Nanisivik Mine
Contaminated Soil Remediation
2016 Progress Report

Prepared for

CanZinco Mines Ltd

Prepared by

SRK Consulting (Canada) Inc.
1CB002.002
February 2017

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Executive Summary

This report provides a summary of contaminated soil remediation completed at the former Nanisivik bulk fuel storage facility in 2016.

Key remediation activities undertaken at the former bulk fuel storage facility in 2016 included:

- Managing the treatment facilities;
- Monitoring biopile performance;
- Off-loading remediated soil from the treatment cells;
- Decommissioning the soil treatment facilities; and
- Stockpiling waste liner from the decommissioned cells for disposal in 2017.

All soil that were present in the biopiles at the start of the 2016 field season met the soil quality remediation objectives by mid-June 2016.

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List of Abbreviations

CCME	Canadian Council of Ministers of the Environment
DND	Department of National Defence
F1	Hydrocarbon Fraction encompasses the range of equivalent carbon number from C6 to C10
F2	Hydrocarbon Fraction encompasses the range of equivalent carbon number from C11 to C16
F3	Hydrocarbon Fraction encompasses the range of equivalent carbon number from C17 to C34
F4	Hydrocarbon Fraction encompasses the range of equivalent carbon number from C35 to C50+
LTA	lower treatment area
NWB	Nunavut Water Board
PHC	petroleum hydrocarbons
PQL	practical quantitation limit
QA/QC	quality assurance/ quality control
RPD	relative percent difference
SQRO	soil quality remediation objective
SSRO	site specific remediation objective
UTA	upper treatment area

1 Introduction

The Nanisivik Mine produced lead and zinc mineral concentrates from 1976 to 2002. The mine infrastructure included a large tank farm providing year-round storage of diesel, gasoline and other fuels. Following mine closure, the facility was operated by a third party to supply fuel for commercial shipping and the Canadian Coast Guard. In February 2009 the Department of National Defence (DND) requested that the bulk fuel storage facility be decommissioned to allow for the construction of a naval facility. Decommissioning of the facility required remediation of petroleum hydrocarbon (PHC) contaminated soil known to be present within the facility's footprint.

Remediation was carried out using landfarming methodologies in which nutrients are added to the soil to stimulate biological activity. The remediation work commenced in 2011 under a Nunavut Water Board (NWB) approved decommissioning and reclamation plan, the *Abandonment and Reclamation Plan, Fuel Tank Farm, Former Nanisivik Mine Site, Nunavut* (Jacques Whitford Stantec Limited 2010) with SRK providing oversight of the work. The abandonment and reclamation plan was updated during the 2014 Water Licence Renewal/Amendment process. The *Abandonment and Reclamation Plan for Treatment of Contaminated Soil at the Former Nanisivik Mine* (SRK Consulting 2014a) was approved by the NWB on January 29, 2015. Subsequently, site specific remedial objectives (SSRO) for PHC Fraction 2 (F2) were accepted by the NWB on July 6, 2015 (NWB 2015). In 2016, PHC contaminated soil treatment activities were completed.

This report provides a summary of soil remediation activities completed at the former Nanisivik bulk fuel storage facility (the Site) in 2016. The report has been prepared to fulfill reporting requirements specified in Schedule B, Part J, Item 13 of NWB Water Licence No. 1AR-NAN1419.

2 Summary of Previous Remediation Activities

This section provides a brief introduction to soil remediation activities completed at the Site from 2011 to 2015. Principal reclamation and remediation work undertaken at the Site included:

- Decommissioning and removal of the petroleum storage tanks;
- Delineation of PHC contaminated soil;
- Construction of soil treatment facilities; and
- Excavation and treatment of PHC contaminated soil.

2011: Decommissioning of the tanks was undertaken in May and June 2011. Prior to demolition, the tanks were placed in a gas free state, and waste liquids and sludge were collected and placed in drums. All scrap materials and PHC contaminated waste from the tank removal were shipped off-site for disposal. Further details are provided in the 2011 Annual Report (Nyrstar 2012).

Delineation of the PHC contaminated soil was conducted to refine the estimated quantity of contaminated soil requiring treatment. Four areas of contamination were identified (Figure 1).

As reported in the 2011 Annual Report, the quantities of soil requiring treatment were determined to be approximately 17,000 m^3 (Nyrstar 2012).

In 2011, eight treatment cells, in which 'biopiles' of PHC contaminated soil were managed, were constructed. The constructed soil treatment facilities were established in two areas, the lower treatment area (LTA) and upper treatment area (UTA) (Figure 1). To provide supplementary treatment capacity, a temporary treatment facility was established within the footprint of the former fuel storage facility (the 'in situ treatment area'). Soil was excavated to remove liners from the former bulk fuel storage facility in 2011 and PHC contaminated soil was placed in the treatment facilities or stockpiled above known areas of contamination. The contaminated soil in the treatment facilities were aerated every four days until winter closure. Further details are provided in the 2011 Annual Report (Nyrstar 2012).

2012: Construction of the treatment facility was completed. Soil samples collected prior to the construction of treatment facilities detected no PHC impacts at the LTA or UTA. Details on the treatment facility design and construction are provided in the *Construction Summary Report, Nanisivik Mine Site* (WESA Inc. 2012).

Routine aeration of the soil continued. Nutrients were applied to the soil in the treatment facilities to encourage bioremediation of hydrocarbons. A vibrating screen to separate cobbles and boulders (oversized rocks) from the finer (<10 cm) contaminated soil, and to improve aeration measures, was mobilized to the Site in August. Soil previously excavated and stockpiled within the footprint of the former fuel storage facility was screened. Biopiles were established in eight new treatment cells. 2,450 m^3 of remediated soil was relocated to the former secondary containment area. Further information on the 2012 remediation activities is provided in the *Nanisivik Mine Contaminated Soil Remediation 2012 Progress Report* (SRK Consulting (Canada) Inc. and WESA, a division of BlueMetric Environmental Inc. 2013 [SRK and WESA 2013]) submitted with the 2012 Annual Report (Nyrstar 2013).

2013: The excavation and treatment of PHC contaminated soil continued. All PHC contaminated soil excavated was processed through the vibrating screen. 4,000 m^3 of oversized rocks was separated from the soil requiring treatment. The vibrating screen was shipped off-site in August. A portion of the former concentrate storage shed pad (the pad) was modified for use as a storage area for oversized rocks and PHC contaminated soil. Lead and zinc concentrate contaminated soil recovered during the modification of the pad was stored in lined crates at the edge of the pad. Biopiles were relocated from the treatment cells to the pad. Stockpiled PHC contaminated soil was relocated to treatment cells. Routine soil aeration and nutrient application continued. Further information on the 2013 remediation activities is provided in the *Nanisivik Mine Contaminated Soil Remediation 2013 Progress Report* (SRK 2014b) submitted with the 2013 Annual Report (Nyrstar 2014).

2014: The excavation and treatment of PHC contaminated soil continued. The portion of the pad utilized for the storage of PHC contaminated soil was expanded. During expansion soil potentially contaminated lead and zinc concentrate was scraped off the expanded area and stored in lined crates. Routine soil aeration and nutrient application continued. 3,650 m^3 of remediated soil was relocated from the treatment cells and pad to the former secondary

containment area. Stockpiled PHC contaminated soil was relocated to treatment cells. Further information on the 2014 remediation activities is provided in the *Nanisivik Mine Contaminated Soil Remediation 2014 Progress Report* (SRK 2015a) submitted with the 2014 Annual Report (Nyrstar 2015a).

2015: The excavation of PHC contaminated soil was completed and the liner remaining in the in situ treatment area was removed. Routine soil aeration and nutrient application continued. 3,650 m^3 of remediated soil was relocated from the treatment cells and pad to the former secondary containment area and an additional 600 m^3 of soil in four biopiles met the remediation objectives at the end of the field season. Stockpiled PHC contaminated soil was removed from the portion of the pad utilized and the pad vacated. The waste concentrate contaminated soil was securely packaged in preparation for shipment off-site for disposal. Further information on the 2015 remediation activities is provided in the *Nanisivik Mine Contaminated Soil Remediation 2015 Progress Report* (SRK 2016) submitted with the 2015 Annual Report (Nyrstar 2016).

3 Soil Quality Remediation Objectives

Soil quality remediation objectives (SQROs) applied during the treatment of PHC contaminated soil in 2016 are listed in Table 3-1. The SQROs include a SSRO for PHC F2 developed based on an assessment of the ecotoxicity of surface soil at the Site (Hemmera 2015). The remaining objectives were derived from generic commercial land use guidelines established by the Canadian Council of Ministers of the Environment (CCME) in *Canadian Environmental Quality Guidelines* (CCME 1999) and *Canada-Wide Standards for Petroleum Hydrocarbons in Soil* (CCME 2008). The PHC SQROs are specified in an update to *Appendix B Soil Quality Remediation Objectives* (SRK 2015b) of the *Abandonment and Reclamation Plan for Treatment of Contaminated Soil at the Former Nanisivik Mine* (SRK 2014a).

Table 3-1: Soil quality remediation objectives for the Nanisivik former bulk fuel storage facility.

Parameter	Surface Soil (mg/kg)	Subsurface Soil (mg/kg)
Benzene	110	360
Toluene	250	500
Ethylbenzene	300	600
Total Xylenes	350	700
PHC Fraction 1 (F1)	320	700
PHC Fraction 2 (F2)	410	1,000
PHC Fraction 3 (F3)	1,700	3,500
PHC Fraction 4 (F4)	3,300	10,000

Source: SRK 2015b.

The SQROs also include NWB approved SSROs for potential metals of concern developed based on a human health and ecological risk assessment (Jacques Whitford Environmental Limited 2003) as listed in Table 3-2.

Table 3-2: Soil quality remediation objectives for the metals at the Nanisivik dock site.

Parameter	Soil (mg/kg)
Lead	4,500
Zinc	44,000
Cadmium	2,800
Copper	5,900

Source: Jacques Whitford Environmental Limited. 2003.

The soil sampling methodology applied in 2016 to confirm the success of soil remediation and the decommissioning of the treatment facilities was described in the *Abandonment and Reclamation Plan for Treatment of Contaminated Soil at the Former Nanisivik Mine* (SRK 2014a) and its Appendix A, *Remediation Confirmatory Soil Sampling Methodology* (SRK 2014c). The sampling methodology has been reviewed and accepted by the NWB and is summarized in the following paragraphs.

The in situ sampling procedure required that the base of the area that formerly held the soil treatment facilities be subdivided into individual composite sampling areas of approximately 25 m by 25 m (or less). The combining of four or five evenly spaced aliquots of soil within the individual composite sample area created the composite sample. A single aliquot of soil from a specific point is a discrete sample. Discrete samples were analyzed by the laboratory as part of the quality assurance and control (QA/QC) measures.

The ex situ sampling procedure required that a composite sample to characterize a stockpile or biopile of soil be created by combining five discrete samples. Discrete remediation confirmatory samples were collected following the turning (aeration) of soil or during the placement of soil into a stockpile. The volume of soil represented by each composite sample typically ranged from 50 m^3 to 150 m^3, with no discrete sample representing more than 50 m^3.

QA/QC measures associated with the collection and analysis of the soil samples included the comparison of field screening results with laboratory data and laboratory analysis of blind duplicates and discrete QA/QC samples. The QA/QC plan requires one duplicate and three discrete samples from one composite sample for every ten composite samples submitted for laboratory analysis.

All remediation confirmation soil samples are analyzed at a laboratory accredited by the Canadian Association for Environmental Analytical Laboratories.

4 Treatment Facility Decommissioning Plan

The plan for decommissioning of the treatment facilities was described in the *Abandonment and Reclamation Plan for Treatment of Contaminated Soil at the Former Nanisivik Mine* (SRK 2014a). The plan has been approved by the NWB. The closure objective for the soil treatment facility is to leave the land in a condition that is suitable for commercial use. The soil quality closure criteria are described above in Section 3. The decommissioning activities entail:

- Contouring the surface of the treatment facility area to inhibit the ponding of water and allow for the commercial use of the area;
- Reuse of the treated soil for commercial purposes or to contour the site;
- Disposal of the waste liner recovered during the decommissioning of the treatment cells in a small landfill near the former industrial complex; and
- Removal from site: two portable trailers, a sea container, a portable outhouse, along with all equipment and supplies utilized for soil reclamation.

5 2016 Remediation Activities

5.1 Introduction

Key remediation activities undertaken at the Site in 2016 included:

- Monitoring biopile performance;
- Off-loading remediated soil from the treatment cells;
- Decommissioning of the treatment facilities;
- Remediation confirmation soil sampling of the base of the treatment facilities; and
- Stockpiling of liners removed from the treatment facilities for disposal in 2017.

The work plan for 2016 was overseen by SRK on behalf of CanZinco. SRK was at Site from June 8 to 14, June 28 to July 3 and August 22 to 30.

5.2 Biopile Management

The UTA and LTA treatment facilities are a series of geosynthetic lined cells where biopiles of PHC contaminated soil are managed (Figure 1). The biopiles of PHC contaminated soil are treated through two principal mechanisms: volatilization and bioremediation. Volatilization occurs when the soil is aerated. In the bioremediation process, microorganisms are responsible for the degradation of the PHC in the soil. Nutrients are added and moisture content managed to enhance the microbial performance.

The four biopiles that met the SQROs at the end of the 2015 season were offloaded on June 10. On June 11, approximately 600 m^3 of soil from cells LTA2 thru LTA6 were relocated to the empty cells and biopiles, with a height of 1.5 m, re-established in the LTA[1] (Appendix A: Photos 1 and 2). An estimated 3,000 m^3 of soil required treatment in 2016.

The biopiles in the UTA and LTA were turned and aerated as listed in Table 5-1 using an excavator (Appendix A: Photo 3). Each full bucket was lifted to the vertical extent of the bucket

[1] In order to accommodate all of the soil that lacked ex situ sample results when the pad was vacated in 2015, the height of the biopiles in LTA2 thru LTA6 in exceeded 1.5 m and the typical volume of 220 m^3(SRK 2016).

arm and then let to fall from elevation to achieve an air exchange. The bottom 0.3 to 0.5 m of the biopiles was frozen and therefore not aerated.

In 2016, upon receipt of positive remediation confirmatory (laboratory) results, aeration of the biopiles ceased. No measures were taken to enhance the microbial performance in 2016.

Table 5-1: 2016 aeration and off-loading schedule.

June						
S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	**9**	**10**	**11**	12	**13**
14	15	16	**17**	**18**	19	20
21	22	23	24	25	26	27
28	**29**	**30**				

July						
S	M	T	W	T	F	S
			1	**2**	3	4
5	6	7	8	9	10	11
12	**13**	**14**	**15**	**16**	**17**	**18**
19	**20**	21	22	23	24	25
26	27	28	29	30	31	

August						
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	**25**	**26**	27	28	29
30	31					

Days when biopiles were aerated

Days when biopiles in the cells were off-loaded

A stockpile of approximately 50 m^3 PHC contaminated soil that did not originate from CanZinco's activities was observed to have been placed to the east of treatment cell UTA5 when SRK arrived on site on June 8, 2016 (Appendix A, Photo 4). A liner appeared to be in place below the stockpile. The stockpile and liner were removed by DND's contractors before SRK returned to site on August 22 (Appendix A, Photo 5).

5.3 Chemical Analysis

Samples were collected and sent to Exova Canada Inc. (Ottawa, Ontario) for analysis. The sampling and analysis focused on:

Remediation Progress Monitoring: Progress monitoring included the characterization of biopiles in accordance with the *Remediation Confirmatory Soil Sampling Methodology* (SRK 2014c) to determine if the soil was remediated.

Decommissioning Confirmation Sampling: Confirmation sampling included the collection of soil samples along the base of the decommissioned treatment cells in accordance with the *Remediation Confirmatory Soil Sampling Methodology* (SRK 2014c) to confirm that the land has not been contaminated during soil treatment.

Quality Assurance/Quality Control Sampling: QA/QC measures associated with the collection and analysis of the soil samples included the laboratory analysis of blind duplicates and discrete QA/QC samples.

5.4 Management of Remediated Soil

The remediated biopiles were off-loaded as indicated in Table 5-1 upon receipt of remediation confirmation analytical results. The soil removed from the cells on June 10 (~600 m^3) was

relocated to a laydown yard built by DND's contractor on the east side of the concrete pad. The soil removed from the cells between June 29 and August 26 (~3,000 m^3) was relocated to a stockpile in the southern part of the former secondary containment area, the CanZinco Yard. DND's contractor was observed to be using soil from the stockpile for the construction of the new fueling facility during SRK's August visit. No records of the volume utilized by DND in 2016 were provided. A stockpile of remediated soil remained on the CanZinco Yard at the end of the season (Appendix A: Photo 6).

5.5 Decommissioning of Treatment Facilities

Decommissioning of the treatment cells commenced August 24 and involved the removal of the liner. Upwards of 0.3 m of remediated soil remained above the liner and an excavator, bulldozer and a skid steer loader were used along with manual labour to the remove the liner from the overlying soil (Appendix A: Photo 7). The liner was consolidated into a single stockpiled at the LTA and contained under snow fence (Appendix A: Photo 8) on August 29. The remediated soil was left on the footprint of the treatment facilities and used to contour the area occupied by the treatment facilities to inhibit the ponding of surface water. Following decommissioning, closure confirmatory samples were collected from the base of the decommissioned facilities (Appendix A: Photo 6).

6 Results

The sample locations are shown on figure 2 and the results are compared to the SQROs in tables 1 and 2 (back of report). QA/QC sample results are provided in table 3 (back of report). The samples identified with the ending "C" represent composite samples. Samples ending in "D" represent discrete grab samples. Samples ending in "Q" represent field duplicates.

6.1 Field Screening

Since 2002, soil samples from potentially PHC contaminated areas have been tested using a bag-headspace method and a portable gas detector. The field screening results were used effectively to guide the excavation of contaminated soil and to characterize soil that passed through the vibrating screener. Field screening results from soil samples collected from biopiles to which nutrients had been applied did not correlate well with the laboratory results (SRK 2016), as such no field screening was conducted in 2016.

6.2 Remediation Performance Monitoring Results

The biopiles in the UTA and LTA were managed as described in Section 4.2. All biopiles were sampled on June 13, 2016. All samples collected adhered to the ex situ remediation confirmatory soil sampling procedure. Results for 29 ex situ confirmatory soil samples are summarized in Table 1 (back of report). This includes 17 composite samples, ten discrete samples and two field duplicates. All samples were analyzed for PHC F2 to F4. Samples collected from the LTA and UTA 2,3,4,7 were also analyzed for potential metal contaminates of concern (lead, zinc, copper and cadmium) as these biopiles may have come into contact with waste concentrate in 2015. All results meet the SQROs.

6.3 Decommissioning Confirmation Results

Results for 23 treatment facility closure confirmation soil samples are summarized in Table 4 (back of report) and illustrated on Figure 2. All samples collected adhered to the in situ remediation confirmatory soil sampling procedure. Table 6-1 below indicates the areas where and the type of sample collected.

Table 6-1: Decommissioning sample summary.

Area	Floor Composite ("F-C")	Floor QA/QC ("F-Q, F-D")	Wall Composite ("W-C")	Wall QA/QC ("F-Q, F-D")	Total
UTA	10	4	-	-	14
LTA	5	4	-	-	9
Total	**10**	**8**	**-**	**-**	**23**

All samples were analyzed for PHC F2 to F4. All results meet the SQROs.

6.4 Quality Assurance and Quality Control

The complete listing of laboratory QA/QC samples and their relative percent difference (RPD) are shown in table 3 (back of report). QA/QC sample identifiers ending in "Q" represent blind field duplicate samples. These monitor a combination of the precision of the laboratory analyses, sample preparation errors, sample collection errors and genuine short scale variations in soil geochemistry. QA/QC sample identifiers ending in "D" represent discrete samples which monitor the homogeneity of composite sample areas. Results that are either below the detection limit for one or both sample pairs, or below the Practical Quantitation Limit (PQL) have RPD's identified as not applicable.

Four sample pairs have blind field duplicate analyses for PHC F2 to F4. One blind field duplicate sample pair was analyzed for lead, zinc, copper and cadmium. All of these pairs have results that were below the PQL for PHC F3 and F4. None of the RPDs were greater than 40% for PHC F2 or lead, zinc, cadmium or copper.

16 composite and discrete sample pairs were analyzed for petroleum hydrocarbons. Five of these composite and discrete sample pairs were also analyzed for lead, zinc, copper and cadmium. All of these pairs have results that were below the PQL for PHC F3 and F4. None of the RPDs were greater than 40% for PHC F2 or lead, zinc, cadmium or copper.

7 Discussion

The remediation of PHC contaminated soil that originated from the Nanisivik Mine bulk fuel storage facility is now complete. In 2016, 3,600 m^3 of soil meeting the SQROs was either used to recontour the treatment areas, relocated to a stockpile in the CanZinco Yard or utilized by DND's contractor for the construction of the naval facility.

The use of the UTA by DND for the storage of PHC contaminated soil in 2015 and 2016 did not result in impacts that exceeded the SQROs after the stockpile was removed.

8 Recommendations

The following recommendations are provided for the 2017 field season:

- The concentrate contaminated soil stored in the three wooden boxes are to be shipped off-site as TDG Class 9.3 dangerous waste and disposed of at an approved facility.
- The waste liner stockpiled at the LTA is to be transferred to the CanZinco landfill. To prevent inadvertent use of the CanZinco landfill site by others all waste liner is to be disposed of in the landfill within one field season and the landfill closed. The landfill is to be operated in accordance with the Landfill Operations and Maintenance Manual (Nyrstar 2015b) and covered in accordance with the NWB reviewed and accepted closure plan described in the Nanisivik Mine Non-Hazardous Waste Landfill (SRK 2014d) memorandum.
- The infrastructure rented by CanZinco from a local supplier remains on the surface lease. It is understood that the owner intends to remove one of the trailers this winter. CanZinco is to assist with the removal of the remaining infrastructure in 2017.
- A site inspection to observe/determine if there are indications that water is ponding on the reclaimed treatment areas should be completed and if required, action taken to inhibit future ponding of water made.

9 Conclusions

Key conclusions from the 2016 soil remediation activities are as follows:

- Soil removed from the constructed treatment cells and placed in the former secondary containment area was remediated in accordance with the SQROs.
- The footprint of the area used for the treatment facilities has been decommissioned in accordance with the plan. Decommissioning of the constructed soil treatment facilities has been completed.
- The use of the remediated soil by others cannot be monitored by CanZinco.
- An estimated 17,350 m^3 of PHC contaminated soil was treated during the remediation of the Nanisivik Mine bulk fuel storage facility

This report, Nanisivik Mine Contaminated Soil Remediation 2016 Progress Report, was prepared by

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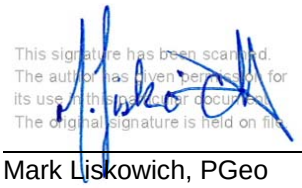

Mark Liskowich, PGeo

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

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Figures

579400 579600 579800 580000

8109800

8109600

159-6

Former Fuel Tank Facility

Area 2

Area 1 & 3 Excavation

Former Secondary Containment Area

Area 4 Excavation

CanZinco Yard

LTA-7 LTA-1 LTA-2 LTA-3 LTA-4 LTA-5 LTA-6

Stormwater Retention Pond

Lower Treatment Area

Upper Treatment Area

Soil Cover

Former Concentrate Shed Concrete Pad

Seacan

DND

Trailers

Almiq Yard

Office & Lunchroom

UTA-9 UTA-10

UTA-8 UTA-7 UTA-6

UTA-5 UTA-4 UTA-3 UTA-2 UTA-1

Stormwater Retention Pond

Vegetation Plots

LEGEND

☐ Water Quality Monitoring Station

0 40 80 120 160 200

Scale in Metres

NOTES

Coordinate System: UTM NAD 1983 Zone 16

Image Source: Google Maps 2016

srk consulting

SRK JOB NO.: 1CB002.002

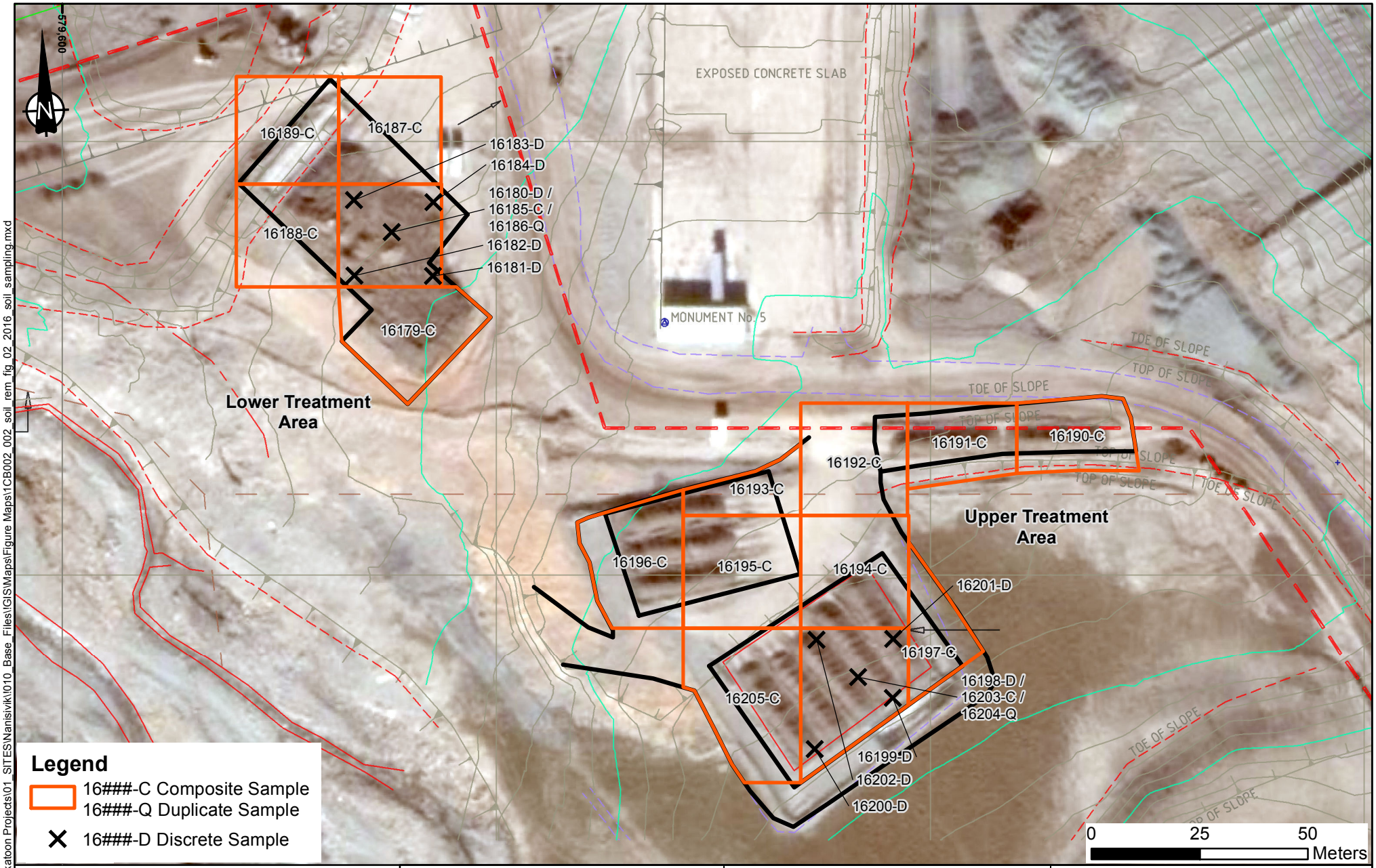
FILE NAME: 1CB002 002_Nanisivik_sample_loc_plan_2016.dwg

nyrstar

Nanisivik Mine Contaminated Soil Remediation
2015 Progress Report

General Site Arrangement

DATE:	APPROVED:	FIGURE:
Jan. 2016	AL	1



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NOTES:
- Topo and Basemap data: Government of Canada
  Dwg. No: C-N143-1216/03-SKETCH 01
- Image source: Google Maps 2016

srk consulting

Job No: 1CB002.002

Filename: 1CB002_002_soil_rem_fig_02_2016_soil_sampling

nyrstar

Contaminated Soil Remediation
2016 Progess Report

Former Nanisivik Mine

Decommissioning Confirmatory Soils Samples

Date:	Approved:	Figure:
Sept 2016	A.L.	2

Tables

Table 1: Biopile Remediation Progress Soil Samples

Location:			LTA1-5	LTA2-4	LTA3-5	LTA4-5	LTA5-4			
Sample ID:			16165-C	16166-C	16167-C	16168-C	16169-C	16170-D	16171-D	16172-D
Sample Date:			6/13/2016	6/13/2016	6/13/2016	6/13/2016	6/13/2016	6/13/2016	6/13/2016	6/13/2016
Moisture			6.4	7.6	8.3	7.2	7	7.9	6.9	6.3
Exova File #			1609934	1609934	1609934	1609934	1609935	1609935	1609935	1609935
Parameter	**Units**	**SQRO**[a]	**Analytical Results**							
Extractable Hydrocarbons										
F1 (C6-C10) [c,d,e]	µg/g	320								
F2 (C10-C16) [b]	µg/g	410	200	190	200	210	170	170	220	180
F3 (C10-C16) [c,d,e]	µg/g	1700	30	30	20	40	30	30	30	40
F4 (C34-C50) [c,d,e]	µg/g	3300	<20	<20	<20	<20	<20	<20	<20	<20
Metals										
Lead [b]	µg/g	4500	130	75	79	74	62	52	81	59
Zinc [b]	µg/g	44000	700	658	631	629	575	539	603	506
Cadmium [b]	µg/g	2800	1.9	1.7	1.7	1.8	1.6	1.4	1.7	1.4
Copper [b]	µg/g	5900	22	23	23	22	22	22	22	22

Bold Concentration greater than or equal to the SQROs

Notes:

"<" = Less than analytical method detection limit.

"-" = Analysis not conducted, or no guideline.

a) Former Nanisivik Mine Soil Quality Remediation Objectives (SQROs)

b) Site-specific Soil Remediation Objective (SSRO)

c) Canadian Council of Ministers of the Environment (CCME) petroleum hydrocarbon soil quality guidelines for commercial land use. The site-specific exposure pathways used to determine the standards include: soil ingestion, soil contact and management limits.

d) Guidelines are dependant upon depth of sample (surface, subsoil >1.5m depth). All samples are surface samples.

e) Guideline is dependant on medium grain size of soil analyzed (Fine <75 µm, Coarse >75 µm). Median grain size of all soil is coarse.

Table 1: Biopile Remediation Progress Soil Samples

Location:			LTA5-4			LTA6-5	LTA7-1	UTA1-5	UTA2-5	UTA3-5
Sample ID:			16173-D	16174-D	16175-Q	16176-C	16177-C	16164-C	16163-C	16162-C
Sample Date:			6/13/2016	6/13/2016	6/13/2016	6/13/2016	6/13/2016	6/13/2016	6/13/2016	6/13/2016
Moisture			6.5	7.2	5.2	7.3	8.8	6.5	6.9	7
Exova File #			1609935	1609935	1609935	1609935	1609935	1609934	1609934	1609934
Parameter	**Units**	**SQRO[a]**	**Analytical Results**							
Extractable Hydrocarbons										
F1 (C6-C10) [c,d,e]	µg/g	320						-	-	-
F2 (C10-C16) [b]	µg/g	410	200	140	230	220	40	220	160	190
F3 (C10-C16) [c,d,e]	µg/g	1700	40	30	40	40	30	40	30	30
F4 (C34-C50) [c,d,e]	µg/g	3300	<20	<20	<20	<20	<20	<20	<20	<20
Metals										
Lead [b]	µg/g	4500	64	70	53	50	940	-	80	72
Zinc [b]	µg/g	44000	509	685	537	558	4250	-	602	647
Cadmium [b]	µg/g	2800	1.4	1.8	1.4	1.3	11	-	1.7	1.8
Copper [b]	µg/g	5900	23	21	23	23	28	-	22	22

Bold Concentration greater than or equal to the SQROs

Notes:

"<" = Less than analytical method detection limit.

"-" = Analysis not conducted, or no guideline.

a) Former Nanisivik Mine Soil Quality Remediation Objectives (SQROs)

b) Site-specific Soil Remediation Objective (SSRO)

c) Canadian Council of Ministers of the Environment (CCME) petroleum hydrocarbon soil quality guidelines for commercial land use. The site-specific exposure pathways used to determine the standards include: soil ingestion, soil contact and management limits.

d) Guidelines are dependant upon depth of sample (surface, subsoil >1.5m depth). All samples are surface samples.

e) Guideline is dependant on medium grain size of soil analyzed (Fine <75 µm, Coarse >75 µm). Median grain size of all soil is coarse.

Table 1: Biopile Remediation Progress Soil Samples

Location:			UTA4-5	UTA5-6	UTA6-6	UTA7-6	UTA8-4			
Sample ID:			16161-C	16160-C	16159-C	16158-C	16156-C	16151-D	16152-D	16153-D
Sample Date:			6/13/2016	6/13/2016	6/13/2016	6/13/2016	6/13/2016	6/13/2016	6/13/2016	6/13/2016
Moisture			7.7	6.6	6.4	6.8	6.7	7.4	6.5	3.4
Exova File #			1609934	1609934	1609934	1609933	1609933	1609933	1609933	1609933
Parameter	**Units**	**SQRO[a]**	**Analytical Results**							
Extractable Hydrocarbons										
F1 (C6-C10) [c,d,e]	µg/g	320	-	-	-	-	-	-	-	-
F2 (C10-C16) [b]	µg/g	410	160	150	120	180	120	120	130	120
F3 (C10-C16) [c,d,e]	µg/g	1700	30	30	<20	20	30	20	30	20
F4 (C34-C50) [c,d,e]	µg/g	3300	<20	<20	<20	<20	<20	<20	<20	<20
Metals										
Lead [b]	µg/g	4500	106	-	-	75	-	-	-	-
Zinc [b]	µg/g	44000	576	-	-	558	-	-	-	-
Cadmium [b]	µg/g	2800	1.6	-	-	1.6	-	-	-	-
Copper [b]	µg/g	5900	21	-	-	24	-	-	-	-

Bold Concentration greater than or equal to the SQROs

Notes:

"<" = Less than analytical method detection limit.

"-" = Analysis not conducted, or no guideline.

a) Former Nanisivik Mine Soil Quality Remediation Objectives (SQROs)

b) Site-specific Soil Remediation Objective (SSRO)

c) Canadian Council of Ministers of the Environment (CCME) petroleum hydrocarbon soil quality guidelines for commercial land use. The site-specific exposure pathways used to determine the standards include: soil ingestion, soil contact and management limits.

d) Guidelines are dependant upon depth of sample (surface, subsoil >1.5m depth). All samples are surface samples.

e) Guideline is dependant on medium grain size of soil analyzed (Fine <75 µm, Coarse >75 µm). Median grain size of all soil is coarse.

Table 1: Biopile Remediation Progress Soil Samples

Location:			UTA8-4			UTA9-5	UTA10-5
Sample ID:			16154-D	16155-D	16157-Q	16150-C	16149-C
Sample Date:			6/13/2016	6/13/2016	6/13/2016	6/13/2016	6/13/2016
Moisture			8.6	5.9	7.7	5.6	7.7
Exova File #			1609933	1609933	1609933	1609933	1609933
Parameter	**Units**	**SQRO[a]**	**Analytical Results**				
Extractable Hydrocarbons							
F1 (C6-C10) [c,d,e]	µg/g	320	-	-	-	-	-
F2 (C10-C16) [b]	µg/g	410	100	130	100	150	110
F3 (C10-C16) [c,d,e]	µg/g	1700	<20	20	20	30	20
F4 (C34-C50) [c,d,e]	µg/g	3300	<20	<20	<20	<20	<20
Metals							
Lead [b]	µg/g	4500	-	-	-	-	-
Zinc [b]	µg/g	44000	-	-	-	-	-
Cadmium [b]	µg/g	2800	-	-	-	-	-
Copper [b]	µg/g	5900	-	-	-	-	-

Bold Concentration greater than or equal to the SQROs

Notes:

"<" = Less than analytical method detection limit.

"-" = Analysis not conducted, or no guideline.

a) Former Nanisivik Mine Soil Quality Remediation Objectives (SQROs)

b) Site-specific Soil Remediation Objective (SSRO)

c) Canadian Council of Ministers of the Environment (CCME) petroleum hydrocarbon soil quality guidelines for commercial land use. The site-specific exposure pathways used to determine the standards include: soil ingestion, soil contact and management limits.

d) Guidelines are dependant upon depth of sample (surface, subsoil >1.5m depth). All samples are surface samples.

e) Guideline is dependant on medium grain size of soil analyzed (Fine <75 µm, Coarse >75 µm). Median grain size of all soil is coarse.

Table 2: In Situ Site Decommissioning Confirmation Soil Samples

Location:			Lower Treatment Area							
Sample ID:			16179-C	16180-D	16183-D	16184-D	16185-C	16186-Q	16187-C	16188-C
Sample Date:			8/28/2016	8/28/2016	8/28/2016	8/28/2016	8/28/2016	8/28/2016	8/28/2016	8/28/2016
Moisture			4.5	5.2	4.6	5.3	4.9	4.9	2.1	3.6
Exova File #			1615542	1615542	1615542	1615542	1615542	1615542	1615542	1615542
Parameter	**Units**	**SQRO[a]**	**Analytical Results**							
Extractable Hydrocarbons										
F1 (C6-C10) [c,d,e]	µg/g	320	-	-	-	-	-	-	-	-
F2 (C10-C16) [b]	µg/g	410	100	90	90	100	110	100	110	80
F3 (C10-C16) [c,d,e]	µg/g	1700	30	30	<20	<20	20	20	20	<20
F4 (C34-C50) [c,d,e]	µg/g	3300	<20	<20	<20	<20	<20	<20	<20	<20

Bold Concentration greater than or equal to the SQROs

Notes:

"<" = Less than analytical method detection limit.

"-" = Analysis not conducted, or no guideline.

a) Former Nanisivik Mine Soil Quality Remediation Objectives (SQROs)

b) Site-specific Soil Remediation Objective (SSRO)

c) Canadian Council of Ministers of the Environment (CCME) petroleum hydrocarbon soil quality guidelines for commercial land use. The site-specific exposure pathways used to determine the standards include: soil ingestion, soil contact and management limits.

d) Guidelines are dependant upon depth of sample (surface, subsoil >1.5m depth). All samples are surface samples.

e) Guideline is dependant on medium grain size of soil analyzed (Fine <75 µm, Coarse >75 µm). Median grain size of all soil sampled is coarse.

Table 2: In Situ Site Decommissioning Confirmation Soil Samples

Location:			LTA	Upper Treatment Area						
Sample ID:			16189-C	16190-C	16191-C	16192-C	16193-C	16194-C	16195-C	16196-C
Sample Date:			8/28/2016	8/28/2016	8/28/2016	8/28/2016	8/28/2016	8/28/2016	8/28/2016	8/28/2016
Moisture			3.8	4.3	6.1	7.2	4.5	3.9	3.9	4.4
Exova File #			1615542	1615543	1615543	1615543	1615543	1615543	1615543	1615543
Parameter	**Units**	**SQRO[a]**	**Analytical Results**							
Extractable Hydrocarbons										
F1 (C6-C10) [c,d,e]	µg/g	320	-	-	-	-	-	-	-	-
F2 (C10-C16) [b]	µg/g	410	80	100	100	100	120	90	140	160
F3 (C10-C16) [c,d,e]	µg/g	1700	20	30	<20	<20	<20	20	20	30
F4 (C34-C50) [c,d,e]	µg/g	3300	<20	<20	<20	<20	<20	<20	<20	<20

Bold Concentration greater than or equal to the SQROs

Notes:

"<" = Less than analytical method detection limit.

"-" = Analysis not conducted, or no guideline.

a) Former Nanisivik Mine Soil Quality Remediation Objectives (SQROs)

b) Site-specific Soil Remediation Objective (SSRO)

c) Canadian Council of Ministers of the Environment (CCME) petroleum hydrocarbon soil quality guidelines for commercial land use. The site-specific exposure pathways used to determine the standards include: soil ingestion, soil contact and management limits.

d) Guidelines are dependant upon depth of sample (surface, subsoil >1.5m depth). All samples are surface samples.

e) Guideline is dependant on medium grain size of soil analyzed (Fine <75 µm, Coarse >75 µm). Median grain size of all soil sampled is coarse.

Table 2: In Situ Site Decommissioning Confirmation Soil Samples

Location:			Upper Treatment Area						
Sample ID:			16197-C	16199-D	16200-D	16202-D	16203-C	16204-Q	16205-C
Sample Date:			8/28/2016	8/28/2016	8/28/2016	8/28/2016	8/28/2016	8/28/2016	8/28/2016
Moisture			5.4	5.8	6.7	5.7	5.2	6.1	4.4
Exova File #			1615543	1615543	1615543	1615544	1615544	1615544	1615544
Parameter	**Units**	**SQRO[a]**	**Analytical Results**						
Extractable Hydrocarbons									
F1 (C6-C10) [c,d,e]	µg/g	320	-	-	-	-	-	-	-
F2 (C10-C16) [b]	µg/g	410	90	80	130	110	100	100	110
F3 (C10-C16) [c,d,e]	µg/g	1700	<20	<20	30	30	20	20	20
F4 (C34-C50) [c,d,e]	µg/g	3300	<20	<20	<20	<20	<20	<20	<20

Bold Concentration greater than or equal to the SQROs

Notes:

"<" = Less than analytical method detection limit.

"-" = Analysis not conducted, or no guideline.

a) Former Nanisivik Mine Soil Quality Remediation Objectives (SQROs)

b) Site-specific Soil Remediation Objective (SSRO)

c) Canadian Council of Ministers of the Environment (CCME) petroleum hydrocarbon soil quality guidelines for commercial land use. The site-specific exposure pathways used to determine the standards include: soil ingestion, soil contact and management limits.

d) Guidelines are dependant upon depth of sample (surface, subsoil >1.5m depth). All samples are surface samples.

e) Guideline is dependant on medium grain size of soil analyzed (Fine <75 µm, Coarse >75 µm). Median grain size of all soil sampled is coarse.

Table 3: Quality Assurance and Quality Control Soil Samples

Location:				LTA5-4						UTA8-4
Sample Parent:				16169-C						16156-C
Duplicate ID:				16170-D	16171-D	16172-D	16173-D	16174-D	16175-Q	16151-D
Parameter	**Units**	**MRL**	**PQL**	**Analytical Results**						
PHC Fraction 2										
Sample Result	µg/g	10	50	170	170	170	170	170	170	120
Duplicate Result	µg/g	10	50	170	220	180	200	140	230	120
RpD	%			0%	26%	6%	16%	19%	30%	0%
PHC Fraction 3										
Sample Result	µg/g	20	100	30	30	30	30	30	30	30
Duplicate Result	µg/g	20	100	30	30	40	40	30	40	20
RpD	%			na	na	na	na	na	na	na
PHC Fraction 4										
Sample Result	µg/g	20	100	<20	<20	<20	<20	<20	<20	<20
Duplicate Result	µg/g	20	100	<20	<20	<20	<20	<20	<20	<20
RpD	%			na	na	na	na	na	na	na
Lead										
Sample Result	µg/g	1	5	62	62	62	62	62	62	-
Duplicate Result	µg/g	1	5	52	81	59	64	70	53	-
RpD	%			18%	27%	5%	3%	12%	16%	
Zinc										
Sample Result	µg/g	2	10	575	575	575	575	575	575	-
Duplicate Result	µg/g	2	10	539	603	506	509	685	537	-
RpD	%			6%	5%	13%	12%	17%	7%	
Cadmium										
Sample Result	µg/g	0.5	2.5	1.6	1.6	1.6	1.6	1.6	1.6	-
Duplicate Result	µg/g	0.5	2.5	1.4	1.7	1.4	1.4	1.8	1.4	-
RpD	%			13%	6%	13%	13%	12%	13%	
Copper										
Sample Result	µg/g	1	5	22	22	22	22	22	22	-
Duplicate Result	µg/g	1	5	22	22	22	23	21	23	-
RpD	%			0%	0%	0%	4%	5%	4%	

Bold RpD value is greater than or equal to 40% and the concentrations of both samples are greater than the PQL.

Notes:

na *RpD value is not applicable because one or both results are less than the PQL.*

RpD *Relative Percent Difference = (Difference/Average)*100.*

PQL *Practical Quantitation Limit = 5 * Method Reporting Limit (MRL)*

MRL *Method Reporting Limit*

Table 3: Quality Assurance and Quality Control Soil Samples

Location:				UTA8-4					Lower Treatment Area	
Sample Parent:				16156-C					16185-C	
Duplicate ID:				16152-D	16153-D	16154-D	16155-D	16157-Q	16180-D	16183-D
Parameter	**Units**	**MRL**	**PQL**	**Analytical Results**						
PHC Fraction 2										
Sample Result	µg/g	10	50	120	120	120	120	120	110	110
Duplicate Result	µg/g	10	50	130	120	100	130	100	90	90
RpD	%			8%	0%	18%	8%	18%	20%	20%
PHC Fraction 3										
Sample Result	µg/g	20	100	30	30	30	30	30	20	20
Duplicate Result	µg/g	20	100	30	20	<20	20	20	30	<20
RpD	%			na	na	na	na	na	na	na
PHC Fraction 4										
Sample Result	µg/g	20	100	<20	<20	<20	<20	<20	<20	<20
Duplicate Result	µg/g	20	100	<20	<20	<20	<20	<20	<20	<20
RpD	%			na	na	na	na	na	na	na
Lead										
Sample Result	µg/g	1	5	-	-	-	-	-	-	-
Duplicate Result	µg/g	1	5	-	-	-	-	-	-	-
RpD	%									
Zinc										
Sample Result	µg/g	2	10	-	-	-	-	-	-	-
Duplicate Result	µg/g	2	10	-	-	-	-	-	-	-
RpD	%									
Cadmium										
Sample Result	µg/g	0.5	2.5	-	-	-	-	-	-	-
Duplicate Result	µg/g	0.5	2.5	-	-	-	-	-	-	-
RpD	%									
Copper										
Sample Result	µg/g	1	5	-	-	-	-	-	-	-
Duplicate Result	µg/g	1	5	-	-	-	-	-	-	-
RpD	%									

Bold RpD value is greater than or equal to 40% and the concentrations of both samples are greater than the PQL.

Notes:

na *RpD value is not applicable because one or both results are less than the PQL.*

RpD *Relative Percent Difference = (Difference/Average)*100.*

PQL *Practical Quantitation Limit = 5 * Method Reporting Limit (MRL)*

MRL *Method Reporting Limit*

Table 3: Quality Assurance and Quality Control Soil Samples

	Location:			Lower Treatment Area		Upper Treatment Area			
	Sample Parent:			16185-C		16203-C			
	Duplicate ID:			16184-D	16186-Q	16199-D	16200-D	16202-D	16203-Q
Parameter	**Units**	**MRL**	**PQL**	**Analytical Results**					
PHC Fraction 2									
Sample Result	µg/g	10	50	110	110	100	100	100	100
Duplicate Result	µg/g	10	50	100	110	80	130	110	100
RpD	%			10%	0%	22%	26%	10%	0%
PHC Fraction 3									
Sample Result	µg/g	20	100	20	20	20	20	20	20
Duplicate Result	µg/g	20	100	<20	20	<20	30	30	20
RpD	%			na	na	na	na	na	na
PHC Fraction 4									
Sample Result	µg/g	20	100	<20	<20	<20	<20	<20	<20
Duplicate Result	µg/g	20	100	<20	<20	<20	<20	<20	<20
RpD	%			na	na	na	na	na	na
Lead									
Sample Result	µg/g	1	5	-	-	-	-	-	-
Duplicate Result	µg/g	1	5	-	-	-	-	-	-
RpD	%								
Zinc									
Sample Result	µg/g	2	10	-	-	-	-	-	-
Duplicate Result	µg/g	2	10	-	-	-	-	-	-
RpD	%								
Cadmium									
Sample Result	µg/g	0.5	2.5	-	-	-	-	-	-
Duplicate Result	µg/g	0.5	2.5	-	-	-	-	-	-
RpD	%								
Copper									
Sample Result	µg/g	1	5	-	-	-	-	-	-
Duplicate Result	µg/g	1	5	-	-	-	-	-	-
RpD	%								

Bold RpD value is greater than or equal to 40% and the concentrations of both samples are greater than the PQL.

Notes:

na *RpD value is not applicable because one or both results are less than the PQL.*

RpD *Relative Percent Difference = (Difference/Average)*100.*

PQL *Practical Quantitation Limit = 5 * Method Reporting Limit (MRL)*

MRL *Method Reporting Limit*

Appendix A – Photographic Record

Photo 1: Some **soil** was relocated from the LTA to the UTA in early June. Facing north.

Photo 2: Biopiles with a height of approximately 1.5 m were re-established in the LTA in early June. Facing north.

Photo 3: The soil in the UTA is being aerated in early June. Facing west.

Photo 4: A stockpile of PHC contaminated soil was observed to have been placed to the east of treatment cell UTA5 on June 8, 2016. Facing north.

Photo 5: The stockpile and liner was removed by DND's contractors before August 22. Facing north.

Photo 6: The stockpile of remediated soil is outlined in yellow. Closure samples were collected from the base of the LTA after the liner was removed. Facing north.

Photo 7: Heavy equipment is used to expose the liner for removal. Facing north.

Photo 8: The liner was consolidated into a single stockpiled at the LTA and covered with orange snow fencing to secure it in place over the winter. Facing north.