kg), nickel (19.3 mg/kg) and chromium (49.1 mg/kg), were lower than the concentrations reported in 2012 (28 mg/kg, 25 mg/kg and 62 mg/kg, respectively) and 2014 (30 mg/kg, 39 mg/kg and 86 mg/kg, respectively). No PHC or PCB were detected from the shallow sample at F3-1 in 2015.

In the deep sample at F3-1 (40-50 cm), the concentration of copper (24.9 mg/kg) exceeded the baseline concentration (24 mg/kg) but was less the background concentration (32 mg/kg). The concentration of copper was similar to the concentration reported in 2014 (24 mg/kg) but less than the concentration reported in 2012 (37 mg/kg). In addition, the concentration of arsenic (12.3 mg/kg) exceeded the background (11 mg/kg) and baseline (8.7 mg/kg) concentrations. The concentration of arsenic was greater than the concentration reported in 2014 (6 mg/kg) but less that the concentration reported in 2012 (14 mg/kg). The concentrations of most other metals, including copper, zinc and chromium were lower than the concentrations reported in 2012 and 2014. No exceedances of the baseline concentrations plus 3σ were reported in 2015. No PHC or PCB were detected from the deep sample at F3-1 in 2015.

F3-2

Sampling location F3-2 is located downgradient of the landfill, approximately 8 m northeast of the toe of the landfill. The estimated elevation of this sampling point is 414.5 masl. Photos 21 and 22 (Appendix D) illustrate the area of the sample and the drainage channel that runs along the northern toe of the landfill. The soil in the area of the sample location consisted of brown sand matrix with pink to grey igneous gravel, pebbles and stone. The excavation contained water soon after the hole was completed.

The shallow sample at F3-2 (0-15 cm) exhibited elevated concentrations of metals. The concentrations of nickel (22.7 mg/kg), zinc (49.3 mg/kg), chromium (57.1 mg/kg) and arsenic (9.7 mg/kg) exceeded their baseline concentrations but were less than their background concentrations. The concentration of most metals, including nickel, zinc and chromium, were less than concentrations observed in 2012 and 2014. No exceedances of the baseline concentrations plus 3σ were reported in 2015. No PHC or PCB were detected from the shallow sample at F3-2 in 2015.

In the deep sample at F3-2 (40-50 cm), the concentration of arsenic (9.6 mg/kg) exceeded the baseline concentration (8.7 mg/kg) but was less than the background concentration (11 mg/kg). The concentration of arsenic was lower than the concentration reported in 2012 (14 mg/kg). The concentration of all other metals, including copper (17.6 mg/kg) and nickel (19.6 mg/kg), were lower than the concentrations reported in 2012 (39 mg/kg and 25 mg/kg, respectively). No exceedances of the baseline concentrations plus 3σ were reported in 2015. No PHC or PCB were detected from the deep sample at F3-2 in 2015.

F3-3

Sampling location F3-3 is located downgradient of the landfill, approximately 6 m north of the toe of the landfill. The estimated elevation of this sampling point is 412.5 masl. Photo 22 (Appendix D) illustrates the area of the sample and the drainage channel that runs along the northern toe of the landfill. The soil in the area of the sample location consisted of brown sand, gravel and stone.

In the shallow sample at F3-3 (0-15 cm), the concentration of nickel (20.2 mg/kg) exceeded the baseline concentration (20 mg/kg) but was less than the background concentration (27 mg/kg). The concentration of nickel was greater than the concentration reported in 2012 (16 mg/kg). In addition, the concentration of arsenic (13.1 mg/kg) exceeded the background (11 mg/kg) and baseline (8.7 mg/kg) concentrations. The concentration of arsenic was greater than the concentration reported in 2012 (5.1 mg/kg); no sample was collected at this location in 2014. The concentration of most other metals were greater than the concentrations reported in 2012. No exceedances of the baseline concentrations plus 3σ were reported in 2015. No PHC or PCB were detected from the shallow sample at F3-3 in 2015.

The deep sample at F3-3 (40-50 cm) exhibited elevated concentrations of metals, most at slightly higher concentrations than those in the shallow sample. The concentrations of copper (29.9 mg/kg), nickel (20.9 mg/kg) and zinc (53.2 mg/kg) exceeded their baseline concentrations but were less than their background concentrations. In addition, the concentration of arsenic (12.2 mg/kg) exceeded the background (11 mg/kg) and baseline (8.7 mg/kg) concentrations. Elevated metal concentrations were observed in 2012 at similar concentrations, although the 2015 arsenic concentration was slightly higher. No exceedances of the baseline concentrations plus 3σ were reported in 2015. No PHC or PCB were detected from the deep sample at F3-3 in 2015.

Table 4-8: Soil Chemical Analysis Results - West Landfill

ID	Depth (cm)	Cu (mg/kg)	Ni (mg/kg)	Co (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Zn (mg/kg)	Cr (mg/kg)	As (mg/kg)	Hg (mg/kg)	Total PCB (mg/kg)	F1 (mg/kg)	F2 (mg/kg)	F3 (mg/kg)	F4 (mg/kg)
Background Mean		32	27	32	1.0	10	59	67	11	0.50	0.0003	NA	NA	NA	NA
Baseline Mean		**24**	**20**	**9.0**	**1.0**	**10**	**49**	**55**	**8.7**	**0.10**	**0.10**	**0.0**	**0**	**0**	**NA**
Baseline + 3σ		39	33	15	1.0	15	77	88	16	0.10	0.13	0	0	0	NA
Upgradient															
F3-1 (0-15)	(0-15)	24.2	19.3	6.7	<0.5	7.2	42.8	49.1	**12**	<0.1	<0.05	<7	<4	<8	<6
F3-1 (40-50)	(40-50)	**24.9**	17.4	6.2	<0.5	7.3	39.5	45.7	**12.3**	<0.1	<0.05	<7	<4	<8	<6
Downgradient															
F3-2 (0-15)	(0-15)	19.1	**22.7**	7.6	<0.5	5.3	**49.3**	**57.1**	**9.7**	<0.1	<0.05	<7	<4	<8	<6
F3-2 (40-50)	(40-50)	17.6	19.6	6.5	<0.5	4.7	42.7	49.3	**9.8**	<0.1	<0.05	<7	<4	<8	<6
F3-3 (0-15)	(0-15)	22.4	**20.2**	7	<0.5	7	45.8	49.8	**13.1**	<0.1	<0.05	<7	<4	<8	<6
F3-3 (40-50)	(40-50)	**29.9**	**20.9**	7.9	<0.5	9.5	**53.2**	54.6	**12.2**	<0.1	<0.05	<7	<4	<8	<6

Notes:

NA: Not available

Underlined values: Results exceed Background arithmetic mean.

Bold Values: Results exceed Baseline arithmetic mean.

4.2.5 Conclusions and Overall Performance of the West Landfill

Based on the visual inspection, there does not appear to be any significant erosion, settlement, exposed waste or indications of instability at the West Landfill. There was some minor self-armouring erosion on the north slope that is not considered a concern. Running water along the north toe and a small pond of water at the south toe do not appear to be impacting landfill stability. Previously observed areas of shallow settlement may be related to construction rather than landfill performance or permafrost thaw and are not considered a concern.

Soil samples were collected at all designated locations in 2015; two soil samples (shallow and deep) were collected at all of the locations. Concentrations of copper, nickel, zinc, chromium and arsenic were detected above the background/baseline arithmetic mean. Most metal concentrations were highest at F3-3 (deep sample), located near the northern toe of the landfill. In some cases the 2015 concentrations were slightly lower than in earlier years (e.g., many parameters at F3-1 and F3-2), and in other cases they were higher (e.g., shallow sample from F3-3). Ponding of water was observed along the northern and southern toes of the landfill; however, no staining was observed in these areas. No detectable concentrations of PHC or Total PCB were noted in any of the samples in 2015.

Given that a number of the environmental sampling results are the same or less than in the two previous sampling sessions, there is no evident impact of the landfill on soil quality. Higher concentrations at the downgradient location could, however be reflective of this location relative to the landfill.

4.2.6 Recommendations for West Landfill

No modifications to the ongoing monitoring program at this landfill are recommended.

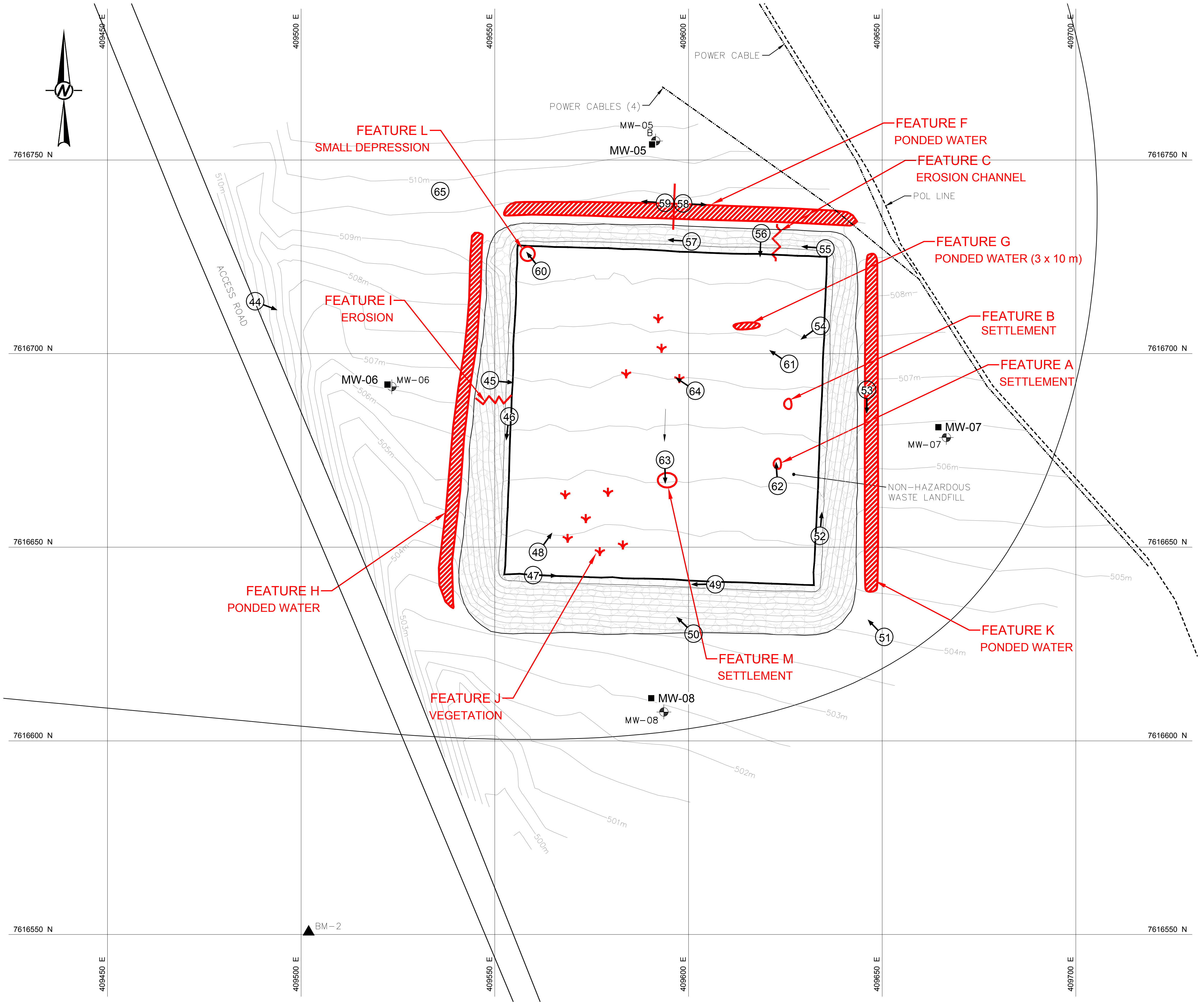
4.3 Non-Hazardous Waste Landfill

4.3.1 Landfill Description

The Non-Hazardous Waste Landfill is located approximately 400m southeast of the station, on the east side of the main access road. The terrain in the vicinity of the landfill slopes to the northwest, from an elevation of 509.5 masl immediately north of the landfill, to an elevation of 503 masl to the south. Based on satellite imagery, this area appears to drain towards the MacBeth River, located approximately 4.8 km to the east.

The design of this landfill included perimeter berms and the placement of a compacted granular fill cover over the landfilled material. This landfill covers an area approximately 10,200 m^2 (including sideslopes). Four groundwater monitoring wells MW-05 through MW-08 are installed around the perimeter of the landfill, to the north, west, east and south.

The long term monitoring plan for this landfill consists of visual monitoring and the periodic collection of soil and groundwater samples. The approximate locations for the collection of soil and groundwater samples are identified on Figure FOX-3.4.



LEGEND

- ⊕ MONITORING WELL LOCATION
- ▲ PERMANENT BENCHMARK LOCATION
- ■ SOIL SAMPLING LOCATION (2015)
- ▨ PONDING (NTS)
- ○ SETTLEMENT (NTS)
- 〰 EROSION (NTS)
- ✢ VEGETATION
- ① ► PHOTOGRAPH VIEWPOINT LOCATION
- ░ TYPE 1 GRANULAR A

NOTES

GRID PROJECTION IS NAD83 ZONE 19N.
ELEVATIONS ARE GEODETIC.

REFERENCE

PREVIOUS INSPECTION FIGURE PROVIDED BY BIOGENIE, A DIVISION OF ENGLOBE CORPORATION, PROJECT NO.CD2655_400_403, DATED JUNE 2015.

0 25 50
1:1,000 METRES

CLIENT
DEPARTMENT OF NATIONAL DEFENCE CANADA

PROJECT
2015 FOX-3 MONITORING REPORT

TITLE
NON-HAZARDOUS WASTE LANDFILL

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-03-24
DESIGNED	RM
PREPARED	TDR
REVIEWED	DCJ
APPROVED	DP

PROJECT NO.	PHASE	REV.	FIGURE
1530908	1000	B	FOX-3.4

Path: \\golder.gds\gal\Mississauga\SIM\Clients\Public_Works_Canada\Canada\99_PROJ\1530908_PWGSC_Dew_Line_Mon_Program_2015_2018\40_PROD\0004_Fox_3_Field_Summary_Report\ | File Name: 15309080004-CM-0010.dwg

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
25 mm
0

4.3.2 Summary of any Scope Deviations

The field work was conducted as per the TOR with the following exceptions:

- The groundwater sampling field sheet for MW-05 was lost in transport and therefore the water level was not reported in 2015.

4.3.3 Visual Inspection

The Non-Hazardous Waste Landfill exhibits some observed minor settlement, erosion, vegetation, and ponded water features. No cracks or exposed waste were observed. Table 4-9 presents a summary of observed visual inspection features and Table 4-10 presents the Preliminary Stability Assessment results. This landfill was assessed to have an “Acceptable” overall landfill performance because all observed features were assessed as “Acceptable.” Table 4-11 is a log of photographs taken during the 2015 visual inspection.

A previously reported crack along the south crest edge (Feature D) was observed in 2015 to be coarse fill where the fines have washed out (see Photos 47 and 49 in Appendix D). It is possible that when the fines were starting to wash out it may have looked like a crack was forming during previous inspections. The coarse rocks that remain along the crest edge are stable and no indications of cracking or slope movement (i.e., sloughing) were observed.

There were three previously observed areas of minor settlement (Features A, B and G) and two new observed areas of minor settlement (Features L and M). The settlement areas were all shallow depressions on the cover surface with ponded water (see Photos 60 through 63 in Appendix D) and are not considered to be of concern.

There was some minor self-armouring erosion on the north slope (previous Feature C) and west slope (new Feature I) that is not considered a concern.

Ponded water was observed along the west toe (previous Feature H), north toe (previous Feature F) and east toe (new Feature K). The ponded water along these parts of the landfill cover toe is likely seasonal from recent snow melt and precipitation during the inspection (see Photos 53, 59 and 65) and is not expected to result in problematic thawing of permafrost.

Sparse vegetation is becoming established on the cover surface (Feature J).

Table 4-9: Visual Inspection Checklist - Non-Hazardous Waste Landfill

SITE NAME: FOX-3 Dewar Lakes
LANDFILL DESIGNATION: Non Hazardous Waste Landfill
DATE OF INSPECTION: August 16, 2015
DATE OF PREVIOUS INSPECTION: August 23, 2013
INSPECTED BY: Darrin Johnson
REPORT PREPARED BY: Darrin Johnson
MONITORING EVENT NUMBER: 3
The inspector/reporter represents to the best of his/her knowledge that the following statements and observations are true and correct and to the best of the preparer's actual knowledge, no material facts have been suppressed or misstated.

Table 4-9: Visual Inspection Checklist - Non-Hazardous Waste Landfill

Checklist Item	Present (Y/N)	Feature ID (A, B, etc.)	Location Description	Easting	Northing	Length (m)	Width (m)	Depth (m)	Extent of Landfill Area (%)	Description	Comparison to Historical Observations	Photos
Settlement	Y	G	Northeast crest	409626	7616697	3	3	0.1	0.09%	Small depressions with ponded water (Acceptable)	New observation	61
		A, B	East crest	409623	7616666	2	1	0.1	0.02%	Small depressions with ponded water (Acceptable)	Previously observed: Unchanged since previous observation	62
		L	Northwest crest corner	409557	7616727	3	1	0.1	0.03%	Small depressions with ponded water (Acceptable)	New	60
		M	Central crest surface	409594	7616673	2	2	0.1	0.04%	Small depression with ponded water (Acceptable)	New	63
Erosion	Y	I	West slope	409549	7616693	10	1	0	0.10%	Self-armouring erosion (Acceptable)	New	45
		C	North slope	409619	7616731	10	1	0	0.10%	Previously noted erosion is self-armouring (Acceptable)	Previously observed. Unchanged since previous observation	56
Lateral Movement	N											
Frost Action	N											
Sloughing	N											

Table 4-9: Visual Inspection Checklist - Non-Hazardous Waste Landfill

Checklist Item	Present (Y/N)	Feature ID (A, B, etc.)	Location Description	Easting	Northing	Length (m)	Width (m)	Depth (m)	Extent of Landfill Area (%)	Description	Comparison to Historical Observations	Photos
Cracking	N	D	South crest edge						0.00%	Previous reported crack appears to be coarser fill. Dropped from feature list. (Acceptable)	Previously observed; not observed in 2015	47,49
Animal Burrows	N											
Vegetation	Y	J	Cover surface	409561	7616649	50	50	-	24.51%	Very sparse grass vegetation (Acceptable)	New observation	48, 64
Staining	Y											
Vegetation Stress	N											
Seepage or Ponded Water	Y	F	North toe	409595	7616739	80	5	0.2	3.92%	Ponded water along toe (Acceptable)	Previously observed: expanded area	57,58,59,65
		G	Cover surface	409626	7616697	3	3	0.1	0.09%	Small depressions with ponded water (Acceptable)	Previously noted as ponded water.	61
		H	West toe	409540	7616700	80	1	0.1	0.78%	Ponded water along toe (Acceptable)	New observation	65
		K	East toe	409646	7616691	80	3	0.2	2.35%	Ponded water running along toe (Acceptable)	New observation	53
Debris and/or Liner Exposed	N											

Table 4-9: Visual Inspection Checklist - Non-Hazardous Waste Landfill

Checklist Item	Present (Y/N)	Feature ID (A, B, etc.)	Location Description	Easting	Northing	Length (m)	Width (m)	Depth (m)	Extent of Landfill Area (%)	Description	Comparison to Historical Observations	Photos
Presence / Condition of Monitoring Instruments	Y		MW-05,06,07,08							Monitoring wells intact		110-113
Features of Note / Other Observations	N											

Landfill Area = 10, 200 m^2.

Table 4-10: Preliminary Stability Assessment - Non-Hazardous Waste Landfill

Feature	Severity Rating	Extent
Settlement	Acceptable	Occasional
Erosion	Acceptable	Isolated
Lateral Movement	Acceptable	-
Frost Action	Acceptable	-
Sloughing	Acceptable	-
Cracking	Acceptable	-
Animal Burrows	Acceptable	-
Vegetation establishment	Acceptable	Occasional
Staining	Acceptable	-
Vegetation Stress	Acceptable	-
Seepage/Ponded Water	Acceptable	Occasional
Debris and/or liner exposure	Acceptable	-
Other	-	-
Overall Landfill Performance	**Acceptable**	

Table 4-11: Summary Table of Photographic Log - Non-Hazardous Waste Landfill

Photo	Description (file name)	Easting	Northing	Date
44	Non-Haz Waste Landfill – West slope, facing east (ATT147_Photo1.jpg) (ATT148_Photo2.jpg)	409488.1071	7616713.51	16-Aug-15
45	Non-Haz Waste Landfill – Feature I, self-armouring erosion on west slope (ATT150_Photo1.jpg)	409548.6963	7616693.09	16-Aug-15
46	Non-Haz Waste Landfill – West crest edge, facing south (ATT151_Photo1.jpg)	409553.7261	7616683.758	16-Aug-15
47	Non-Haz Waste Landfill – South crest edge, facing east, previous reported crack appears to be coarser fill on slope near crest edge (ATT152_Photo1.jpg)	409559.9006	7616642.769	16-Aug-15
48	Non-Haz Waste Landfill – Cover surface facing northeast, Feature J, very sparse vegetation on cover and small areas of ponded water (ATT153_Photo1.jpg)	409561.1345	7616648.768	16-Aug-15
49	Non-Haz Waste Landfill – South crest edge, facing west (ATT154_Photo1.jpg)	409606.906	7616640.416	16-Aug-15
50	Non-Haz Waste Landfill – South slope facing northwest, some self-armouring erosion leaving cobbles and boulders (ATT155_Photo1.jpg)	409601.2866	7616627.657	16-Aug-15
51	Non-Haz Waste Landfill – southeast corner (ATT157_Photo1.jpg) (ATT158_Photo2.jpg)	409650.5289	7616626.806	16-Aug-15

Table 4-11: Summary Table of Photographic Log - Non-Hazardous Waste Landfill

Photo	Description (file name)	Easting	Northing	Date
52	Non-Haz Waste Landfill – East crest edge, facing north, coarse boulders at crest edge where fines have washed out (ATT159_Photo1.jpg)	409633.8797	7616652.942	16-Aug-15
53	Non-Haz Waste Landfill – Feature K, water stream running along east toe (ATT160_Photo1.jpg)	409646.0807	7616690.644	16-Aug-15
54	Non-Haz Waste Landfill – Cover surface facing southwest (ATT162_Photo1.jpg)	409634.0317	7616707.166	16-Aug-15
55	Non-Haz Waste Landfill – North slope facing west, some snow on slope and ponded water at toe (Feature F) (ATT163_Photo1.jpg)	409635.3293	7616727.112	16-Aug-15
56	Non-Haz Waste Landfill – Feature C, previously noted erosion on north slope is self-armouring (ATT164_Photo1.jpg)	409618.7667	7616731.077	16-Aug-15
57	Non-Haz Waste Landfill – North crest edge facing west, water at toe (Feature F) (ATT169_Photo1.jpg)	409600.7836	7616728.938	16-Aug-15
58	Non-Haz Waste Landfill – Feature F, ponded water along north toe, facing east (ATT171_Photo1.jpg)	409595.2134	7616739.071	16-Aug-15
59	Non-Haz Waste Landfill – Feature F, ponded water along north toe, facing west (ATT172_Photo2.jpg)	409595.2134	7616739.071	16-Aug-15
60	Non-Haz Waste Landfill – Feature L, three small depressions with ponded water on northwest crest corner – Feature E, ponded water at the toe (ATT173_Photo1.jpg)	409557.3127	7616726.662	16-Aug-15
61	Non-Haz Waste Landfill – Feature G, some minor depressions with ponded water (ATT165_Photo1.jpg)	409625.9771	7616697.341	16-Aug-15
62	Non-Haz Waste Landfill – Feature A, minor depressions with ponded water (ATT166_Photo1.jpg)	409622.9877	7616665.852	16-Aug-15
63	Non-Haz Waste Landfill – Feature M, shallow depression with ponded water (ATT167_Photo1.jpg)	409593.9116	7616672.576	16-Aug-15
64	Non-Haz Waste Landfill – Feature J, some occasional sparse grass vegetation (ATT168_Photo1.jpg)	409601.7471	7616690.388	16-Aug-15
65	Non-Haz Waste Landfill – Feature F, North and west slopes (ATT174_Photo1.jpg) (ATT175_Photo2.jpg)	409535.8866	7616741.925	16-Aug-15

4.3.4 Soil Sampling

Table 4-12 presents a summary of analytical results for soil samples collected at the Non-Hazardous Waste Landfill. MW-05 represents an upgradient sampling location, whereas MW-06 and MW-07 represent cross-gradient sampling locations and MW-08 represents a downgradient sampling location, all based on topography. It is noted that MW-06 and MW-07 were historically recorded as downgradient sampling locations.

MW-05

Sampling location MW-05 is located upgradient of the landfill, approximately 18 m north of the toe of the landfill. The estimated elevation of this sampling point is 510 masl. As shown in Photo 65 (Appendix D), some ponding of water was observed near the northern toe of the landfill in this area, between the landfill and the soil sample location. As shown in Photo 162, the area consists of boulders and rocks, infilled with stony sand and gravel and established vegetation. The soils consisted of grey sand, gravel and stone.

The shallow sample at MW-05 (0-15 cm) exhibited elevated concentrations of metals. The concentration of nickel (31.8 mg/kg) exceeded the background concentration (27 mg/kg). The concentration of zinc (67.6 mg/kg) exceeded the background concentration (59 mg/kg) and was equal to the baseline concentration (68 mg/kg). In addition, the concentration of copper (40.4 mg/kg), lead (10.1 mg/kg), chromium (82.1 mg/kg) and arsenic (15.8 mg/kg) exceeded the background and baseline concentrations. Elevated metal concentrations were observed in 2012 and 2014 at similar concentrations. No exceedances of the baseline concentrations plus 3σ were reported in 2015. No PHC or PCB were detected from the shallow sample at MW-05 in 2015.

The deep sample at MW-05 (40-50 cm) also exhibited elevated concentrations of metals, at similar concentrations to those in the shallow sample. The concentrations of nickel (30.6 mg/kg), zinc (65.7 mg/kg) and chromium (79.8 mg/kg) exceeded their background concentrations. In addition, the concentration of copper (42.9 mg/kg) and arsenic (15.7 mg/kg) exceeded their background and baseline concentrations. Elevated metal concentrations were observed in 2012 and 2014 at similar concentrations. No exceedances of the baseline concentrations plus 3σ were reported in 2015. No PHC or PCB were detected from the deep sample at MW-05 in 2015.

MW-06

Sampling location MW-06 is located cross-gradient of the landfill, approximately 18 m west of the western toe of the landfill. The estimated elevation of this sampling point is 506 masl. As shown in Photograph 44 (Appendix D), the area is covered with boulder and stone with sparse but established vegetation. As shown in Photo 165, the area consists of boulders and rocks, infilled with stony sand and gravel and established vegetation and there was standing water in the area. The soils consisted of grey sand, gravel and stone.

In the shallow sample at MW-06 (0-15 cm), the concentration of chromium (69.3 mg/kg) exceeded the baseline concentration (67 mg/kg). The concentration of chromium was less than the concentration reported in 2012 (94 mg/kg) and 2014 (82 mg/kg). In addition, the concentration of arsenic (14.1 mg/kg) exceeded the background (11 mg/kg) and baseline (13 mg/kg) concentrations. Similarly, the concentration of arsenic was less than the concentration reported in 2012 (19 mg/kg) and 2014 (16 mg/kg). The concentrations of most other metals were less than the concentrations reported in 2012 and 2014. No exceedances of the baseline concentrations plus 3σ were reported in 2015. No PHC or PCB were detected from the shallow sample at MW-06 in 2015.

The deep sample at MW-06 (40-50 cm) exhibited elevated concentrations of metals, at higher concentrations than those in the shallow sample. The concentrations of nickel (30.1 mg/kg), zinc (64.6 mg/kg) and chromium (78.8 mg/kg) exceeded their background concentrations. In addition, the concentration of copper (40.1 mg/kg) and arsenic (17.7 mg/kg) exceeded their background and baseline concentrations. Most metal concentrations observed in 2015 were lower than those observed in 2012 and 2014. No exceedances of the baseline concentrations plus 3σ were reported in 2015. No PHC or PCB were detected from the deep sample at MW-06 in 2015.

MW-07

Sampling location MW-07 is located cross-gradient of the landfill, approximately 18 m east of the eastern toe of the landfill. The estimated elevation of this sampling point is 506.5 masl. As shown in Photograph 53 (Appendix D), some running water was observed near the eastern toe of the landfill in this area between the landfill and the soil sample location. As shown in Photo 168, the area consists of boulders and rocks, infilled with stony sand and gravel and established vegetation. The soils consisted of brown sand and gravel.

The shallow sample at MW-07 (0-15 cm) exhibited elevated concentrations of metals. The concentrations of nickel (30.9 mg/kg) and zinc (64.8 mg/kg) exceeded their background concentrations (27 mg/kg and 59 mg/kg, respectively). In addition, the concentrations of copper (42.5 mg/kg), lead (10.2 mg/kg), chromium (82.9 mg/kg), arsenic (21 mg/kg) exceeded their background and baseline concentrations. Elevated metal concentrations were observed in 2012 and 2014 at similar concentrations. No exceedances of the baseline concentrations plus 3σ were reported in 2015. No PHC or PCB were detected from the shallow sample at MW-07 in 2015.

The deep sample at MW-07 (40-50 cm) also exhibited elevated concentrations of metals, at slightly lower concentrations than those in the shallow sample. The concentrations of nickel (29.2 mg/kg), zinc (62 mg/kg) and chromium (76 mg/kg) exceeded their background concentrations. In addition, the concentration of copper (41 mg/kg) and arsenic (18.8 mg/kg) exceeded their background and baseline concentrations. Elevated metal concentrations were observed in 2012 and 2014 at similar concentrations. No exceedances of the baseline concentrations plus 3σ were reported in 2015. No PHC or PCB were detected from the deep sample at MW-07 in 2015.

MW-08

Sampling location MW-08 is located downgradient of the landfill, approximately 16 m south of the southern toe of landfill. The estimated elevation of this sampling point is 502.5 masl. As shown in Photo 171, the area consists of boulders and rocks, infilled with stony sand and gravel and established vegetation. The soils consisted of grey to brown sand and gravel.

In the shallow sample at MW-08 (0-15 cm), the concentration of chromium (68.3 mg/kg) and arsenic (12.1 mg/kg) exceeded their baseline concentrations (67 mg/kg and 11 mg/kg, respectively). The concentrations of chromium and arsenic were less than the concentrations reported in 2012 (84 mg/kg and 17 mg/kg, respectively) and 2014 (85 mg/kg and 14 mg/kg, respectively), which was similarly the case for most other metals. No exceedances of the baseline concentrations plus 3σ were reported in 2015. No PHC or PCB were detected from the shallow sample at MW-08 in 2015.

The deep sample at MW-08 (30-40 cm) exhibited elevated concentrations of metals, at slightly higher concentrations than those in the shallow sample. The concentrations of nickel (30.3 mg/kg), zinc (62.9 mg/kg) and chromium (75.6 mg/kg) exceeded their background concentrations. In addition, the concentration of arsenic (13.1 mg/kg) exceeded the background (11 mg/kg) and baseline (13 mg/kg) concentrations. Most metal concentrations observed in 2015 were lower than those observed in 2014 but high than those observed in 2012. No exceedances of the baseline concentrations plus 3σ were reported in 2015. No PHC or PCB were detected from the deep sample at MW-08 in 2015.

Table 4-12: Soil Chemical Analysis Results - Non-Hazardous Waste Landfill

ID	Depth (cm)	Cu (mg/kg)	Ni (mg/kg)	Co (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Zn (mg/kg)	Cr (mg/kg)	As (mg/kg)	Hg (mg/kg)	Total PCBs (mg/kg)	F1 (mg/kg)	F2 (mg/kg)	F3 (mg/kg)	F4 (mg/kg)
Background Mean		32	27	32	1.0	10	59	67	11	0.05	0.0003	NA	NA	NA	NA
Baseline Mean		**38**	**33**	**12**	**1.0**	**10**	**68**	**80**	**13**	**0.10**	**0.10**	**NA**	**NA**	**NA**	**NA**
Baseline + 3σ		64	44	17	1.0	15	92	110	26	0.10	0.151	NA	NA	NA	NA
Upgradient															
MW-05 (0-15)	(0-15)	**40.4**	31.8	10.3	<0.5	**10.1**	67.6	**82.1**	**15.8**	<0.1	<0.05	<7	<4	<8	<6
MW-05 (40-50)	(40-50)	**42.9**	30.6	10.4	<0.5	8.9	65.7	79.8	**15.7**	<0.1	<0.05	<7	<4	<8	<6
Cross-gradient															
MW-06 (0-15)	(0-15)	29.3	26.4	8.3	<0.5	7.8	53.7	69.3	**14.1**	<0.1	<0.05	<7	<4	<8	<6
MW-06 (40-50)	(40-50)	**40.1**	30.1	9.7	<0.5	9.4	64.6	78.8	**17.7**	<0.1	<0.05	<7	<4	<8	<6
MW-07 (0-15)	(0-15)	**42.5**	30.9	9.9	<0.5	**10.2**	64.8	**82.9**	**21**	<0.1	<0.05	<7	<4	<8	<6
MW-07 (40-50)	(40-50)	**41**	29.2	9.4	<0.5	9.1	62	76	**18.8**	<0.1	<0.05	<7	<4	<8	<6
Downgradient															
MW-08 (0-15)	(0-15)	25.8	26.6	8.6	<0.5	7.3	57.1	68.3	12.1	<0.1	<0.05	<7	<4	<8	<6
MW-08 (30-40)	(30-40)	29.4	30.3	9.8	<0.5	7.3	62.9	75.6	**13.1**	<0.1	<0.05	<7	<4	<8	<6

Notes:

NA: Not available

ID: Soil sample location ID.

Underlined values: Results exceed Background arithmetic mean.

Bold Values: Results exceed Baseline arithmetic mean.

4.3.5 Groundwater Sampling

Groundwater sampling and monitoring well inspection field records are included in Appendix B. Table 4-13 presents a summary of groundwater levels and analytical results for groundwater samples collected at the Non-Hazardous Waste Landfill.

MW-05

The groundwater results at MW-05 (MW0905) exhibited elevated concentrations of zinc and chromium. The concentration of zinc (0.377 mg/L) exceeded the baseline concentration (0.14 mg/L), whereas the concentration of chromium was equivalent to the baseline of 0.005 mg/L. The concentrations of zinc and chromium, were lower in 2015 in comparison to the concentrations observed in 2014 (5.3 mg/L and 0.23 mg/L, respectively), which was similarly the case for all other metals. No exceedances of the baseline concentrations plus 3σ were reported in 2015. No PHC or PCB were detected in the groundwater sample collected at MW-05 in 2015.

MW-06

A duplicate sample was collected at MW-06 sample location, and therefore the average concentrations are discussed relative to baseline values. The calculated RPD values indicated the original and duplicate sample results differ by more than 40% for some of the observed metals (i.e., Cu, Ni, Cd, Zn, As) and are typically lower in the duplicate sample.

The depth to groundwater measured at MW-06 in 2015 was 0.63 m below grade. The groundwater results at MW-06 (MW0906) exhibited elevated concentrations of arsenic. The average concentration of arsenic (0.0065 mg/L) exceeded the baseline concentration (0.003 mg/L) but was less than the baseline concentration plus 3σ (0.009 mg/L). Similar concentrations of arsenic were observed in 2012 (0.0056 mg/L) and 2014 (less than 0.020 mg/L). The concentrations of most other metals were less than or similar to those reported in 2012 and 2014. No PHC or PCB were detected in the groundwater sample collected at MW-06 in 2015.

MW-07

The depth to groundwater measured at MW-07 in 2015 was 0.41 m below grade. The groundwater results at MW-07 (MW0907) exhibited elevated concentrations of zinc, chromium and arsenic. The concentrations of zinc (0.336 mg/L), chromium (0.02 mg/L) and arsenic (0.004 mg/L) exceeded their baseline concentrations. The concentrations of all metals were lower than those observed in 2012 and 2014. No exceedances of the baseline concentrations plus 3σ were reported in 2015. No PHC or PCB were detected in the groundwater sample collected at MW-07 in 2015.

MW-08

The depth to groundwater measured at MW-08 in 2015 was 0.24 m below grade. The groundwater results at MW-08 (MW0908) exhibited elevated concentrations of zinc, chromium and arsenic. The concentrations of zinc (0.323 mg/L), chromium (0.005 mg/L) and arsenic (0.009 mg/L) exceeded their baseline concentrations. The concentration of arsenic was equal to the baseline concentration plus 3σ (0.009 mg/L). The concentrations of zinc and chromium were lower in 2015 in comparison to the concentrations observed in 2014 (0.51 mg/L and 0.14 mg/L, respectively), but similar to those observed in 2012 (0.27 mg/L and 0.0075 mg/L, respectively), which was similarly the case for most other metals. No PHC or PCB were detected in the groundwater sample collected at MW-08 in 2015.

Table 4-13: Monitoring Well Groundwater Levels and Groundwater Chemical Analysis Results - Non-Hazardous Waste Landfill

ID	GW Depth BGS (m)	Cu (mg/L)	Ni (mg/L)	Co (mg/L)	Cd (mg/L)	Pb (mg/L)	Zn (mg/L)	Cr (mg/L)	As (mg/L)	Hg (mg/L)	Total PCBs (mg/L)	F1 (mg/L)	F2 (mg/L)	F3 (mg/L)	F4 (mg/L)
Baseline Mean		**NA**	**NA**	**NA**	**NA**	**NA**	**0.14**	**0.005**	**0.003**	**0.0004**	**0.003**	**NA**	**NA**	**NA**	**NA**
Baseline + 3σ		NA	NA	NA	NA	NA	0.81	0.0089	0.0090	0.0002	0.0027	NA	NA	NA	NA
Upgradient															
MW0905	--	0.0036	0.033	0.0087	0.0007	0.0023	**0.377**	**0.005**	0.002	<0.0001	<0.00005	<0.025	<0.1	<0.1	<0.1
Cross-gradient															
MW0906	0.63	0.0622	0.022	0.0033	0.0003	0.011	**0.233**	**0.006**	**0.008**	<0.0001	<0.00005	<0.025	<0.1	<0.1	<0.1
MW0906 (Duplicate)	0.63	0.027	0.01	<0.001	0.00007	<0.001	0.017	<0.002	**0.005**	0.000023	<0.00005	<0.025	<0.1	<0.1	<0.1
MW0906 (Dup Avg)	0.63	0.04	0.02	0.002	0.0002	0.01	0.13	0.004	**0.007**	0.00006	<0.00005	<0.025	<0.1	<0.1	<0.1
MW0907	0.41	0.0267	0.045	0.0061	0.0002	0.004	**0.336**	**0.02**	**0.004**	<0.0001	<0.00005	<0.025	<0.1	<0.1	<0.1
Downgradient															
MW0908	0.24	0.0062	0.012	0.0014	0.0001	0.0075	**0.323**	**0.005**	**0.009**	<0.0001	<0.00005	<0.025	<0.1	<0.1	<0.1

Notes:

ID: Monitoring well location ID.

GW: Groundwater.

BGS: Below ground surface.

NA: Not available

Bold Values: Results exceed Baseline arithmetic mean.

4.3.6 Conclusions and Overall Performance of the Non-Hazardous Waste Landfill

Based on the visual inspection, there does not appear to be any significant erosion, settlement, cracking, exposed waste or indications of instability at the Non-Hazardous Waste Landfill. Some minor self-armouring erosion on the north and west slopes does not appear to be worsening. There are some shallow settlement depressions on the cover surface with ponded water but they are not considered to be of concern. Shallow ponded water along the west, north and east toe appears to be from recent snow melt and/or precipitation and is not anticipated to result in increased thawing of permafrost.

Soil samples were collected at all designated locations in 2015; two soil samples were collected at all of sampling locations. Concentrations of copper, nickel, lead, zinc, chromium and arsenic were detected above the background/baseline arithmetic mean at two or more soil sampling locations. Concentrations were highest overall at the shallow sample location MW-07 shallow. At all four locations, the concentrations of most metals were similar to or less than those observed in 2012 and 2014. No detectable concentrations of PHC or PCB were noted in any of the samples in 2015.

In 2015, groundwater samples were collected from all four monitoring wells adjacent to the landfill. Exceedances of the baseline values were reported for zinc, chromium and arsenic; however, these concentrations were generally lower than those reported in 2012 and 2014. No detectable concentrations of PHC or PCB were noted in any of the groundwater samples in 2015.

Comparison of groundwater elevations based on estimated grade elevation and the measured water depth in the wells indicates that groundwater was higher at MW-06 and MW-07, and lowest towards the south at MW-08, which follows the topography in the area.

Based on the results, there does not appear to be significant impact to groundwater quality from the landfill at the four monitoring wells adjacent to the landfill.

4.3.7 Recommendations for Non-Hazardous Waste Landfill

No modifications to the ongoing monitoring program at this landfill are recommended.

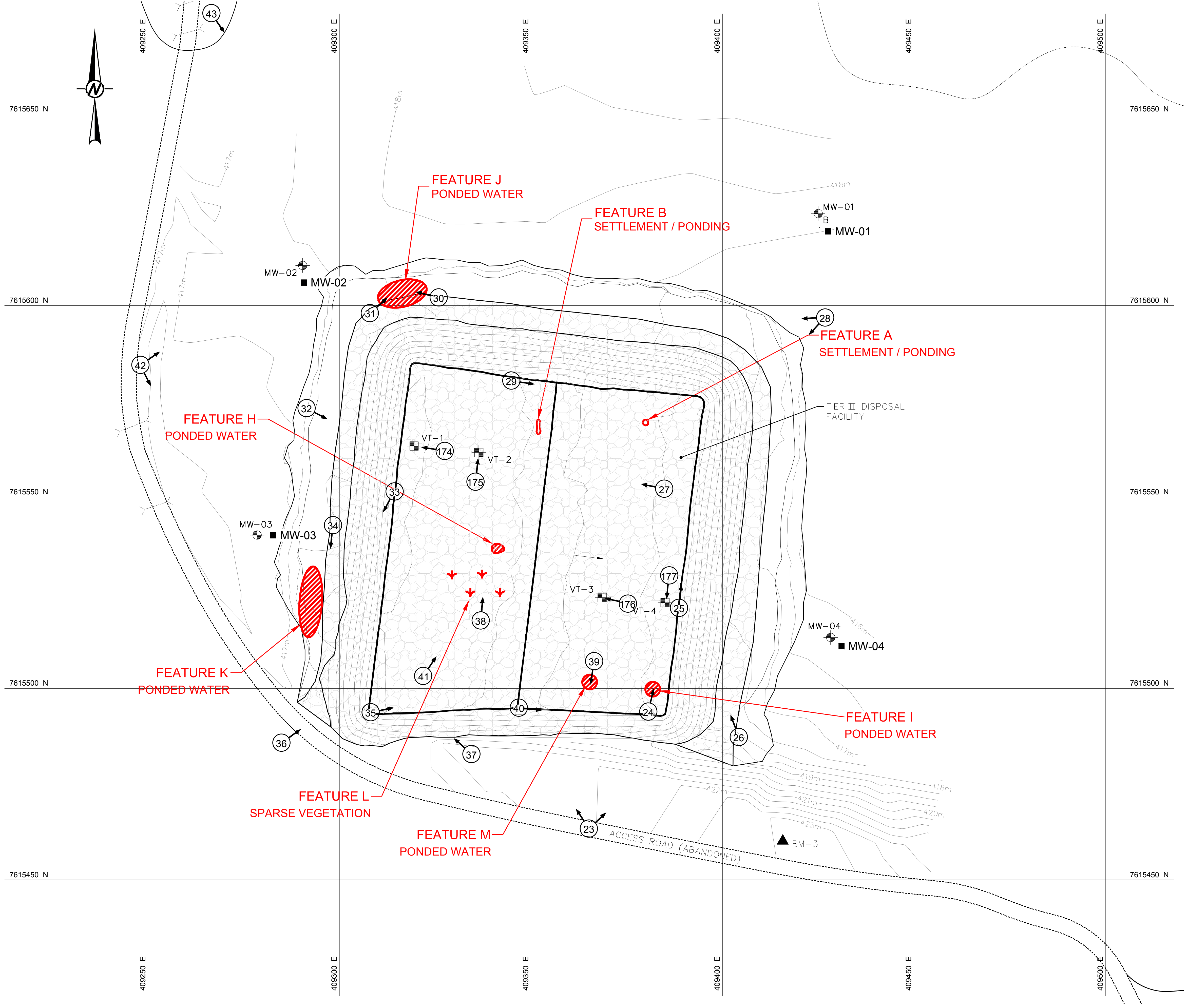
4.4 Tier II Disposal Facility

4.4.1 Landfill Description

The Tier II Disposal Facility is located in the northern portion of the middle site area, east of the abandoned access road, west of the main access road. The terrain in the immediate vicinity of the landfill is relatively flat. Elevations immediately adjacent to the landfill range from approximately 420 masl at a local high point to the south, to elevations of 417 to 418 masl adjacent to the landfill. Based on satellite imagery, this area appears to drain towards the MacBeth River, located approximately 4.8 km to the southwest.

The landfill cell construction consisted of the placement of low-permeability, saturated, compacted berms, the installation of a liner system over the berms and along the landfill base, and the placement of a cover liner system over the landfill contents with the placement of overlying sufficient granular fill to promote freeze-back of landfill contents. The Tier II Disposal Facility is approximately 12,600 m^2 in area, including the sideslopes.

Four groundwater monitoring wells, MW-01 through MW-04 were installed at the landfill perimeter; four thermistors were installed within the landfill. The long term monitoring plan consists of visual monitoring, the collection of soil and groundwater samples, and monitoring of subsurface ground temperatures of the landfill. Approximate locations for the collection of soil and groundwater samples, and thermistor installation locations are identified on Figure FOX-3.5.



LEGEND

⊕	MONITORING WELL LOCATION
⊕B	BACKGROUND MONITORING WELL LOCATION
▚	GROUND TEMPERATURE CABLE LOCATION
▲	PERMANENT BENCHMARK LOCATION
■	SOIL SAMPLING LOCATION 2015
① ➤	PHOTOGRAPH VIEWPOINT LOCATION
○	SETTLEMENT (NTS)
▨	PONDING (NTS)
✣	VEGETATION (NTS)
	TYPE 1 GRANULAR A

NOTE

GRID PROJECTION IS NAD83 ZONE 19N.
ELEVATIONS ARE GEODETIC.

REFERENCE

PREVIOUS INSPECTION FIGURE PROVIDED BY BIOGENIE, A DIVISION OF ENGLOBE CORPORATION, PROJECT NO.CD2655_400_403, DATED JUNE 2015.

0 25 50
1:1,000 METRES

CLIENT
DEPARTMENT OF NATIONAL DEFENCE CANADA

PROJECT
2015 FOX-3 MONITORING REPORT

TITLE
TIER II DISPOSAL FACILITY

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-03-24
DESIGNED	RM
PREPARED	TDR
REVIEWED	DCJ
APPROVED	DP

PROJECT NO.	PHASE	REV.	FIGURE
1530908	1000	B	FOX-3.5

Path: \\golder.gds\gal\Mississauga\SIM\Clients\Public_Works_Canada\Canada\99_PROJ\1530908_PWGSC_Dew_Line_Mon_Program_2015_2018\40_PROD\0004_Fox_3_Field_Summary_Report\ | File Name: 15309080004-CM-0011.dwg

25 mm

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

4.4.2 Summary of any Scope Deviations

The field work was conducted as per the TOR. There were no notable exceptions to the scope of work.

4.4.3 Visual Inspection

The Tier II Disposal Facility has some observed minor settlement, vegetation and ponded water features. No erosion, cracks or exposed waste were observed. Table 4-14 presents a summary of observed visual inspection features and Table 4-15 presents the Preliminary Stability Assessment results. This landfill was assessed to have an “Acceptable” overall landfill performance because all observed features were assessed as “Acceptable.” Table 4-16 is a log of photographs taken during the 2015 visual inspection.

There were five shallow depressions on the cover surface with ponded water. Two areas were previously reported as minor settlement (Features A and B) and were observed to have ponded water during the 2015 inspection. Feature H was previously reported as ponded water consistent with the 2015 inspection observations. Features I and M (new in 2015) were similar shallow depressions on the cover surface with ponded water (see Photos 24 and 39 in Appendix D). Feature M was an area of cobbles and boulders with ponded water in a shallow depression. These shallow depressions on the cover surface with ponded water are not a concern, provided they do not increase in size or depth over time.

Ponded water was observed along the northwest toe (new Feature J) and west toe (new Feature K). These ponds of water along the toe of the landfill are shallow and likely from recent snow melt and/or precipitation (see Photos 31 and 34). These ponded areas are not expected to result in problematic thawing of permafrost.

Sparse vegetation is becoming established on the cover surface (Feature L).

Table 4-14: Visual Inspection Checklist - Tier II Disposal Facility

SITE NAME: FOX-3 Dewar Lakes
LANDFILL DESIGNATION: Tier II Disposal Facility
DATE OF INSPECTION: August 16, 2015
DATE OF PREVIOUS INSPECTION: August 24, 2013
INSPECTED BY: Darrin Johnson
REPORT PREPARED BY: Darrin Johnson
MONITORING EVENT NUMBER: 3
The inspector/reporter represents to the best of his/her knowledge that the following statements and observations are true and correct and to the best of the preparer's actual knowledge, no material facts have been suppressed or misstated.

Table 4-14: Visual Inspection Checklist - Tier II Disposal Facility

Checklist Item	Present (Y/N)	Feature ID (A, B, etc.)	Location Description	Easting	Northing	Length (m)	Width (m)	Depth (m)	Extent of Landfill Area (%)	Description (Severity Rating)	Comparison to Historical Observations	Photos
Settlement	Y	A,B	Northeast crest surface	409326	7615602	10	10	0.1	0.79%	Depressions with ponded water. Previously reported as settlement. (Acceptable)	Depressions filled with water.	27
Erosion	N											
Lateral Movement	N											
Frost Action	N											
Sloughing	N											
Cracking	N											
Animal Burrows	N											
Vegetation	Y	L	Central cover surface	409337	7615517.733	20	20	-	3.17%	Some very sparse vegetation (Acceptable)	New	38
Staining	N											
Vegetation Stress	N											

Table 4-14: Visual Inspection Checklist - Tier II Disposal Facility

Checklist Item	Present (Y/N)	Feature ID (A, B, etc.)	Location Description	Easting	Northing	Length (m)	Width (m)	Depth (m)	Extent of Landfill Area (%)	Description (Severity Rating)	Comparison to Historical Observations	Photos
Seepage or Ponded Water	Y	H	Cover surface	409385	7615552	2	2	0.1	0.03%	Depression with ponded water (Acceptable)	-New	38
		I	Crest surface in southeast corner	409381	7615494	10	2	0.1	0.16%	Depression with ponded water (Acceptable)	New	24
		J	northwest toe	409326	7615602	20	10	0.2	1.59%	Ponded water along toe (Acceptable)	New	30, 31
		K	west toe	409298	7615543	10	3	0.2	0.24%	Ponded water along toe (Acceptable)	New	33, 34
		M	Cover surface	409366	7615507	1	1	0.1	0.01%	Cobbles and boulders with ponded water (Acceptable)	New	39
Debris and/or Liner Exposed	N											
Presence / Condition of Monitoring Instruments	Y		VT-1,2,3,4 and MW-01,02,03,04							Thermistors and monitoring wells intact.		108,109, 174, 175, 176,177
Features of Note/Other Observations	N											

Landfill Area = 12,600 m^2.

Table 4-15: Preliminary Stability Assessment - Tier II Disposal Facility

Feature	Severity Rating	Extent
Settlement	Acceptable	Occasional
Erosion	Acceptable	-
Lateral Movement	Acceptable	-
Frost Action	Acceptable	-
Sloughing	Acceptable	-
Cracking	Acceptable	-
Animal Burrows	Acceptable	-
Vegetation establishment	Acceptable	Isolated
Staining	Acceptable	-
Vegetation Stress	Acceptable	-
Seepage/Ponded Water	Acceptable	Occasional
Debris and/or liner exposure	Acceptable	-
Other	-	-
Overall Landfill Performance	**Acceptable**	

Table 4-16: Summary Table of Photographic Log – Tier II Disposal Facility

Photo	Description (file name)	Easting	Northing	Date
23	Tier II Disposal Facility – South slope, looking north towards station – 3 photo panoramic (ATT117_Photo3.jpg) (ATT116_Photo3.jpg) (ATT115_Photo3.jpg)	409365.0968	7615463.372	16-Aug-15
24	Tier II Disposal Facility – Feature I, ponded water on crest surface in southeast corner (ATT118_Photo1.jpg)	409380.6143	7615493.941	16-Aug-15
25	Tier II Disposal Facility – East crest edge, looking north (ATT120_Photo1.jpg)	409388.6488	7615521.044	16-Aug-15
26	Tier II Disposal Facility – East slope, looking north (ATT121_Photo1.jpg)	409404.2417	7615487.301	16-Aug-15
27	Tier II Disposal Facility – Ponded water on cover surface, previously reported Features A and B (settlement) and Feature H, facing west (ATT123_Photo1.jpg)	409384.7853	7615552.13	16-Aug-15
28	Tier II Disposal Facility – East and north slopes, facing southwest (ATT124_Photo1.jpg) (ATT125_Photo2.jpg)	409426.7973	7615596.84	16-Aug-15
29	Tier II Disposal Facility – North crest edge, facing east, large cobbles and boulders (ATT126_Photo1.jpg)	409344.8424	7615580.396	16-Aug-15
30	Tier II Disposal Facility – Feature J, ponded water at northwest toe (ATT127_Photo1.jpg)	409325.8979	7615602.079	16-Aug-15
31	Tier II Disposal Facility – Feature J, ponded water at northwest toe (ATT128_Photo1.jpg)	409307.9041	7615598.008	16-Aug-15

Table 4-16: Summary Table of Photographic Log – Tier II Disposal Facility

Photo	Description (file name)	Easting	Northing	Date
32	Tier II Disposal Facility – West slope, facing east (ATT132_Photo3.jpg)	409291.3953	7615573.203	16-Aug-15
33	Tier II Disposal Facility – West crest edge, facing south, ponded water at toe (Feature K) (ATT135_Photo1.jpg)	409314.3851	7615551.447	16-Aug-15
34	Tier II Disposal Facility – Feature K, water at west toe (ATT136_Photo1.jpg)	409298.3142	7615542.639	16-Aug-15
35	Tier II Disposal Facility – South crest edge, facing east (ATT137_Photo1.jpg)	409308.109	7615493.781	16-Aug-15
36	Tier II Disposal Facility – West slope from southwest toe (ATT138_Photo1.jpg)	409284.8189	7615485.793	16-Aug-15
37	Tier II Disposal Facility – West end of south slope, facing northwest (ATT139_Photo1.jpg)	409334.4485	7615482.839	16-Aug-15
38	Tier II Disposal Facility – Feature L, some very sparse vegetation on cover surface (ATT140_Photo1.jpg)	409336.8535	7615517.733	16-Aug-15
39	Tier II Disposal Facility – Feature M, cobbles and boulders on cover surface with ponded water (ATT141_Photo1.jpg)	409366.4865	7615507.118	16-Aug-15
40	Tier II Disposal Facility – South crest edge, facing east (ATT142_Photo1.jpg)	409346.8223	7615494.962	16-Aug-15
41	Tier II Disposal Facility – Cover surface, facing northeast (ATT143_Photo1.jpg)	409321.8385	7615503.27	16-Aug-15
42	Tier II Disposal Facility – West side, facing east (ATT144_Photo1.jpg) (ATT145_Photo2.jpg)	409247.9967	7615584.505	16-Aug-15
43	Tier II Disposal Facility – From hill above landfill, facing south (ATT146_Photo1.jpg)	409265.8811	7615862.129	16-Aug-15

4.4.4 Thermal Monitoring

The data recorded on the thermistor dataloggers located at the Tier II Disposal Facility (VT-1, 2, 3 and 4) was downloaded using a laptop computer and Prolog software from Lakewood Systems Ltd. Thermistor inspection and data downloading details were recorded on field record sheets included in Appendix B.

4.4.5 Soil Sampling

Table 4-17 presents a summary of analytical results for soil samples collected at the Tier II Disposal Facility. MW-01 and MW-02 represent upgradient sampling locations, whereas MW-03 and MW-04 represent cross-gradient or downgradient sampling locations, although all locations are essentially at similar grades. MW-02 was considered a downgradient location historically, however, based on the regional topography and water levels recorded in 2015, it is recommended this location be re-classified as an upgradient sampling location.

MW-01

Sampling location MW-01 is located approximately 25 m northeast of the toe of the landfill. The estimated elevation of this sampling point is 417.5 masl. As shown in the background of Photo 25 and in Photo 150 (Appendix D), the area is covered with rock and stones with well-established vegetation. Standing water was observed in the area of the well. The soils in the sample location consist of brown sand, gravel and stone.

A duplicate sample was collected at the shallow MW-01 (0-15 cm) sample location, and therefore the average concentrations are discussed relative to background and baseline values. The calculated RPD values indicated the original and duplicate sample results differ by less than 20% for all parameters.

The shallow samples at MW-01 (0-15 cm) exhibited elevated concentrations of metals. The average concentrations of copper (46 mg/kg), nickel (39 mg/kg), zinc (71 mg/kg), chromium (89 mg/kg) and arsenic (29 mg/kg) exceeded their background and baseline concentrations. Metal concentrations were observed from 2012 to 2014 at similar concentrations. No exceedances of the baseline concentrations plus 3σ were reported in 2015. No PHC or PCB were detected from the shallow samples at MW-01 in 2015.

The deep sample at MW-01 (40-50 cm) also exhibited elevated concentrations of metals, at similar concentrations to those in the shallow sample. The concentrations of copper (48.6 mg/kg), nickel (38 mg/kg), zinc (66.7 mg/kg), chromium (87.9 mg/kg) and arsenic (28.7 mg/kg) exceeded background and baseline concentrations. Elevated metal concentrations were observed from 2012 to 2014 at similar concentrations. No exceedances of the baseline concentrations plus 3σ were reported in 2015. No PHC or PCB were detected from the deep sample at MW-05 in 2015.

MW-02

Sampling location MW-02 is located upgradient of the landfill, approximately 5 m northwest of the toe of the landfill. The estimated elevation of this sampling point is 417.5 masl. As shown in Photograph 31 (Appendix D), some ponding of water was observed near the northwestern toe of the landfill in this area. As shown in Photo 153 (Appendix D), the area is covered with boulders rock and stones with sparse vegetation in the areas where coarse soils is present. The soils in the sample location consist of brown sand, gravel and stone.

In the shallow sample at MW-02 (0-15 cm), the concentration of arsenic (14.7 mg/kg) exceeded the background (11 mg/kg) and baseline (14 mg/kg) concentrations but was less than the baseline concentration plus 3σ (32 mg/kg). The concentration of arsenic was less than the concentrations reported in 2012 (28 mg/kg) and 2014 (18 mg/kg), but similar to the concentration reported in 2013 (14 mg/kg). The concentrations of most other metals were less than the concentrations reported from 2012 to 2014. No PHC or PCB were detected from the shallow sample at MW-02 in 2015.

In the deep sample at MW-02 (40-50 cm), the concentration of arsenic (13.4 mg/kg) exceeded the background concentration (11 mg/kg). The concentration of arsenic was less than the concentrations reported in 2012 (18 mg/kg) and 2014 (14 mg/kg) but greater than the concentration reported in 2013 (11 mg/kg). The concentrations of most other metals were less than the concentrations reported from 2012 to 2014. No PHC or PCB were detected from the deep sample at MW-02 in 2015.

MW-03

Sampling location MW-03 is located downgradient of the landfill, approximately 5 m west of the toe of the landfill. The estimated elevation of this sampling point is 417 masl. As shown in Photo 156 (Appendix D), the area is covered with boulders rock and stones with established vegetation in the areas where coarse soils is present. The soils in the sample location consist of brown sand with gravel and stone.

The shallow sample at MW-03 (0-15 cm) exhibited elevated concentrations of metals. The concentrations of zinc (59.5 mg/kg), chromium (70.1 mg/kg) and arsenic (12.5 mg/kg) exceeded their background concentrations. In addition, the concentrations of nickel (33.8 mg/kg) exceeded the background (27 mg/kg) and baseline (32 mg/kg) concentrations but was less than the baseline concentration plus 3σ (54 mg/kg). The concentrations of most metals were less than the concentrations reported from 2012 to 2014. No PHC or PCB were detected from the shallow sample at MW-03 in 2015.

The deep sample at MW-03 (40-50 cm) also exhibited elevated concentrations of metals, at higher concentrations than those in the shallow sample. The concentrations of copper (36 mg/kg), zinc (62.9 mg/kg) and chromium (77.6 mg/kg) exceeded their background concentrations. In addition, the concentration of nickel (36.7 mg/kg) and arsenic (16.1 mg/kg) exceeded their background and baseline concentrations. The metal concentrations observed in 2015 were slightly higher than those reported in 2013 but less than those reported in 2012. No exceedances of the baseline concentrations plus 3σ were reported in 2015. No PHC or PCB were detected from the deep sample at MW-03 in 2015.

MW-04

Sampling location MW-04 is located downgradient of the landfill, approximately 5 m east of the eastern toe of landfill. The estimated elevation of this sampling point is 416.5 masl. As shown in Photo 159 (Appendix D), the area is covered with boulders rock and stones with established vegetation in the areas where coarse soils is present. The soils in the sample location consist of grey sand with gravel and stone.

In the shallow sample at MW-04 (0-15 cm), the concentration of arsenic (13.6 mg/kg) exceeded the background (11 mg/kg) concentration. The concentration of arsenic was less than the concentrations reported from 2012 to 2014 (between 19 mg/kg and 37 mg/kg). Similarly, the concentrations of most other metals were less than the concentrations reported from 2012 to 2014. No PHC or PCB were detected from the shallow sample at MW-04 in 2015.

In the deep sample at MW-04 (40-50 cm), the concentration of copper (34.4 mg/kg) arsenic (12.6 mg/kg) exceeded their background concentrations (32 mg/kg and 11 mg/kg, respectively). The concentration of copper was greater than the concentrations reported in 2012 (30 mg/kg) but less than the concentration reported in 2013 (39 mg/kg). The concentration of arsenic was less than the concentrations reported in 2012 (15 mg/kg) and 2013 (21 mg/kg). The concentration of lead (10 mg/kg) was equivalent to the background (10 mg/kg) and baseline (10 mg/kg) concentrations. The concentration of lead was greater than the concentrations reported in 2012 (6.9 mg/kg) and 2013 (8.0 mg/kg). The concentrations of most other metals were less than the concentrations reported in 2012 and 2013. No PHC or PCB were detected from the deep sample at MW-04 in 2015.

Table 4-17: Soil Chemical Analysis Results - Tier II Disposal Facility

ID	Depth (cm)	Cu (mg/kg)	Ni (mg/kg)	Co (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Zn (mg/kg)	Cr (mg/kg)	As (mg/kg)	Hg (mg/kg)	Total PCBs (mg/kg)	F1 (mg/kg)	F2 (mg/kg)	F3 (mg/kg)	F4 (mg/kg)
Background Mean		32	27	32	1.0	10	59	67	11	0.05	0.0030	NA	NA	NA	NA
Baseline Mean		**38**	**32**	**13**	**1.0**	**10**	**64**	**79**	**14**	**0.10**	**0.10**	**NA**	**NA**	**NA**	**NA**
Baseline + 3σ		74	54	22	1.0	21	92	118	32	0.10	0.16	NA	NA	NA	NA
Upgradient															
MW-01 (0-15)	(0-15)	**46.8**	**37.8**	11.3	<0.5	9.7	**65.9**	**87.3**	**30**	<0.1	<0.05	<7	<4	<8	<6
MW-01 (0-15) (Duplicate)	(0-15)	**46**	**41**	11.2	<0.5	8	**77**	**90**	**28**	<0.10	<0.1	<5	<4	<8	<6
MW-01 (0-15) (Dup Avg)	(0-15)	**46**	**39**	11.3	<0.5	9	**71**	**89**	**29**	<0.1	<0.1	<6	<4	<8	<6
MW-01 (40-50)	(40-50)	**48.6**	**38**	10.8	<0.5	9.9	**66.7**	**87.9**	**28.7**	<0.1	<0.05	<7	<4	<8	<6
MW-02 (0-15)	(0-15)	27.5	24.7	8	<0.5	7.9	51.8	61.8	**14.7**	<0.1	<0.05	<7	<4	<8	<6
MW-02 (40-50)	(40-50)	29.1	24.1	8.2	<0.5	8.2	51.4	59.7	13.4	<0.1	<0.05	<7	<4	<8	<6
Downgradient															
MW-03 (0-15)	(0-15)	29	**33.8**	10.6	<0.5	6.2	59.5	70.1	12.5	<0.1	<0.05	<7	<4	<8	<6
MW-03 (40-50)	(40-50)	36	**36.7**	11.8	<0.5	8.2	62.9	77.6	**16.1**	<0.1	<0.05	<7	<4	<8	<6
MW-04 (0-15)	(0-15)	26.6	23.7	7.9	<0.5	8.1	50.4	65.1	13.6	<0.1	<0.05	<7	<4	<8	<6
MW-04 (40-50)	(40-50)	34.4	25.3	8.4	<0.5	**10**	54.7	66.7	12.6	<0.1	<0.05	<7	<4	<8	<6

Notes:

NA: Not available.

ID: Soil sample location ID.

Underlined values: Results exceed Background arithmetic mean.

Bold Values: Results exceed Baseline arithmetic mean.

4.4.6 Groundwater Sampling

Groundwater sampling and monitoring well inspection field records are included in Appendix B. Table 4-18 presents a summary of groundwater levels and analytical results for groundwater samples collected at the Tier II Disposal Facility.

MW-01

The depth to groundwater measured at MW-01 in 2015 was 0.59 m below grade. The groundwater results at MW-01 (MW0901) exhibited elevated concentrations of chromium and arsenic. The concentrations of chromium (0.006 mg/L) and arsenic (0.004 mg/L) exceeded their baseline concentrations (0.005 mg/L and 0.003 mg/L, respectively). The concentrations of chromium and arsenic were lower in 2015 in comparison to those observed in previous years, which was similarly the case for all other metals. No exceedances of the baseline concentrations plus 3σ were reported in 2015. No PHC or PCB were detected in the groundwater sample collected at MW-01 in 2015.

MW-02

The depth to groundwater measured at MW-02 in 2015 was 0.98 m below grade. The groundwater results at MW-02 (MW0902) exhibited elevated concentrations of chromium and arsenic. The concentrations of chromium (0.011 mg/L) and arsenic (0.008 mg/L) exceeded their baseline concentrations (0.005 mg/L and 0.003 mg/L, respectively). The concentration of chromium was lower than the concentration reported in 2013 (0.028 mg/L) but similar to the concentration reported in 2012 (0.010 mg/L). The concentration of arsenic was higher than the concentration reported in 2013 (0.0022 mg/L). The concentrations of most other metals were lower than those observed in 2014 but greater than those observed in 2012 and 2013. No exceedances of the baseline concentrations plus 3σ were reported in 2015. No PHC or PCB were detected in the groundwater sample collected at MW-02 in 2015.

MW-03

The depth to groundwater measured at MW-03 in 2015 was 0.58 m below grade. The groundwater results at MW-03 (MW0903) exhibited elevated concentrations of zinc and arsenic. The concentrations of zinc (2.06 mg/L) and arsenic (0.004 mg/L) exceeded their baseline concentrations (0.79 mg/L and 0.003 mg/L, respectively). The concentrations of chromium, zinc and arsenic were generally lower in 2015 in comparison to those observed in previous years, which was similarly the case for all other metals. No exceedances of the baseline concentrations plus 3σ were reported in 2015. No PHC or PCB were detected in the groundwater sample collected at MW-03 in 2015.

MW-04

The depth to groundwater measured at MW-04 in 2015 was 0.44 m below grade. The groundwater results at MW-04 (MW0904) indicated all parameters were less than the baseline values. The concentrations of all metals were lower in comparison to those observed from 2012 to 2014. No PHC or PCB were detected in the groundwater sample collected at MW-04 in 2015.

Table 4-18: Monitoring Well Groundwater Levels and Groundwater Chemical Analysis Results - Tier II Disposal Facility

ID	GW Depth BGS (m)	Cu (mg/L)	Ni (mg/L)	Co (mg/L)	Cd (mg/L)	Pb (mg/L)	Zn (mg/L)	Cr (mg/L)	As (mg/L)	Hg (mg/L)	Total PCBs (mg/L)	F1 (mg/L)	F2 (mg/L)	F3 (mg/L)	F4 (mg/L)
Baseline Mean		**NA**	**NA**	**NA**	**NA**	**NA**	**0.79**	**0.0050**	**0.0030**	**0.00040**	**0.003**	**NA**	**NA**	**NA**	**NA**
Baseline + 3σ		NA	NA	NA	NA	NA	5.0	0.025	0.013	0.00040	0.005	NA	NA	NA	NA
Upgradient															
MW-01	0.59	0.0282	0.073	0.0161	0.0004	0.0113	0.09	**0.006**	**0.004**	<0.0001	<0.00005	<0.025	<0.1	<0.1	<0.1
MW-02	0.98	0.0979	0.054	0.0051	0.0002	0.0184	0.239	**0.011**	**0.008**	<0.0001	<0.00005	<0.025	<0.1	<0.1	<0.1
Cross-gradient															
MW-03	0.58	0.0374	0.038	0.0045	0.0002	0.0011	**2.06**	<0.001	**0.005**	<0.0001	<0.00005	<0.025	<0.1	<0.1	<0.1
MW-04	0.44	<0.0005	0.103	0.0377	0.0008	0.0019	0.06	<0.001	<0.001	<0.0001	<0.00005	<0.025	<0.1	<0.1	<0.1

Notes:

ID: Monitoring well location ID.

GW: Groundwater.

BGS: Below ground surface.

NA: Not available

Bold Values: Results exceed Baseline arithmetic mean.

4.4.7 Conclusions and Overall Performance of the Tier II Disposal Facility

Based on the visual inspection, there were no indications of instability at the Tier II Disposal Facility. No erosion, cracks, staining or exposed waste was observed. There were five shallow depressions on the cover surface with ponded water that are not considered to be a concern. Some shallow ponded water was observed along the northwestern and west toe of the landfill; however they are not expected to contribute to increased thawing of permafrost.

Soil samples were collected at all designated locations in 2015; two soil samples were collected at all of sampling locations. Concentrations of copper, nickel, zinc, chromium and arsenic were detected above the background/baseline arithmetic mean at two or more soil sampling locations. Lead was detected at the background and baseline concentrations at MW-04. Most metal concentrations were highest at MW-01. At all four locations, the concentrations of most metals were similar to or less than those observed from 2012 to 2014. No detectable concentrations of PHC or PCB were noted in any of the samples in 2015.

In 2015, groundwater samples were collected from all four monitoring wells adjacent to the landfill. Exceedances of the baseline values were reported for zinc, chromium and arsenic. At MW-01, MW-03 and MW-04, these concentrations were generally lower than those reported from 2012 to 2014. At MW-02, concentrations were generally lower than those reported in 2014 but greater than those reported in 2012 and 2013. No detectable concentrations of PHC or PCB were noted in any of the groundwater samples in 2015.

Comparison of groundwater elevations based on estimated grade elevation and the measured water depth in the wells indicates that groundwater in was highest at MW-01, and lowest towards the south at MW-04.

Based on the results, there does not appear to be significant impact to groundwater quality from the landfill at the four monitoring wells adjacent to the landfill.

4.4.8 Recommendations for Tier II Disposal Facility

No modifications to the ongoing monitoring program at this landfill are recommended.

5.0 QA/QC RESULTS

This section contains the results of the QA/QC program described in Section 3.3. The results are described in terms of accuracy, reliability (blank analysis) and reproducibility (duplicate analysis).

The four DEW Line sites monitored in 2015 were performed using a single deployment of Golder personnel and equipment and the standard operating procedures were consistent from site to site. The QA/QC analysis below contains both program-level and site-level discussions, where appropriate. The laboratory reports related to the site-level discussion are contained in Appendix C.

5.1 Hold Times

The generally accepted hold times for the parameters analyzed in this program are:

- Metals in soil: 180 days, metals in water 60 days;
- Mercury in soil and water is 28 days
- PCB in soil: 365 days and 7 days in water
- PHC-F1 in soil: 48 hours (if unpreserved), PHC-F1 in water: 7 days
- PHC F2-F4 in soil: 14 days, PHC F2-F4 in water: 7 days

FOX-3, the groundwater sampling was carried out on August 19, 2015 and the samples were received at Paracel eight days later, on August 27, 2015. The soil sampling was carried out on August 17 and 18, 2015 and the samples were received at Paracel on Aug 28, which was 10 to 11 days later. The duplicate soil and groundwater samples were received at AGAT on August 27, 2015, 11 days post-sampling for the earliest soil samples and eight days post sampling for groundwater.

Maximum hold times were achieved for all parameters being analyzed in soil except for PHC-F1 which was exceeded by 8-9 days due to its very short hold time of 48 hours. The very short hold time for unpreserved PHC-F1 in soil is a known issue but it has been decided to not preserve this parameter in order to maintain consistency with earlier data in the program.

For groundwater, the maximum hold time of 7 days for PCB, and PHC F1-F4 were exceeded by one day. This was due to the fact that we could not get a resupply flight into FOX-3 for four days due to weather conditions. Given that the hold time for PCB and PHC F1-F4 in water was exceeded by only one day and that the concentrations of these parameters were below detection in all water samples, the delay is not expected to have had a material effect on the reported results.

5.2 Accuracy

Accuracy is a measure of how close a measured value is to the true value. The accuracy of the laboratory data is generally evaluated by the laboratory through the use of matrix spikes or surrogate recoveries. For the FOX-3 samples, Paracel performed a spike analysis on water and one on soil. The spike recoveries for lead and PCB in soil were close to the upper end of the acceptable range; however every parameter met the acceptable data quantity objectives. AGAT also performed a matrix spike on FOX-3 soil and water samples and all of their results were within their own data quality objectives. The labs' data quality objectives for PHC and PCB were 60-140% recovery, and 80-120% recovery for metals.

5.3 Reliability

Reliability is a measure of certainty that the concentrations reported by the labs are reliable indicators of field conditions and have not been affected other sources of contamination. The analysis of blanks provides a measure of reliability. Two sets of bottles of deionized water for Trip Blanks accompanied the team on the 2015 monitoring program; one from Paracel and one from AGAT. These bottles were not opened at the sites. The analytical reports from both labs indicate that no parameter was detected in the Trip Blanks at the end of the trip. One field blank was prepared on the 2015 program. Sample bottles were filled with distilled water in the field at CAM-5. No parameter was detected in the field blank.

The Trip Blank and Field Blank sample results suggest that no external sources of contamination have affected the reported lab results.

5.4 Reproducibility (Duplicate Analysis)

The reproducibility of lab results was measured through the testing of field duplicate samples. Duplicate soil samples were prepared in the field by mixing the soil in a stainless steel bowl and taking portions of soil and alternately filling the sample jars for the two labs. If a duplicate from the lower of the two sample intervals was being prepared, it was sometimes mixed at the bottom of the test pit.

The total number of original soil samples collected was 230, for which 22 duplicate soil samples were prepared and analyzed, providing a duplicate rate of approximately 10%. For groundwater, a total of 26 samples were collected and five duplicates were analyzed, which is a duplicate rate of more than 10%. The distribution of duplicate soil and groundwater samples over the four sites is provided in the table below.

Four soil duplicates and one groundwater duplicate were prepared at FOX-3.

Soil Samples and Duplicates

	DEW Line Site				Totals
	CAM-5	FOX-2	FOX-3	DYE-M	
Soil Samples Collected	27	38	40	125	230
Duplicate Soil Samples	3	3	4	12	22
Percent	11.1%	7.9%	10.0%	9.6%	9.6%

Groundwater Samples and Duplicates

	DEW Line Site				Totals
	CAM-5	FOX-2	FOX-3	DYE-M	
Monitoring Well Sampled	5	11	8	12	26
Duplicate Groundwater Samples	1	1	1	2	5
Percent	20.0%	9.1%	12.5%	16.7%	13.9%

To determine the precision of the original and duplicate sample results, the RPD was calculated according to the following equation:

$$RPD = \frac{|x_2 - x_1|}{\left(\frac{x_1 + x_2}{2}\right)} \times 100\%$$

Where, x_1 and x_2 are the original and duplicate concentrations of a given parameter in a pair. RPD can only be calculated if concentrations of given parameter are greater than the analytical method detection limits (MDL) in both the duplicate and original samples of the pair. Additionally, lower precision in the RPD calculation occurs when the reported concentrations are less than five (5) times the MDL. RPDs have been calculated wherever the concentrations of a parameter were five (5) times greater than the MDL in both the original and duplicate samples. Sample RPD were calculated by taking the average of the parameter RPD for a given sample-duplicate pair, and a program-level RPD was calculated by taking the average of all sample RPD to arrive at a program-wide indication of repeatability.

The TOR sets a data quality objective (DQO) for the RPD in soil and groundwater between a sample and its duplicate of 30%. A discussion or the RPD for the program and at FOX-3 is provided below.

5.4.1 Soil Samples

Organics and PCB

All of the duplicate pairs of soil samples in the program had PHC F1-F3 results which were below the detection limit and all PCB concentrations were below the detection limit. The precision of these results is therefore not a concern.

Metals

Program Level Interpretation

Mercury and cadmium were below detection limits for all 22 original and duplicate pairs in the program. RPD calculations were undertaken on the seven remaining metals (copper, nickel, cobalt, lead, zinc, chromium and arsenic) for the 22 pairs of duplicate soil samples. The program-level average RPD for the soil sample duplicate analysis was 18%, which slightly exceeded the met the specified data quality objective for inorganics of 15%.

Four of the 22 soil sample pairs in the program had a sample average RPD of over 30%; but they were not collected at FOX-3. Overall, the most frequent metals to have an RPD over 30% were zinc, lead and copper. The results for the samples analyzed by AGAT exhibited generally higher metals concentrations in 13 cases; Paracel's overall concentrations were higher in seven cases, and in two cases it was evenly spilt. There appears to be a bias in that results from AGAT were generally higher than those of Paracel.

Site Level Interpretation

From the four soil sample duplicates taken at FOX-3 there were 28 potential parameter pairs for RPD analysis (7 metals times 4 samples). As shown in the table below, all of the 28 potential metal parameter pairs had concentrations greater than 5 times the MDL in both the original and duplicate, and therefore all 28 individual RPDs were calculated. The individual RPDs ranged from 1% to 25%. Lead had the highest RPD, from 15% to 25% and arsenic was the lowest, from 1 to 7%. The average of the 28 RPD calculations from the four samples was just 9%, which was on the low side of the range of RPD in the program and met the data quality objective of less than 15%. The table below shows the metals results and RPD calculations for FOX-3.

With all of the individual RPDs at FOX-3 below 30% and a site average RPD of 9%, it is concluded that the reproducibility of the soil sample results at FOX-3 was acceptable.

Relative Percent Difference Analysis of Soil Data at FOX-3

		Parameter Concentrations (mg/kg)								
Sample ID	**Lab**	**Cu**	**Ni**	**Co**	**Pb**	**Zn**	**Cr**	**As**	**Sample Average RPD**	**Any Over 30%?**
MDL		<1	<1	<1	<1	<1	<1	<1		
F3-10 (40-50)	Paracel	26.2	25.6	9.1	7	56.2	63.1	9.7	12%	no
F3-10 (40-50) (Duplicate)	AGAT	30	29	9.9	6	70	69	10		
RPD		14%	12%	8%	15%	22%	9%	3%		
F3-12 (0-15)	Paracel	39.5	32.1	10.7	9	63	73.4	15.9	10%	no
F3-12 (0-15) (Duplicate)	AGAT	39	35	11.7	7	75	78	16		
RPD		1%	9%	9%	25%	17%	6%	1%		
F3-5 (0-15)	Paracel	29.3	27.3	9.4	7.4	59.6	70.7	13.2	8%	no
F3-5 (0-15) (Duplicate)	AGAT	29	29	9.3	6	72	73	13		
RPD		1%	6%	1%	21%	19%	3%	2%		
MW-01 (0-15)	Paracel	46.8	37.8	11.3	9.7	65.9	87.3	30	8%	no
MW-01 (0-15) (Duplicate)	AGAT	46	41	11.2	8	77	90	28		
RPD		2%	8%	1%	19%	16%	3%	7%		
Concentration <5 x MDL		none							9%	no

5.4.2 Groundwater Samples

Organics and PCB

All five of the duplicate pairs of groundwater samples in the program had PHC F1-F3 results which were below the detection limit and all PCB concentrations were below the detection limit. The precision of these results is therefore not a concern.

Metals

Program Level Interpretation

Given the five groundwater duplicate pairs and nine metals analyzed, there were 45 potential parameters pairs for duplicate analysis via RPD calculation (9 metals times 5 samples); however, only twenty of these parameter pairs had both parameters detected above the MDL, and only 13 had both parameters greater than five times the MDL and were therefore eligible for RPD analysis.

The program-level average RPD for water analysis of metals (where both parameters were over five times the MDL) was 30%, which exceeds the data quality objective of 15%.

Site Level Interpretation

MW0906 was the groundwater sample that had a duplicate at FOX-3. As shown in the table below, there were only three groundwater parameter pairs for which the concentrations in the original and duplicate were over 5 times the MDL (copper, nickel, arsenic) thus three RPDs were calculated for the groundwater duplicate at FOX-3. The three RPDs were rather high (79%, 75%, 46%). The actual concentrations of metals in groundwater at FOX-3 were low, with six of the nine metals at less than 5 times the MDL and the others just over that threshold. Another possible reason for the higher than desirable RPD was that little purging was performed due to the very limited volume of groundwater available in the well, and priority being given to obtaining the groundwater sample before all available groundwater was removed.

Relative Percent Difference Analysis of Groundwater Data at FOX-3

		Parameter Concentrations (mg/L)										
Sample ID	**Lab**	**Cu**	**Ni**	**Co**	**Cd**	**Pb**	**Zn**	**Cr**	**As**	**Hg**	**Average RPD**	**Any Over 30%?**
MDL		<0.0005	<0.001	<0.0005	<0.0001	<0.0001	<0.005	<0.001	<0.001	<0.0001		
MW0906	Paracel	0.0622	0.022	0.0033	0.0003	0.011	0.233	0.006	0.008	<0.0001	67%	3
MW0906 (Duplicate)	AGAT	0.027	0.01	<0.001	0.00007	<0.001	0.017	<0.002	0.005	0.000023		
RPD		79%	75%						46%		67%	
Concentration <5 x MDL		🟨										

Report Signature Page

We trust that this Monitoring Report meets the Project requirements of DND. Please direct any questions to the undersigned.

GOLDER ASSOCIATES LTD.

Reza Moghaddam, Ph.D., P.Eng.
Geotechnical Engineer

1/4/2016
P.J. DEWAELE

Paul Dewaele, M.Sc. P.Eng. (NU, NT, ON)
Principal, Geo-Environmental Engineer

April 6/2016
D.C. JOHNSON

Darrin Johnson, P.Eng. (NU, NT, ON), PMP
Associate, Project Manager and
Geotechnical Engineer

Don Plenderleith

Don Plenderleith, P.Eng. (NU, NT, ON), PMP
Principal, Project Director and Environmental Engineer

DCJ/DHP/RM/PJD/JEB

Golder, Golder Associates and the GA globe design are trademarks of Golder Associates Corporation.

\\golder.gds\gal\ottawa\active\2015\3 proj\1530908 pwgsc dew line\6_1000_2015\9_final reports\r2_fox-3\final version\1530908_final 2015 fox-3 monitoring report_31mar2016.docx

APPENDIX A

Report Limitations

REPORT LIMITATIONS

This report has been prepared as an assessment of the environmental condition and visual inspection of the subject site. The monitoring program described in this report was conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practising under similar conditions, subject to the time limits and financial and physical constraints applicable to the services. The scope of work was carried out in accordance with the agreement between Golder Associates Ltd. and the client.

The assessment of environmental conditions at this Site has been made using the results of chemical analysis of soil and groundwater from a limited number of locations. The Site conditions between sampling locations have been inferred based on conditions observed at sampling locations. Subsurface conditions may vary from those encountered at the sample locations. Additional study, including further subsurface investigation, can reduce the inherent uncertainties associated with this type of study. However, it is never possible, even with exhaustive sampling and testing, to dismiss the possibility that part of a Site may be contaminated and remain undetected. Visual inspection comments are based on observed conditions at the time of the inspection and may change with time.

Any use which a third party makes of this report, or any reliance on, or decisions to be made based on it, are the responsibility of such third parties. Golder Associates Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on the information contained in this report.

The content of this report is based on information collected during our monitoring program, our present understanding of the Site conditions, and our professional judgement in light of such information at the time of writing this report. This report provides a professional opinion and therefore no warranty is expressed, implied, or made as to the conclusions and recommendations offered in this report. This report does not provide a legal opinion regarding compliance with applicable laws. With respect to regulatory compliance issues, it should be noted that regulatory statutes and the interpretation of regulatory statutes are subject to change.

The findings and conclusions of this report are valid only as of the date of this report. If new information is discovered, Golder Associates Ltd. should be requested to re-evaluate the conclusions of this report, and to provide amendments as required.

APPENDIX B

Field Records

Monitoring Well Sampling Logs

Thermistor Inspection Record Sheets

Thermistor Inspection Field Record Sheet

Inspector Name:	Reza Moghaddam	Inspection Date:	August 16 , 2015
Inspector Signature / Prepared By:			

Thermistor Information (*Some Information can be pre-populated from thermistor logs)

Site Name:	**FOX-3**	Landfill:	Tier II Disposal Facility		
Thermistor Number:	**VT-1**	Inclination:	Vertical		
Datalogger model no:		Datalogger cable download model:			
*Install Date:	**2011-09-07**	First Date Event	**27-Aug-14**	Last Date Event	**16-Aug-15**
*Coordinates and Elevation	N **7615563**	E **409318**	Elev **422 m**		
Length of Cable (m)	**9.54**	Cable Lead Above Ground (m)	3.71		
Datalogger Serial #	**9100022**	Nodal Points	14		

Thermistor Inspection

	Good	Needs Maintenance	Description
Casing	X	☐	
Cover	X	☐	
Data Logger	X	☐	
Cable	X	☐	
Beads	X	☐	
Lock condition	X	☐	
Battery Installation Date	**2011-09-07**		
Battery Levels	Main 11.34	Aux 13.63	

Manual Ground Temperature Readings

Bead	Volts	Degrees C
1	1.1056	5.3536
2	1.0762	4.3930
3	1.0208	2.5764
4	1.0147	2.3760
5	0.9694	0.8859
6	0.9259	-0.5575
7	0.8931	-1.6560
8	0.8609	-2.9375

Bead	Volts	Degrees C
9	0.8863	-3.5851
10	0.8089	-4.5291
11	0.7855	-5.3451
12	0.7874	-5.9812
13	0.7560	-6.3841
14	0.7405	-6.9397

Battery Information

Batteries changed ? Yes ☐ No ☒ Monitoring Year:

Battery model number installed:

Expected battery life (years):

Datalogger Programming (Describe programming completed; beads and frequency)

Observations and Proposed Maintenance

Memory 39% used.

Thermistor Inspection Field Record Sheet

Inspector Name:	Reza Moghaddam	Inspection Date:	August 16 , 2015
Inspector Signature / Prepared By:			

Thermistor Information (*Some Information can be pre-populated from thermistor logs)

Site Name:	**FOX-3**	Landfill:	Tier II Disposal Facility		
Thermistor Number:	**VT-2**	Inclination:	Vertical		
Datalogger model no:		Datalogger cable download model:			
*Install Date:	**2011-09-07**	First Date Event	**27-Aug-14**	Last Date Event	**16-Aug-15**
*Coordinates and Elevation		N **7615562**	E **409336**	Elev	**422.44 m**
Length of Cable (m)	**7.52**	Cable Lead Above Ground (m)	3.92		
Datalogger Serial #	**9100028**	Nodal Points	10		

Thermistor Inspection

	Good	Needs Maintenance	Description
Casing	X	☐	
Cover	X	☐	
Data Logger	X	☐	
Cable	X	☐	
Beads	X	☐	
Lock condition	X	☐	

Battery Installation Date **2011-09-07**

Battery Levels Main 11.34 Aux 13.50

Manual Ground Temperature Readings

Bead	Volts	Degrees C
1	1.8852	4.6874
2	1.1068	5.3910
3	1.0633	3.9687
4	1.0195	2.5339
5	1.0023	1.9699
6	0.9603	0.5856
7	0.9114	-1.0442
8	0.878	-2.3526

Bead	Volts	Degrees C
9	0.8484	-3.1702
10	0.8186	-4.1939

Battery Information

Batteries changed ? Yes ☐ No ☒ Monitoring Year:

Battery model number installed:

Expected battery life (years):

Datalogger Programming (Describe programming completed; beads and frequency)

Observations and Proposed Maintenance

Memory 39% used.

Thermistor Inspection Field Record Sheet

Inspector Name:	Reza Moghaddam	Inspection Date:	August 16 , 2015
Inspector Signature / Prepared By:			

Thermistor Information (*Some Information can be pre-populated from thermistor logs)

Site Name:	**FOX-3**	Landfill:	Tier II Disposal Facility		
Thermistor Number:	**VT-3**	Inclination:	Vertical		
Datalogger model no:		Datalogger cable download model:			
*Install Date:	**2011-09-07**	First Date Event	**27-Aug-14**	Last Date Event	**16-Aug-15**
*Coordinates and Elevation		N **7615523**	E **409367**	Elev	**422.59m**
Length of Cable (m)	**8.05**	Cable Lead Above Ground (m)	4.32		
Datalogger Serial #	**9100048**	Nodal Points	11		

Thermistor Inspection

	Good	Needs Maintenance	Description
Casing	X	☐	
Cover	X	☐	
Data Logger	X	☐	
Cable	X	☐	
Beads	X	☐	
Lock condition	X	☐	
Battery Installation Date	**2011-09-07**		
Battery Levels	Main 11.34	Aux 13.26	

Manual Ground Temperature Readings

Bead	Volts	Degrees C
1	1.1213	5.8676
2	1.1417	6.5344
3	1.1013	5.2114
4	1.0189	2.5163
5	1.005	2.0577
6	0.966	0.7724
7	0.9156	-0.9039
8	0.8937	-1.6300

Bead	Volts	Degrees C
9	0.8504	-3.1026
10	0.8242	-4.0019
11	0.7973	-4.9320

Battery Information

Batteries changed ? Yes ☐ No ☒ Monitoring Year: ______

Battery model number installed: ______

Expected battery life (years): ______

Datalogger Programming (Describe programming completed; beads and frequency)

Observations and Proposed Maintenance

Memory 39% used.

Thermistor Inspection Field Record Sheet

Inspector Name:	Reza Moghaddam	Inspection Date:	August 16 , 2015
Inspector Signature / Prepared By:			

Thermistor Information (*Some Information can be pre-populated from thermistor logs)

Site Name:	**FOX-3**	Landfill:	Tier II Disposal Facility		
Thermistor Number:	**VT-4**	Inclination:	Vertical		
Datalogger model no:		Datalogger cable download model:			
*Install Date:	**2011-09-07**	First Date Event	**27-Aug-14**	Last Date Event	**16-Aug-15**
*Coordinates and Elevation		N **7615522**	E **409384**	Elev	**422.56 m**
Length of Cable (m)	**10**	Cable Lead Above Ground (m)	4.05		
Datalogger Serial #	**9100049**	Nodal Points	15		

Thermistor Inspection

	Good	Needs Maintenance	Description
Casing	X	☐	
Cover	X	☐	
Data Logger	X	☐	
Cable	X	☐	
Beads	X	☐	
Lock condition	X	☐	
Battery Installation Date	**2011-09-07**		
Battery Levels	Main 11.34	Aux 13.38	

Manual Ground Temperature Readings

Bead	Volts	Degrees C
1	1.1422	6.5518
2	1.1116	5.5488
3	1.0316	2.9318
4	1.0115	2.2708
5	0.9904	1.5781
6	0.9391	-0.1205
7	0.9035	-1.3075
8	0.8700	-2.4362

Bead	Volts	Degrees C
9	0.8425	-3.3735
10	0.8143	-4.3415
11	0.7903	-5.1770
12	0.7655	-6.0487
13	0.7492	-6.6286
14	0.7350	-7.1342
15	0.7241	-7.5277

Battery Information

Batteries changed ? Yes ☐ No ☒ Monitoring Year:

Battery model number installed:

Expected battery life (years):

Datalogger Programming (Describe programming completed; beads and frequency)

Observations and Proposed Maintenance

Memory 39% used.

Annex J: Monitoring Wells Sampling Log

Site Name: FOX3
Landfill Name: Tier II Facility
Monitoring Well ID: MW-01
Sample Number(s) include dups.: MW-01
Bottles filled (by parameter type) BTEX, Metals, Mercury, F2-F4, PCB
Date of Sampling Event: 19 August 2015 Time: 4:00
Weather Rain
Names of Samplers KR
Description of well condition and surrounding ground conditions (note ponding of water):
Small puddles on surface. 10 cm of water in casing.
Lock (condition, presence, model, manufacturer): No lock

Pre-Measured Data (from water well record log)

Depth of well installation (cm): 0
Diameter of well (cm): 4.4
Depth to top of screen (cm): 0
Length of screened section (cm): 0

Field Measurements

Measurement method (interface probe, tape, etc): Interface Probe
Well pipe height above ground (cm) (to top of pipe): 30
Static water level (cm) from top of pipe: 89
Static water level (cm) (below ground surface) calculated: 59
Measured well refusal depth (cm) (measured after sampling): 184
Thickness of water column (cm): 95
Static Volume of water in well (mL): 1445
Free product thickness (mm): N/A
Evidence of Sludge or siltation: N/A

Purge Information Summary

Purging/sampling equipment, sampling technique and equipment calibration information:
<100mL removed from well to facilitate measurement of field parameters.
Filling of sample bottles was completed directly after measurement. Peristaltic pump @ <0.100 L/min
Well purged (Y/N): N/A
Recharge Rate: N/A
Volume Purged (L) (note multiple purging events):

Parameter	Initial	Stablized	Final	Notes
pH	8.05			
Conductivity (mS/cm)	0.218			
Turbidity (NTU)	919			
Temperature (degC)	3.55			

Visual/olfactory observations:
Turbid

Decontamination of sampling equipment

Type of decontamination fluid(s):
Number of washes: N/A
Number of rinses: N/A

Other relevant comments:

Annex J: Monitoring Wells Sampling Log

Site Name: FOX3 Landfill Name:
Monitoring Well ID: MW-02 Tier II Facility
Sample Number(s) include dups.: MW-02
Bottles filled (by parameter type) BTEX, Metals, Mercury, F2-F4, PCB
Date of Sampling Event: 19 August 2015 Time: 3:30
Weather Light rain
Names of Samplers KR
Description of well condition and surrounding ground conditions (note ponding of water):
Standing water southeast of well, wet soil adjacent.
Lock (condition, presence, model, manufacturer): Crown working.

Pre-Measured Data (from water well record log)

Depth of well installation (cm): 0 Diameter of well (cm): 4.4
Depth to top of screen (cm): 0 Length of screened section (cm): 0

Field Measurements

Measurement method (interface probe, tape, etc): Interface Probe
Well pipe height above ground (cm) (to top of pipe): 0
Static water level (cm) from top of pipe: 98
Static water level (cm) (below ground surface) calculated: 98
Measured well refusal depth (cm) (measured after sampling): 198
Thickness of water column (cm): 100 Static Volume of water in well (mL): 1521
Free product thickness (mm): N/A Evidence of Sludge or siltation: N/A

Purge Information Summary

Purging/sampling equipment, sampling technique and equipment calibration information:
<100mL removed from well to facilitate measurement of field parameters.
Filling of sample bottles was completed directly after measurement. Peristaltic pump @ <0.100 L/min
Well purged (Y/N): N/A Recharge Rate: N/A
Volume Purged (L) (note multiple purging events):

Parameter	Initial	Stablized	Final	Notes
pH	8.5			
Conductivity (mS/cm)	0.176			
Turbidity (NTU)	533			
Temperature (degC)	4			

Visual/olfactory observations:
Turbid

Decontamination of sampling equipment

Type of decontamination fluid(s):
Number of washes: N/A Number of rinses: N/A

Other relevant comments:

Annex J: Monitoring Wells Sampling Log

Site Name: FOX3

Landfill Name: Tier II Facility

Monitoring Well ID: MW-03

Sample Number(s) include dups.: MW-03

Bottles filled (by parameter type) BTEX, Metals, Mercury, F2-F4, PCB

Date of Sampling Event: 19 August 2015 Time: 3:30

Weather Light rain

Names of Samplers KR

Description of well condition and surrounding ground conditions (note ponding of water):
Standing water southeast of well, wet soil adjacent.

Lock (condition, presence, model, manufacturer): Crown working.

Pre-Measured Data (from water well record log)

Depth of well installation (cm): 0

Diameter of well (cm): 4.4

Depth to top of screen (cm): 0

Length of screened section (cm): 0

Field Measurements

Measurement method (interface probe, tape, etc): Interface Probe

Well pipe height above ground (cm) (to top of pipe): 54

Static water level (cm) from top of pipe: 112

Static water level (cm) (below ground surface) calculated: 58

Measured well refusal depth (cm) (measured after sampling): 217

Thickness of water column (cm): 105

Static Volume of water in well (mL): 1597

Free product thickness (mm): N/A

Evidence of Sludge or siltation: N/A

Purge Information Summary

Purging/sampling equipment, sampling technique and equipment calibration information:
<100mL removed from well to facilitate measurement of field parameters.
Filling of sample bottles was completed directly after measurement. Peristaltic pump @ <0.100 L/min

Well purged (Y/N): N/A

Recharge Rate: N/A

Volume Purged (L) (note multiple purging events):

Parameter	Initial	Stablized	Final	Notes
pH	8.6			
Conductivity (mS/cm)	0.123			
Turbidity (NTU)	44.3			
Temperature (degC)	3.74			

Visual/olfactory observations:
Turbid

Decontamination of sampling equipment

Type of decontamination fluid(s):

Number of washes: N/A

Number of rinses: N/A

Other relevant comments:

Annex J: Monitoring Wells Sampling Log

Site Name: FOX3
Landfill Name: Tier II Facility
Monitoring Well ID: MW-04
Sample Number(s) include dups.: MW-04
Bottles filled (by parameter type) BTEX, Metals, Mercury, F2-F4, PCB
Date of Sampling Event: 19 August 2015 Time: 4:30
Weather Rain
Names of Samplers KR
Description of well condition and surrounding ground conditions (note ponding of water):
Standing water adjacent to well, 2 cm water in casing, casing I sloose.
Lock (condition, presence, model, manufacturer): Crown, working

Pre-Measured Data (from water well record log)

Depth of well installation (cm): 0
Diameter of well (cm): 4.4
Depth to top of screen (cm): 0
Length of screened section (cm): 0

Field Measurements

Measurement method (interface probe, tape, etc): Interface Probe
Well pipe height above ground (cm) (to top of pipe): 37
Static water level (cm) from top of pipe: 81
Static water level (cm) (below ground surface) calculated: 44
Measured well refusal depth (cm) (measured after sampling): 200
Thickness of water column (cm): 119
Static Volume of water in well (mL): 1809
Free product thickness (mm): N/A
Evidence of Sludge or siltation: N/A

Purge Information Summary

Purging/sampling equipment, sampling technique and equipment calibration information:
<100mL removed from well to facilitate measurement of field parameters.
Filling of sample bottles was completed directly after measurement. Peristaltic pump @ <0.100 L/min
Well purged (Y/N): N/A
Recharge Rate: N/A
Volume Purged (L) (note multiple purging events):

Parameter	Initial	Stablized	Final	Notes
pH	8.2			
Conductivity (mS/cm)	0.183			
Turbidity (NTU)	555			
Temperature (degC)	3.47			

Visual/olfactory observations:
Turbid

Decontamination of sampling equipment

Type of decontamination fluid(s):
Number of washes: N/A
Number of rinses: N/A

Other relevant comments:

Annex J: Monitoring Wells Sampling Log

Site Name: FOX3 Landfill Name: Non-Haz Waste LF
Monitoring Well ID: MW-06
Sample Number(s) include dups.: MW-06 and MW-06 Duplicate
Bottles filled (by parameter type) BTEX, Metals, Mercury, F2-F4, PCB
Date of Sampling Event: 19 August 2015 Time: 2:30
Weather Light rain
Names of Samplers KR
Description of well condition and surrounding ground conditions (note ponding of water):
Roadside ditch adjacent to well has flowing water.
Lock (condition, presence, model, manufacturer): Crown working.

Pre-Measured Data (from water well record log)

Depth of well installation (cm): 0 Diameter of well (cm): 4.4
Depth to top of screen (cm): 0 Length of screened section (cm): 0

Field Measurements

Measurement method (interface probe, tape, etc): Interface Probe
Well pipe height above ground (cm) (to top of pipe): 37
Static water level (cm) from top of pipe: 100
Static water level (cm) (below ground surface) calculated: 63
Measured well refusal depth (cm) (measured after sampling): 206
Thickness of water column (cm): 106 Static Volume of water in well (mL): 1612
Free product thickness (mm): N/A Evidence of Sludge or siltation: N/A

Purge Information Summary

Purging/sampling equipment, sampling technique and equipment calibration information:
<100mL removed from well to facilitate measurement of field parameters.
Filling of sample bottles was completed directly after measurement. Peristaltic pump @ <0.100 L/min
Well purged (Y/N): N/A Recharge Rate: N/A
Volume Purged (L) (note multiple purging events):

Parameter	Initial	Stablized	Final	Notes
pH	8.92			
Conductivity (mS/cm)	0.115			
Turbidity (NTU)	459			
Temperature (degC)	3.7			

Visual/olfactory observations:
Turbid

Decontamination of sampling equipment

Type of decontamination fluid(s):
Number of washes: N/A Number of rinses: N/A

Other relevant comments:

Annex J: Monitoring Wells Sampling Log

Site Name: FOX3 Landfill Name: Non-Haz Waste LF
Monitoring Well ID: MW-07
Sample Number(s) include dups.: MW-07
Bottles filled (by parameter type) BTEX, Metals, Mercury, F2-F4, partial PCB
Date of Sampling Event: 19 August 2015 Time: 1:15
Weather Clear, +5
Names of Samplers KR
Description of well condition and surrounding ground conditions (note ponding of water):
No surface water ponded, ground is wet. 10cm of water in casing
Lock (condition, presence, model, manufacturer): Crown working.

Pre-Measured Data (from water well record log)

Depth of well installation (cm): 0 Diameter of well (cm): 4.4
Depth to top of screen (cm): 0 Length of screened section (cm): 0

Field Measurements

Measurement method (interface probe, tape, etc): Interface Probe
Well pipe height above ground (cm) (to top of pipe): 30
Static water level (cm) from top of pipe: 71
Static water level (cm) (below ground surface) calculated: 41
Measured well refusal depth (cm) (measured after sampling): 177
Thickness of water column (cm): 106 Static Volume of water in well (mL): 1612
Free product thickness (mm): N/A Evidence of Sludge or siltation: N/A

Purge Information Summary

Purging/sampling equipment, sampling technique and equipment calibration information:
<100mL removed from well to facilitate measurement of field parameters.
Filling of sample bottles was completed directly after measurement. Peristaltic pump @ <0.100 L/min
Well purged (Y/N): N/A Recharge Rate: N/A
Volume Purged (L) (note multiple purging events):

Parameter	Initial	Stablized	Final	Notes
pH	9.2			
Conductivity (mS/cm)	0.17			
Turbidity (NTU)	591			
Temperature (degC)	3.9			

Visual/olfactory observations:
Turbid

Decontamination of sampling equipment

Type of decontamination fluid(s):
Number of washes: N/A Number of rinses: N/A

Other relevant comments:

Annex J: Monitoring Wells Sampling Log

Site Name: FOX3
Landfill Name: Non-Haz Waste LF
Monitoring Well ID: MW-08
Sample Number(s) include dups.: MW-08
Bottles filled (by parameter type) BTEX, Metals, Mercury, F2-F4, PCB
Date of Sampling Event: 19 August 2015 Time: 12:37
Weather Clear, +5
Names of Samplers KR
Description of well condition and surrounding ground conditions (note ponding of water):
rocky area, no standing water.
Lock (condition, presence, model, manufacturer): Crown working.

Pre-Measured Data (from water well record log)

Depth of well installation (cm): 0
Diameter of well (cm): 4.4
Depth to top of screen (cm): 0
Length of screened section (cm): 0

Field Measurements

Measurement method (interface probe, tape, etc): Interface Probe
Well pipe height above ground (cm) (to top of pipe): 84
Static water level (cm) from top of pipe: 108
Static water level (cm) (below ground surface) calculated: 24
Measured well refusal depth (cm) (measured after sampling): 182
Thickness of water column (cm): 74
Static Volume of water in well (mL): 1125
Free product thickness (mm): N/A
Evidence of Sludge or siltation: N/A

Purge Information Summary

Purging/sampling equipment, sampling technique and equipment calibration information:
<100mL removed from well to facilitate measurement of field parameters.
Filling of sample bottles was completed directly after measurement. Peristaltic pump @ <0.100 L/min
Well purged (Y/N): N/A
Recharge Rate: N/A
Volume Purged (L) (note multiple purging events):

Parameter	Initial	Stablized	Final	Notes
pH	10.1			
Conductivity (mS/cm)	0.292			
Turbidity (NTU)	285			
Temperature (degC)	3.2			

Visual/olfactory observations:
Turbid

Decontamination of sampling equipment

Type of decontamination fluid(s):
Number of washes: N/A
Number of rinses: N/A

Other relevant comments:

GOLDER PROJECT #1530908 PHASE 1000

ANNEX M: Thermistor Inspection Template

Inspector Name:	Inspection Date: August
Inspector Signature / Prepared By:	

Thermistor Information (*Some Information can be pre-populated from thermistor logs)

Site Name: FOX3		Landfill: Tier II Disposal Facility	
Thermistor Number: ✓ T4		Inclination:	
Datalogger model no:		Datalogger cable download model:	
*Install Date:		First Date Event	Last Date Event
*Coordinates and Elevation	N	E	Elev
Length of Cable (m)		Cable Lead Above Ground (m)	
Datalogger Serial # 09100049		Nodal Points	

Thermistor Inspection

	Good	Needs Maintenance	Description
Casing	☑	☐	
Cover	☑	☐	
Data Logger	☑	☐	
Cable	☑	☐	
Beads	☑	☐	
Lock condition	☑	☐	

Battery Installation Date

Battery Levels Main 9 11.34 Aux 12 13.38

Manual Ground Temperature Readings

Bead	ohms	Degrees C
1	1.1422	6.5518
2	1.1116	5.5482
3	1.0316	2.9318
4	1.0115	2.2708
5	0.9904	1.5781
6	0.9391	-0.1205
7	0.9035	-1.3075
8	0.8700	-2.4302

Bead	ohms	Degrees C
9	0.8425	-3.3735
10	0.8143	-4.3415
11	0.7903	-5.1770
12	0.7655	-6.0887
13	0.7492	-6.628
14	0.7350	-7.1342
15	0.7241	-7.5273

Battery Information

Batteries changed ? Yes ☐ No ☑ Monitoring Year:

Battery model number installed:

Expected battery life (years):

Datalogger Programming (Describe programming completed; beads and frequency)

Memory 39% used

Observations and Proposed Maintenance

GOLDER PROJECT #1530908 PHASE 1000

ANNEX M: Thermistor Inspection Template

Inspector Name: Pedro mo
Inspection Date: AUGUST Aug/6
Inspector Signature / Prepared By:

Thermistor Information (*Some Information can be pre-populated from thermistor logs)

Site Name: Fa3
Landfill: Tier II Disposal
Thermistor Number: √ T3
Inclination:
Datalogger model no:
Datalogger cable download model:
*Install Date:
First Date Event
Last Date Event
*Coordinates and Elevation N E Elev
Length of Cable (m)
Cable Lead Above Ground (m)
Datalogger Serial # 091 0048
Nodal Points

Thermistor Inspection

	Good	Needs Maintenance	Description
Casing	☑	☐	
Cover	☑	☐	
Data Logger	☐	☐	
Cable	☑	☐	
Beads	☑	☐	
Lock condition	☑	☐	

Battery Installation Date

Battery Levels Main 9 11.34 Aux 012 13.26

Manual Ground Temperature Readings

Bead	ohms	Degrees C
1	1.1213	5.8676
2	1.1417	6.5344
3	1.1013	5.2114
4	1.0189	2.5163
5	1.0050	2.0577
6	0.9660	0.7724
7	0.91560	-0.9039
8	0.8937	-1.6100

Bead	ohms	Degrees C
9	0.8504	-3.1026
10	0.8242	-4.0019
11	0.7973	-4.9520

Battery Information

Batteries changed ? Yes ☐ No ☑
Monitoring Year:
Battery model number installed:
Expected battery life (years):

Datalogger Programming (Describe programming completed; beads and frequency)

Observations and Proposed Maintenance

39%. Memory used

GOLDER PROJECT #1530908 PHASE 1000

ANNEX M: Thermistor Inspection Template

Inspector Name: Reza Moghadam	Inspection Date: August Aug 6, 2015
Inspector Signature / Prepared By:	

Thermistor Information (*Some Information can be pre-populated from thermistor logs)

Site Name: FOX II	Landfill: Tier II Disposal		
Thermistor Number: VT2	Inclination:		
Datalogger model no:	Datalogger cable download model:		
*Install Date:	First Date Event	Last Date Event	
*Coordinates and Elevation	N	E	Elev
Length of Cable (m)	Cable Lead Above Ground (m)		
Datalogger Serial # 0910028	Nodal Points		

Thermistor Inspection

	Good	Needs Maintenance	Description
Casing	☑	☐	
Cover	☑	☐	
Data Logger	☑	☐	
Cable	☑	☐	
Beads	☑	☐	
Lock condition	☑	☐	
Battery Installation Date			
Battery Levels	Main 4.34	Aux 13.50	

Manual Ground Temperature Readings

Bead	ohms	Degrees C
1	1.0852	4.6874
2	1.1068	5.3910
3	1.0633	3.9687
4	1.0195	2.5339
5	1.0023	1.9699
6	0.9603	0.5856
7	0.9114	-1.0442
8	0.8780	-2.3516

Bead	ohms	Degrees C
9	0.8484	-3.1702
10	0.8186	-4.1939

Battery Information

Batteries changed ? Yes ☐ No ☑ Monitoring Year:

Battery model number installed:

Expected battery life (years):

Datalogger Programming (Describe programming completed; beads and frequency)

Observations and Proposed Maintenance

39% used memory

GOLDER PROJECT #1530908 PHASE 1000

ANNEX M: Thermistor Inspection Template

Inspector Name: Rosa	Inspection Date: August 16, 2011
Inspector Signature / Prepared By:	

Thermistor Information (*Some Information can be pre-populated from thermistor logs)

Site Name:	[redacted]	Landfill: Tier. II Disposal	
Thermistor Number:	[redacted]	Inclination:	
Datalogger model no:	[redacted]	Datalogger cable download model:	[redacted]
*Install Date:		First Date Event	Last Date Event
*Coordinates and Elevation	N	E	Elev
Length of Cable (m)		Cable Lead Above Ground (m)	
Datalogger Serial #		Nodal Points	

Thermistor Inspection

	Good	Needs Maintenance	Description
Casing	☑	☐	
Cover	☑	☐	
Data Logger	☑	☐	
Cable	☑	☐	
Beads	☑	☐	
Lock condition	☑	☐	

Battery Installation Date

Battery Levels Main 9 11.34 Aux 12 13.63

Manual Ground Temperature Readings

Bead	ohms	Degrees C
1	1.1056	5.3536
2	1.0762	4.3930
3	1.0208	2.5784
4	1.0147	2.3760
5	0.9694	0.8359
6	0.9259	-0.5575
7	0.8931	-1.6560
8	0.8609	-29375

Bead	ohms	Degrees C
9	0.7863	-3.5851
10	0.8089	-4.5291
11	0.7855	-5.3457
12	0.7674	-5.9812
13	0.7560	-6.3841
14	0.7405	-6.9397

Battery Information

Batteries changed ? Yes ☐ No ☑ Monitoring Year:

Battery model number installed:

Expected battery life (years):

Datalogger Programming (Describe programming completed; beads and frequency)

Observations and Proposed Maintenance

39% Used memory

GOLDER PROJECT #1530908 PHASE 1000

ANNEX J: Monitoring Well Sampling Log (Complete All Fields)

Site Name: Fox3 Landfill Name:

Monitoring Well ID: MW0908

Sample Number(s) include dups.: ALL no dup

Bottles filled (by parameter type): Bottles filled.

Date of Sampling Event: AUGUST 19/2015 Time: 12:37

Weather: clear, +50

Names of Samplers: KR

Description of Well Condition and Surrounding ground conditions (note ponding of water): rocky surrounding no standing water.

Lock (condition, presence, model, manufacturer): crown, working

Pre-Measured Data (From Water Well Record Log)

*Depth of well installation (cm)= Diameter of well (cm)=

*Depth to top of screen (cm)= Length screened section (cm)=

*note: *depths are from ground surface*

Field Measurements

Measurement method (interface probe, tape, etc): IP.

Well pipe height above ground (cm) (to top of pipe)= 84cm.

Static water level (cm) from top of pipe = 108 cm.

Static water level (cm) (below ground surface) calculated =

Measured well refusal depth (cm) (measure after sampling)= 182cm

Thickness of water column (cm)= Static volume of water in well (mL)=

Free product thickness (mm)= Evidence of sludge or siltation:

Purging Information Summary*

Purging/sampling equipment, sampling technique and equipment calibration information: peristaltic.

Well purged (Y/N): Y Recharge Rate:

Volume Purged (L) (note multiple purging events if applicable): 40 mL

Parameter	Initial	Stabilized	Final	*Notes (if not stabilized)*
pH	10.10			
Conductivity (uS/cm)	0.292			
Turbidity (NTU)	285			
Temperature (degC)	3.2.			

Visual/olfactory observations (incl. colour, odour, presence of free product/sheen/globules, siltation…): turbid

Decontamination of sampling equipment

Type of decontamination fluid (s):

Number washes: Number rinses:

Other Relevant Comments:

* Complete field notes including full suite of water quality indicator parameters VS time as per EPA low flow sampling procedures should be apended to this summary.

GOLDER PROJECT #1530908 PHASE 1000

ANNEX J: Monitoring Well Sampling Log (Complete All Fields)

Site Name: Fox 3 Landfill Name:

Monitoring Well ID: MW0907

Sample Number(s) include dups.:

Bottles filled (by parameter type): All bottles PCB not quite full

Date of Sampling Event: AUGUST Time: ~~1pm~~ 1:15

Weather:

Names of Samplers: KR.

Description of Well Condition and Surrounding ground conditions (note ponding of water): no surface water, wet ground.

Lock (condition, presence, model, manufacturer): crown working.

Pre-Measured Data (From Water Well Record Log)

*Depth of well installation (cm)= Diameter of well (cm)=

*Depth to top of screen (cm)= Length screened section (cm)=

*note: *depths are from ground surface*

Field Measurements

Measurement method (interface probe, tape, etc): IP

Well pipe height above ground (cm) (to top of pipe)= 30 cm. (10 cm water in casing)

Static water level (cm) from top of pipe = 71

Static water level (cm) (below ground surface) calculated =

Measured well refusal depth (cm) (measure after sampling)= 177

Thickness of water column (cm)= Static volume of water in well (mL)=

Free product thickness (mm)= Evidence of sludge or siltation:

Purging Information Summary*

Purging/sampling equipment, sampling technique and equipment calibration information: peristaltic

Well purged (Y/N): y Recharge Rate:

Volume Purged (L) (note multiple purging events if applicable): 40ml for field measurement.

Parameter	Initial	Stabilized	Final	*Notes (if not stabilized)*
pH	9.2			
Conductivity (uS/cm)	0.170			
Turbidity (NTU)	591			
Temperature (degC)	3.9			

Visual/olfactory observations (incl. colour, odour, presence of free product/sheen/globules, siltation…): turbid,

Decontamination of sampling equipment

Type of decontamination fluid (s):

Number washes: Number rinses:

Other Relevant Comments:

* Complete field notes including full suite of water quality indicator parameters VS time as per EPA low flow sampling procedures should be apended to this summary.

GOLDER PROJECT #1530908 PHASE 1000

ANNEX J: Monitoring Well Sampling Log (Complete All Fields)

Site Name: Fox 3. Landfill Name:

Monitoring Well ID: MW0905

Sample Number(s) include dups.:

Bottles filled (by parameter type): all bottles

Date of Sampling Event: AUGUST 19. Time: 1:40

Weather: light rain.

Names of Samplers: KR

Description of Well Condition and Surrounding ground conditions (note ponding of water): wet at surface no ponded water.

Lock (condition, presence, model, manufacturer): Crown working

Pre-Measured Data (From Water Well Record Log)

*Depth of well installation (cm)= Diameter of well (cm)=

*Depth to top of screen (cm)= Length screened section (cm)=

*note: *depths are from ground surface*

Field Measurements

Measurement method (interface probe, tape, etc): IP

Well pipe height above ground (cm) (to top of pipe)= 30 no water in casing

Static water level (cm) from top of pipe = 80

Static water level (cm) (below ground surface) calculated =

Measured well refusal depth (cm) (measure after sampling)= 185

Thickness of water column (cm)= Static volume of water in well (mL)=

Free product thickness (mm)= Evidence of sludge or siltation:

Purging Information Summary*

Purging/sampling equipment, sampling technique and equipment calibration information: peristaltic

Well purged (Y/N): Y Recharge Rate:

Volume Purged (L) (note multiple purging events if applicable): 40 L

Parameter	Initial	Stabilized	Final	*Notes (if not stabilized)*
pH	8.92			
Conductivity (uS/cm)	0.255			
Turbidity (NTU)	41 96			
Temperature (degC)	3.62			

Visual/olfactory observations (incl. colour, odour, presence of free product/sheen/globules, siltation…): turbid.

Decontamination of sampling equipment

Type of decontamination fluid (s):

Number washes: Number rinses:

Other Relevant Comments:

* Complete field notes including full suite of water quality indicator parameters VS time as per EPA low flow sampling procedures should be apended to this summary.

GOLDER PROJECT #1530908 PHASE 1000

ANNEX J: Monitoring Well Sampling Log (Complete All Fields)

Site Name: Fox3 Landfill Name: ________

Monitoring Well ID: MW0906

Sample Number(s) include (dups): duplicate here.

Bottles filled (by parameter type): all bottles + all dupliates.

Date of Sampling Event: AUGUST Time: 2:30

Weather: light rain

Names of Samplers: KR

Description of Well Condition and Surrounding ground conditions (note ponding of water): ~~dt~~ roadside ditch is carrying surfacewater downhill

Lock (condition, presence, model, manufacturer): crown good.

Pre-Measured Data (From Water Well Record Log)

*Depth of well installation (cm)= ________ Diameter of well (cm)= ________

*Depth to top of screen (cm)= ________ Length screened section (cm)= ________

*note: *depths are from ground surface*

Field Measurements

Measurement method (interface probe, tape, etc): IP

Well pipe height above ground (cm) (to top of pipe)= 37 dry inside casing)

Static water level (cm) from top of pipe = 100 cm

Static water level (cm) (below ground surface) calculated = ________

Measured well refusal depth (cm) (measure after sampling)= 206 cm

Thickness of water column (cm)= ________ Static volume of water in well (mL)= ________

Free product thickness (mm)= ________ Evidence of sludge or siltation: ________

Purging Information Summary*

Purging/sampling equipment, sampling technique and equipment calibration information: Peristaltic.

Well purged (Y/N): Y Recharge Rate: ________

Volume Purged (L) (note multiple purging events if applicable): 40~L

Parameter	Initial	Stabilized	Final	*Notes (if not stabilized)*
pH	8.92			
Conductivity (uS/cm)	0.115			
Turbidity (NTU)	459			
Temperature (degC)	3.7			

Visual/olfactory observations (incl. colour, odour, presence of free product/sheen/globules, siltation…): turbid.

Decontamination of sampling equipment

Type of decontamination fluid (s): ________

Number washes: ________ Number rinses: ________

Other Relevant Comments: ________

* Complete field notes including full suite of water quality indicator parameters VS time as per EPA low flow sampling procedures should be apended to this summary.

GOLDER PROJECT #1530908 PHASE 1000

ANNEX J: Monitoring Well Sampling Log (Complete All Fields)

Site Name: Fox3 Landfill Name:

Monitoring Well ID: MW0903

Sample Number(s) include dups.:

Bottles filled (by parameter type): All bottles

Date of Sampling Event: AUGUST 19 Time: 3:00.

Weather: light rain

Names of Samplers: KR.

Description of Well Condition and Surrounding ground conditions (note ponding of water): standing water southwest of well. wet soil adjacent.

Lock (condition, presence, model, manufacturer): Crown good

Pre-Measured Data (From Water Well Record Log)

*Depth of well installation (cm)= Diameter of well (cm)=

*Depth to top of screen (cm)= Length screened section (cm)=

*note: *depths are from ground surface*

Field Measurements

Measurement method (interface probe, tape, etc):

Well pipe height above ground (cm) (to top of pipe)= 54

Static water level (cm) from top of pipe = 112

Static water level (cm) (below ground surface) calculated =

Measured well refusal depth (cm) (measure after sampling)= 217

Thickness of water column (cm)= Static volume of water in well (mL)=

Free product thickness (mm)= Evidence of sludge or siltation:

Purging Information Summary*

Purging/sampling equipment, sampling technique and equipment calibration information: peristaltic.

Well purged (Y/N): Y Recharge Rate:

Volume Purged (L) (note multiple purging events if applicable): 40 mL

Parameter	Initial	Stabilized	Final	*Notes (if not stabilized)*
pH	8.6			
Conductivity (uS/cm)	0.123			
Turbidity (NTU)	44.3			
Temperature (degC)	3.74.			

Visual/olfactory observations (incl. colour, odour, presence of free product/sheen/globules, siltation…): turbid.

Decontamination of sampling equipment

Type of decontamination fluid (s):

Number washes: Number rinses:

Other Relevant Comments:

* Complete field notes including full suite of water quality indicator parameters VS time as per EPA low flow sampling procedures should be apended to this summary.

GOLDER PROJECT #1530908 PHASE 1000

ANNEX J: Monitoring Well Sampling Log (Complete All Fields)

Site Name: Fox3 Landfill Name: ______
Monitoring Well ID: MW 0902
Sample Number(s) include dups.: ______
Bottles filled (by parameter type): ______
Date of Sampling Event: AUGUST 19/2015 Time: 3:30
Weather: light rain.
Names of Samplers: KR.
Description of Well Condition and Surrounding ground conditions (note ponding of water): well has jacked up. bottom of casing is above grade.
Lock (condition, presence, model, manufacturer): ______

Pre-Measured Data (From Water Well Record Log)

*Depth of well installation (cm)= ______ Diameter of well (cm)= ______
*Depth to top of screen (cm)= ______ Length screened section (cm)= ______
*note: *depths are from ground surface*

Field Measurements

Measurement method (interface probe, tape, etc): IP.
Well pipe height above ground (cm) (to top of pipe)= 64 from ground. ← note wellpipe is level with ground inside casing
Static water level (cm) from top of pipe = 98
Static water level (cm) (below ground surface) calculated = ______
Measured well refusal depth (cm) (measure after sampling)= 198
Thickness of water column (cm)= ______ Static volume of water in well (mL)= ______
Free product thickness (mm)= ______ Evidence of sludge or siltation: ______

Purging Information Summary*

Purging/sampling equipment, sampling technique and equipment calibration information: peristaltic.
Well purged (Y/N): Y Recharge Rate: ______
Volume Purged (L) (note multiple purging events if applicable): 40mL

Parameter	Initial	Stabilized	Final	*Notes (if not stabilized)*
pH	8.5			
Conductivity (uS/cm)	0.176			
Turbidity (NTU)	533			
Temperature (degC)	4.00			

Visual/olfactory observations (incl. colour, odour, presence of free product/sheen/globules, siltation…): ______

Decontamination of sampling equipment

Type of decontamination fluid (s): ______
Number washes: ______ Number rinses: ______
Other Relevant Comments: ______

* Complete field notes including full suite of water quality indicator parameters VS time as per EPA low flow sampling procedures should be apended to this summary.

GOLDER PROJECT #1530908 PHASE 1000

ANNEX J: Monitoring Well Sampling Log (Complete All Fields)

Site Name: FOX3 Landfill Name:

Monitoring Well ID: MW0901

Sample Number(s) include dups.:

Bottles filled (by parameter type): ALL

Date of Sampling Event: AUGUST Time: 4:00

Weather: Rain

Names of Samplers: KR.

Description of Well Condition and Surrounding ground conditions (note ponding of water): small puddles on surface.

Lock (condition, presence, model, manufacturer): no lock.

Pre-Measured Data (From Water Well Record Log)

*Depth of well installation (cm)= Diameter of well (cm)=

*Depth to top of screen (cm)= Length screened section (cm)=

*note: *depths are from ground surface*

Field Measurements

Measurement method (interface probe, tape, etc): IP.

Well pipe height above ground (cm) (to top of pipe)= 30 (10cm water in casing)

Static water level (cm) from top of pipe = 89.

Static water level (cm) (below ground surface) calculated =

Measured well refusal depth (cm) (measure after sampling)= 184.

Thickness of water column (cm)= Static volume of water in well (mL)=

Free product thickness (mm)= Evidence of sludge or siltation:

Purging Information Summary*

Purging/sampling equipment, sampling technique and equipment calibration information: pe. staltic.

Well purged (Y/N): Y Recharge Rate:

Volume Purged (L) (note multiple purging events if applicable): 40 mL

Parameter	Initial	Stabilized	Final	*Notes (if not stabilized)*
pH	8.05			
Conductivity (uS/cm)	0.218			
Turbidity (NTU)	919			
Temperature (degC)	3.55			

Visual/olfactory observations (incl. colour, odour, presence of free product/sheen/globules, siltation...): turbid

Decontamination of sampling equipment

Type of decontamination fluid (s):

Number washes: Number rinses:

Other Relevant Comments:

* Complete field notes including full suite of water quality indicator parameters VS time as per EPA low flow sampling procedures should be apended to this summary.

GOLDER PROJECT #1530908 PHASE 1000

ANNEX J: Monitoring Well Sampling Log (Complete All Fields)

Site Name: Fox3 Landfill Name: ______

Monitoring Well ID: MW0404

Sample Number(s) include dups.: ______

Bottles filled (by parameter type): ______

Date of Sampling Event: AUGUST 19 Time: 4:30

Weather: Rain.

Names of Samplers: KR

Description of Well Condition and Surrounding ground conditions (note ponding of water): Standing water adjacent to well head. casing loose.

Lock (condition, presence, model, manufacturer): crown, good.

Pre-Measured Data (From Water Well Record Log)

*Depth of well installation (cm)= ______ Diameter of well (cm)= ______

*Depth to top of screen (cm)= ______ Length screened section (cm)= ______

*note: *depths are from ground surface*

Field Measurements

Measurement method (interface probe, tape, etc): IP

Well pipe height above ground (cm) (to top of pipe)= 37 cm (2cm water in casing)

Static water level (cm) from top of pipe = 81 cm

Static water level (cm) (below ground surface) calculated = ______

Measured well refusal depth (cm) (measure after sampling)= 200cm

Thickness of water column (cm)= ______ Static volume of water in well (mL)= ______

Free product thickness (mm)= ______ Evidence of sludge or siltation: ______

Purging Information Summary*

Purging/sampling equipment, sampling technique and equipment calibration information: peristaltic

Well purged (Y/N): Y Recharge Rate: ______

Volume Purged (L) (note multiple purging events if applicable): 40mL

Parameter	Initial	Stabilized	Final	*Notes (if not stabilized)*
pH	8.2			
Conductivity (uS/cm)	0,183			
Turbidity (NTU)	555			
Temperature (degC)	3,47			

Visual/olfactory observations (incl. colour, odour, presence of free product/sheen/globules, siltation…): turbid water but 555 seems too high.

Decontamination of sampling equipment

Type of decontamination fluid (s): ______

Number washes: ______ Number rinses: ______

Other Relevant Comments: ______

* Complete field notes including full suite of water quality indicator parameters VS time as per EPA low flow sampling procedures should be apended to this summary.

APPENDIX C

Laboratory Certificates of Analysis and QA/QC Reports

PARACEL
LABORATORIES LTD.

TRUSTED .
RESPONSIVE .
RELIABLE .

Head Office
300-2319 St. Laurent Blvd.
Ottawa, Ontario K1G 4J8
p: 1-800-749-1947
e: paracel@paracellabs.com
www.paracellabs.com

Chain of Custody
(Lab Use Only)
Nº 22995

Page 1 of 6

Golder Associates Ltd.
Nicole MacDonald
1931 Robertson Road
Ottawa, Ontario K2H 5B7
613-592-9600

Project Ref: Dew Lines Sites Landfill Monitoring
Quote: 15-304 Golder Dew Lines Monitoring
Email address: Nicole_macdonald@golder.com
Darrin_johnson@golder.com

TAT: [✓] Regular [ ] 3 Day
[ ] 2 Day [ ] 1 Day

Date Required:

Criteria: [ ] O. Reg. 153/04 (As Amended) Table ___ [ ] RSC Filing [ ] O. Reg. 558/00 [ ] PWQO [✓] CCME [ ] SUB (Storm) [ ] SUB (Sanitary) Municipality:________ [ ] Other: ________

Matrix Type: S (Soil/Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

Paracel Order Number:

quote 15-304

Required Analyses

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Date	Time	F1-F4	Metals/Inorganics	PCB-								
1	F3-4 (0-15)	S		2	Aug 18/15	—	X	X	X								
2	F3-4 (40-50)					—											
3	F3-5 (0-15)					—											
4	F3-5 (40-50)					—											
5	F3-6 (0-15)					—											
6	F3-6 (40-50)					—											
7	F3-7 (0-15)					—											
8	F3-7 (40-50)					—											
9	F3-8 (0-15)					—											
10	F3-8 (40-50) BROKEN	↓		↓	↓	—	↓	↓	↓								

Comments:
↳ may have glass inside

Method of Delivery: Walk-in

Relinquished By (Sign):

Relinquished By (Print): Tony Lyon

Date/Time: Aug 28, 2015 5:00

Received by Driver/Depot: Karen Cull

Date/Time: Aug 28/15 5:00

Temperature: ______ °C

Received at Lab:

Date/Time:

Temperature: ______ °C

Verified By:

Date/Time:

pH Verified [ ] By: ______

PARACEL
LABORATORIES LTD.

TRUSTED .
RESPONSIVE .
RELIABLE .

Head Office
300-2319 St. Laurent Blvd.
Ottawa, Ontario K1G 4J8
p: 1-800-749-1947
e: paracel@paracellabs.com
www.paracellabs.com

Chain of Custody
(Lab Use Only)
№ 22998

Page 2 of 6

Golder Associates Ltd.
Nicole MacDonald
1931 Robertson Road
Ottawa, Ontario K2H 5B7
613-592-9600

Project Ref: Dew Lines Sites Landfill Monitoring
Quote: 15-304 Golder Dew Lines Monitoring
Email address: Nicole_macdonald@golder.com
Darrin_johnson@golder.com

TAT: [✓] Regular [ ] 3 Day
[ ] 2 Day [ ] 1 Day
Date Required:

Criteria: [ ] O. Reg. 153/04 (As Amended) Table ___ [ ] RSC Filing [ ] O. Reg. 558/00 [ ] PWQO [✓] CCME [ ] SUB (Storm) [ ] SUB (Sanitary) Municipality: ________ [ ] Other: ________

Matrix Type: S (Soil/Sed.) **GW** (Ground Water) **SW** (Surface Water) **SS** (Storm/Sanitary Sewer) **P** (Paint) **A** (Air) **O** (Other)

Paracel Order Number:

quote 15-304

Required Analyses

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	F1-F4	Metals/Inorg.	PCB								
1	F3-9 (0-15)	S		2	Aug 18/15	—	x	x	x								
2	F3-9 (40-50)	↓		↓	↓	—	↓	↓	↓								
3	F3-10 (0-15)	↓		↓	↓	—	↓	↓	↓								
4	F3-10 (40-50)	↓		↓	↓	—	↓	↓	↓								
5	F3-11 (0-15)	↓		↓	↓	—	↓	↓	↓								
6	F3-11 (40-50)	↓		↓	↓	—	↓	↓	↓								
7	F3-12 (0-15)	↓		↓	↓	—	↓	↓	↓								
8	F3-12 (40-50)	↓		↓	↓	—	↓	↓	↓								
9	F3-1 (0-15)	↓		↓	Aug17/15	—	↓	↓	↓								
10	F3-1 (40-50)	↓		↓	Aug 17	—	↓	↓	↓								

Comments:

Method of Delivery: Walk-in

Relinquished By (Sign):
Relinquished By (Print): Tony Lyon
Date/Time: Aug 28, 2015 5:00

Received by Driver/Depot: Kavin Gill
Date/Time: Aug 28/15 5:00
Temperature: ____ °C

Received at Lab:
Date/Time:
Temperature: ____ °C

Verified By:
Date/Time:
pH Verified [ ] By: ________

PARACEL
LABORATORIES LTD.

TRUSTED .
RESPONSIVE .
RELIABLE .

OTTAWA ◉ KINGSTON ◉ NIAGARA ◉ MISSISSAUGA ◉ SARNIA

Head Office
300-2319 St. Laurent Blvd.
Ottawa, Ontario K1G 4J8
p: 1-800-749-1947
e: paracel@paracellabs.com
www.paracellabs.com

Chain of Custody
(Lab Use Only)
№ 19649

Page 3 of 6

Client Name: Golder Associates Ltd.
Contact Name: Niccle MacDonald
Address: 1931 Robertson Rodd, Ottawa
Telephone: 613 592 9600

Project Reference: 1530908
Quote # 15-304
PO #
Email Address: niccle_macdonald@golder.com
darrin_johnson@golder.com

TAT: ☑ Regular ☐ 3 Day
☐ 2 Day ☐ 1 Day
Date Required:

Criteria: ☐ O. Reg. 153/04 (As Amended) Table ___ ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☑ CCME ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality: ______ ☐ Other: ______

Matrix Type: S (Soil/Sed.) **GW** (Ground Water) **SW** (Surface Water) **SS** (Storm/Sanitary Sewer) **P** (Paint) **A** (Air) **O** (Other)

Paracel Order Number:

Required Analyses

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	quote 15-304										
1	F3-2 (0-15)	S		2	Aug17/15	—	X										
2	F3-2 (40-50)	↓		↓	↓	—	X										
3	F3-3 (0-15)					—	X										
4	F3-3 (40-50)					—	X										
5	MW-05 (0-15)				Aug18/15	—	X										
6	MW-05 (40-50)				↓	—	X										
7	MW-06 (0-15)					—	X										
8	MW-06 (40-50)					—	X										
9	MW-07 (0-15)					—	X										
10	MW-07 (40-50)					—	X										

Comments:

Method of Delivery: Walk-in

Relinquished By (Sign):
Relinquished By (Print): Tony Lyon
Date/Time: Aug 28, 2015 5:00

Received by Driver/Depot: Kaur Gill
Date/Time: Aug 28/15 5:00
Temperature: ______ °C

Received at Lab:
Date/Time:
Temperature: ______ °C

Verified By:
Date/Time:
pH Verified ☐ By: ______

PARACEL
LABORATORIES LTD.

TRUSTED .
RESPONSIVE .
RELIABLE .

OTTAWA ◉ KINGSTON ◉ NIAGARA ◉ MISSISSAUGA ◉ SARNIA

Head Office
300-2319 St. Laurent Blvd.
Ottawa, Ontario K1G 4J8
p: 1-800-749-1947
e: paracel@paracellabs.com
www.paracellabs.com

Chain of Custody
(Lab Use Only)

Nº 98030

Page 4 of 6

Client Name: Golder Associates Ltd

Contact Name: Nicole MacDonald

Address: 1931 Robertson Road, Ottawa

Telephone: 613 592 9600

Project Reference: 1530908

Quote # 15 - 304

PO #

Email Address: nicole_macdonald@golder.com
damin_johnson@golder.com

TAT: [✓] Regular [ ] 3 Day [ ] 2 Day [ ] 1 Day

Date Required:

Criteria: [ ] O. Reg. 153/04 (As Amended) Table __ [ ] RSC Filing [ ] O. Reg. 558/00 [ ] PWQO [✓] CCME [ ] SUB (Storm) [ ] SUB (Sanitary) Municipality: __________ [ ] Other: __________

Matrix Type: S (Soil/Sed.) **GW** (Ground Water) **SW** (Surface Water) **SS** (Storm/Sanitary Sewer) **P** (Paint) **A** (Air) **O** (Other)

Paracel Order Number:

Required Analyses

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	**Sample Taken** Date	**Sample Taken** Time	PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (HWS)	quote 15-304						
1	MW-08 (0-15)	S		2	Aug18/15	—								X						
2	MW-08 (30-40)	↓		↓	↓	—								X						
3	MW-01 (0-15)	↓		↓	↓	—								X						
4	MW-01 (40-50)	↓		↓	↓	—								X						
5	MW-02 (0-15)	↓		↓	↓	—								X						
6	MW-02 (40-50)	↓		↓	↓	—								X						
7	MW-03 (0-15)	↓		↓	↓	—								X						
8	MW-03 (40-50)	↓		↓	↓	—								X						
9	MW-04 (0-15)	↓		↓	↓	—								X						
10	MW-04 (40-50)	↓		↓	↓	—								X						

Comments:

Method of Delivery: Walk-in

Relinquished By (Sign):

Relinquished By (Print): Tony Lyon

Date/Time: Aug 28, 2015 / 5:00

Received by Driver/Depot:

Date/Time: Aug 28/15 5:00

Temperature: ______ °C

Received at Lab:

Date/Time:

Temperature: ______ °C

Verified By:

Date/Time:

pH Verified [ ] By: __________

PARACEL LABORATORIES LTD.

TRUSTED .
RESPONSIVE .
RELIABLE .

OTTAWA ◉ KINGSTON ◉ NIAGARA ◉ MISSISSAUGA ◉ SARNIA

Head Office
300-2319 St. Laurent Blvd.
Ottawa, Ontario K1G 4J8
p: 1-800-749-1947
e: paracel@paracellabs.com
www.paracellabs.com

Chain of Custody
(Lab Use Only)

№ 102402

Page 1 of 1

Client Name: Golder Associates Ltd.

Contact Name: Nicole MacDonald

Address: 1931 Robertson Road, Ottawa

Telephone: 613 592 9600

Project Reference: 1530908

Quote # 15-304 Golder DEW Line

PO #

Email Address: nicole_macdonald@golder.com
darrin_johnson@golder.com

TAT: ☑ Regular ☐ 3 Day ☐ 2 Day ☐ 1 Day

Date Required:

Criteria: ☐ O. Reg. 153/04 (As Amended) Table ___ ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☑ CCME ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality: ______ ☐ Other: ______

Matrix Type: **S** (Soil/Sed.) **GW** (Ground Water) **SW** (Surface Water) **SS** (Storm/Sanitary Sewer) **P** (Paint) **A** (Air) **O** (Other)

Paracel Order Number:

Required Analyses

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken		PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (HWS)	quote 15-304						
					Date	Time														
1	MW0901	GW		6	Aug19/15	16:00								X						
2	MW0902	|		6	|	15:30								X						
3	MW0903	|		6	|	15:00								X						
4	MW0904	|		6	|	16:30								X						
5	MW0905	|		6	|	13:40								X						
6	MW0906	|		6	|	14:30								X						
7	MW0907	|		6	|	13:15								X						
8	MW0908 *	↓		5	↓	12:40								X						
9																				
10																				

Comments: * mercury bottle for MW0908 broke, please try to analyze from other bottles

Method of Delivery:

Relinquished By (Sign): N MacDonald

Relinquished By (Print): Nicole MacDonald

Date/Time: Aug 26/15 18:30

Received by Driver/Depot:

Date/Time:

Temperature: ______ °C

Received at Lab:

Date/Time:

Temperature: ______ °C

Verified By:

Date/Time:

pH Verified ☐ By: ______

Chain of Custody (Env) - Rev 0.5 May 2013

PARACEL
LABORATORIES LTD.
TRUSTED.
RESPONSIVE.
RELIABLE.

300 - 2319 St. Laurent Blvd
Ottawa, ON, K1G 4J8
1-800-749-1947
www.paracellabs.com

Certificate of Analysis

Golder Associates Ltd. (Ottawa)

1931 Robertson Rd.
Ottawa, ON K2H 5B7
Attn: Nicole MacDonald

Client PO:
Project: 1530908
Custody: 22995/8,19649,98030/31,23963

Report Date: 29-Sep-2015
Order Date: 28-Aug-2015

Revised Repo

Order #: 1536025

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	**Client ID**
1536025-01	F3-4 (0-15)
1536025-02	F3-4 (40-50)
1536025-03	F3-5 (0-15)
1536025-04	F3-5 (40-50)
1536025-05	F3-6 (0-15)
1536025-06	F3-6 (40-50)
1536025-07	F3-7 (0-15)
1536025-08	F3-7 (40-50)
1536025-09	F3-8 (0-15)
1536025-10	F3-8 (40-50)
1536025-11	F3-9 (0-15)
1536025-12	F3-9 (40-50)
1536025-13	F3-10 (0-15)
1536025-14	F3-10 (40-50)
1536025-15	F3-11 (0-15)
1536025-16	F3-11 (40-50)
1536025-17	F3-12 (0-15)
1536025-18	F3-12 (40-50)
1536025-19	F3-1 (0-15)
1536025-20	F3-1 (40-50)
1536025-21	F3-2 (0-15)
1536025-22	F3-2 (40-50)
1536025-23	F3-3 (0-15)
1536025-24	F3-3 (40-50)
1536025-25	MW-05 (0-15)
1536025-26	MW-05 (40-50)
1536025-27	MW-06 (0-15)
1536025-28	MW-06 (40-50)
1536025-29	MW-07 (0-15)
1536025-30	MW-07 (40-50)

Approved By: Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

1536025-31	MW-08 (0-15)
1536025-32	MW-08 (30-40)
1536025-33	MW-01 (0-15)
1536025-34	MW-01 (40-50)
1536025-35	MW-02 (0-15)
1536025-36	MW-02 (40-50)
1536025-37	MW-03 (0-15)
1536025-38	MW-03 (40-50)
1536025-39	MW-04 (0-15)
1536025-40	MW-04 (40-50)

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
CCME-SQG: Metals by ICP-OES	based on MOE E3470, ICP-OES	2-Sep-15	2-Sep-15
Mercury by CVAA	EPA 7471B - CVAA, digestion	3-Sep-15	3-Sep-15
PCBs, total	SW846 8082A - GC-ECD	31-Aug-15	3-Sep-15
PHC F1	CWS Tier 1 - P&T GC-FID	31-Aug-15	3-Sep-15
PHC F2 - F4	CWS Tier 1 - GC-FID, extraction	31-Aug-15	1-Sep-15
Solids, %	Gravimetric, calculation	2-Sep-15	2-Sep-15

Certificate of Analysis

Client: **Golder Associates Ltd. (Ottawa)**

Client PO:

Report Date: 29-Sep-2015

Order Date:28-Aug-2015

Project Description: 1530908

Client ID:		F3-4 (0-15)	F3-4 (40-50)	F3-5 (0-15)	F3-5 (40-50)
Sample Date:		18-Aug-15	18-Aug-15	18-Aug-15	18-Aug-15
Sample ID:		1536025-01	1536025-02	1536025-03	1536025-04
	MDL/Units	Soil	Soil	Soil	Soil
Physical Characteristics					
% Solids	0.1 % by Wt.	89.6	88.0	88.9	87.6
Metals					
Arsenic	1.0 ug/g dry	16.4	17.7	13.2	15.3
Cadmium	0.5 ug/g dry	<0.5	<0.5	<0.5	<0.5
Chromium	1.0 ug/g dry	71.6	70.4	70.7	72.8
Cobalt	1.0 ug/g dry	10.0	9.8	9.4	10.3
Copper	1.0 ug/g dry	43.3	38.4	29.3	38.0
Lead	1.0 ug/g dry	10.1	9.3	7.4	8.9
Mercury	0.1 ug/g dry	<0.1	<0.1	<0.1	<0.1
Nickel	1.0 ug/g dry	29.3	28.3	27.3	29.5
Zinc	1.0 ug/g dry	66.3	64.8	59.6	61.8
Hydrocarbons					
F1 PHCs (C6-C10)	7 ug/g dry	<7 [1]	<7 [1]	<7 [1]	<7 [1]
F2 PHCs (C10-C16)	4 ug/g dry	<4	<4	<4	<4
F3 PHCs (C16-C34)	8 ug/g dry	<8	<8	<8	<8
F4 PHCs (C34-C50)	6 ug/g dry	<6	<6	<6	<6
PCBs					
PCBs, total	0.05 ug/g dry	<0.05	<0.05	<0.05	<0.05
Decachlorobiphenyl	Surrogate	60.0%	90.0%	81.0%	92.0%

Certificate of Analysis

Client: **Golder Associates Ltd. (Ottawa)**

Client PO:

Report Date: 29-Sep-2015

Order Date:28-Aug-2015

Project Description: 1530908

	Client ID: **Sample Date:** **Sample ID:** **MDL/Units**	F3-6 (0-15) 18-Aug-15 1536025-05 Soil	F3-6 (40-50) 18-Aug-15 1536025-06 Soil	F3-7 (0-15) 18-Aug-15 1536025-07 Soil	F3-7 (40-50) 18-Aug-15 1536025-08 Soil
Physical Characteristics					
% Solids	0.1 % by Wt.	88.8	88.8	86.2	88.1
Metals					
Arsenic	1.0 ug/g dry	15.3	16.3	13.5	17.5
Cadmium	0.5 ug/g dry	<0.5	<0.5	<0.5	<0.5
Chromium	1.0 ug/g dry	67.5	68.4	67.6	71.9
Cobalt	1.0 ug/g dry	9.8	10.0	9.5	10.4
Copper	1.0 ug/g dry	37.9	44.7	34.6	40.1
Lead	1.0 ug/g dry	8.9	9.3	8.5	8.8
Mercury	0.1 ug/g dry	<0.1	<0.1	<0.1	<0.1
Nickel	1.0 ug/g dry	29.1	30.1	28.3	30.4
Zinc	1.0 ug/g dry	64.0	64.5	60.0	64.9
Hydrocarbons					
F1 PHCs (C6-C10)	7 ug/g dry	<7 [1]	<7 [1]	<7 [1]	<7 [1]
F2 PHCs (C10-C16)	4 ug/g dry	<4	<4	<4	<4
F3 PHCs (C16-C34)	8 ug/g dry	<8	<8	<8	<8
F4 PHCs (C34-C50)	6 ug/g dry	<6	<6	<6	<6
PCBs					
PCBs, total	0.05 ug/g dry	<0.05	<0.05	<0.05	<0.05
Decachlorobiphenyl	Surrogate	90.0%	85.0%	90.0%	88.0%

Certificate of Analysis

Report Date: 29-Sep-2015

Client: **Golder Associates Ltd. (Ottawa)**

Order Date:28-Aug-2015

Client PO:

Project Description: 1530908

Client ID: **Sample Date:** **Sample ID:**	**MDL/Units**	F3-8 (0-15) 18-Aug-15 1536025-09 Soil	F3-8 (40-50) 18-Aug-15 1536025-10 Soil	F3-9 (0-15) 18-Aug-15 1536025-11 Soil	F3-9 (40-50) 18-Aug-15 1536025-12 Soil
Physical Characteristics					
% Solids	0.1 % by Wt.	89.4	89.7	87.1	88.3
Metals					
Arsenic	1.0 ug/g dry	13.6	12.0	16.9	14.2
Cadmium	0.5 ug/g dry	<0.5	<0.5	<0.5	<0.5
Chromium	1.0 ug/g dry	70.1	68.1	74.5	64.5
Cobalt	1.0 ug/g dry	9.6	9.7	10.9	10.1
Copper	1.0 ug/g dry	38.9	39.3	38.5	36.4
Lead	1.0 ug/g dry	9.4	8.9	8.4	8.2
Mercury	0.1 ug/g dry	<0.1	<0.1	<0.1	<0.1
Nickel	1.0 ug/g dry	28.8	28.2	30.9	28.8
Zinc	1.0 ug/g dry	64.8	64.9	62.9	58.1
Hydrocarbons					
F1 PHCs (C6-C10)	7 ug/g dry	<7 [1]	<7 [1]	<7 [1]	<7 [1]
F2 PHCs (C10-C16)	4 ug/g dry	<4	<4	<4	<4
F3 PHCs (C16-C34)	8 ug/g dry	<8	<8	<8	<8
F4 PHCs (C34-C50)	6 ug/g dry	<6	7	<6	<6
PCBs					
PCBs, total	0.05 ug/g dry	<0.05	<0.05	<0.05	<0.05
Decachlorobiphenyl	Surrogate	64.0%	105%	66.0%	70.0%

Certificate of Analysis
Client: **Golder Associates Ltd. (Ottawa)**
Client PO:

Report Date: 29-Sep-2015
Order Date:28-Aug-2015
Project Description: 1530908

	Client ID: **Sample Date:** **Sample ID:**	F3-10 (0-15) 18-Aug-15 1536025-13	F3-10 (40-50) 18-Aug-15 1536025-14	F3-11 (0-15) 18-Aug-15 1536025-15	F3-11 (40-50) 18-Aug-15 1536025-16
	MDL/Units	Soil	Soil	Soil	Soil
Physical Characteristics					
% Solids	0.1 % by Wt.	89.2	89.3	86.8	86.7
Metals					
Arsenic	1.0 ug/g dry	11.3	9.7	18.1	18.7
Cadmium	0.5 ug/g dry	<0.5	<0.5	<0.5	<0.5
Chromium	1.0 ug/g dry	63.2	63.1	68.3	73.0
Cobalt	1.0 ug/g dry	9.1	9.1	10.5	10.9
Copper	1.0 ug/g dry	31.7	26.2	39.0	39.9
Lead	1.0 ug/g dry	7.4	7.0	8.8	8.5
Mercury	0.1 ug/g dry	<0.1	<0.1	<0.1	<0.1
Nickel	1.0 ug/g dry	25.9	25.6	30.8	32.7
Zinc	1.0 ug/g dry	55.5	56.2	60.4	64.8
Hydrocarbons					
F1 PHCs (C6-C10)	7 ug/g dry	<7 [1]	<7 [1]	<7 [1]	<7 [1]
F2 PHCs (C10-C16)	4 ug/g dry	<4	<4	<4	<4
F3 PHCs (C16-C34)	8 ug/g dry	<8	<8	<8	<8
F4 PHCs (C34-C50)	6 ug/g dry	<6	<6	<6	<6
PCBs					
PCBs, total	0.05 ug/g dry	<0.05	<0.05	<0.05	<0.05
Decachlorobiphenyl	Surrogate	94.0%	94.0%	89.0%	90.0%

Certificate of Analysis

Client: **Golder Associates Ltd. (Ottawa)**

Client PO:

Report Date: 29-Sep-2015

Order Date:28-Aug-2015

Project Description: 1530908

Client ID:		F3-12 (0-15)	F3-12 (40-50)	F3-1 (0-15)	F3-1 (40-50)
Sample Date:		18-Aug-15	18-Aug-15	17-Aug-15	17-Aug-15
Sample ID:		1536025-17	1536025-18	1536025-19	1536025-20
	MDL/Units	Soil	Soil	Soil	Soil
Physical Characteristics					
% Solids	0.1 % by Wt.	82.6	87.5	92.8	93.4
Metals					
Arsenic	1.0 ug/g dry	15.9	18.1	12.0	12.3
Cadmium	0.5 ug/g dry	<0.5	<0.5	<0.5	<0.5
Chromium	1.0 ug/g dry	73.4	75.7	49.1	45.7
Cobalt	1.0 ug/g dry	10.7	10.9	6.7	6.2
Copper	1.0 ug/g dry	39.5	43.9	24.2	24.9
Lead	1.0 ug/g dry	9.0	9.1	7.2	7.3
Mercury	0.1 ug/g dry	<0.1	<0.1	<0.1	<0.1
Nickel	1.0 ug/g dry	32.1	33.5	19.3	17.4
Zinc	1.0 ug/g dry	63.0	65.3	42.8	39.5
Hydrocarbons					
F1 PHCs (C6-C10)	7 ug/g dry	<7 [1]	<7 [1]	<7 [1]	<7 [1]
F2 PHCs (C10-C16)	4 ug/g dry	<4	<4	<4	<4
F3 PHCs (C16-C34)	8 ug/g dry	<8	<8	<8	<8
F4 PHCs (C34-C50)	6 ug/g dry	<6	<6	<6	<6
PCBs					
PCBs, total	0.05 ug/g dry	<0.05	<0.05	<0.05	<0.05
Decachlorobiphenyl	Surrogate	90.0%	92.0%	90.0%	88.0%

Certificate of Analysis

Report Date: 29-Sep-2015

Client: **Golder Associates Ltd. (Ottawa)**

Order Date:28-Aug-2015

Client PO:

Project Description: 1530908

Client ID: **Sample Date:** **Sample ID:**	**MDL/Units**	F3-2 (0-15) 17-Aug-15 1536025-21 Soil	F3-2 (40-50) 17-Aug-15 1536025-22 Soil	F3-3 (0-15) 17-Aug-15 1536025-23 Soil	F3-3 (40-50) 17-Aug-15 1536025-24 Soil
Physical Characteristics					
% Solids	0.1 % by Wt.	82.1	85.4	92.7	91.3
Metals					
Arsenic	1.0 ug/g dry	9.7	9.8	13.1	12.2
Cadmium	0.5 ug/g dry	<0.5	<0.5	<0.5	<0.5
Chromium	1.0 ug/g dry	57.1	49.3	49.8	54.6
Cobalt	1.0 ug/g dry	7.6	6.5	7.0	7.9
Copper	1.0 ug/g dry	19.1	17.6	22.4	29.9
Lead	1.0 ug/g dry	5.3	4.7	7.0	9.5
Mercury	0.1 ug/g dry	<0.1	<0.1	<0.1	<0.1
Nickel	1.0 ug/g dry	22.7	19.6	20.2	20.9
Zinc	1.0 ug/g dry	49.3	42.7	45.8	53.2
Hydrocarbons					
F1 PHCs (C6-C10)	7 ug/g dry	<7 [1]	<7 [1]	<7 [1]	<7 [1]
F2 PHCs (C10-C16)	4 ug/g dry	<4	<4	<4	<4
F3 PHCs (C16-C34)	8 ug/g dry	<8	<8	<8	<8
F4 PHCs (C34-C50)	6 ug/g dry	<6	<6	<6	<6
PCBs					
PCBs, total	0.05 ug/g dry	<0.05	<0.05	<0.05	<0.05
Decachlorobiphenyl	Surrogate	66.0%	82.0%	85.0%	90.0%

Certificate of Analysis
Client: **Golder Associates Ltd. (Ottawa)**
Client PO:

Report Date: 29-Sep-2015
Order Date:28-Aug-2015
Project Description: 1530908

	Client ID:	MW-05 (0-15)	MW-05 (40-50)	MW-06 (0-15)	MW-06 (40-50)
	Sample Date:	18-Aug-15	18-Aug-15	18-Aug-15	18-Aug-15
	Sample ID:	1536025-25	1536025-26	1536025-27	1536025-28
	MDL/Units	Soil	Soil	Soil	Soil
Physical Characteristics					
% Solids	0.1 % by Wt.	87.4	86.8	85.4	90.7
Metals					
Arsenic	1.0 ug/g dry	15.8	15.7	14.1	17.7
Cadmium	0.5 ug/g dry	<0.5	<0.5	<0.5	<0.5
Chromium	1.0 ug/g dry	82.1	79.8	69.3	78.8
Cobalt	1.0 ug/g dry	10.3	10.4	8.3	9.7
Copper	1.0 ug/g dry	40.4	42.9	29.3	40.1
Lead	1.0 ug/g dry	10.1	8.9	7.8	9.4
Mercury	0.1 ug/g dry	<0.1	<0.1	<0.1	<0.1
Nickel	1.0 ug/g dry	31.8	30.6	26.4	30.1
Zinc	1.0 ug/g dry	67.6	65.7	53.7	64.6
Hydrocarbons					
F1 PHCs (C6-C10)	7 ug/g dry	<7 [1]	<7 [1]	<7 [1]	<7 [1]
F2 PHCs (C10-C16)	4 ug/g dry	<4	<4	<4	<4
F3 PHCs (C16-C34)	8 ug/g dry	<8	<8	<8	<8
F4 PHCs (C34-C50)	6 ug/g dry	<6	<6	<6	<6
PCBs					
PCBs, total	0.05 ug/g dry	<0.05	<0.05	<0.05	<0.05
Decachlorobiphenyl	Surrogate	68.0%	91.0%	93.0%	90.0%

Certificate of Analysis
Client: **Golder Associates Ltd. (Ottawa)**
Client PO:

Report Date: 29-Sep-2015
Order Date:28-Aug-2015
Project Description: 1530908

Client ID:		MW-07 (0-15)	MW-07 (40-50)	MW-08 (0-15)	MW-08 (30-40)
Sample Date:		18-Aug-15	18-Aug-15	18-Aug-15	18-Aug-15
Sample ID:		1536025-29	1536025-30	1536025-31	1536025-32
	MDL/Units	Soil	Soil	Soil	Soil
Physical Characteristics					
% Solids	0.1 % by Wt.	83.5	85.6	88.1	88.3
Metals					
Arsenic	1.0 ug/g dry	21.0	18.8	12.1	13.1
Cadmium	0.5 ug/g dry	<0.5	<0.5	<0.5	<0.5
Chromium	1.0 ug/g dry	82.9	76.0	68.3	75.6
Cobalt	1.0 ug/g dry	9.9	9.4	8.6	9.8
Copper	1.0 ug/g dry	42.5	41.0	25.8	29.4
Lead	1.0 ug/g dry	10.2	9.1	7.3	7.3
Mercury	0.1 ug/g dry	<0.1	<0.1	<0.1	<0.1
Nickel	1.0 ug/g dry	30.9	29.2	26.6	30.3
Zinc	1.0 ug/g dry	64.8	62.0	57.1	62.9
Hydrocarbons					
F1 PHCs (C6-C10)	7 ug/g dry	<7 [1]	<7 [1]	<7 [1]	<7 [1]
F2 PHCs (C10-C16)	4 ug/g dry	<4	<4	<4	<4
F3 PHCs (C16-C34)	8 ug/g dry	<8	<8	<8	<8
F4 PHCs (C34-C50)	6 ug/g dry	<6	<6	<6	<6
PCBs					
PCBs, total	0.05 ug/g dry	<0.05	<0.05	<0.05	<0.05
Decachlorobiphenyl	Surrogate	92.0%	68.0%	92.0%	68.0%

Certificate of Analysis

Report Date: 29-Sep-2015

Client: **Golder Associates Ltd. (Ottawa)**

Order Date:28-Aug-2015

Client PO:

Project Description: 1530908

	Client ID: **Sample Date:** **Sample ID:** **MDL/Units**	MW-01 (0-15) 18-Aug-15 1536025-33 Soil	MW-01 (40-50) 18-Aug-15 1536025-34 Soil	MW-02 (0-15) 18-Aug-15 1536025-35 Soil	MW-02 (40-50) 18-Aug-15 1536025-36 Soil
Physical Characteristics					
% Solids	0.1 % by Wt.	87.7	85.1	88.4	85.3
Metals					
Arsenic	1.0 ug/g dry	30.0	28.7	14.7	13.4
Cadmium	0.5 ug/g dry	<0.5	<0.5	<0.5	<0.5
Chromium	1.0 ug/g dry	87.3	87.9	61.8	59.7
Cobalt	1.0 ug/g dry	11.3	10.8	8.0	8.2
Copper	1.0 ug/g dry	46.8	48.6	27.5	29.1
Lead	1.0 ug/g dry	9.7	9.9	7.9	8.2
Mercury	0.1 ug/g dry	<0.1	<0.1	<0.1	<0.1
Nickel	1.0 ug/g dry	37.8	38.0	24.7	24.1
Zinc	1.0 ug/g dry	65.9	66.7	51.8	51.4
Hydrocarbons					
F1 PHCs (C6-C10)	7 ug/g dry	<7 [1]	<7 [1]	<7 [1]	<7 [1]
F2 PHCs (C10-C16)	4 ug/g dry	<4	<4	<4	<4
F3 PHCs (C16-C34)	8 ug/g dry	<8	<8	<8	<8
F4 PHCs (C34-C50)	6 ug/g dry	<6	<6	<6	<6
PCBs					
PCBs, total	0.05 ug/g dry	<0.05	<0.05	<0.05	<0.05
Decachlorobiphenyl	Surrogate	93.0%	91.0%	75.0%	113%

Certificate of Analysis
Client: **Golder Associates Ltd. (Ottawa)**
Client PO:

Report Date: 29-Sep-2015
Order Date:28-Aug-2015
Project Description: 1530908

	Client ID:	MW-03 (0-15)	MW-03 (40-50)	MW-04 (0-15)	MW-04 (40-50)
	Sample Date:	18-Aug-15	18-Aug-15	18-Aug-15	18-Aug-15
	Sample ID:	1536025-37	1536025-38	1536025-39	1536025-40
	MDL/Units	Soil	Soil	Soil	Soil
Physical Characteristics					
% Solids	0.1 % by Wt.	86.2	87.4	87.8	83.9
Metals					
Arsenic	1.0 ug/g dry	12.5	16.1	13.6	12.6
Cadmium	0.5 ug/g dry	<0.5	<0.5	<0.5	<0.5
Chromium	1.0 ug/g dry	70.1	77.6	65.1	66.7
Cobalt	1.0 ug/g dry	10.6	11.8	7.9	8.4
Copper	1.0 ug/g dry	29.0	36.0	26.6	34.4
Lead	1.0 ug/g dry	6.2	8.2	8.1	10.0
Mercury	0.1 ug/g dry	<0.1	<0.1	<0.1	<0.1
Nickel	1.0 ug/g dry	33.8	36.7	23.7	25.3
Zinc	1.0 ug/g dry	59.5	62.9	50.4	54.7
Hydrocarbons					
F1 PHCs (C6-C10)	7 ug/g dry	<7 [1]	<7 [1]	<7 [1]	<7 [1]
F2 PHCs (C10-C16)	4 ug/g dry	<4	<4	<4	<4
F3 PHCs (C16-C34)	8 ug/g dry	<8	<8	<8	<8
F4 PHCs (C34-C50)	6 ug/g dry	<6	<6	<6	<6
PCBs					
PCBs, total	0.05 ug/g dry	<0.05	<0.05	<0.05	<0.05
Decachlorobiphenyl	Surrogate	86.0%	86.0%	68.0%	87.0%

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	ND	7	ug/g						
F2 PHCs (C10-C16)	ND	4	ug/g						
F3 PHCs (C16-C34)	ND	8	ug/g						
F4 PHCs (C34-C50)	ND	6	ug/g						
Metals									
Arsenic	ND	1.0	ug/g						
Cadmium	ND	0.5	ug/g						
Chromium	ND	1.0	ug/g						
Cobalt	ND	1.0	ug/g						
Copper	ND	1.0	ug/g						
Lead	ND	1.0	ug/g						
Mercury	ND	0.1	ug/g						
Nickel	ND	1.0	ug/g						
Zinc	ND	1.0	ug/g						
PCBs									
PCBs, total	ND	0.05	ug/g						
Surrogate: Decachlorobiphenyl	*0.0840*		*ug/g*		*84.0*	*60-140*			

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	ND	7	ug/g dry	ND				40	
F2 PHCs (C10-C16)	ND	4	ug/g dry	ND				30	
F3 PHCs (C16-C34)	ND	8	ug/g dry	ND				30	
F4 PHCs (C34-C50)	ND	6	ug/g dry	ND				30	
Metals									
Arsenic	16.5	1.0	ug/g dry	16.4			0.1	30	
Cadmium	ND	0.5	ug/g dry	ND			0.0	30	
Chromium	71.3	1.0	ug/g dry	71.6			0.4	30	
Cobalt	9.97	1.0	ug/g dry	9.97			0.0	30	
Copper	43.7	1.0	ug/g dry	43.3			0.7	30	
Lead	9.87	1.0	ug/g dry	10.1			2.5	30	
Mercury	ND	0.1	ug/g dry	ND			0.0	35	
Nickel	28.7	1.0	ug/g dry	29.3			1.9	30	
Zinc	66.4	1.0	ug/g dry	66.3			0.1	30	
PCBs									
PCBs, total	ND	0.05	ug/g dry	ND				40	
Surrogate: Decachlorobiphenyl	*0.105*		*ug/g dry*	*ND*	*94.0*	*60-140*			
Physical Characteristics									
% Solids	80.3	0.1	% by Wt.	82.4			2.5	25	

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	191	7	ug/g	ND	95.5	80-120			
F2 PHCs (C10-C16)	89	4	ug/g	ND	84.4	60-140			
F3 PHCs (C16-C34)	228	8	ug/g	ND	105	60-140			
F4 PHCs (C34-C50)	147	6	ug/g	ND	101	60-140			
Metals									
Arsenic	20.9		ug/L	ND	83.6	70-130			
Cadmium	25.0		ug/L	ND	100	70-130			
Chromium	28.8		ug/L	ND	115	70-130			
Cobalt	24.8		ug/L	ND	99.0	70-130			
Copper	27.3		ug/L	ND	109	70-130			
Lead	31.1		ug/L	ND	124	70-130			
Mercury	1.32	0.1	ug/g	ND	87.9	72-128			
Nickel	26.7		ug/L	ND	107	70-130			
Zinc	24.9		ug/L	ND	99.7	70-130			
PCBs									
PCBs, total	0.623	0.05	ug/g	ND	140	60-140			
Surrogate: Decachlorobiphenyl	*0.100*		*ug/g*		*90.0*	*60-140*			

Qualifier Notes:

Login Qualifiers :

Container(s) - Broken/cracked cap - Soil jar broken
Applies to samples: F3-8 (40-50)

Sample Qualifiers :

1 : Holding time had been exceeded upon sample receipt.

Sample Data Revisions

None

Work Order Revisions / Comments:

Revision 1 - This report includes an updated client Sample list.

Other Report Notes:

n/a: not applicable
ND: Not Detected
MDL: Method Detection Limit
Source Result: Data used as source for matrix and duplicate samples
%REC: Percent recovery.
RPD: Relative percent difference.

Soil results are reported on a dry weight basis when the units are denoted with 'dry'.
Where %Solids is reported, moisture loss includes the loss of volatile hydrocarbons.

CCME PHC additional information:

- The method for the analysis of PHCs complies with the Reference Method for the CWS PHC and is validated for use in the laboratory. All prescribed quality criteria identified in the method has been met.
- F1 range corrected for BTEX.
- F2 to F3 ranges corrected for appropriate PAHs where available.
- The gravimetric heavy hydrocarbons (F4G) are not to be added to C6 to C50 hydrocarbons.
- In the case where F4 and F4G are both reported, the greater of the two results is to be used for comparison to CWS PHC criteria.

PARACEL LABORATORIES LTD. | TRUSTED . RESPONSIVE . RELIABLE .

Head Office
300-2319 St. Laurent Blvd.
Ottawa, Ontario K1G 4J8
p: 1-800-749-1947
e: paracel@paracellabs.com
www.paracellabs.com

Chain of Custody
(Lab Use Only)
№ 22995

Page 1 of 6

Golder Associates Ltd.
Nicole MacDonald
1931 Robertson Road
Ottawa, Ontario K2H 5B7
613-592-9600

Project Ref: Dew Lines Sites Landfill Monitoring
Quote: 15-304 Golder Dew Lines Monitoring
Email address: Nicole_macdonald@golder.com
Darrin_johnson@golder.com

TAT: ☑ Regular ☐ 3 Day ☐ 2 Day ☐ 1 Day

Date Required:

Criteria: ☐ O. Reg. 153/04 (As Amended) Table __ ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☑ CCME ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality:______ ☐ Other:______

Matrix Type: S (Soil/Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

quote 15-304

Required Analyses

Paracel Order Number:
1536025

0
117
22

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	F1-F4	Metals/Inorganics	PCB-
✓ 1	F3-4 (0-15)	S		2	Aug 18/15	—	X	X	X
✓ 2	F3-4 (40-50)					—			
✓ 3	F3-5 (0-15)					—			
✓ 4	F3-5 (40-50)					—			
✓ 5	F3-6 (0-15)					—			
✓ 6	F3-6 (40-50)					—			
✓ 7	F3-7 (0-15)					—			
✓ 8	F3-7 (40-50)					—			
✓ 9	F3-8 (0-15)					~~—~~ —			
✓ 10	F3-8 (40-50) BROKEN	↓		↓	↓	—	↓	↓	↓

Comments:
↳ may have glass inside

Method of Delivery: Walk-in

Relinquished By (Sign):
Relinquished By (Print): Tony Lyon
Date/Time: Aug 28, 2015 5:00

Received by Driver/Depot: Karen Gill
Date/Time: Aug 28/15 5:00
Temperature: 8.4 °C

Received at Lab: D. Charlebois
Date/Time: AUG31/15 9:35
Temperature: 13.0 °C

Verified By: D Charlebois
Date/Time: AUG31/15 10:48
pH Verified ☒ By: N/A

PARACEL
LABORATORIES LTD.

TRUSTED .
RESPONSIVE .
RELIABLE .

Head Office
300-2319 St. Laurent Blvd.
Ottawa, Ontario K1G 4J8
p: 1-800-749-1947
e: paracel@paracellabs.com
www.paracellabs.com

Chain of Custody
(Lab Use Only)
№ 22998

Page 2 of 6

Golder Associates Ltd.
Nicole MacDonald
1931 Robertson Road
Ottawa, Ontario K2H 5B7
613-592-9600

Project Ref: Dew Lines Sites Landfill Monitoring
Quote: 15-304 Golder Dew Lines Monitoring
Email address: Nicole_macdonald@golder.com
Darrin_johnson@golder.com

TAT: [✓] Regular [ ] 3 Day
[ ] 2 Day [ ] 1 Day
Date Required: ______

Criteria: [ ] O. Reg. 153/04 (As Amended) Table __ [ ] RSC Filing [ ] O. Reg. 558/00 [ ] PWQO [✓] CCME [ ] SUB (Storm) [ ] SUB (Sanitary) Municipality: ______ [ ] Other: ______

Matrix Type: S (Soil/Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

Required Analyses

quote 15-304

Paracel Order Number:
1536025

		Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	F1-F4	metals/Inorg	PCB
✓	1	F3-9 (0-15)	S		2	Aug 18/15	—	X	X	X
✓	2	F3-9 (40-50)					—			
✓	3	F3-10 (0-15)					—			
✓	4	F3-10 (40-50)					—			
✓	5	F3-11 (0-15)					—			
✓	6	F3-11 (40-50)					—			
✓	7	F3-12 (0-15)					—			
✓	8	F3-12 (40-50)					—			
✓	9	F3-1 (0-15)				Aug 17/15	—			
✓	10	F3-1 (40-50)				Aug 17	—			

Comments:

Method of Delivery: Walk-in

Relinquished By (Sign):
Relinquished By (Print): Tony Lyon
Date/Time: Aug 28, 2015 5:00

Received by Driver/Depot: Karen Cull
Date/Time: Aug 28/15 5:00
Temperature: 8.4 °C

Received at Lab: O. Charlebois
Date/Time: Aug 31/15 9:35
Temperature: 10.0 °C

Verified By: O. Charlebois
Date/Time: Aug 31/15 10:43
pH Verified [X] By: N/A

Chain of Custody (Blank) - Rev 0.3 Oct. 2014

PARACEL
LABORATORIES LTD.

TRUSTED.
RESPONSIVE.
RELIABLE.

OTTAWA ◉ KINGSTON ◉ NIAGARA ◉ MISSISSAUGA ◉ SARNIA

Head Office
300-2319 St. Laurent Blvd.
Ottawa, Ontario K1G 4J8
p: 1-800-749-1947
e: paracel@paracellabs.com
www.paracellabs.com

Chain of Custody
(Lab Use Only)
№ 19649

Page 3 of 6

Client Name: Golder Associates Ltd.
Contact Name: Nicole MacDonald
Address: 1931 Robertson Road, Ottawa
Telephone: 613 592 9600

Project Reference: 1530908
Quote # 15-304
PO #
Email Address: nicole_macdonald@golder.com
darrin_johnson@golder.com

TAT: ☑ Regular ☐ 3 Day
☐ 2 Day ☐ 1 Day
Date Required:

Criteria: ☐ O. Reg. 153/04 (As Amended) Table __ ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☑ CCME ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality:__________ ☐ Other:__________

Matrix Type: S (Soil/Sed.) **GW** (Ground Water) **SW** (Surface Water) **SS** (Storm/Sanitary Sewer) **P** (Paint) **A** (Air) **O** (Other)

Required Analyses

Paracel Order Number:
1536025

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	quote 15-304										
1	F3-2 (0-15)	S		2	Aug17/15	–	X										
2	F3-2 (40-50)	↓		↓	↓	–	X										
3	F3-3 (0-15)					–	X										
4	F3-3 (40-50)					–	X										
5	MW-05 (0-15)				Aug18/15	–	X										
6	MW-05 (40-50)				↓	–	X										
7	MW-06 (0-15)					–	X										
8	MW-06 (40-50)					–	X										
9	MW-07 (0-15)					–	X										
10	MW-07 (40-50)					–	X										

Comments:

Method of Delivery: Walk-in

Relinquished By (Sign):
Relinquished By (Print): Tony Lyon
Date/Time: Aug 28, 2015 5:00

Received by Driver/Depot: Karen Cull
Date/Time: Aug 28/15 5:00
Temperature: 8.4 °C

Received at Lab: D.Charlebois
Date/Time: Aug31/15 9:35
Temperature: 10.0 °C

Verified By: D.Charlebois
Date/Time: Aug31/15 10:43
pH Verified ☒ By: N/A

PARACEL
LABORATORIES LTD.

TRUSTED.
RESPONSIVE.
RELIABLE.

OTTAWA ◉ KINGSTON ◉ NIAGARA ◉ MISSISSAUGA ◉ SARNIA

Head Office
300-2319 St. Laurent Blvd.
Ottawa, Ontario K1G 4J8
p: 1-800-749-1947
e: paracel@paracellabs.com
www.paracellabs.com

Chain of Custody
(Lab Use Only)
Nº 98030

Page 4 of 6

Client Name: Golder Associates Ltd
Contact Name: Nicole MacDonald
Address: 1931 Robertson Road, Ottawa
Telephone: 613 592 9600

Project Reference: 1530908
Quote # 15-304
PO #
Email Address: nicole_macdonald@golder.com, damin_johnson@golder.com

TAT: [✓] Regular [ ] 3 Day
[ ] 2 Day [ ] 1 Day
Date Required:

Criteria: [ ] O. Reg. 153/04 (As Amended) Table __ [ ] RSC Filing [ ] O. Reg. 558/00 [ ] PWQO [✓] CCME [ ] SUB (Storm) [ ] SUB (Sanitary) Municipality: ____________ [ ] Other: ____________

Matrix Type: **S** (Soil/Sed.) **GW** (Ground Water) **SW** (Surface Water) **SS** (Storm/Sanitary Sewer) **P** (Paint) **A** (Air) **O** (Other)

Paracel Order Number: 1536025

Required Analyses

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (HWS)	quote 15-304						
1	MW-08 (0-15)	S		2	Aug18/15	–								X						
2	MW-08 (30-40)					–								X						
3	MW-01 (0-15)					–								X						
4	MW-01 (40-50)					–								X						
5	MW-02 (0-15)					–								X						
6	MW-02 (40-50)					–								X						
7	MW-03 (0-15)					–								X						
8	MW-03 (40-50)					–								X						
9	MW-04 (0-15)					–								X						
10	MW-04 (40-50)	↓		↓	↓	–								X						

Comments:

Method of Delivery: Walk-in

Relinquished By (Sign):
Relinquished By (Print): Tony Lyon
Date/Time: Aug 28, 2015 / 5:00

Received by Driver/Depot: Kaun Cull
Date/Time: Aug 28/15 5:00
Temperature: 8.4 °C

Received at Lab: D. Charlebois
Date/Time: AUG 31/15 9:35
Temperature: 0.0 °C

Verified By: D. Charlebois
Date/Time: AUG 31/15 10:48
pH Verified [X] By: N/A

PARACEL LABORATORIES LTD.

TRUSTED.
RESPONSIVE.
RELIABLE.

OTTAWA ◉ KINGSTON ◉ NIAGARA ◉ MISSISSAUGA ◉ SARNIA

Head Office
300-2319 St. Laurent Blvd.
Ottawa, Ontario K1G 4J8
p: 1-800-749-1947
e: paracel@paracellabs.com
www.paracellabs.com

Chain of Custody
(Lab Use Only)
№ 98031

Page 5 of 6

Client Name: Golder Associates Ltd
Contact Name: Nicole MacDonald
Address: 1931 Robertson Road, Ottawa
Telephone: 613 592 9600

Project Reference: 1530908
Quote # 15-304
PO #
Email Address: nicole_macdonald@golder.com
damin_johnson@golder.com

TAT: ☑ Regular ☐ 3 Day ☐ 2 Day ☐ 1 Day
Date Required:

Criteria: ☐ O. Reg. 153/04 (As Amended) Table __ ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☑ CCME ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality: ______ ☐ Other: ______

Matrix Type: S (Soil/Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

Paracel Order Number: 1536025

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Date	Time	PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (HWS)	quote 15-304						
1	MW-05 (0-15)	S		2	Aug 21/15	14:40								X						
2	MW-05 (30-40)	↓		↓	↓	14:40								X						
3	MW-06 (0-15)					13:50								X						
4	MW-06 (40-50)					13:50								X						
5	MW-07 (0-15)					13:15								X						
6	MW-07 (40-50)					13:15								X						
7	MW-08 (0-15)					12:10								X						
8	MW-08 (40-50)					12:10								X						
9	F2-6 (0-15)					11:00								X						
10	F2-6 (40-50)					11:00								X						

Comments:

Method of Delivery: Walk-in

Relinquished By (Sign):
Relinquished By (Print): Tony Lyon
Date/Time: Aug 28, 2015 5:00

Received by Driver/Depot: Karin Cul
Date/Time: Aug 28/15 5:00
Temperature: 8.4 °C

Received at Lab: D. Charlebois
Date/Time: AUG 31/15 9:35
Temperature: 10.0 °C

Verified By: D. Charlebois
Date/Time: AUG 31/15 10:43
pH Verified ☒ By: N/A

Chain of Custody (Env) - Rev 0.5 May 2013

PARACEL LABORATORIES LTD. | TRUSTED. RESPONSIVE. RELIABLE.

Head Office
300-2319 St. Laurent Blvd.
Ottawa, Ontario K1G 4J8
p: 1-800-749-1947
e: paracel@paracellabs.com
www.paracellabs.com

Chain of Custody
(Lab Use Only)
№ 23963

Page 6 of 6

Golder Associates Ltd.
Nicole MacDonald
1931 Robertson Road
Ottawa, Ontario K2H 5B7
613-592-9600

Project Ref: Dew Lines Sites Landfill Monitoring
Quote: 15-304 Golder Dew Lines Monitoring
Email address: Nicole_macdonald@golder.com
Darrin_johnson@golder.com

TAT: [✓] Regular [ ] 3 Day
[ ] 2 Day [ ] 1 Day
Date Required: ______

Criteria: [ ] O. Reg. 153/04 (As Amended) Table __ [ ] RSC Filing [ ] O. Reg. 558/00 [ ] PWQO [✓] CCME [ ] SUB (Storm) [ ] SUB (Sanitary) Municipality: ______ [ ] Other: ______

Matrix Type: S (Soil/Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

Paracel Order Number: 1536025

Required Analyses: quote 15-304

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	PCB	[illegible]	F1-F4								
✓ 1	F2-7 (0-15)	S		2	Aug 21	10:45	X	X	X								
✓ 2	F2-7 (40-50)	↓		↓	↓	10:45	↓	↓	↓								
✓ 3	F2-8 (0-15)	↓		↓	↓	10:20	↓	↓	↓								
✓ 4	F2-8 (40-50)	↓		↓	↓	10:20	↓	↓	↓								
✓ 5	F2-9 (0-15)	↓		↓	↓	10:10	↓	↓	↓								
✓ 6	F2-9 (40-50)	↓		↓	↓	10:10	↓	↓	↓								
– 7	~~MW07~~	W		6			↓	↓	↓								
– 8	~~MW08~~	↓		↓	↓		↓	↓	↓								
– 9	~~MW06~~	↓		↓	↓		↓	↓	↓								
10																	

Comments:

Method of Delivery: Walk-in

Relinquished By (Sign):	Received by Driver/Depot: Karen Cull	Received at Lab: D. Charlebois	Verified By: D. Charlebois
Relinquished By (Print): Tom Lyon	Date/Time: Aug 28/15 5:00	Date/Time: Aug 31/15 9:35	Date/Time: Aug 31/15 10:48
Date/Time: Aug 28, 2015 5:00	Temperature: 8.4 °C	Temperature: 0.5 °C	pH Verified [✓] By: N/A

PARACEL LABORATORIES LTD.
TRUSTED. RESPONSIVE. RELIABLE.

300 - 2319 St. Laurent Blvd
Ottawa, ON, K1G 4J8
1-800-749-1947
www.paracellabs.com

Certificate of Analysis

Golder Associates Ltd. (Ottawa)

1931 Robertson Rd.
Ottawa, ON K2H 5B7
Attn: Nicole MacDonald

Client PO:
Project: 1530908
Custody: 102402

Report Date: 2-Sep-2015
Order Date: 27-Aug-2015

Order #: 1535254

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
1535254-01	MW0901
1535254-02	MW0902
1535254-03	MW0903
1535254-04	MW0904
1535254-05	MW0905
1535254-06	MW0906
1535254-07	MW0907
1535254-08	MW0908

Approved By:

Dale Robertson, BSc
Laboratory Director

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Mercury by CVAA	EPA 245.1 - Cold Vapour AA	1-Sep-15	1-Sep-15
Metals, ICP-MS	EPA 200.8 - ICP-MS	28-Aug-15	28-Aug-15
PCBs, total	EPA 608 - GC-ECD	31-Aug-15	1-Sep-15
PHC F1	CWS Tier 1 - P&T GC-FID	28-Aug-15	28-Aug-15
PHC F2 - F4	CWS Tier 1 - GC-FID, extraction	31-Aug-15	31-Aug-15

Certificate of Analysis

Report Date: 02-Sep-2015

Client: **Golder Associates Ltd. (Ottawa)**

Order Date:27-Aug-2015

Client PO:

Project Description: 1530908

	Client ID:	MW0901	MW0902	MW0903	MW0904
	Sample Date:	19-Aug-15	19-Aug-15	19-Aug-15	19-Aug-15
	Sample ID:	1535254-01	1535254-02	1535254-03	1535254-04
	MDL/Units	Water	Water	Water	Water
Metals					
Mercury	0.1 ug/L	<0.1	<0.1	<0.1	<0.1
Arsenic	1 ug/L	4	8	5	<1
Cadmium	0.1 ug/L	0.4	0.2	0.2	0.8
Chromium	1 ug/L	6	11	<1	<1
Cobalt	0.5 ug/L	16.1	5.1	4.5	37.7
Copper	0.5 ug/L	28.2	97.9	37.4	<0.5
Lead	0.1 ug/L	11.3	18.4	1.1	1.9
Nickel	1 ug/L	73	54	38	103
Zinc	5 ug/L	90	239	2060	60
Hydrocarbons					
F1 PHCs (C6-C10)	25 ug/L	<25 [1]	<25 [1]	<25 [1]	<25 [1]
F2 PHCs (C10-C16)	100 ug/L	<100 [1]	<100 [1]	<100 [1]	<100 [1]
F3 PHCs (C16-C34)	100 ug/L	<100 [1]	<100 [1]	<100 [1]	<100 [1]
F4 PHCs (C34-C50)	100 ug/L	<100 [1]	<100 [1]	<100 [1]	<100 [1]
PCBs					
PCBs, total	0.05 ug/L	<0.05	<0.05	<0.05	<0.05
Decachlorobiphenyl	Surrogate	70.2%	60.0%	71.0%	74.0%

Certificate of Analysis

Report Date: 02-Sep-2015

Client: **Golder Associates Ltd. (Ottawa)**

Order Date:27-Aug-2015

Client PO:

Project Description: 1530908

Client ID: **Sample Date:** **Sample ID:**		MW0905 19-Aug-15 1535254-05 Water	MW0906 19-Aug-15 1535254-06 Water	MW0907 19-Aug-15 1535254-07 Water	MW0908 19-Aug-15 1535254-08 Water
	MDL/Units				
Metals					
Mercury	0.1 ug/L	<0.1	<0.1	<0.1	<0.1
Arsenic	1 ug/L	2	8	4	9
Cadmium	0.1 ug/L	0.7	0.3	0.2	0.1
Chromium	1 ug/L	5	6	20	5
Cobalt	0.5 ug/L	8.7	3.3	6.1	1.4
Copper	0.5 ug/L	3.6	62.2	26.7	6.2
Lead	0.1 ug/L	2.3	11.0	4.0	7.5
Nickel	1 ug/L	33	22	45	12
Zinc	5 ug/L	377	233	336	323
Hydrocarbons					
F1 PHCs (C6-C10)	25 ug/L	<25 [1]	<25 [1]	<25 [1]	<25 [1]
F2 PHCs (C10-C16)	100 ug/L	<100 [1]	<100 [1]	<100 [1]	<100 [1]
F3 PHCs (C16-C34)	100 ug/L	<100 [1]	<100 [1]	<100 [1]	<100 [1]
F4 PHCs (C34-C50)	100 ug/L	<100 [1]	<100 [1]	<100 [1]	<100 [1]
PCBs					
PCBs, total	0.05 ug/L	<0.05	<0.05	<0.05	<0.05
Decachlorobiphenyl	Surrogate	74.6%	72.0%	63.3%	88.0%

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	ND	25	ug/L						
F2 PHCs (C10-C16)	ND	100	ug/L						
F3 PHCs (C16-C34)	ND	100	ug/L						
F4 PHCs (C34-C50)	ND	100	ug/L						
Metals									
Mercury	ND	0.1	ug/L						
Arsenic	ND	1	ug/L						
Cadmium	ND	0.1	ug/L						
Chromium	ND	1	ug/L						
Cobalt	ND	0.5	ug/L						
Copper	ND	0.5	ug/L						
Lead	ND	0.1	ug/L						
Nickel	ND	1	ug/L						
Zinc	ND	5	ug/L						
PCBs									
PCBs, total	ND	0.05	ug/L						
Surrogate: Decachlorobiphenyl	*0.413*		*ug/L*		*82.5*	*60-140*			

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	ND	25	ug/L	ND				30	
Metals									
Mercury	ND	0.1	ug/L	ND			0.0	20	
Arsenic	ND	1	ug/L	ND				20	
Cadmium	ND	0.1	ug/L	ND			0.0	20	
Chromium	ND	1	ug/L	ND				20	
Cobalt	ND	0.5	ug/L	ND			0.0	20	
Copper	ND	0.5	ug/L	ND				20	
Lead	ND	0.1	ug/L	ND				20	
Nickel	ND	1	ug/L	ND				20	
Zinc	ND	5	ug/L	ND			0.0	20	

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	1570	25	ug/L	ND	78.5	68-117			
F2 PHCs (C10-C16)	1470	100	ug/L	ND	81.7	60-140			
F3 PHCs (C16-C34)	3300	100	ug/L	ND	88.7	60-140			
F4 PHCs (C34-C50)	2060	100	ug/L	ND	83.1	60-140			
Metals									
Mercury	3.31	0.1	ug/L	ND	110	78-137			
Arsenic	50.7		ug/L	ND	101	80-120			
Cadmium	48.5		ug/L	ND	97.0	80-120			
Chromium	49.8		ug/L	ND	99.6	80-120			
Cobalt	49.1		ug/L	0.0007	98.1	80-120			
Copper	43.5		ug/L	ND	87.0	80-120			
Lead	46.5		ug/L	ND	93.1	80-120			
Nickel	49.1		ug/L	ND	98.3	80-120			
Zinc	53		ug/L	3	99.6	80-120			
PCBs									
PCBs, total	1.23	0.05	ug/L	ND	123	60-140			
Surrogate: Decachlorobiphenyl	*0.300*		*ug/L*		*60.0*	*60-140*			

Qualifier Notes:

Login Qualifiers :

Sample - Not preserved - metals and mercury not preserved

Applies to samples: MW0901, MW0902, MW0903, MW0904, MW0905, MW0906, MW0907

Sample - Not preserved - metals not preserved

Applies to samples: MW0908

Sample - Not submitted in the correct container - No mercury bottle submitted, subsampled from unpreserved metals bottle into preserved mercury bottle

Applies to samples: MW0908

Sample Qualifiers :

1 : Holding time had been exceeded upon sample receipt.

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable
ND: Not Detected
MDL: Method Detection Limit
Source Result: Data used as source for matrix and duplicate samples
%REC: Percent recovery.
RPD: Relative percent difference.

CCME PHC additional information:

- The method for the analysis of PHCs complies with the Reference Method for the CWS PHC and is validated for use in the laboratory. All prescribed quality criteria identified in the method has been met.
- F1 range corrected for BTEX.
- F2 to F3 ranges corrected for appropriate PAHs where available.
- The gravimetric heavy hydrocarbons (F4G) are not to be added to C6 to C50 hydrocarbons.
- In the case where F4 and F4G are both reported, the greater of the two results is to be used for comparison to CWS PHC criteria.

PARACEL
LABORATORIES LTD.

TRUSTED.
RESPONSIVE.
RELIABLE.

OTTAWA ◉ KINGSTON ◉ NIAGARA ◉ MISSISSAUGA ◉ SARNIA

Head Office
300-2319 St. Laurent Blvd.
Ottawa, Ontario K1G 4J8
p: 1-800-749-1947
e: paracel@paracellabs.com
www.paracellabs.com

Chain of Custody
(Lab Use Only)

№ 102402

Page 1 of 1

Client Name: Golder Associates Ltd.
Contact Name: Nicole MacDonald
Address: 1931 Robertson Road, Ottawa
Telephone: 613 592 9600

Project Reference: 1530908
Quote # 15-304 Golder DEW Line
PO #
Email Address: nicole_macdonald@golder.com
darrin_johnson@golder.com

TAT: ☑ Regular ☐ 3 Day ☐ 2 Day ☐ 1 Day
Date Required: ______

Criteria: ☐ O. Reg. 153/04 (As Amended) Table __ ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☑ CCME ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality: ______ ☐ Other: ______

Matrix Type: S (Soil/Sed.) **GW** (Ground Water) **SW** (Surface Water) **SS** (Storm/Sanitary Sewer) **P** (Paint) **A** (Air) **O** (Other)

Paracel Order Number: 1535254

Required Analyses

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (HWS)	quote 15-304						
1	MW0901	GW		6	Aug19/15	16:00								X						
2	MW0902	|		6	|	15:30								X						
3	MW0903	|		6	|	15:00								X						
4	MW0904	|		6	|	16:30								X						
5	MW0905	|		6	|	13:40								X						
6	MW0906	|		6	|	14:30								X						
7	MW0907	|		6	|	13:15								X						
8	MW0908 *	↓		5	↓	12:40								X						
9																				
10																				

Comments: * mercury bottle for MW0908 broke, please try to analyze from other bottles
↳ Took sample from unpreserved metals bottle to preserved mercury bottle.

Method of Delivery: Drop Box

Relinquished By (Sign): N MacDonald.
Relinquished By (Print): Nicole MacDonald
Date/Time: Aug 26/15 18:30

Received by Driver/Depot:
Date/Time: Aug. 27/15 7:00am
Temperature: 11.3 °C

Received at Lab: D.Charlebois
Date/Time: Aug27/15 10:25
Temperature: 2.6 °C

Verified By: D.Charlebois
Date/Time: Aug27/15 10:48
pH Verified ~~[ ]~~ By: DC

AGAT Laboratories

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
www.agatlabs.com webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water intended for human consumption)

Laboratory Use Only

Work Order #:

Cooler Quantity:

Arrival Temperatures:

Custody Seal Intact: ☐Yes ☐No ☐N/A

Notes:

Report Information:

Company: Golder Associates Ltd.

Contact: Nicole MacDonald

Address: 1931 Robertson Road, Ottawa

Phone: 613 592 9600 Fax: 613 592 9601

Reports to be sent to:

1. Email: nicole_macdonald@golder.com
2. Email: darrin_johnson@golder.com

Regulatory Requirements: ☐ No Regulatory Requirement

(Please check all applicable boxes)

☐Regulation 153/04
Table ______ *Indicate One*
☐Ind/Com
☐Res/Park
☐Agriculture
Soil Texture *(Check One)*
☐Coarse
☐Fine

☐Sewer Use
☐Sanitary
☐Storm
Region ______ *Indicate One*

☐Regulation 558
☒CCME
☐Prov. Water Quality Objectives (PWQO)
☐Other
______ *Indicate One*

Is this submission for a **Record of Site Condition**? ☐ Yes ☒ No

Report Guideline on Certificate of Analysis ☒ Yes ☐ No

Turnaround Time (TAT) Required:

Regular TAT ☒ 5 to 7 Business Days

Rush TAT **(Rush Surcharges Apply)**

☐ 3 Business Days ☐ 2 Business Days ☐ 1 Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

Project Information:

Project: DEW Line Landfill Monitoring 1530908

Site Location: FOX-2 & FOX-3

Sampled By: KR

AGAT Quote #: 69566

Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☒ No ☐

Company:

Contact: Don Plenderleith

Address:

Email: dplenderleith@golder.com

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	(Check Applicable) **ORPs:** ☐ B-HWS ☐ Cl ☐ CN ☐ Cr⁶⁺ ☐ EC ☐ FOC ☐ NO₃/NO₂ ☐ Total N ☐ Hg ☐ pH ☐ SAR	**Nutrients:** ☐ TP ☐ NH₃ ☐ TKN ☐ NO₃ ☐ NO₂ ☐ NO₃/NO₂	**Volatiles:** ☐ VOC ☐ BTEX ☐ THM	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	Sewer Use	quote 69566								
MW0906	Aug 19/15	14:30	7	GW																	X								
F3-5 (15-30)	Aug 18/15	–	3	S																	X								
F3-10 (40-50)	↓	–	3	S																	X								
MW-01 (15-30)		–	3	S																	X								
F3-12 (15-30)		–	3	S																	X								
~~MW08 (0-15)~~	~~Aug 21/15~~	~~12:10~~	~~3~~	~~S~~																	~~X~~								
~~MW06 (0-15)~~	~~↓~~	~~13:50~~	~~3~~	~~S~~																	~~X~~								

Samples Relinquished By (Print Name and Sign): Nicole MacDonald	Date Aug 26/15	Time 18:45	Samples Received By (Print Name and Sign):	Date	Time	Page 1 of 1
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time	Nº: T000650

Pink Copy - Client | Yellow Copy - AGAT | White Copy- AGAT

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: **GOLDER ASSOCIATES LTD**
1931 ROBERTSON ROAD
OTTAWA, ON K2H5B7
(613) 592-9600

ATTENTION TO: **Nicole MacDonald**

PROJECT: **DEW Line Landfill Monitoring 1530908**

AGAT WORK ORDER: **15Z012020**

SOIL ANALYSIS REVIEWED BY: **Anthony Dapaah, PhD (Chem), Inorganic Lab Manager**

TRACE ORGANICS REVIEWED BY: **Inga Kuzmina, Trace Organics Lab Manager**

WATER ANALYSIS REVIEWED BY: **Amanjot Bhela, Inorganic Coordinator**

DATE REPORTED: **Nov 13, 2015**

PAGES (INCLUDING COVER): **13**

VERSION*: **2**

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

VERSION 2:Nov 13, 2015

The RDL for zinc has been revised to comply with the required regulatory standards.

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

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 15Z012020

PROJECT: DEW Line Landfill Monitoring 1530908

CLIENT NAME: GOLDER ASSOCIATES LTD

ATTENTION TO: Nicole MacDonald

SAMPLING SITE:Fox 2 & Fox 3

SAMPLED BY:

Metals Scan (Soil) (incl. Hg)

DATE RECEIVED: 2015-08-27

DATE REPORTED: 2015-11-13

			SAMPLE DESCRIPTION:	F3-5 (0-15)	F3-10 (40-50)	MW-01 (0-15)	F3-12 (0-15)	MW08 (0-15)	MW06 (0-15)
			SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil
			DATE SAMPLED:	8/18/2015	8/18/2015	8/18/2015	8/18/2015	8/21/2015	8/21/2015
Parameter	**Unit**	**G / S**	**RDL**	6911107	6911111	6911115	6911118	6911121	6911125
Arsenic	µg/g		1	13	10	28	16	53	25
Cadmium	µg/g		0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cobalt	µg/g		0.5	9.3	9.9	11.2	11.7	59.7	18.0
Chromium	µg/g		2	73	69	90	78	73	79
Copper	µg/g		1	29	30	46	39	82	40
Lead	µg/g		1	6	6	8	7	12	12
Mercury	µg/g		0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Nickel	µg/g		1	29	29	41	35	163	47
Zinc	µg/g		2	72	70	77	75	211	110

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

6911107-6911125 Nov 13, 2015

The RDL for zinc has been revised to comply with the required regulatory standards.

Certified By:

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: GOLDER ASSOCIATES LTD

ATTENTION TO: Nicole MacDonald

SAMPLING SITE:Fox 2 & Fox 3

SAMPLED BY:

O. Reg. 153(511) - PHCs F1 - F4 (Soil)

DATE RECEIVED: 2015-08-27

DATE REPORTED: 2015-11-13

			SAMPLE DESCRIPTION:	F3-5 (0-15)	F3-10 (40-50)	MW-01 (0-15)	F3-12 (0-15)	MW08 (0-15)	MW06 (0-15)
			SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil
			DATE SAMPLED:	8/18/2015	8/18/2015	8/18/2015	8/18/2015	8/21/2015	8/21/2015
Parameter	**Unit**	**G / S**	**RDL**	**6911107**	**6911111**	**6911115**	**6911118**	**6911121**	**6911125**
Benzene	µg/g		0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Toluene	µg/g		0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Ethylbenzene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Xylene Mixture	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
F1 (C6 to C10)	µg/g		5	<5	<5	<5	<5	<5	<5
F1 (C6 to C10) minus BTEX	µg/g		5	<5	<5	<5	<5	<5	<5
F2 (C10 to C16)	µg/g		4	<4	<4	<4	<4	<4	<4
F3 (C16 to C34)	µg/g		8	<8	<8	<8	<8	<8	57
F4 (C34 to C50)	µg/g		6	<6	<6	<6	<6	<6	40
Gravimetric Heavy Hydrocarbons	µg/g		50	NA	NA	NA	NA	NA	NA
Moisture Content	%		0.1	13.0	15.4	18.9	5.9	8.6	13.7
Surrogate	**Unit**	**Acceptable Limits**							
Terphenyl	%	60-140		110	120	112	99	102	98

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

6911107-6911125 Results are based on sample dry weight.
The C6-C10 fraction is calculated using Toluene response factor.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons are not included in the Total C16-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
The chromatogram has returned to baseline by the retention time of nC50.
Total C6 - C50 results are corrected for BTEX contributions.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
Extraction and holding times were met for this sample.
Fractions 1-4 are quantified with the contribution of PAHs. Under Ontario Regulation 153, results are considered valid without determining the PAH contribution if not requested by the client.
Quality Control Data is available upon request.

Certified By:

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 15Z012020

PROJECT: DEW Line Landfill Monitoring 1530908

CLIENT NAME: GOLDER ASSOCIATES LTD

ATTENTION TO: Nicole MacDonald

SAMPLING SITE:Fox 2 & Fox 3

SAMPLED BY:

O. Reg. 153(511) - PHCs F1 - F4 (Water)

DATE RECEIVED: 2015-08-27

DATE REPORTED: 2015-11-13

			SAMPLE DESCRIPTION:	MW0906
			SAMPLE TYPE:	Water
			DATE SAMPLED:	8/19/2015
Parameter	**Unit**	**G / S**	**RDL**	**6911081**
Benzene	µg/L		0.20	<0.20
Toluene	µg/L		0.20	<0.20
Ethylbenzene	µg/L		0.10	<0.10
Xylene Mixture	µg/L		0.20	<0.20
F1 (C6 to C10)	µg/L		25	<25
F1 (C6 to C10) minus BTEX	µg/L		25	<25
F2 (C10 to C16)	µg/L		100	<100
F3 (C16 to C34)	µg/L		100	<100
F4 (C34 to C50)	µg/L		100	<100
Gravimetric Heavy Hydrocarbons	µg/L		500	NA
Surrogate	**Unit**	**Acceptable Limits**		
Terphenyl	%	60-140		63

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

6911081 The C6-C10 fraction is calculated using Toluene response factor.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and nC34.
Gravimetric Heavy Hydrocarbons are not included in the Total C16 - C50 and are only determined if the chromatogram of the C34 - C50 Hydrocarbons indicated that hydrocarbons >C50 are present.
The chromatogram has returned to baseline by the retention time of nC50.
Total C6-C50 results are corrected for BTEX contributions.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 nC34 average.
Linearity is within 15%.
Extraction and holding times were met for this sample.
Fractions 1-4 are quantified with the contribution of PAHs. Under Ontario Regulation 153/04, results are considered valid without determining the PAH contribution if not requested by the client.
NA = Not Applicable

Certified By:

PCBs (Aroclors) - Soil

DATE RECEIVED: 2015-08-27

DATE REPORTED: 2015-11-13

			SAMPLE DESCRIPTION:	F3-5 (0-15)	F3-10 (40-50)	MW-01 (0-15)	F3-12 (0-15)	MW08 (0-15)	MW06 (0-15)
			SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil
			DATE SAMPLED:	8/18/2015	8/18/2015	8/18/2015	8/18/2015	8/21/2015	8/21/2015
Parameter	**Unit**	**G / S**	**RDL**	**6911107**	**6911111**	**6911115**	**6911118**	**6911121**	**6911125**
Aroclor 1242	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCBs	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate	**Unit**	**Acceptable Limits**							
Decachlorobiphenyl	%	60-130		96	80	88	76	84	88

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

6911107-6911125 Results are based on the dry weight of soil extracted.

Certified By:

Certificate of Analysis

AGAT WORK ORDER: 15Z012020

PROJECT: DEW Line Landfill Monitoring 1530908

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: GOLDER ASSOCIATES LTD

ATTENTION TO: Nicole MacDonald

SAMPLING SITE:Fox 2 & Fox 3

SAMPLED BY:

PCBs (water) (Aroclors)

DATE RECEIVED: 2015-08-27

DATE REPORTED: 2015-11-13

			SAMPLE DESCRIPTION:	MW0906
			SAMPLE TYPE:	Water
			DATE SAMPLED:	8/19/2015
Parameter	**Unit**	**G / S**	**RDL**	**6911081**
Aroclor 1242	µg/L		0.05	<0.05
Aroclor 1248	µg/L		0.05	<0.05
Aroclor 1254	µg/L		0.05	<0.05
Aroclor 1260	µg/L		0.05	<0.05
PCBs	µg/L		0.05	<0.05
Surrogate	**Unit**	**Acceptable Limits**		
Decachlorobiphenyl	%	60-130		85

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

Certified By:

Certificate of Analysis

AGAT WORK ORDER: 15Z012020

PROJECT: DEW Line Landfill Monitoring 1530908

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: GOLDER ASSOCIATES LTD

ATTENTION TO: Nicole MacDonald

SAMPLING SITE:Fox 2 & Fox 3

SAMPLED BY:

Metals - CCME Metals - (Water) - mg/L (incl. Hg)

DATE RECEIVED: 2015-08-27

DATE REPORTED: 2015-11-13

			SAMPLE DESCRIPTION:	MW0906
			SAMPLE TYPE:	Water
			DATE SAMPLED:	8/19/2015
Parameter	**Unit**	**G / S**	**RDL**	**6911081**
Arsenic	mg/L		0.001	0.005
Cadmium	mg/L		0.00002	0.00007
Chromium	mg/L		0.002	<0.002
Cobalt	mg/L		0.001	<0.001
Copper	mg/L		0.002	0.027
Lead	mg/L		0.001	<0.001
Mercury	mg/L		0.000016	0.000023
Nickel	mg/L		0.003	0.010
Zinc	mg/L		0.005	0.017

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

Certified By: Amanjot Bhela

Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD **AGAT WORK ORDER: 15Z012020**
PROJECT: DEW Line Landfill Monitoring 1530908 **ATTENTION TO: Nicole MacDonald**
SAMPLING SITE:Fox 2 & Fox 3 **SAMPLED BY:**

Soil Analysis

RPT Date: Nov 13, 2015			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Metals Scan (Soil) (incl. Hg)															
Arsenic	6911115	6911115	28	28	0.0%	< 1	105%	70%	130%	92%	80%	120%	94%	70%	130%
Cadmium	6911115	6911115	<0.5	<0.5	0.0%	< 0.5	109%	70%	130%	103%	80%	120%	105%	70%	130%
Cobalt	6911115	6911115	11.2	11.4	1.8%	< 0.5	96%	70%	130%	98%	80%	120%	99%	70%	130%
Chromium	6911115	6911115	90	92	2.2%	< 2	85%	70%	130%	94%	80%	120%	100%	70%	130%
Copper	6911115	6911115	46	47	2.2%	< 1	90%	70%	130%	99%	80%	120%	89%	70%	130%
Lead	6911115	6911115	8	8	0.0%	< 1	112%	70%	130%	97%	80%	120%	96%	70%	130%
Mercury	6911115	6911115	<0.10	<0.10	0.0%	< 0.10	102%	70%	130%	99%	80%	120%	98%	70%	130%
Nickel	6911115	6911115	41	41	0.0%	< 1	98%	70%	130%	100%	80%	120%	101%	70%	130%
Zinc	6911115	6911115	77	78	1.3%	< 2	102%	70%	130%	109%	80%	120%	114%	70%	130%

Certified By: ______________________

Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD **AGAT WORK ORDER: 15Z012020**

PROJECT: DEW Line Landfill Monitoring 1530908 **ATTENTION TO: Nicole MacDonald**

SAMPLING SITE:Fox 2 & Fox 3 **SAMPLED BY:**

Trace Organics Analysis

RPT Date: Nov 13, 2015			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
PCBs (Aroclors) - Soil															
Aroclor 1242	6911487		< 0.05	< 0.05	0.0%	< 0.05	NA	60%	130%	NA	60%	130%	NA	60%	130%
Aroclor 1248	6911487		< 0.05	< 0.05	0.0%	< 0.05	NA	60%	130%	NA	60%	130%	NA	60%	130%
Aroclor 1254	6911487		< 0.05	< 0.05	0.0%	< 0.05	NA	60%	130%	NA	60%	130%	NA	60%	130%
Aroclor 1260	6911487		< 0.05	< 0.05	0.0%	< 0.05	NA	60%	130%	NA	60%	130%	NA	60%	130%
PCBs	6911487		< 0.05	< 0.05	0.0%	< 0.05	98%	60%	140%	85%	60%	140%	82%	60%	140%
PCBs (water) (Aroclors)															
Aroclor 1242		TW	< 0.1	< 0.1	0.0%	< 0.1	NA	60%	130%	NA	60%	130%	NA	60%	130%
Aroclor 1248		TW	< 0.1	< 0.1	0.0%	< 0.1	NA	60%	130%	NA	60%	130%	NA	60%	130%
Aroclor 1254		TW	< 0.1	< 0.1	0.0%	< 0.1	NA	60%	130%	NA	60%	130%	NA	60%	130%
Aroclor 1260		TW	< 0.1	< 0.1	0.0%	< 0.1	NA	60%	130%	NA	60%	130%	NA	60%	130%
PCBs		TW	< 0.1	< 0.1	0.0%	< 0.1	114%	60%	140%	114%	60%	140%	102%	60%	140%
O. Reg. 153(511) - PHCs F1 - F4 (Soil)															
Benzene	6927322		< 0.02	< 0.02	0.0%	< 0.02	91%	60%	130%	106%	60%	130%	109%	60%	130%
Toluene	6927322		< 0.08	< 0.08	0.0%	< 0.08	96%	60%	130%	110%	60%	130%	112%	60%	130%
Ethylbenzene	6927322		< 0.05	< 0.05	0.0%	< 0.05	104%	60%	130%	114%	60%	130%	116%	60%	130%
Xylene Mixture	6927322		< 0.05	< 0.05	0.0%	< 0.05	95%	60%	130%	115%	60%	130%	115%	60%	130%
F1 (C6 to C10)	6927322		< 5	< 5	0.0%	< 5	81%	60%	130%	87%	85%	115%	85%	70%	130%
F2 (C10 to C16)	6913470		< 4	< 4	0.0%	< 4	100%	60%	130%	96%	80%	120%	93%	70%	130%
F3 (C16 to C34)	6913470		< 8	< 8	0.0%	< 8	98%	60%	130%	108%	80%	120%	98%	70%	130%
F4 (C34 to C50)	6913470		< 6	< 6	0.0%	< 6	84%	60%	130%	108%	80%	120%	100%	70%	130%
O. Reg. 153(511) - PHCs F1 - F4 (Water)															
Benzene	6927322		< 0.20	< 0.20	0.0%	< 0.20	91%	50%	140%	106%	60%	130%	109%	50%	140%
Toluene	6927322		< 0.20	< 0.20	0.0%	< 0.20	96%	50%	140%	110%	60%	130%	112%	50%	140%
Ethylbenzene	6927322		< 0.10	< 0.10	0.0%	< 0.10	104%	50%	140%	114%	60%	130%	116%	50%	140%
Xylene Mixture	6927322		< 0.20	< 0.20	0.0%	< 0.20	95%	50%	140%	115%	60%	130%	115%	50%	140%
F1 (C6 to C10)	6927322		< 25	< 25	0.0%	< 25	81%	60%	140%	87%	60%	140%	85%	60%	140%
F2 (C10 to C16)		TW	< 100	< 100	0.0%	< 100	98%	60%	140%	77%	60%	140%	78%	60%	140%
F3 (C16 to C34)		TW	< 100	< 100	0.0%	< 100	98%	60%	140%	83%	60%	140%	78%	60%	140%
F4 (C34 to C50)		TW	< 100	< 100	0.0%	< 100	98%	60%	140%	80%	60%	140%	80%	60%	140%

Comments: TW: Tap water analysis has been performed as QC sample testing for duplicate and matrix spike due to insufficient sample volume.

Certified By:

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD
PROJECT: DEW Line Landfill Monitoring 1530908
SAMPLING SITE:Fox 2 & Fox 3

AGAT WORK ORDER: 15Z012020
ATTENTION TO: Nicole MacDonald
SAMPLED BY:

Water Analysis

RPT Date: Nov 13, 2015			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Metals - CCME Metals - (Water) - mg/L (incl. Hg)															
Arsenic	6907017		0.008	0.007	13.3%	< 0.001	101%	90%	110%	106%	90%	110%	106%	70%	130%
Cadmium	6907017		0.00008	0.00004	NA	< 0.00002	104%	90%	110%	104%	90%	110%	109%	70%	130%
Chromium	6907017		0.005	0.005	0.0%	< 0.002	101%	90%	110%	93%	90%	110%	111%	70%	130%
Cobalt	6907017		0.004	0.004	0.0%	< 0.001	102%	90%	110%	104%	90%	110%	102%	70%	130%
Copper	6907017		<0.002	<0.002	0.0%	< 0.002	102%	90%	110%	109%	90%	110%	101%	70%	130%
Lead	6907017		<0.001	<0.001	0.0%	< 0.001	99%	90%	110%	106%	90%	110%	98%	70%	130%
Mercury	6923129		<0.	<0.	0.0%	< 0.000016	102%	90%	110%	100%	90%	110%	100%	80%	120%
Nickel	6907017		0.006	0.006	0.0%	< 0.003	106%	90%	110%	105%	90%	110%	107%	70%	130%
Zinc	6907017		<0.005	<0.005	0.0%	< 0.005	100%	90%	110%	106%	90%	110%	101%	70%	130%

Comments: .NA Signifies Not Applicable.
RPD Qualifier for Cadmium: As the average value for the sample and a duplicate is less than 5X RDL, lab's RPD acceptance criteria is not applicable.

Certified By: Amanjot Bhela

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Method Summary

CLIENT NAME: GOLDER ASSOCIATES LTD **AGAT WORK ORDER: 15Z012020**

PROJECT: DEW Line Landfill Monitoring 1530908 **ATTENTION TO: Nicole MacDonald**

SAMPLING SITE:Fox 2 & Fox 3 **SAMPLED BY:**

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Arsenic	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Cadmium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Cobalt	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Copper	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Lead	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Mercury	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Nickel	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Zinc	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Trace Organics Analysis			
Benzene	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS
Toluene	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS
Ethylbenzene	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS
Xylene Mixture	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS
F1 (C6 to C10)	VOL-91-5009	CCME Tier 1 Method	P & T GC/FID
F1 (C6 to C10) minus BTEX	VOL-91-5009	CCME Tier 1 Method	P & T GC/FID
F2 (C10 to C16)	VOL-91-5009	CCME Tier 1 Method, EPA SW846 8015	GC / FID
F3 (C16 to C34)	VOL-91-5009	CCME Tier 1 Method, EPA SW846 8015	GC / FID
F4 (C34 to C50)	VOL-91-5009	CCME Tier 1 Method, EPA SW846 8015	GC / FID
Gravimetric Heavy Hydrocarbons	VOL-91-5009	CCME Tier 1 Method	BALANCE
Moisture Content	VOL-91-5009	CCME Tier 1 Method	BALANCE
Terphenyl	VOL-91-5009		GC/FID
Benzene	VOL-91-5010	MOE PHC-E3421	(P&T)GC/FID
Toluene	VOL-91-5010	MOE PHC-E3421	(P&T)GC/FID
Ethylbenzene	VOL-91-5010	MOE PHC-E3421	(P&T)GC/FID
Xylene Mixture	VOL-91-5010	MOE PHC-E3421	(P&T)GC/FID
F1 (C6 to C10)	VOL-91-5010	MOE PHC-E3421	(P&T)GC/FID
F1 (C6 to C10) minus BTEX	VOL-91-5010	MOE PHC-E3421	(P&T)GC/FID
F2 (C10 to C16)	VOL-91-5010	MOE PHC-E3421	GC/FID
F3 (C16 to C34)	VOL-91-5010	MOE PHC-E3421	GC/FID
F4 (C34 to C50)	VOL -91- 5010	MOE PHC-E3421	GC/FID
Gravimetric Heavy Hydrocarbons	VOL-91-5010	MOE PHC-E3421	BALANCE
Terphenyl	VOL-91-5010		GC/FID
Aroclor 1242	ORG-91-5113	EPA SW-846 3541 & 8082	GC/ECD
Aroclor 1248	ORG-91-5113	EPA SW-846 3541 & 8082	GC/ECD
Aroclor 1254	ORG-91-5113	EPA SW-846 3541 & 8082	GC/ECD
Aroclor 1260	ORG-91-5113	EPA SW-846 3541 & 8082	GC/ECD
PCBs	ORG-91-5113	EPA SW-846 3541 & 8082	GC/ECD
Decachlorobiphenyl	ORG-91-5113	EPA SW-846 3541 & 8082	GC/ECD
Aroclor 1242	ORG-91-5112	EPA SW-846 3510 & 8082	GC/ECD
Aroclor 1248	ORG-91-5112	EPA SW-846 3510 & 8082	GC/ECD
Aroclor 1254	ORG-91-5112	EPA SW-846 3510 & 8082	GC/ECD
Aroclor 1260	ORG-91-5112	EPA SW-846 3510 & 8082	GC/ECD
PCBs	ORG-91-5112	EPA SW-846 3510 & 8082	GC/ECD
Decachlorobiphenyl	ORG-91-5112	EPA SW-846 3510 & 8082	GC/ECD

Method Summary

CLIENT NAME: GOLDER ASSOCIATES LTD

PROJECT: DEW Line Landfill Monitoring 1530908

SAMPLING SITE:Fox 2 & Fox 3

AGAT WORK ORDER: 15Z012020

ATTENTION TO: Nicole MacDonald

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Water Analysis			
Arsenic	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Cadmium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Chromium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Cobalt	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Copper	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Lead	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Mercury	MET-93-6100	EPA SW-846 7470 & 245.1	CVAAS
Nickel	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Zinc	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS

AGAT Laboratories

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
www.agatlabs.com webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water intended for human consumption)

Laboratory Use Only

Work Order #: 15Z012020

Cooler Quantity: 1

Arrival Temperatures: 3 | 3 | 3
2.6 | 3.4 | 2.1

Custody Seal Intact: ☐Yes ☐No ☑N/A

Notes:

Report Information:

Company: Golder Associates Ltd.

Contact: Nicole MacDonald

Address: 1931 Robertson Road, Ottawa

Phone: 613 5929600 Fax: 613 592 9601

Reports to be sent to:

1. Email: nicole_macdonald@golder.com
2. Email: darrin_johnson@golder.com

Regulatory Requirements: ☐ No Regulatory Requirement

(Please check all applicable boxes)

☐Regulation 153/04
Table ____ Indicate One
☐Ind/Com
☐Res/Park
☐Agriculture
Soil Texture (Check One)
☐Coarse
☐Fine

☐Sewer Use
☐Sanitary
☐Storm
Region ____ Indicate One

☐Regulation 558
☒CCME
☐Prov. Water Quality Objectives (PWQO)
☐Other
____ Indicate One

Is this submission for a **Record of Site Condition?**
☐ Yes ☒ No

Report Guideline on Certificate of Analysis
☒ Yes ☐ No

Turnaround Time (TAT) Required:

Regular TAT ☒ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ 1 Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

Project Information:

Project: DEW Line Landfill Monitoring 1530908

Site Location: FOX-2 + FOX-3

Sampled By: KR

AGAT Quote #: 69566

Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☒ No ☐

Company:

Contact: Don Plenderleith

Address:

Email: dplenderleith@golder.com

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

(Check Applicable)

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	**ORPs:** ☐B-HWS ☐Cl ☐CN ☐Cr^{6+} ☐EC ☐FOC ☐NO_3/NO_2 ☐Total N ☐Hg ☐pH ☐SAR	**Nutrients:** ☐TP ☐NH_3 ☐TKN ☐NO_3 ☐NO_2 ☐NO_3/NO_2	**Volatiles:** ☐VOC ☐BTEX ☐THM	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	Sewer Use	Quote 69566
MW0906	Aug 19/15	14:30	7	GW																	X
F3-5 (15-30)	Aug 18/15	–	3	S																	X
F3-10 (40-50)	↓	–	3	S																	X
MW-01 (15-30)		–	3	S																	X
F3-12 (15-30)		–	3	S																	X
MW08 (0-15)	Aug 21/15	12:10	3	S																	X
MW06 (0-15)	↓	13:50	3	S																	X

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time	
Nicole MacDonald	Aug 26/15	18:45	L Berthelet	Aug 27/15	8h00	Page 1 of 1
			Shazmin Aug 28/15	10:00		Nº: T000650

Pink Copy - Client | Yellow Copy - AGAT | White Copy- AGAT

FOX-3 - Tier II Disposal Facility- Summary of Monitoring Soil Analytical Data

Sample ID	Location	Year	Monitoring Year	Monitoring Phase	Depth (cm)	Cu (mg/kg)	Ni (mg/kg)	Co (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Zn (mg/kg)	Cr (mg/kg)	As (mg/kg)	Hg (mg/kg)	Total PCB (mg/kg)	F1 C_6-C_{10} (mg/kg)	F2 C_{10}-C_{16} (mg/kg)	F3 C_{16}-C_{34} (mg/kg)	Modified TPH^ - Total C6-C34 (mg/kg)
Background Data - Arithmetic mean*						32	27	32	1.0	10	59	67	11	0.05	0.0030				N/A
Baseline Data - Arithmetic mean*						**38**	**32**	**13**	**1.0**	**10**	**64**	**79**	**14**	**0.10**	**0.10**				**10**
Baseline Data - Standard Deviation						12	7	3.2	0.0	3.6	9.1	13	6.2	0.00	0.021				8.1
Baseline Data mean + 3xStandard Deviation						74	54	22	1.0	21	92	118	32	0.10	0.16				34
If baseline or background arithmetic mean was below the detection limit, the mean has been modified to match the detection limit value.																			
DEW Line Cleanup Tier I Criteria										*200*					*1.0*				
DEW Line Cleanup Tier II Criteria & Hydrocarbon Action Level						*100*	*100*	*50*	*5.0*	*500*	*500*	*250*	*61*	*2.0*	*5.0*				*2500*
Monitoring Data																			
Upgradient																			
	MW # 1 surface																		
12-19388/89**	MW-1	2012	1	1	0-10	**48**	**40**	10	<0.50	9.1	**75**	78	**20**	0.014	0.020	<5.0	<10	<50	**33**
2013-F3-MW-01-A	MW-1	2013	2	1	0-10	**48**	**39**	9.3	<0.10	7.0	**71**	79	**18**	<0.050	<0.010	<10	<10	<10	**15**
F3-MW-1-S-A-2014	MW-1	2014	3	1	0-10	36	**36**	9.0	<0.50	7.0	**65**	**87**	**29**	<0.10	<0.020	<10	<10	<20	**20**
MW-01 (0-15) (Dup Avg)	MW-1	2015	4	1	0-15	**46**	**39**	11.3	<0.5	9	**71**	**89**	**29**	<0.1	<0.1	<6	<4	<8	9
	MW-1		5	1															#N/A
	MW-1		7	2															#N/A
	MW-1		10	2															#N/A
	MW-1		15	2															#N/A
	MW-1		25	2															#N/A
																			#N/A
																			#N/A
																			#N/A
																			#N/A
	MW # 1 depth																		
12-19390/91**	MW-1	2012	1	1	30-40	**51**	**48**	12	<0.50	9.5	**87**	**110**	**33**	0.011	<0.020	<5.0	<10	<50	**33**
2013-F3-MW-01-B	MW-1	2013	2	1	40 - 50	33	32	8.7	<0.10	6.0	61	73	**16**	<0.050	<0.010	<10	<10	<10	**15**
F3-MW-1-S-B-2014	MW-1	2014	3	1	40 - 50	**44**	**35**	9.0	<0.50	8.0	**70**	**89**	**23**	<0.10	<0.020	<10	<10	<20	**20**
MW-01 (40-50)	MW-1	2015	4	1	40 - 50	**48.6**	**38**	10.8	<0.5	9.9	**66.7**	**87.9**	**28.7**	<0.1	<0.05	<7	<4	<8	10
	MW-1		5	1															#N/A
	MW-1		7	2															#N/A
	MW-1		10	2															#N/A
	MW-1		15	2															#N/A
	MW-1		25	2															#N/A
																			#N/A
																			#N/A
																			#N/A
																			#N/A

FOX-3 - Tier II Disposal Facility- Summary of Monitoring Soil Analytical Data

Sample ID	Location	Year	Monitoring Year	Monitoring Phase	Depth (cm)	Cu (mg/kg)	Ni (mg/kg)	Co (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Zn (mg/kg)	Cr (mg/kg)	As (mg/kg)	Hg (mg/kg)	Total PCB (mg/kg)	F1 C_6-C_{10} (mg/kg)	F2 C_{10}-C_{16} (mg/kg)	F3 C_{16}-C_{34} (mg/kg)	Modified TPH^ - Total C6-C34 (mg/kg)
Downgradient																			
	MW # 2 surface																		
12-19392/93**	MW-2	2012	1	1	0-10	**57**	**42**	12	<0.50	**12**	**88**	**100**	**28**	<0.010	<0.020	<5.0	<10	<50	**33**
2013-F3-MW-02-A	MW-2	2013	2	1	1 -10	31	29	9.3	<0.1	8.0	60	69	**14**	<0.05	<0.010	<10	<10	22.00	**32**
F3-MW-2-S-A-2014	MW-2	2014	3	1	0-10	34	**35**	9.0	<0.50	7.0	**65**	**80**	**18**	<0.10	<0.020	<10	<10	<20	**20**
MW-02 (0-15)	MW-2	2015	4	1	0-15	27.5	24.7	8	<0.5	7.9	51.8	61.8	**14.7**	<0.1	<0.05	<7	<4	<8	10
	MW-2		5	1															#N/A
	MW-2		7	2															#N/A
	MW-2		10	2															#N/A
	MW-2		15	2															#N/A
	MW-2		25	2															#N/A
																			#N/A
																			#N/A
																			#N/A
																			#N/A
	MW # 2 depth																		
12-19394/95**	MW-2	2012	1	1	30-40	**47**	**39**	12	<0.50	**12**	**81**	**87**	**18**	<0.010	<0.020	<5.0	<10	<50	**33**
2013-C5-MW-06-B	MW-2	2013	2	1	40 - 50	30	29	8.9	<0.1	8.0	63	71	11	<0.050	<0.010	<10	<10	<10	**15**
F3-MW-2-S-B-2014	MW-2	2014	3	1	40 - 50	35	**45**	11	<0.50	7.0	**73**	**104**	**14**	<0.10	<0.020	<10	<10	<20	**20**
MW-02 (40-50)	MW-2	2015	4	1	40 - 50	29.1	24.1	8.2	<0.5	8.2	51.4	59.7	13.4	<0.1	<0.05	<7	<4	<8	10
	MW-2		5	1															#N/A
	MW-2		7	2															#N/A
	MW-2		10	2															#N/A
	MW-2		15	2															#N/A
	MW-2		25	2															#N/A
																			#N/A
																			#N/A
																			#N/A
																			#N/A
	MW # 3 surface																		
12-19396/97**	MW-3	2012	1	1	0-10	37	**36**	10	<0.50	7.2	**77**	**88**	**17**	<0.010	<0.020	<5.0	<10	<50	**33**
2013-F3-MW-03-A/03-A-D	MW-3	2013	2	1	0-10	34	**34**	10	<0.10	7.0	**67**	75	**14**	<0.050	0.015	<10	<10	<10	**15**
F3-MW-3-S-A-2014	MW-3	2014	3	1	0-10	**44**	**37**	11	<0.50	6.0	**70**	**83**	**15**	<0.10	<0.020	<10	<10	<20	**20**
MW-03 (0-15)	MW-3	2015	4	1	0-15	29	**33.8**	10.6	<0.5	6.2	59.5	70.1	12.5	<0.1	<0.05	<7	<4	<8	10
	MW-3		5	1															#N/A
	MW-3		7	2															#N/A
	MW-3		10	2															#N/A
	MW-3		15	2															#N/A
	MW-3		25	2															#N/A
																			#N/A
																			#N/A
																			#N/A
																			#N/A

FOX-3 - Tier II Disposal Facility- Summary of Monitoring Soil Analytical Data

Sample ID	Location	Year	Monitoring Year	Monitoring Phase	Depth (cm)	Cu (mg/kg)	Ni (mg/kg)	Co (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Zn (mg/kg)	Cr (mg/kg)	As (mg/kg)	Hg (mg/kg)	Total PCB (mg/kg)	F1 C_6-C_{10} (mg/kg)	F2 C_{10}-C_{16} (mg/kg)	F3 C_{16}-C_{34} (mg/kg)	Modified TPH^ - Total C6-C34 (mg/kg)
	MW # 3 depth																		
12-19398/99**	MW-3	2012	1	1	30-40	**49**	**45**	**13**	<0.50	9.7	**100**	**100**	**21**	<0.010	<0.020	<5.0	<10	<50	**33**
2013-F3-MW-03-B	MW-3	2013	2	1	40 - 50	30	**33**	11	<0.10	6.0	61	74	12	<0.050	<0.010	<10	<10	<10	**15**
not sampled - bedrock reached at 0.15m	MW-3	2014	3	1															#N/A
MW-03 (40-50)	MW-3	2015	4	1	40 - 50	36	**36.7**	11.8	<0.5	8.2	62.9	77.6	**16.1**	<0.1	<0.05	<7	<4	<8	10
	MW-3		5	1															#N/A
	MW-3		7	2															#N/A
	MW-3		10	2															#N/A
	MW-3		15	2															#N/A
	MW-3		25	2															#N/A
																			#N/A
																			#N/A
																			#N/A
																			#N/A
	MW # 4 surface																		
12-19384/85**	MW-4	2012	1	1	0-10	**49**	**51**	**14**	<0.50	**11**	**93**	**120**	**26**	<0.010	<0.020	<5.0	<10	<50	**33**
2013-F3-MW-04-A	MW-4	2013	2	1	0 -10	35	**38**	11	<0.10	7.0	63	**85**	**19**	<0.050	<0.010	<10	<10	11	**21**
F3-MW-4-S-A-2014	MW-4	2014	3	1	0-10	**43**	**50**	12	<0.50	8.0	**70**	**116**	**37**	<0.10	<0.020	<10	<10	30	**40**
MW-04 (0-15)	MW-4	2015	4	1	0-15	26.6	23.7	7.9	<0.5	8.1	50.4	65.1	13.6	<0.1	<0.05	<7	<4	<8	10
	MW-4		5	1															#N/A
	MW-4		7	2															#N/A
	MW-4		10	2															#N/A
	MW-4		15	2															#N/A
	MW-4		25	2															#N/A
																			#N/A
																			#N/A
																			#N/A
																			#N/A
	MW # 4 depth																		
12-19386/87**	MW-4	2012	1	1	30-40	30	32	9.7	<0.50	6.9	64	**81**	**15**	<0.010	<0.020	<5.0	<10	<50	**33**
2013-F3-MW-04-B	MW-4	2013	2	1	40 - 50	**39**	**38**	11	<0.10	8.0	**70**	**88**	**21**	<0.050	<0.010	<10	<10	<10	**15**
not sampled - bedrock reached at 0.15m depth	MW-4	2014	3	1															#N/A
MW-04 (40-50)	MW-4	2015	4	1	40 - 50	34.4	25.3	8.4	<0.5	**10**	54.7	66.7	12.6	<0.1	<0.05	<7	<4	<8	10
	MW-4		5	1															#N/A
	MW-4		7	2															#N/A
	MW-4		10	2															#N/A
	MW-4		15	2															#N/A
	MW-4		25	2															#N/A
																			#N/A
																			#N/A

Note: Modified TPH Total (C_6-C_{34}) has been calculated by adding results for F1, F2 and F3.

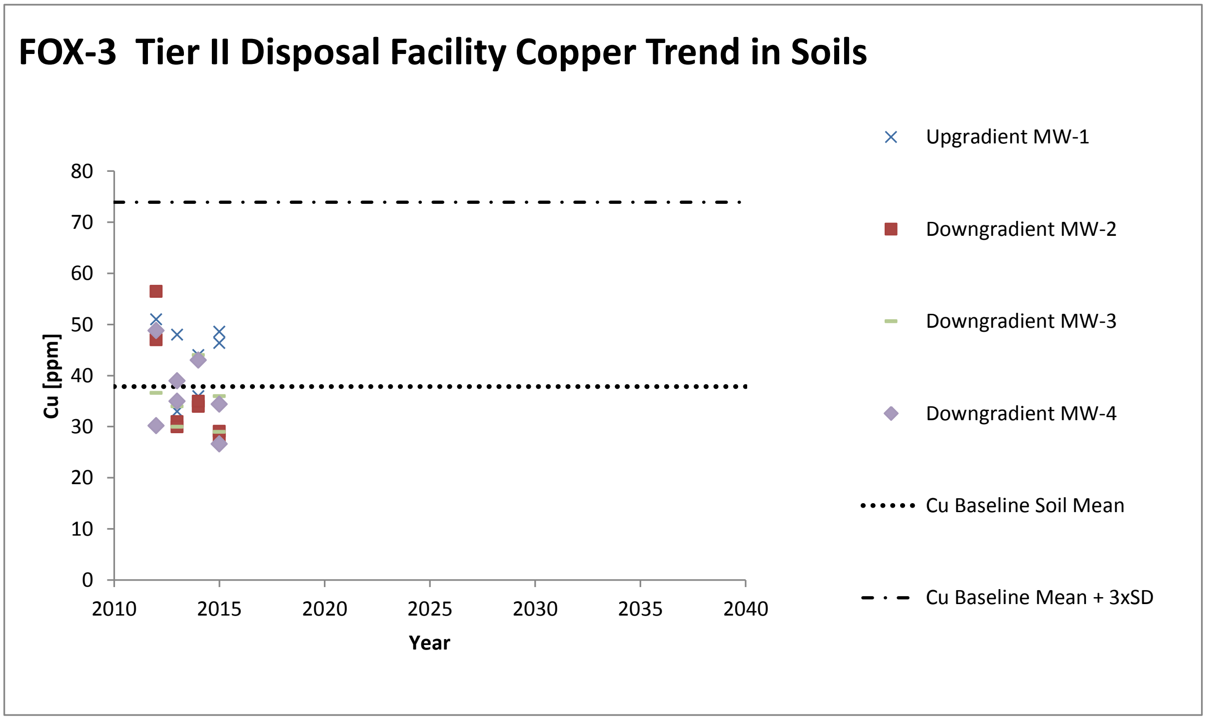
** two samples taken, one analyzed for inorganics and PCBs, one analyzed for TPH

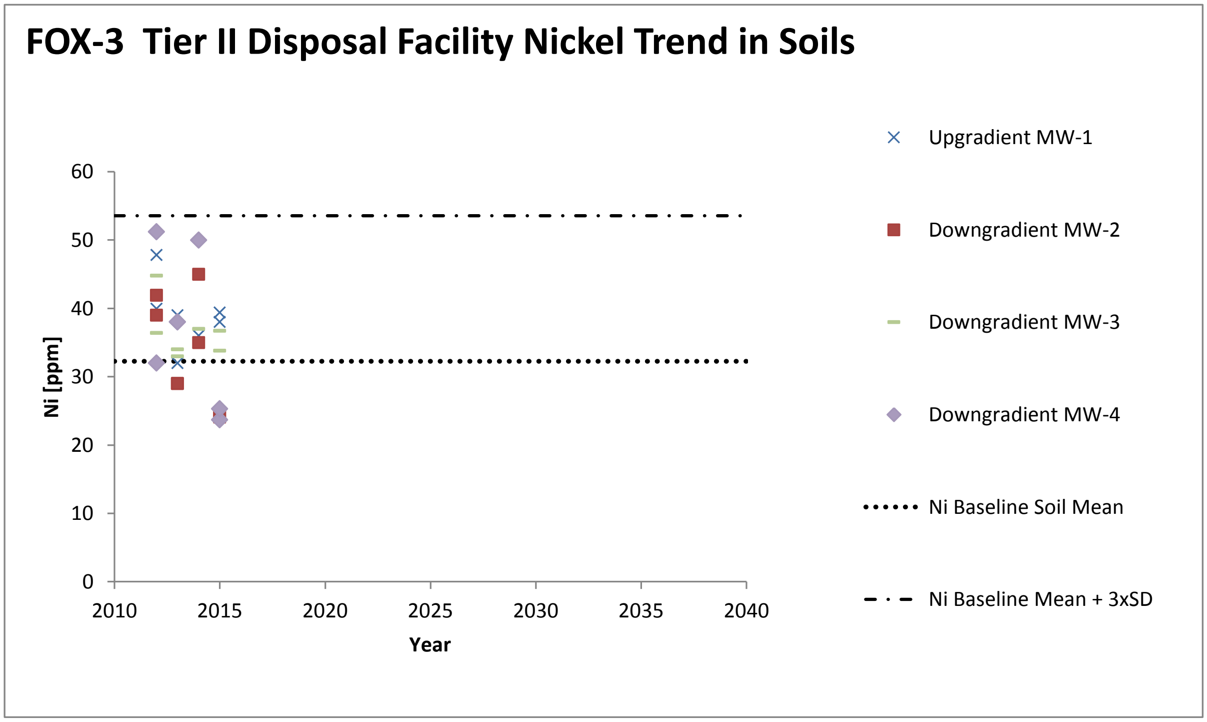
Legend

XX	sample exceeds background
XX	**sample exceeds baseline**
XX	*sample exceeds DLCU Tier I criteria*
XX	*sample exceeds DLCU Tier II criteria*

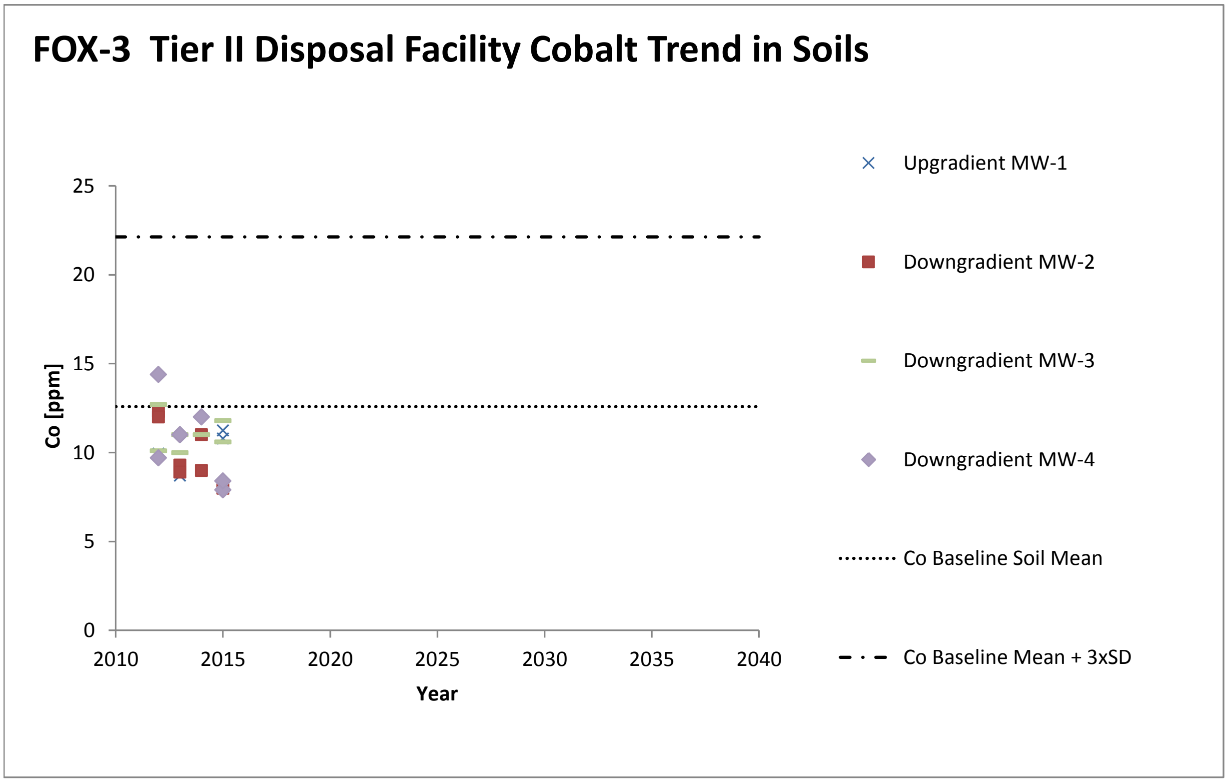
FOX-3 Tier II Disposal Facility Trends in Soil Inorganics, PCBs and PHCs (modified TPH)

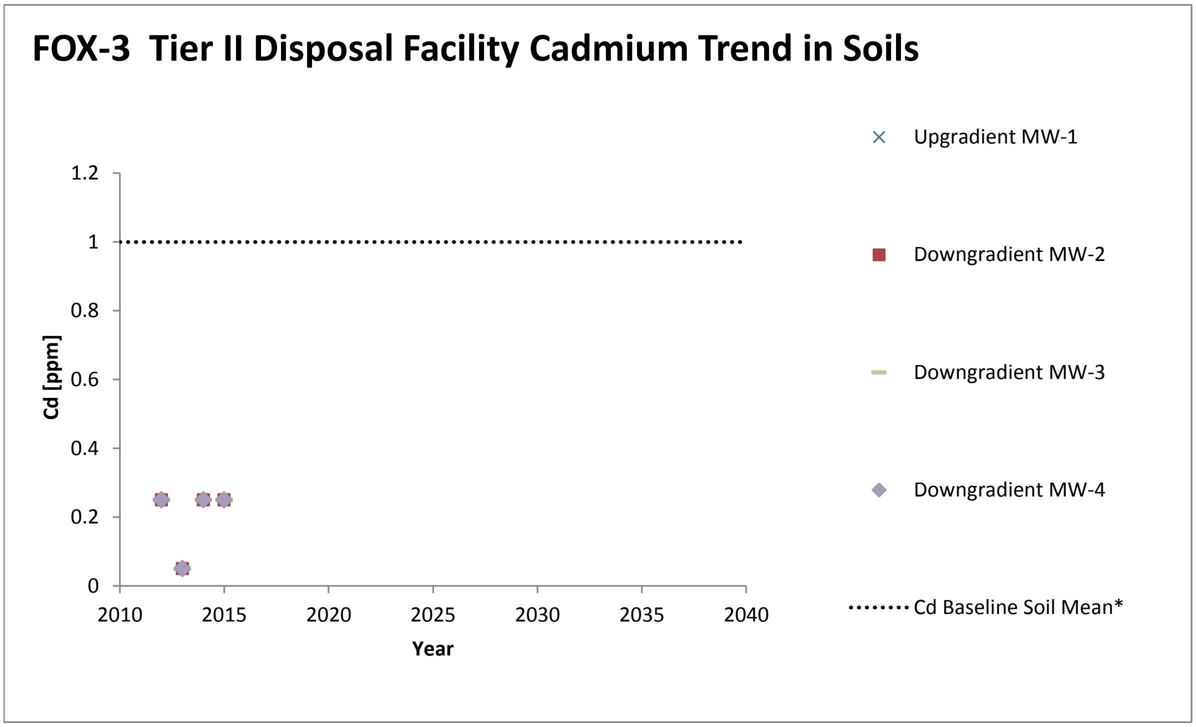
Where results are below detection, half of the detection limit has been used in the charts for the sample points. Trendlines are intended for visual interpretation of temporal trends. When all monitoring results are below detection, trendlines are a reflection of changes in detection limit. Users should refer to data tables.





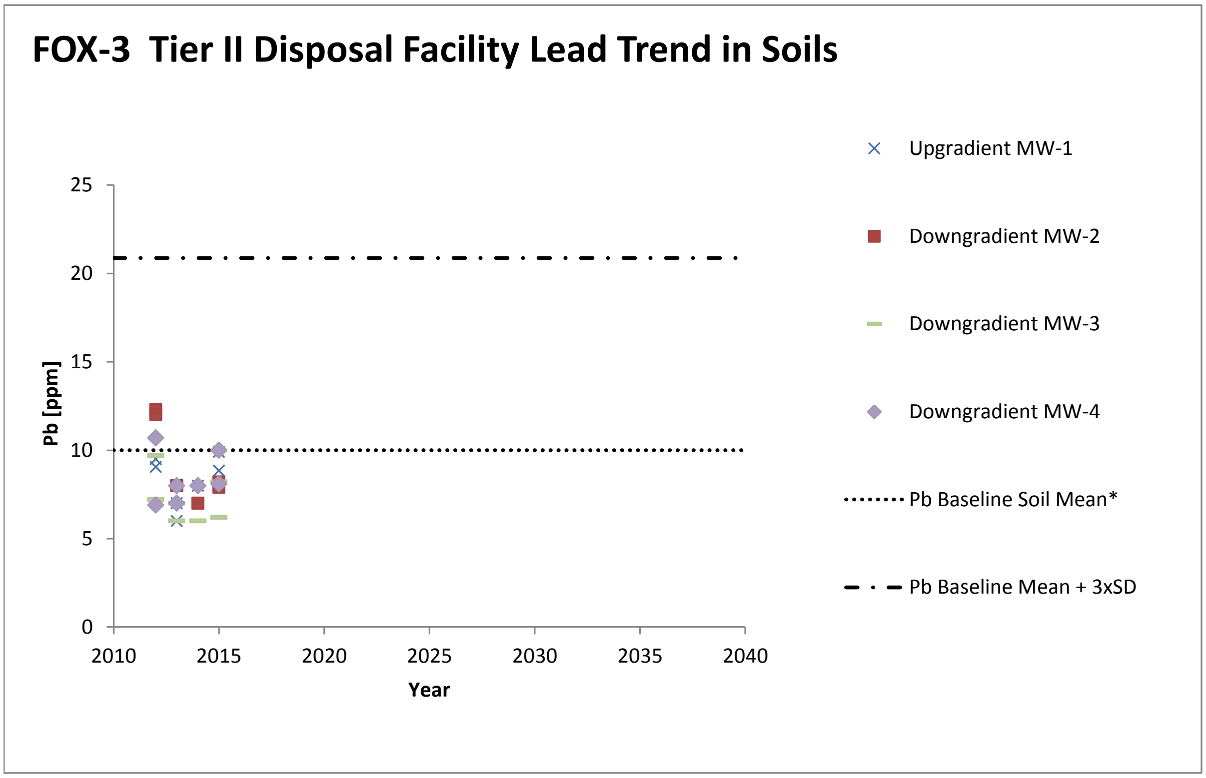
FOX-3 Tier II Disposal Facility Trends in Soil Inorganics, PCBs and PHCs (modified TPH)



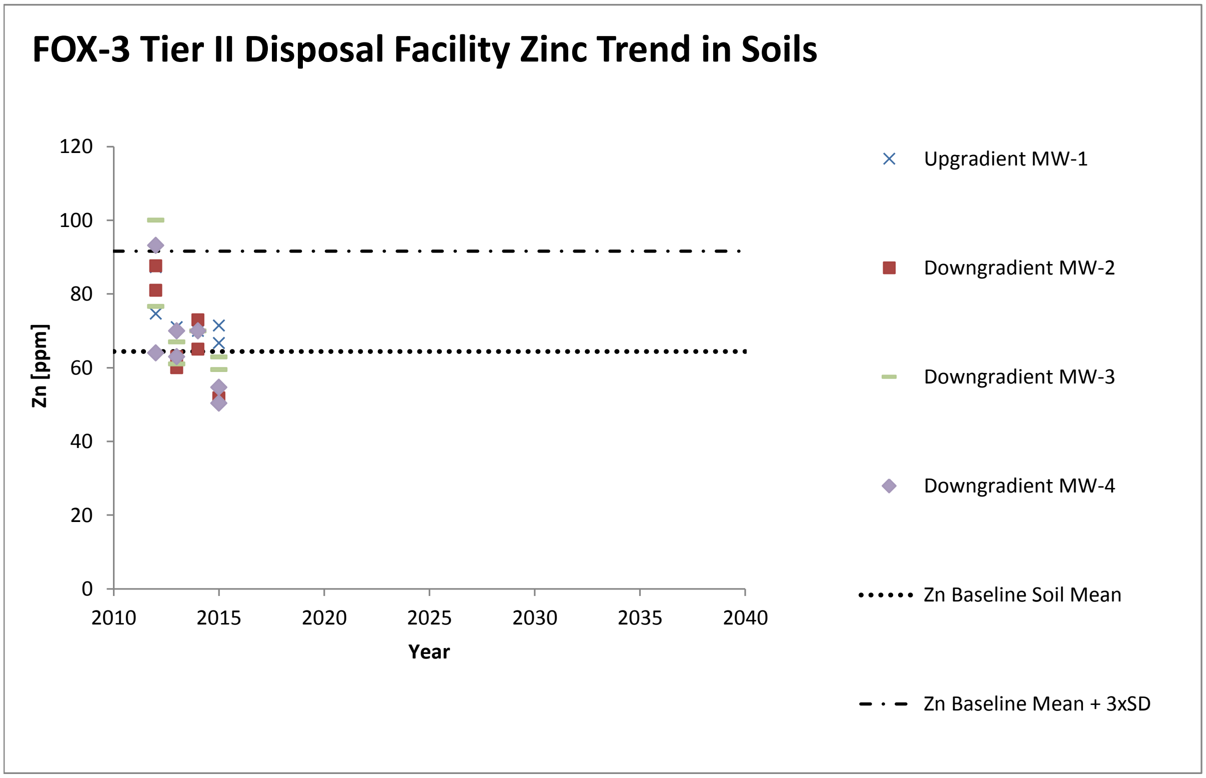


*Cd Baseline Mean is equal to the baseline detection limit.
**Cd Baseline SD = 0

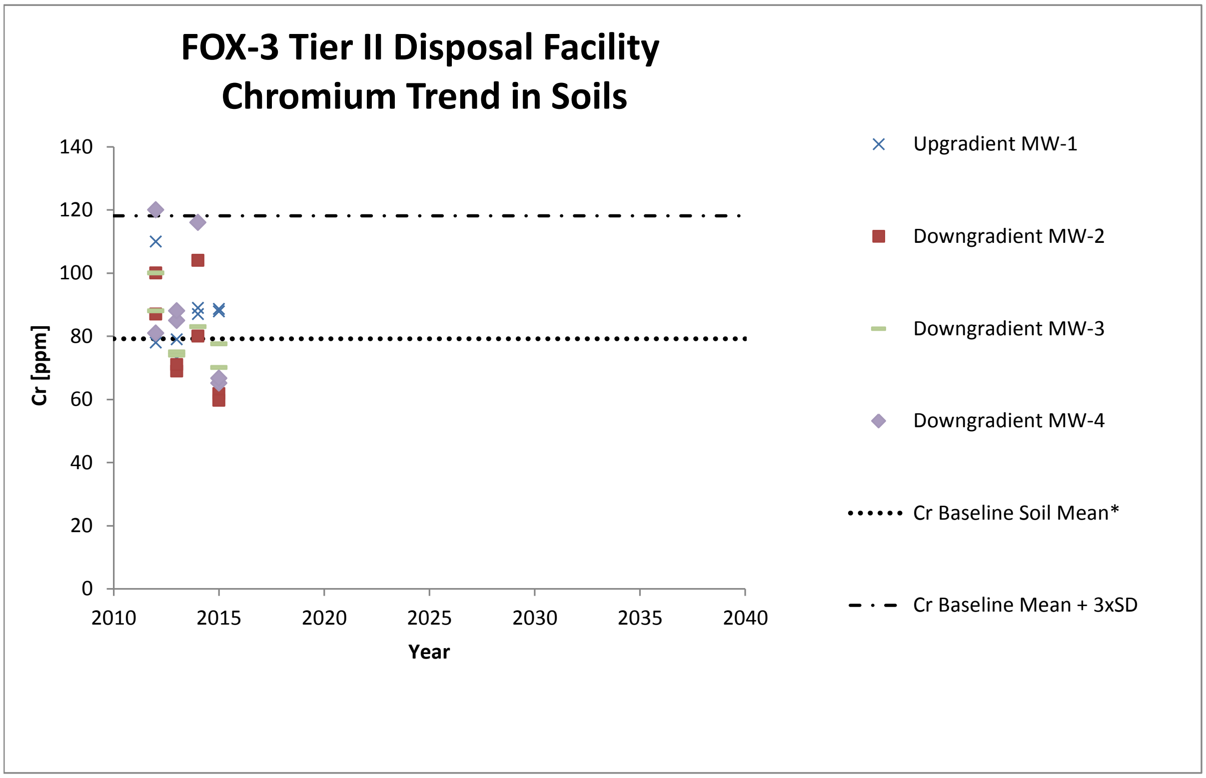
FOX-3 Tier II Disposal Facility Trends in Soil Inorganics, PCBs and PHCs (modified TPH)

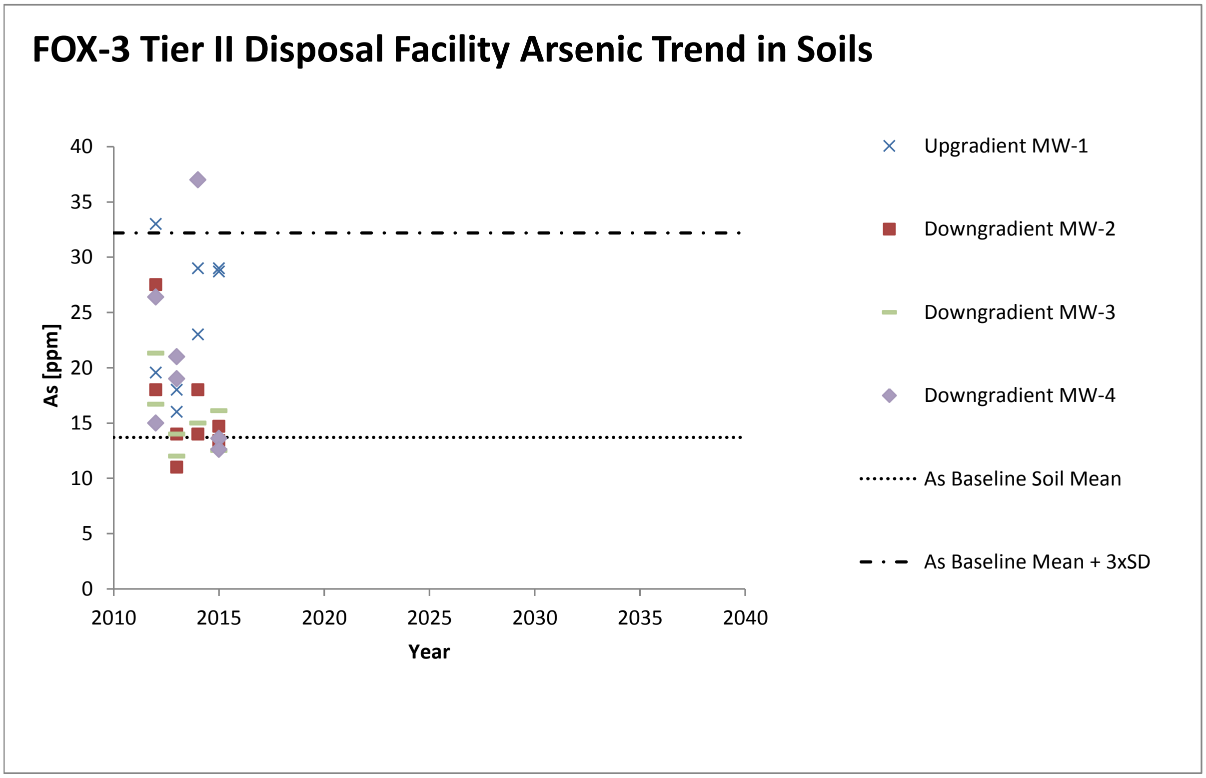


*Pb Baseline Mean is equal to the baseline detection limit.

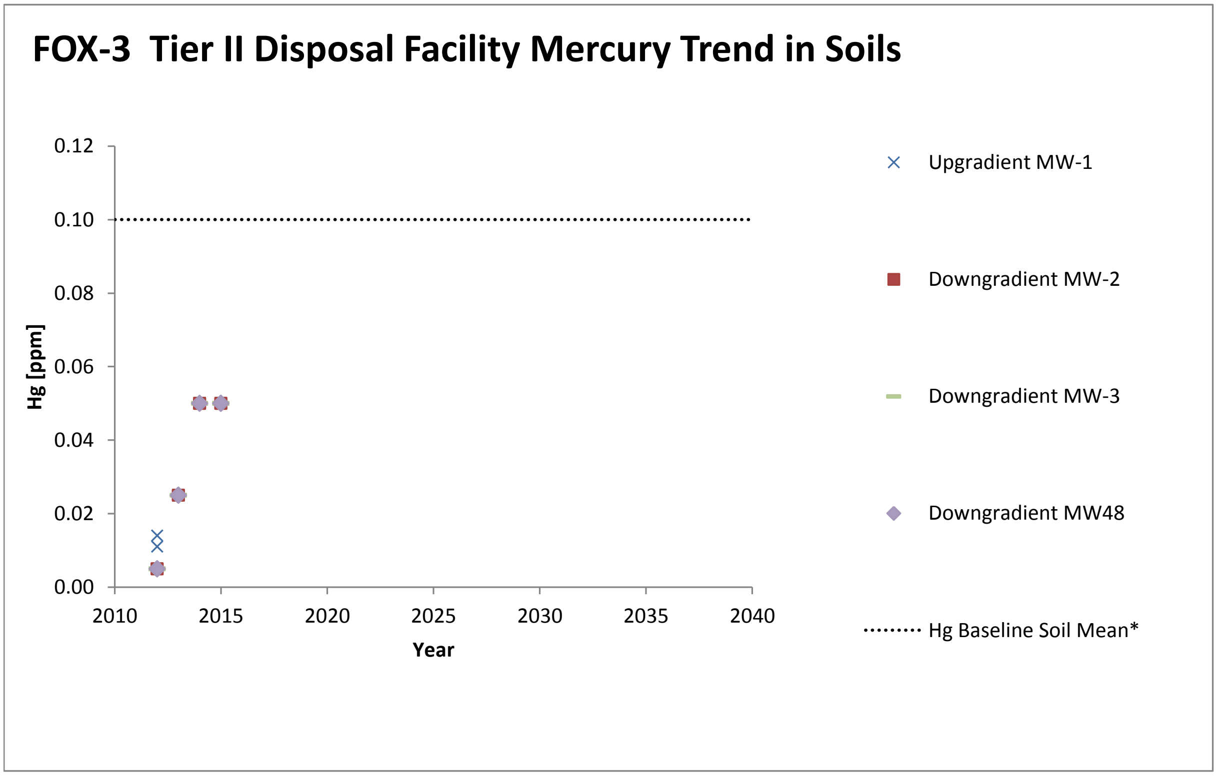


FOX-3 Tier II Disposal Facility Trends in Soil Inorganics, PCBs and PHCs (modified TPH)

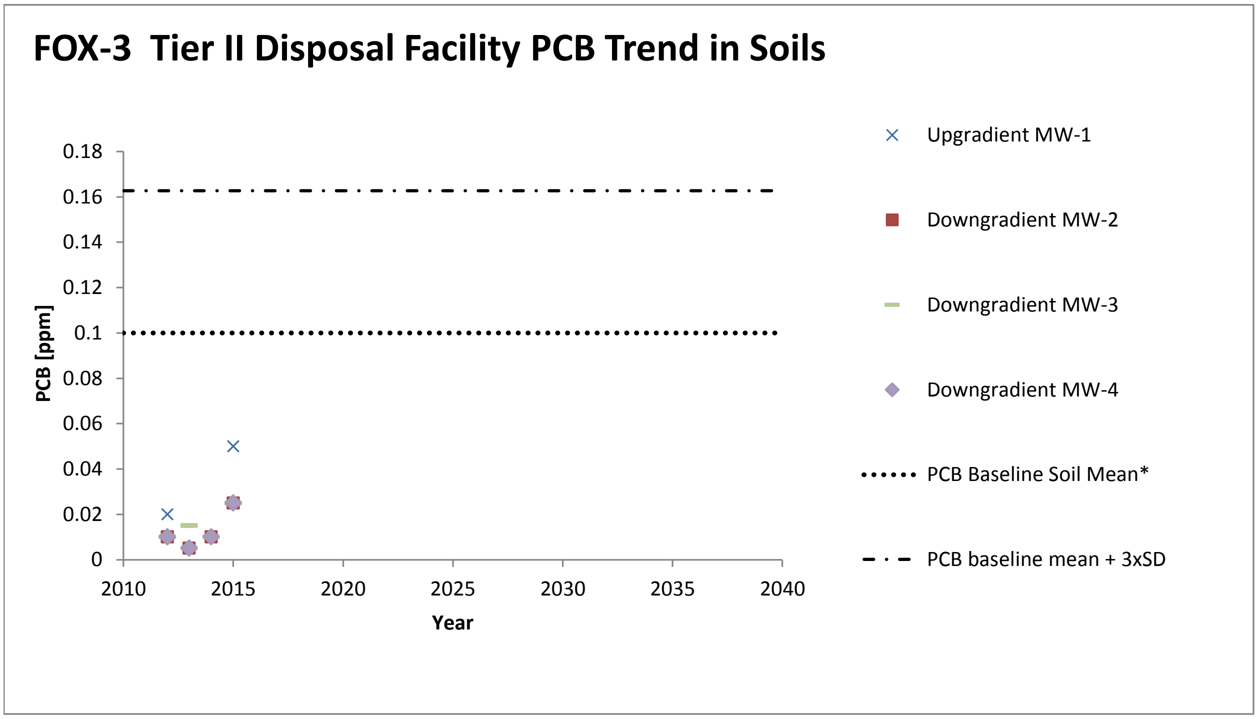




FOX-3 Tier II Disposal Facility Trends in Soil Inorganics, PCBs and PHCs (modified TPH)

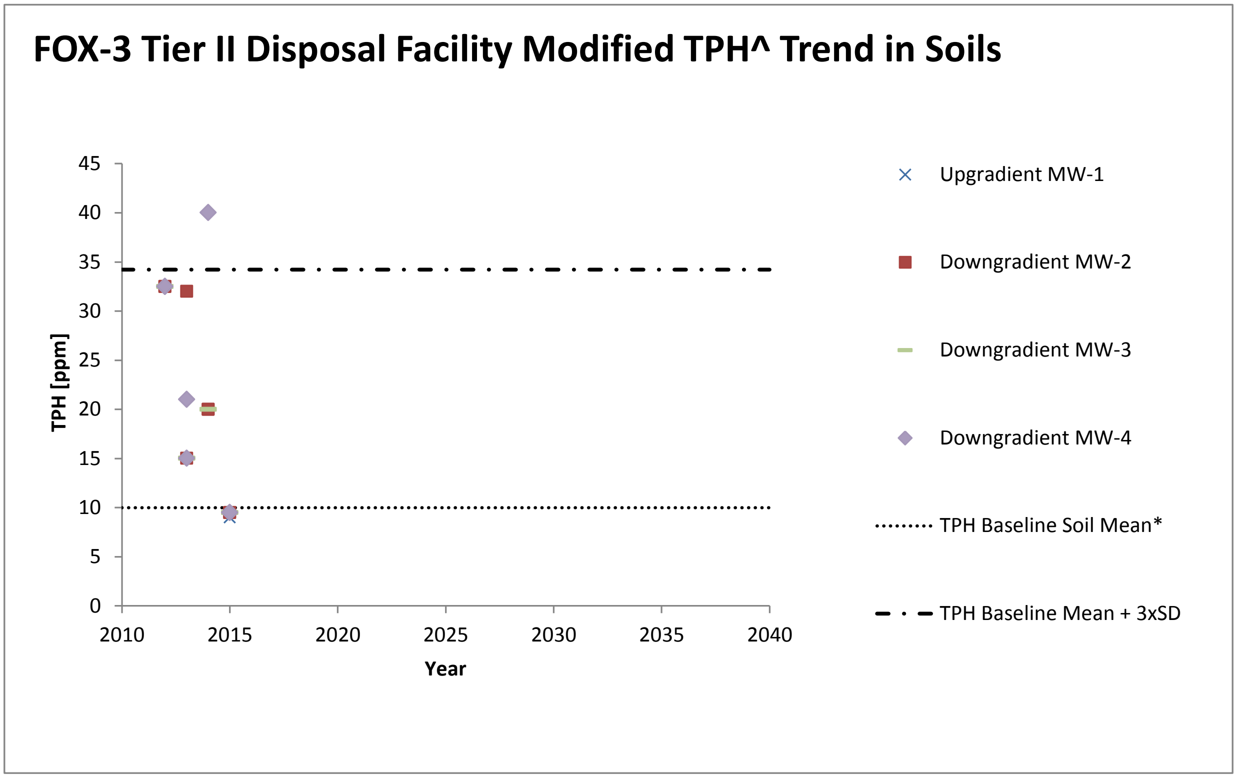


*Hg Baseline Mean is equal to the baseline detection limit.
** Hg Baseline SD = 0



*PCB Baseline Mean is equal to the baseline detection limit.

FOX-3 Tier II Disposal Facility Trends in Soil Inorganics, PCBs and PHCs (modified TPH)



*TPH Baseline Mean is equal to the baseline detection limit.

^ Modified TPH is Sum of F1, F2 and F3 fractions (C_6 - C_{34})

FOX-3 - Tier II Disposal Facility - Summary of Monitoring Groundwater Analytical Data

Sample ID	Location	Date	Monitoring Year	Monitoring Phase	Cu (mg/L)	Ni (mg/L)	Co (mg/L)	Cd (mg/L)	Pb (mg/L)	Zn (mg/L)	Cr (mg/L)	As (mg/L)	Hg (mg/L)	Total PCB (mg/L)	F1 C_6-C_{10} (mg/L)	F2 C_{10}-C_{16} (mg/L)	F3 C_{16}-C_{34} (mg/L)	Modified TPH^ - Total C6-C34 (mg/L)
Baseline Data																		
Upgradient:																		
09-27668	MW-01	2009			0.014	0.034	0.0090	<0.0010	<0.010	0.2	<0.0050	0.00500	0.00050	<0.000020	0.05	<0.50	<1.0	0.80
10-35994	MW-01	2010			0.008	0.055	0.011	<0.0010	<0.010	0.14	0.019	0.011	<0.00040	<0.000020	<0.050	<0.50	<1.0	0.78
11-28765	MW-01	2011			0.006	0.14	0.0097	<0.0010	<0.010	0.094	<0.0050	<0.0030	<0.00040	<0.0030	<0.050	<0.50	<1.0	0.78
																		0.00
Downgradient:																		
10-36009	MW-02	2010			0.014	0.030	0.0062	<0.0010	<0.010	0.058	<0.0050	<0.0030	<0.00040	<0.000020	<0.050	<0.50	<1.0	0.78
10-36004	MW-03	2010			0.0060	0.082	0.017	<0.0010	<0.010	3.5	<0.0050	<0.0030	<0.00040	<0.000020	<0.050	<0.50	<1.0	0.78
10-35999	MW-04	2010			<0.0050	0.0071	<0.0030	<0.0010	<0.010	<0.010	0.0072	<0.0030	<0.00040	<0.000020	<0.050	<0.50	<1.0	0.78
11-28766	MW-02	2011			0.027	0.022	<0.0030	<0.0010	<0.010	<0.010	0.0070	<0.0030	<0.00040	<0.0030	<0.050	<0.50	<1.0	0.78
11-28767	MW-03	2011			0.030	0.18	0.018	0.0012	<0.010	2.5	0.016	0.0034	<0.00040	<0.0030	<0.050	<0.50	<1.0	0.78
11-28768	MW-04	2011			0.0067	0.12	0.040	0.0015	<0.010	0.042	<0.0050	<0.0030	<0.00040	<0.0030	<0.050	<0.50	<1.0	0.78
		N value			9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0				10
		Arithmetic Mean			**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**0.79**	**0.0074**	**0.0029**	**0.00020**	**0.00067**				**0.25**
		Arithmetic Mean Corrected for Detection Limit			**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**0.79**	**0.0050**	**0.0030**	**0.00040**	**0.003**				**1.0**
		Standard Deviation			**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	1.4	0.0067	0.0033	0.0	0.00079				0.0083
		Arithmetic Mean + 3xStandard Deviation			**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	5.0	0.025	0.013	0.00040	0.005				1.03
		Detection Limit			0.0050	0.010	0.0030	0.0010	0.010	0.0010	0.0050	0.0030	0.00040	0.0030				1.0
Monitoring Data																		
Upgradient - MW- 1																		
12-50004	MW-1	2012	1	1	0.20	0.53	0.087	0.0015	0.024	0.52	**0.15**	**0.06**	<0.00010	<0.000040	<0.05	<0.10	<0.25	0.20
2013-F3-MW-01	MW-1	2013	2	1	0.37	0.72	0.13	0.0028	0.054	0.56	**0.39**	**0.13**	0.000040	<0.000010	<0.025	<0.10	<0.10	0.11
F3-MW-1-2014	MW-1	2014	3	1	0.16	0.43	0.090	<0.0080	0.030	0.35	**0.24**	**0.05**	<0.00010	<0.00010	<0.020	<0.020	0.34	0.36
MW0901	MW-1	2015	4	1	0.0282	0.073	0.0161	0.0004	0.0113	0.09	**0.006**	**0.004**	<0.0001	<0.00005	<0.025	<0.1	<0.1	0.1125
	MW-1		5	1														#N/A
	MW-1		7	2														#N/A
	MW-1		10	2														#N/A
	MW-1		15	2														#N/A
	MW-1		25	2														#N/A
																		#N/A

FOX-3 - Tier II Disposal Facility - Summary of Monitoring Groundwater Analytical Data

Sample ID	Location	Date	Monitoring Year	Monitoring Phase	Cu (mg/L)	Ni (mg/L)	Co (mg/L)	Cd (mg/L)	Pb (mg/L)	Zn (mg/L)	Cr (mg/L)	As (mg/L)	Hg (mg/L)	Total PCB (mg/L)	F1 C_6- C_{10} (mg/L)	F2 C_{10} C_{16} (mg/L)	F3 C_{16}-C_{34} (mg/L)	Modified TPH^ - Total C6-C34 (mg/L)
Downgradient - MW-2																		
12-50006	MW-2	2012	1	1	0.062	0.032	<0.0050	<0.00090	0.010	0.064	**0.010**	<0.010	<0.00010	<0.000040	<0.05	<0.10	<0.25	0.20
2013-F3-MW-02	MW-2	2013	2	1	0.015	0.043	0.0035	0.00033	0.00086	0.017	**0.028**	0.0022	<0.000010	<0.000010	<0.025	<0.10	<0.10	0.11
F3-MW-2-2014*	MW-2	2014	3	1	0.19	0.14	0.020	<0.0080	0.060	0.26	<0.050	<0.020	<0.0001	<0.00010				#N/A
MW0902	MW-2	2015	4	1	0.0979	0.054	0.0051	0.0002	0.0184	0.239	**0.011**	**0.008**	<0.0001	<0.00005	<0.025	<0.1	<0.1	0.11
	MW-2		5	1														#N/A
	MW-2		7	2														#N/A
	MW-2		10	2														#N/A
	MW-2		15	2														#N/A
	MW-2		25	2														#N/A
																		#N/A
Downgradient - MW-3																		
12-50007/08**	MW-3	2012	1	1	0.032	0.11	0.016	0.0012	0.0014	**2.1**	**0.019**	**0.0055**	<0.00010	<0.000040	<0.05	<0.10	<0.25	0.2
2013-F3-MW-03	MW-3	2013	2	1	0.037	0.11	0.020	0.0012	0.00044	0.37	**0.020**	**0.0079**	0.000020	<0.000010	<0.025	<0.10	<0.10	0.1
F3-MW-3-2014*	MW-3	2014	3	1	0.040	0.30	0.020	<0.0080	<0.010	**2.4**	**0.26**	<0.020	<0.00010	<0.00010				#N/A
MW0903	MW-3	2015	4	1	0.0374	0.038	0.0045	0.0002	0.0011	**2.06**	<0.001	**0.005**	<0.0001	<0.00005	<0.025	<0.1	<0.1	0.1
	MW-3		5	1														#N/A
	MW-3		7	2														#N/A
	MW-3		10	2														#N/A
	MW-3		15	2														#N/A
	MW-3		25	2														#N/A
																		#N/A
Downgradient - MW-4																		
12-50003	MW-4	2012	1	1	0.018	0.24	0.075	0.0019	0.0022	0.089	**0.080**	0.0011	<0.00010	<0.000040	<0.05	<0.10	<0.25	0.2
2013-F3-MW-04/04-D	MW-4	2013	2	1	0.016	0.24	0.079	0.0018	0.0019	0.096	**0.048**	0.0022	<0.00001	<0.000010	<0.025	<0.10	<0.10	0.1
F3-MW-4-2014	MW-4	2014	3	1	0.040	0.28	0.080	<0.0080	0.010	0.15	**0.11**	<0.020	<0.00010	<0.00010	<0.020	<0.020	<0.050	0.0
MW0904	MW-4	2015	4	1	<0.0005	0.103	0.0377	0.0008	0.0019	0.06	<0.001	<0.001	<0.0001	<0.00005	<0.025	<0.1	<0.1	0.1
	MW-4		5	1														#N/A
	MW-4		7	2														#N/A
	MW-4		10	2														#N/A
	MW-4		15	2														#N/A
	MW-4		25	2														#N/A

Note: Modified TPH Total (C_6-C_{34}) has been calculated by adding results for F1, F2 and F3.

Some baseline ground water results for inorganic elements were reported as dissolved instead of total in 2009, 2010, and 2011. These results were excluded from the baseline average calculation but kept in the summary table for reference and are highlighted blue.

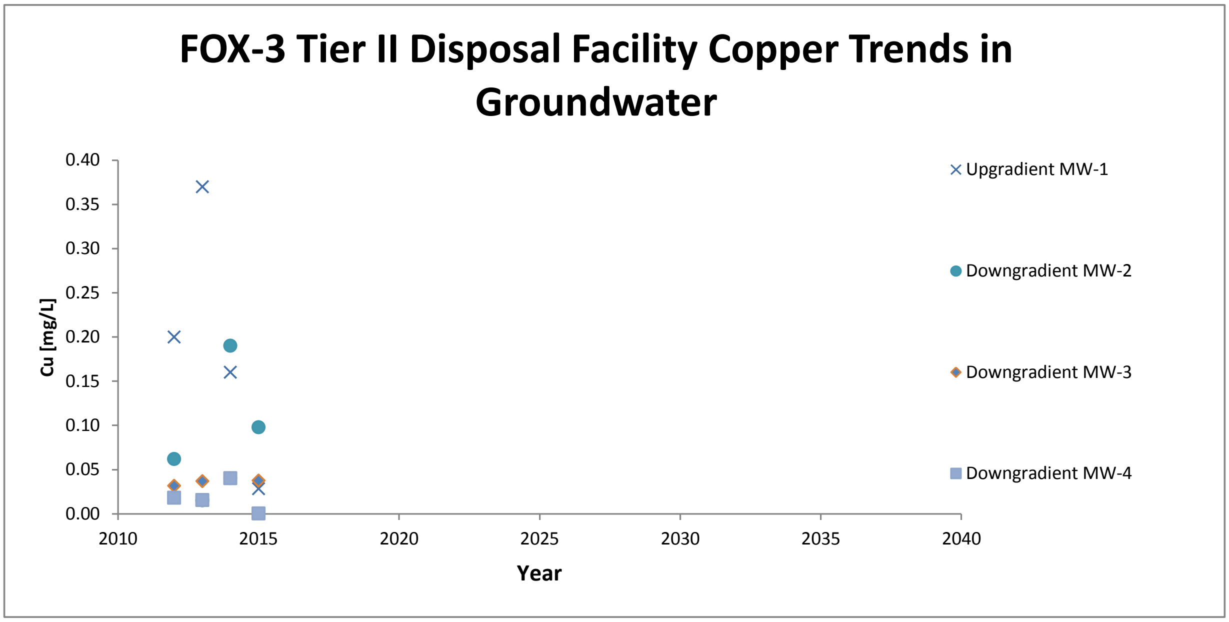
* insufficient volume for analysis of TPH

** two samples taken, one analyzed for inorganics and PCBs, one analyzed for TPH

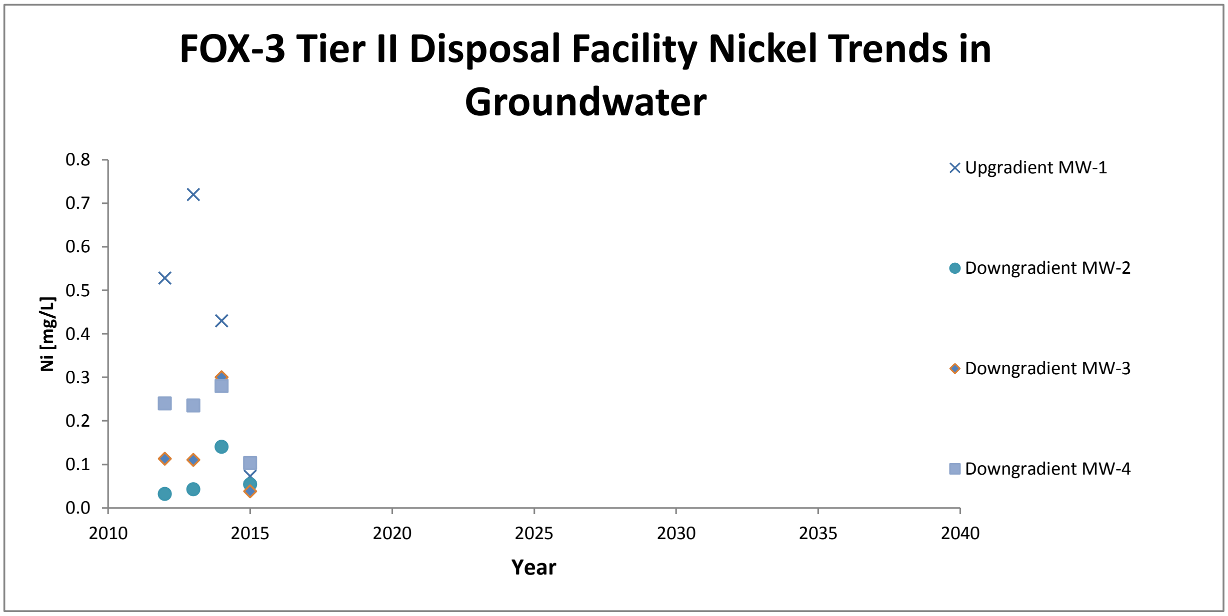
FOX-3 Tier II Disposal Facility Graphs of Trends for Inorganic Elements, PCBs and TPH in Groundwater Samples

Where results are below detection, half of the detection limit has been used in the charts for the sample points.

Trendlines are intended for visual interpretation of temporal trends. When all monitoring results are below detection, trendlines are a reflection of changes in detection limit. Users should refer to data tables.

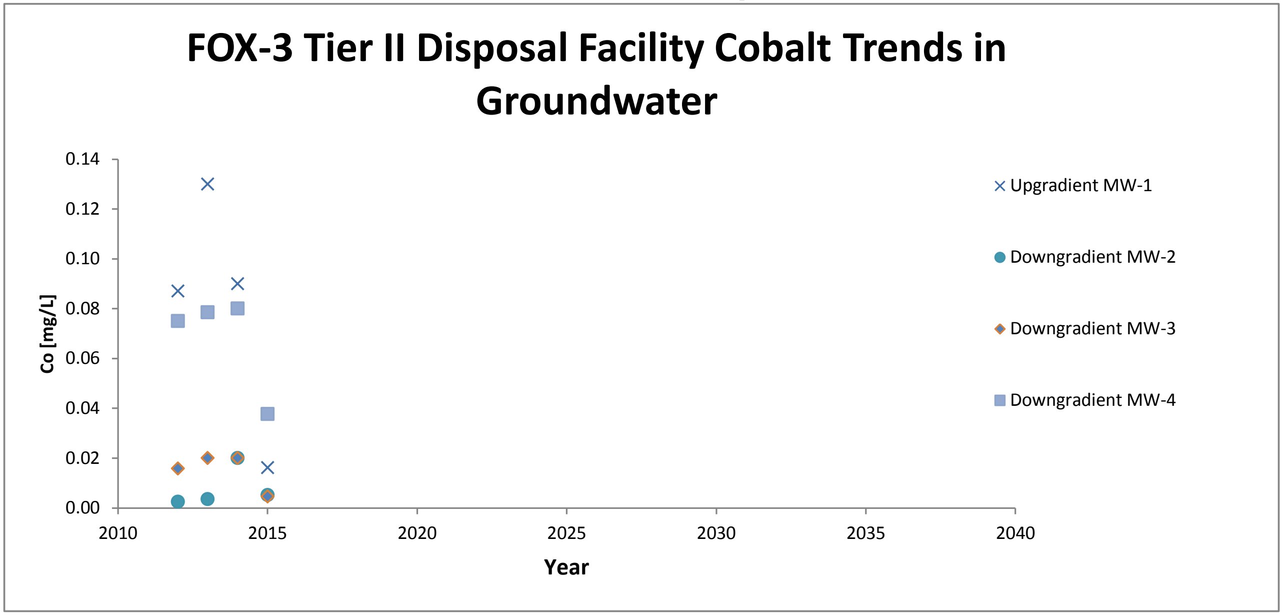


Some baseline groundwater results for inorganic elements were reported as dissolved instead of total in 2009, 2010, and 2011. As a result, there is no baseline average for copper in Tier II GW.

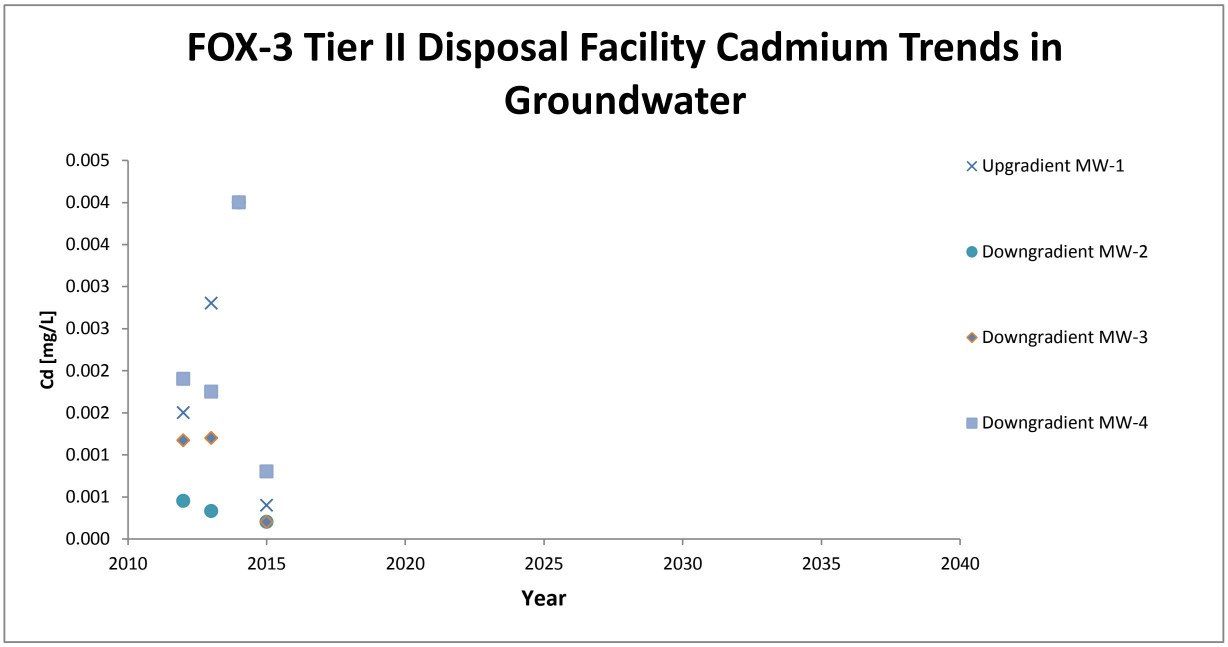


Some baseline groundwater results for inorganic elements were reported as dissolved instead of total in 2009, 2010, and 2011. As a result, there is no baseline average for nickel in Tier II GW.

FOX-3 Tier II Disposal Facility Graphs of Trends for Inorganic Elements, PCBs and TPH in Groundwater Samples

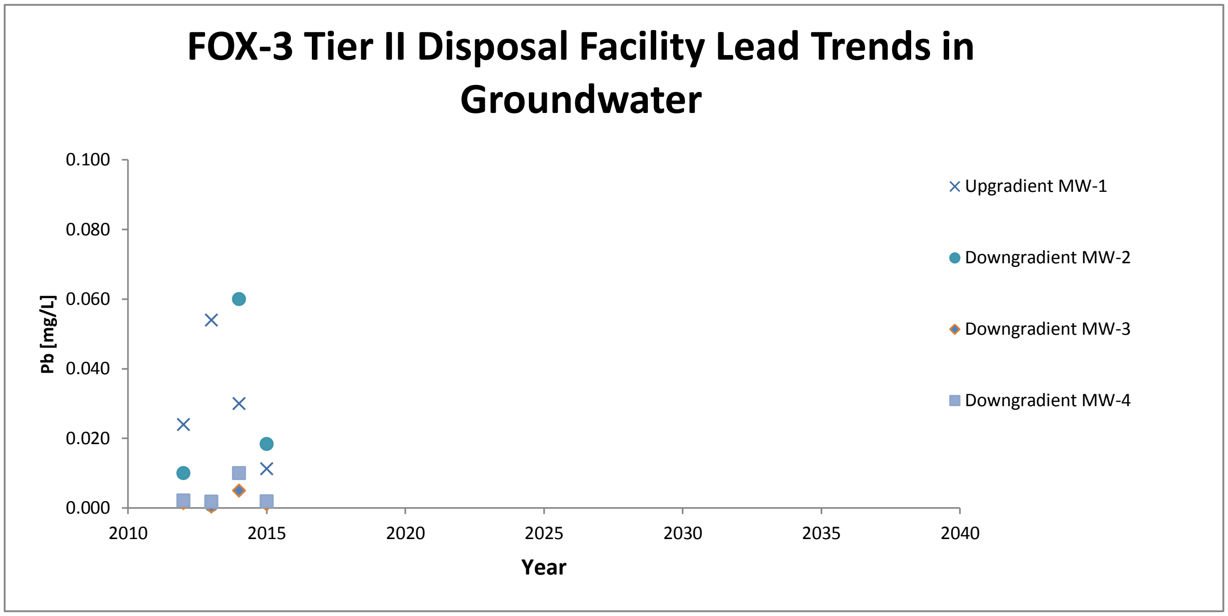


Some baseline groundwater results for inorganic elements were reported as dissolved instead of total in 2009, 2010, and 2011. As a result, there is no baseline average for cobalt in Tier II GW.

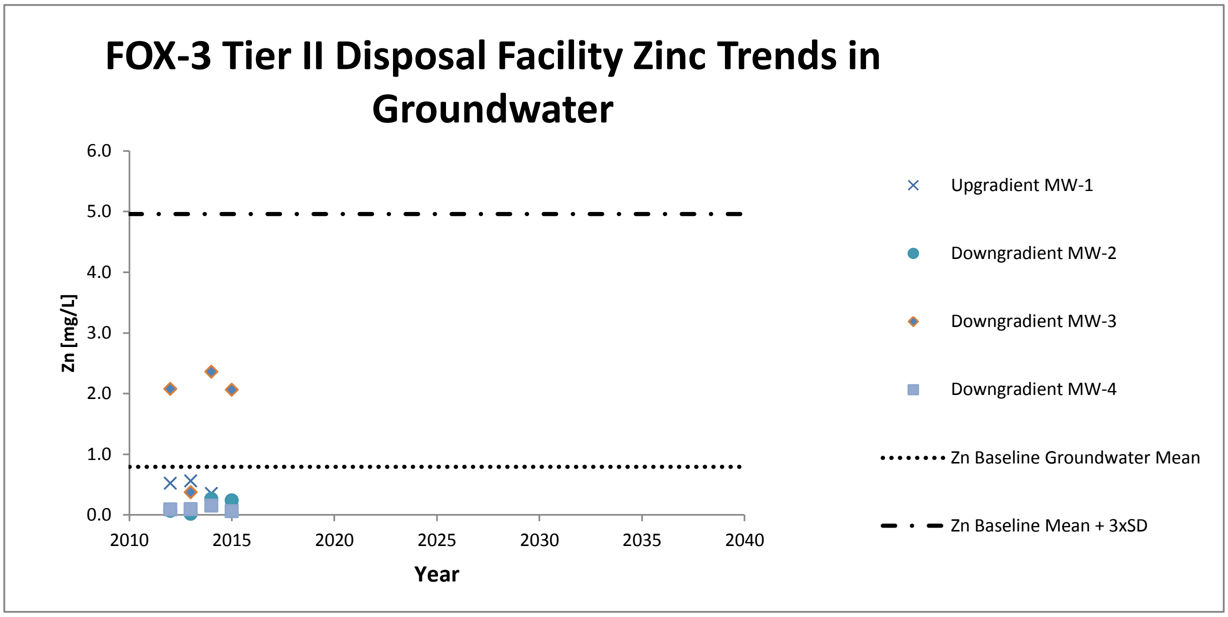


Some baseline groundwater results for inorganic elements were reported as dissolved instead of total in 2009, 2010, and 2011. As a result, there is no baseline average for cadmium in Tier II GW.

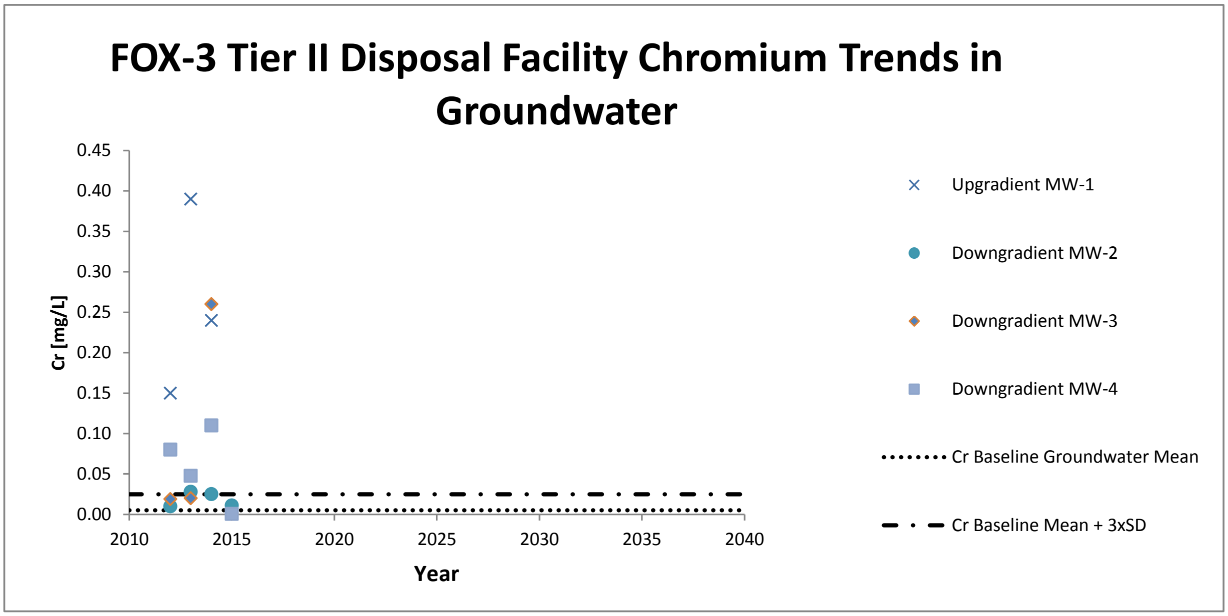
FOX-3 Tier II Disposal Facility Graphs of Trends for Inorganic Elements, PCBs and TPH in Groundwater Samples



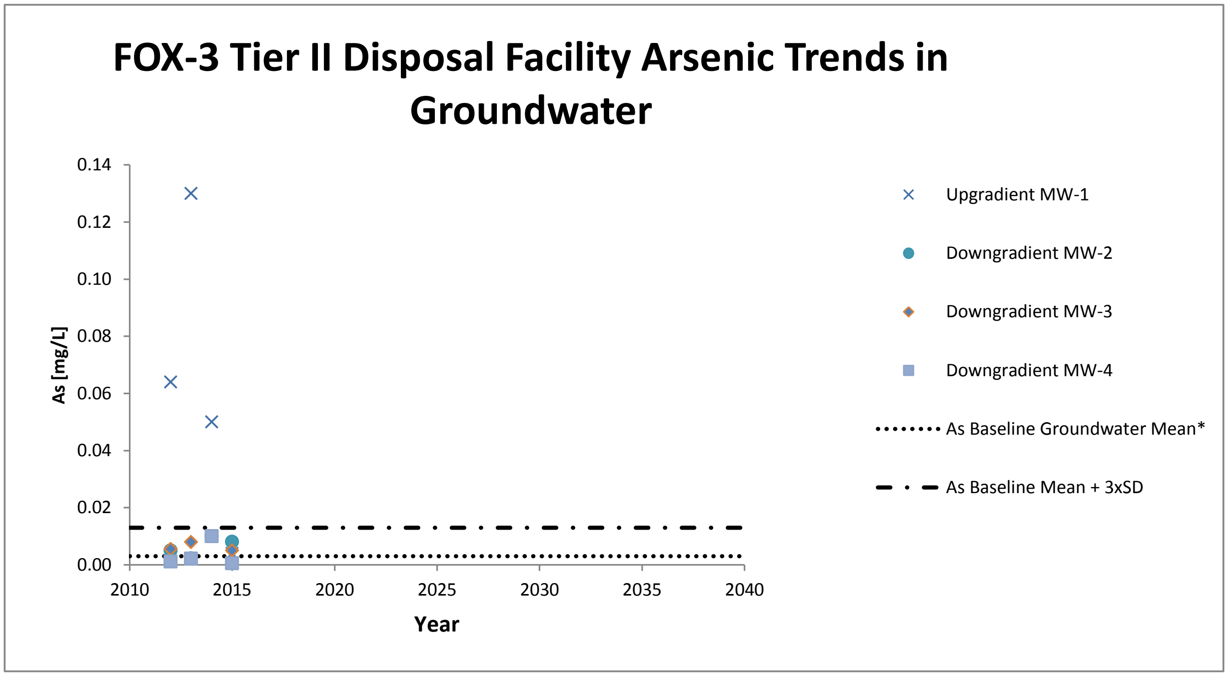
Some baseline groundwater results for inorganic elements were reported as dissolved instead of total in 2009, 2010, and 2011. As a result, there is no baseline average for lead in Tier II GW.



FOX-3 Tier II Disposal Facility Graphs of Trends for Inorganic Elements, PCBs and TPH in Groundwater Samples

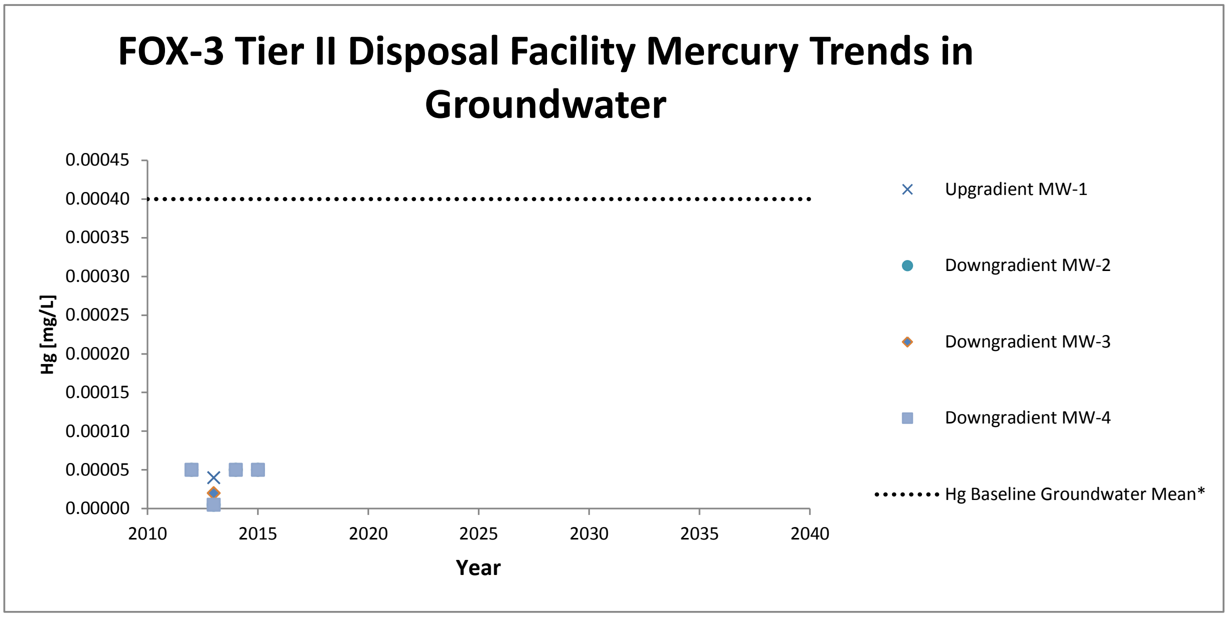


* Cr Baseline Arithmetic Mean is equal to the baseline detection limit

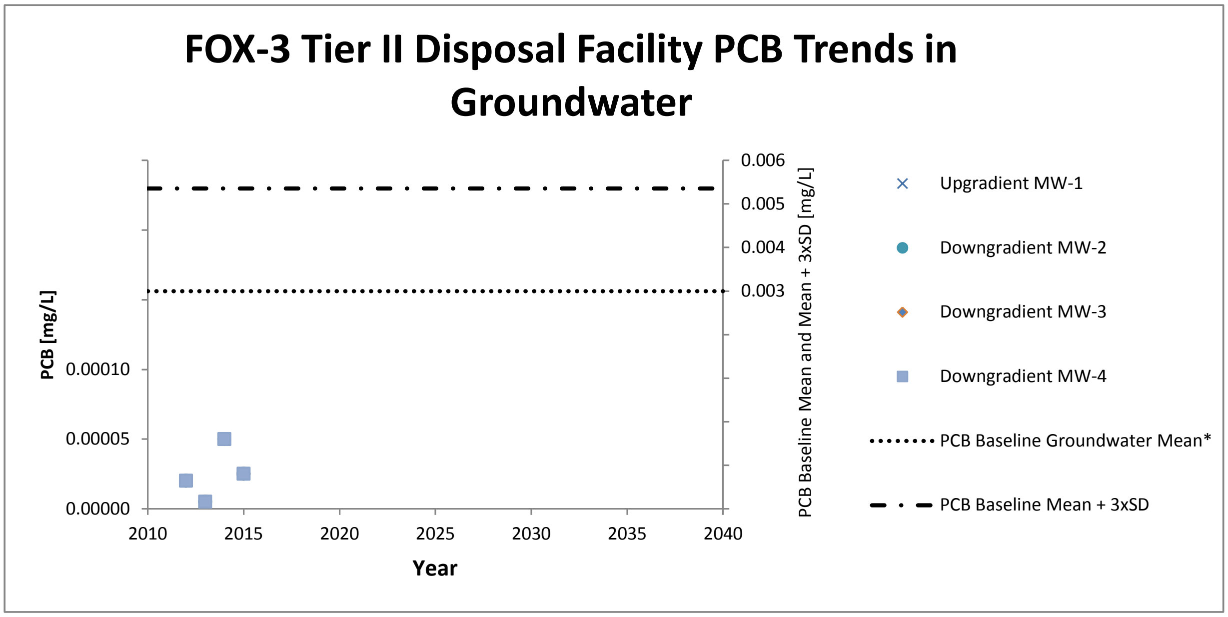


* As Baseline Arithmetic Mean is equal to the baseline detection limit

FOX-3 Tier II Disposal Facility Graphs of Trends for Inorganic Elements, PCBs and TPH in Groundwater Samples

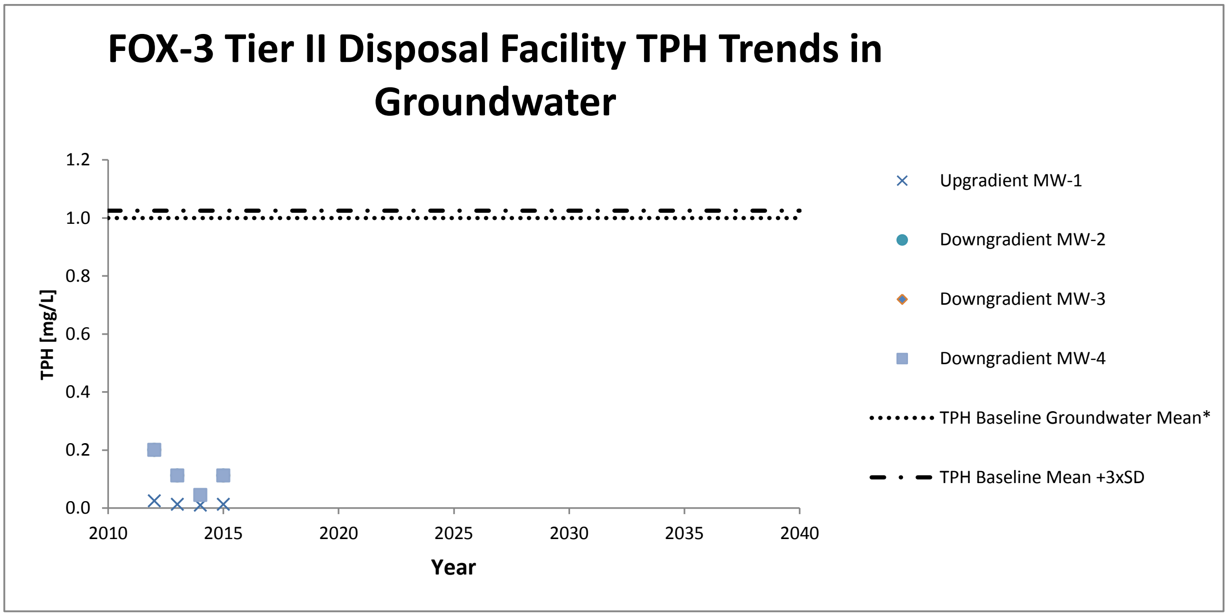


*Hg Baseline Mean is equal to the baseline detection limit.
*Hg Baseline SD = 0



*PCB Baseline Arithmetic Mean is equal to the baseline detection limit.

FOX-3 Tier II Disposal Facility Graphs of Trends for Inorganic Elements, PCBs and TPH in Groundwater Samples



*TPH Baseline Arithmetic Mean is equal to the baseline detection limit.

FOX-3- Non Hazardous Waste Landfill - Summary of Monitoring Soil Analytical Data

Sample ID	Location	Year	Monitoring Year	Monitoring Phase	Depth (cm)	Cu (mg/kg)	Ni (mg/kg)	Co (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Zn (mg/kg)	Cr (mg/kg)	As (mg/kg)	Hg (mg/kg)	Total PCB (mg/kg)	F1 C_6-C_{10} (mg/kg)	F2 C_{10}-C_{16} (mg/kg)	F3 C_{16}-C_{34} (mg/kg)	Modified TPH^ - Total C6-C34 (mg/kg)
Background Data - Arithmetic Mean*						32	27	32	1.0	10	59	67	11	0.05	0.0003				
Baseline Data - Arithmetic Mean*						**38**	**33**	**12**	**1.0**	**10**	**68**	**80**	**13**	**0.10**	**0.10**				**19**
Baseline Data - Standard Deviation						8.8	3.8	1.6	0.0	1.5	8.1	10	4.7	0.0	0.017				17
Baseline Data Mean + 3xStandard Deviation						64	44	17	1.0	15	92	110	26	0.10	0.151				69
**** If baseline or background arithmetic mean was below the detection limit, the mean has been modified to match the detection limit value.***																			
DEW Line Cleanup Tier I Criteria										*200*					*1*				
DEW Line Cleanup Tier II Criteria & Hydrocarbon Action Level						*100*	*100*	*50*	*5*	*500*	*500*	*250*	*61*	*2.0*	*5*				*2500*
Monitoring Data																			
Upgradient																			
	MW-5 surface																		
12-19368/69**	MW-5	2012	1	1	0-10	**55**	**38**	9.8	<0.50	7.2	**97**	**84**	**16**	<0.010	<0.020	<5.0	<10	<50	**33**
F3-MW-5-S-A-2014	MW-5	2014	3	1	0-10	28	30	8.0	<0.50	5.0	62	75	10	<0.10	<0.020	<10	<10	<20	**20**
MW-05 (0-15)	MW-5	2015	4	1	0-15	**40.4**	31.8	10.3	<0.5	**10.1**	**67.6**	**82.1**	**15.8**	<0.1	<0.05	<7	<4	<8	10
	MW-5		7	2															#N/A
	MW-5		10	2															#N/A
	MW-5		15	2															#N/A
	MW-5		25	2															#N/A
																			#N/A
																			#N/A
																			#N/A
	MW-5 depth																		
12-19370/71**	MW-5	2012	1	1	30-40	**41**	31	8.7	<0.50	7.7	**75**	78	**21**	<0.010	<0.020	<5.0	<10	<50	**33**
F3-MW-5-S-B-2014	MW-5	2014	3	1	40-50	31	**38**	10	<0.50	6.0	67	**93**	**18**	<0.10	<0.020	<10	<10	<20	**20**
MW-05 (40-50)	MW-5	2015	4	1	40-50	**42.9**	30.6	10.4	<0.5	8.9	65.7	79.8	**15.7**	<0.1	<0.05	<7	<4	<8	10
	MW-5		7	2															#N/A
	MW-5		10	2															#N/A
	MW-5		15	2															#N/A
	MW-5		25	2															#N/A
																			#N/A
																			#N/A

FOX-3- Non Hazardous Waste Landfill - Summary of Monitoring Soil Analytical Data

Sample ID	Location	Year	Monitoring Year	Monitoring Phase	Depth (cm)	Cu (mg/kg)	Ni (mg/kg)	Co (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Zn (mg/kg)	Cr (mg/kg)	As (mg/kg)	Hg (mg/kg)	Total PCB (mg/kg)	F1 C_6-C_{10} (mg/kg)	F2 C_{10}-C_{16} (mg/kg)	F3 C_{16}-C_{34} (mg/kg)	Modified TPH^ - Total C6-C34 (mg/kg)
Downgradient																			
	MW-6 surface																		
12-19372/73**	MW-6	2012	1	1	0-10	**55**	**40**	12	<0.50	**11**	**88**	**94**	**19**	<0.010	<0.020	<5.0	<10	<50	**33**
F3-MW-6-S-A-2014	MW-6	2014	3	1	0-10	**40**	**33**	10	<0.50	7.0	**74**	**82**	**16**	<0.10	<0.020	<10	<10	<20	**20**
MW-06 (0-15)	MW-6	2015	4	1	0-15	29.3	26.4	8.3	<0.5	7.8	53.7	69.3	**14.1**	<0.1	<0.05	<7	<4	<8	10
	MW-6		7	2															#N/A
	MW-6		10	2															#N/A
	MW-6		15	2															#N/A
	MW-6		25	2															#N/A
																			#N/A
																			#N/A
																			#N/A
	MW-6 depth																		
12-19374/75**	MW-6	2012	1	1	30-40	**50**	**42**	12	<0.50	**22**	**91**	**110**	**24**	<0.010	<0.020	<5.0	<10	<50	**33**
F3-MW-6-S-B-2014	MW-6	2014	3	1	40-50	**44**	**36**	11.0	<0.50	8.0	**76**	**91**	**18**	<0.10	<0.020	<10	<10	<20	**20**
MW-06 (40-50)	MW-6	2015	4	1	40-50	**40.1**	30.1	9.7	<0.5	9.4	64.6	78.8	**17.7**	<0.1	<0.05	<7	<4	<8	10
	MW-6		7	2															#N/A
	MW-6		10	2															#N/A
	MW-6		15	2															#N/A
	MW-6		25	2															#N/A
																			#N/A
																			#N/A
																			#N/A
	MW-7 surface																		
12-19376/77**	MW-7	2012	1	1	0-10	**42**	**39**	11	<0.50	8.1	**87**	**91**	**18**	<0.010	<0.020	<5.0	<10	<50	**33**
F3-MW-7-S-A-2014	MW-7	2014	3	1	0-10	36	**38**	10	<0.50	6.0	**75**	**98**	**14**	<0.10	<0.020	<10	<10	<20	**20**
MW-07 (0-15)	MW-7	2015	4	1	0-15	**42.5**	30.9	9.9	<0.5	**10.2**	64.8	**82.9**	**21**	<0.1	<0.05	<7	<4	<8	10
	MW-7		7	2															#N/A
	MW-7		10	2															#N/A
	MW-7		15	2															#N/A
	MW-7		25	2															#N/A
																			#N/A
																			#N/A
																			#N/A
																			#N/A

FOX-3- Non Hazardous Waste Landfill - Summary of Monitoring Soil Analytical Data

Sample ID	Location	Year	Monitoring Year	Monitoring Phase	Depth (cm)	Cu (mg/kg)	Ni (mg/kg)	Co (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Zn (mg/kg)	Cr (mg/kg)	As (mg/kg)	Hg (mg/kg)	Total PCB (mg/kg)	F1 C_6-C_{10} (mg/kg)	F2 C_{10}-C_{16} (mg/kg)	F3 C_{16}-C_{34} (mg/kg)	Modified TPH^ - Total C6-C34 (mg/kg)
	MW-7 depth																		
12-19378/79**	MW-7	2012	1	1	30-40	**52**	**43**	12	<0.50	8.5	**95**	**110**	**19**	<0.010	<0.020	<5.0	<10	<50	**33**
F3-MW-7-S-B-2014	MW-7	2014	3	1	40-50	**38**	**34**	10	<0.50	6.0	**73**	**85**	**16**	<0.10	<0.020	<10	<10	<20	**20**
MW-07 (40-50)	MW-7	2015	4	1	40-50	**41**	29.2	9.4	<0.5	9.1	62	76	**18.8**	<0.1	<0.05	<7	<4	<8	10
	MW-7		7	2															#N/A
	MW-7		10	2															#N/A
	MW-7		15	2															#N/A
	MW-7		25	2															#N/A
																			#N/A
																			#N/A
																			#N/A
	MW-8 surface																		
12-19380/81**	MW-8	2012	1	1	0-10	**42**	**36**	10	<0.50	**10**	67	**84**	**17**	<0.010	<0.020	<5.0	<10	<50	**33**
F3-MW-8-S-A-2014	MW-8	2014	3	1	0-10	**40**	**38**	10.0	<0.50	7	**80**	**85**	**14**	<0.10	<0.020	<10	<10	<20	**20**
MW-08 (0-15)	MW-8	2015	4	1	0-15	25.8	26.6	8.6	<0.5	7.3	57.1	68.3	12.1	<0.1	<0.05	<7	<4	<8	10
	MW-8		7	2															#N/A
	MW-8		10	2															#N/A
	MW-8		15	2															#N/A
	MW-8		25	2															#N/A
																			#N/A
																			#N/A
																			#N/A
	MW-8 depth																		
12-19382/83**	MW-8	2012	1	1	30-40	31	25	7.4	<0.50	7.4	61	63	11	<0.010	<0.020	<5.0	<10	<50	**33**
F3-MW-8-S-B-2014	MW-8	2014	3	1	40-50	**38**	**40**	11	<0.50	7.0	**85**	**96**	**18**	<0.10	<0.020	<10	<10	<20	**20**
MW-08 (30-40)	MW-8	2015	4	1	30-40	29.4	30.3	9.8	<0.5	7.3	62.9	75.6	**13.1**	<0.1	<0.05	<7	<4	<8	10
	MW-8		7	2															#N/A
	MW-8		10	2															#N/A
	MW-8		15	2															#N/A
	MW-8		25	2															#N/A
																			#N/A
																			#N/A
																			#N/A

Note: Modified TPH Total (C_6-C_{34}) has been calculated by adding results for F1, F2 and F3.

N/A = not analyzed

** two samples taken, one analyzed for inorganics and PCBs, one analyzed for TPH

Soil and Groundwater samples were not sampled at the NHWL in 2013

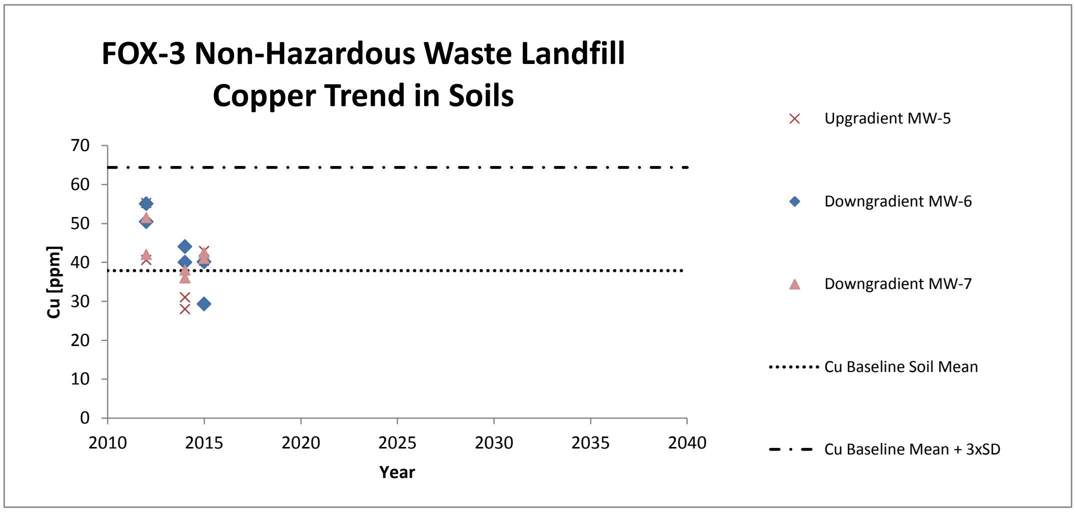
Legend

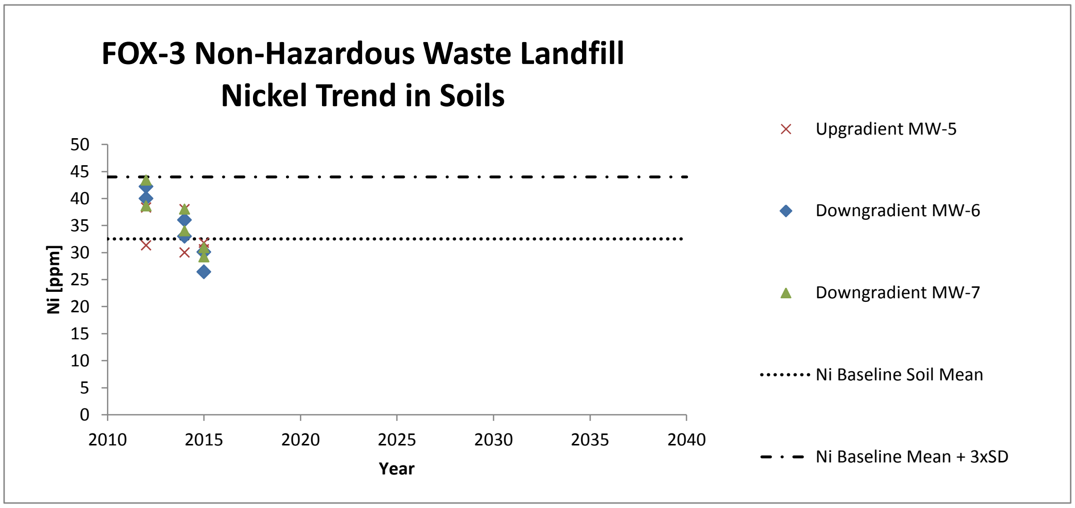
XX	sample exceeds background
XX	**sample exceeds baseline**
XX	*sample exceeds DLCU Tier I criteria*
XX	*sample exceeds DLCU Tier II criteria*

FOX-3 Non-Hazardous Waste Landfill Trends in Soil Inorganics, PCBs and PHCs (modified TPH)

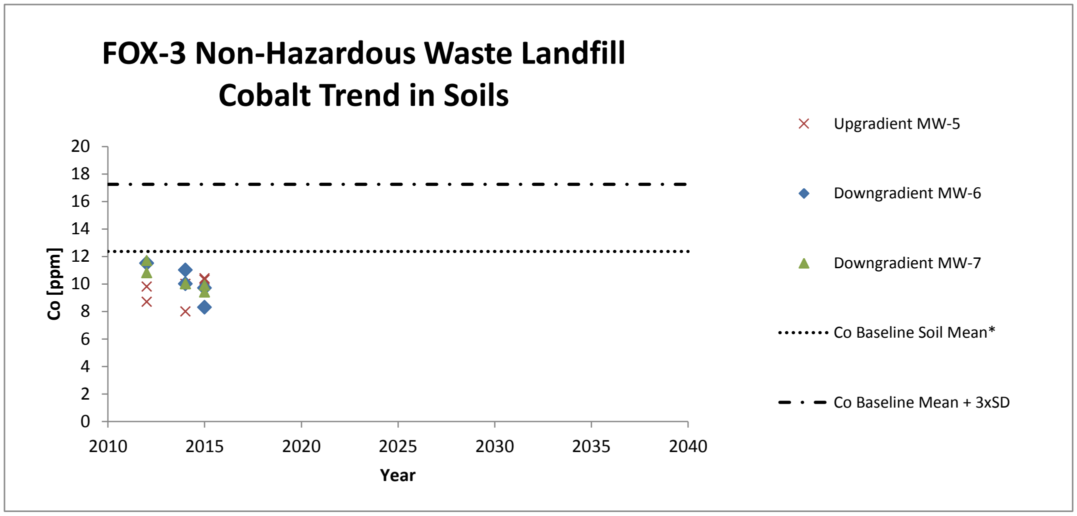
Where results are below detection, half of the detection limit has been used in the charts for the sample points.

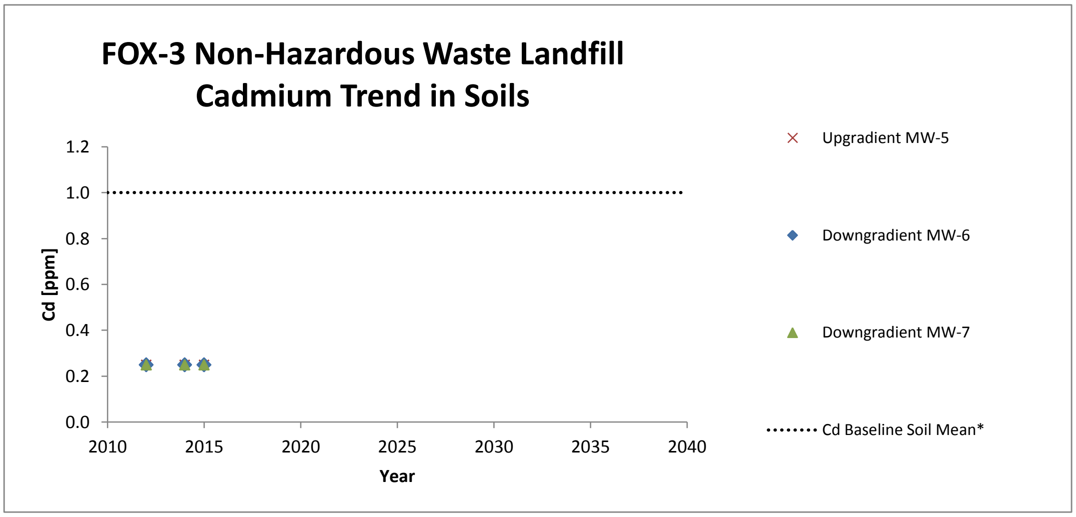
Trendlines are intended for visual interpretation of temporal trends. When all monitoring results are below detection, trendlines are a reflection of changes in detection limit. Users should refer to data tables.





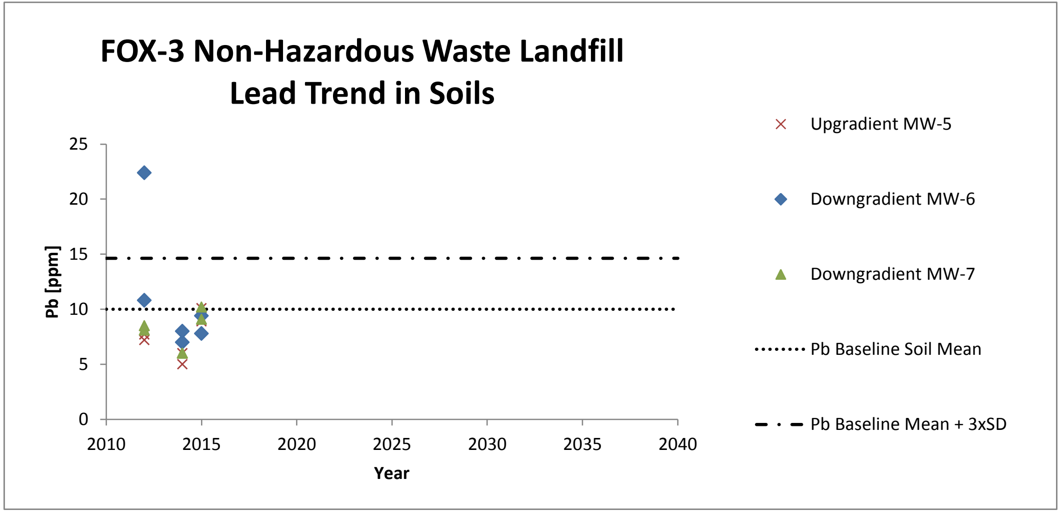
FOX-3 Non-Hazardous Waste Landfill Trends in Soil Inorganics, PCBs and PHCs (modified TPH)



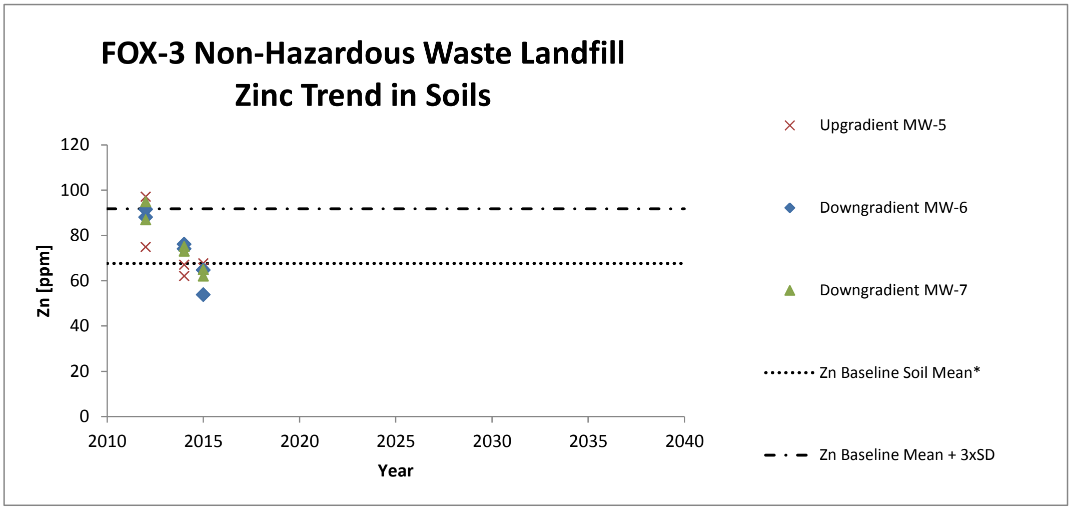


*Cd Baseline Arithmetic Mean is equal to the baseline detection limit.
*Cd Baseline SD = 0

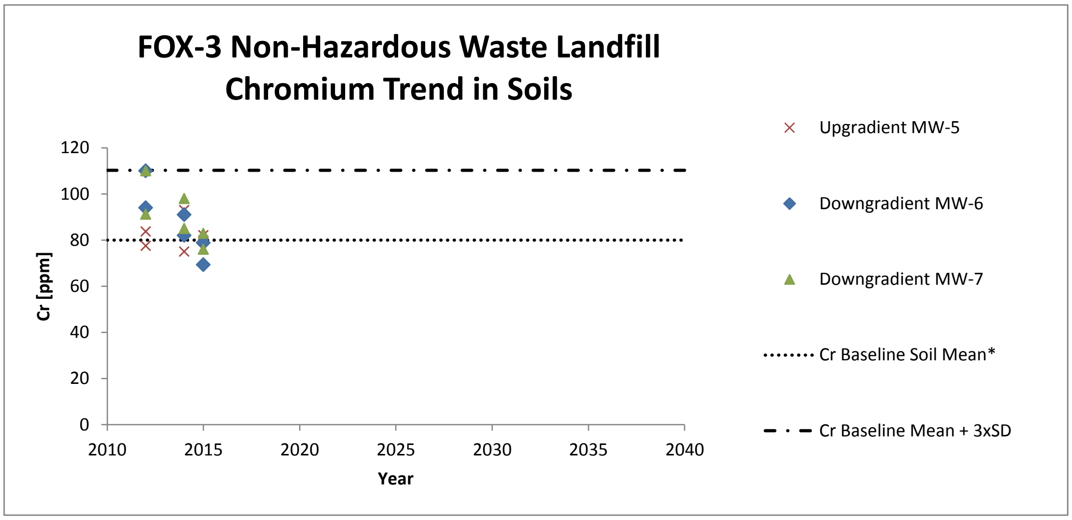
FOX-3 Non-Hazardous Waste Landfill Trends in Soil Inorganics, PCBs and PHCs (modified TPH)

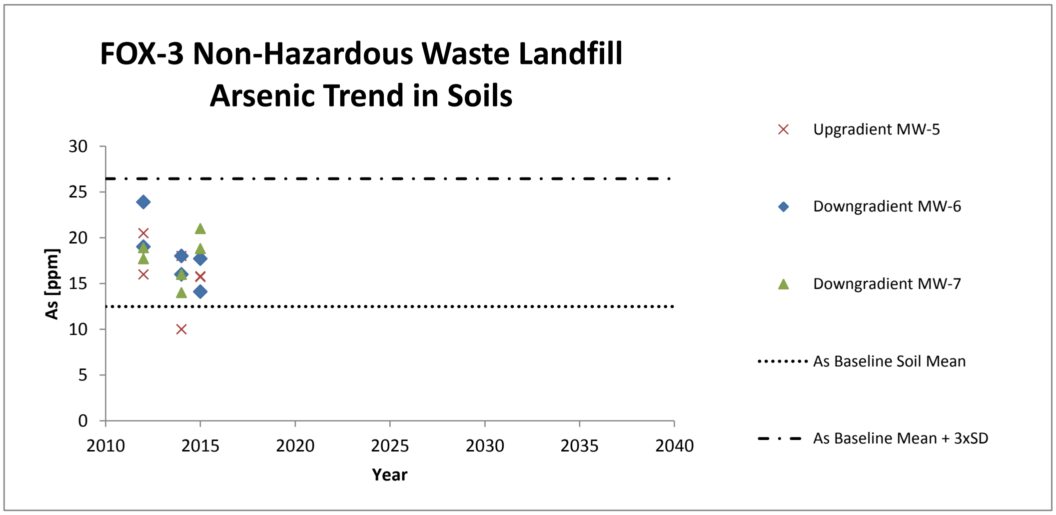


*Pb Baseline Arithmetic Mean is equal to the baseline detection limit.

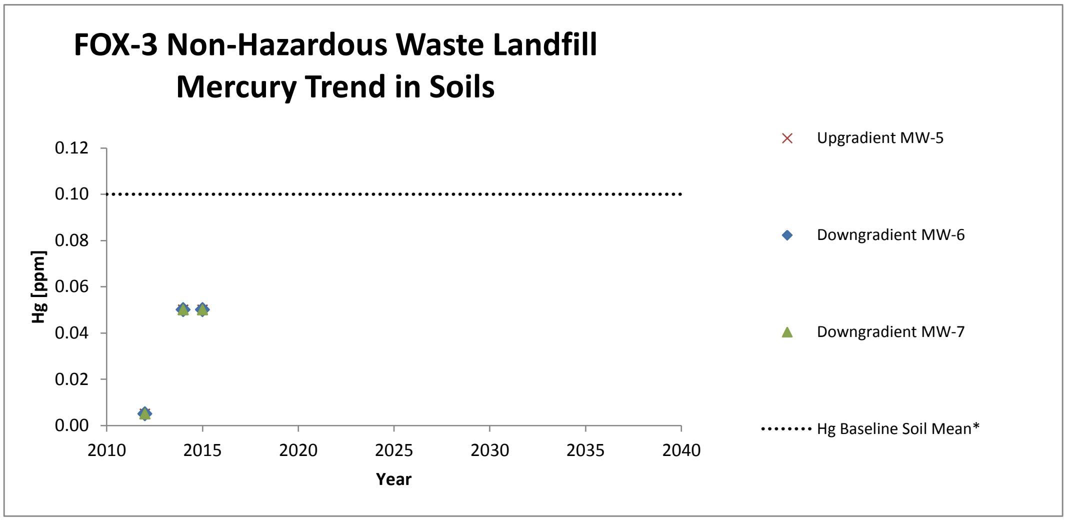


FOX-3 Non-Hazardous Waste Landfill Trends in Soil Inorganics, PCBs and PHCs (modified TPH)

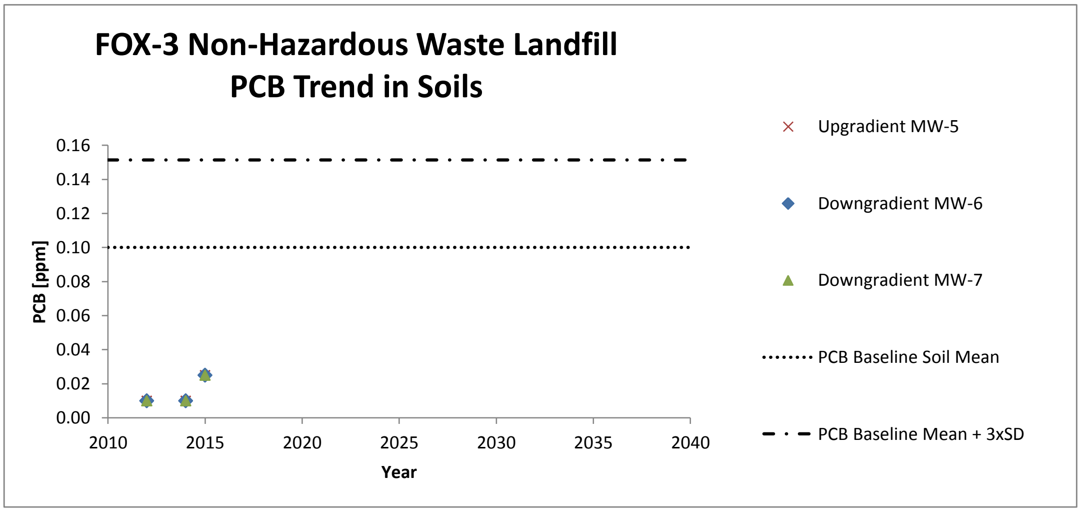




FOX-3 Non-Hazardous Waste Landfill Trends in Soil Inorganics, PCBs and PHCs (modified TPH)

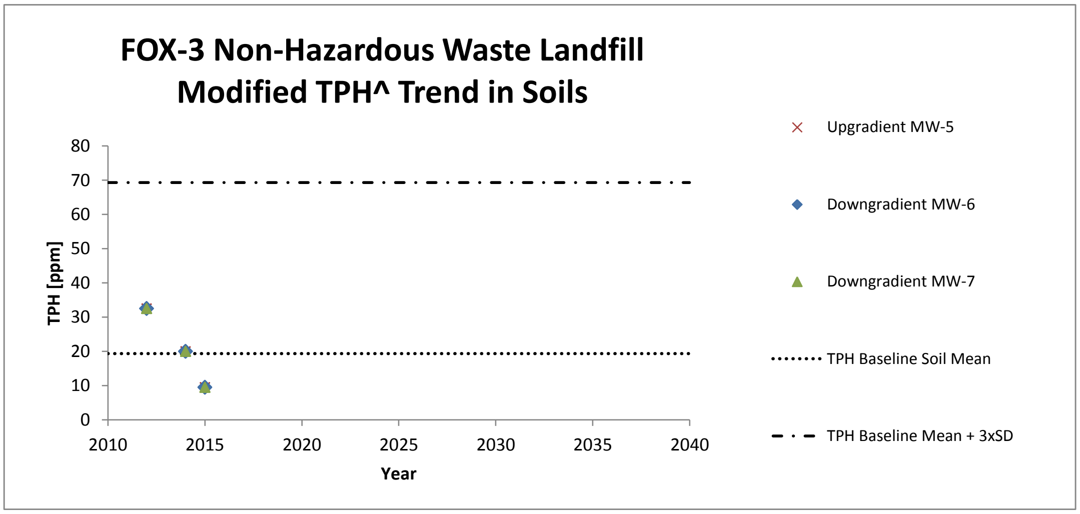


*Hg Baseline Arithmetic Mean is equal to the baseline detection limit.
** Hg results below detection for all monitoring samples. Trendlines reflect changes in detection limit.



*PCB Baseline Arithmetic mean is equal to the detection limit

FOX-3 Non-Hazardous Waste Landfill Trends in Soil Inorganics, PCBs and PHCs (modified TPH)



^ Modified TPH is Sum of F1, F2 and F3 fractions (C_6 - C_{34})

FOX-3 - Non Hazardous Waste Landfill - Summary of Monitoring Groundwater Analytical Data

Sample ID	Location	Date	Monitoring Year	Monitoring Phase	Cu (mg/L)	Ni (mg/L)	Co (mg/L)	Cd (mg/L)	Pb (mg/L)	Zn (mg/L)	Cr (mg/L)	As (mg/L)	Hg (mg/L)	Total PCB (mg/L)	F1 C_6-C_{10} (mg/L)	F2 C_{10}-C_{16} (mg/L)	F3 C_{16}-C_{34} (mg/L)	Modified TPH^ - Total C6-C34 (mg/L)
Baseline Data																		
Upgradient:																		
09-27693	MW-05	2009			0.013	0.018	<0.0030	<0.0010	<0.010	<0.010	<0.0050	<0.0030	<0.00040	<0.000020	0.26	8.7	2.3	11
10-36019	MW-05	2010			0.0098	0.044	0.0040	<0.0010	<0.010	<0.010	<0.0050	<0.0030	<0.00040	<0.000020	<0.050	<0.50	<1.0	0.8
11-28769	MW-05	2011			0.0086	0.23	0.062	0.0012	<0.010	0.37	<0.0050	<0.0030	<0.00040	<0.0030	<0.050	< 0.50	<1.0	0.8
																		0.0
Downgradient:																		
09-27701	MW-06	2009			<0.0050	0.033	<0.0030	<0.0010	<0.010	0.018	<0.0050	<0.0030	<0.00040	<0.000020	<0.050	<0.50	<1.0	0.8
09-27684	MW-07	2009			0.014	0.061	0.0080	<0.0010	<0.010	0.018	<0.0050	0.004	<0.00040	<0.000020	<0.050	0.5	<1.0	1.0
09-27676	MW-08	2009			0.009	0.007	<0.0030	<0.0010	<0.010	0.017	<0.0050	0.026	<0.00040	<0.000020	<0.050	0.7	<1.0	1.2
10-36014	MW-06	2010			<0.0050	<0.0050	<0.0030	<0.0010	<0.010	0.019	0.006	<0.0030	<0.00040	<0.000020	<0.050	<0.50	<1.0	0.8
10-36029	MW-07	2010			0.008	0.054	0.0129	<0.0010	<0.010	0.040	<0.0050	0.0061	<0.00040	<0.000020	<0.050	<0.50	<1.0	0.8
10-36024	MW-08	2010			0.006	0.007	<0.0030	<0.0010	<0.010	<0.010	0.007	0.0060	<0.00040	<0.000020	<0.050	<0.50	<1.0	0.8
11-28770	MW-06	2011			0.014	0.102	0.0281	<0.0010	<0.010	0.061	<0.0050	<0.0030	<0.00040	<0.0030	<0.050	< 0.50	<1.0	0.8
11-28771	MW-07	2011			0.016	0.15	0.0170	<0.0010	<0.010	0.600	<0.0050	<0.0030	<0.00040	<0.0030	<0.050	< 0.50	<1.0	0.8
11-28772	MW-08	2011			0.009	0.007	<0.0030	<0.0010	<0.010	0.012	<0.0050	<0.0030	<0.00040	<0.0030	<0.050	< 0.50	<1.0	0.8
		N value			12	12	12	12	12	12	12	12	12	12				13
		Arithmetic Mean			**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**0.14**	**0.0035**	**0.0026**	**0.00020**	**0.00051**				**1.0**
		Arithmetic Mean Corrected for Detection Limit			**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**0.14**	**0.005**	**0.003**	**0.0004**	**0.003**				**1.0**
		Standard Deviation			**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	0.22	0.0018	0.0021	0.0	0.00073				3.0
		Arithmetic Mean + 3xStandard Deviation			**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	0.81	0.0089	0.0090	0.0002	0.0027				10
		Detection Limit			0.0050	0.0050	0.0030	0.0010	0.010	0.010	0.0050	0.0030	0.0004	0.0030				1.0
Monitoring Data																		
Upgradient - MW- 5																		
12-50009*	MW-5	2012	1	1									<0.00080^	<0.00080^	<0.05	0.25	0.65	0.93
F3-MW-5-2014*	MW-5	2014	3	1	0.18	0.27	0.07	<0.008	0.09	**5.3**	**0.23**	**0.04**	<0.00010	<0.00050				#N/A
MW0905	MW-5	2015	4	1	0.0036	0.033	0.0087	0.0007	0.0023	**0.377**	**0.005**	0.002	<0.0001	<0.00005	<0.025	<0.1	<0.1	0.1
	MW-5		7	2														#N/A
	MW-5		10	2														#N/A
	MW-5		15	2														#N/A
	MW-5		25	2														#N/A
																		#N/A
																		#N/A
																		#N/A
																		#N/A

FOX-3 - Non Hazardous Waste Landfill - Summary of Monitoring Groundwater Analytical Data

Sample ID	Location	Date	Monitoring Year	Monitoring Phase	Cu (mg/L)	Ni (mg/L)	Co (mg/L)	Cd (mg/L)	Pb (mg/L)	Zn (mg/L)	Cr (mg/L)	As (mg/L)	Hg (mg/L)	Total PCB (mg/L)	F1 C_6-C_{10} (mg/L)	F2 C_{10}-C_{16} (mg/L)	F3 C_{16}-C_{34} (mg/L)	Modified TPH^ - Total C6-C34 (mg/L)
Downgradient - MW-6																		
12-50000	MW-6	2012	1	1	0.043	0.021	0.0033	0.00030	0.0056	**0.17**	**0.013**	**0.0056**	<0.00010	<0.000040	<0.05	<0.10	<0.25	0.20
F3-MW-6-2014*	MW-6	2014	3	1	0.14	0.090	<0.010	<0.0080	0.03	**0.68**	**0.090**	<0.020	<0.00010	<0.00010				#N/A
MW0906 (Dup Avg)	MW-6	2015	4	1	0.04	0.02	0.002	0.0002	0.01	0.13	0.004	**0.0065**	0.000023	<0.00005	<0.025	<0.1	<0.1	0.11
	MW-6		7	2														#N/A
	MW-6		10	2														#N/A
	MW-6		15	2														#N/A
	MW-6		25	2														#N/A
																		#N/A
																		#N/A
																		#N/A
																		#N/A
Downgradient - MW-7																		
12-50001	MW-7	2012	1	1	0.093	0.85	0.034	0.00093	0.026	**0.95**	**0.15**	**0.017**	<0.00010	<0.000040	<0.05	<0.10	<0.25	0.20
F3-MW-7-2014*	MW-7	2014	3	1	0.16	0.42	0.030	<0.0080	0.030	**1.1**	**0.03**	**0.54**	<0.00010	<0.00010				#N/A
MW0907	MW-7	2015	4	1	0.0267	0.045	0.0061	0.0002	0.004	**0.336**	**0.02**	**0.004**	<0.0001	<0.00005	<0.025	<0.1	<0.1	0.11
	MW-7		7	2														#N/A
	MW-7		10	2														#N/A
	MW-7		15	2														#N/A
	MW-7		25	2														#N/A
																		#N/A
																		#N/A
																		#N/A
																		#N/A
Downgradient - MW-8																		
12-50002	MW-8	2012	1	1	0.026	0.012	0.0012	0.00021	0.0077	**0.27**	**0.0075**	**0.010**	<0.00010	<0.000040	<0.05	<0.10	<0.25	0.20
F3-MW-8-2014*	MW-8	2014	3	1	0.04	0.10	<0.010	<0.0080	0.02	**0.51**	**0.14**	<0.020	<0.00010	<0.00010				#N/A
MW0908	MW-7	2015	4	1	0.0062	0.012	0.0014	0.0001	0.0075	**0.323**	**0.005**	**0.009**	<0.0001	<0.00005	<0.025	<0.1	<0.1	0.11
	MW-7		7	2														#N/A
	MW-7		10	2														#N/A
	MW-7		15	2														#N/A
	MW-7		25	2														#N/A
																		#N/A
																		#N/A
																		#N/A
																		#N/A

Note: Modified TPH Total (C_6-C_{34}) has been calculated by adding results for F1, F2 and F3.

Some baseline ground water results for inorganic elements were reported as dissolved instead of total in 2009, 2010, and 2011. These results were excluded from the baseline average calculation but kept in the summary table for reference and highlighted blue.

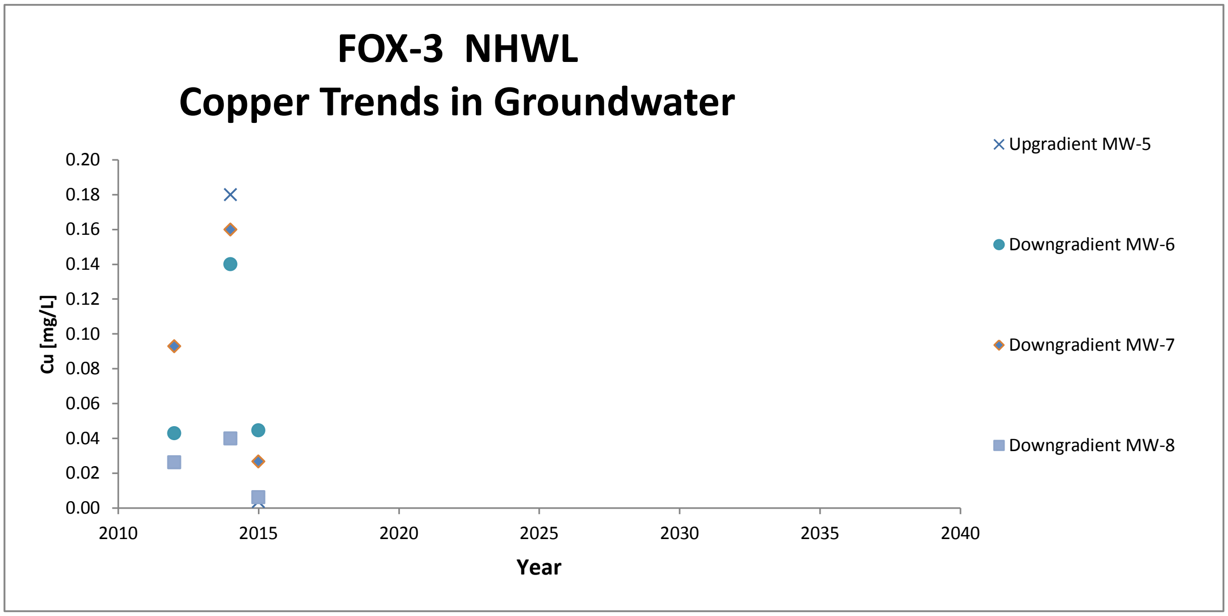
* insufficient volume at these wells to analyze all analytes

^ detection limit adjusted for this sample 50009 due to sample matrix effects and reextraction with lower sample volume. These higher detection limits have been removed from the charts.

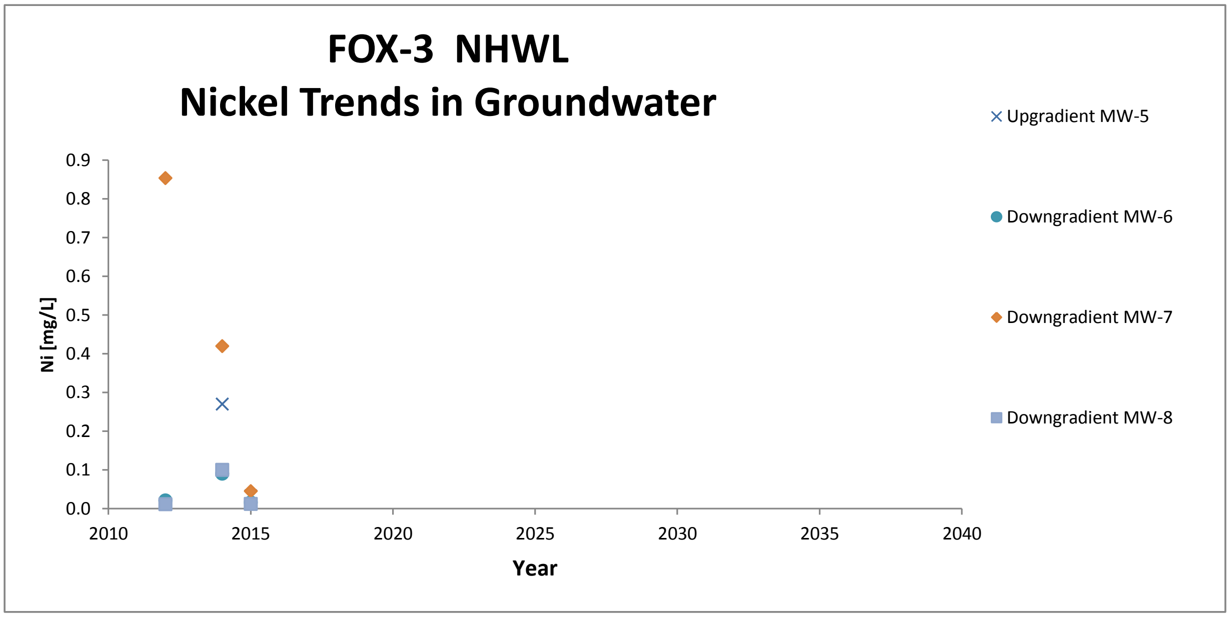
Soil and Groundwater samples were not sampled at the NHWL in 2013

FOX-3 Non-Hazardous Waste Landfill Trends for Inorganic Elements, PCBs and TPH in Groundwater Samples

Where results are below detection, half of the detection limit has been used in the charts for the sample points. Trendlines are intended for visual interpretation of temporal trends. When all monitoring results are below detection, trendlines are a reflection of changes in detection limit. Users should refer to data tables.

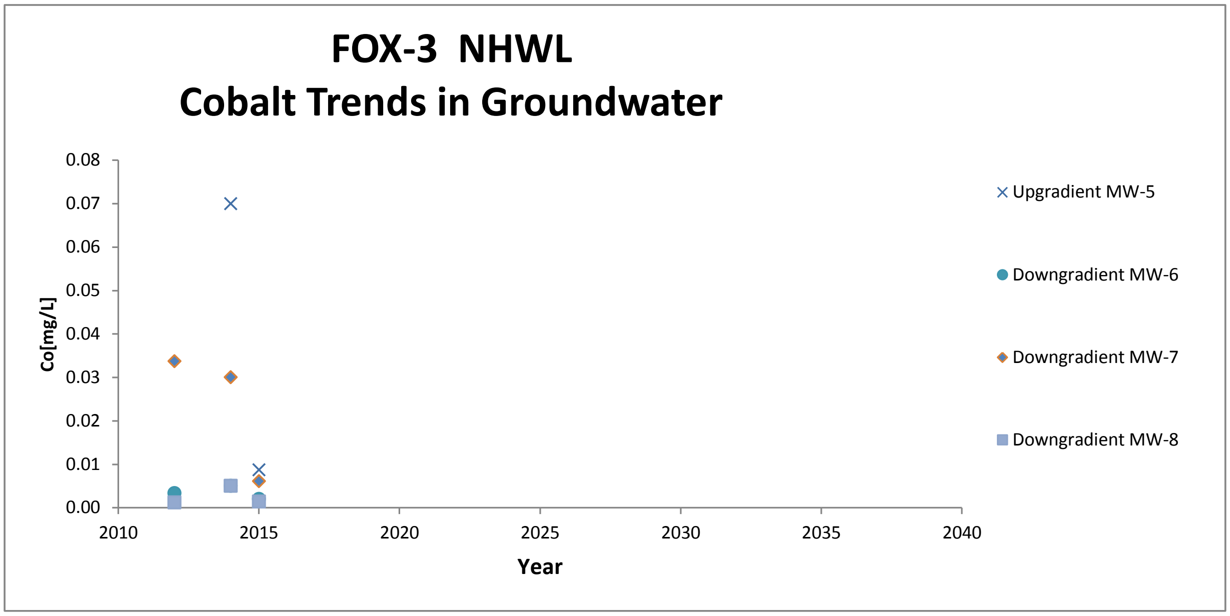


Some baseline groundwater results for inorganic elements were reported as dissolved instead of total in 2009, 2010, and 2011. As a result, there is no baseline average for copper in Tier II GW.

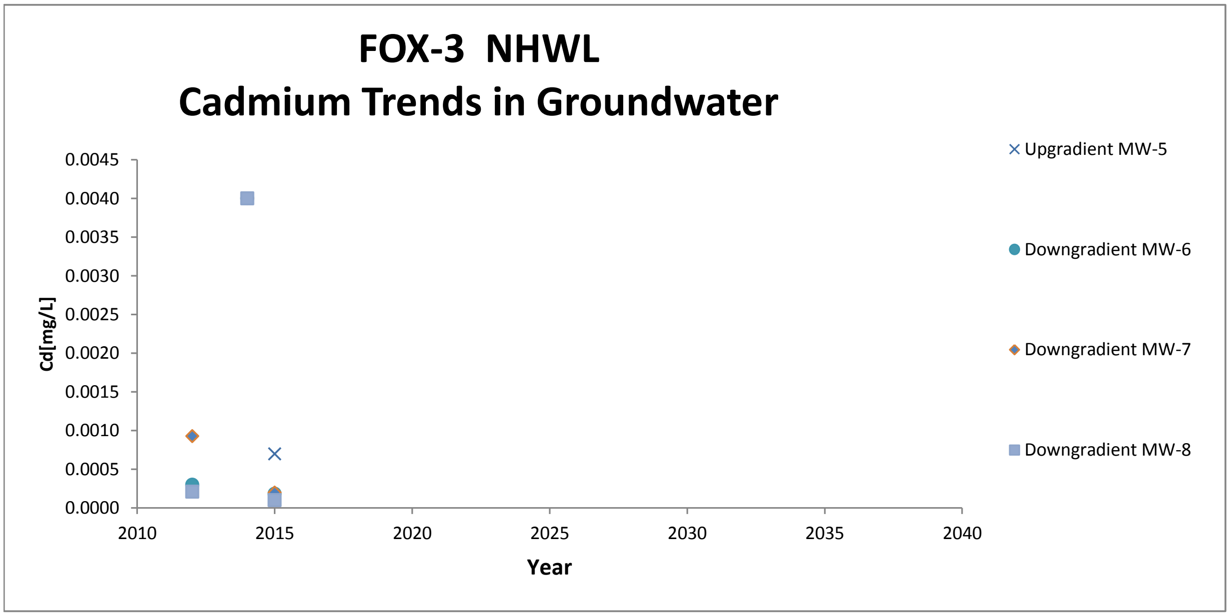


Some baseline groundwater results for inorganic elements were reported as dissolved instead of total in 2009, 2010, and 2011. As a result, there is no baseline average for nickel in Tier II GW.

FOX-3 Non-Hazardous Waste Landfill Trends for Inorganic Elements, PCBs and TPH in Groundwater Samples

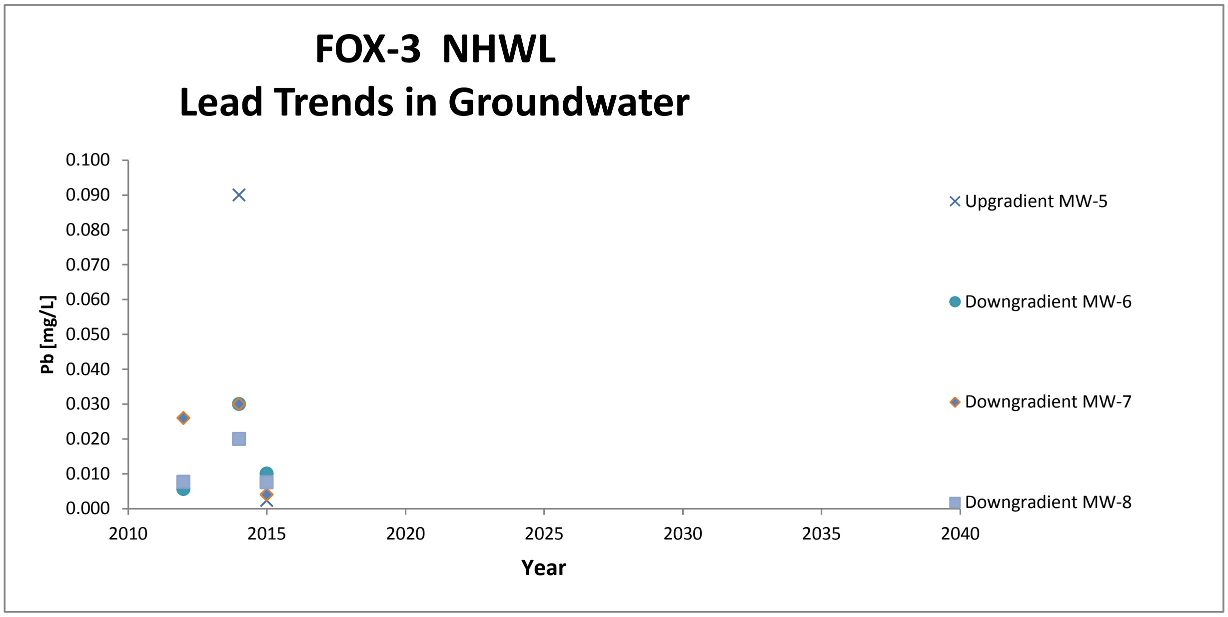


Some baseline groundwater results for inorganic elements were reported as dissolved instead of total in 2009, 2010, and 2011. As a result, there is no baseline average for cobalt in Tier II GW.



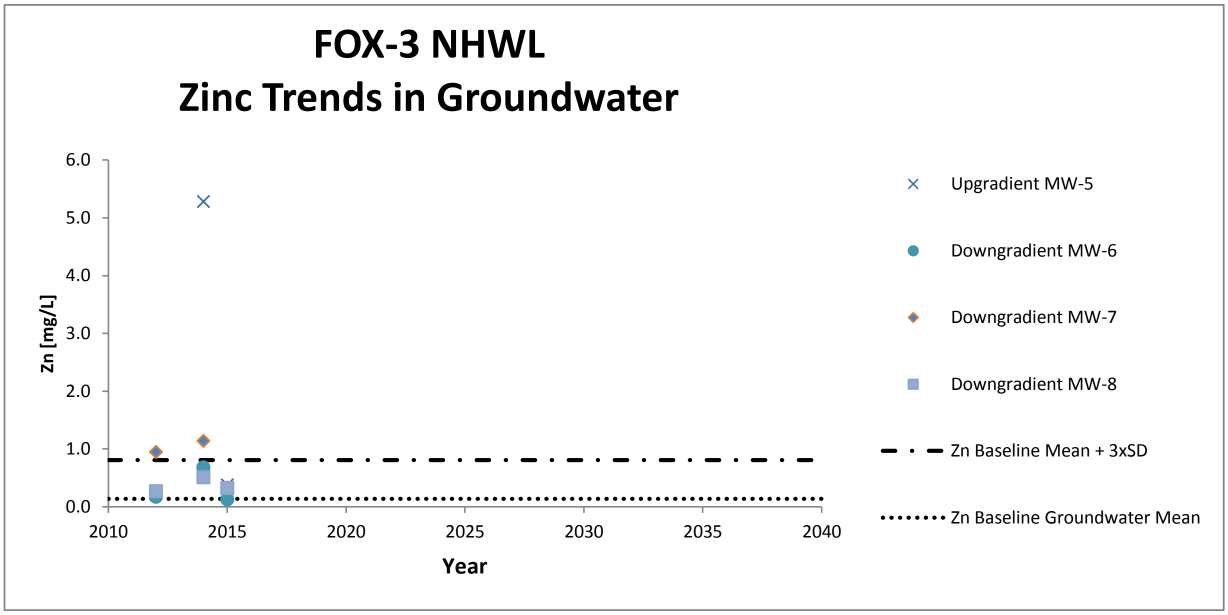
Some baseline groundwater results for inorganic elements were reported as dissolved instead of total in 2009, 2010, and 2011. As a result, there is no baseline average for cadmium in Tier II GW.

FOX-3 Non-Hazardous Waste Landfill Trends for Inorganic Elements, PCBs and TPH in Groundwater Samples

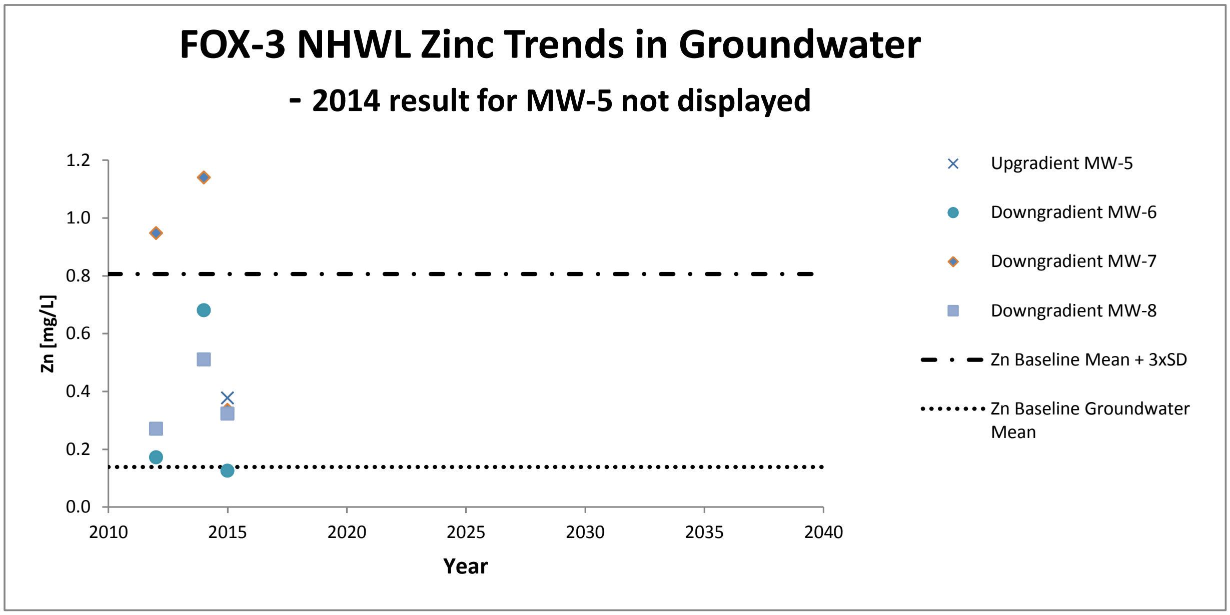


Some baseline groundwater results for inorganic elements were reported as dissolved instead of total in 2009, 2010, and 2011. As a result, there is no baseline average for lead in Tier II GW.

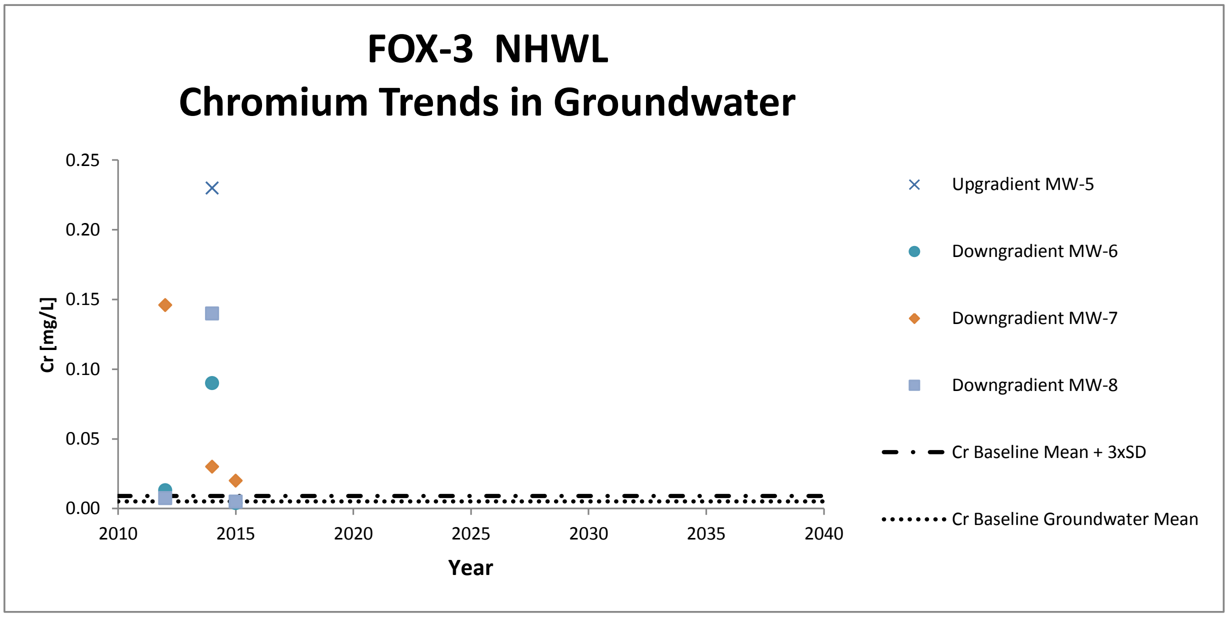
FOX-3 Non-Hazardous Waste Landfill Trends for Inorganic Elements, PCBs and TPH in Groundwater Samples



Zinc chart after removal of the 2014 MW-5 Upgradient result of 5.3 mg/L.

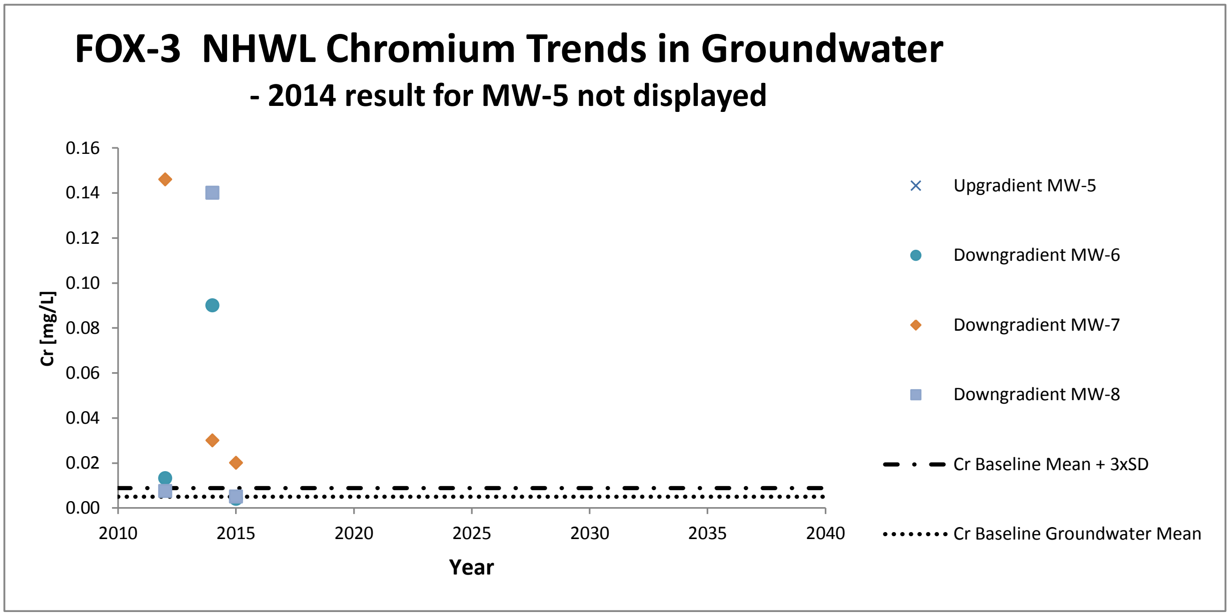


FOX-3 Non-Hazardous Waste Landfill Trends for Inorganic Elements, PCBs and TPH in Groundwater Samples

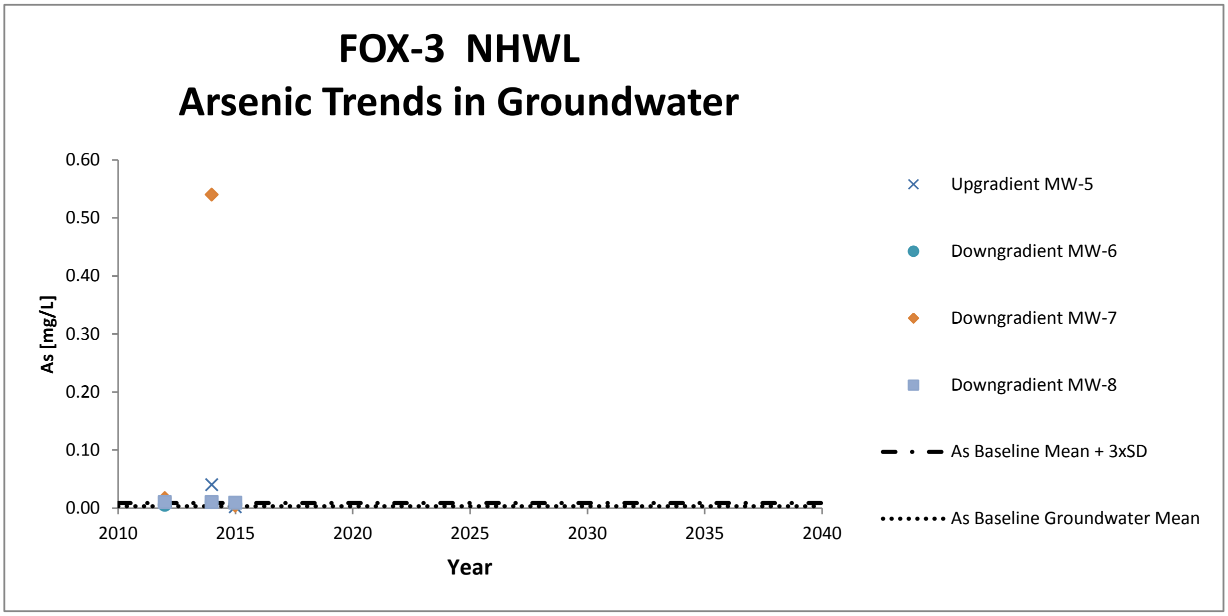


* Cr Baseline Arithmetic mean equals the baseline detection limit

Chromium chart after removal of the 2014 MW-5 Upgradient result of 0.23 mg/L.

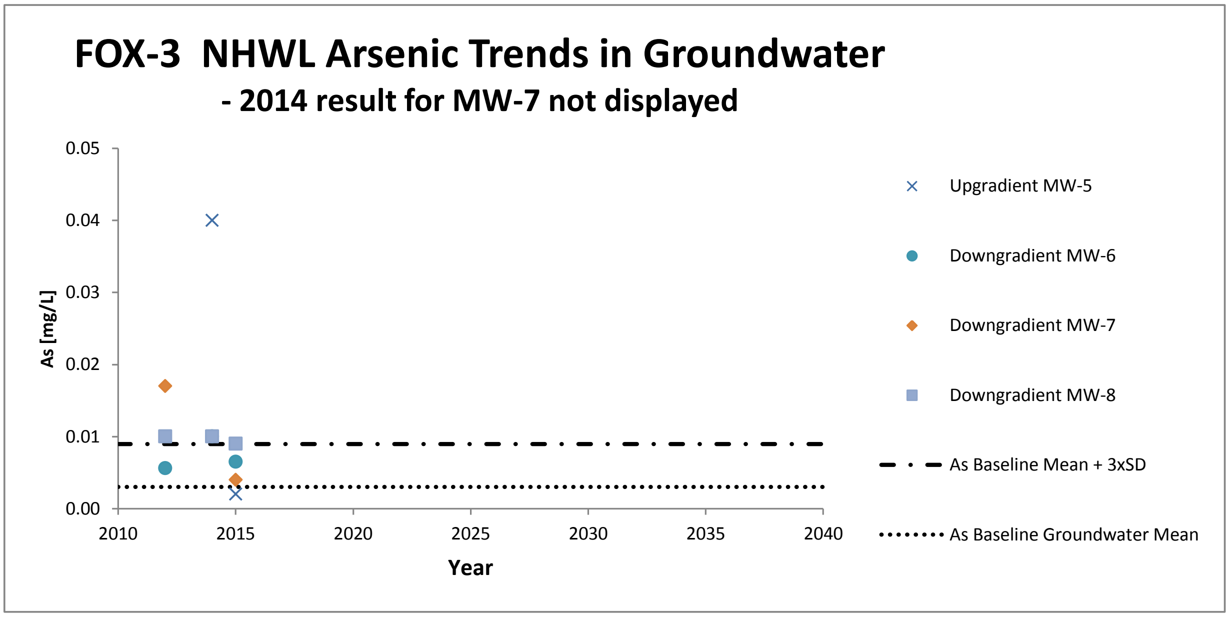


FOX-3 Non-Hazardous Waste Landfill Trends for Inorganic Elements, PCBs and TPH in Groundwater Samples

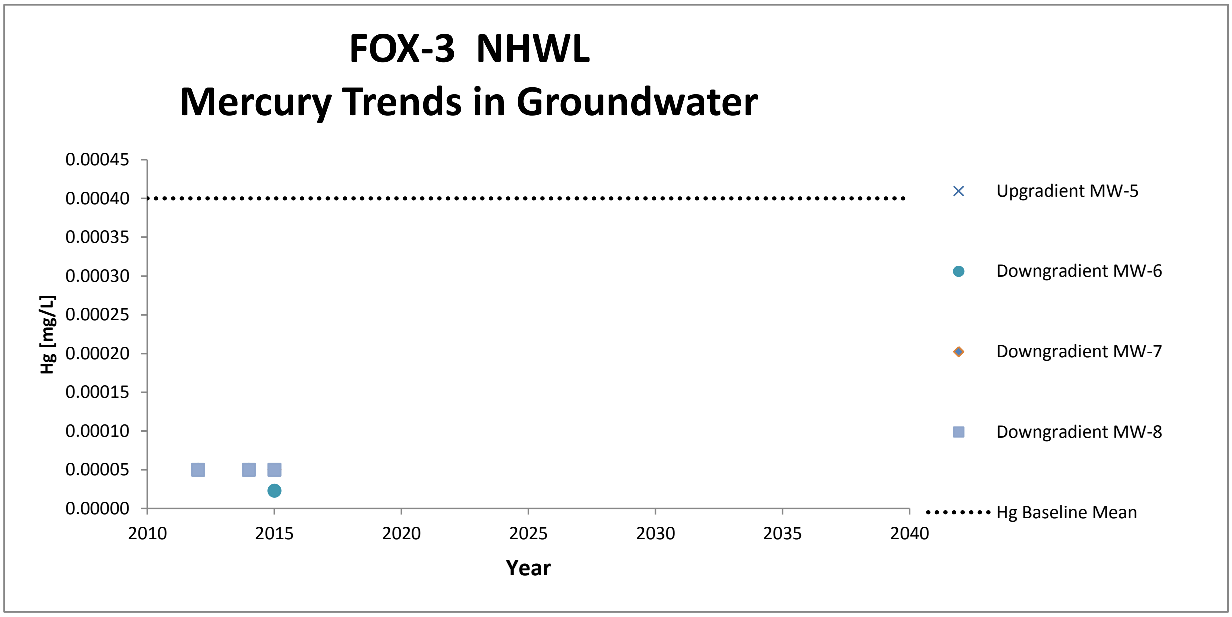


* As Baseline Arithmetic mean equals the baseline detection limit

Arsenic chart after removal of 2014 MW-7 Downgradient result of 0.54 mg/L.

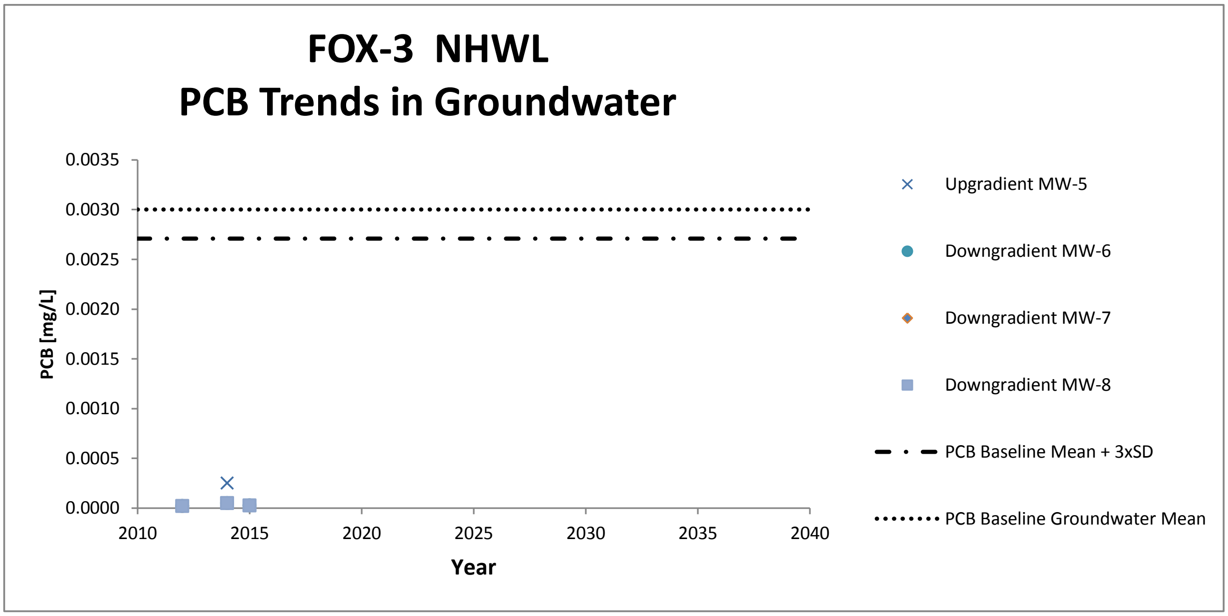


FOX-3 Non-Hazardous Waste Landfill Trends for Inorganic Elements, PCBs and TPH in Groundwater Samples



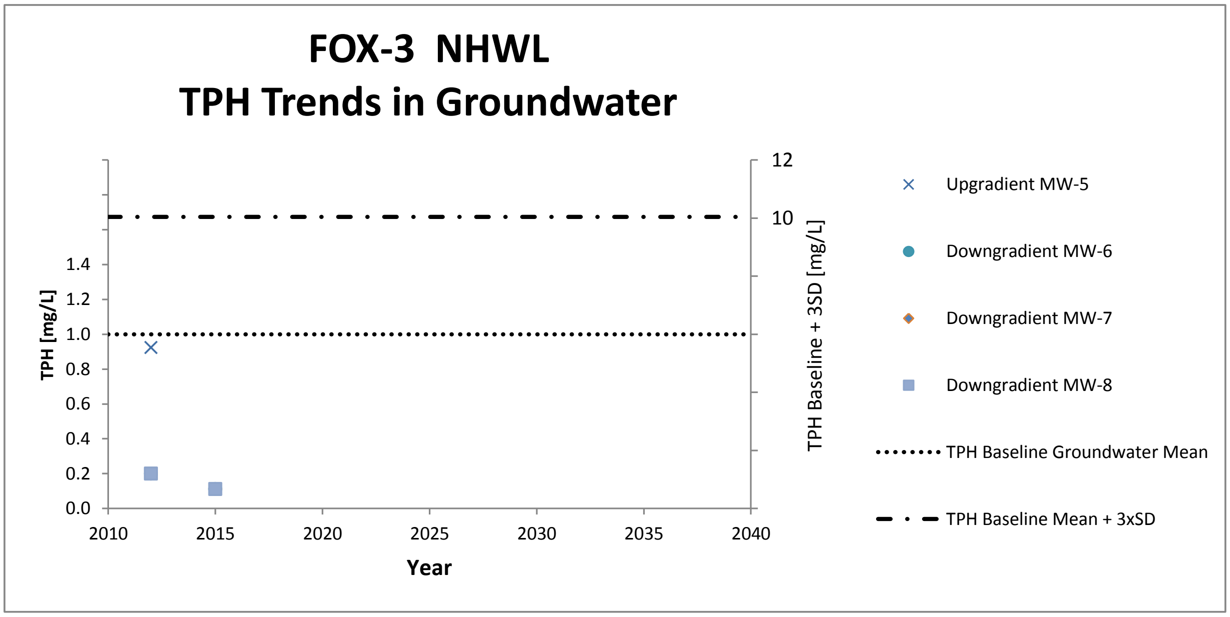
*Hg Baseline Mean is equal to the baseline detection limit.

*Hg Baseline SD = 0



* PCB Baseline Arithmetic mean equals the baseline detection limit

FOX-3 Non-Hazardous Waste Landfill Trends for Inorganic Elements, PCBs and TPH in Groundwater Samples



* TPH Baseline Arithmetic mean equals the baseline detection limit

FOX-3 - West Landfill - Summary of Monitoring Soil Analytical Data

Sample ID	Location	Year	Monitoring Year	Monitoring Phase	Depth (cm)	Cu (mg/kg)	Ni (mg/kg)	Co (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Zn (mg/kg)	Cr (mg/kg)	As (mg/kg)	Hg (mg/kg)	Total PCB (mg/kg)	F1 C_6-C_{10} (mg/kg)	F2 C_{10}-C_{16} (mg/kg)	F3 C_{16}-C_{34} (mg/kg)	Modified TPH^ - Total C6-C34 (mg/kg)
Background Data - Arithmetic Mean*						32	27	32	1.0	10	59	67	11	0.50	0.0003				N/A
Baseline Data - Arithmetic Mean*						**24**	**20**	**9.0**	**1.0**	**10**	**49**	**55**	**8.7**	**0.10**	**0.10**	**0.0**	**0**	**0**	**27**
Baseline Data - Standard Deviation						4.8	4.3	2.0	0.0	1.6	9.4	11	2.4	0.0	0.011	0.0	0	0.0	27
Baseline Data Mean + 3xStandard Deviation						39	33	15	1.0	15	77	88	16	0.10	0.13	0	0	0	108
***If baseline or background arithmetic mean was below the detection limit, the mean has been modified to match the detection limit value.**																			
DEW Line Cleanup Tier I Criteria										*200*					*1*				
DEW Line Cleanup Tier II Criteria & Hydrocarbon Action Level						*100*	*100*	*50*	*5*	*500*	*500*	*250*	*61*	*2.0*	*5*				*2500*
Monitoring Data																			
Upgradient																			
	F3-1 surface																		
12-19356/57**	F3-1	2012	1	1	0-10	**28**	**25**	7.9	<0.50	6.8	**63**	**62**	**11**	<0.010	<0.020	<5.0	<10	<50	**33**
F3-1-A-2014	F3-1	2014	3	1	0-10	**30**	**39**	8	<0.50	9.0	**52**	**86**	**10**	<0.10	<0.020	<10	<10	<20	20
F3-1 (0-15)	F3-1	2015	4	1	0-15	24.2	19.3	6.7	<0.5	7.2	42.8	49.1	**12**	<0.1	<0.05	<7	<4	<8	10
	F3-1		7	2															#N/A
	F3-1		10	2															#N/A
	F3-1		15	2															#N/A
	F3-1		25	2															#N/A
																			#N/A
																			#N/A
																			#N/A
																			#N/A
	F3-1 depth																		
12-19358/59**	F3-1	2012	1	1	30-40	**37**	**31**	**9.2**	<0.50	**10**	**70**	**72**	**14**	<0.010	<0.020	<5.0	<10	<50	**33**
F3-1-B-2014	F3-1	2014	3	1	40-50	24	**69**	8.0	<0.50	5.0	**57**	**163**	6.0	<0.10	<0.020	<10	<10	<20	20
F3-1 (40-50)	F3-1	2015	4	1	40-50	**24.9**	17.4	6.2	<0.5	7.3	39.5	45.7	**12.3**	<0.1	<0.05	<7	<4	<8	10
	F3-1		7	2															#N/A
	F3-1		10	2															#N/A
	F3-1		15	2															#N/A
	F3-1		25	2															#N/A
																			#N/A
																			#N/A
																			#N/A
																			#N/A

FOX-3 - West Landfill - Summary of Monitoring Soil Analytical Data

Sample ID	Location	Year	Monitoring Year	Monitoring Phase	Depth (cm)	Cu (mg/kg)	Ni (mg/kg)	Co (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Zn (mg/kg)	Cr (mg/kg)	As (mg/kg)	Hg (mg/kg)	Total PCB (mg/kg)	F1 C_6-C_{10} (mg/kg)	F2 C_{10}-C_{16} (mg/kg)	F3 C_{16}-C_{34} (mg/kg)	Modified TPH^ - Total C6-C34 (mg/kg)
Downgradient																			
	F3-2 surface																		
12-19360/61**	F3-2	2012	1	1	0-10	23	**24**	7.5	<0.50	7.1	**61**	**60**	**10**	<0.010	<0.020	<5.0	<10	<50	**33**
F3-2-A-2014	F3-2	2014	3	1	0-10	**26**	**43**	8.0	<0.50	6.0	**56**	**109**	**9.0**	<0.10	<0.020	<10	<10	<20	20
F3-2 (0-15)	F3-2	2015	4	1	0-15	19.1	**22.7**	7.6	<0.5	5.3	**49.3**	**57.1**	**9.7**	<0.1	<0.05	<7	<4	<8	10
	F3-2		7	2															#N/A
	F3-2		10	2															#N/A
	F3-2		15	2															#N/A
	F3-2		25	2															#N/A
																			#N/A
																			#N/A
																			#N/A
																			#N/A
	F3-2 depth																		
12-19362/63**	F3-2	2012	1	1	30-40	**39**	**25**	7.7	<0.50	7.2	**65**	**66**	**14**	<0.010	<0.020	<5.0	<10	<50	**33**
not sampled - bedrock reached at 0.18 m	F3-2	2014	3	1															#N/A
F3-2 (40-50)	F3-2	2015	4	1	40-50	17.6	19.6	6.5	<0.5	4.7	42.7	49.3	**9.8**	<0.1	<0.05	<7	<4	<8	10
	F3-2		7	2															#N/A
	F3-2		10	2															#N/A
	F3-2		15	2															#N/A
	F3-2		25	2															#N/A
																			#N/A
																			#N/A
																			#N/A
																			#N/A

FOX-3 - West Landfill - Summary of Monitoring Soil Analytical Data

Sample ID	Location	Year	Monitoring Year	Monitoring Phase	Depth (cm)	Cu (mg/kg)	Ni (mg/kg)	Co (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Zn (mg/kg)	Cr (mg/kg)	As (mg/kg)	Hg (mg/kg)	Total PCB (mg/kg)	F1 C_6-C_{10} (mg/kg)	F2 C_{10}-C_{16} (mg/kg)	F3 C_{16}-C_{34} (mg/kg)	Modified TPH^ - Total C6-C34 (mg/kg)
	F3-3 surface																		
12-19364/65**	F3-3	2012	1	1	0-10	15	16	5.0	<0.50	4.1	**51**	41	5.1	<0.010	<0.020	<5.0	<10	<50	**33**
F3-3-A-2014 - lost in transport	F3-3	2014	3	1															#N/A
F3-3 (0-15)	F3-2	2015	4	1	0-15	22.4	**20.2**	7	<0.5	7	45.8	49.8	**13.1**	<0.1	<0.05	<7	<4	<8	10
	F3-2		7	2															#N/A
	F3-2		10	2															#N/A
	F3-2		15	2															#N/A
	F3-2		25	2															#N/A
																			#N/A
																			#N/A
																			#N/A
																			#N/A
	F3-3 depth																		
12-19366/67**	F3-3	2012	1	1	30-40	21	**21**	6.6	<0.50	5.2	**63**	**56**	8.5	<0.010	<0.020	<5.0	<10	<50	**33**
not sampled - bedrock reached at 0.22 m	F3-3	2014	3	1															#N/A
F3-3 (40-50)	F3-2	2015	4	1	40-50	**29.9**	**20.9**	7.9	<0.5	9.5	**53.2**	54.6	**12.2**	<0.1	<0.05	<7	<4	<8	10
	F3-2		7	2															#N/A
	F3-2		10	2															#N/A
	F3-2		15	2															#N/A
	F3-2		25	2															#N/A
																			#N/A
																			#N/A
																			#N/A
																			#N/A

Note: Modified TPH Total (C_6-C_{34}) has been calculated by adding results for F1, F2 and F3.

** two samples taken, one analyzed for inorganics and PCBs, one analyzed for TPH

Soil and Groundwater samples were not sampled at the West Landfill in 2013

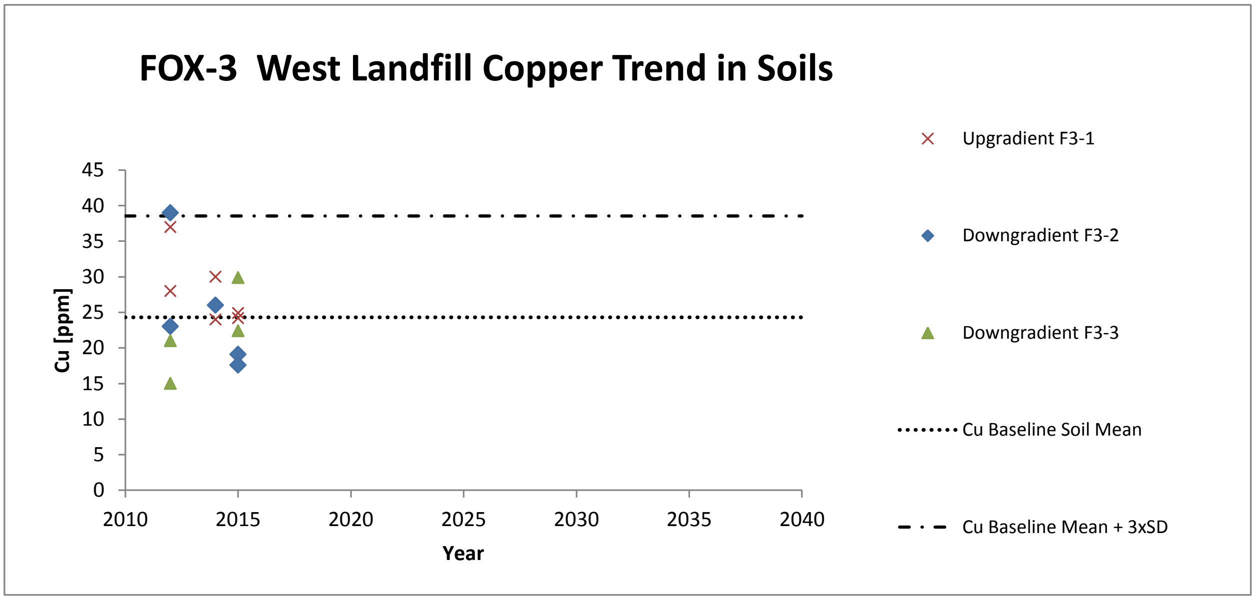
site-specific As criteria

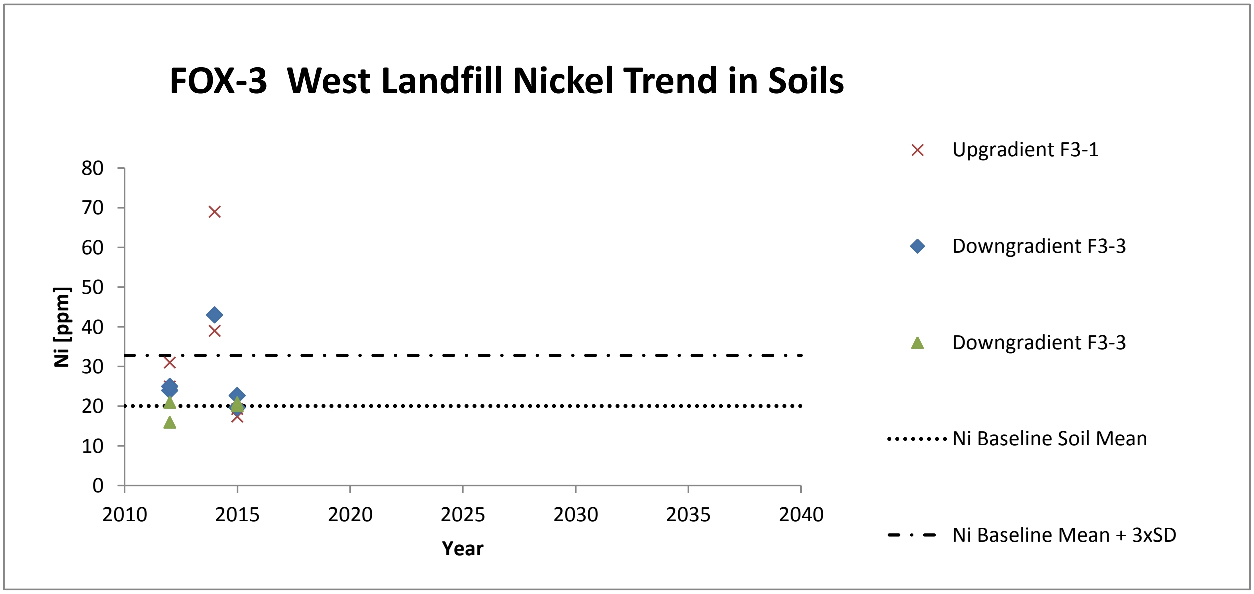
Legend

XX	sample exceeds background
XX	**sample exceeds baseline**
XX	*sample exceeds DLCU Tier I criteria*
XX	*sample exceeds DLCU Tier II criteria*

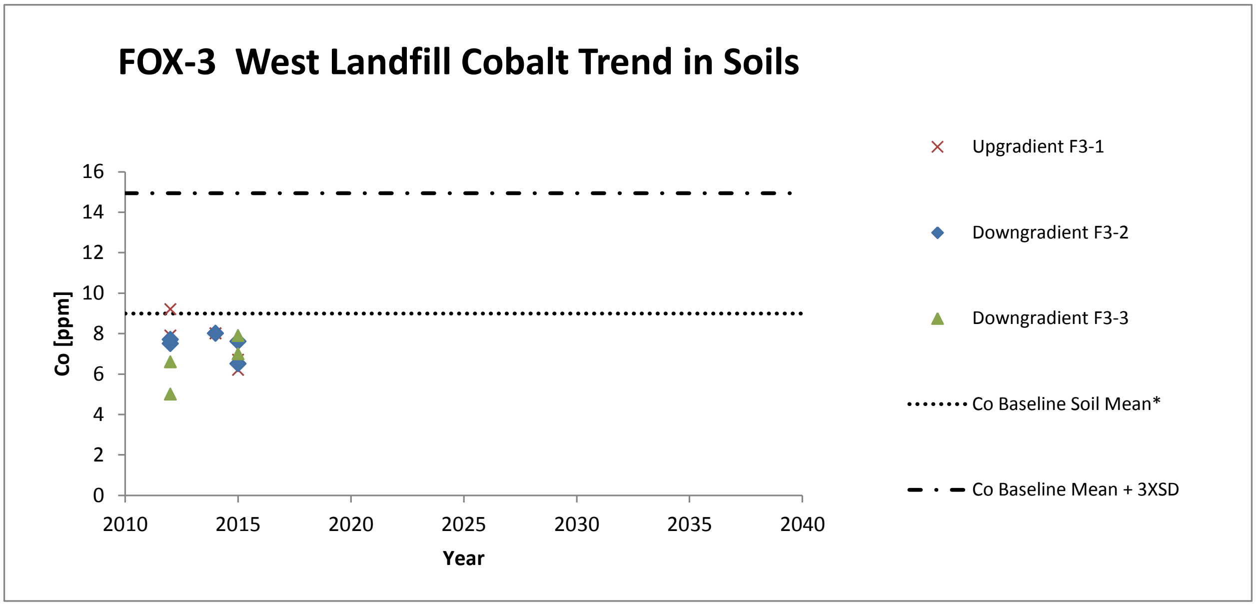
FOX-3 West Landfill Trends in Soil Inorganics, PCBs and PHCs (modified TPH)

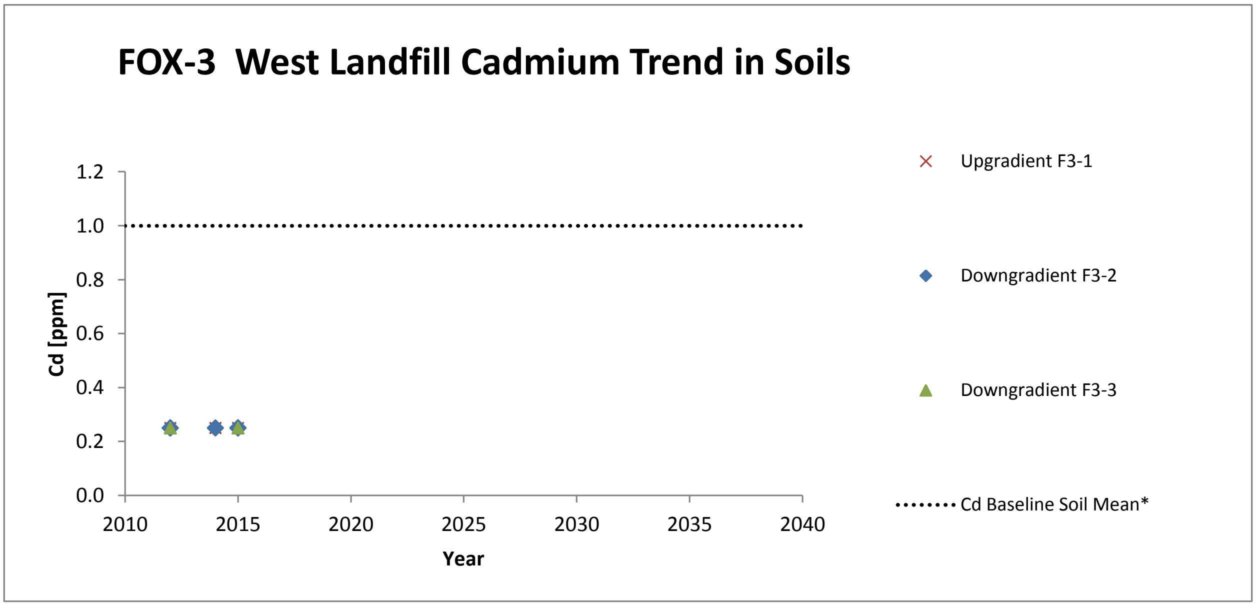
Where results are below detection, half of the detection limit has been used in the charts for the sample points. Trendlines are intended for visual interpretation of temporal trends. When all monitoring results are below detection, trendlines are a reflection of changes in detection limit. Users should refer to data tables.





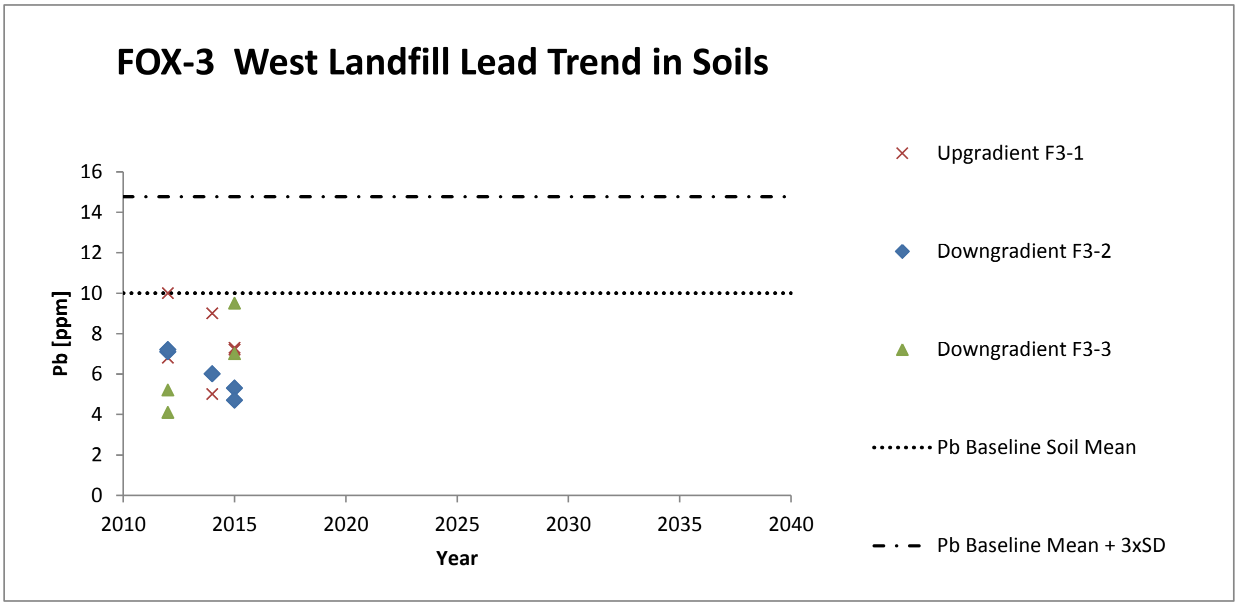
FOX-3   West Landfill Trends in Soil Inorganics, PCBs and PHCs (modified TPH)



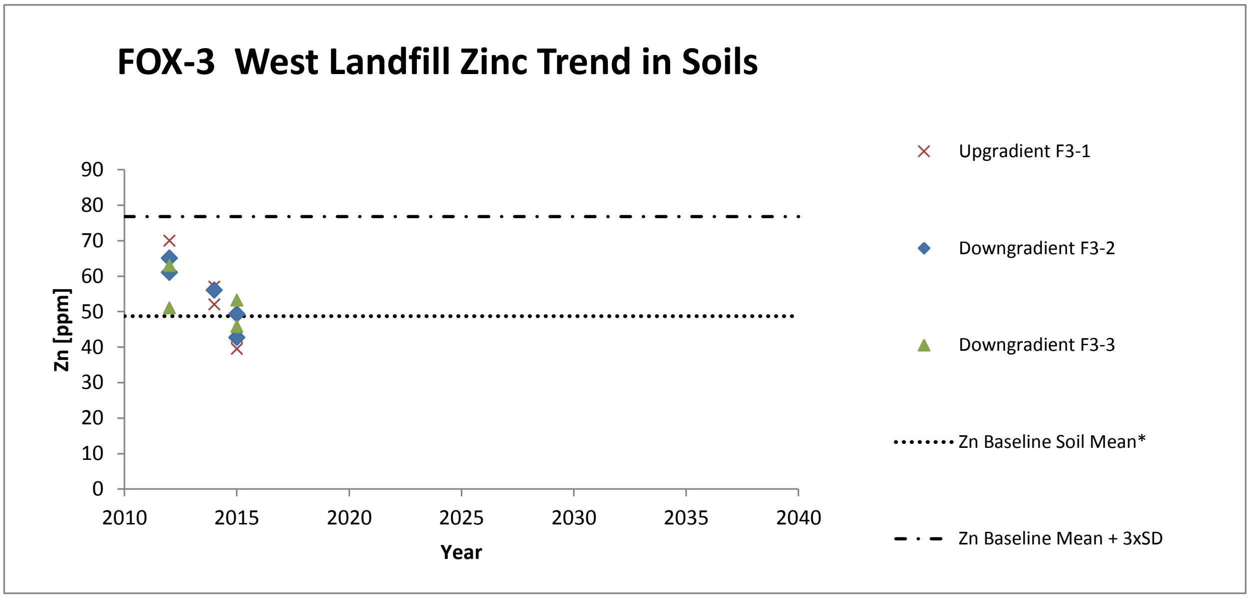


*Cd Baseline Arithmetic Mean is equal to the baseline detection limit.
*Cd Baseline SD = 0

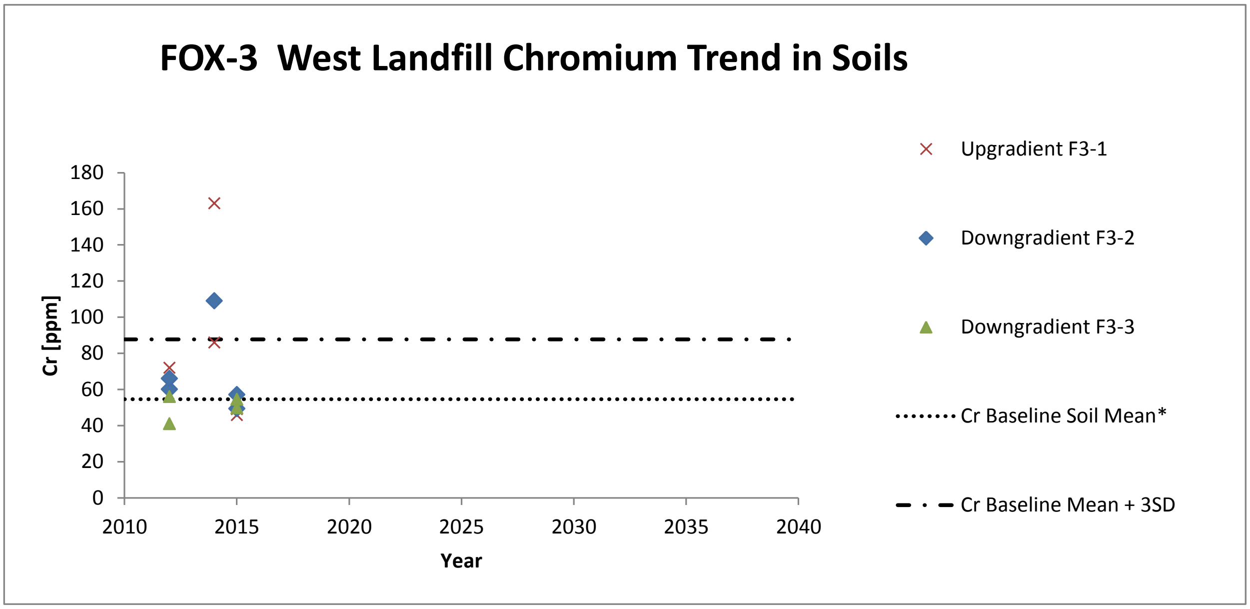
FOX-3 West Landfill Trends in Soil Inorganics, PCBs and PHCs (modified TPH)

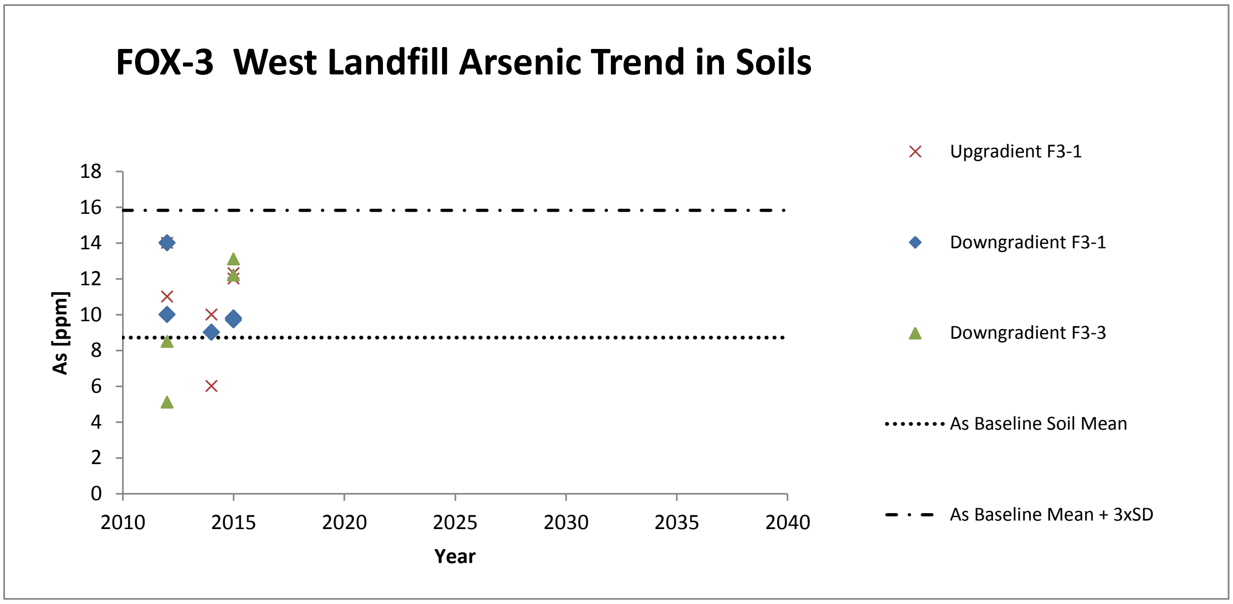


*Pb Baseline Arithmetic Mean is equal to the baseline detection limit.

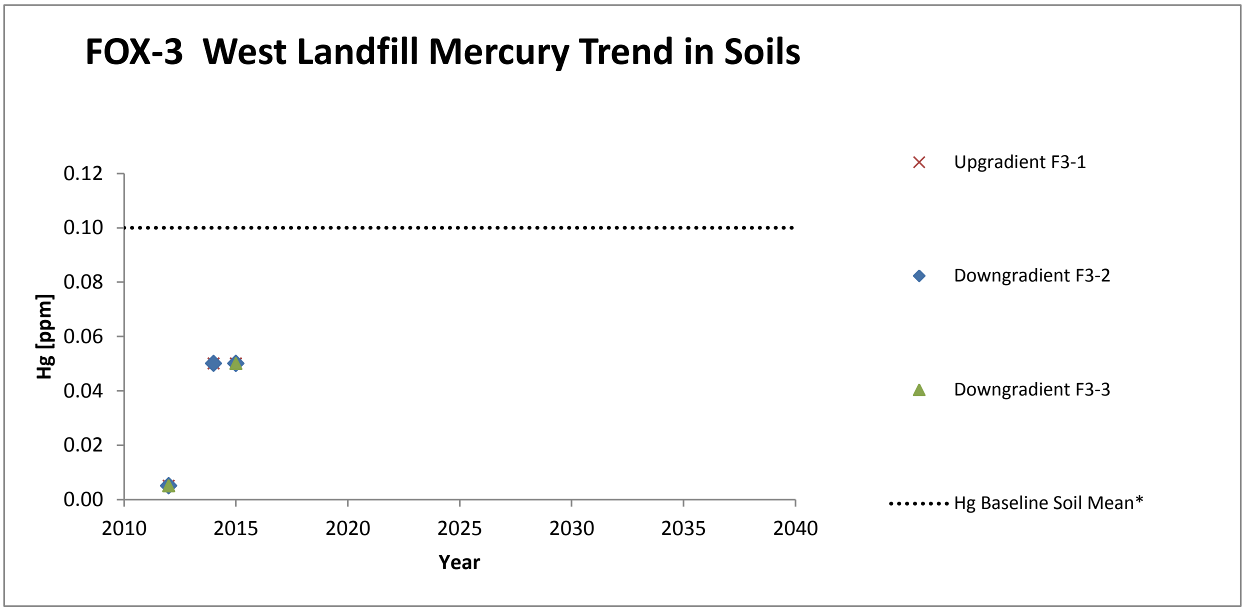


FOX-3 West Landfill Trends in Soil Inorganics, PCBs and PHCs (modified TPH)

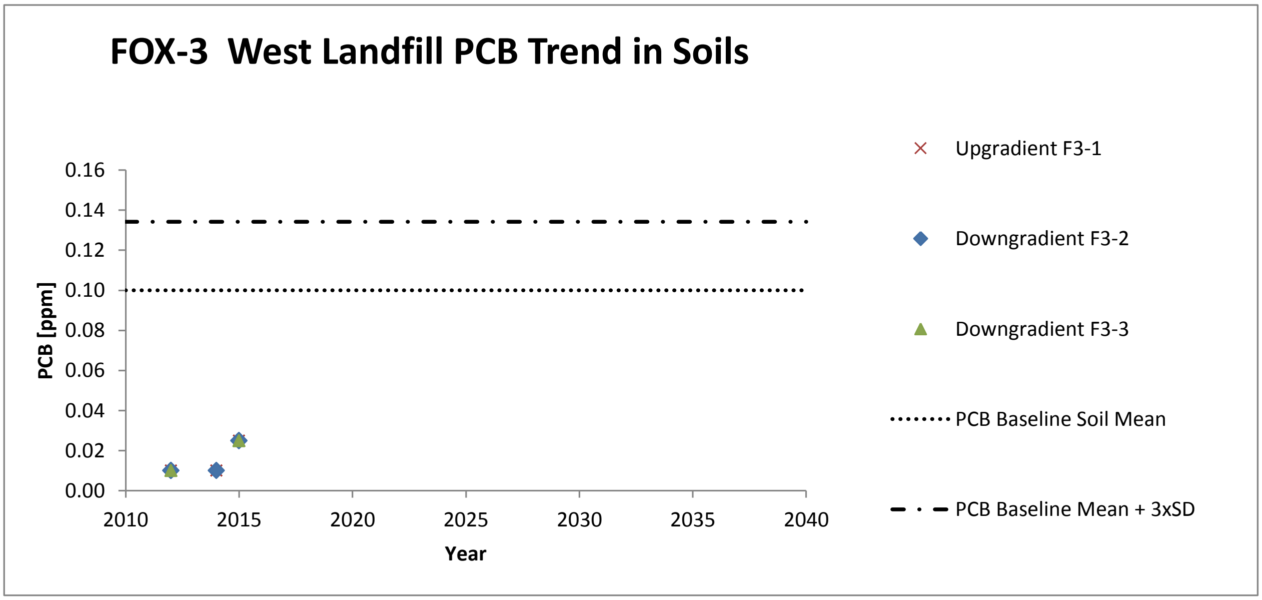




FOX-3 West Landfill Trends in Soil Inorganics, PCBs and PHCs (modified TPH)

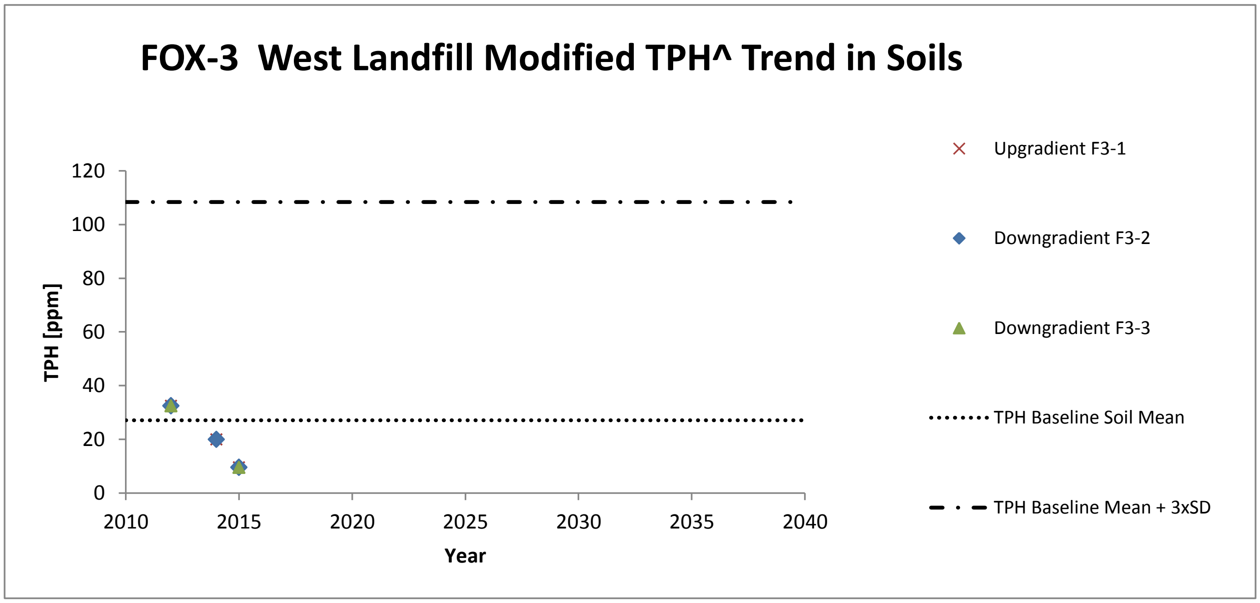


*Hg Baseline Arithmetic Mean is equal to the baseline detection limit.
Hg Baseline SD=0



*PCB Baseline Arithmetic Mean is equal to the baseline detection limit.

FOX-3   West Landfill Trends in Soil Inorganics, PCBs and PHCs (modified TPH)



^ Modified TPH is Sum of F1, F2 and F3 fractions (C_6 - C_{34})

FOX-3 - Station West Landfill - Summary of Monitoring Soil Analytical Data

Sample ID	Location	Year	Monitoring Year	Monitoring Phase	Depth (cm)	Cu (mg/kg)	Ni (mg/kg)	Co (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Zn (mg/kg)	Cr (mg/kg)	As (mg/kg)	Hg (mg/kg)	Total PCB (mg/kg)	F1 C_6-C_{10} (mg/kg)	F2 C_{10}-C_{16} (mg/kg)	F3 C_{16}-C_{34} (mg/kg)	Modified TPH^ - Total C6-C34 (mg/kg)
Background Data - Arithmetic Mean*						32	27	32	1.0	10	59	67	11	0.10	0.003				40
Baseline Data - Arithmetic Mean*						**40**	**31**	**13**	**1.0**	**10**	**71**	**77**	**10**	**0.10**	**0.10**	10	4.0	9.0	**40**
Baseline Data - Standard Deviation						7.6	3.9	1.7	0.0	3.7	15	9	3.9	0.0	0.029	0.0	1.8	3.4	436
Baseline Data Mean + 3xStandard Deviation						62	43	18	1.0	21	117	104	22	0.10	0.19	10	9.5	19	1347
**** If baseline or background arithmetic mean was below the detection limit, the mean has been modified to match the detection limit value.***																			
DEW Line Cleanup Tier I Criteria										*200*					*1*				
DEW Line Cleanup Tier II Criteria & Hydrocarbon Action Level						*100*	*100*	*50*	*5*	*500*	*500*	*250*	*61*	*2.0*	*5*				*2500*
Monitoring Data																			
Upgradient																			
	F3-8 surface																		
12-19336/37**	F3-8	2012	1	1	0-10	29	30	8.7	<0.50	**16**	**72**	69	10	<0.010	<0.020	<5.0	<10	<50	33
F3-8-A-2014	F3-8	2014	3	1	0-10	38	**34**	10	<0.50	7.0	**78**	**87**	**14**	<0.10	<0.020	<10	<10	<20	20
F3-8 (0-15)	F3-8	2015	4	1	0-15	38.9	28.8	9.6	<0.5	9.4	64.8	70.1	**13.6**	<0.1	<0.05	<7	<4	<8	10
	F3-8	2018	7	2															#N/A
	F3-8	2021	10	2															#N/A
	F3-8	2026	15	2															#N/A
	F3-8	2036	25	2															#N/A
																			#N/A
																			#N/A
																			#N/A
	F3-8 depth																		
12-19338/39**	F3-8	2012	1	1	30-40	35	**32**	9.5	<0.50	6.8	**79**	76	**14**	<0.010	<0.020	<5.0	<10	<50	33
F3-8-B-2014	F3-8	2014	3	1	40-50	**42**	**33**	10	<0.50	8.0	**74**	77	**17**	<0.1	<0.020	<10	<10	<20	20
F3-8 (40-50)	F3-8	2015	4	1	40-50	39.3	28.2	9.7	<0.5	8.9	64.9	68.1	**12**	<0.1	<0.05	<7	<4	<8	10
	F3-8	2018	7	2															#N/A
	F3-8	2021	10	2															#N/A
	F3-8	2026	15	2															#N/A
	F3-8	2036	25	2															#N/A
																			#N/A
																			#N/A
																			#N/A

FOX-3 - Station West Landfill - Summary of Monitoring Soil Analytical Data

Sample ID	Location	Year	Monitoring Year	Monitoring Phase	Depth (cm)	Cu (mg/kg)	Ni (mg/kg)	Co (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Zn (mg/kg)	Cr (mg/kg)	As (mg/kg)	Hg (mg/kg)	Total PCB (mg/kg)	F1 C_6-C_{10} (mg/kg)	F2 C_{10}-C_{16} (mg/kg)	F3 C_{16}-C_{34} (mg/kg)	Modified TPH^ - Total C6-C34 (mg/kg)
	F3-10 surface																		
12-19344/45**	F3-10	2012	1	1	0-10	32	31	9.2	<0.50	5.8	**75**	72	**11**	<0.010	<0.020	<5.0	<10	<50	33
F3-10-A-2014	F3-10	2014	3	1	0-10	39	**41**	11	<0.50	8.0	**82**	**97**	**13**	<0.10	<0.020	<10	<10	<20	20
F3-10 (0-15)	F3-10	2015	4	1	0-15	31.7	25.9	9.1	<0.5	7.4	55.5	63.2	**11.3**	<0.1	<0.05	<7	<4	<8	10
	F3-10	2018	7	2															#N/A
	F3-10	2021	10	2															#N/A
	F3-10	2026	15	2															#N/A
	F3-10	2036	25	2															#N/A
																			#N/A
																			#N/A
																			#N/A
	F3-10 depth																		
12-19346/47**	F3-10	2012	1	1	30-40	34	**32**	9.5	<0.50	5.6	70	74	**11**	<0.010	<0.020	<5.0	<10	<50	33
F3-10-B-2014	F3-10	2014	3	1	40-50	30	**38**	9	<0.50	5.0	67	**95**	**12**	<0.10	<0.020	<10	<10	<20	20
F3-10 (40-50) (Dup Avg)	F3-10	2015	4	1	40-50	28	27	9.5	<0.5	7	63	66	10	<0.1	<0.1	<6	<4	<8	9
	F3-10	2018	7	2															#N/A
	F3-10	2021	10	2															#N/A
	F3-10	2026	15	2															#N/A
	F3-10	2036	25	2															#N/A
																			#N/A
																			#N/A
																			#N/A
Downgradient																			
	F3-4 surface																		
12-19320/21**	F3-4	2012	1	1	0-10	**59**	28	8.5	<0.50	**51**	**130**	69	**11**	0.012	0.073	<5.0	<10	76	**84**
F3-4-A-2014	F3-4	2014	3	1	0-10	27	28	9	<0.50	6	63.0	74	**23**	<0.10	<0.020	<10	<10	<20	20
F3-4 (0-15)	F3-4	2015	4	1	0-15	**43.3**	29.3	10	<0.5	**10.1**	66.3	71.6	**16.4**	<0.1	<0.05	<7	<4	<8	10
	F3-4	2018	7	2															#N/A
	F3-4	2021	10	2															#N/A
	F3-4	2026	15	2															#N/A
	F3-4	2036	25	2															#N/A
																			#N/A
																			#N/A
																			#N/A

FOX-3 - Station West Landfill - Summary of Monitoring Soil Analytical Data

Sample ID	Location	Year	Monitoring Year	Monitoring Phase	Depth (cm)	Cu (mg/kg)	Ni (mg/kg)	Co (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Zn (mg/kg)	Cr (mg/kg)	As (mg/kg)	Hg (mg/kg)	Total PCB (mg/kg)	F1 C_6-C_{10} (mg/kg)	F2 C_{10}-C_{16} (mg/kg)	F3 C_{16}-C_{34} (mg/kg)	Modified TPH^ - Total C6-C34 (mg/kg)
	F3-4 depth																		
12-19322/23**	F3-4	2012	1	1	30-40	**47**	**32**	8.6	<0.50	**34**	**110**	**84**	**15**	<0.010	<0.020	<5.0	<10	<50	33
F3-4-B-2014	F3-4	2014	3	1	40-50	**42**	**32**	9.0	0.5	8.0	**72**	**84**	**19**	<0.10	<0.020	<10	<10	<20	20
F3-4 (40-50)	F3-4	2015	4	1	40-50	38.4	28.3	9.8	<0.5	9.3	64.8	70.4	**17.7**	<0.1	<0.05	<7	<4	<8	10
	F3-4	2018	7	2															#N/A
	F3-4	2021	10	2															#N/A
	F3-4	2026	15	2															#N/A
	F3-4	2036	25	2															#N/A
																			#N/A
																			#N/A
																			#N/A
	F3-5 surface																		
12-19324/25**	F3-5	2012	1	1	0-10	32	30	8.9	<0.50	5.6	**74**	75	**13**	<0.010	<0.020	<5.0	<10	<50	33
F3-5-A-2014	F3-5	2014	3	1	0-10	**45**	**38**	12	<0.50	9.0	**97**	**82**	**14**	<0.10	<0.020	<10	<10	<20	20
F3-5 (0-15) (Dup Avg)	F3-5	2015	4	1	0-15	29	28	9.4	<0.5	7	66	72	**13**	<0.1	<0.1	<6	<4	<8	9
	F3-5	2018	7	2															#N/A
	F3-5	2021	10	2															#N/A
	F3-5	2026	15	2															#N/A
	F3-5	2036	25	2															#N/A
																			#N/A
																			#N/A
																			#N/A
	F3-5 depth																		
12-19326/27**	F3-5	2012	1	1	30-40	32	26	7.9	<0.50	5.3	**73**	66	**13**	<0.010	<0.020	<5.0	<10	<50	33
F3-5-B-2014	F3-5	2014	3	1	40-50	**40**	**37**	12	<0.50	7.0	**82**	**83**	**14**	<0.10	<0.020	<10	<10	<20	20
F3-5 (40-50)	F3-5	2015	4	1	40-50	38	29.5	10.3	<0.5	8.9	61.8	72.8	**15.3**	<0.1	<0.05	<7	<4	<8	10
	F3-5	2018	7	2															#N/A
	F3-5	2021	10	2															#N/A
	F3-5	2026	15	2															#N/A
	F3-5	2036	25	2															#N/A
																			#N/A
																			#N/A
																			#N/A

FOX-3 - Station West Landfill - Summary of Monitoring Soil Analytical Data

Sample ID	Location	Year	Monitoring Year	Monitoring Phase	Depth (cm)	Cu (mg/kg)	Ni (mg/kg)	Co (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Zn (mg/kg)	Cr (mg/kg)	As (mg/kg)	Hg (mg/kg)	Total PCB (mg/kg)	F1 C_6-C_{10} (mg/kg)	F2 C_{10}-C_{16} (mg/kg)	F3 C_{16}-C_{34} (mg/kg)	Modified TPH^ - Total C6-C34 (mg/kg)
	F3- 6 surface																		
12-19328/29**	F3-6	2012	1	1	0-10	34	28	8.7	<0.50	6.3	**73**	69	**16**	<0.010	<0.020	<5.0	<10	<50	33
F3-6-A-2014	F3-6	2014	3	1	0-10	34	**34**	8	<0.50	6.0	**72**	**81**	**13**	<0.10	<0.020	<10	<10	<20	20
F3-6 (0-15)	F3-6	2015	4	1	0-15	37.9	29.1	9.8	<0.5	8.9	64	67.5	**15.3**	<0.1	<0.05	<7	<4	<8	10
	F3-6	2018	7	2															#N/A
	F3-6	2021	10	2															#N/A
	F3-6	2026	15	2															#N/A
	F3-6	2036	25	2															#N/A
																			#N/A
																			#N/A
																			#N/A
	F3-6 depth																		
12-19330/31**	F3-6	2012	1	1	30-40	31	27	8.0	<0.50	6.8	70	65	**14**	<0.010	<0.020	<5.0	<10	<50	33
not sampled - bedrock reached at 0.2m	F3-6	2014	3	1															#N/A
F3-6 (40-50)	F3-6	2015	4	1	40-50	**44.7**	30.1	10	<0.5	9.3	64.5	68.4	**16.3**	<0.1	<0.05	<7	<4	<8	10
	F3-6	2018	7	2															#N/A
	F3-6	2021	10	2															#N/A
	F3-6	2026	15	2															#N/A
	F3-6	2036	25	2															#N/A
																			#N/A
																			#N/A
																			#N/A
	F3-7 surface																		
12-19332/33**	F3-7	2012	1	1	0-10	28	26	7.6	<0.50	5.1	62	68	**11**	<0.010	<0.020	<5.0	<10	<50	33
F3-7-A-2014	F3-7	2014	3	1	0-10	**40**	**40**	9	<0.50	7.0	66	**94**	**17**	<0.10	<0.020	<10	160	1050	**1215**
F3-7 (0-15)	F3-7	2015	4	1	0-15	34.6	28.3	9.5	<0.5	8.5	60	67.6	**13.5**	<0.1	<0.05	<7	<4	<8	10
	F3-7	2018	7	2															#N/A
	F3-7	2021	10	2															#N/A
	F3-7	2026	15	2															#N/A
	F3-7	2036	25	2															#N/A
																			#N/A
																			#N/A
																			#N/A

FOX-3 - Station West Landfill - Summary of Monitoring Soil Analytical Data

Sample ID	Location	Year	Monitoring Year	Monitoring Phase	Depth (cm)	Cu (mg/kg)	Ni (mg/kg)	Co (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Zn (mg/kg)	Cr (mg/kg)	As (mg/kg)	Hg (mg/kg)	Total PCB (mg/kg)	F1 C_6-C_{10} (mg/kg)	F2 C_{10}-C_{16} (mg/kg)	F3 C_{16}-C_{34} (mg/kg)	Modified TPH^ - Total C6-C34 (mg/kg)
	F3-7 depth																		
12-19334/35**	F3-7	2012	1	1	30-40	31	27	8.0	<0.50	6.3	**78**	73	**14**	<0.010	<0.020	<5.0	<10	<50	33
F3-7-B-2014	F3-7	2014	3	1	40-50	33	28	8.0	<0.50	5.0	58	63	10	<0.10	<0.020	<10	30	240	**275**
F3-7 (40-50)	F3-7	2015	4	1	40-50	**40.1**	30.4	10.4	<0.5	8.8	64.9	71.9	**17.5**	<0.1	<0.05	<7	<4	<8	10
	F3-7	2018	7	2															#N/A
	F3-7	2021	10	2															#N/A
	F3-7	2026	15	2															#N/A
	F3-7	2036	25	2															#N/A
																			#N/A
																			#N/A
																			#N/A
	F3- 9 surface																		
12-19340/41**	F3-9	2012	1	1	0-10	34	30	8.8	<0.50	6.3	71	70	**12**	<0.010	<0.020	<5.0	<10	<50	33
F3-9-A-2014	F3-9	2014	3	1	0-10	**48**	**39**	11	<0.50	8.0	**81**	**83**	**16**	<0.10	<0.020	<10	<10	<20	20
F3-9 (0-15)	F3-9	2015	4	1	0-15	38.5	30.9	10.9	<0.5	8.4	62.9	74.5	**16.9**	<0.1	<0.05	<7	<4	<8	10
	F3-9	2018	7	2															#N/A
	F3-9	2021	10	2															#N/A
	F3-9	2026	15	2															#N/A
	F3-9	2036	25	2															#N/A
																			#N/A
																			#N/A
																			#N/A
	F3- 9 depth																		
12-19342/43**	F3-9	2012	1	1	30-40	**47**	**35**	10	<0.50	7.4	**80**	**78**	**17**	<0.010	<0.020	<5.0	<10	<50	33
F3-9-B-2014	F3-9	2014	3	1	40-50	**45**	**41**	11	<0.5	7.0	**75**	**87.0**	**15**	<0.1	<0.02	<10	<10	<20	20
F3-9 (40-50)	F3-9	2015	4	1	40-50	36.4	28.8	10.1	<0.5	8.2	58.1	64.5	**14.2**	<0.1	<0.05	<7	<4	<8	10
	F3-9	2018	7	2															#N/A
	F3-9	2021	10	2															#N/A
	F3-9	2026	15	2															#N/A
	F3-9	2036	25	2															#N/A
																			#N/A
																			#N/A
																			#N/A

FOX-3 - Station West Landfill - Summary of Monitoring Soil Analytical Data

Sample ID	Location	Year	Monitoring Year	Monitoring Phase	Depth (cm)	Cu (mg/kg)	Ni (mg/kg)	Co (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Zn (mg/kg)	Cr (mg/kg)	As (mg/kg)	Hg (mg/kg)	Total PCB (mg/kg)	F1 C_6-C_{10} (mg/kg)	F2 C_{10}-C_{16} (mg/kg)	F3 C_{16}-C_{34} (mg/kg)	Modified TPH^ - Total C6-C34 (mg/kg)
	F3- 11 surface																		
12-19348/49**	F3-11	2012	1	1	0-10	37	**33**	10	<0.50	6.5	**73**	73	**16**	<0.010	<0.020	<5.0	<10	<50	33
F3-11-A-2014	F3-11	2014	3	1	0-10	**50**	**51**	**16**	<0.50	6.0	**80**	**87**	**21**	<0.10	<0.020	<10	<10	<20	20
F3-11 (0-15)	F3-11	2015	4	1	0-15	39	30.8	10.5	<0.5	8.8	60.4	68.3	**18.1**	<0.1	<0.05	<7	<4	<8	10
	F3-11	2018	7	2															#N/A
	F3-11	2021	10	2															#N/A
	F3-11	2026	15	2															#N/A
	F3-11	2036	25	2															#N/A
																			#N/A
																			#N/A
																			#N/A
	F3- 11 depth																		
12-19350/51**	F3-11	2012	1	1	30-40	**47**	**36**	11	<0.50	7.1	**76**	**81**	**21**	<0.010	<0.020	<5.0	<10	<50	33
F3-11-B-2014	F3-11	2014	3	1	40-50	**56**	**54**	**16**	<0.5	7.0	**87**	**85**	**24**	<0.10	<0.020	<10	<10	<20	20
F3-11 (40-50)	F3-11	2015	4	1	40-50	**39.9**	**32.7**	10.9	<0.5	8.5	64.8	73	**18.7**	<0.1	<0.05	<7	<4	<8	10
	F3-11	2018	7	2															#N/A
	F3-11	2021	10	2															#N/A
	F3-11	2026	15	2															#N/A
	F3-11	2036	25	2															#N/A
																			#N/A
																			#N/A
																			#N/A

FOX-3 - Station West Landfill - Summary of Monitoring Soil Analytical Data

Sample ID	Location	Year	Monitoring Year	Monitoring Phase	Depth (cm)	Cu (mg/kg)	Ni (mg/kg)	Co (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Zn (mg/kg)	Cr (mg/kg)	As (mg/kg)	Hg (mg/kg)	Total PCB (mg/kg)	F1 C_6-C_{10} (mg/kg)	F2 C_{10}-C_{16} (mg/kg)	F3 C_{16}-C_{34} (mg/kg)	Modified TPH^ - Total C6-C34 (mg/kg)
	F3- 12 surface																		
12-19352/53**	F3-12	2012	1	1	0-10	**43**	**37**	9.7	<0.50	7.4	**75**	**79**	**19**	<0.010	<0.020	<5.0	<10	<50	33
F3-12-A-2014	F3-12	2014	3	1	0-10	**55**	**39**	11	<0.50	8.0	**80**	**87**	**24**	<0.10	<0.020	<10	<10	<20	20
F3-12 (0-15) (Dup Avg)	F3-12	2015	4	1	0-15	39	**34**	11.2	<0.5	8	69	76	**16**	<0.1	<0.1	<6	<4	<8	9
	F3-12	2018	7	2															#N/A
	F3-12	2021	10	2															#N/A
	F3-12	2026	15	2															#N/A
	F3-12	2036	25	2															#N/A
																			#N/A
																			#N/A
																			#N/A
	F3- 12 depth																		
12-19354/55**	F3-12	2012	1	1	30-40	31	27	7.7	<0.50	5.6	**72**	66	**12**	<0.010	<0.020	<5.0	<10	<50	33
F3-12-B-2014	F3-12	2014	3	1	40-50	**50**	**39**	11	<0.5	7.0	**78**	**89**	**22**	<0.10	<0.020	<10	<10	<20	20
F3-12 (40-50)	F3-12	2015	4	1	40-50	**43.9**	**33.5**	10.9	<0.5	9.1	65.3	75.7	**18.1**	<0.1	<0.05	<7	<4	<8	10
	F3-12	2018	7	2															#N/A
	F3-12	2021	10	2															#N/A
	F3-12	2026	15	2															#N/A
	F3-12	2036	25	2															#N/A
																			#N/A
																			#N/A
																			#N/A

Note: Modified TPH Total (C_6-C_{34}) has been calculated by adding results for F1, F2 and F3.

N/A = not analyzed

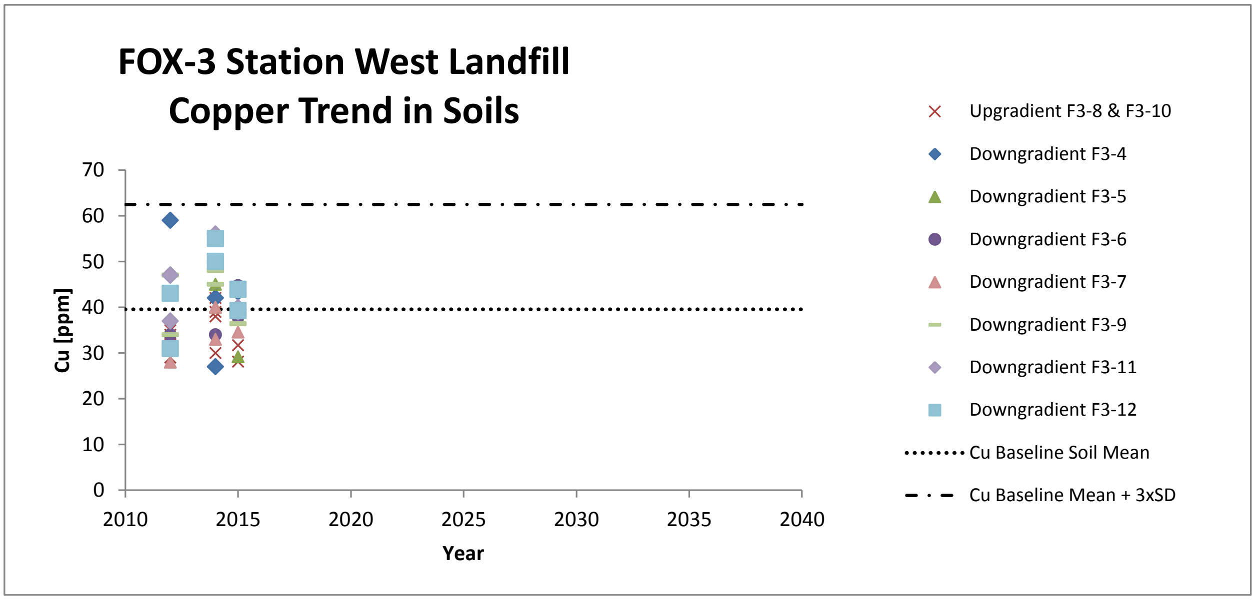
Soil and Groundwater samples were not sampled at the Station West Landfill in 2013

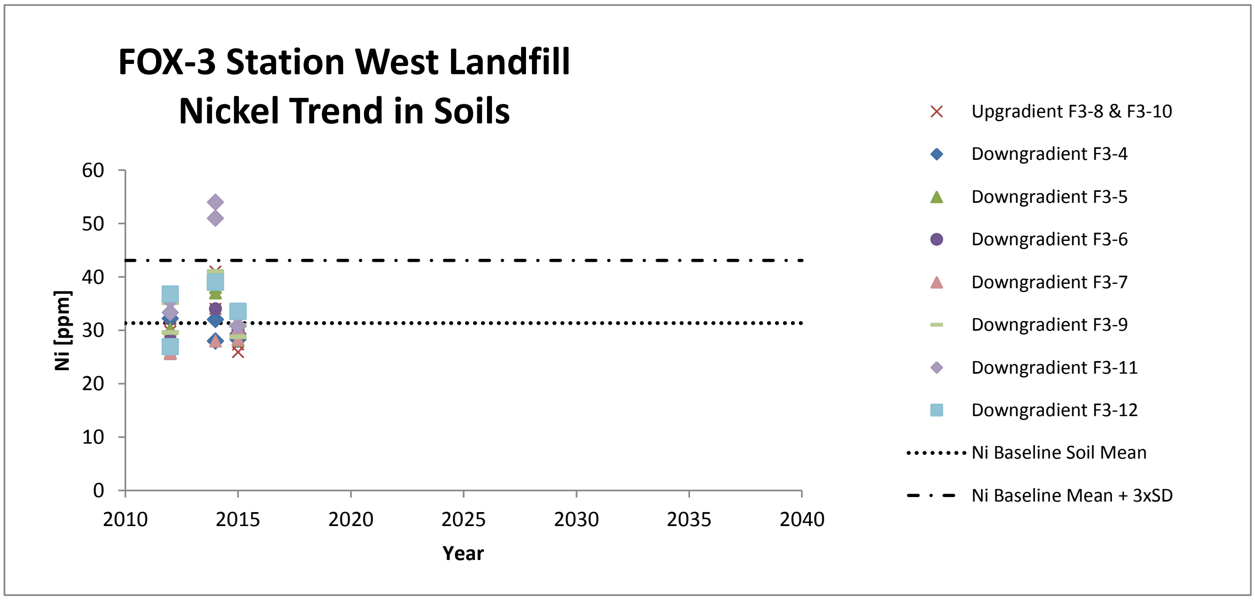
Legend

XX	sample exceeds background
XX	**sample exceeds baseline**
XX	*sample exceeds DLCU Tier I criteria*
XX	*sample exceeds DLCU Tier II criteria*

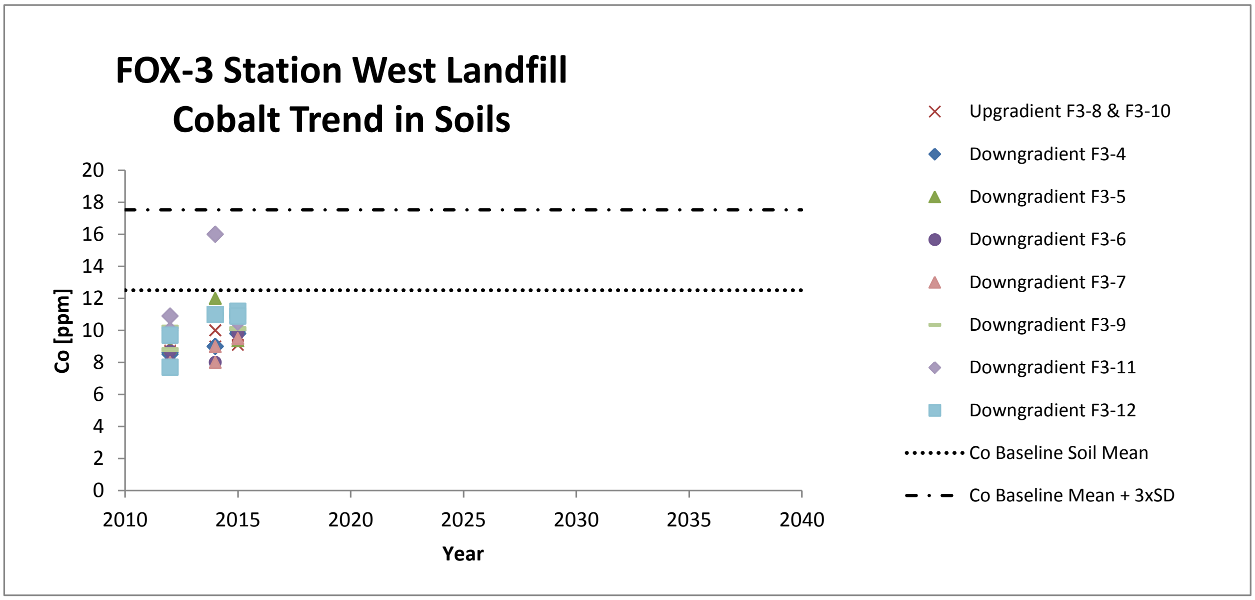
FOX-3 Station West Landfill Trends in Soil Inorganics, PCBs and PHCs (modified TPH)

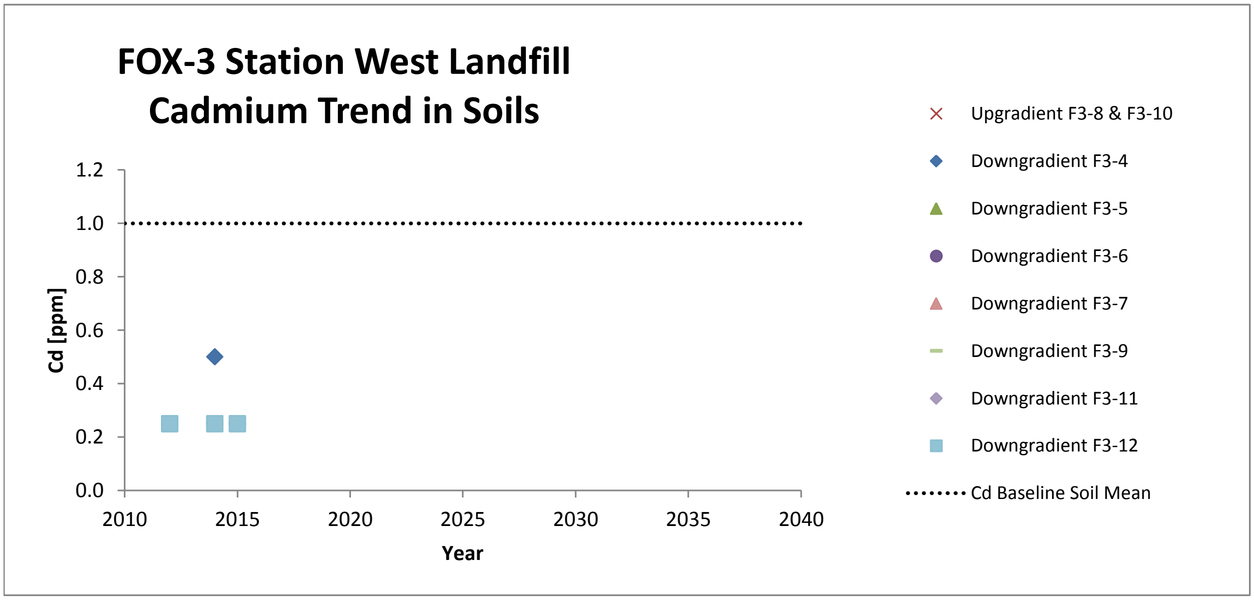
Where results are below detection, half of the detection limit has been used in the charts for the sample points. Trendlines are intended for visual interpretation of temporal trends. When all monitoring results are below detection, trendlines are a reflection of changes in detection limit. Users should refer to data tables.





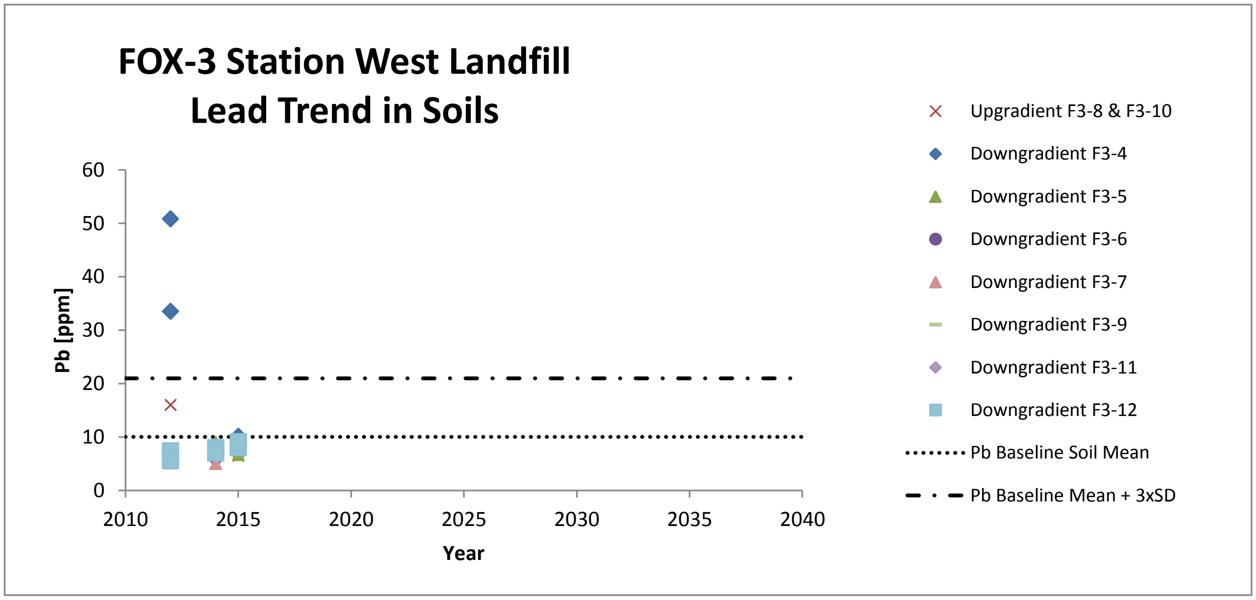
FOX-3 Station West Landfill Trends in Soil Inorganics, PCBs and PHCs (modified TPH)

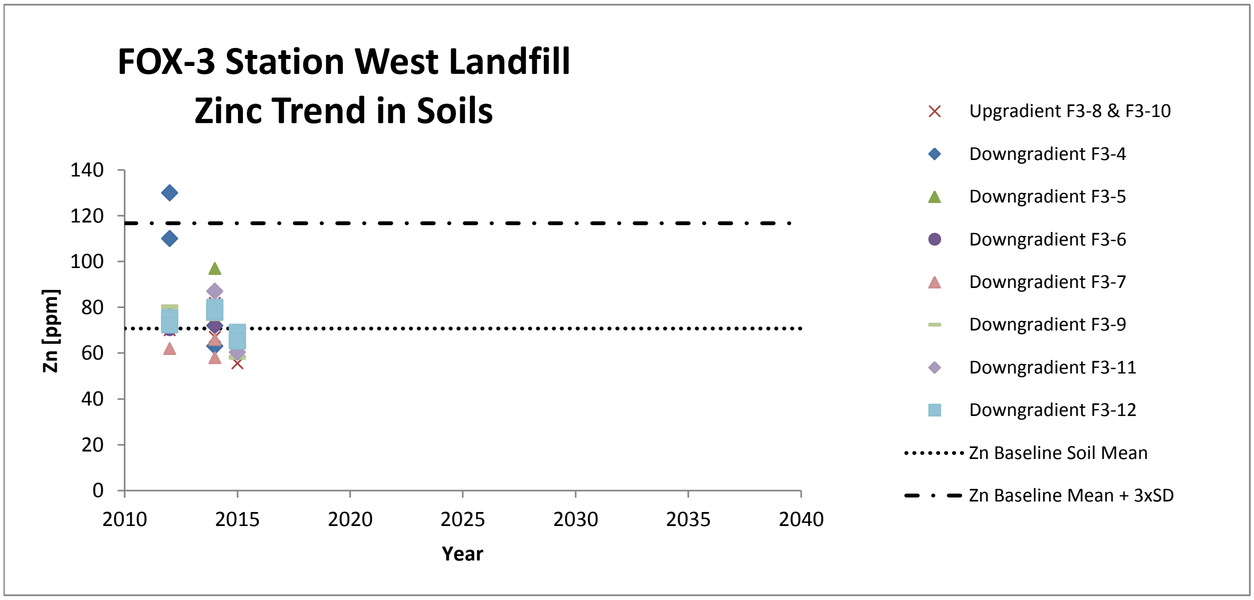




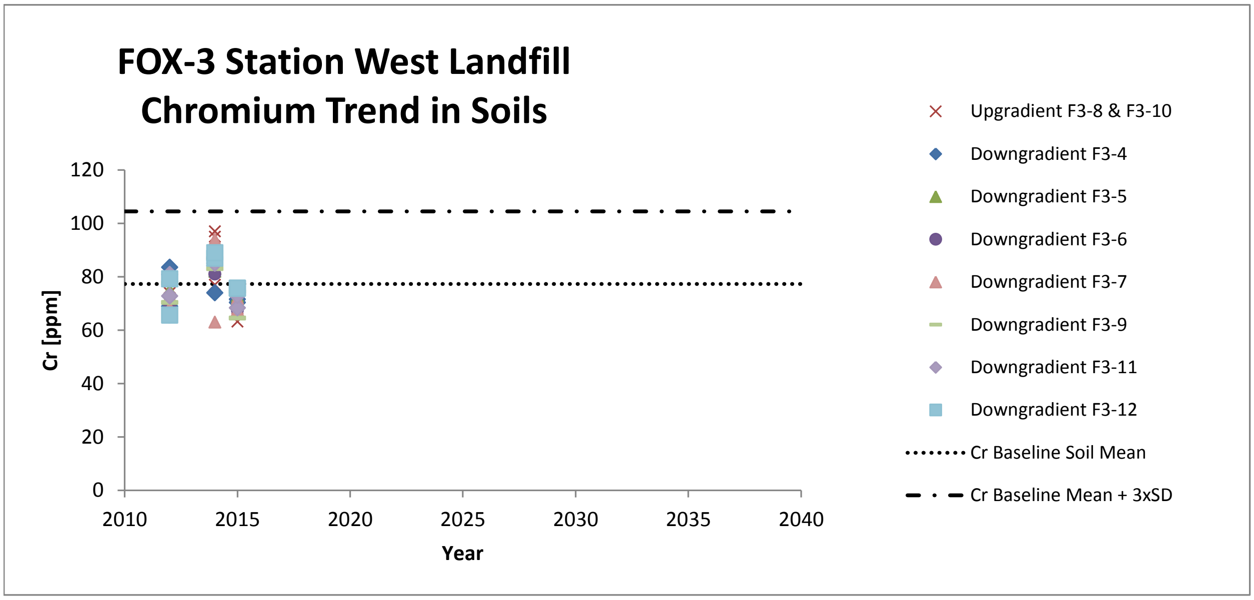
*Cd Baseline Arithmetic Mean is equal to the baseline detection limit.
*Cd Baseline SD = 0

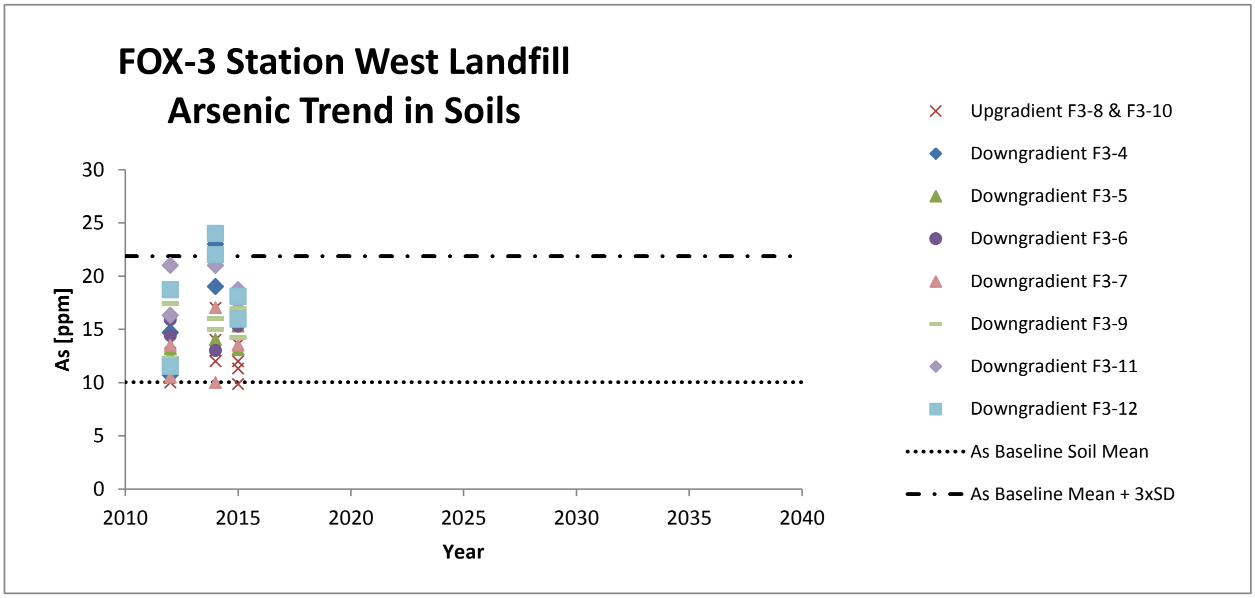
FOX-3 Station West Landfill Trends in Soil Inorganics, PCBs and PHCs (modified TPH)



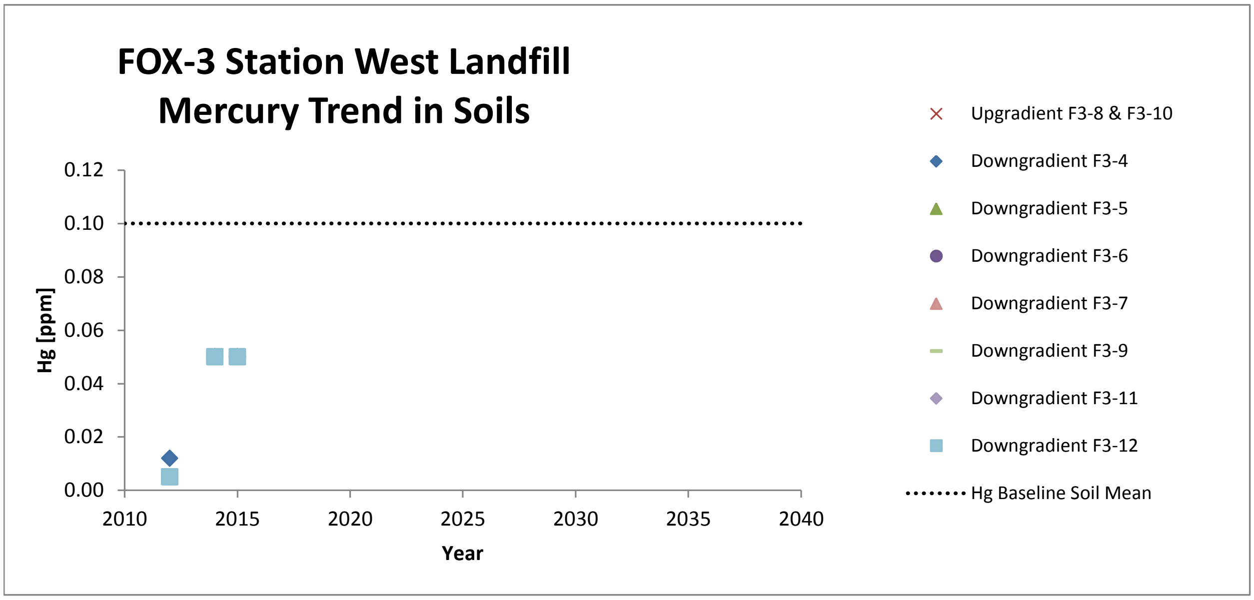


FOX-3   Station West Landfill Trends in Soil Inorganics, PCBs and PHCs (modified TPH)

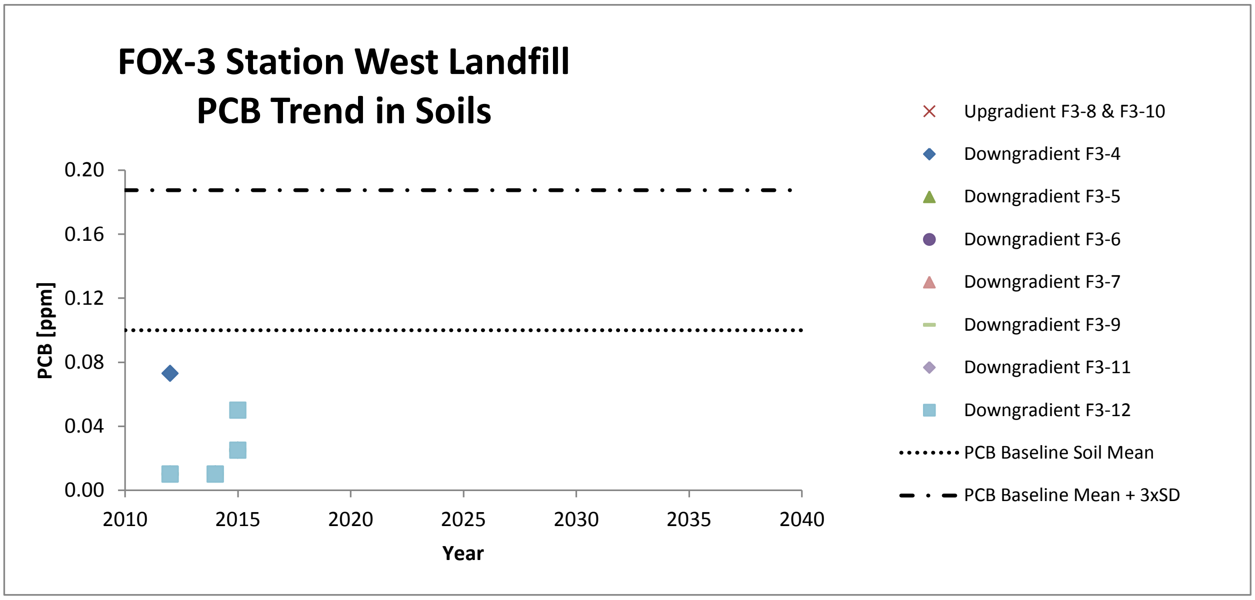




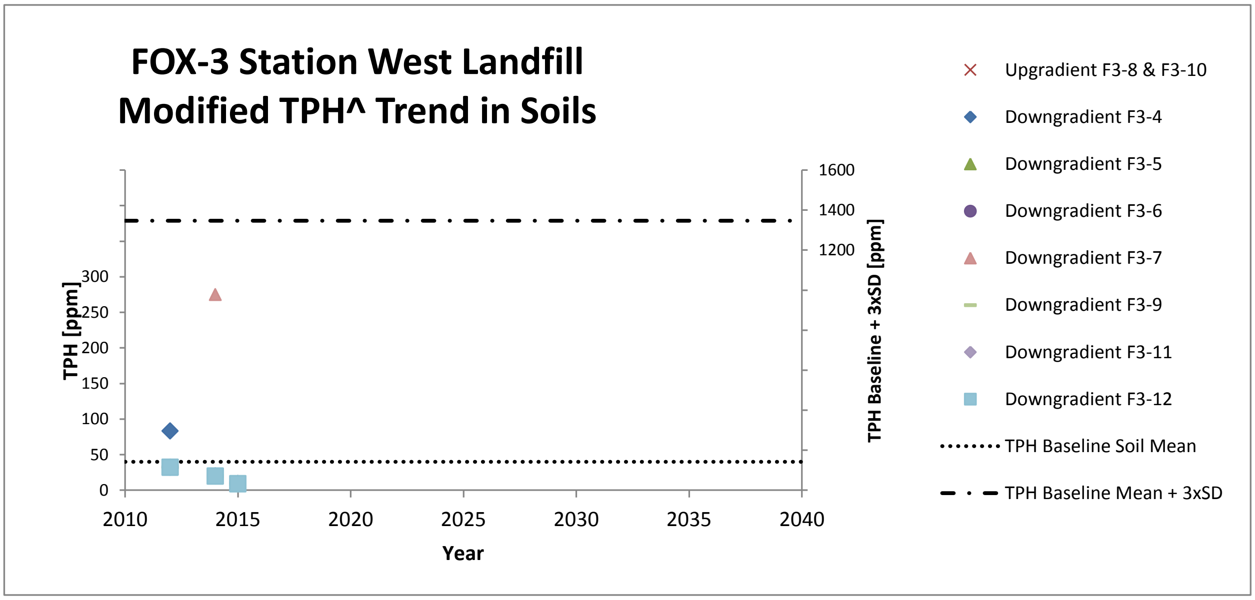
FOX-3 Station West Landfill Trends in Soil Inorganics, PCBs and PHCs (modified TPH)



*Hg Baseline Arithmetic Mean is equal to the baseline detection limit.
** Hg results below detection for all monitoring samples. Trendlines reflect changes in detection limit.



FOX-3   Station West Landfill Trends in Soil Inorganics, PCBs and PHCs (modified TPH)



APPENDIX D

Photograph Log

Visual Inspection Photographs

Thermistor Photographs

Monitoring Well Photographs

Soil Sampling Photographs

PHOTOS

Photo 1: West Landfill – West crest and slope, looking north, previously reported settlement (Feature E) (ATT8_Photo1.jpg)

Photo 2: West Landfill – West crest and slope looking south (ATT7_Photo1.jpg)

Photo 3: *West Landfill – South crest and slope, looking east from southwest corner (ATT9_Photo1.jpg)*

Photo 4: *West Landfill – Feature G, ponded water at south toe (ATT10_Photo1.jpg)*

Photo 5: West Landfill – South crest and slope, looking west (ATT11_Photo1.jpg)

Photo 6: West Landfill – East slope and toe, looking north (ATT12_Photo1.jpg)

Photo 7: West Landfill – North slope, looking west (ATT13_Photo1.jpg)

Photo 8: West Landfill – Feature D, ponded water at north toe, looking west (ATT14_Photo1.jpg)

Photo 9: West Landfill – Feature F, previously observed settlement on north slope (ATT15_Photo1.jpg)

Photo 10: West Landfill – Feature H, minor self-armouring erosion channel on north slope, looking north (ATT18_Photo1.jpg)

Photo 11: West Landfill – Feature A, minor settlement and rough area on the cover surface (ATT19_Photo1.jpg)

Photo 12: West Landfill – Cover surface overview, looking west from east crest (ATT20_Photo1.jpg) (ATT21_Photo2.jpg)

Photo 13: West Landfill – Feature B, ponded water, previously reported as settlement, 1 x 1 m (ATT22_Photo1.jpg)

Photo 14: West Landfill – Feature I, sparse vegetation (ATT23_Photo1.jpg)

Photo 15: West Landfill – Feature J, minor settlement on north slope (ATT25_Photo2.jpg)

Photo 16: West Landfill – Feature K, minor settlement on northwest slope (ATT26_Photo1.jpg)

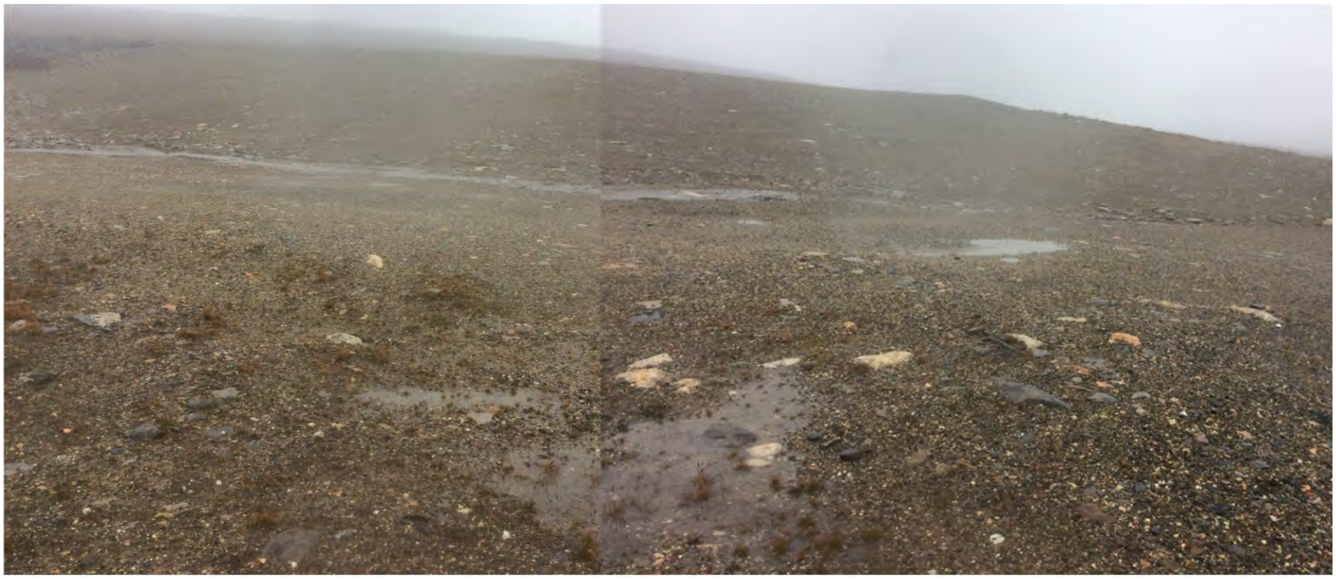


Photo 17: West Landfill – north slope and toe overview, looking south (ATT27_Photo1.jpg) (ATT28_Photo2.jpg)

Photo 18: West Landfill – Feature D, ponded water and drainage channel along access road (ATT29_Photo1.jpg)

Photo 19: West Landfill – North slope and crest, looking east from northwest corner (ATT6_Photo1.jpg)

Photo 20: West Landfill – Feature D, running water along the north toe and road, looking east (ATT5_Photo1.jpg)

Photo 21: West Landfill – Feature D, running water along the north toe and road, looking west (ATT3_Photo1.jpg)

Photo 22: West Landfill – Feature D, running water along the north toe and road, looking west (ATT4_Photo1.jpg)

Photo 23: *Tier II Disposal Facility – South slope, looking north towards station – 3 photo panoramic (ATT117_Photo3.jpg) (ATT116_Photo3.jpg) (ATT115_Photo3.jpg)*

Photo 24: *Tier II Disposal Facility – Feature I, ponded water on crest surface in southeast corner (ATT118_Photo1.jpg)*

Photo 25: *Tier II Disposal Facility – East crest edge, looking north (ATT120_Photo1.jpg)*

Photo 26: *Tier II Disposal Facility – East slope, looking north (ATT121_Photo1.jpg)*

Photo 27: Tier II Disposal Facility – Ponded water on cover surface, previously reported Features A and B (settlement) and Feature H, facing west (ATT123_Photo1.jpg)

Photo 28: Tier II Disposal Facility – East and north slopes, facing southwest (ATT124_Photo1.jpg) (ATT125_Photo2.jpg)

Photo 29: Tier II Disposal Facility – North crest edge, facing east, large cobbles and boulders (ATT126_Photo1.jpg)

Photo 30: Tier II Disposal Facility – Feature J, ponded water at northwest toe (ATT127_Photo1.jpg)

Photo 31: Tier II Disposal Facility – Feature J, ponded water at northwest toe (ATT128_Photo1.jpg)

Photo 32: Tier II Disposal Facility – West slope, facing east (ATT132_Photo3.jpg)

Photo 33: Tier II Disposal Facility – West crest edge, facing south, ponded water at toe (Feature K) (ATT135_Photo1.jpg)

Photo 34: Tier II Disposal Facility – Feature K, water at west toe (ATT136_Photo1.jpg)

Photo 35: Tier II Disposal Facility – South crest edge, facing east (ATT137_Photo1.jpg)

Photo 36: Tier II Disposal Facility – West slope from southwest toe (ATT138_Photo1.jpg)

Photo 37: Tier II Disposal Facility – West end of south slope, facing northwest (ATT139_Photo1.jpg)

Photo 38: Tier II Disposal Facility – very sparse vegetation on cover surface (Feature L), depression with ponded water in background (Feature H) (ATT140_Photo1.jpg)

Photo 39: Tier II Disposal Facility – Feature M, cobbles and boulders on cover surface with ponded water (ATT141_Photo1.jpg)

Photo 40: Tier II Disposal Facility – South crest edge, facing east (ATT142_Photo1.jpg)

Photo 41: Tier II Disposal Facility – Cover surface, facing northeast (ATT143_Photo1.jpg)

Photo 42: Tier II Disposal Facility – West side, facing east (ATT144_Photo1.jpg) (ATT145_Photo2.jpg)

Photo 43: Tier II Disposal Facility – From hill above landfill, facing south (ATT146_Photo1.jpg)

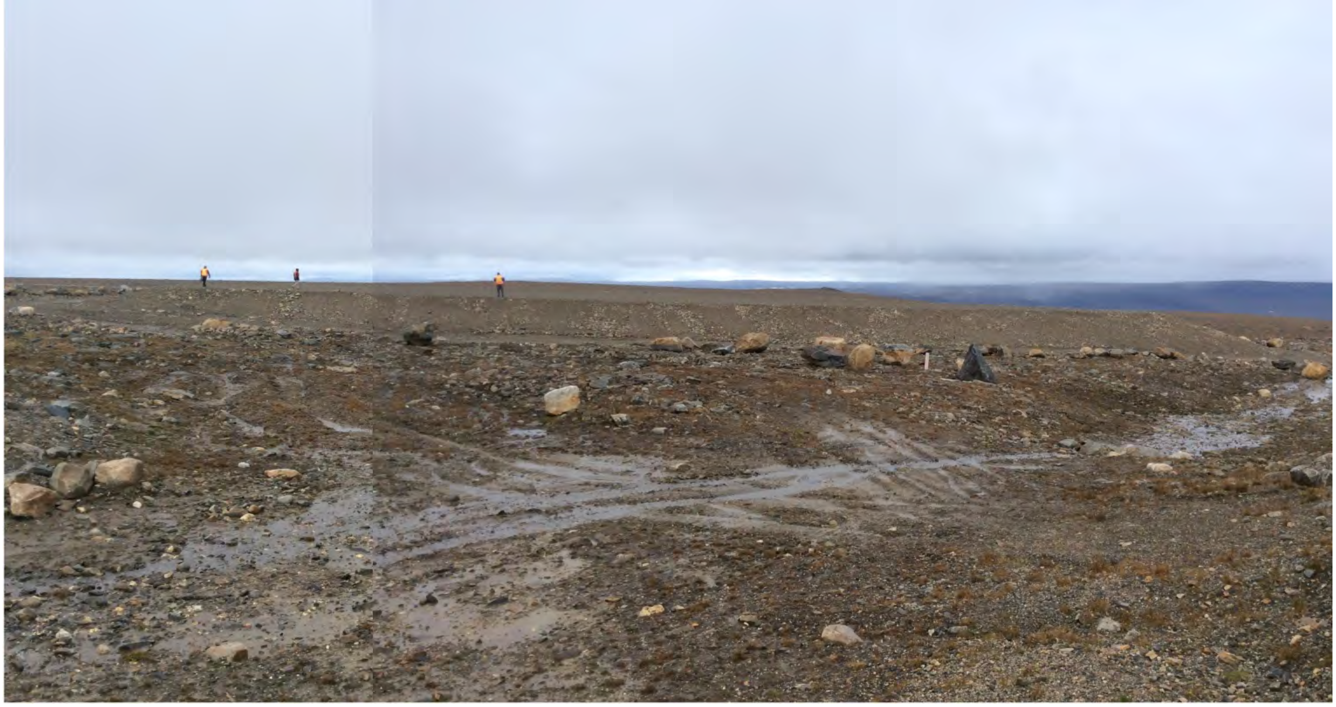


Photo 44: Non-Haz Waste Landfill – West slope, facing east (ATT147_Photo1.jpg) (ATT148_Photo2.jpg)

Photo 45: Non-Haz Waste Landfill – Feature I, self-armouring erosion on west slope (ATT150_Photo1.jpg)

Photo 46: Non-Haz Waste Landfill – West crest edge, facing south (ATT151_Photo1.jpg)

Photo 47: *Non-Haz Waste Landfill – South crest edge, facing east, previous reported crack (Feature D) appears to be coarser fill on slope near crest edge (ATT152_Photo1.jpg)*

Photo 48: *Non-Haz Waste Landfill – Cover surface facing northeast, Feature J, very sparse vegetation on cover (ATT153_Photo1.jpg)*

Photo 49: Non-Haz Waste Landfill – South crest edge, facing west (ATT154_Photo1.jpg)

Photo 50: Non-Haz Waste Landfill – South slope facing northwest, some self-armouring erosion leaving cobbles and boulders (ATT155_Photo1.jpg)

Photo 51: Non-Haz Waste Landfill – southeast corner (ATT157_Photo1.jpg) (ATT158_Photo2.jpg)

Photo 52: Non-Haz Waste Landfill – East crest edge, facing north, coarse boulders at crest edge where fines have washed out (ATT159_Photo1.jpg)

Photo 53: Non-Haz Waste Landfill – Feature K, water running along east toe (ATT160_Photo1.jpg)

Photo 54: Non-Haz Waste Landfill – Cover surface facing southwest (ATT162_Photo1.jpg)

Photo 55: Non-Haz Waste Landfill – North slope facing west, some snow on slope and ponded water at toe (Feature F) (ATT163_Photo1.jpg)

Photo 56: Non-Haz Waste Landfill – Feature C, previously noted erosion on north slope is self-armouring (ATT164_Photo1.jpg)

Photo 57: Non-Haz Waste Landfill – North crest edge facing west, water at toe (Feature F) (ATT169_Photo1.jpg)

Photo 58: Non-Haz Waste Landfill – Feature F, ponded water along north toe, facing east (ATT171_Photo1.jpg)

Photo 59: *Non-Haz Waste Landfill – Feature F, ponded water along north toe, facing west (ATT172_Photo2.jpg)*

Photo 60: *Non-Haz Waste Landfill – Small depressions with ponded water on northwest crest corner (Feature L), ponded water at the toe (Feature F) (ATT173_Photo1.jpg)*

Photo 61: Non-Haz Waste Landfill – Feature G, previously observed small depressions with ponded water (ATT165_Photo1.jpg)

Photo 62: Non-Haz Waste Landfill – previously observed Features A and B, small depressions with ponded water (ATT166_Photo1.jpg)

Photo 63: Non-Haz Waste Landfill – Feature M, shallow depression with ponded water (ATT167_Photo1.jpg)

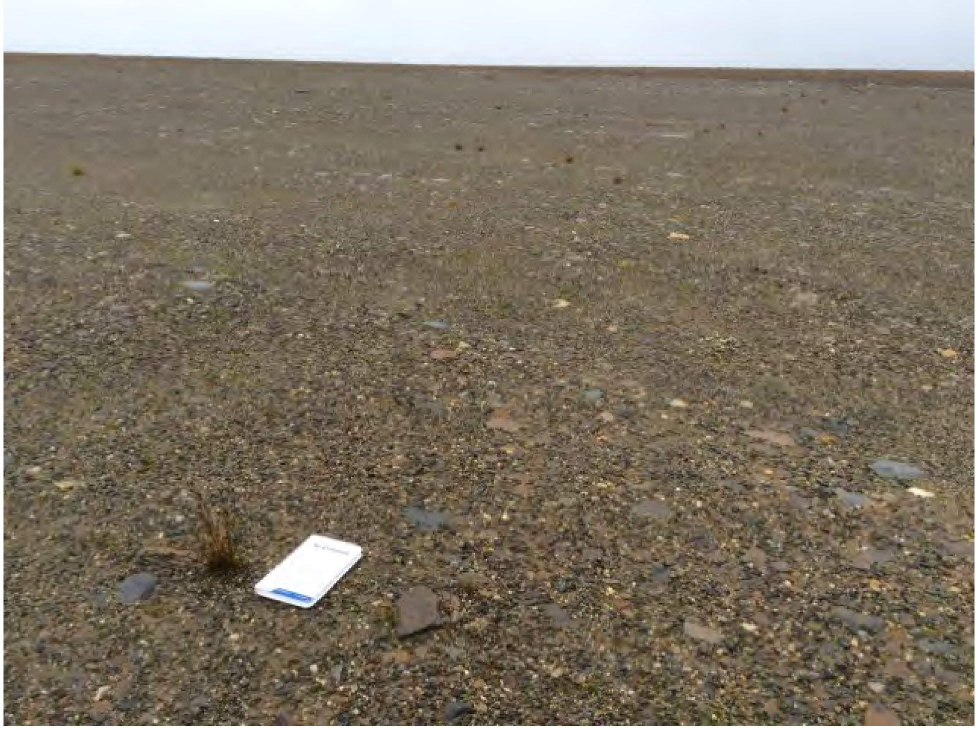


Photo 64: Non-Haz Waste Landfill – Feature J, occasional sparse grass vegetation on cover (ATT168_Photo1.jpg)

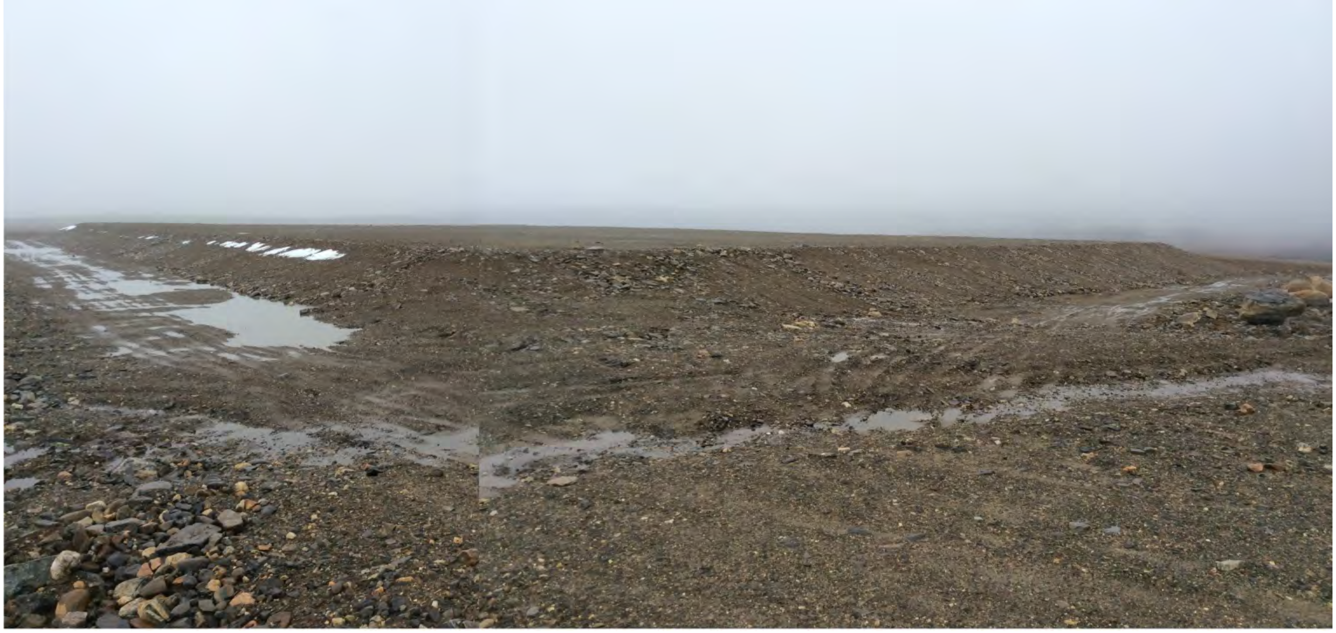


Photo 65: Non-Haz Waste Landfill – North and west slopes, ponded water along north toe (Feature F), ponded water along west toe (Feature H) (ATT174_Photo1.jpg) (ATT175_Photo2.jpg)

Photo 66: Station West Landfill, Lobe A – Southeast slope, facing northeast – Feature X, running water along toe, fuel tank (Feature Y) in background (ATT176_Photo1.jpg)

Photo 67: Station West Landfill, Lobe A – Feature Y, fuel tank (ATT177_Photo1.jpg)

Photo 68: Station West Landfill, Lobe A – Southeast crest edge and toe, facing south (ATT178_Photo2.jpg)

Photo 69: *Station West Landfill, Lobe A – Feature B, red staining (ATT179_Photo1.jpg)*

Photo 70: *Station West Landfill, Lobe A – Feature B, red staining (ATT180_Photo2.jpg)*

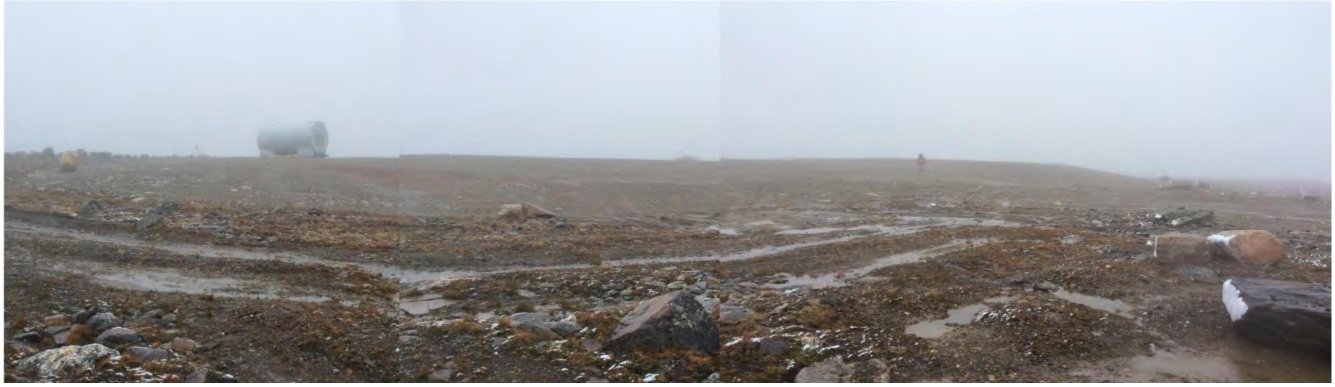


Photo 71: Station West Landfill, Lobe A – Northeast end facing south, ponded water at toe (previous Feature V) (ATT181_Photo1.jpg) (ATT182_Photo2.jpg) (ATT183_Photo3.jpg)

Photo 72: Station West Landfill, Lobe A – Northwest slope, facing southwest (ATT184_Photo1.jpg)

Photo 73: *Station West Landfill, Lobe A – Northwest crest edge, facing southwest, some small puddles on cover (ATT185_Photo1.jpg)*

Photo 74: *Station West Landfill, Lobe A – Area of coarser rock fill on west slope, facing southwest (ATT186_Photo1.jpg)*

Photo 75: Station West Landfill, Lobe A – Coarse rock fill on west slope, facing northeast (ATT187_Photo1.jpg)

Photo 76: Station West Landfill, Lobe A – orange plastic conduit (Feature C/S) (ATT188_Photo1.jpg)

Photo 77: *Station West Landfill, Lobe A – South slope and surface, facing northeast (ATT189_Photo1.jpg)*

Photo 78: *Station West Landfill, Lobe A – CM1 Benchmark (ATT190_Photo2.jpg)*

Photo 79: Station West Landfill, Lobe A – Southeast crest edge, facing northeast, ponded/running water along toe (new Feature X) (ATT191_Photo1.jpg)

Photo 80: Station West Landfill, Lobe A – Shallow depressions with ponded water (previous Feature W) (ATT192_Photo1.jpg)

Photo 81: Station West Landfill, Lobe A – Cover surface facing northwest, shallow depressions with ponded water (previous Feature E) and shallow runoff channels (previous Feature U) in background (ATT193_Photo1.jpg)

Photo 82: NWS Landfill (Operational), facing northwest (ATT194_Photo1.jpg)

Photo 83: NWS Landfill (Operational), facing south (ATT195_Photo1.jpg)

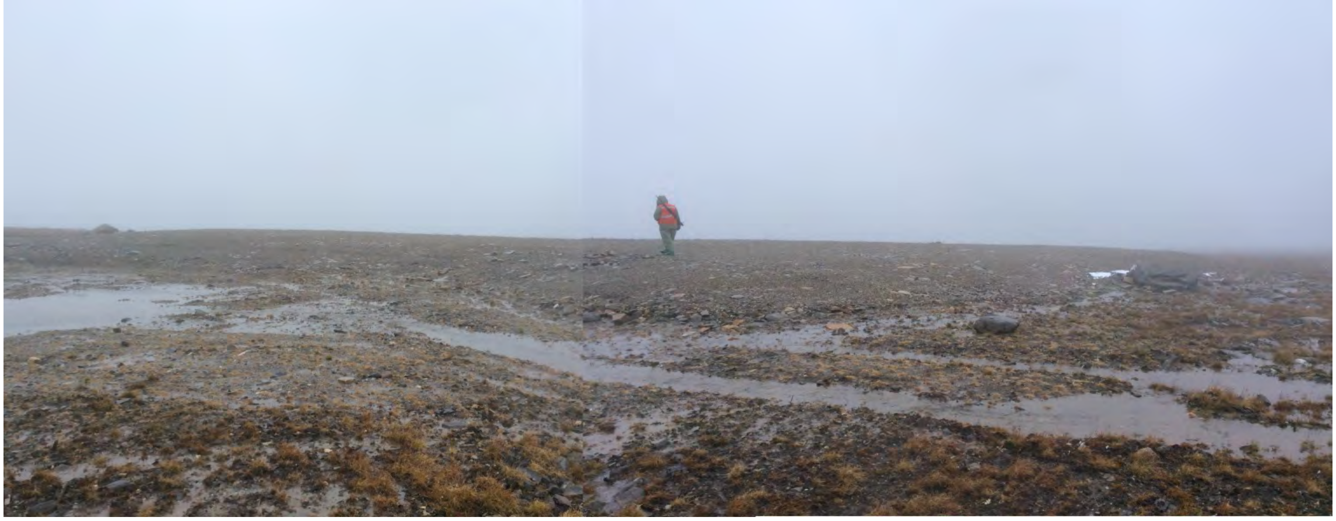


Photo 84: Station West Landfill, Lobe E2 – North slope and toe, facing south (ATT196_Photo1.jpg) (ATT197_Photo2.jpg)

Photo 85: Station West Landfill, Lobe E2 – North crest edge facing east, Feature AA, some pounded water at toe (ATT198_Photo1.jpg)

Photo 86: Station West Landfill, Lobe E2 – North crest edge, facing southwest (ATT199_Photo1.jpg)

Photo 87: *Station West Landfill, Lobe E2 – Cover surface, facing east, previously observed minor settlement in left middleground (Feature J), sparse vegetation in foreground and middleground (Feature Z) (ATT200_Photo1.jpg)*

Photo 88: *Station West Landfill, Lobe E2 – West slope, facing north (ATT201_Photo1.jpg)*

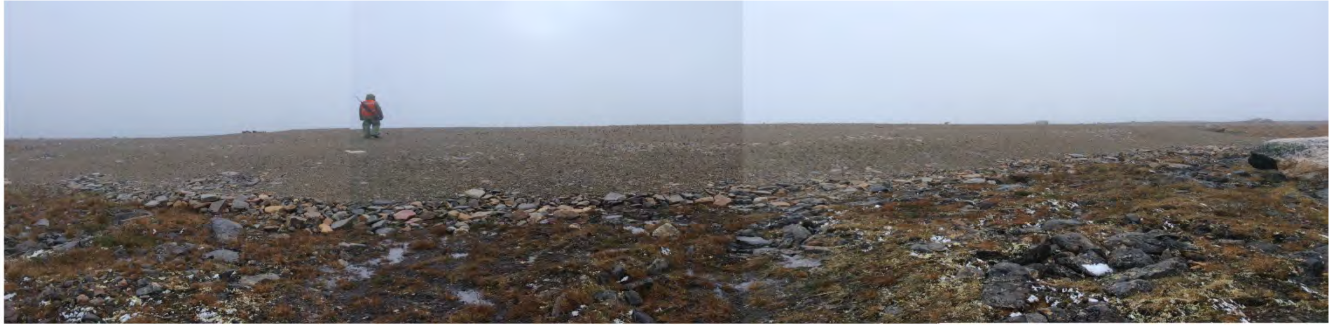


Photo 89: Station West Landfill, Lobe E2 – South slope facing north (ATT202_Photo1.jpg) (ATT203_Photo2.jpg) (ATT204_Photo3.jpg)

Photo 90: Station West Landfill, Lobe E2 – East crest edge and slope, facing north (ATT205_Photo1.jpg)

Photo 91: Station West Landfill, Lobe E2 – North toe, geotextile (previous Feature I) surrounded by ponded water (Feature AA) (ATT206_Photo1.jpg)

Photo 92: Station West Landfill, Lobe E2 – Slope at northeast corner, facing north, ponded water at toe (Feature AA) (ATT207_Photo1.jpg)

Photo 93: Station West Landfill, Lobe F – Northeast slope, facing west (ATT217_Photo1.jpg) (ATT218_Photo2.jpg) (ATT219_Photo3.jpg)

Photo 94: Station West Landfill, Lobe F – East crest edge, facing south, Feature AB, some water running along toe (ATT220_Photo1.jpg)

Photo 95: *Station West Landfill, Lobe F – North toe, facing west, Feature AB, ponded water at toe (ATT233_Photo1.jpg)*

Photo 96: *Station West Landfill, Lobe F – North slope and toe, facing east, Feature AB, water at toe (ATT223_Photo1.jpg*

Photo 97: Station West Landfill, Lobe F – Feature Z, moss and sparse grass on cover (ATT221_Photo1.jpg)

Photo 98: Station West Landfill, Lobe F – Feature K, shallow depression with ponded water (ATT222_Photo1.jpg)

Photo 99: Station West Landfill, Lobe F – West slope, facing south (ATT224_Photo1.jpg)

Photo 100: Station West Landfill, Lobe F – Cover surface facing east (ATT225_Photo1.jpg)

Photo 101: Station West Landfill, Lobe F – Feature M, minor self-armouring erosion on southwest slope (ATT226_Photo1.jpg)

Photo 102: Station West Landfill, Lobe F – Feature N, staining, previously reported as seepage (ATT227_Photo1.jpg)

Photo 103: *Station West Landfill, Lobe F – Feature P, minor self-armouring erosion from linear equipment tracks (ATT228_Photo1.jpg)*

Photo 104: *Station West Landfill, Lobe F – Feature P, minor self-armouring erosion, facing toe (ATT229_Photo1.jpg)*

Photo 105: Station West Landfill, Lobe F – Cover surface facing north, some coarse rock fill in foreground (ATT230_Photo1.jpg)

Photo 106: Station West Landfill, Lobe F – East slope, facing north, water running along toe (Feature AB) (ATT231_Photo1.jpg)

Photo 107: Station West Landfill, Lobe F – Cover surface facing north (ATT232_Photo1.jpg)

Photo 108: Monitoring well [MW-01], Tier II Disposal Facility

Photo 109: *Monitoring well [MW-02], Tier II Disposal Facility*

Photo 110: *Monitoring Well [MW-05], Non-Haz Waste Landfill*

Photo 111: Monitoring Well [MW-06] Non-Haz Waste Landfill

Photo 112: Monitoring Well [MW-07], Non-Haz Waste Landfill

Photo 113: Monitoring Well [MW-08], Non-Haz Waste Landfill

Photo 114: Soil sample [F3-1] (1 before excavation), West Landfill

Photo 115: Soil sample [F3-1] (2 after excavation), West Landfill

Photo 116: Soil sample [F3-1] (3 after backfilling), West Landfill

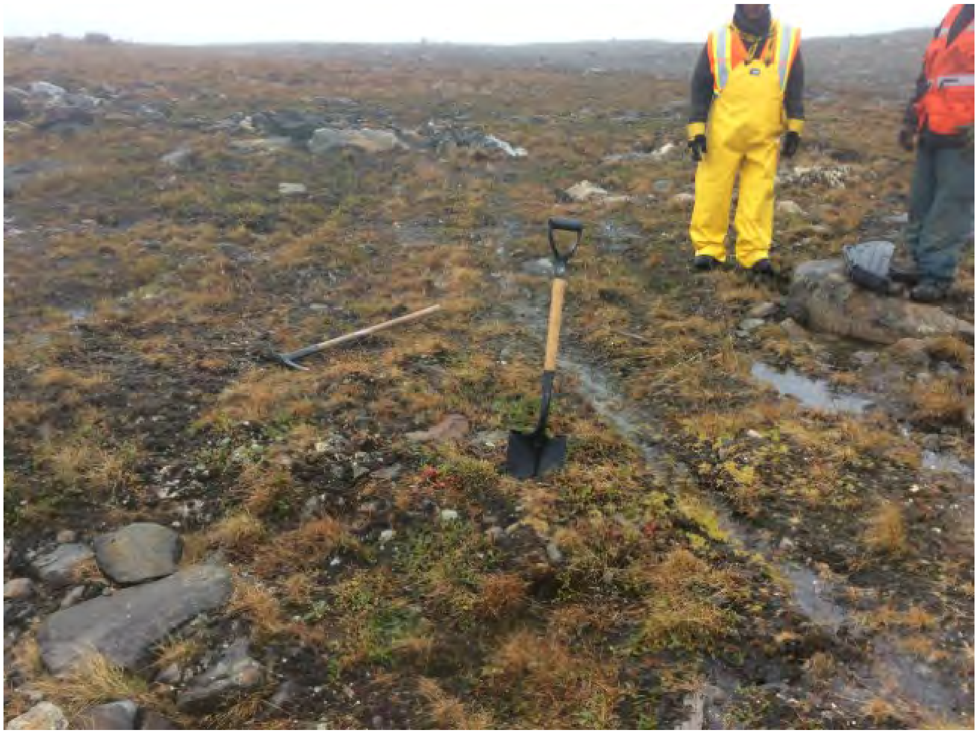


Photo 117: Soil sample [F3-10] (1 before excavation),Station West Landfill

Photo 118: Soil sample [F3-10] (2 after excavation),Station West Landfill

Photo 119: Soil sample [F3-10] (3 after backfilling),Station West Landfill

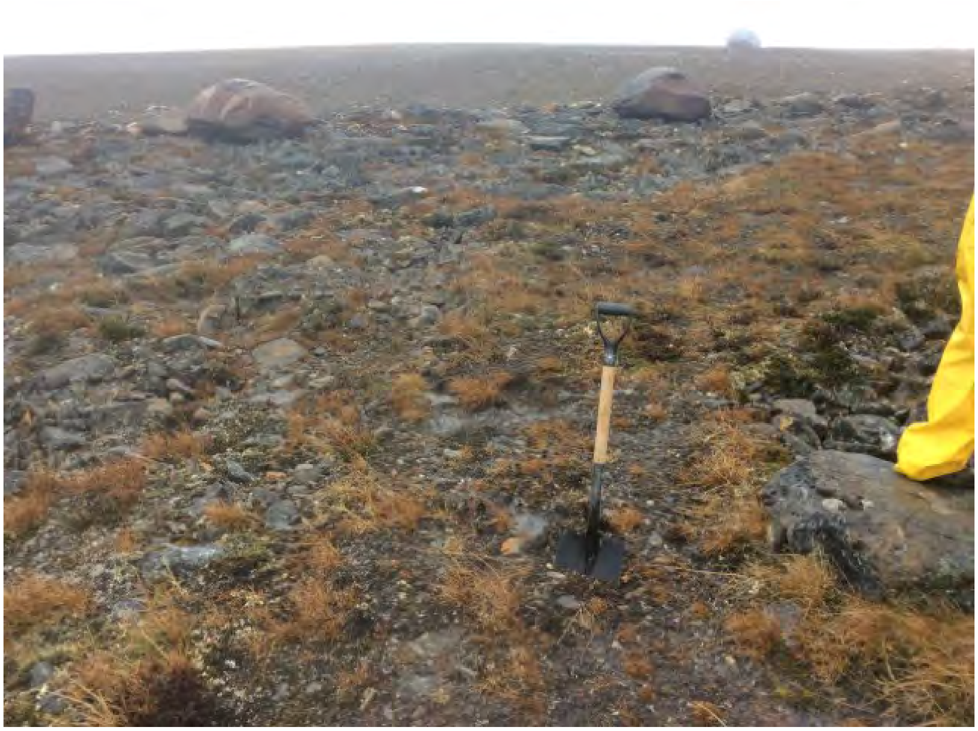


Photo 120: Soil sample [F3-11] (1 before excavation),Station West Landfill

Photo 121: Soil sample [F3-11] (2 after excavation),Station West Landfill

Photo 122: Soil sample [F3-11] (3 after backfilling),Station West Landfill

Photo 123: Soil sample [F3-12] (1 before excavation),Station West Landfill

Photo 124: Soil sample [F3-12] (2 after excavation),Station West Landfill

Photo 125: *Soil sample [F3-12] (3 after backfilling),Station West Landfill*

Photo 126: *Soil sample [F3-2] (1 before excavation), West Landfill*

Photo 127: Soil sample [F3-2] (2 after excavation), West Landfill

Photo 128: Soil sample [F3-2] (3 after backfilling), West Landfill

Photo 129: Soil sample [F3-3] (1 before excavation), West Landfill

Photo 130: Soil sample [F3-3] (2 after excavation), West Landfill

Photo 131: Soil sample [F3-3] (3 after backfilling), West Landfill

Photo 132: Soil sample [F3-4] (1 before excavation),Station West Landfill

Photo 133: Soil sample [F3-4] (2 after excavation),Station West Landfill

Photo 134: Soil sample [F3-4] (3 after backfilling),Station West Landfill

Photo 135: Soil sample [F3-5] (1 before excavation),Station West Landfill

Photo 136: Soil sample [F3-5] (2 after excavation),Station West Landfill

Photo 137: *Soil sample [F3-5] (3 after backfilling),Station West Landfill*

Photo 138: *Soil sample [F3-6] (1 before excavation),Station West Landfill*

Photo 139: Soil sample [F3-6] (2 after excavation),Station West Landfill

Photo 140: Soil sample [F3-6] (3 after backfiling),Station West Landfill

Photo 141: *Soil sample [F3-7] (1 before excavation),Station West Landfill*

Photo 142: *Soil sample [F3-7] (2 after excavation),Station West Landfill*

Photo 143: *Soil sample [F3-7] (3 after backfilling),Station West Landfill*

Photo 144: *Soil sample [F3-8] (1 before excavation),Station West Landfill*

Photo 145: *Soil sample [F3-8] (2 after excavation),Station West Landfill*

Photo 146: *Soil sample [F3-8] (3 after backfilling),Station West Landfill*

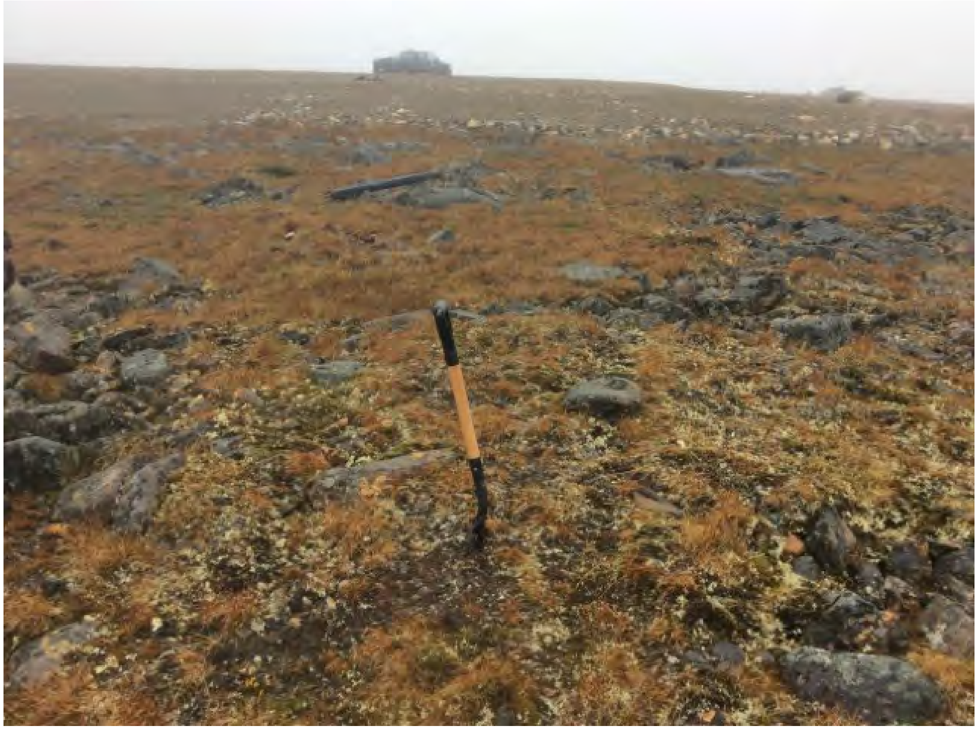


Photo 147: Soil sample [F3-9] (1 before excavation),Station West Landfill

Photo 148: Soil sample [F3-9] (2 after excavation),Station West Landfill

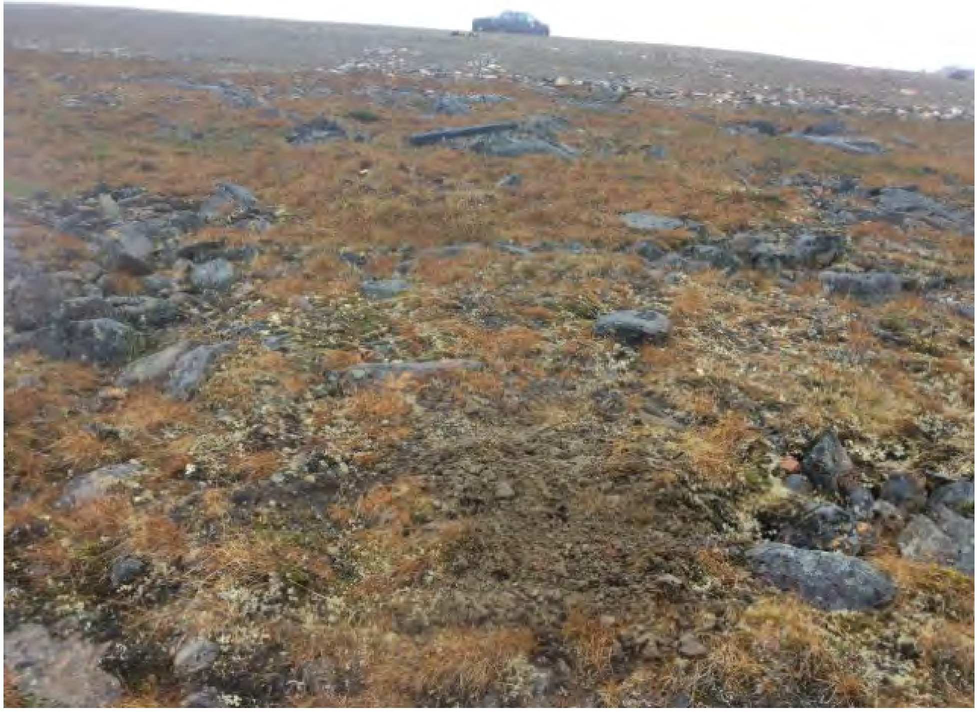


Photo 149: Soil sample [F3-9] (3 after backfilling),Station West Landfill

Photo 150: Soil sample [MW-01] (1 before excavation),Tier II Disposal Facility

Photo 151: Soil sample [MW-01] (2 after excavation),Tier II Disposal Facility

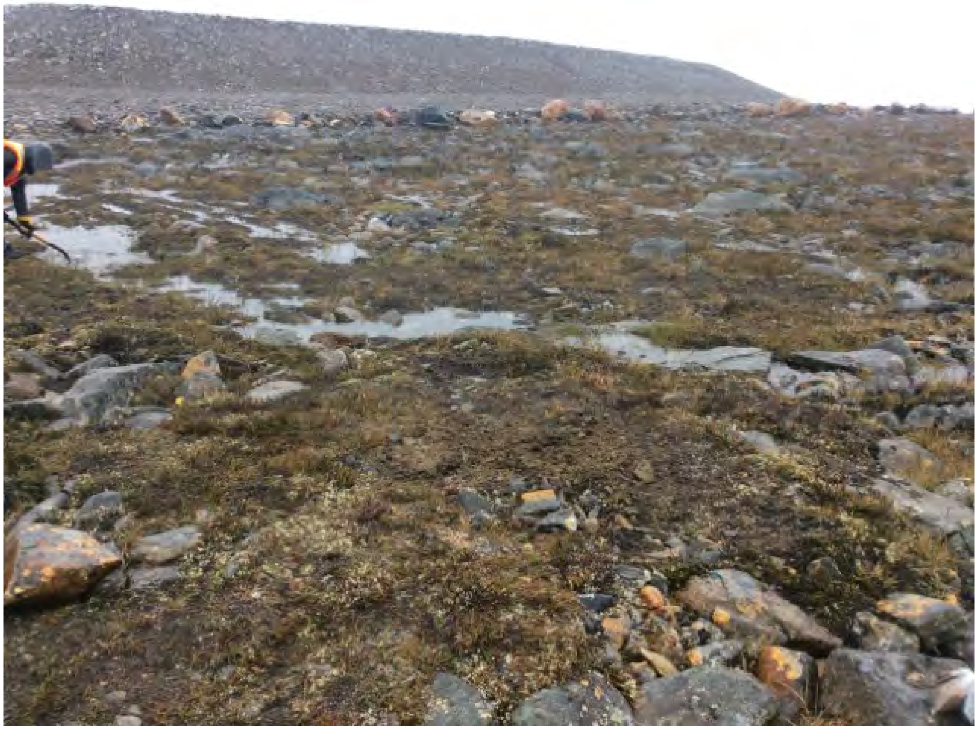


Photo 152: Soil sample [MW-01] (3 after backfilling),Tier II Disposal Facility

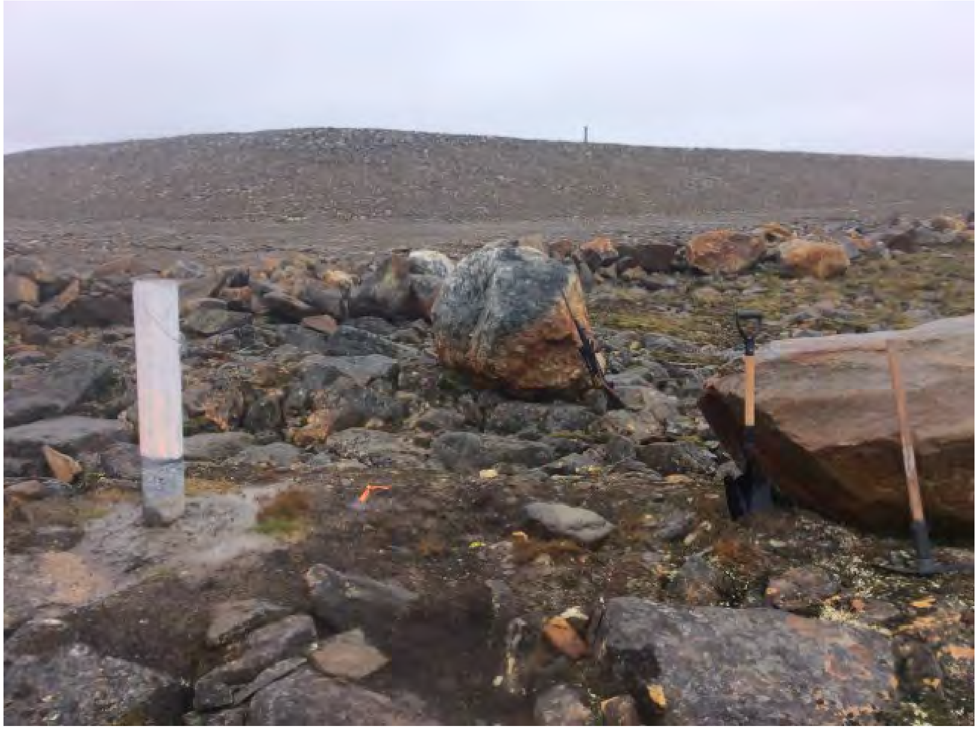


Photo 153: Soil sample [MW-02] (1 before excavation),Tier II Disposal Facility

Photo 154: Soil sample [MW-02] (2 after excavation),Tier II Disposal Facility

Photo 155: Soil sample [MW-02] (3 after backfilling),Tier II Disposal Facility

Photo 156: Soil sample [MW-03] (1 before excavation),Tier II Disposal Facility

Photo 157: Soil sample [MW-03] (2 after excavation),Tier II Disposal Facility

Photo 158: Soil sample [MW-03] (3 after backfilling),Tier II Disposal Facility

Photo 159: *Soil sample [MW-04] (1 before excavation),Tier II Disposal Facility*

Photo 160: *Soil sample [MW-04] (2 after excavation),Tier II Disposal Facility*

Photo 161: Soil sample [MW-04] (3 after backfilling),Tier II Disposal Facility

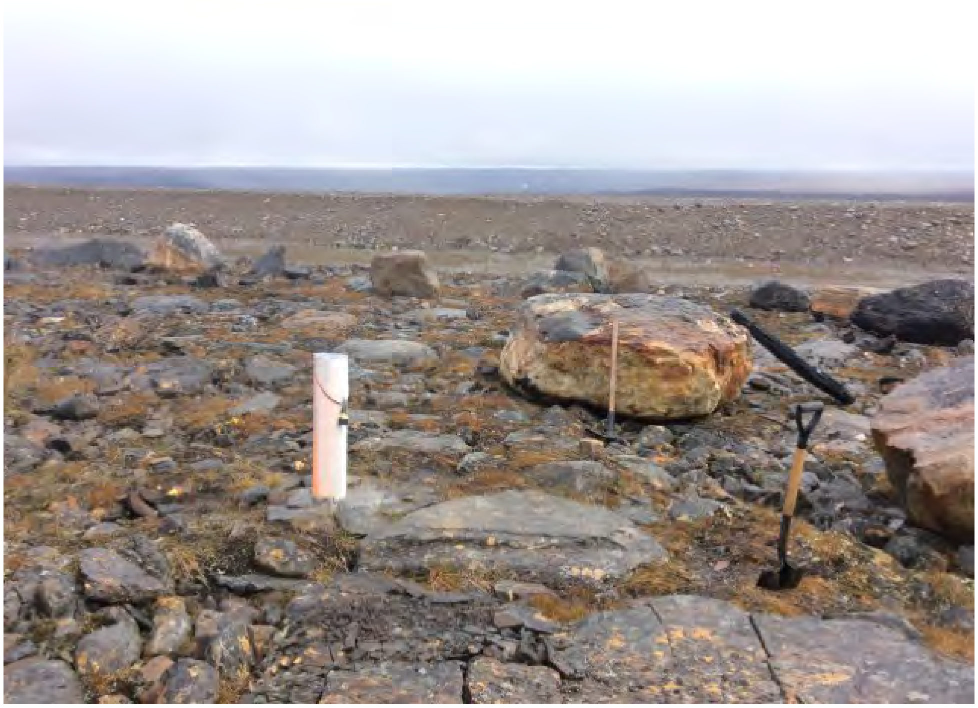


Photo 162: Soil sample [MW-05] (1 before excavation), Non-Haz Waste Landfill

Photo 163: Soil sample [MW-05] (2 before excavation), Non-Haz Waste Landfill

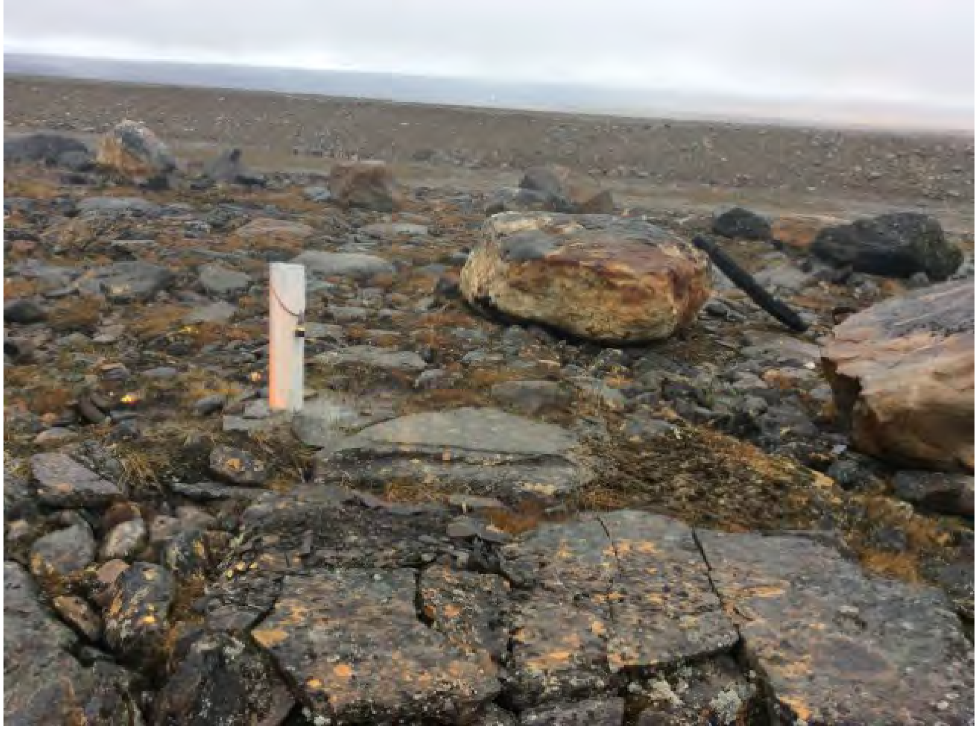


Photo 164: Soil sample [MW-05] (3 after backfilling), Non-Haz Waste Landfill

Photo 165: Soil sample [MW-06] (1 before excavation), Non-Haz Waste Landfill

Photo 166: Soil sample [MW-06] (2 after excavation), Non-Haz Waste Landfill

Photo 167: *Soil sample [MW-06] (3 after backfilling), Non-Haz Waste Landfill*

Photo 168: *Soil sample [MW-07] (1 before excavation), Non-Haz Waste Landfill*

Photo 169: *Soil sample [MW-07] (2 after excavation), Non-Haz Waste Landfill*

Photo 170: *Soil sample [MW-07] (3 after backfilling), Non-Haz Waste Landfill*

Photo 171: Soil sample [MW-08] (1 before excavation), Non-Haz Waste Landfill

Photo 172: Soil sample [MW-08] (2 after excavation), Non-Haz Waste Landfill

Photo 173: Soil sample [MW-08] (3 after backfilling), Non-Haz Waste Landfill

Photo 174: Tier II Disposal Facility – Thermistor VT-1, looking west (ATT133_Photo1.jpg)

Photo 175: Tier II Disposal Facility – Thermistor VT-2, looking north (ATT134_Photo1.jpg)

Photo 176: Tier II Disposal Facility – Thermistor VT-3, looking west (ATT122_Photo1.jpg)

Photo 177: Tier II Disposal Facility – Thermistor VT-4, looking south (ATT119_Photo1.jpg)

c:\users\hpeters\documents\mining division\1530908_draft dew line monitoring\appendix d_fox-3 site inspection photographs_11jan2016.docx

APPENDIX E

2015 FOX-3 Thermokast Regrade Visual Inspection Report

Table of Contents

TABLES

FIGURES

ATTACHMENT

1.0 BACKGROUND

The Regraded Thermokarst Area is located at the FOX-3 DEW Line Site on the east side of the airstrip along the Macbeth River (“Thermokarst Area”). In 2012, the Dew Line Clean-Up (DLCU) First Year Monitoring Program at FOX-3 identified settlement and cracking in the Thermokarst Area with the potential for continued settlement and slope movement. In 2013, a DLCU Quality Assurance Maintenance Program completed remedial works that involved placement and grading of granular fill within the settlement areas and cracks to prevent further degradation of the underlying permafrost and mitigate further slope movement. Golder Associates Ltd. carried out a visual inspection of the Thermokarst Area on August 17, 2015 to assess and document the condition of the 2013 remedial works.

2.0 SUMMARY OF ANY SCOPE DEVIATIONS

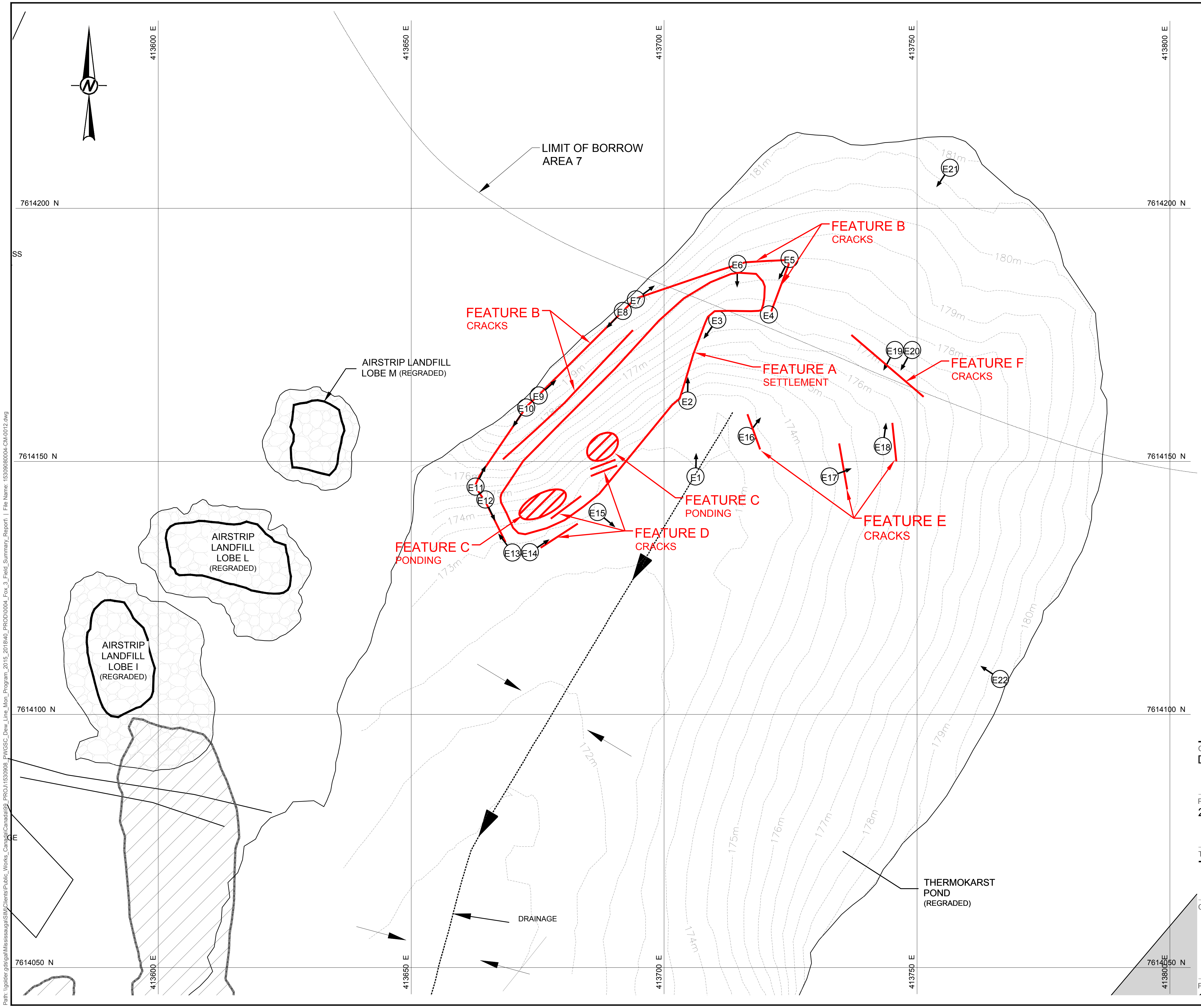
The field work was conducted as per the TOR. There were no notable exceptions to the scope of work.

3.0 VISUAL INSPECTION RESULTS

It appears that significant additional thaw settlement and cracking has occurred since the Thermokarst Area was regraded in 2013. The Thermokarst Area was observed to have several large tension cracks around the perimeter of the thaw settlement with ponded water in the lowest part of the settlement depression. Table E-1 presents a summary of observed visual inspection features and Table E-2 presents the Preliminary Stability Assessment results. Table E-3 is a log of photographs taken during the 2015 visual inspection.

Several long tension cracks (Features B and D) extend around the perimeter of the settlement area (Feature A) and indicate a potential for slope movement and/or slope failure. Additional concentric tension cracks (Features E and F) were observed on the slopes around the settlement area. In the centre of the settlement area, at the bottom of the depression, there was ponded water (Feature C) that is likely contributing to permafrost thaw and related settlement. Isolated weathering was observed within some of the cracks (Feature F). Photos E-2 to E-20 illustrate the thaw settlement, central ponded water and tension cracks observed in the Thermokarst Area during the 2015 inspection.

The Thermokarst Area was assessed to have a “Significant” overall performance because of “Numerous” cracks extending around the perimeter of new thaw settlement. The size and frequency of the tension cracks indicate that the slopes around the settlement area are unstable and at risk of sloughing into the depression.



LEGEND

- ⊕ MONITORING WELL LOCATION
- ⊕B BACKGROUND MONITORING WELL LOCATION
- ▦ GROUND TEMPERATURE CABLE LOCATION
- ▲ PERMANENT BENCHMARK LOCATION
- SOIL SAMPLING LOCATION 2015
- ① ► PHOTOGRAPH VIEWPOINT LOCATION
- ○ SETTLEMENT (NTS)
- ▨ PONDING (NTS)
- — CRACKS (NTS)
- TYPE 1 GRANULAR 1

NOTE

GRID PROJECTION IS NAD83 ZONE 19N. ELEVATIONS ARE GEODETIC.

REFERENCES

BASEMAPPING PROVIDED BY BIOGENIE, A DIVISION OF ENGLOBE CORPORATION, PROJECT NO.CD2655_400_403, DATED JUNE 2015.

CONTOURING INN AREA OF REGRADED THERMOKARST PROVIDES PROVIDED BY DEPARTMENT OF NATION DEFENCE, DRAWING NO. H-D67/1-9101-112, DATED 2007-08-24

0 12.5 25
1:750 METRES

CLIENT
DEPARTMENT OF NATIONAL DEFENCE CANADA

PROJECT
2015 FOX-3 MONITORING REPORT

TITLE
THERMOKARST AREA

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-03-24
DESIGNED	RM
PREPARED	TDR
REVIEWED	DCJ
APPROVED	DP

PROJECT NO.	PHASE	REV.	FIGURE
1530908	1000	B	E-1

25 mm

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

Path: \\golder.gds\gal\Mississauga\SIM\Clients\Public_Works_Canada\Canada\99_PROJ\1530908_PWGSC_Dew_Line_Mon_Program_2015_2018\40_PROD\0004_Fox_3_Field_Summary_Report\ | File Name: 1530908-0004-CM-0012.dwg

Table E-1: Visual Inspection Checklist – Thermokarst Area

Checklist Item	Present (Y/N)	Feature ID (A, B, etc.)	Location Description	Easting	Northing	Length (m)	Width (m)	Depth (m)	Description	Photos
Settlement	Y	A	Regraded thermokarst area	413705	7614162	80	40	3	Deep thaw settlement with ponded water in centre	E2-3, 5 and 6
Erosion	N									
Lateral Movement	N									
Frost Action	N									
Sloughing	N									
Cracking	Y	B	Northwest slope above settlement area	413720.7	7614179	80	0.1	0.3	Long tension crack	E4,7, 8, 9 , 10, 11, 12
		D	South of west settlement area	413686.8	7614140	50	0.1	0.3	Tension crack	E15
		E	South of east settlement area	413732.7	7614147	30	0.1	0.3	Small tension crack	E16, 17 and 18
		F	East of settlement area	413745.6	7614172	20	0.1	0.3	Weathered tension crack	E19 and 20
Lateral Movement	N									
Animal Burrows	N									
Vegetation	N									
Staining	N									
Animal Burrows	N									
Vegetation Stress	N									
Seepage or Ponded Water	Y	C	Central low point of thermokarst area	413670	7614132	10	2	0.5	Ponded water	E13 and 14

Table E-1: Visual Inspection Checklist – Thermokarst Area

Checklist Item	Present (Y/N)	Feature ID (A, B, etc.)	Location Description	Easting	Northing	Length (m)	Width (m)	Depth (m)	Description	Photos
Vegetation Stress	N									
Debris and/or Liner Exposed	N									
Presence / Condition of Monitoring Instruments	N									
Features of Note / Other Observations	N									

Table E-2: Preliminary Stability Assessment – Thermokarst Area

Feature	Severity Rating	Extent
Settlement	Significant	Extensive
Erosion	Marginal	Isolated
Lateral Movement	Acceptable	-
Frost Action	Acceptable	-
Sloughing	Acceptable	-
Cracking	Significant	Numerous
Animal Burrows	Acceptable	-
Vegetation establishment	Acceptable	-
Staining	Acceptable	-
Vegetation Stress	Acceptable	-
Seepage/Ponded Water	Significant	Occasional
Debris and/or liner exposure	Acceptable	-
Other	-	-
Overall Performance	**Significant**	

Table E-3: Summary Table of Photographic Log – Thermokarst Area

Photo	Description	Easting	Northing	Date
E1	Thermokarst – Thermokarst from central drainage facing North (ATT30_Photo1.jpg)	413,706.2	7,614,147.0	17-Aug-2015
E2	Thermokarst – Edge of thaw settlement (ATT31_Photo1.jpg)	413,704.6	7,614,162.0	17-Aug-2015
E3	Thermokarst – Perimeter of thaw settlement (ATT32_Photo1.jpg)	413,710.5	7,614,178.0	17-Aug-2015
E4	Thermokarst – Tension crack along thaw settlement perimeter (ATT33_Photo1.jpg)	413,720.7	7,614,179.0	17-Aug-2015
E5	Thermokarst – Thaw settlement perimeter (ATT34_Photo1.jpg)	413,724.8	7,614,190.0	17-Aug-2015
E6	Thermokarst – Top of thaw settlement slope (ATT35_Photo1.jpg)	413,714.5	7,614,189.0	17-Aug-2015
E7	Thermokarst – Top of upper tension crack (ATT36_Photo1.jpg)	413,694.4	7,614,182.0	17-Aug-2015
E8	Thermokarst – Top of upper tension crack (ATT37_Photo2.jpg)	413,694.4	7,614,182.0	17-Aug-2015
E9	Thermokarst – Top of tension crack (ATT38_Photo1.jpg)	413,675.2	7,614,163.0	17-Aug-2015
E10	Thermokarst – Top of tension crack (ATT39_Photo2.jpg)	413,675.2	7,614,163.0	17-Aug-2015
E11	Thermokarst – Top of tension crack (ATT40_Photo1.jpg)	413,662.7	7,614,145.0	17-Aug-2015
E12	Thermokarst – Top of tension crack (ATT41_Photo2.jpg)	413,662.7	7,614,145.0	17-Aug-2015

Table E-3: Summary Table of Photographic Log – Thermokarst Area

Photo	Description	Easting	Northing	Date
E13	Thermokarst – Ponded water in low point of thermokarst settlement area (ATT42_Photo1.jpg)	413,670.0	7,614,132.0	17-Aug-2015
E14	Thermokarst – Ponded water in low point of thermokarst settlement area (ATT43_Photo2.jpg)	413,670.0	7,614,132.0	17-Aug-2015
E15	Thermokarst – Multiple tension cracks towards ponded water in settlement (ATT44_Photo1.jpg)	413,686.8	7,614,140.0	17-Aug-2015
E16	Thermokarst – Tension cracks around settlement area – Facing away from river, 15m long x 0.1m wide (ATT45_Photo1.jpg)	413,716.3	7,614,155.0	17-Aug-2015
E17	Thermokarst – Small tension crack towards filled in area (ATT46_Photo1.jpg)	413,732.7	7,614,147.0	17-Aug-2015
E18	Thermokarst – Small crack on slope down to filled settlement area (ATT47_Photo1.jpg)	413,743.2	7,614,153.0	17-Aug-2015
E19	Thermokarst – Weathered tension crack on slope above filled settlement area (ATT48_Photo1.jpg)	413,745.6	7,614,172.0	17-Aug-2015
E20	Thermokarst – Weathered tension crack on slope above filled settlement area (ATT49_Photo2.jpg)	413,745.6	7,614,172.0	17-Aug-2015
E21	Thermokarst – Facing thermokarst area towards river (ATT50_Photo1.jpg)	413,756.5	7,614,208.0	17-Aug-2015
E22	Thermokarst – Facing thermokarst settlement area and airstrip (ATT51_Photo1.jpg)	413,766.4	7,614,107.0	17-Aug-2015

4.0 CONCLUSIONS OF THERMOKARST AREA VISUAL INSPECTION

Based on the visual inspection, it appears that there will be further future settlement and cracking which may result in slope instability at the Thermokarst Area. Based on the 2013 remedial work experience, it seems that ongoing degradation (i.e., thaw) of the underlying permafrost will not be prevented by placing and grading additional granular fill over the settlement areas. Therefore, potential further settlement and slope movement should be expected to occur even if additional granular fill is placed in this area. The thaw of permafrost and related settlement in the Thermokarst Area may be a natural process (e.g., related to groundwater flow and the nearby river) and cannot be mitigated or prevented.

Additional settlement and slope movement in the Thermokarst Area is not expected to impact the airstrip. However, the proximity of the nearby landfills (i.e., Airstrip Landfills - Lobes M, L, I) to the Thermokarst Area settlement depression and tension cracks should be monitored. It may become necessary to relocate some or all of the nearby landfills (i.e., Airstrip Landfills - Lobes M, L, I) in the future.

5.0 RECOMMENDATIONS FOR THERMOKARST AREA

No additional placement or regrading of granular fill in the Thermokarst Area is recommended at this time. However, it is recommended that ongoing DLCU monitoring at FOX-3 should include the Thermokarst Area and nearby Airstrip Landfills (Lobes M, L and I) to ensure the integrity of these landfills is not impacted from future settlement in the Thermokarst Area.

ATTACHMENT

Photographs E1 to E22

PHOTOS

Photo E1: Thermokarst – Thermokarst from central drainage facing North (ATT30_Photo1.jpg)

Photo E2: Thermokarst – Edge of thaw settlement – Feature A (ATT31_Photo1.jpg)

Photo E3: Thermokarst – Perimeter of thaw settlement – Feature A (ATT32_Photo1.jpg)

Photo E4: Thermokarst – Feature B - tension crack along thaw settlement perimeter (ATT33_Photo1.jpg)

Photo E5: Thermokarst – Feature A - thaw settlement perimeter (ATT34_Photo1.jpg)

Photo E6: Thermokarst – Feature A - top of thaw settlement slope (ATT35_Photo1.jpg)

Photo E7: Thermokarst – Feature B - top of upper tension crack (ATT36_Photo1.jpg)

Photo E8: Thermokarst – Top of upper tension crack - Feature B (ATT37_Photo2.jpg)

Photo E9: Thermokarst – Top of tension crack - Feature B (ATT38_Photo1.jpg)

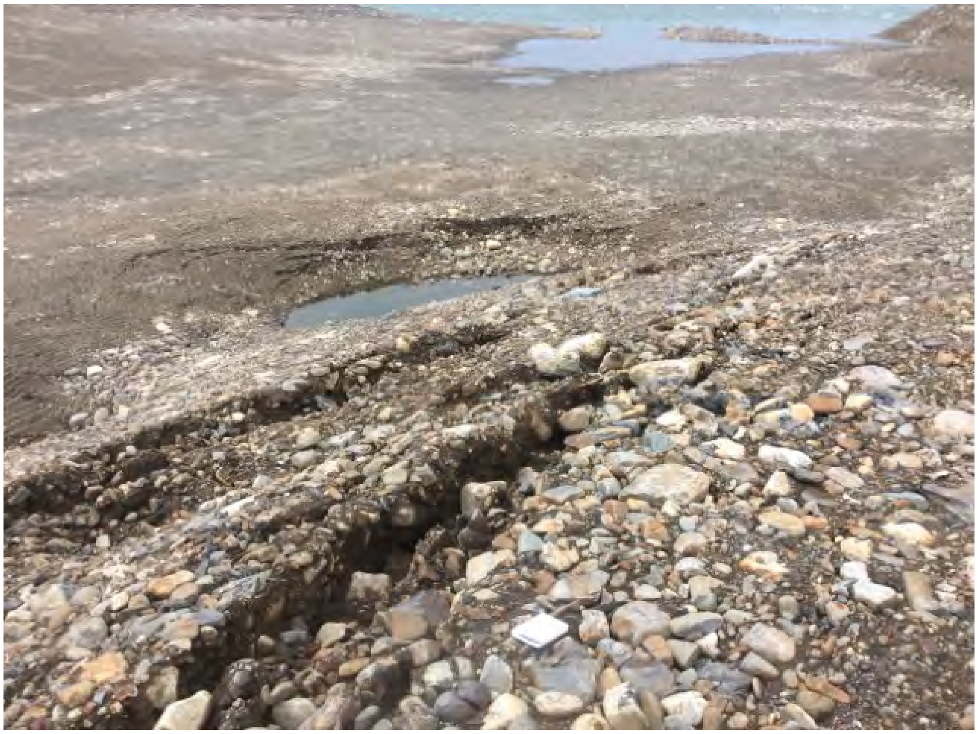


Photo E10: Thermokarst – Top of tension crack - Feature B (ATT39_Photo2.jpg)

Photo E11: Thermokarst – Top of tension crack - Feature B (ATT40_Photo1.jpg)

Photo E12: Thermokarst – Top of tension crack (ATT41_Photo2.jpg)

Photo E13: Thermokarst – Feature C - ponded water in low point of thermokarst settlement area (ATT42_Photo1.jpg)

Photo E14: Thermokarst – Feature C - ponded water in low point of thermokarst settlement area (ATT43_Photo2.jpg)

Photo E15: Thermokarst – Feature D - multiple tension cracks towards ponded water in settlement (ATT44_Photo1.jpg)

Photo E16: *Thermokarst – Tension cracks around settlement area – Facing away from river, 15m long x 0.1m wide (ATT45_Photo1.jpg)*

Photo 17: *Thermokarst – Feature E - small tension crack towards filled in area (ATT46_Photo1.jpg)*

Photo E18: Thermokarst – Feature E - small crack on slope down to filled settlement area (ATT47_Photo1.jpg)

Photo E19: Thermokarst – Feature F - weathered tension crack on slope above filled settlement area (ATT48_Photo1.jpg)

Photo E20: Thermokarst – Feature F - weathered tension crack on slope above filled settlement area (ATT49_Photo2.jpg)

Photo E21: Thermokarst – Facing thermokarst area towards river (ATT50_Photo1.jpg)

Photo E22: Thermokarst – Facing thermokarst settlement area and airstrip (ATT51_Photo1.jpg)

\\golder.gds\gal\ottawa\active\2015\3 proj\1530908 pwgsc dew line\6_1000_2015\9_final reports\r2_fox-3\app e_thermokarst area\3_appendix e_fox-3 thermokarst inspection photographs_nov2015.docx

At Golder Associates we strive to be the most respected global company providing consulting, design, and construction services in earth, environment, and related areas of energy. Employee owned since our formation in 1960, our focus, unique culture and operating environment offer opportunities and the freedom to excel, which attracts the leading specialists in our fields. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees who operate from offices located throughout Africa, Asia, Australasia, Europe, North America, and South America.

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

solutions@golder.com
www.golder.com

Golder Associates Ltd.
1931 Robertson Road
Ottawa, Ontario, K2H 5B7
Canada
T: +1 (613) 592 9600