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Remedial Action Plan / Risk Management Plan, Canadian Coast Guard Southside Base, Berth 28, Southside Road, St. John's, NL

Prepared for

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Final Report

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EXECUTIVE SUMMARY

Stantec Consulting Ltd. (Stantec) was retained by Public Works and Government Services Canada (PWGSC) and Fisheries and Oceans Canada (DFO) to develop a remedial action plan (RAP) / risk management plan (RMP) for the Canadian Coast Guard (CCG) Southside Base located off Southside Road in St. John's, Newfoundland and Labrador (NL) (refer to Drawing No. 121412715-EE-01 in Appendix A). The purpose of this work is to evaluate remedial alternatives and determine the most viable option(s) to address petroleum hydrocarbon impacted soil identified on the property.

Based on the results of previous environmental investigations of the site including the most recent Phase II ESA and HHERA completed by Stantec in 2013 and 2014, respectively, an approximately 340 m^2 area of soil at the site is impacted with F1 and F2 PHC fraction concentrations exceeding the toxicological based SSTLs (F1 = 474 mg/kg; F2 = 4,560 mg/kg) for indoor air. The potential for vapour intrusion into the proposed site building was further evaluated by carrying out a soil vapour sampling program at the site as part of the HHRA. This soil vapour data was used to predict indoor air concentrations once the building is completed, and further supported the HHRA findings that unacceptable risk may be present at the site for a Site Worker and Site Visitor (i.e., building occupant) exposed to F1 and F2 PHC fractions and benzene via inhalation of indoor air. Therefore, based on the findings of the HHERA there is a requirement for the implementation of remedial / risk management measures at the site to address the potential for soil vapour intrusion into the proposed future site building associated with residual petroleum hydrocarbon impacted soil at the site.

The number of feasible options for remediation at the CCG Southside Base site is considered limited due to the physical setting of the site, which is located immediately adjacent to the marine environment (i.e., St. John's Harbor), and is characterized by a shallow groundwater table, and dynamic groundwater flow regime (i.e., tidal influence and direct marine-surface water interaction) that would be expected to impact the application and effectiveness of many remediation technologies at the site. Two remedial options were evaluated to address the potential for soil vapour intrusion into the proposed future site building associated with residual petroleum hydrocarbon impacted soil at the site:

- Option #1: Soil Remediation; and,
- Option #2: Implementation of a Risk Management Approach (Installation of a Sub-slab Venting System).

Both these options satisfy the fundamental threshold criteria of overall protection of human health and the environment; and, compliance with applicable regulations and regulatory requirements. In addition, both of these options can be readily implemented at the site over a relatively short time-frame thereby avoiding the requirement for interim remedial/risk management measures to manage potential indoor vapor intrusion issues during the treatment

period. Please note this remedial options evaluation is intended to address site impacts based on Stantec's understanding of current conditions at the site, as well as future land use associated with the proposed office tower building development, and may not be adequate to address site impacts under different future land use conditions at the site.

Based on a review of the two remedial options' techniques, advantages/disadvantages, as well as other characteristics and opinion of probable costs, Remedial Options #2 is selected as the preferred option to address the potential for soil vapour intrusion into the proposed future site building associated with residual petroleum hydrocarbon impacted soil at the site. Limited design and construction details are currently available for the proposed office tower building, which preclude the development of a detailed remediation plan at this time. However, a number of recommendations are provided herein that can be incorporated into a detailed remediation plan once additional information is available regarding the development plans for the site. In particular recommendations are provided with respect to the design, installation and operation of the sub-slab venting system, as well as handling and disposal practices for contaminated material encountered during building construction excavation activities. In addition, a number of recommendations are provided with respect to health and safety requirements to address potential hazards associated with environmental contamination on the property during the construction project. Please note that the provided health and safety requirements are not considered a full health and safety plan for the site, and it is recommended that a site-specific Health and Safety plan be prepared for the construction project to provide appropriate protection against all known and potential hazards that may be encountered during excavation activities associated with building construction. The plan should describe the potential hazards at the sites, identify the personnel responsible for health and safety, and outline the health and safety procedures and equipment required for activities at the site to minimize the potential hazards to all personnel.

The statements made in the executive summary are subject to the same limitations included in the Closure Section 8.0 and are to be read in conjunction with the remainder of this report.

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1.0 INTRODUCTION

Stantec Consulting Ltd. (Stantec) was retained by Public Works and Government Services Canada (PWGSC) and Fisheries and Oceans Canada (DFO) to develop a remedial action plan (RAP) / risk management plan (RMP) for the Canadian Coast Guard (CCG) Southside Base located off Southside Road in St. John's, Newfoundland and Labrador (NL) (refer to Drawing No. 121412715-EE-01 in Appendix A). The purpose of this work is to evaluate remedial alternatives and determine the most viable option(s) to address petroleum hydrocarbon impacted soil identified on the property.

1.1 Site Description

The Canadian Coast Guard (CCG) Southside Base is located on the Southside Road in St. John's, NL, and consists of the Administration Building, the Buoy Maintenance Facility, Berth 28 and the Hazardous Materials Storage Area. The subject site is the area adjacent to the Buoy Maintenance Facility known as Berth 28 (Pier 28).

Berth 28 is currently being used as an equipment storage yard and parking area for the CCG Southside Base. The site is intended to be the future location of the CCG Southside Base office tower. The office tower will be located on the eastern portion of the site between the property boundary and the City of St. John's sewer outfall. Although the final design has not been confirmed to date, it is understood that the future site building will be a slab-on-grade multi-story office tower with a footprint of approximately 1,850 m^2.

The Berth 28 property is approximately 1 ha in area consisting of the concrete deck/wharf and the land up-gradient of the wharf. The subject property site is located in an industrial area along the south side of the St. John's Harbour Front. The CCG Buoy Maintenance Facility of the CCG Southside Base (Pier 29) is located adjacent to the southwest of the site. To the northeast of the site is HMCS Cabot (Pier 27). Southside Road is located to the southeast of the site and provides site access. The waters of St. John's Harbour are located to the northwest.

According to aerial photographs and information provided on historical fire insurance plans, the subject site and adjacent properties have had a long history of commercial activity spanning more than 100 years. Records dating back to 1880 indicate that historical commercial activities at the site included seal oil rendering and manufacturing, cooperage, an ice house, a machine shop, as well as various lay-down and warehouse storage of seal and cod oil, fish, salt, lumber, coal, fertilizer, marine supplies, and flour and molasses. The first record of storage of petroleum hydrocarbon product was in 1914, and included a 50 foot (15.2 m), 35,000 gallon (132,500 L) aboveground oil storage tank (AST) located to the northeast of the site near Southside Road. Various additional fuel oil storage tanks were present on the property up until 1993. The current use of the site as a laydown/storage yard appears to have existed since 2003.

Based on existing data for the area, the principal natural overburden material, beneath surficial fill material, is glacial till and discontinuous marine sediments, which directly overlies bedrock.

The characteristic permeability of these soils is moderate. The site is relatively flat with a slope along the southeast boundary adjacent to Southside Road. Surface water drainage on the site is expected to flow towards St. John's Harbour, located adjacent to the site along the northwest boundary. Two catch basins are present on the site, and all storm water drainage is expected to be either by these catch basins or overland flow. Based on the local topography and the groundwater levels noted in the monitor wells installed for the Phase II ESA (Stantec, 2013a), the direction of groundwater flow at the site is to the northwest towards St. John's Harbour. The direction of regional groundwater flow is also towards the northwest. Groundwater on the Site and in the general area of the Site is not utilized as a source of drinking water.

1.2 Previous Work

Previous environmental work conducted at the site included an initial Phase II Environmental Site Assessment (ESA) test pitting program by MGI Limited in 2001, a sediment sampling program in adjacent portions of the harbor by AMEC Earth and Environmental (AMEC) in 2002, and most recently a Phase II ESA and Human Health and Ecological Risk Assessment by Stantec in 2013 and 2014, respectively. The results of these investigations are documented in the following reports:

- Phase II Environmental Site Assessment at Canadian Coast Guard Base, Berth 28, Southside, St. John's Harbour, St. John's, NL, MGI Limited, November 2001;
- Phase II Environmental Site Assessment, Water Lot Sediment Sampling, Canadian Coast Guard Southside Base, St. John's, NL, AMEC Earth & Environmental, April 2002;
- Phase II Environmental Site Assessment, Canadian Coast Guard Southside Base, Berth 28, Southside Road, St. John's, NL, Stantec Consulting Ltd., April 2013;
- Groundwater Resampling Program, Canadian Coast Guard Southside Base, Berth 28, Southside Road, St. John's, NL, Stantec Consulting Ltd., September, 2013; and,
- Human Health and Ecological Risk Assessment, Canadian Coast Guard Southside Base, Berth 28, Southside Road, St. John's, NL, March, 2014.

In 2001, an initial Phase II ESA was completed on the property that involved the placement of ten (10) test pits across site. Refer to Drawing No. 121412715-EE-02 in Appendix A for the locations of the test pits. Samples collected from the test pits were analyzed for petroleum hydrocarbons (i.e., total petroleum hydrocarbons (TPH) and benzene, toluene, ethylbenzene and xylenes (BTEX)), metals and polycyclic aromatic hydrocarbons (PAHs). Petroleum hydrocarbons were detected in all of the test pits, with four (4) test pits (i.e., TP104, TP106, TP107 and TP110) having concentrations that exceeded applicable guidelines at that time. Metals were detected in all of the test pits, with six (6) test pits (i.e., TP101 to TP103, TP105, TP106 and TP107) having concentrations that exceeded applicable guidelines at that time. PAHs were detected in the six test pits that were sampled, with five (5) test pits (i.e., TP101, TP103, TP105, TP106 and TP107) having concentrations that exceeded applicable guidelines at that time. See Appendix B for a copy of the laboratory results for the MGI 2001 test pit investigation.

In 2002, Waterlot Sediment Sampling was conducted at the CCG Southside Base, and included sediment sample locations immediately adjacent to the subject site. The scope of work included the collection of ten (10) ocean bottom sediment samples and the laboratory analysis of TPH and BTEX, metals, PAHs and polychlorinated biphenyls (PCBs). Exceedances of TPH, metals, PCBs and PAHs concentrations greater than the applicable guidelines at the time were identified, including in several sediment samples collected adjacent to the site.

In 2013, Stantec carried out a Phase II ESA as part of a combined geotechnical/environmental investigation of the property. The Phase II ESA included the drilling of fifteen (15) boreholes completed as monitor wells, and associated soil and groundwater sampling. Twelve (12) geotechnical/environmental boreholes (i.e., BH1 to BH12) were placed on the eastern portion of the site in the vicinity of the proposed new office tower building, and three (3) additional environmental boreholes completed as monitor wells (i.e., BH13 to BH15) were installed on the western portion of the site. Refer to Drawing No. 121412715-EE-02 in Appendix A for the locations of the boreholes. No liquid phase petroleum hydrocarbons (free product) were observed in any of the monitor wells completed on site. Soil and groundwater samples were analyzed for petroleum hydrocarbons, metals, PCBs and PAHs. Widespread impacts were identified in soil and groundwater across the site, with concentrations of petroleum hydrocarbons, metals and PAHs identified in soil and groundwater at numerous borehole locations exceeding the applicable Tier I guidelines. Concentrations of PCBs were not detected in any of the soil or groundwater samples analyzed at the site. In addition, leachability analysis was carried out for petroleum hydrocarbons, lead, fluoranthene, naphthalene and phenanthrene in select soil samples with concentrations exceeding the applicable Tier I guidelines to further evaluate disposal options and requirements for treatment. Concentrations of lead were detected in the leachate from the tested samples, but they did not exceed the regulatory guideline (i.e., 5,000 µg/L). Detected levels of petroleum hydrocarbons, fluoranthene, naphthalene and phenanthrene were also identified in leachate, but there are no known regulatory guidelines for leachate for these parameters. Due to poor soil recovery during borehole drilling and resulting limited soil sample size, leachate analysis could not be performed for all metals and PAHs parameters that exceeded guidelines at the site. See Appendix B for the laboratory analytical summary tables (Table B.1 to B.13) for the Phase II ESA.

On May 14, 2013, Stantec carried out a groundwater resampling program at the site to further evaluate elevated concentrations of dissolved PAHs and mercury in groundwater identified during the Phase II ESA. In particular, during the Phase II ESA groundwater sampling program, the presence of sediment was noted in a number of groundwater samples submitted for analysis that returned elevated concentrations of PAHs and mercury. Since, it was considered possible that the concentrations of dissolved PAHs and mercury identified in the groundwater samples could potentially have been derived from particle-bound PAHs and mercury in the sediment that were liberated into a dissolved phase during laboratory sample preparation, it was recommended to resample groundwater in select monitor wells at the site and verify actual dissolved groundwater concentrations of PAHs and mercury prior to commencing the Human Health and Ecological Risk Assessment for the property. Since the analytical methods used by the laboratory for analysis of PAHs and mercury in groundwater does not include sample filtration, it was requested that the groundwater samples collected as part of the resampling

program be allowed to settle, followed by decanting the sample prior to analysis. Analytical results from the groundwater resampling program showed a reduction in the concentrations of PAHs and mercury as compared to the Phase II ESA results; and, with the exception of mercury in groundwater in monitor well BH15, no concentrations of PAHs and mercury were identified that exceeded applicable guidelines. See Appendix B for the laboratory analytical summary tables (Table B.10 and B.11) for the groundwater resampling program.

1.3 Human Health and Ecological Risk Assessment Results

A human health and ecological risk assessment was carried out to address human and ecological health risks associated with petroleum hydrocarbons, PAHs and metals in soil and groundwater at the site.

The human health risk assessment considered a "Current Land Use" scenario (i.e., industrial land use comprising equipment storage yard and parking area), as well as "Future Land Use" conditions (i.e., commercial land use comprising a proposed office tower building development). Based on the results of a qualitative risk screening, chemicals of concern (COCs), including benzene, petroleum hydrocarbon (PHC) fractions F1, F2 and F3, naphthalene, carcinogenic PAHs, and lead in soil were carried forward in the human health risk assessment, and were assessed with respect to potential exposure to various current and future human receptors on the property, including commercial workers (office), dockyard workers, site visitors, and construction workers (during site development).

Based on a qualitative human health risk evaluation, the conceptual model developed for evaluating the quantitative exposure of the human receptors included:

- Site workers and visitor may be exposed to petroleum hydrocarbons through the inhalation of indoor air vapours (from impacted soil and/or groundwater).
- Construction workers may be exposed to petroleum hydrocarbons, PAHs and metals via dermal contact, ingestion and inhalation of soil particles and dermal contact with groundwater.

The results of the quantitative human health risk assessment concluded that the detected concentrations of PHC fractions, PAHs and metals in soil and groundwater at the site are not expected to pose unacceptable risks to human receptors (i.e., site workers and visitors, and construction workers), with the exception of concentrations of PHC fractions F1 and F2 identified in soil samples in borehole BH3, BH6 and BH15, which exceeded the calculated SSTLs. No unacceptable risks to construction workers were identified as a result of identified COCs in soils at the site. Further, all concentrations of COCs in groundwater were within acceptable limits and no unacceptable risk to human health was identified as a result of exposure to groundwater on the site.

The SSTLs calculated for PHC F1 and F2 in soil were derived using soil data to model a predicted indoor air concentration. These modeled values are based on conservative assumptions of site conditions, and as such are expected to be higher than the actual indoor air concentrations of these parameters. Therefore, a soil vapour sampling program was carried out

as part of the HHRA to further evaluate the potential for vapour intrusion into the proposed site building, and to provide a more realistic estimate of anticipated indoor air concentrations of these parameters in the proposed site building as a result of subsurface petroleum hydrocarbon impacted soil present on the property. A total of four (4) soil vapour probes, labeled VP01 to VP04, were installed at the site for the purposes of carrying out soil vapour sampling. The locations of the soil vapour probes are shown on Drawing No. 121412715-EE-02 in Appendix A, and targeted the area of petroleum hydrocarbon impacted soil in the vicinity of the proposed building, as identified as part of the Phase II ESA. Soil vapour analytical results indicate the presence of petroleum hydrocarbons in all four (4) of the soil vapour samples collected at the site, with total petroleum hydrocarbon concentrations ranging from 417 µg/m^3 in soil vapour probe VP1 to 259,330 µg/m^3 in soil vapour probe VP4. This soil vapour data was used to predict indoor air concentrations once the building is completed, and further supported the HHRA findings that unacceptable risk may be present at the site for a Site Worker and Site Visitor (i.e., building occupant) exposed to F1 and F2 PHC fractions and benzene via inhalation of indoor air.

Based on the results of a qualitative ecological health risk screening, chemicals of concern (COCs), including manganese, naphthalene, and phenanthrene in soil were carried forward in the ecological risk assessment, and were assessed with respect to potential exposure to various wildlife receptors including the Masked Shrew (Sorex cinereus), Meadow Vole (Microtus pennsylvanicus), Herring Gull (Larus argentatus), and terrestrial invertebrate & plants, and fish & aquatic invertebrates/plants.

Based on a qualitative ecological risk evaluation, the conceptual model developed for evaluating the quantitative exposure of the ecological receptors included:

- Terrestrial wildlife receptors (i.e., birds and mammals) may be exposed to COCs through ingestion of soil and water (i.e., as a result of feeding, drinking, and grooming);
- Terrestrial wildlife receptors (i.e., birds and mammals) may be exposed to COCs through ingestion of plants or prey species that have accumulated chemicals from the soil, and other media; and,
- Plants and invertebrates may be exposed to COCs through direct contact with soils.

Based on results of the ecological risk assessment, it was concluded that as the site is currently completely covered in asphalt/concrete, and in the future will also accommodate the office tower development, there is no probable exposure pathway for terrestrial ecological receptors to be exposed to COCs in soil and groundwater at the site, and as such no unacceptable risk to ecological receptors is expected on the property associated with concentrations of PHC fractions, PAHs and metals in soil and groundwater at the site. Exposure of marine receptors to impacted sediment in the harbor adjacent to the site was not included in scope of work of the ERA, or the scope of this project.

1.4 Regulatory Framework

1.4.1 Petroleum Hydrocarbons in Soil

As the site is federally-owned, federal guidelines for petroleum hydrocarbons have been referenced. The Canadian Council of Ministers of the Environment (CCME) Canada Wide Standard (CWS) for Petroleum Hydrocarbons (PHC) in Soil (CCME, 2008) is a three tiered, risk based remedial standard for contaminated soil. Standards have been developed for four generic land uses – agricultural, residential/parkland, commercial, and industrial. For the purposes of the CWS, PHC are considered to be comprised of four fractions, these being Fraction 1 (F1): C_6-C_{10}, Fraction 2 (F2): >C_{10}-C_{16}, Fraction 3 (F3): >C_{16}-C_{34}, and Fraction 4 (F4): >C_{34}-C_{50}. The CWS is based on a tiered approach to site management. Within this tiered approach, three tiers of increasing technical complexity (Tier 1, 2 and 3) are available for the management of impacted sites. The same high level of environmental and human health protection is required at all three tiers. Tier 1 levels are used when the proponent accepts the base assumptions and parameters in the Tier 1 exposure scenarios. Tier 2 levels may be generated and used when site conditions exist that significantly modify the exposure and risk scenarios. Tier 3 levels are based on site-specific assessment and management of risks.

As a result of this tiered approach, the clean-up criteria defined under the guidance document allow for greater flexibility in managing contaminated sites.

For a Tier 1 assessment, the most stringent pathway-specific Tier 1 level for petroleum hydrocarbons in surface soil is used (Tables 2 and 3 in the CWS for PHC in Soil, User Guidance, January 2008). These standards are based on default conditions for typical sites and exposure pathways and are classified by land use and soil type. In addition, the petroleum hydrocarbon standards are dependent on the defined four petroleum hydrocarbon fractions (*i.e.,* the standards differ for the F1, F2, F3, and F4 carbon fractions).

Based on the CCME CWS for PHC user guidance document, if site concentrations exceed the Tier 1 CWS for PHC, the site may be remediated to the Tier 1 generic standards, or alternatively if generic assumptions inherent in the Tier 1 values are not appropriate for the site, a Tier 2 or Tier 3 assessment may be completed to accommodate unique site characteristics, and determine more appropriate site-specific clean-up criteria.

In addition to toxicological-based guidelines for human and ecological health, the CCME CWS also include management limits to address other potential effects related to the physical nature of petroleum hydrocarbons and considers additional scientific, technical and socio-economic factors. As part of site assessment, the site concentrations are also compared to the Management Limits for the four individual carbon fractions (i.e., F1, F2, F3, and F4) (Tables 2 to 5 in the CWS for PHC in Soil, User Guidance, January 2008). If the Management Limits are exceeded, there is a need for field quantization of the following factors prior to applying the exposure pathway-specific values:

- Free phase formation;
- Exposure of workers in trenches to PHC vapours;

- Fire and explosive hazards;
- Effects on buried infrastructure;
- Aesthetic considerations; and,
- Technological factors.

The CWS for PHC in soils exclude known carcinogens such as benzene, as well as toluene, ethylbenzene and xylenes (TEX), which are addressed separately as individual target compounds. The concentrations of benzene, toluene, ethylbenzene and xylenes in soil on the Site were compared to the CCME Canadian Soil Quality Guidelines (CSQGs) (CCME, 2010). The CCME CSQGs provide limits for contaminants in soil and are intended to maintain, improve, and/or protect environmental quality and human health at contaminated sites in general. Like the CCME CWS-PHC, these criteria include numerical values for the assessment and remediation of soil in the context of agricultural, residential/parkland, commercial, and industrial land uses. In addition to land use, the CCME CSQGs include numerical values depending on soil texture (i.e., coarse or fine grained soils).

The site is publicly accessible and adjacent property use includes commercial land. For petroleum hydrocarbon indicator compounds (i.e., carbon fractions F1, F2, F3, and F4, and BTEX parameters benzene, toluene, ethylbenzene and xylenes) in soil, both the CCME CWS-PHC and the CCME CSQGS commercial guidelines for a coarse-grained soil were used as initial screening values for environmental assessment of the site, with site-specific target levels (SSTLs) developed for benzene, and carbon fractions F1 and F2 as part of the Stantec 2013 HHERA. For the purpose of evaluation of requirements for remediation / risk management provided herein, concentrations of benzene, and carbon fractions F1 and F2 in soil are compared to SSTLs derived for the site as part of the HHERA.

1.4.2 Metals, PAHs, PCBs and General Chemistry in Soil

The applicable federal guidelines for metals, PAHs, PCBs and general chemistry in soil are considered to be the CCME CSQGs, and its associated documents. The CCME CSQGs are derived using toxicological data to determine the threshold level to key receptors. For metals, PAHs, PCBs and general chemistry in soil, the CCME CSQGS commercial guidelines for a coarse-grained soil were used as initial screening values for environmental assessment of the site, with SSTLs developed for lead, and PAH compounds naphthalene and B(a)P TPE as part of the HHERA.

1.4.3 Petroleum Hydrocarbons, Metals, PAHs, PCBs and General Chemistry in Groundwater

The Federal Contaminated Sites Action Plan (FCSAP) was established to help federal departments, agencies and custodians address federal contaminated sites, so as to reduce environmental and human health risks as well as federal financial environmental liability associated with the higher risk federal contaminated sites.

The Environment Canada (EC) Federal Interim Groundwater Quality Guidelines (FIGQGs) last updated November 2012 were developed to assist federal custodians in assessing, remediating/risk managing federal contaminated sites funded under FCSAP (EC, 2012). Federal custodians are advised to use these interim guidelines as an interim measure until Canadian groundwater quality guidelines are available.

The EC FIGQGs follow a tiered framework, consistent with the Canadian Soil Quality Guidelines development through the CCME. A Tier 1 approach is a direct application of the generic numerical guidelines; specifically, application of the lowest guideline for any exposure pathway. A Tier 2 approach allows for the development of site-specific remediation objectives through the consideration of site-specific conditions, by modifying (within limits) the numerical guidelines based on site-specific conditions and focusing on exposure pathways and receptors that are applicable to the site. Finally, a Tier 3 approach uses the site-specific risk assessment to develop site-specific remediation objectives. Based on the existing site conditions for the subject site, the FIGQGs for marine life for a site with commercial/industrial land use and coarse-grained soil are applicable at the site for BTEX parameters, metals, PAHs, PCBs and general chemistry parameters. Note the FIGQGs currently do not include any guideline values for petroleum hydrocarbon carbon fractions F1, F2, F3, and F4.

In addition, for those parameters for which there is no applicable FIGQG value, Stantec has utilized the Ontario Ministry of the Environment's (MOE) Soil, Groundwater and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act, April 2011, for a full-depth generic site with non-potable groundwater (MOE, 2011). The MOE groundwater guidelines are protective of aquatic receptors in surface waters which could be affected by the discharge of groundwater. Stantec has applied the MOE guidelines for other environmental investigations where no applicable federal guidelines exist, and has obtained regulatory acceptance.

1.4.4 Leachate

The guidelines used to evaluate results of leachate in soil analysis carried out as part of the environmental assessment of the site was the Environment Canada, Interprovincial Movement of Hazardous Waste and Hazardous Recyclable Material Regulations, Schedule 2 (Table of Hazardous Constituents Controlled Under Leachate Test and Regulated Limits) (EC, 2012). Please note these are not environmental guidelines, but rather are used to further characterize soil samples with concentrations exceeding the applicable environmental guidelines to further evaluate disposal options and requirements for treatment.

2.0 CONTAMINANT DISTRIBUTION

Based on the results of previous environmental investigations of the site including the most recent Phase II ESA and HHERA completed by Stantec in 2013 and 2014, respectively, an approximately 340 m^2 area of soil in the vicinity of borehole BH3 and BH6 is impacted with F1 and F2 PHC fraction concentrations exceeding the toxicological based SSTLs (F1 = 474 mg/kg;

F2 = 4,560 mg/kg) for indoor air. Note, while F1 and F2 PHC fraction concentrations were also detected in soil at BH15 at levels that exceed the SSTLs, this borehole is located in an asphalt-covered area at a distance greater than 30 m away from the proposed building footprint, and the vapour intrusion exposure pathway is thus not considered to be operable at this location. However, it should be noted that if a building is proposed in the BH15 location, PHC concentrations may need further consideration for the indoor air pathway in this area.

The petroleum hydrocarbon-impacted area is shown on Drawing No. 121412715-EE-03 in Appendix A, and is defined based on field and analytical evidence identified in borehole BH3 and BH6 during Stantec's Phase II ESA. Further, the limit of the petroleum hydrocarbon-impacted area is extended to the northeast based on analytical results from historical test pit TP106 completed by MGI in 2001, which reported concentrations of F1 and F2 PHC fractions, as well as benzene in soil above the calculated SSTLs for the site. While the analytical data from this test pit are dated and may not represent current environmental conditions, it is conservatively used for the purposes of this assessment along with the absence of impacts identified in borehole BH4 to define the limits of impacted material in this area. Soil samples with concentrations of petroleum hydrocarbons that exceed the SSTLs in this area were identified at depths ranging from 1.3 m to 3.8 m below ground surface (mbgs). Based on the defined area of impacts and identified thickness of impacts (i.e., approximately 2.5 m), the approximate volume of petroleum hydrocarbon impacted soil exceeding SSTLs is 850 m^3.

3.0 PROPOSED REMEDIAL OPTIONS

For most impacted sites, a variety of remedial/risk management options exist to reduce or eliminate identified human health risks. Typical remedial/risk management options may reduce or eliminate the assessed risk by removing or reducing the defined hazard or by reducing the expected receptor exposure to the identified hazard.

The HHRA has indicated the following issue on the site that requires remedial / risk management measures:

1. The concentrations of PHC fractions F1 and F2 and benzene in soil in the vicinity of borehole BH3 and BH6 may potentially cause an adverse risk to on-site commercial receptors (i.e., site workers and site visitors), through the indoor air inhalation pathway, under future land use conditions (i.e., occupancy of the proposed site building). The potential for vapour intrusion into the proposed site building was further evaluated by carrying out a soil vapour sampling program at the site as part of the HHRA. This soil vapour data was used to predict indoor air concentrations once the building is completed, and further supported the HHRA findings that unacceptable risk may be present at the site for a Site Worker and Site Visitor (i.e., building occupant) exposed to F1 and F2 PHC fractions and benzene via inhalation of indoor air.

Potential remedial options to eliminate/mitigate soil vapour intrusion into the proposed site building were evaluated against a variety of criteria to assist in screening out the most

appropriate alternative. As a minimum, all options must meet two fundamental threshold criteria:

- Overall protection of human health and the environment; and,
- Compliance with applicable regulations and regulatory requirements.

Based upon the threshold criteria listed above, the list of options can be reduced further by evaluation against the following secondary criteria:

- Long-term effectiveness and permanence with respect to residual risk after remediation;
- Reduction of toxicity, mobility or volume;
- Implementability (considering site characteristics; as well as technical and administrative feasibility in the context of available services and materials necessary to implement the option);
- Time required to implement and achieve remedial objectives; and,
- Cost - both capital, as well as operation and maintenance.

The number of feasible options for remediation at the CCG Southside Base site is considered limited due to the physical setting of the site, which is located immediately adjacent to the marine environment (i.e., St. John's Harbor), and is characterized by a shallow groundwater table, and dynamic groundwater flow regime (i.e., tidal influence and direct groundwater-marine surface water interaction) that would be expected to impact the application and effectiveness of many remediation technologies at the site. In particular, while various in-situ remediation techniques, which rely on biological, chemical or thermal treatments applied directly to the impacted zone, may be considered plausible to treat the residual petroleum hydrocarbon impacted soil at the site, fluctuations in the physical-chemical characteristics of soil and groundwater at the site due to tidal effects and direct groundwater-marine surface water interaction would be expected to pose challenges to their effective application. Further, in-situ remediation techniques require a period of treatment (i.e., greater than 1 year), during which time additional interim remedial/risk management measures would have to be implemented at the site to manage potential indoor vapor intrusion issues during the treatment period.

Therefore, the remedial options considered were limited to those that satisfy the two fundamental threshold criteria, but also can be readily implemented at the site and require a relatively short time-frame. The following remedial/risk management strategies are considered to address the potential for soil vapour intrusion into the proposed future site building associated with residual petroleum hydrocarbon impacted soil at the site:

- Option #1: Soil Remediation; and,
- Option #2: Implementation of a Risk Management Approach (Installation of a Sub-slab Venting System).

A brief description and the characteristics of each option are presented below, as well as summarized on a remedial options evaluation spreadsheet provided in Table 3.1 below. Please note this remedial options evaluation is intended to address site impacts based on Stantec's understanding of current conditions at the site, as well as future land use associated with the

proposed office tower building development, and may not be adequate to address site impacts under different future land use conditions at the site.

Option #1 - Soil Remediation

This option involves excavation and removal of all soil with elevated concentrations of petroleum hydrocarbons from within the identified impacted area and disposal at a licensed, off-site soil treatment facility. Based on provided information, it is understood that the site has a required "no-dig" setback from the wharf retaining wall of 3 m (10'). This "no-dig" setback overlaps the northwest portion of the identified impacted area, and thereby reduces the area of allowable excavation and soil removal to 267 m^2. This reduced area of allowable remedial excavation is hereafter referred to as "the effective remediation area". The location of the "no-dig" setback with respect to the identified impacted area is shown on Drawing No. 121412715-EE-03 in Appendix A, along with the reduced effective remediation area. Based on an identified thickness of impacts of 2.5 m, it is estimated that approximately 668 m^3 of petroleum hydrocarbon-impacted soil is to be remediated in the effective remediation area. A summary of soil requiring remediation and located outside the no-dig zone (i.e., effective remediation area) is provided in Table 3.2.

The overall opinion of cost for this option is $344,000, and is based on a typical rate of approximately $515 per m^3 ($258 per tonne) for soil excavation (including costs for transport and soil disposal at a soil treatment facility for petroleum hydrocarbons, as well as metals and PAHs). The closest soil treatment facility licensed for petroleum hydrocarbons, as well as metals and PAHs is Universal Environmental Services Inc (UESI) soil treatment facility in Sunnyside, NL, located approximately 150 km west of the Site. The opinion of probable cost provided herein includes transportation costs to this facility. Please note, soil analytical data collected as part of the Phase II ESA for the site indicated concentrations of copper (Cu) and lead (Pb) in borehole BH3 that exceed commercial guidelines, and thus require further consideration for treatment/disposal of the petroleum hydrocarbon-impacted material. Due to poor soil sample recoveries in the boreholes, leachate analysis could only be performed on limited soil samples with elevated metals and potential for metals leachate is considered under evaluated in soils at the site.

Further, historical results from the MGI 2001 test pit investigation also indicated elevated concentrations of these metals, as well as arsenic (As) and PAHs (naphthalene, chrysene, and Benzo(a)pyrene) in soil at former test pit locations TP106 and TP107 within the impacted area, but leachate analysis was not performed during this investigation. In the absence of leachate analysis, the opinion of probable cost provided herein, conservatively assumes that petroleum hydrocarbon-impacted soil within the effective remediation area also contains metals and PAHs impacts (i.e., exceeds commercial guidelines and is leachable), and thus requires treatment at a soil treatment facility licensed for the receipt of metals- and/or PAHs-impacted material. However, it is recommended that leachate analysis be performed on soil within the remediation area, preferably prior to commencing construction excavation activities, to further evaluate soil treatment/disposal options, and in particular to determine whether metals and/or PAHs leachate is an issue. Please note if metals and/or PAHs leachate is not an issue, and soil within the

remediation area only requires treatment for petroleum hydrocarbons, soil treatment costs could potentially be reduced by approximately $115 per m^3 ($230 per tonne) from that quoted herein.

This option is a relatively straight forward process that involves the use of typical and readily available heavy equipment such as excavators, backhoes and tandem dump trucks, and can be readily carried out over a relatively short duration (i.e., 3 to 4 weeks), depending on availability of trucks. However, a "no-dig" set back in the vicinity of the identified impacted area prevents full site remediation and following completion of this option, residual petroleum hydrocarbon impacts would remain at the site with potential soil vapour risks. Therefore this option fails to meet fundamental remediation threshold criteria, and as a sole remedial option is not considered suitable for the site.

Table 3.1 Remediation Summary Table – CCG Southside Base, St. John's, NL

COC	Max Concentration (mg/kg)	EPC (mg/kg)	Guideline (mg/kg)	Location	Area (m^2)	Volume (m^3)	Tonnage (1,000 kg)
Benzene PHC (F1) PHC (F2)	29.1 1,400 24,000	n/a	2.35 474[1] 4,560[1]	TP107 BH3	267	668	1,336

Notes:
1. Site-specific Target Levels (SSTLs) derived by Stantec for the protection of human receptors (site worker and site visitor)
n/a = not applicable

Option #2 - Risk Management Strategy – Installation of a Sub-Slab Venting System

Option #2 refers to the use of a sub-slab venting system beneath the building to prevent migration of petroleum hydrocarbon vapours into the proposed site building. This system would comprise a network of perforated piping beneath the concrete floor slab of the building that is vented to the exterior of the building to direct soil vapours away from beneath the foundation. Both a passive or active system can be utilized. A passive system relies on wind currents to induce vapour flow through the pipes; while a mechanical exhaust fan is used to induce vapour flow beneath the building in an active system. An active venting system is generally considered more effective and is recommended for the site.

Note while the primary objective of the sub-slab venting system is to prevent vapour intrusion into the building; use of this system can also have the added benefit of reducing petroleum hydrocarbon concentrations in the impacted area by venting volatilized petroleum hydrocarbon compounds; as well as encouraging an influx of oxygen into the impacted area as "make-up air", thereby enhancing biodegradation processes. Further, this system would also be expected to mitigate potential ingress of radon soil gas into the building, which was identified as part of the Phase II ESA.

The overall opinion of cost for this option is $300,000 and covers design and construction of an active sub-slab venting system beneath the proposed building. In addition, the provided opinion

of probable costs includes the installation of an impermeable geomembrane vapour barrier as part of the sub-slab venting system to further inhibit vapour intrusion into the building. Note, the provided opinion of cost does not cover operation, maintenance and monitoring costs over the operational life of the system; however, an annual cost of approximately $10,000 would be expected.

This option would eliminate soil vapour intrusion into the proposed site building, thus removing adverse risk to the Site Worker and Site Visitor (i.e., future building occupant) through the indoor air inhalation pathway and satisfying fundamental remediation threshold criteria. Also, this option would have minimal site disturbance, and relatively low construction capital costs.

Based on information provided, it is understood that a sub-slab venting system is being considered in the proposed building design, since full remediation of petroleum hydrocarbon impacted soil cannot be carried out on the site. Note this sub-slab venting system would also serve to mitigate potential intrusion of soil radon gas previously detected at the site as part of the Phase II ESA.

Table 3.2 Qualitative Remedial Options Evaluation

Site: Canadian Coast Guard Southside Base, Berth 28, Southside Road, St. John's, NL
PWGSC and DFO
Date: December 16, 2013
Remedial Objective:Eliminate potential risks to human receptors as the result of petroleum hydrocarbon impacted soil on the site.

	Remedial Option	Application	Advantages	Disadvantages	Time Frame	Costs	Other Considerations/ Comments	Ranking
1	Excavation and off-site disposal in a soil treatment facility	Excavate petroleum hydrocarbon impacted soil, transport and dispose off-site at a soil treatment facility. The remedial excavation would then be backfilled with clean, imported fill.	This option would remove the petroleum hydrocarbon impacted soil from the site, eliminating all potential risks identified with the impacted soil for current and future land uses. This is a relatively straight forward process that involves the use of typical and readily available heavy equipment such as excavators, backhoes and tandem dump trucks.	Intrusive method that requires excavation. However, a "no-dig" set back in the vicinity of the identified impacted area prevents full site remediation and following completion of this option, residual petroleum hydrocarbon impacts would remain at the site with potential soil vapour risks. Therefore this option fails to meet fundamental remediation threshold criteria, and as a sole remedial option is not considered suitable for the site.	3 - 4 weeks (dependent on number of dump trucks utilized)	High ($344,000; based on unit cost of ~ $515 per m3 ($258 per tonne) for soil excavation (including costs for transport and soil disposal at a soil treatment facility for petroleum hydrocarbons, as well as metals and PAHs; i.e., UESI soil treatment facility in Sunnyside, NL, located approximately 150 km west of the Site)	Timeline is dependent on number of dump trucks utilized.	2
2	Install sub-slab venting system as part of the new building construction.	Install an active sub-slab venting system beneath the building to prevent a vapor pathway into the proposed site building. This system would comprise a network of perforated ventilation piping beneath the concrete floor slab of the building that is vented to the exterior of the building to direct soil vapors under the foundation preventing it from migrating into the structure. In addition, the system would be equipped with a mechanical exhaust fan to induce vapour flow beneath the building.	This method would involve little or no soil excavation apart from what would be needed for the installation of the system and the building's construction. Removes exposure pathway (i.e., indoor air) with contaminated soil, and therefore meets fundamental remediation threshold criteria.	Requires time for design and evaluation for construction of the sub-slab vapour extraction system. The system would require an annual cost for operation, maintenance and indoor air monitoring. Exclusively used without full removal of the contamination source can potentially lead to long-term use and associated issued such as changes in ownership, a limited life-span on system parts, and long term operational and monitoring costs.	2 months for investigation and design of system. Installed during construction of the building. Operation, maintenance, and monitoring requirements over lifetime of system.	Moderate (~$300,000 covers initial capital cost for active sub-slab venting system, as well as impermeable geomembrane vapour barrier. Does not include annual operation, maintenance and air monitoring costs, estimated at ~$10,000 per year).	Once installed and operating, indoor air monitoring may indicate that additional mitigation may be necessary.	1

4.0 DETAILED REMEDIAL ACTION PLAN

The preferred remedial option to address soil vapour intrusion into the proposed site building is to install a sub-slab venting system beneath the building as part of construction. A detailed work plan, including a construction plan and drawings for the sub-slab venting system can be provided once further building design and construction details are known for the site; however the following should be considered with respect to installation of the sub-slab venting system:

- Consider installation of an active sub-slab venting system that utilizes a powered exhaust fan to direct vapour flow. Passive systems are considered less effective since they rely on natural wind effects and are therefore susceptible to variations in climatic conditions.

- Since the normal presence of various cracks, expansion joints and opening in the concrete slab can facilitate vapour intrusion, it is recommended that a geomembrane vapour barrier be installed below the slab during building construction along with the venting system to further block potential vapour intrusion into the building.

- In addition to the vapour membrane, ensure cracks/annular spaces around utilities, the floor/wall join, and/or cracks in the concrete floor are well sealed with an epoxy-based sealant that is impenetrable to vapours, and seal and vent any floor sumps as these may also serve as an easy access point for vapours.

- To further mitigate vapour intrusion into the building, maintain a positive pressure within the building relative to the sub-slab utilizing the building's HVAC system.

- Future monitoring of the sub-slab venting system, sub-slab vapour and differential building pressure is required to assess the effectiveness of the system and determine and optimize its operating parameters.

Remedial Option #2 (install a sub-slab venting system beneath the building as part of construction) is recommended as the preferred option for the site. Also, as part of this option, it is possible that building construction excavation activities at the site will result in removal of some petroleum hydrocarbon impacted soil. The volume of soil required to be removed from within the limits of the effective remediation area to accommodate construction of the building is not known at this time; however it is possible that building construction excavation will require removal of at least a portion of impacted material from this area. Removal of petroleum hydrocarbon impacted material as dictated by construction excavation requirements is not considered a soil remediation program as presented under Remedial Option #1, but would be expected to reduce source contamination in this area and possibly reduce soil vapour concentrations beneath the building, thereby reducing the operation period of this system and associated operation, maintenance and monitoring costs. Further, removal of petroleum hydrocarbon-impacted soil from this area is also considered to be beneficial since it would

eliminate the requirement for specialized building materials suitable for use in petroleum hydrocarbon-impacted environments.

Any petroleum hydrocarbon-impacted soil removed from the effective remediation area as part of construction excavation activities will need to be disposed of at a licensed soil treatment facility. Note since metals and PAHs concentrations in soil that exceed commercial guidelines have also been detected in soil in the effective remediation area, it is recommended that leachate analysis be performed on the excavated soil prior to being removed from site to further evaluate suitable soil treatment/disposal options. In particular metals and PAHs leachate analysis should be performed to evaluate potential mobility of these parameters, and requirements for specialized treatment for metals and PAHs in soil. It is recommended that leachate characterization of site soil be carried out prior to commencing construction excavation activities to avoid schedule delays and need to temporarily stockpile excavated material.

If the impacted soil is to be stockpiled on the site prior to removal from the site (i.e., awaiting metals leachate testing, etc.), it is recommended to have a PVC liner beneath the soil to avoid potential contamination of other areas of the site. In addition, while work is not occurring on the site and during rainy periods, it is recommended to keep the stockpiled soil covered.

Following construction excavation activities and prior to building construction (including installation of the sub-slab venting system), it is recommended to collect confirmatory soil samples, for analysis of petroleum hydrocarbons, to document levels of petroleum hydrocarbons remaining in the soil. Once required construction excavation is complete, the excavated areas should be backfilled with clean, imported fill, which would be placed in such a way to conform to building design requirements.

5.0 HEALTH AND SAFETY REQUIREMENTS

Any personnel engaged in remediation and/or construction excavation activities on the site should be advised of the potential risks associated with exposure to residual chemicals of concern in soil and/or groundwater.

A site-specific Health and Safety plan should be prepared to provide appropriate protection against all known and potential hazards that may be encountered during excavation activities associated with completing site remediation and/or building construction. The plan will describe the potential hazards at the sites, identify the personnel responsible for health and safety, and outline the health and safety procedures and equipment required for activities at the site to minimize the potential hazards to all personnel.

As a minimum any personnel engaged in remediation and/or construction excavation activities on the site should adhere to the following worker protection guidelines:

- No smoking, eating or drinking is permitted in work areas where personnel may be exposed to chemicals of concern.

- Do not ingest soil or groundwater from work areas.
- Wash your hands well before smoking, eating or drinking after working in areas where you could be exposed to chemicals of concern.
- Personnel working in areas where they may be exposed to chemicals of concern in soil or groundwater must wear appropriate personal protective equipment. For construction workers involved in the construction phase, this should include as a minimum: protective coveralls, gloves, CSA standard safety boots and safety glasses or goggles.
- A volatile organic carbon monitor should be used to monitor organic vapours in ambient air in all excavations where the chemical of concern is petroleum hydrocarbons.
- Where the VOC monitor indicates > 30 ppm total VOCs (TVOCs) (i.e., 10% of the American Conference of Governmental Industrial Hygienists (ACGIH) 8-hr time weighted average of 300 ppm for gasoline in air) workers should wear respiratory protection.
- A flammable gas monitor should be used to monitor for % Lower Explosive Limit (LEL) in ambient air in all excavations where the chemical of concern is petroleum hydrocarbons.
- Do not work in or around excavations if the flammable gas reading exceeds 20% LEL. Ventilate the work area and retest for flammable gases before resuming work in the area. Industry practice is to use 10% to 20% of the LEL as a maximum limit for personnel working in and around excavations. The more stringent limit (i.e., 10% LEL) provides a higher factor of safety and may be used at the discretion of the supervisor or project manager.
- Where there is potential for inhalation of dust, workers should wear respiratory protection for dust.
- Clean and decontaminate equipment and tools that are used in impacted areas of a site before storing the equipment or tools.
- If free phase petroleum hydrocarbon product or any other area of highly suspected contamination is encountered that has not been identified in this report, stop work immediately and report to the supervisor or project manager.

6.0 OTHER RISK MANAGEMENT CONSIDERATIONS

In addition to toxicological based guidelines for human and ecological health, the CCME CWS (2008) includes management limits to ensure that the PHC CWS is protective of other potential effects and to incorporate consideration of additional scientific, technical and socio-economic factors. Factors currently considered in the management limits include free phase formation, exposure of workers in trenches to petroleum hydrocarbon vapours, fire and explosive hazards, effects on buried infrastructure, aesthetic considerations and technological factors (see Table 9). If the Management Limits are exceeded, there is a need for field quantization of these factors prior to applying the exposure pathway-specific values:

Below each of the management limit effects have been considered as they apply to the Site.

- Formation of Free Phase – Due to the relatively high mobility and solubility of PHC Fraction F1, the guideline for the F1 Fraction should consider the potential presence of a free phase. Based on this, an F1 Fraction limit of 700 mg/kg in coarse-grained soils has been established (CWS, 2008). The PHC F1 fraction concentration in soil samples collected from boreholes BH3, BH6, and BH15, as well as in soil samples collected from historical test pits TP104 and TP107 completed by MGI in 2001 exceed this management limit. However, no free product was observed at these locations during field investigation, and as such the potential for substantive free product is considered to be low at the site. It is recommended however that if any free product is encountered during building construction excavation activities, it be removed and transported of site for disposal at a licenced liquid waste facility.
- Exposure of Workers in Trenches to Petroleum Hydrocarbon Vapours - Limits of 1,000 mg/kg for F1 and F2 Fractions are deemed protective of adverse effects on workers in trenches. PHC Fraction F1 and F2 concentrations that exceed this management limit have been identified in soil samples collected from boreholes BH3, BH6, and BH15, as well as in soil samples collected from historical test pits TP101, TP104, TP105, TP106, TP107, TP109 and TP110 completed by MGI in 2001. Therefore, an appropriate site-specific health and safety plan should be developed and implemented if workers are to enter trenches in these areas.
- Effects on Buried Infrastructure - As stated in the CWS, the CCME did not derive a threshold for the PHC fraction for effects on buried infrastructure due to the inadequate data available. However, it is stated that potential effects of PHC on buried infrastructure should be addressed on a site-specific basis where utilities or other infrastructure are in contact with contaminated soils. A particular concern noted in the CWS is the potential for buried infrastructure corridors to act as conduits allowing petroleum hydrocarbons to migrate directly into and contaminate drinking water supplies. Since there is no potable water supply within the drainage catchment area of the site, contamination of potable water due to petroleum hydrocarbon impacted soil at the site is not a concern. However, an additional concern related to buried infrastructure is the potential for petroleum hydrocarbons to react with and damage various utility materials. This is particularly true for some plastics, rubber and other polymeric materials used in pipe work, service conduits, jointing seals and protective coatings on concrete and metals, which when subjected to petroleum hydrocarbons at sufficient concentrations can experience physical damage, possibly to the extent that the utility no longer meets design specifications. Based on provided preliminary site development plans, significant underground infrastructure is expected to be installed in areas of the site with concentrations of petroleum hydrocarbons in soil that exceed established management limits for this effect (i.e., as shown on Drawing No. 121412715-EE-04 in Appendix A). As such, potential damage to buried infrastructure related to petroleum hydrocarbons should be considered as part of the design and installation of underground infrastructure at the site, including the selection of suitable materials that are resistant to exposure to petroleum hydrocarbon contamination.
- Fire and Explosive Hazards – Field screening for soil combustible vapour concentrations was completed on a number of soil samples collected as part of the Phase II ESA

borehole drilling program. The highest recorded combustible vapour concentration value was 678 parts per million (ppm) measured in soil sample SS4 collected in borehole BH03. This combustible vapour concentration value is considerably below the lower explosive limit (LEL) for diesel (i.e., 6%). Therefore, fire and explosive hazards are not considered to be a concern at the site. However, the CCME developed a PHC F1 and F2 fraction limit of 1,400 mg/kg and 5,200 mg/kg respectively to be further protective of this potential effect. PHC Fraction F1 and F2 concentrations that exceed this management limit have been identified in a soil sample collected from borehole BH3, as well as in soil samples collected from historical test pits TP101, TP104, TP106, and TP107 completed by MGI in 2001. Therefore, underground enclosed spaces with very low air exchange rates in these areas should be monitored for % Lower Explosive Limit (LEL) in ambient air, and an appropriate site-specific health and safety plan should be developed and implemented if workers are to enter enclosed spaces in these areas.

- Aesthetic Considerations - High concentrations of petroleum hydrocarbons can adversely affect aesthetics. Specific effects may include odours, visible impacts on soils, or effects on the taste of potable water. However, it is assumed that the CWS guidelines for the vapour intrusion pathway will be protective of odours in buildings in most cases. In addition as the site will be mainly covered and is a non-potable site, the visible impacts on soils or effects on the taste of potable water are essentially negligible. Therefore, the remaining petroleum hydrocarbon impacts are not considered to be an aesthetic concern.
- Technological Factors – Based on the land use and the proposed building for the site, the upset limit for F3 in subsoil was determined to be 3,500 mg/kg. The PHC F3 upset limit was established by CWS primarily with respect to bioremediation capabilities, since bioremediation is considered the preferred technology for dealing with petroleum hydrocarbon impacted soils. PHC Fraction F3 concentrations that exceed this management limit have been identified in a soil sample collected from borehole BH3, as well as in a soil sample collected from historical test pit TP106 completed by MGI in 2001. These soil samples were collected from within the identified remediation area, and are being addressed through the proposed implementation of Remedial Option #2 (install a sub-slab venting system beneath the building as part of construction). Therefore, the amenability of petroleum-hydrocarbon impacted soil on the site to bioremediation technologies, and the exceedance of site soils to the management limit for this effect is not considered a concern at the site.

Table 6.1 Management Limit Screening - Soil (PHC)

COPC	Maximum Concentration (mg/kg)	CCME CWS Management Limit (mg/kg)	Maximum > Management Limit
PHC F1 (C6-C10) - BTEX	1,400	700	✓
PHC F2 (C10-C16 Hydrocarbons)	24,000	1,000	✓
PHC F3 (C16-C34 Hydrocarbons)	14,300	3,500	✓

An area of approximately 1,580 m^2 has concentrations of petroleum hydrocarbons that exceed the CCME CWS Management Limits for PHC Fractions F1, F2 and F3 (as shown on Drawing No. 121412715-EE-04 in Appendix A). The depth of these impacts over the noted area range from near surface to 3.6 m below ground surface (mbgs). Therefore, any soil removed from this area as part of construction excavation activities should follow a site-specific Health and Safety plan as discussed in Section 5.0 to provide appropriate protection against all known and potential hazards associated with PHCs that may be encountered during excavation activities. Also, as discussed above, appropriate building materials suitable for use in petroleum hydrocarbon impacted soil should be considered as part of site development, particularly where underground infrastructure will be present in the noted areas that exceed the Management Limits for this effect.

7.0 SOIL DISPOSAL

A total area of approximately 3,270 m^2 has been identified at the site as having concentrations of petroleum hydrocarbons in soil that exceed the NLDEC disposal guideline of 1,000 mg/kg, indicating that any soil excavated from this area as part of building construction excavation activities and removed from site would not be permitted for disposal at a municipal landfill, but rather would require disposal at a licensed contaminated soil treatment facility (as shown on Drawing No. 121412715-EE-05 in Appendix A). Further, the majority of this petroleum hydrocarbon-impacted area with soil concentrations greater than the 1,000 mg/kg landfill disposal threshold also contain concentrations of metals and PAHs in soil that exceed commercial guidelines, and without additional leachate analysis would require specialized disposal at a soil treatment facility licensed for the receipt of metals- and PAHs-impacted material. The exception of this disposal requirement is a small approximately 700 m^2 area in the vicinity of BH08 and historical test pits TP104, TP109, and TP110, which is limited to petroleum hydrocarbon impacts only and therefore would be permitted for disposal at a soil treatment facility exclusively licensed for petroleum hydrocarbons only. A number of local petroleum hydrocarbon contaminated soil treatment facilities are present in the St. John's area within 20 km of the site; while the closest soil treatment facility licensed for metals and PAHs is Universal Environmental Services Inc (UESI) soil treatment facility in Sunnyside, NL, located approximately 150 km west of the Site. Given the additional travel and treatment costs associated with disposal of metals- and PAHs-impacted soil at the UESI soil treatment facility in Sunnyside, NL, it is recommended to carry out additional leachate analysis on site soils to further evaluate soil treatment/disposal options, and in particular to determine whether metals and/or PAHs leachate is an issue, and specialized soil treatment is a requirement. Further, it is recommended that leachate characterization of site soil be carried out prior to commencing construction excavation activities to avoid schedule delays and need to temporarily stockpile excavated material.

Further, excavated impacted soil should not be stockpiled in an unprotected area where site users or visitors could come into contact with the soil. If impacted soil is stockpiled on site, it should be placed on an impermeable liner to prevent contamination of underlying soil. Impacted soil should also be covered with an impermeable cover while stockpiled.

Ensure that unattended excavations are appropriately barricaded and marked to keep unauthorized personnel out.

Ensure that drainage from stockpiled excavated impacted soil is collected and disposed of at an appropriate facility or directed back into the excavation.

At the end of the construction or excavation activity, ensure that all known impacted portions of the site are covered by a suitable barrier (e.g., asphalt, concrete or minimum 0.3 m thick layer of clean fill) to prevent dermal contact with the impacted soil and/or groundwater.

8.0 CLOSURE

This report has been prepared for the sole benefit of Public Works and Government Services Canada (PWGSC) and Fisheries and Oceans Canada (DFO). The report may not be relied upon by any other person or entity without the express written consent of Stantec and PWGSC and DFO.

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

The information contained in this report is based upon work undertaken by trained professional and technical staff in accordance with generally accepted engineering and scientific practices at the time the work was performed. The conclusions presented herein represent the best technical judgment of Stantec based on the information obtained from the specific sampling locations. Selective destructive testing was undertaken during this assessment subject to the limitations described in this report.

In addition, analysis has been carried out for a limited number of chemical parameters, and it should not be inferred that other chemical species are not present. Due to the nature of the investigation and the limited data available, Stantec cannot warrant against undiscovered environmental liabilities.

If any conditions become apparent that differ significantly from our understanding of conditions as presented in this report, we request that this information be brought to our attention so that we may re-assess the information presented herein.

This report was written by Carolyn Anstey-Moore, M.Sc., M.A.Sc., P.Geo. and Paula Brennan, M.A.Sc., P.Eng. and reviewed by Jim Slade, P.Eng., P.Geo.

Yours truly,

STANTEC CONSULTING LTD.

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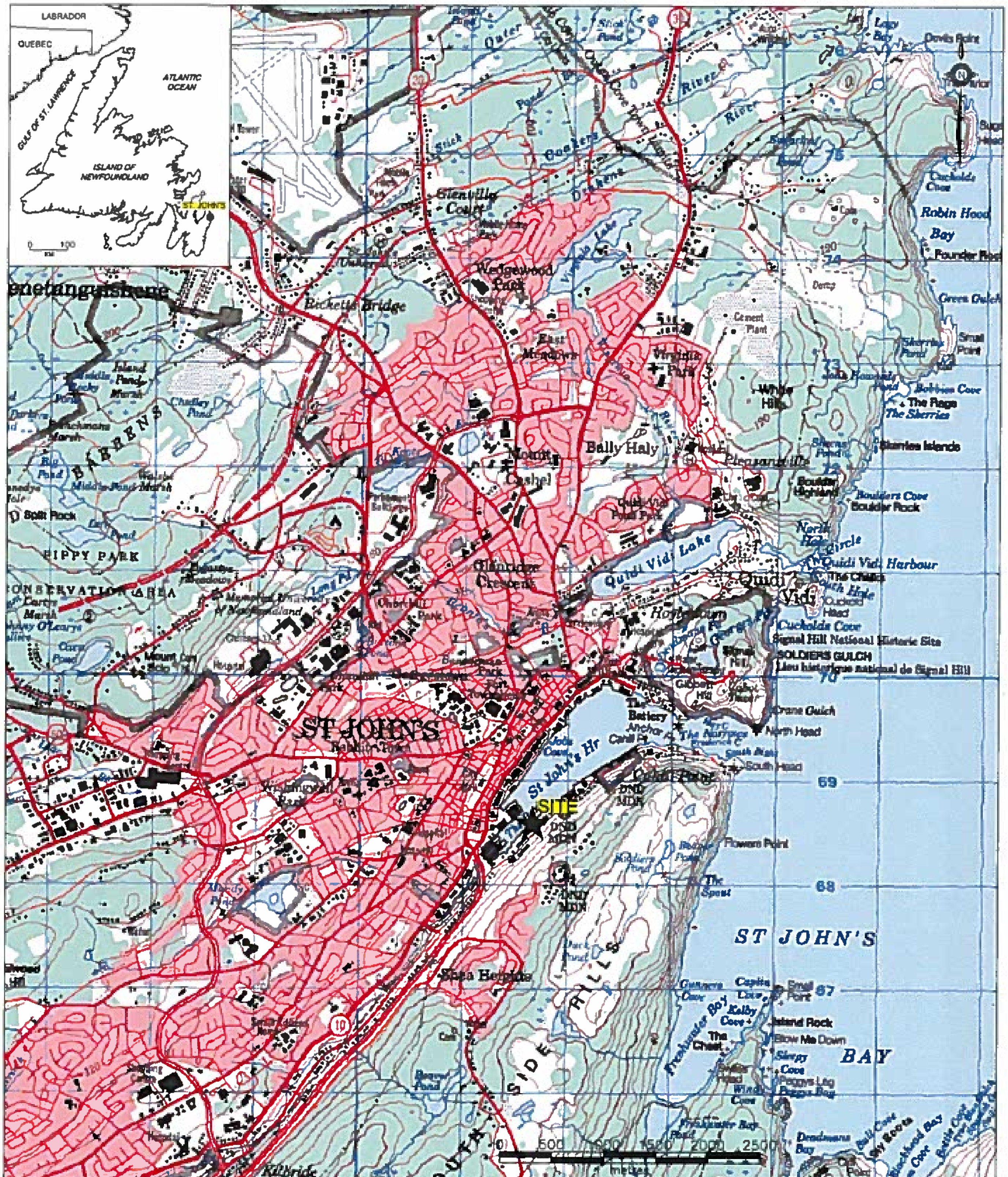
APPENDIX A

Drawings



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CLIENT: ENVIRONMENTAL SERVICES; PUBLIC WORKS & GOVERNMENT SERVICES CANADA	SCALE: 1:50,000	DATE: MAR. 11, 2014	REV. No. 0
	DRAWN BY: N.M.	EDITED BY: S.N.	CHECKED BY:
PROJECT TITLE: REMEDIAL ACTION PLAN / RISK MANAGEMENT PLAN, CANADIAN COAST GUARD SOUTHSIDE BASE, BERTH 28, ST. JOHN'S, NL	DRAWING No: 121412715-EE-01	CAD FILE: 121412715-EE-01	
DRAWING TITLE: SITE LOCATION PLAN	Stantec		

11MAR14 9:45AM

LEGEND

- STANTEC BOREHOLE/MONITOR WELL LOCATION (2013)
- MGI TEST PIT LOCATION (2001)
- SOIL VAPOUR PROBE LOCATION (2013) (INSTALLED TO 1.5 mbgs AND SCREENED FROM 1.0 - 1.5 mbgs, 1" Ø PROBES)
- NO DIG ZONE

NOTES:

1) THIS DRAWING ILLUSTRATES SUPPORTING INFORM ATION SPECIFIC TO A STANTEC CONSULTING LTD. REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.
2) DO NOT SCALE FROM DRAWING.
3)AUTOCAD BASEMAP (512652-0001-CI-DR-C05) PROVIDED BY CLIENT, 2014.
4) AS-ADVANCED BOREHOLE COORDINATES PROVIDED BY HAWCO KING RENOUF | ALLNORTH CONSULTANTS OF ST. JOHN'S. NIL (2013).

CLIENT:

ENVIRONMENTAL SERVICES;
PUBLIC WORKS & GOVERNMENT
SERVICES CANADA

PROJECT TITLE:

REMEDIAL ACTION PLAN /
RISK MANAGEMENT PLAN,
CANADIAN COAST GUARD SOUTHSIDE BASE,
BERTH 28, ST. JOHN'S, NL

DRAWING TITLE:

SITE PLAN SHOWING THE LOCATIONS
OF ENVIRONMENTAL SAMPLES ON
OVERALL SITE UTILITIES BASE MAP

Stantec Consulting Ltd.

SCALE:	DATE:	REV No
1:500	MAR. 31, 2014	
DRAWN BY: S.N.	EDITED BY: N.M.	CHECKED BY:
DRAWING No: 121412715-EE-02	CAD FILE: 121412715-EE-02.DWG	

Stantec

31MAR14 9:00AM

LEGEND

- STANTEC BOREHOLE/MONITOR WELL LOCATION (2013)
- MGI TEST PIT LOCATION (2001)
- SOIL VAPOUR PROBE LOCATION (2013) (INSTALLED TO 1.5 mbgs AND SCREENED FROM 1.0 - 1.5 mbgs, 1" Ø PROBES)
- AREA OF SOIL WITH CONCENTRATIONS OF PHC FRACTIONS F1 & F2 > SSTLs
- EFFECTIVE PHC IMPACTED SOIL REMEDIATION AREA (OUTSIDE "NO DIG ZONE")
- NO DIG ZONE

NOTES:

1) THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC CONSULTING LTD. REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.
2) DO NOT SCALE FROM DRAWING.
3)AUTOCAD BASEMAP (512652-0001-CI-DR-C05) PROVIDED BY CLIENT, 2014.
4) AS-ADVANCED BOREHOLE COORDINATES PROVIDED BY HAWCO KING RENOUF) ALLNORTH CONSULTANTS OF ST. JOHN'S, NL (2013).

CLIENT

ENVIRONMENTAL SERVICES;
PUBLIC WORKS & GOVERNMENT
SERVICES CANADA

PROJECT TITLE:

REMEDIAL ACTION PLAN /
RISK MANAGEMENT PLAN,
CANADIAN COAST GUARD SOUTHSIDE BASE,
BERTH 28, ST. JOHN'S, NL

DRAWING TITLE:

SITE PLAN SHOWING THE ESTIMATED EXTENT OF PETROLEUM HYDROCARBON (F1 & F2) IMPACTED SOIL EXCEEDING SSTLs ON OVERALL SITE UTILITIES BASE MAP

Stantec Consulting Ltd.

SCALE:	DATE:	REV No.
1:500	MAR. 31, 2014	0
DRAWN BY: S.N.	EDITED BY: N.M.	CHECKED BY:
DRAWING No: 121412715-EE-03	CAD FILE: 121412715-EE-03.DWG	

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31MAR14 9:00AM

LEGEND

- STANTEC BOREHOLE/MONITOR WELL LOCATION (2013)
- MGI TEST PIT LOCATION (2001)
- SOIL VAPOUR PROBE LOCATION (2013) (INSTALLED TO 1.5 mbgs AND SCREENED FROM 1.0 - 1.5 mbgs, 1" Ø PROBES)
- AREA OF SOIL WITH CONCENTRATIONS OF PHC FRACTIONS F1, F2 & F3 > MANAGEMENT LIMITS
- NO DIG ZONE

NOTES:

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CLIENT:

ENVIRONMENTAL SERVICES;
PUBLIC WORKS & GOVERNMENT SERVICES CANADA

PROJECT TITLE:

REMEDIAL ACTION PLAN /
RISK MANAGEMENT PLAN,
CANADIAN COAST GUARD SOUTHSIDE BASE,
BERTH 28, ST. JOHN'S, NL

DRAWING TITLE:

SITE PLAN SHOWING THE ESTIMATED EXTENT OF PETROLEUM HYDROCARBON (F1, F2 & F3) IMPACTED SOIL EXCEEDING MANAGEMENT LIMITS ON OVERALL SITE UTILITIES BASE MAP

Stantec Consulting Ltd.

SCALE:	DATE:	REV No.
1:500	MAR. 31, 2014	0
DRAWN BY: S.N.	EDITED BY: N.M.	CHECKED BY:
DRAWING No: 121412715-EE-04	CAD FILE: 121412715-EE-04.DWG	

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31MAR14 9:00AM

LEGEND

- STANTEC BOREHOLE/MONITOR WELL LOCATION (2013)
- MGI TEST PIT LOCATION (2001)
- SOIL VAPOUR PROBE LOCATION (2013) (INSTALLED TO 1.5 mbgs AND SCREENED FROM 1.0 - 1.5 mbgs, 1" Ø PROBES)
- AREA OF SOIL WITH CONCENTRATIONS OF TPH > 1,000 mg/kg (*i.e.* LANDFILL DISPOSAL THRESHOLD)
- AREA OF SOIL WITH CONCENTRATIONS OF TPH > 1,000 mg/kg; AND METALS/PAHs > CCME COMMERCIAL GUIDELINES (i.e., REQUIRED SOIL TREATMENT
- NO DIG ZONE

NOTES:

1) THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC CONSULTING LTD. REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.
2) DO NOT SCALE FROM DRAWING.
3)AUTOCAD BASEMAP (512652-0001-CI-DR-C05) PROVIDED BY CLIENT, 2014.
4) AS-ADVANCED BOREHOLE COORDINATES PROVIDED BY HAWCO KING RENOUF | ALLNORTH CONSULTANTS OF ST. JOHN'S, NL (2013).

CLIENT:

ENVIRONMENTAL SERVICES;
PUBLIC WORKS & GOVERNMENT SERVICES CANADA

PROJECT TITLE:

REMEDIAL ACTION PLAN /
RISK MANAGEMENT PLAN,
CANADIAN COAST GUARD SOUTHSIDE BASE,
BERTH 28, ST. JOHN'S, NL

DRAWING TITLE:

SITE PLAN SHOWING DISPOSAL REQUIREMENTS FOR IMPACTED SOIL ON OVERALL SITE UTILITIES BASE MAP

Stantec Consulting Ltd.

SCALE:	DATE:	REV. No.
1:500	MAR. 31, 2014	0
DRAWN BY: S.N.	EDITED BY: N.M.	CHECKED BY:
DRAWING No: 121412715-EE-05	CAD FILE: 121412715-EE-05.DWG	

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31MAR14 9:00AM

APPENDIX B

Laboratory Analytical Summary Tables

(Stantec 2013 & MGI 2001)

Table B.1 Results of Laboratory Analysis of Petroleum Hydrocarbons in Soil
Remedial Action Plan/Risk Management Plan
Canadian Coast Guard Southside Base, Berth 28, Southside Road, St. John's, NL
Stantec Project No. 121412715

Sample ID	Depth (mbgs)	Date	Benzene	Toluene	Ethylbenzene	Xylenes	C_6-C_{10} F1	C_{10}-C_{16} F2	C_{16}-C_{32} [5] F3	>C_{32} [5] F4	Modified TPH - Tier I [4]	Comments
		RDL	0.025	0.025	0.025	0.05	2.5	10	15	-	15	-
		Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	-	mg/kg	-
		CWS [1, 2]	0.03	0.37	0.082	11	320 (eco/ indoor) 970 (gw)	260 (eco) 380 (gw)	1,700 (eco)	3,300	-	-
		CWS Management Limit [3]	-	-	-	-	700	1,000	3,500	10,000	-	-
		SSTLs[6]	-	-	-	-	474	4,560	-	-	-	-
Stantec 2013												
BH1-SS3	1.6 - 2.2	04-Mar-13	**0.16**	0.28	0.052	0.40	17	220	450	-	700*	WFO/LO
BH1-SS9	5.7 - 6.3	04-Mar-13	nd	nd	nd	nd	nd	nd	157	-	150*	NR
BH2-SS5	2.9 - 3.6	27-Feb-13	nd	nd	nd	nd	nd	***1,800***	730	-	2,500	WFO
BH2-SS7	4.4 - 5.0	27-Feb-13	**0.83**	0.29	**0.66**	1.2	190	nd	43	-	230*	NR
BH3-SS4	2.6 - 3.2	06-Mar-13	**0.36**	0.15	**1.8**	3.4	***1,400***	***24,000***	**14,300**	-	40,000	WFO
BH4-SS5	2.2 - 2.6	28-Feb-13	**0.18**	0.18	nd	0.31	10	***1,300***	1070	-	2,400	WFO
BH5-SS4	2.1 - 2.7	21-Feb-13	nd	0.22	0.045	0.076	5.4	36	230	-	270	NR
BH6-SS4	2.9 - 3.5	25-Feb-13	nd	0.14	**0.73**	4.0	***1,200***	***4,300***	**2,170**	-	7,700	WFO
BH7-SS1	0.2 - 0.7	25-Feb-13	nd	nd	nd	nd	nd	nd	32	-	32*	PLO
BH7-SS6	3.4 - 4.0	25-Feb-13	nd	nd	nd	nd	nd	nd	24	-	24*	NR
BH8-SS4	2.1 - 2.7	20-Feb-13	nd	nd	nd	nd	18	80	21	-	120	WFO
BH9-SS2	0.8 - 1.4	24-Feb-13	nd	nd	nd	nd	nd	nd	nd	-	nd	-
BH10-SS1	0.4 - 1.2	05-Mar-13	0.030	0.056	nd	0.079	7.1	66	135	-	210	WFO / NR-LO
BH11-SS1	0.3 - 0.8	07-Mar-13	nd	nd	nd	nd	nd	nd	31	-	31*	LO
BH12-SS2	1.0 - 1.3	03-Mar-13	nd	nd	nd	nd	nd	nd	137	-	140	NR
BH13-SS5	2.1 - 3.2	22-Feb-13	**0.038**	0.079	nd	0.057	3.5	180	138	-	320	WFO
BS14-SS3	1.6 - 2.2	24-Feb-13	**0.033**	0.10	0.044	0.34	nd	***670***	1480	-	2,100	NR
BS14-AS3C	2.3	24-Feb-13	nd	nd	nd	nd	nd	19	**2,510**	-	2,500*	LO
BH15-SS1	0.2 - 0.8	26-Feb-13	nd	nd	nd	nd	nd	nd	16	-	16*	PLO
BH15-SS1 Lab-Dup	-	-	-	-	-	-	-	nd	19	-	-*	-
BH15-SS3	1.6 - 2.2	26-Feb-13	nd	nd	**0.085**	0.42	***720***	***5,000***	**1,750**	-	7,500	WFO

Notes:

1 = CCME CSQG = Canadian Council of Ministers of the Environment (CCME) Canadian Soil Quality Guidelines (CSQGs) for the Protection of Environmental and Human Health for BTEX (CSQG on-line 2013) - Commercial Site, coarse-grained soil

2 = CCME CWS PHC = CCME Canada Wide Standards (CWS) for Petroleum Hydrocarbons (PHC) in Soil (January 2008) - Commercial Site (eco soil contact, vapour inhalation (indoor) and protection of groundwater for aquatic life) (Table 3)

3 = CCME CWS PHC Management Limit for a Commercial Site (January 2008)

4 = Modified TPH = total petroleum hydrocarbons excluding BTEX

5 = Atlantic PIRI analytical method does not analyse for >C32. Laboratory certificate indicates (Yes or No) whether chromatogram for each sample returns to baseline after C32. Samples are considered to have returned to baseline if the area from C32-C36 is less than 10% of the area from C10-C32.

6 = Site-specific Target Level (SSTL), Stantec (2013)

* = Baseline not reached at C32; sample may contain carbon fractions >C32

Triple silica gel clean-up was used by the laboratory to remove organic interferences from sample extracts.

RDL = Reportable Detection Limit for routine analysis; nd = Not detected above standard RDL; na = Not applicable

FO = Fuel Oil; WFO = weathered fuel oil; LO = Lube Oil; PLO = Possible Lube Oil; NR = no resemblance to petroleum hydrocarbons

mbgs = metres below ground surface

Bold/Grey Shaded = Value exceeds CCME and/or CWS eco/indoor guideline

Yellow Shaded = Value exceeds SSTL

Italics = Value exceeds CWS gw guideline

Underlined = Value exceeds CWS Management Limit

Table B.2 Results of Laboratory Analysis of Fractionated Petroleum Hydrocarbons in Soil
Remedial Action Plan/Risk Management Plan
Canadian Coast Guard Southside Base, Berth 28, Southside Road, St. John's, NL
Stantec Project No. 121412715

Parameters	RDL	Units	CWS [1, 2]	CWS Mgmt. Limit [3]	BH6-SS4	BH15-SS3	BH15-SS3 Lab-Dup
					2.9 - 3.5 mbgs	1.6 - 2.2 mbgs	-
					25-Feb-13	26-Feb-13	-
Benzene	0.025	mg/kg	0.03	-	**0.0870**	nd	-
Toluene	0.025	mg/kg	0.37	-	0.2	nd	-
Ethylbenzene	0.025	mg/kg	0.082	-	**0.60**	**0.10**	-
Xylenes	0.050	mg/kg	11	-	3.6	0.41	-
Aliphatic >C6-C8	2.0	mg/kg	-	-	390	160	-
Aliphatic >C8-C10	4.0	mg/kg	-	-	750	570	-
>C8-C10 Aromatics (-EX)	0.10	mg/kg	-	-	80	44	-
Aliphatic >C10-C12	8.0	mg/kg	-	-	880	1,000	780
Aliphatic >C12-C16	15	mg/kg	-	-	2,100	2,100	1,600
Aliphatic >C16-C21	15	mg/kg	-	-	1,200	790	590
Aliphatic >C21-<C32	15	mg/kg	-	-	260	96	68
Aromatic >C10-C12	4.0	mg/kg	-	-	340	220	240
Aromatic >C12-C16	15	mg/kg	-	-	620	580	570
Aromatic >C16-C21	15	mg/kg	-	-	570	370	330
Aromatic >C21-<C32	15	mg/kg	-	-	180	98	81
C_6-C_{10} - F1	-	mg/kg	320 (eco/indoor) 970 (gw)	700	***1,220***	**774**	-
C_{10}-C_{16} - F2	-	mg/kg	260 (eco) 380 (gw)	1,000	***3,940***	***3,900***	**-**
C_{16}-C_{32} [5] - F3	-	mg/kg	1,700 (eco)	3,500	**2,210**	1,354	-
>C_{32} [5] - F4	-	-	3,300 (eco)	10,000	-	-	-
Modified TPH - Tier 2 [4]	15	mg/kg	-	-	7,300	6,000	-
Resemblance	-	-	-	-	WFO, LO	WFO, PLO	-

Notes:

1 = CCME CSQG = Canadian Council of Ministers of the Environment (CCME) Canadian Soil Quality Guidelines (CSQGs) for the Protection of Environmental and Human Health for BTEX (CSQG on-line September 2012) - Commercial Site, coarse-grained soil

2 = CCME CWS PHC = CCME Canada Wide Standards (CWS) for Petroleum Hydrocarbons (PHC) in Soil (January 2008) - Commercial Site (eco soil contact, vapour inhalation (indoor) and protection of groundwater for aquatic life) (Table 3)

3 = CCME CWS PHC Management Limit for a Commercial Site (January 2008)

4 = Modified TPH = total petroleum hydrocarbons excluding BTEX

5 = Atlantic PIRI analytical method does not analyse for >C32. Laboratory certificate indicates (Yes or No) whether chromatogram for each sample returns to baseline after C32. Samples are considered to have returned to baseline if the area from C32-C36 is less than 10% of the area from C10-C32.

Triple silica gel clean-up was used by the laboratory to remove organic interferences from sample extracts.

RDL = Reportable Detection Limit for routine analysis; nd = Not detected above standard RDL; na = Not applicable

WFO = weathered fuel oil; LO = Lube Oil; PLO = Possible Lube Oil

mbgs = metres below ground surface

Bold/Shaded = Value exceeds CCME and/or CWS eco/indoor guideline

Italics = Value exceeds CWS gw guideline

Underlined = Value exceeds CWS Management Limit

Table B.3 Results of Laboratory Analysis of Available Metals in Soil
Remedial Action Plan/Risk Management Plan
Canadian Coast Guard Southside Base, Berth 28, Southside Road, St. John's, NL
Stantec Project No. 121412715

Parameters	RDL	Units	Guideline[1]	BH1-SS3	BH1-SS9	BH2-SS5	BH2-SS5 Lab-Dup	BH2-SS5 Lab-Dup 2	BH2-SS7	BH3-SS4	BH4-SS5	BH5-SS4
				1.6 - 2.2 mbgs	5.7 - 6.3 mbgs	2.9 - 3.6 mbgs	-	-	4.4 - 5.0 mbgs	2.6 - 3.2 mbgs	2.2 - 2.6 mbgs	2.1 - 2.7 mbgs
				04-Mar-13	04-Mar-13	27-Feb-13	-	-	27-Feb-13	06-Mar-13	28-Feb-13	21-Feb-13
Aluminum	10	mg/kg	-	11,000	12,000	15,000	14,000	-	6,100	11,000	11,000	16,000
Antimony	2.0	mg/kg	40	4	nd	nd	nd	-	nd	nd	4.5	nd
Arsenic	2.0	mg/kg	12	11	5	**19**	**20**	-	**16**	9.6	**46**	6.8
Barium	5.0	mg/kg	2,000	58	30	54	52	-	52	63	120	41
Beryllium	2.0	mg/kg	8	nd	nd	nd	nd	-	nd	nd	nd	nd
Boron	5.0	mg/kg	-	nd	61	nd	nd	-	nd	nd	nd	nd
Cadmium	0.30	mg/kg	22	0.35	1	nd	nd	-	nd	1	0.88	0.9
Chromium	2.0	mg/kg	87	17	17	28	38	-	15	32	51	22
Cobalt	1.0	mg/kg	300	9.4	6	12	13	-	5.4	11	15	8.5
Copper	2.0	mg/kg	91	38	26	57	**120**	59	23	**280**	**130**	24
Iron	50	mg/kg	-	31,000	21,000	60,000	64,000	-	27,000	170,000	57,000	32,000
Lead	0.50	mg/kg	260	220	18	230	230	-	**280**	**390**	**2,700**	170
Manganese	2.0	mg/kg	-	690	350	760	790	-	370	1,100	360	620
Mercury	0.10	mg/kg	24	0.3	nd	0.22	0.29	-	0.17	0.36	0.72	nd
Molybdenum	2.0	mg/kg	40	3.1	15	7.6	10	-	7.8	18	11	2.2
Nickel	2.0	mg/kg	50	15	15	26	29	-	20	25	**73**	19
Selenium	2.0	mg/kg	2.9	nd	1.4	nd	nd	-	1.2	nd	2.0	nd
Silver	0.50	mg/kg	40	nd	2.1	0.9	0.77	-	0.76	1.6	nd	nd
Strontium	5.0	mg/kg	-	25	780	31	37	-	23	84	63	11
Thallium	0.10	mg/kg	1	nd	0.28	0.15	0.14	-	0.24	nd	0.37	nd
Tin	2.0	mg/kg	300	12	nd	5.7	6.3	-	3.4	18	**320**	3.9
Uranium	0.10	mg/kg	33	0.84	10	3.1	3.4	-	1.9	3.6	3.5	0.62
Vanadium	2.0	mg/kg	130	20	30	28	28	-	15	36	45	23
Zinc	5.0	mg/kg	360	120	100	120	130	-	62	200	**880**	88

Notes:
1 = Canadian Council of Ministers of the Environment (CCME) Canadian Soil Quality Guidelines (CSQG on-line 2013). Commercial land use.

RDL = Reportable Detection Limit for routine analysis
nd = Not detected above standard RDL
mbgs = metres below ground surface
Lab-Dup = Laboratory QA/QC duplicate sample
Bold/Shaded = Value exceeds applicable guideline

Table B.3 Results of Laboratory Analysis of Available Metals in Soil (cont.)
Remedial Action Plan/Risk Management Plan
Canadian Coast Guard Southside Base, Berth 28, Southside Road, St. John's, NL
Stantec Project No. 121412715

Parameters	RDL	Units	Guideline[1]	BH6-SS4	BH6-SS4 Lab-Dup	BH7-SS1	BH7-SS6	BH8-SS4	BH9-SS2	BH10-SS1	BH11-SS1
				2.9 - 3.5 mbgs	-	0.2 - 0.7 mbgs	3.4 - 4.0 mbgs	2.1 - 2.7 mbgs	0.8 - 1.4 mbgs	0.4 - 1.2 mbgs	0.3 - 0.8 mbgs
				25-Feb-13	-	25-Feb-13	25-Feb-13	20-Feb-13	24-Feb-13	05-Mar-13	07-Mar-13
Aluminum	10	mg/kg	-	13,000	13,000	7,600	16,000	16,000	11,000	11,000	10,000
Antimony	2.0	mg/kg	40	3.6	nd	nd	nd	nd	nd	nd	nd
Arsenic	2.0	mg/kg	12	7.9	8.0	3.5	3.6	2.9	4.7	4.6	4.8
Barium	5.0	mg/kg	2,000	59	52	36	38	20	34	41	36
Beryllium	2.0	mg/kg	8	nd	nd	nd	nd	nd	nd	nd	nd
Boron	5.0	mg/kg	-	nd	nd	nd	nd	nd	nd	nd	nd
Cadmium	0.30	mg/kg	22	nd	nd	0.46	nd	nd	nd	nd	0.32
Chromium	2.0	mg/kg	87	21	17	12	21	35	9.4	14	21
Cobalt	1.0	mg/kg	300	11	11	6.1	8.8	8.2	8.3	7.9	7.8
Copper	2.0	mg/kg	91	31	30	11	45	20	14	21	25
Iron	50	mg/kg	-	27,000	26,000	17,000	29,000	33,000	20,000	23,000	26,000
Lead	0.50	mg/kg	260	210	200	12	15	42	12	32	12
Manganese	2.0	mg/kg	-	690	680	660	620	630	880	840	820
Mercury	0.10	mg/kg	24	0.11	nd	nd	nd	nd	nd	nd	nd
Molybdenum	2.0	mg/kg	40	3.2	3.3	nd	nd	3.9	nd	nd	nd
Nickel	2.0	mg/kg	50	13	13	7.2	21	21	6.8	12	18
Selenium	2.0	mg/kg	2.9	nd	nd	nd	nd	nd	nd	nd	nd
Silver	0.50	mg/kg	40	0.75	nd	nd	5.3	nd	nd	nd	nd
Strontium	5.0	mg/kg	-	21	20	6.3	21	7.6	19	18	30
Thallium	0.10	mg/kg	1	nd	nd	nd	nd	nd	nd	nd	nd
Tin	2.0	mg/kg	300	4.1	2.5	nd	nd	nd	nd	nd	nd
Uranium	0.10	mg/kg	33	1.4	1.4	0.38	3.7	0.48	0.63	0.42	0.64
Vanadium	2.0	mg/kg	130	19	20	8.9	25	22	13	19	26
Zinc	5.0	mg/kg	360	130	120	45	63	69	54	81	59

Notes:
1 = Canadian Council of Ministers of the Environment (CCME) Canadian Soil Quality Guidelines (CSQG on-line 2013). Commercial land use.

RDL = Reportable Detection Limit for routine analysis
nd = Not detected above standard RDL
mbgs = metres below ground surface
Lab-Dup = Laboratory QA/QC duplicate sample

Table B.3 Results of Laboratory Analysis of Available Metals in Soil (cont.)
Remedial Action Plan/Risk Management Plan
Canadian Coast Guard Southside Base, Berth 28, Southside Road, St. John's, NL
Stantec Project No. 121412715

Parameters	RDL	Units	Guideline[1]	BH12-SS2	BH13-SS3	BH13-SS5	BH14-SS3	BH14-AS3C	BH15-SS1	BH15-SS3
				1.0 - 1.3 mbgs	1.3 - 1.9 mbgs	2.1 - 3.2 mbgs	1.6 - 2.2 mbgs	2.3 mbgs	0.2 - 0.8 mbgs	1.6 - 2.2 mbgs
				03-Mar-13	22-Feb-13	22-Feb-13	24-Feb-13	24-Feb-13	26-Feb-13	26-Feb-13
Aluminum	10	mg/kg	-	9,200	14,000	13,000	9,700	6,800	7,800	17,000
Antimony	2.0	mg/kg	40	nd	nd	nd	nd	nd	nd	nd
Arsenic	2.0	mg/kg	12	4.8	5.3	8.7	**15**	2.9	4.2	12
Barium	5.0	mg/kg	2,000	45	33	72	140	26	21	110
Beryllium	2.0	mg/kg	8	nd	nd	nd	nd	nd	nd	nd
Boron	5.0	mg/kg	-	nd	nd	nd	nd	nd	nd	nd
Cadmium	0.30	mg/kg	22	nd	nd	nd	0.31	nd	nd	nd
Chromium	2.0	mg/kg	87	13	24	24	33	33	7.1	18
Cobalt	1.0	mg/kg	300	7.8	11	9.9	8.7	5.1	6.5	10
Copper	2.0	mg/kg	91	23	24	36	51	15	12	43
Iron	50	mg/kg	-	25,000	29,000	31,000	34,000	16,000	18,000	34,000
Lead	0.50	mg/kg	260	26	27	160	**340**	11	14	**850**
Manganese	2.0	mg/kg	-	790	850	800	610	540	730	620
Mercury	0.10	mg/kg	24	nd	nd	0.22	0.65	nd	nd	0.44
Molybdenum	2.0	mg/kg	40	nd	nd	2.8	5	nd	nd	nd
Nickel	2.0	mg/kg	50	12	16	15	18	9.6	6.7	20
Selenium	2.0	mg/kg	2.9	nd	nd	nd	nd	nd	nd	nd
Silver	0.50	mg/kg	40	nd	nd	nd	0.77	nd	nd	nd
Strontium	5.0	mg/kg	-	15	24	31	33	9.7	6.3	30
Thallium	0.10	mg/kg	1	nd	nd	nd	0.11	nd	nd	0.11
Tin	2.0	mg/kg	300	3.8	nd	4.2	15	nd	nd	27
Uranium	0.10	mg/kg	33	0.49	0.56	0.66	0.66	0.38	0.35	0.86
Vanadium	2.0	mg/kg	130	16	26	21	24	30	9.3	23
Zinc	5.0	mg/kg	360	82	78	110	140	53	47	140

Notes:
1 = Canadian Council of Ministers of the Environment (CCME) Canadian Soil Quality Guidelines (CSQG on-line 2013). Commercial land use.

RDL = Reportable Detection Limit for routine analysis
nd = Not detected above standard RDL
mbgs = metres below ground surface
Bold/Shaded = Value exceeds applicable guideline

Table B.4 Results of Laboratory Analysis of Polycyclic Aromatic Hydrocarbons in Soi
Remedial Action Plan/Risk Management Plan
Canadian Coast Guard Southside Base, Berth 28, Southside Road, St. John's, NL
Stantec Project No. 121412715

Parameter	RDL	Units	B(a)P PEF	CCME $CSQG_{HH}$[1] (All Land Uses)	HH Guidelines - Other Jurisdictions[2] (All Land Uses)	CCME $CSQG_{EH}$[1] - (Comm.)	BH1-SS3	BH1-SS3 Lab-Dup	BH1-SS9	BH2-SS5	BH2-SS7	BH3-SS4	BH4-SS5
							1.6 - 2.2 mbgs	-	5.7 - 6.3 mbgs	2.9 - 3.6 mbgs	4.4 - 5.0 mbgs	2.6 - 3.2 mbgs	2.2 - 2.6 mbgs
							04-Mar-13	-	04-Mar-13	27-Feb-13	27-Feb-13	06-Mar-13	28-Feb-13
Non-Carcinognic PAHs													
1-Methylnaphthalene	0.01	mg/kg	-	-	560*	-	0.37	0.26	nd	0.69	0.058	12	0.96
2-Methylnaphthalene	0.01	mg/kg	-	-	560*	-	0.44	0.32	nd	nd	0.031	2.9	0.96
Acenaphthene	0.01	mg/kg	-	-	96*	-	0.067	0.053	nd	nd	0.16	4.3	1.2
Acenaphthylene	0.01	mg/kg	-	-	9.6*	-	nd	nd	nd	nd	0.088	nd	1.7
Anthracene	0.01	mg/kg	-	-	4,200*	32	0.20	0.20	nd	1.5	0.4	nd	2.2
Fluoranthene	0.01	mg/kg	-	-	9.6*	180	1.4	1.8	0.05	3.4	1.6	5.5	17
Fluorene	0.01	mg/kg	-	-	5,600*	-	0.13	0.097	nd	0.55	0.14	3.6	nd
Naphthalene	0.01	mg/kg	-	-	2,800*	22/0.013[4]	0.33	0.22	nd	0.48	0.055	2.9	1.5
Perylene	0.01	mg/kg	-	-	2,800**	-	0.18	0.19	0.44	0.17	0.12	0.32	1.3
Phenanthrene	0.01	mg/kg	-	-	3,800**	50/0.046[4]	0.73	0.73	nd	1.1	0.64	11	13
Pyrene	0.01	mg/kg	-	-	96*	100	1.2	1.5	0.056	2.8	1.7	5.2	19
Carcinogenic PAHs													
Benzo[a]anthracene	0.01	mg/kg	0.1	-	-	10	0.84	0.99	nd	1.2	0.95	2.0	6.8
Benzo[a]pyrene	0.01	mg/kg	1	-	-	72	0.64	0.67	nd	0.89	0.65	1.5	6.6
Benzo[b]fluoranthene	0.01	mg/kg	0.1	-	-	10	0.64	0.62	nd	0.62	0.40	1.2	4.8
Benzo[ghi]perylene	0.01	mg/kg	0.01	-	-	-	0.54	0.52	nd	0.53	0.33	1.0	4.5
Benzo[j]fluoranthene	0.01	mg/kg	0.1	-	-	10	0.34	0.33	nd	0.39	0.24	0.71	3.1
Benzo[k]fluoranthene	0.01	mg/kg	0.1	-	-	10	0.33	0.33	nd	0.35	0.23	0.67	2.8
Chrysene	0.01	mg/kg	0.01	-	-	-	0.94	1.1	nd	1.2	0.78	2.3	7.3
Indeno[1,2,3-cd]pyrene	0.01	mg/kg	0.1	-	-	10	0.43	0.43	nd	0.37	0.24	0.72	3.4
Dibenz[a,h]anthracene	0.01	mg/kg	1	-	-	10	0.12	0.11	nd	0.12	0.079	0.20	0.9
Benzo(a)pyrene TPE concentration				5.3[1,5]	-	-	1.0	1.1	0.013	1.3	0.9	2.3	**9.7**

Notes:

1 = Canadian Counsel of Ministers of the Environment (CCME) Soil Quality Guidelines for the Protection of Environmental and Human Health (CSQG on-line 2013). As per CCME recommendations, soil samples are compared against the soil quality guidelines for the protection of human health and environmental health separately. Commercial land use.

2 = Human Health Criteria for non-carcinogenic PAHs in soil. Guidelines from other jurisdictions applied in the absence of applicable CCME guidelines. Source guideline for specific PAH parameter:*Ontario Ministry of the Environment (MOE) Soil, Groundwater and Sediment Standards for Use Under Part XV.I of the Environmental Protection Act April 15, 2011. Soil Components for Table 3 – Full Depth, Non-potable Scenario (lowest applicable human health guideline); **Texas Risk Reduction Program (TRRP) Tier I protective concentration level (PCL), Table 5 (June 2012).

3 = Carcinogenic PAHs assessed as B[a]P TPE for Human Health

4 = Guideline if potential impact to surface water (freshwater)

5 = Based on CCME guidelines for ingestion, inhalation and dermal exposures. Where a parameter is not detected, 1/2 of the RDL is used in the TPE calculation.

B[a]P TPE = Benzo(a)pyrene Total Potency Equivalent concentration. Calculation assumes that soil is not contaminated with coal tar or creosote timbers

B(a)P PEF = Benzo(a)pyrene Potency Equivalent Factor

TPE = Total potency equivalent

RDL = Reportable Detection Limit for routine analysis

nd = not detected above standard RDL

" - " = no guideline available

mbgs = metres below ground surface

Bold/Shaded = Value exceeds applicable guideline

Lab-Dup = Laboratory QA/QC duplicate sample

Table B.4 Results of Laboratory Analysis of Polycyclic Aromatic Hydrocarbons in Soil (cont.
Remedial Action Plan/Risk Management Plan
Canadian Coast Guard Southside Base, Berth 28, Southside Road, St. John's, NL
Stantec Project No. 121412715

Parameter	RDL	Units	B(a)P PEF	CCME $CSQG_{HH}$[1] (All Land Uses)	HH Guidelines - Other Jurisdictions[2] (All Land Uses)	CCME $CSQG_{EH}$[1] - (Comm.)	BH5-SS4	BH5-SS4 Lab-Dup	BH6-SS4	BH7-SS1	BH7-SS6	BH8-SS4	BH9-SS2
							2.1 - 2.7 mbgs	-	2.9 - 3.5 mbgs	0.2 - 0.7 mbgs	3.4 - 4.0 mbgs	2.1 - 2.7 mbgs	0.8 - 1.4 mbgs
							21-Feb-13	-	25-Feb-13	25-Feb-13	25-Feb-13	20-Feb-13	24-Feb-13
Non-Carcinognic PAHs													
1-Methylnaphthalene	0.01	mg/kg	-	-	560*	-	0.23	0.31	2.5	nd	nd	0.021	nd
2-Methylnaphthalene	0.01	mg/kg	-	-	560*	-	0.19	0.28	1.6	nd	nd	0.033	nd
Acenaphthene	0.01	mg/kg	-	-	96*	-	0.56	1.9	0.2	nd	0.039	0.015	nd
Acenaphthylene	0.01	mg/kg	-	-	9.6*	-	0.085	0.14	0.27	nd	nd	nd	nd
Anthracene	0.01	mg/kg	-	-	4,200*	32	4.3	15	0.35	nd	nd	nd	nd
Fluoranthene	0.01	mg/kg	-	-	9.6*	180	**12**	**44**	0.84	0.014	nd	0.065	0.017
Fluorene	0.01	mg/kg	-	-	5,600*	-	1.9	6.7	0.78	nd	0.033	0.024	nd
Naphthalene	0.01	mg/kg	-	-	2,800*	22/0.013[4]	0.24	0.39	1.1	nd	nd	0.35	nd
Perylene	0.01	mg/kg	-	-	2,800**	-	1.1	2.7	0.22	nd	0.014	nd	nd
Phenanthrene	0.01	mg/kg	-	-	3,800**	50/0.046[4]	8.9	19	1.6	0.026	nd	0.074	0.024
Pyrene	0.01	mg/kg	-	-	96*	100	12	45	0.83	0.014	nd	0.081	0.016
Carcinogenic PAHs													
Benzo[a]anthracene	0.01	mg/kg	0.1	-	-	10	5.8	**22**	0.52	nd	nd	0.036	nd
Benzo[a]pyrene	0.01	mg/kg	1	-	-	72	5.0	17	0.53	nd	nd	0.040	nd
Benzo[b]fluoranthene	0.01	mg/kg	0.1	-	-	10	3.2	9.8	0.40	nd	nd	0.029	nd
Benzo[ghi]perylene	0.01	mg/kg	0.01	-	-	-	2.1	7.3	0.36	nd	nd	0.028	nd
Benzo[j]fluoranthene	0.01	mg/kg	0.1	-	-	10	2.2	6.9	0.32	nd	nd	0.019	nd
Benzo[k]fluoranthene	0.01	mg/kg	0.1	-	-	10	2.0	6.2	0.25	nd	nd	0.017	nd
Chrysene	0.01	mg/kg	0.01	-	-	-	5.9	21	0.64	0.018	nd	0.042	nd
Indeno[1,2,3-cd]pyrene	0.01	mg/kg	0.1	-	-	10	1.8	5.9	0.31	nd	nd	0.022	nd
Dibenz[a,h]anthracene	0.01	mg/kg	1	-	-	10	0.62	1.7	0.081	nd	nd	nd	nd
Benzo(a)pyrene TPE concentration				5.3[1,5]	-	-	**7.2**	**24.1**	0.801	0.013	0.013	0.058	0.013

Notes:

1 = Canadian Counsel of Ministers of the Environment (CCME) Soil Quality Guidelines for the Protection of Environmental and Human Health (CSQG on-line 2013). As per CCME recommendations, soil samples are compared against the soil quality guidelines for the protection of human health and environmental health separately. Commercial land use.

2 = Human Health Criteria for non-carcinogenic PAHs in soil. Guidelines from other jurisdictions applied in the absence of applicable CCME guidelines. Source guideline for specific PAH parameter:*Ontario Ministry of the Environment (MOE) Soil, Groundwater and Sediment Standards for Use Under Part XV.I of the Environmental Protection Act April 15, 2011. Soil Components for Table 3 – Full Depth, Non-potable Scenario (lowest applicable human health guideline); **Texas Risk Reduction Program (TRRP) Tier I protective concentration level (PCL), Table 5 (June 2012).

3 = Carcinogenic PAHs assessed as B[a]P TPE for Human Health

4 = Guideline if potential impact to surface water (freshwater)

5 = Based on CCME guidelines for ingestion, inhalation and dermal exposures. Where a parameter is not detected, 1/2 of the RDL is used in the TPE calculation.

B[a]P TPE = Benzo(a)pyrene Total Potency Equivalent concentration. Calculation assumes that soil is not contaminated with coal tar or creosote timbers

B(a)P PEF = Benzo(a)pyrene Potency Equivalent Factor

TPE = Total potency equivalent

RDL = Reportable Detection Limit for routine analysis

nd = not detected above standard RDL

" - " = no guideline available

mbgs = metres below ground surface

Bold/Shaded = Value exceeds applicable guideline

Lab-Dup = Laboratory QA/QC duplicate sample

Table B.4 Results of Laboratory Analysis of Polycyclic Aromatic Hydrocarbons in Soil (cont.
Remedial Action Plan/Risk Management Plan
Canadian Coast Guard Southside Base, Berth 28, Southside Road, St. John's, NL
Stantec Project No. 121412715

Parameter	RDL	Units	B(a)P PEF	CCME $CSQG_{HH}$[1] (All Land Uses)	HH Guidelines - Other Jurisdictions[2] (All Land Uses)	CCME $CSQG_{EH}$[1] - (Comm.)	BH10-SS1	BH11-SS1	BH12-SS2	BH13-SS3	BH13-SS3 Lab-Dup	BH13-SS5
							0.4 - 1.2 mbgs	0.3 - 0.8 mbgs	1.0 - 1.3 mbgs	1.3 - 1.9 mbgs	-	2.1 - 3.2 mbgs
							05-Mar-13	07-Mar-13	03-Mar-13	22-Feb-13	-	22-Feb-13
Non-Carcinognic PAHs												
1-Methylnaphthalene	0.01	mg/kg	-	-	560*	-	0.11	nd	0.34	0.011	0.013	0.054
2-Methylnaphthalene	0.01	mg/kg	-	-	560*	-	0.17	nd	0.42	0.016	0.018	0.097
Acenaphthene	0.01	mg/kg	-	-	96*	-	0.36	nd	1.3	nd	nd	0.087
Acenaphthylene	0.01	mg/kg	-	-	9.6*	-	0.034	nd	0.078	nd	nd	nd
Anthracene	0.01	mg/kg	-	-	4,200*	32	0.51	nd	2.2	0.019	0.024	0.08
Fluoranthene	0.01	mg/kg	-	-	9.6*	180	2.1	0.062	9.3	0.15	0.17	0.5
Fluorene	0.01	mg/kg	-	-	5,600*	-	0.5	nd	1.4	nd	nd	0.069
Naphthalene	0.01	mg/kg	-	-	2,800*	22/0.013[4]	0.34	nd	0.58	0.013	0.014	0.057
Perylene	0.01	mg/kg	-	-	2,800**	-	0.089	nd	0.49	0.026	0.029	0.073
Phenanthrene	0.01	mg/kg	-	-	3,800**	50/0.046[4]	2.1	0.031	11	0.094	0.1	0.25
Pyrene	0.01	mg/kg	-	-	96*	100	1.6	0.056	7.1	0.13	0.14	0.44
Carcinogenic PAHs												
Benzo[a]anthracene	0.01	mg/kg	0.1	-	-	10	0.59	0.033	4.0	0.076	0.086	0.23
Benzo[a]pyrene	0.01	mg/kg	1	-	-	72	0.380	0.027	2.4	0.095	0.110	0.280
Benzo[b]fluoranthene	0.01	mg/kg	0.1	-	-	10	0.32	0.026	1.7	0.076	0.086	0.22
Benzo[ghi]perylene	0.01	mg/kg	0.01	-	-	-	0.18	0.025	1.0	0.074	0.083	0.21
Benzo[j]fluoranthene	0.01	mg/kg	0.1	-	-	10	0.19	0.015	1.1	0.045	0.051	0.13
Benzo[k]fluoranthene	0.01	mg/kg	0.1	-	-	10	0.18	0.013	1.1	0.042	0.049	0.12
Chrysene	0.01	mg/kg	0.01	-	-	-	0.64	0.047	4.0	0.083	0.09	0.24
Indeno[1,2,3-cd]pyrene	0.01	mg/kg	0.1	-	-	10	0.17	0.017	0.95	0.061	0.07	0.17
Dibenz[a,h]anthracene	0.01	mg/kg	1	-	-	10	0.049	nd	0.32	0.015	0.016	0.045
Benzo(a)pyrene TPE concentration				$5.3^{1,5}$	-	-	0.58	0.043	3.7	0.14	0.16	0.42

Notes:

1 = Canadian Counsel of Ministers of the Environment (CCME) Soil Quality Guidelines for the Protection of Environmental and Human Health (CSQG on-line 2013). As per CCME recommendations, soil samples are compared against the soil quality guidelines for the protection of human health and environmental health separately. Commercial land use.

2 = Human Health Criteria for non-carcinogenic PAHs in soil. Guidelines from other jurisdictions applied in the absence of applicable CCME guidelines. Source guideline for specific PAH parameter:*Ontario Ministry of the Environment (MOE) Soil, Groundwater and Sediment Standards for Use Under Part XV.I of the Environmental Protection Act April 15, 2011. Soil Components for Table 3 – Full Depth, Non-potable Scenario (lowest applicable human health guideline); **Texas Risk Reduction Program (TRRP) Tier I protective concentration level (PCL), Table 5 (June 2012).

3 = Carcinogenic PAHs assessed as B[a]P TPE for Human Health

4 = Guideline if potential impact to surface water (freshwater)

5 = Based on CCME guidelines for ingestion, inhalation and dermal exposures. Where a parameter is not detected, 1/2 of the RDL is used in the TPE calculation.

B[a]P TPE = Benzo(a)pyrene Total Potency Equivalent concentration. Calculation assumes that soil is not contaminated with coal tar or creosote timbers

B(a)P PEF = Benzo(a)pyrene Potency Equivalent Factor

TPE = Total potency equivalent

RDL = Reportable Detection Limit for routine analysis

nd = not detected above standard RDL

" - " = no guideline available

mbgs = metres below ground surface

Bold/Shaded = Value exceeds applicable guideline

Lab-Dup = Laboratory QA/QC duplicate sample

Table B.4 Results of Laboratory Analysis of Polycyclic Aromatic Hydrocarbons in Soil (cont.
Remedial Action Plan/Risk Management Plan
Canadian Coast Guard Southside Base, Berth 28, Southside Road, St. John's, NL
Stantec Project No. 121412715

Parameter	RDL	Units	B(a)P PEF	CCME $CSQG_{HH}$[1] (All Land Uses)	HH Guidelines - Other Jurisdictions[2] (All Land Uses)	CCME $CSQG_{EH}$[1] - (Comm.)	BH14-SS3	BH14-AS3C	BH15-SS1	BH15-SS3
							1.6 - 2.2 mbgs	2.3 mbgs	0.2 - 0.8 mbgs	1.6 - 2.2 mbgs
							24-Feb-13	24-Feb-13	26-Feb-13	26-Feb-13
Non-Carcinognic PAHs										
1-Methylnaphthalene	0.01	mg/kg	-	-	560*	-	8.1	0.011	nd	2.6
2-Methylnaphthalene	0.01	mg/kg	-	-	560*	-	13	0.014	nd	0.13
Acenaphthene	0.01	mg/kg	-	-	96*	-	12	nd	nd	0.36
Acenaphthylene	0.01	mg/kg	-	-	9.6*	-	5.0	nd	nd	0.33
Anthracene	0.01	mg/kg	-	-	4,200*	32	20	nd	nd	0.12
Fluoranthene	0.01	mg/kg	-	-	9.6*	180	**64**	0.04	nd	0.64
Fluorene	0.01	mg/kg	-	-	5,600*	-	21	0.01	nd	0.78
Naphthalene	0.01	mg/kg	-	-	2,800*	22/0.013[4]	**38**	0.01	nd	0.066
Perylene	0.01	mg/kg	-	-	2,800**	-	3.6	0.035	nd	0.047
Phenanthrene	0.01	mg/kg	-	-	3,800**	50/0.046[4]	**100**	0.04	nd	0.95
Pyrene	0.01	mg/kg	-	-	96*	100	52	0.12	nd	0.65
Carcinogenic PAHs										
Benzo[a]anthracene	0.01	mg/kg	0.1	-	-	10	**25**	nd	nd	0.28
Benzo[a]pyrene	0.01	mg/kg	1	-	-	72	16	0.044	nd	0.22
Benzo[b]fluoranthene	0.01	mg/kg	0.1	-	-	10	**11**	nd	nd	0.2
Benzo[ghi]perylene	0.01	mg/kg	0.01	-	-	-	7.5	0.11	nd	0.12
Benzo[j]fluoranthene	0.01	mg/kg	0.1	-	-	10	7.0	nd	nd	0.12
Benzo[k]fluoranthene	0.01	mg/kg	0.1	-	-	10	6.5	nd	nd	0.12
Chrysene	0.01	mg/kg	0.01	-	-	-	23	0.56	0.014	0.32
Indeno[1,2,3-cd]pyrene	0.01	mg/kg	0.1	-	-	10	6.7	nd	nd	0.11
Dibenz[a,h]anthracene	0.01	mg/kg	1	-	-	10	2.0	nd	nd	0.031
Benzo(a)pyrene TPE concentration				5.3[1,5]	-	-	**23.9**	0.06	0.013	0.34

Notes:

1 = Canadian Counsel of Ministers of the Environment (CCME) Soil Quality Guidelines for the Protection of Environmental and Human Health (CSQG on-line 2013). As per CCME recommendations, soil samples are compared against the soil quality guidelines for the protection of human health and environmental health separately. Commercial land use.

2 = Human Health Criteria for non-carcinogenic PAHs in soil. Guidelines from other jurisdictions applied in the absence of applicable CCME guidelines. Source guideline for specific PAH parameter:*Ontario Ministry of the Environment (MOE) Soil, Groundwater and Sediment Standards for Use Under Part XV.I of the Environmental Protection Act April 15, 2011. Soil Components for Table 3 – Full Depth, Non-potable Scenario (lowest applicable human health guideline); **Texas Risk Reduction Program (TRRP) Tier I protective concentration level (PCL), Table 5 (June 2012).

3 = Carcinogenic PAHs assessed as B[a]P TPE for Human Health

4 = Guideline if potential impact to surface water (freshwater)

5 = Based on CCME guidelines for ingestion, inhalation and dermal exposures. Where a parameter is not detected, 1/2 of the RDL is used in the TPE calculation.

B[a]P TPE = Benzo(a)pyrene Total Potency Equivalent concentration. Calculation assumes that soil is not contaminated with coal tar or creosote timbers

B(a)P PEF = Benzo(a)pyrene Potency Equivalent Factor

TPE = Total potency equivalent

RDL = Reportable Detection Limit for routine analysis

nd = not detected above standard RDL

" - " = no guideline available

mbgs = metres below ground surface

Bold/Shaded = Value exceeds applicable guideline

Table B.5 Results of Laboratory Analysis of Polychlorinated Biphenyls in Soil
Remedial Action Plan/Risk Management Plan
Canadian Coast Guard Southside Base, Berth 28, Southside Road, St. John's, NL
Stantec Project No. 121412715

Sample I.D.	Depth (mbgs)	Date	Polychlorinated Biphenyls (PCBs)
BH1-SS3	1.6 - 2.2	04-Mar-13	nd
BH1-SS3 Lab-Dup	-	-	nd
BH1-SS9	5.7 - 6.3	04-Mar-13	nd
BH2-SS5	2.9 - 3.6	27-Feb-13	nd
BH3-SS4	2.6 - 3.2	06-Mar-13	nd
BH4-SS5	2.2 - 2.6	28-Feb-13	nd
BH4-SS5 Lab-Dup	-	-	nd
BH5-SS4	2.1 - 2.7	21-Feb-13	nd
BH5-SS4 Lab-Dup	-	-	nd
BH6-SS4	2.9 - 3.5	25-Feb-13	nd
BH7-SS1	0.2 - 0.7	25-Feb-13	nd
BH7-SS6	3.4 - 4.0	25-Feb-13	nd
BH8-SS4	2.1 - 2.7	20-Feb-13	nd
BH9-SS2	0.8 - 1.4	24-Feb-13	nd
BH10-SS1	0.4 - 1.2	05-Mar-13	nd
BH11-SS1	0.3 - 0.8	07-Mar-13	nd
BS12-SS2	1.0 - 1.3	03-Mar-13	nd
BH13-SS3	1.3 - 1.9	22-Feb-13	nd
BH14-SS3	1.6 - 3.2	24-Feb-13	nd
BH14-AS3C	2.3	24-Feb-13	nd
BH15-SS1	0.2 - 0.8	26-Feb-13	nd
BH15-SS1 Lab-Dup	-	-	nd
BH15-SS3	1.6 - 2.2	26-Feb-13	nd
		RDL	0.05
		Units	mg/kg
		Guideline[1]	33

Notes:
1 = Canadian Council of Ministers of the Environment (CCME) Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health (CSQG on-line 2013). Commercial land use.

RDL = Reportable Detection Limit for routine analysis
nd = Not detected above standard RDL
mbgs = metres below ground surface
Lab-Dup = Laboratory QA/QC duplicate sample

Table B.6 Results of Laboratory Analysis of Total Oil and Grease in Soil
Remedial Action Plan/Risk Management Plan
Canadian Coast Guard Southside Base, Berth 28, Southside Road, St. John's, NL
Stantec Project No. 121412715

Sample I.D.	Depth (mbgs)	Date	Total Oil & Grease
BH2-SS5	2.9 - 3.6	27-Feb-13	1,800
BH5-SS4	2.1 - 2.7	21-Feb-13	1,400
BH6-SS4	2.9 - 3.5	25-Feb-13	5,200
BH8-SS4	2.1 - 2.7	20-Feb-13	660
BH8-SS4 Lab-Dup	-	-	600
BH13-SS5	2.1 - 3.2	22-Feb-13	480
BH15-SS3	1.6 - 2.2	26-Feb-13	3,500
		RDL	0.05
		Units	mg/kg

Notes:
RDL = Reportable Detection Limit for routine analysis
nd = Not detected above standard RDL
mbgs = metres below ground surface
Lab-Dup = Laboratory QA/QC duplicate sample

Table B.7 Results of Laboratory Analysis of Leachate in Soil
Remedial Action Plan/Risk Management Plan
Canadian Coast Guard Southside Base, Berth 28, Southside Road, St. John's, NL
Stantec Project No. 121412715

Parameters	Units	Guideline[1]	RDL	BH6-SS4	BH14-SS3	BH14-SS3 Lab-Dup	BH14-AS3C	BH14-AS3C Lab-Dup	BH15-SS3
				2.9 - 3.5 mbgs	1.6 - 2.2 mbgs	-	2.3 mbgs	-	1.6 - 2.2 mbgs
				25-Feb-13	24-Feb-13	-	24-Feb-13	-	26-Feb-13
Leachable >C10-C16 Hydrocarbons	µg/L	-	0.20	1.1	1.7	1.7	nd	-	0.92
Leachable >C16-C21 Hydrocarbons	µg/L	-	0.20	nd	0.46	0.47	nd	-	nd
Leachable >C21-<C32 Hydrocarbons	µg/L	-	0.50	nd	nd	nd	nd	-	nd
Leachable Lead	µg/L	5,000	5.0	410	2,200	-	10	-	540
Leachable Fluoranthene	µg/L	-	0.10	0.21	8.5	-	nd	nd	0.30
Leachable Naphthalene	µg/L	-	2.0	8.4	600	-	nd	nd	nd
Leachable Phenanthrene	µg/L	-	0.10	1.5	93	-	0.20	0.24	1.7

Notes:
1 = Environment Canada, Interprovincial Movement of Hazardous Waste and Hazardous Recyclable Material Regulations, Schedule 2 (Table of Hazardous Constituents Controlled Under Leachate Test and Regulated Limits), January 2002

RDL = Reportable Detection Limit
nd = Not detected above standard RDL
'-' = no applicable guidelines
Lab-Dup = Laboratory QA/QC duplicate sample

Table B.8 Results of Laboratory Analysis of Petroleum Hydrocarbons in Groundwater
Remedial Action Plan/Risk Management Plan
Canadian Coast Guard Southside Base, Berth 28, Southside Road, St. John's, NL
Stantec Project No. 121412715

Parameters	RDL	Units	FIGQGs[1]	ON MOE[2]	BH1	BH2	BH4	BH5	BH7	BH8	BH11	BH13	BH15
					12-Mar-13	12-Mar-13	12-Mar-13	12-Mar-13	12-Mar-13	12-Mar-13	12-Mar-13	12-Mar-13	12-Mar-13
Benzene	0.001	mg/L	0.2	0.044	nd	nd	0.002	nd	nd	nd	0.003	nd	nd
Toluene	0.001	mg/L	8.9	14	nd	nd	nd	nd	nd	nd	0.002	nd	nd
Ethylbenzene	0.001	mg/L	11	1.8	nd	nd	nd	nd	nd	nd	0.004	nd	nd
Xylenes	0.002	mg/L	-	3.3	nd	nd	nd	nd	nd	nd	0.011	nd	nd
C_6-C_{10} - F1	0.01	mg/L	-	0.42	nd	0.017	0.064	nd	nd	0.079	0.2	nd	0.20
C_{10}-C_{16} - F2	0.05	mg/L	-	0.15	0.085	0.068	0.13	0.055	0.15	**1.2**	**0.28**	0.088	**1.1**
C_{16}-C_{32}[4] - F3	0.1	mg/L	-	0.5	nd	nd	nd	0.165	0.085	**0.63**	0.061	nd	0.25
>C_{32}[4] - F4	-	mg/L	-	0.5	-	-	-	-	-	-	-	-	-
Modified TPH - Tier I[3]	0.1	mg/L	-	-	nd	nd	0.19	0.22*	0.23	1.9*	0.54	nd	1.5
Resemblance	-	-	-	-	NR FO	G/FO	G/FO	NR FO/LO	FO	FO	G	FO	G/FO

Notes:

1 = Federal Interim Groundwater Quality Guidelines (FIGQGs), Generic Guidelines for Commercial and Industrial Land Uses (November 2012), Tier 2 for Marine Life Water Use (Table 3)

2 = Ontario Ministry of the Environment (MOE) Soil, Groundwater and Sediment Standards for Use Under Part XV.1 of the *Environmental Protection Act.* April 15, 2011. Generic site condition standards for use within 30 m of a water body in a non-potable groundwater condition (Table 9)

3 = Modified TPH - Tier I does not include BTEX

4 = Atlantic PIRI analytical method does not analyse for >C32. Laboratory certificate indicates (Yes or No) whether chromatogram for each sample returns to baseline after C32. Samples are considered to have returned to baseline if the area from C32-C36 is less than 10% of the area from C10-C32.

* = Baseline not reached at C32; sample may contain carbon fractions >C32

Bold/shaded/underlined = exceeds ON MOE criteria

RDL = Reportable Detection Limit

nd = Not detected above standard RDL

na = Not applicable

G = Gasoline; FO = fuel oil; LO = lube oil; NR = no resemblance to petroleum hydrocarbons

Table B.9 Results of Laboratory Analysis of Fractionated Petroleum Hydrocarbons in Groundwater
Remedial Action Plan/Risk Management Plan
Canadian Coast Guard Southside Base, Berth 28, Southside Road, St. John's, NL
Stantec Project No. 121412715

Parameters	RDL	Units	FIGQGs[1]	ON MOE[2]	BH6	BH6 Lab-Dup	BH15
					12-Mar-13		13-Mar-13
Benzene	0.001	mg/L	0.2	0.044	0.016	-	nd
Toluene	0.001	mg/L	8.9	18	0.0038	-	nd
Ethylbenzene	0.001	mg/L	11	2.3	0.067	-	nd
Xylenes	0.002	mg/L	-	4.2	0.12	-	0.0030
Aliphatic >C6-C8	0.010	mg/L	-	-	0.47	-	0.13
Aliphatic >C8-C10	0.010	mg/L	-	-	0.12	-	0.091
>C8-C10 Aromatics (-EX)	0.010	mg/L	-	-	0.62	-	0.045
Aliphatic >C10-C12	0.010	mg/L	-	-	0.12	0.096	0.35
Aliphatic >C12-C16	0.050	mg/L	-	-	0.26	0.23	0.78
Aliphatic >C16-C21	0.050	mg/L	-	-	0.14	0.13	0.32
Aliphatic >C21-<C32	0.100	mg/L	-	-	nd	nd	nd
Aromatic >C10-C12	0.010	mg/L	-	-	0.54	0.46	0.19
Aromatic >C12-C16	0.050	mg/L	-	-	0.33	0.29	0.31
Aromatic >C16-C21	0.050	mg/L	-	-	0.17	0.15	0.19
Aromatic >C21-<C32	0.100	mg/L	-	-	nd	nd	nd
C_6-C_{10} - F1	-	mg/L	-	0.75	**1.21**	-	0.27
C_{10}-C_{16} - F2	-	mg/L	-	0.15	**1.25**	-	**1.63**
C_{16}-C_{32}[4] - F3	-	mg/L	-	0.5	0.41	-	**0.61**
>C_{32}[4] - F4	-	mg/L	-	0.5	-	-	-
Modified TPH - Tier 2[3]	0.11	mg/L	-	-	2.8	-	2.4
Resemblance	-	-	-	-	G, WFO	-	WFO

Notes:

1 = Federal Interim Groundwater Quality Guidelines (FIGQGs), Generic Guidelines for Commercial and Industrial Land Uses (November 2012), Tier 2 for Marine Life Water Use (Table 3)

2 = Ontario Ministry of the Environment (MOE) Soil, Groundwater and Sediment Standards for Use Under Part XV.1 of the *Environmental Protection Act.* April 15, 2011. Generic site condition standards for use within 30 m of a water body in a non-potable groundwater condition (Table 9)

3 = Modified TPH - Tier I does not include BTEX

4 = Atlantic PIRI analytical method does not analyse for >C32. Laboratory certificate indicates (Yes or No) whether chromatogram for each sample returns to baseline after C32. Samples are considered to have returned to baseline if the area from C32-C36 is less than 10% of the area from C10-C32.

Bold/shaded/underlined = exceeds ON MOE criteria

RDL = Reportable Detection Limit

nd = Not detected above standard RDL

Lab-Dup = Laboratory QA/QC duplicate sample

na = Not applicable

G = Gasoline; WFO = weathered fuel oil

Table B.10 Results of Laboratory Analysis of Dissolved Metals in Groundwater
Remedial Action Plan/Risk Management Plan
Canadian Coast Guard Southside Base, Berth 28, Southside Road, St. John's, NL
Stantec Project No. 121412715

Parameters	RDL	Units	FIGQGs[1]	ON MOE[2]	BH1	BH2	BH4	BH5	BH6
					12-Mar-13	12-Mar-13	12-Mar-13	12-Mar-13	12-Mar-13
Aluminum	5.0	ug/L	-	-	nd	nd	nd	11.2	7.6
Antimony	1.0	ug/L	-	16,000	nd	nd	nd	nd	nd
Arsenic	1.0	ug/L	12.5	1,500	nd	1.0	nd	nd	nd
Barium	1.0	ug/L	500	23,000	36.2	264	427	72.9	86.1
Beryllium	1.0	ug/L	100	53	nd	nd	nd	nd	nd
Bismuth	2.0	ug/L	-	-	nd	nd	nd	nd	nd
Boron	50	ug/L	5,000	36,000	150	371	425	nd	nd
Cadmium	0.017	ug/L	0.12	2.1	0.028	nd	nd	0.033	0.017
Calcium	100	ug/L	-	-	35,900	88,300	149,000	11,400	22,400
Chromium	1.0	ug/L	56	640	nd	nd	nd	nd	nd
Cobalt	0.40	ug/L	-	52	1.32	3.15	1.57	1.32	5.67
Copper	2.0	ug/L	2.0	69	nd	nd	nd	nd	nd
Iron	50	ug/L	-	-	nd	8120	15100	nd	1220
Lead	0.50	ug/L	2.0	20	nd	nd	nd	nd	0.53
Magnesium	100	ug/L	-	-	52,500	164,000	215,000	5,490	5,690
Manganese	2.0	ug/L	-	-	395	11900	14500	126	1880
Mercury	0.013	ug/L	0.016	0.29	**0.053**	**0.050**	nd	**0.10**	nd
Molybdenum	2.0	ug/L	-	7,300	2.2	3.1	2.2	nd	nd
Nickel	2.0	ug/L	83	390	3.6	nd	nd	4.1	4.8
Phosphorus	100	ug/L	-	-	nd	nd	nd	nd	nd
Potassium	100	ug/L	-	-	12600	36,900	45,100	2,170	2,940
Selenium	1.0	ug/L	54	50	nd	nd	nd	nd	nd
Silver	0.10	ug/L	1.5	1.2	nd	nd	nd	nd	nd
Sodium	100	ug/L	-	180,000	**414,000**	**1,240,000**	**1,570,000**	75,200	94,400
Strontium	2.0	ug/L	-	-	429	1270	1750	62	91.3
Thallium	0.10	ug/L	-	400	nd	nd	nd	nd	nd
Tin	2.0	ug/L	-	-	nd	nd	nd	nd	nd
Titanium	2.0	ug/L	-	-	nd	nd	nd	nd	nd
Uranium	0.10	ug/L	-	330	nd	0.12	1.76	nd	nd
Vanadium	2.0	ug/L	-	200	nd	nd	nd	nd	nd
Zinc	5.0	ug/L	10	890	6.5	nd	nd	**10.8**	9.5

Notes:

1 = Federal Interim Groundwater Quality Guidelines (FIGQGs), Generic Guidelines for Commercial and Industrial Land Uses (November 2012), Tier 2 for Marine Life Water Use (Table 3)

2 = Ontario Ministry of the Environment (MOE) Soil, Groundwater and Sediment Standards for Use Under Part XV.1 of the *Environmental Protection Act.* April 15, 2011. Generic site condition standards for use within 30 m of a water body in a non-potable groundwater condition (Table 9)

RDL = Reportable Detection Limit for routine analysis

nd = Not detected above standard RDL

"-" = No applicable guideline

na = Not available

Bold/shaded = exceeds FIGQG criteria

Bold/shaded/underlined = exceeds ON MOE criteria

Table B.10 Results of Laboratory Analysis of Dissolved Metals in Groundwater (cont.)
Remedial Action Plan/Risk Management Plan
Canadian Coast Guard Southside Base, Berth 28, Southside Road, St. John's, NL
Stantec Project No. 121412715

Parameters	RDL	Units	FIGQGs[1]	ON MOE[2]	BH7	BH8		BH11	BH13	BH15	
					12-Mar-13	12-Mar-13	14-May-13	12-Mar-13	12-Mar-13	13-Mar-13	14-May-13
Aluminum	5.0	ug/L	-	-	14.2	5.9	-	51.9	nd	11.2	-
Antimony	1.0	ug/L	-	16,000	nd	nd	-	1	nd	nd	-
Arsenic	1.0	ug/L	12.5	1,500	nd	nd	-	5.9	nd	3.0	-
Barium	1.0	ug/L	500	23,000	94.4	19.7	-	**750**	61.9	10.4	-
Beryllium	1.0	ug/L	100	53	nd	nd	-	nd	nd	nd	-
Bismuth	2.0	ug/L	-	-	nd	nd	-	nd	nd	nd	-
Boron	50	ug/L	5,000	36,000	nd	nd	-	nd	697	nd	-
Cadmium	0.017	ug/L	0.12	2.1	0.078	nd	-	nd	0.037	nd	-
Calcium	100	ug/L	-	-	41,400	11,300	-	61,400	78,900	10,600	-
Chromium	1.0	ug/L	56	640	nd	nd	-	nd	nd	nd	-
Cobalt	0.40	ug/L	-	52	3.11	1.55	-	nd	2.63	nd	-
Copper	2.0	ug/L	2.0	69	**3.6**	nd	-	**2.3**	nd	nd	-
Iron	50	ug/L	-	-	nd	621	-	nd	nd	nd	-
Lead	0.50	ug/L	2.0	20	nd	nd	-	nd	nd	1.00	-
Magnesium	100	ug/L	-	-	6,810	2,320	-	5,160	141,000	3,900	-
Manganese	2.0	ug/L	-	-	164	389	-	7.3	1340	234	-
Mercury	0.013	ug/L	0.016	0.29	**0.022**	**0.35**	nd	**0.041**	**0.18**	**1.3**	**0.022**
Molybdenum	2.0	ug/L	-	7,300	nd	2.5	-	7	nd	nd	-
Nickel	2.0	ug/L	83	390	10.2	9.9	-	nd	7.4	nd	-
Phosphorus	100	ug/L	-	-	nd	nd	-	103	nd	nd	-
Potassium	100	ug/L	-	-	4,710	2,020	-	4,180	46,200	3,130	-
Selenium	1.0	ug/L	54	50	nd	nd	-	nd	nd	nd	-
Silver	0.10	ug/L	1.5	1.2	nd	nd	-	nd	nd	nd	-
Sodium	100	ug/L	-	180,000	**277,000**	52,500	-	**378,000**	**1,410,000**	58,800	-
Strontium	2.0	ug/L	-	-	163	46	-	277	860	48.6	-
Thallium	0.10	ug/L	-	400	nd	nd	-	nd	nd	nd	-
Tin	2.0	ug/L	-	-	nd	nd	-	nd	nd	nd	-
Titanium	2.0	ug/L	-	-	nd	nd	-	nd	nd	nd	-
Uranium	0.10	ug/L	-	330	nd	nd	-	1.8	0.22	nd	-
Vanadium	2.0	ug/L	-	200	nd	nd	-	4.6	nd	nd	-
Zinc	5.0	ug/L	10	890	**43.6**	7.2	-	nd	**23.4**	5.6	-

Notes:

1 = Federal Interim Groundwater Quality Guidelines (FIGQGs), Generic Guidelines for Commercial and Industrial Land Uses (November 2012), Tier 2 for Marine Life Water Use (Table 3)

2 = Ontario Ministry of the Environment (MOE) Soil, Groundwater and Sediment Standards for Use Under Part XV.1 of the *Environmental Protection Act.* April 15, 2011. Generic site condition standards for use within 30 m of a water body in a non-potable groundwater condition (Table 9)

RDL = Reportable Detection Limit for routine analysis

nd = Not detected above standard RDL

"-" = No applicable guideline

na = Not available

Bold/shaded = exceeds FIGQG criteria

Bold/shaded/underlined = exceeds ON MOE criteria

Table B.11 Results of Laboratory Analysis of Polycyclic Aromatic Hydrocarbons in Groundwater
Remedial Action Plan/Risk Management Plan
Canadian Coast Guard Southside Base, Berth 28, Southside Road, St. John's, NL
Stantec Project No. 121412715

Parameters	RDL	Units	FIGQGs[1]	ON MOE[2]	BH1			BH2	BH4	BH5		BH6	BH7	BH8	BH11	BH13	BH15
					12-Mar-13	14-May-13	14-May-13 Lab-Dup	12-Mar-13	12-Mar-13	12-Mar-13	14-May-13	12-Mar-13	12-Mar-13	12-Mar-13	12-Mar-13	12-Mar-13	13-Mar-13
1-Methylnaphthalene	0.05	ug/L	-	1,500	2.7	nd	nd	0.32	nd	0.13	nd	13	nd	0.14	2.0	0.20	1.7
2-Methylnaphthalene	0.05	ug/L	-	1,500	4.0	nd	nd	0.20	nd	0.15	nd	4.4	nd	nd	1.4	0.081	nd
Acenaphthene	0.01	ug/L	-	600	4.5	nd	nd	0.27	0.3	nd	nd	0.36	0.012	nd	0.28	0.50	0.29
Acenaphthylene	0.01	ug/L	-	1.4	0.74	nd	nd	0.085	nd	0.038	nd	nd	0.021	nd	nd	nd	nd
Anthracene	0.01	ug/L	-	1.0	**9.1**	nd	nd	0.46	nd	**1.8**	nd	nd	0.029	nd	nd	0.30	nd
Benzo(a)anthracene	0.01	ug/L	-	1.8	**12**	nd	nd	0.63	0.011	**3.4**	nd	0.013	0.12	0.58	0.021	0.25	0.026
Benzo(a)pyrene	0.01	ug/L	-	0.81	**7.9**	nd	nd	0.53	nd	**2.3**	nd	nd	0.098	0.53	0.012	0.20	0.021
Benzo(b)fluoranthene	0.01	ug/L	-	0.75	**5.4**	nd	nd	0.41	nd	**1.6**	nd	nd	0.079	0.40	0.011	0.16	0.019
Benzo(g,h,i)perylene	0.01	ug/L	-	0.2	**3.8**	nd	nd	**0.34**	nd	**1.0**	nd	nd	0.06	**0.33**	0.01	0.12	0.015
Benzo(j)fluoranthene	0.01	ug/L	-	na	3.4	nd	nd	0.25	nd	1.0	nd	nd	0.046	0.25	nd	0.094	0.011
Benzo(k)fluoranthene	0.01	ug/L	-	0.4	**3.2**	nd	nd	0.23	nd	**1.0**	nd	nd	0.043	0.22	nd	0.086	nd
Chrysene	0.01	ug/L	-	0.7	**11**	nd	nd	0.67	0.011	**3.3**	nd	0.018	0.13	**0.71**	0.03	0.26	0.031
Dibenzo(a,h,)anthracene	0.01	ug/L	-	0.4	**0.89**	nd	nd	0.085	nd	0.26	nd	nd	0.015	0.077	nd	0.029	nd
Fluoranthene	0.01	ug/L	-	73	30	0.019	0.016	1.9	0.037	7.7	nd	0.054	0.17	1.3	0.14	1.0	0.13
Fluorene	0.01	ug/L	-	290	6.6	nd	nd	0.41	0.67	1.1	nd	0.97	0.018	0.35	0.46	0.40	0.56
Indeno(1,2,3-c,d) pyrene	0.01	ug/L	-	0.2	**2.9**	nd	nd	**0.25**	nd	**0.73**	nd	nd	0.044	**0.25**	nd	0.093	0.011
Naphthalene	0.20	ug/L	1.4	1,400	**6.8**	nd	nd	0.33	nd	0.26	nd	**13**	nd	nd	**3.6**	nd	nd
Perylene	0.01	ug/L	-	na	1.7	nd	nd	0.13	nd	0.45	nd	nd	0.023	0.13	nd	0.07	nd
Phenanthrene	0.01	ug/L	-	380	35	0.025	0.02	0.99	nd	4.6	nd	0.37	0.065	0.73	0.50	1.3	0.14
Pyrene	0.01	ug/L	-	5.7	25	0.017	0.015	1.6	0.031	**7.4**	nd	0.052	0.18	1.7	0.12	0.83	0.12

Notes:

1 = Federal Interim Groundwater Quality Guidelines (FIGQGs), Generic Guidelines for Commercial and Industrial Land Uses (November 2012), Tier 2 for Marine Life Water Use (Table 3)

2 = Ontario Ministry of the Environment (MOE) Soil, Groundwater and Sediment Standards for Use Under Part XV.1 of the *Environmental Protection Act.* April 15, 2011. Generic site condition standards for use within 30 m of a water body in a non-potable groundwater condition (Table 9)

RDL = Reportable Detection Limit

nd = Not detected above standard RDL

Bold/shaded = exceeds FIGQG criteria

Bold/shaded/underlined = exceeds ON MOE criteria

Lab report noted that the samples contained sediment.

Table B.12 Results of Laboratory Analysis of Polychlorinated Biphenyls in Groundwater
Remedial Action Plan/Risk Management Plan
Canadian Coast Guard Southside Base, Berth 28, Southside Road, St. John's, NL
Stantec Project No. 121412715

Parameter		Polychlorinated Biphenyls (PCBs)
	RDL	0.05
	Units	ug/L
	ON MOE[1]	0.2
BH1	12-Mar-13	nd
BH2	12-Mar-13	nd
BH4	12-Mar-13	nd
BH5	12-Mar-13	nd
BH6	12-Mar-13	nd
BH7	12-Mar-13	nd
BH8	12-Mar-13	nd
BH11	12-Mar-13	nd
BH13	12-Mar-13	nd
BH15	13-Mar-13	nd

Notes:

1 = Ontario Ministry of the Environment (MOE) Soil, Groundwater and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act. April 15, 2011. Generic site condition standards for use within 30 m of a water body in a non-potable groundwater condition (Table 9)

RDL = Reportable Detection Limit for routine analysis
nd = Not detected above standard RDL

Table B.13 Results of Laboratory Analysis of General Chemistry in Groundwater
Phase II Environmental Site Assessment
Canadian Coast Guard Southside Base, Berth 28, Southside Road, St. John's, NL
Stantec Project No. 121412715

Parameters	RDL	Units	Guidelines[1]	BH1	BH1 Lab-Dup	BH2	BH4	BH5	BH6	BH7	BH8	BH11	BH13	BH15
				12-Mar-13	-	12-Mar-13	12-Mar-13	12-Mar-13	12-Mar-13	12-Mar-13	12-Mar-13	12-Mar-13	12-Mar-13	13-Mar-13
Alkalinity	1.0	mg/L $CaC0_3$	-	22	22	29	23	14	18	20	12	54	72	32
Sulphate	2.0	mg/L	-	71	72	270	280	20	13	25	13	13	380	17
Chloride	50	mg/L	-	580	580	2,100	2,300	140	190	490	110	550	2,500	100
Reactive Silica	0.5	mg/L SiO2	-	5.6	6.0	5.2	5.3	5.2	6.0	4.9	5.1	7.0	3.5	7.1
Orthophosphate	0.010	mg/L P	-	nd	nd	nd	nd	nd	nd	0.014	nd	0.066	nd	nd
Nitrate + Nitrite	0.050	mg/L N	-	0.18	-	nd	0.073	0.10	nd	0.15	0.11	0.083	0.10	0.083
Nitrate	0.050	mg/L N	16	0.18	-	nd	0.073	0.1	nd	0.15	0.11	0.083	0.10	0.083
Nitrite	0.010	mg/L	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
True Color	5.0	TCU	-	nd	nd	150	240	nd	160	nd	nd	5.8	nd	nd
Total Organic Carbon	5.0	mg/L	-	7.1	-	5.9	2.7	nd	5.5	nd	nd	nd	8.0	19
Turbidity	1.0	NTU	-	560	-	340	210	>1,000	370	>1,000	>1,000	660	380	>1,000
Conductivity	1.0	uS/cm		2,100	2,100	6,900	7,500	520	690	1,700	410	2000	8,200	430
pH	-	Units	7.0 - 8.7	7.02	7.08	**6.94**	**6.85**	**6.97**	**6.91**	7.09	**6.90**	**8.99**	7.24	7.10
Hardness	1.0	mg/L $CaC0_3$	-	310	-	900	1300	51	79	130	38	170	780	43
Bicarbonate	1.0	mg/L $CaC0_3$	-	22	-	29	23	14	18	20	12	54	72	32
Total Dissolved Solids	1.0	mg/L	-	1,180	-	3,970	4,570	266	345	859	201	1,060	4,550	220

Notes:
1 = Federal Interim Groundwater Quality Guidelines (FIGQGs), Generic Guidelines for Commercial and Industrial Land Uses (November 2012), Tier 2 for Marine Life Water Use
RDL = Reportable Detection Limit
nd = Not detected above standard RDL
"-" = indicates value is not available or does not apply
Lab-Dup = Laboratory QA/QC duplicate sample
Bold/shaded = exceeds FIGQG criteria

TABLE 1: Soil Sample Analysis for Petroleum Hydrocarbons

Parameter	Unit	Detection Limit	TP104-SS2 1.0 - 1.5 m 10-Oct-01	TP105-SS2 0.5 - 1.0 m 10-Oct-01	TP105-SS3 1.0 - 1.8 m 10-Oct-01	TP106-SS1 0.2 - 0.9 m 10-Oct-01	TP106-SS2 1.4 - 1.9 m 10-Oct-01	TP107-SS1 0.2 - 0.9 m 10-Oct-01	TP107-SS2 1.3 - 1.9 m 10-Oct-01	Atlantic PIRI Guideline Criteria	
										surface	sub-surface
Benzene	mg/kg	0.025	0.036	2.48	0.45	<	0.72	<	29.2	120	1.4
Toulene	mg/kg	0.025	0.07	4.6	0.999	<	0.635	<	42.1	4800	34
Ethylbenzene	mg/kg	0.025	0.029	1.21	2.21	<	0.388	<	231	2400	20
Xylenes	mg/kg	0.05	0.113	6.8	9.45	<	2.08	<	939	3200	25
TPuH C6-C10	mg/kg	2.5	<	78	180	<	77	<	4000	na	na
TExH C10-C21	mg/kg	15	20	760	5200	21	15,000	<	18,000	na	na
TExH C21-C32	mg/kg	15	43	340	300	24	4600	<	1700	na	na
Modified TPH	mg/kg	na	63	1178	5680	45	19,677	<	23,000	1740	10,000
TPH	mg/kg	na	63.248	1193.09	5693.109	45	19,680.82	<	24,941.30	na	na

Notes:

Analysis completed by Philip Analytical Services Corporation of St. John's, Newfoundland, using Atlantic PIRI method of analysis.

Atlantic PIRI Tier I Guideline Criteria = Criteria for surface and sub-surface soils on commercial site, with non-potable groundwater and sand.

Shading indicates a guideline exceedance.

na = not applicable / not available

< = parameter below detection limit

TP = test pit

EX = excavation

SS = soil sample

( ) = not detected at the elevated detection limit shown in parenthese

shading indicates guideline exceedence

TABLE 1: Soil Sample Analysis for Petroleum Hydrocarbons

Parameter	Unit	Detection Limit	TP101-SS1 0.4 - 0.9 m 10-Oct-01	TP101-SS2 1.0 - 1.8 m 10-Oct-01	TP102-SS2 0.3 - 0.9 m 10-Oct-01	TP102-SS3 1.0 - 1.8 m 10-Oct-01	TP103-SS1 0.2 - 0.9 m 10-Oct-01	TP103-SS2 1.4 - 1.8 m 10-Oct-01	TP104-SS1 0.2 - 0.9 m 10-Oct-01	Atlantic PIRI Guideline Criteria surface	 sub-surface
Benzene	mg/kg	0.025	<	0.304	0.43	0.834	1.92	0.419	17.3	120	1.4
Toulene	mg/kg	0.025	<	0.523	0.946	1.55	3.55	0.838	17.6	4800	34
Ethylbenzene	mg/kg	0.025	<	0.234	0.141	0.152	0.452	0.164	71.5	2400	20
Xylenes	mg/kg	0.05	<	1.86	1.03	0.865	3.79	1.08	274	3200	25
TPuH C6-C10	mg/kg	2.5	<	76	3.3	<	11	3.4	1400	na	na
TExH C10-C21	mg/kg	15	170	5400	460	< (30)	260	190	7700	na	na
TExH C21-C32	mg/kg	15	470	1900	580	< (100)	230	240	880	na	na
Modified TPH	mg/kg	32	640	7376	1043.3	<	501	4334	9960	1740	10,000
TPH	mg/kg	na	640	7378.921	1045.847	3.401	510.712	4336.501	10360.4	na	na

Notes:

Analysis completed by Phillip Analytical Services Corporation of St. John's, Newfoundland, using Atlantic PIRI method of analysis.

Atlantic PIRI Tier I Guideline Criteria = Criteria for surface and sub-surface soils on commercial site, with non-potable groundwater and sand.

Shading indicates a guideline exceedance.

na = not applicable / not available

< = parameter below detection limit

TP = test pit

EX = excavation

SS = soil sample

( ) = not detected at the elevated detection limit shown in parenthese

shading indicates guideline exceedence

TABLE 1: Soil Sample Analysis for Petroleum Hydrocarbons

Parameter	Unit	Detection Limit	TP108-SS1 0.2 - 0.9 m 10-Oct-01	TP108-SS2 1.0 - 1.2 m 10-Oct-01	TP109-SS1 0.2 - 0.9 m 10-Oct-01	TP109-SS2 1.0 - 1.25 m 10-Oct-01	TP110-SS2 0.6 - 1.0 m 10-Oct-01	TP110-SS3 1.0 - 1.75 m 10-Oct-01		Atlantic PIRI Guideline Criteria	
										surface	sub-surface
Benzene	mg/kg	0.025	<	0.04	<	<	0.14	0.385		120	1.4
Toulene	mg/kg	0.025	<	0.109	<	0.202	0.554	1.34		4800	34
Ethylbenzene	mg/kg	0.025	<	0.138	0.033	1.71	0.898	1.04		2400	20
Xylenes	mg/kg	0.05	<	0.707	0.065	10.9	5.56	5.94		3200	25
TPuH C6-C10	mg/kg	2.5	<	24	<	340	150	130		na	na
TExH C10-C21	mg/kg	15	180	290	160	1,000	4,700	3,700		na	na
TExH C21-C32	mg/kg	15	37	33	24	120	180	120		na	na
Modified TPH	mg/kg	na	217	347	184	1,460	5,030	3,950		1740	10,000
TPH	mg/kg	na	217	347.994	184.098	1,472.81	5,037.15	3,958.71		na	na

320
260
1700

Notes:

Analysis completed by Philip Analytical Services Corporation of St. John's, Newfoundland, using Atlantic PIRI method of analysis.

Atlantic PIRI Tier I Guideline Criteria = Criteria for surface and sub-surface soils on commercial site, with non-potable groundwater and sand.

Shading indicates a guideline exceedance.

na = not applicable / not available

< = parameter below detection limit

TP = test pit

EX = excavation

SS = soil sample

( ) = not detected at the elevated detection limit shown in parenthese

shading indicates guideline exceedence

TABLE 2: Soil Sample Analytical Results (Metal Scan)

Parameter	Unit	Detection Limit	TP101 - SS1 0.4 - 0.9 m 10-Oct-01	TP101 - SS2 1.0 - 1.8 m 10-Oct-01	TP102 - SS2 0.3 - 0.9 m 10-Oct-01	TP102 - SS3 1.0 - 1.8 m 10-Oct-01	TP103 - SS1 0.2 - 0.9 m 10-Oct-01	TP103 - SS2 1.4 - 1.8 m 10-Oct-01	Guideline Criteria
Aluminum	mg/kg	10	6200.0	11000.0	7900.0	6500.0	9300.0	13000.0	
Antimony	mg/kg	2	<	<	<	<	<	<	40*
Antimony Rec.	%		20.0	20.0	20.0	20.0	20.0	20.0	
Arsenic	mg/kg	2.0	8.0	35.0	12.0	49.0	14.0	39.0	12
Barium	mg/kg	5	150.0	510.0	15.0	14.0	160.0	94.0	2000
Beryllium	mg/kg	5	<	<	<	<	<	<	8*
Boron	mg/kg	5	28.0	18.0	<	<	<	13.0	
Cadmium	mg/kg	0.3	0.3	0.7	1.8	0.5	0.4	0.3	22
Chromium	mg/kg	2	11.0	26.0	18.0	8.0	12.0	14.0	87
Cobalt	mg/kg	1	8.0	14.0	7.0	8.0	10.0	24.0	300*
Copper	mg/kg	2	48.0	340.0	120.0	190.0	120.0	360.0	91
Iron	mg/kg	20	40000.0	57000.0	21000.0	21000.0	29000.0	51000.0	
Iron Recovery	%		80.0	80.0	80.0	80.0	80.0	80.0	
Lead	mg/kg	0.5	220.0	1600.0	1600.0	580.0	280.0	520.0	600
Manganese	mg/kg	2	910.0	1000.0	520.0	550.0	720.0	600.0	-
Molybdenum	mg/kg	2	4.0	6.0	2.0	5.0	2.0	6.0	40*
Nickel	mg/kg	2	14.0	23.0	14.0	15.0	15.0	21.0	50
Selenium	mg/kg	2.0	<	2.0	<	<	<	<	10*
Silver	mg/kg	0.5	<	<	1.0	<	<	<	40*
Strontium	mg/kg	5	71.0	70.0	22.0	95.0	19.0	110.0	
Thallium	mg/kg	0.1	0.1	0.2	0.1	0.2	0.2	0.3	1
Uranium	mg/kg	0.1	2.5	2.4	0.4	0.8	0.7	3.3	
Vanadium	mg/kg	2	20.0	37.0	19.0	26.0	21.0	24.0	130
Zinc	mg/kg	2	470.0	770.0	470.0	240.0	280.0	470.0	360

Notes:

Analysis completed by Philip Analytical Services Corporation of St. John's, Newfoundland.

Detection Limit is the lowest limit that can be quantified with confidence

< = parameter below detection limit

Guideline Criteria = Canadian Council of Ministers of the Environment (CCME) Canadian Soil Quality Guidelines (updated 2001) for Industrial sites or, where marked with an "*", CCME Interim Canadian Environmental Quality Criteria for Contaminated Sites (September 1991) for Commercial/Industrial Sites.

shading Indicates guideline exceedence

Phase II ESA
Canadian Coast Guard, Berth 28
St. John's, Newfoundland

TABLE 2: Soil Sample Analytical Results (Metal Scan)

Parameter	Unit	Detection Limit	TP107 - SS1 0.2 - 0.9 m 10-Oct-01	TP107 - SS2 1.3 - 1.9 m 10-Oct-01	TP108 - SS1 0.2 - 0.9 m 10-Oct-01	TP108 - SS2 1.0 - 1.2 m 10-Oct-01	TP109 - SS1 0.2 - 0.9 m 10-Oct-01	TP109 - SS2 1.0 - 1.25 m 10-Oct-01	Guideline Criteria
Aluminum	mg/kg	10	9700.0	15000.0	11000.0	11000.0	16000.0	20000.0	
Antimony	mg/kg	2	<	<	<	<	<	<	40*
Antimony Rec.	%		30.0	30.0	30.0	30.0	30.0	30.0	
Arsenic	mg/kg	2.0	4.0	13.0	4.0	4.0	5.0	5.0	12
Barium	mg/kg	5	16.0	12.0	14.0	32.0	32.0	29.0	2000
Beryllium	mg/kg	5	<	<	<	<	<	<	8*
Boron	mg/kg	5	<	0.9	<	<	<	<	
Cadmium	mg/kg	0.3	<	0.3	<	<	<	<	22
Chromium	mg/kg	2	5.0	16.0	6.0	9.0	16.0	18.0	87
Cobalt	mg/kg	1	5.0	16.0	5.0	7.0	11.0	11.0	300*
Copper	mg/kg	2	11.0	20.0	11.0	19.0	30.0	43.0	91
Iron	mg/kg	20	17000.0	29000.0	17000.0	20000.0	29000.0	26000.0	
Iron Recovery	%		80.0	80.0	80.0	80.0	80.0	80.0	
Lead	mg/kg	0.5	11.0	430.0	11.0	30.0	34.0	42.0	600
Manganese	mg/kg	2	510.0	1100.0	530.0	570.0	630.0	560.0	-
Molybdenum	mg/kg	2	<	2.0	<	<	<	<	40*
Nickel	mg/kg	2	6.0	19.0	6.0	9.0	19.0	19.0	50
Selenium	mg/kg	2.0	<	<	<	<	<	<	10*
Silver	mg/kg	0.5	<	<	<	<	<	<	40*
Strontium	mg/kg	5	<	43.0	<	6.0	6.0	<	
Thallium	mg/kg	0.1	0.1	0.2	0.1	0.1	0.1	0.1	1
Uranium	mg/kg	0.1	0.4	2.0	0.3	0.4	0.4	0.6	
Vanadium	mg/kg	2	9.0	25.0	9.0	12.0	22.0	20.0	130
Zinc	mg/kg	2	50.0	260.0	50.0	70.0	120.0	160.0	360

Notes:

Analysis completed by Philip Analytical Services Corporation of St. John's, Newfoundland.

Detection Limit is the lowest limit that can be quantified with confidence

< = parameter below detection limit

Guideline Criteria = Canadian Council of Ministers of the Environment (CCME) Canadian Soil Quality Guidelines (updated 2001) for Industrial sites or, where marked with an "*", CCME Interim Canadian Environmental Quality Criteria for Contaminated Sites (September 1991) for Commercial/Industrial Sites.

shading Indicates guideline exceedence

TABLE 2: Soil Sample Analytical Results (Metal Scan)

Parameter	Unit	Detection Limit	TP104 - SS1 0.2 - 0.9 m 10-Oct-01	TP104 - SS2 1.0 - 1.5 m 10-Oct-01	TP105 - SS2 0.5 - 1.0 m 10-Oct-01	TP105 - SS3 1.0 - 1.8 m 10-Oct-01	TP106 - SS1 0.2 - 0.9 m 10-Oct-01	TP106 - SS2 1.4 - 1.9 m 10-Oct-01	Guideline Criteria
Aluminum	mg/kg	10	8500.0	9000.0	5800.0	16000.0	9000.0	9100.0	
Antimony	mg/kg	2	<	<	<	<	<	<	40*
Antimony Rec.	%		20.0	20.0	30.0	30.0	30.0	30.0	
Arsenic	mg/kg	2.0	3.0	4.0	25.0	10.0	4.0	24.0	12
Barium	mg/kg	5	17.0	180.0	190.0	82.0	22.0	230.0	2000
Beryllium	mg/kg	5	<	<	<	<	<	<	8*
Boron	mg/kg	5	<	<	<	<	<	13.0	
Cadmium	mg/kg	0.3	<	<	0.7	0.5	<	0.3	22
Chromium	mg/kg	2	4.0	6.0	7.0	15.0	6.0	150.0	87
Cobalt	mg/kg	1	6.0	7.0	4.0	17.0	6.0	18.0	300*
Copper	mg/kg	2	11.0	14.0	75.0	72.0	11.0	84.0	91
Iron	mg/kg	20	15000.0	17000.0	16000.0	28000.0	16000.0	46000.0	
Iron Recovery	%		80.0	80.0	80.0	80.0	80.0	80.0	
Lead	mg/kg	0.5	11.0	21.0	230.0	360.0	14.0	1600.0	600
Manganese	mg/kg	2	550.0	710.0	170.0	470.0	590.0	510.0	-
Molybdenum	mg/kg	2	<	<	2.0	2.0	<	4.0	40*
Nickel	mg/kg	2	6.0	8.0	10.0	23.0	9.0	230.0	50
Selenium	mg/kg	2.0	<	<	<	<	<	<	10*
Silver	mg/kg	0.5	<	<	<	<	<	<	40*
Strontium	mg/kg	5	5.0	13.0	24.0	13.0	6.0	66.0	
Thallium	mg/kg	0.1	0.1	0.1	0.3	0.2	<	0.1	1
Uranium	mg/kg	0.1	0.3	0.4	0.3	0.9	0.4	4.6	
Vanadium	mg/kg	2	8.0	10.0	13.0	22.0	9.0	35.0	130
Zinc	mg/kg	2	50.0	83.0	790.0	210.0	50.0	290.0	360

Notes:

Analysis completed by Philip Analytical Services Corporation of St. John's, Newfoundland.

Detection Limit is the lowest limit that can be quantified with confidence

< = parameter below detection limit

Guideline Criteria = Canadian Council of Ministers of the Environment (CCME) Canadian Soil Quality Guidelines (updated 2001) for Industrial sites or, where marked with an "*", CCME Interim Canadian Environmental Quality Criteria for Contaminated Sites (September 1991) for Commercial/Industrial Sites.

shading indicates guideline exceedence

TABLE 2: Soil Sample Analytical Results (Metal Scan)

Parameter	Unit	Detection Limit	TP110-SS2 0.6 - 1.0 m 10-Oct-01	TP110-SS3 1.0 - 1.75 m 10-Oct-01				Guideline Criteria
Aluminum	mg/kg	10	16000.0	16000.0				
Antimony	mg/kg	2	<	<				40*
Antimony Rec.	%		30.0	30.0				
Arsenic	mg/kg	2.0	7.0	6.0				12
Barium	mg/kg	5	24.0	31.0				2000
Beryllium	mg/kg	5	<	<				8*
Boron	mg/kg	5	<	<				
Cadmium	mg/kg	0.3	<	<				22
Chromium	mg/kg	2	16.0	16.0				87
Cobalt	mg/kg	1	9.0	9.0				300*
Copper	mg/kg	2	31.0	34.0				91
Iron	mg/kg	20	26000.0	25000.0				
Iron Recovery	%		80.0	80.0				
Lead	mg/kg	0.5	63.0	58.0				600
Manganese	mg/kg	2	530.0	500.0				-
Molybdenum	mg/kg	2	<	<				40*
Nickel	mg/kg	2	17.0	21.0				50
Selenium	mg/kg	2.0	<	<				10*
Silver	mg/kg	0.5	<	<				40*
Strontium	mg/kg	5	8.0	6.0				
Thallium	mg/kg	0.1	0.1	0.1				1
Uranium	mg/kg	0.1	0.5	0.5				
Vanadium	mg/kg	2	21.0	20.0				130
Zinc	mg/kg	2	80.0	90.0				360

Notes:

Analysis completed by Philip Analytical Services Corporation of St. John's, Newfoundland.

Detection Limit is the lowest limit that can be quantified with confidence

< = parameter below detection limit

Guideline Criteria = Canadian Council of Ministers of the Environment (CCME) Canadian Soil Quality Guidelines (updated 2001) for Industrial sites or, where marked with an "*", CCME Interim Canadian Environmental Quality Criteria for Contaminated Sites (September 1991) for Commercial/Industrial Sites.

shading indicates guideline exceedence

TABLE 3: Soil Sample Analytical Results (PAHs)

Parameter	Unit	Detection Limit	TP101-SS2 1.0 - 1.8 m 10-Oct-01	TP103-SS2 1.4 - 1.8 m, 10-Oct-01	TP105-SS3 1.0 - 1.8 m 10-Oct-01	Guideline Criteria
Naphthalene	mg/kg	0.05	1.1	13	0.91	22
2-Methylnaphthalene	mg/kg	0.05	0.89	10	0.99	-
1-Methylnaphthalene	mg/kg	0.05	0.95	21	0.91	-
Acenaphthylene	mg/kg	0.05	< (0.8)	< (0.7)	< (0.2)	-
Acenaphthene	mg/kg	0.05	1.2	< (0.5)	13	-
Fluorene	mg/kg	0.05	1.3	4.4	0.52	-
Phenanthrene	mg/kg	0.05	7.8	7.7	0.92	50
Anthracene	mg/kg	0.05	2.4	< (1)	< (0.2)	-
Fluoranthene	mg/kg	0.05	13	6.9	1.2	-
Pyrene	mg/kg	0.05	11	6.1	1.2	100
Benzo(a)Anthracene	mg/kg	0.05	6.7	4.7	0.92	-
Chrysene	mg/kg	0.05	6	4.4	0.85	15
Benzo(b)Fluoranthene	mg/kg	0.05	4.4	3.2	0.76	10
Benzo(k)Fluoranthene	mg/kg	0.05	4.4	3.2	0.76	10
Benzo(a)pyrene	mg/kg	0.05	5.9	4.1	1.1	0.7
Perylene	mg/kg	0.05	1.3	0.79	0.22	-
Indeno(1,2,3,-c,d)Pyrene	mg/kg	0.05	4.6	2.7	0.7	10
Dibenzo(a,h)Anthracene	mg/kg	0.05	0.76	0.63	0.15	10
Benzo(g,h,i)perylene	mg/kg	0.05	3.8	2.3	0.58	-

Notes:

Laboratory analysis completed by Philip Analytical Services Corporation of St. John's, Newfoundland.

Detection Limit is the lowest limit that can be quantified with confidence

< = parameter below detection limit

Guideline Criteria = Canadian Council of Ministers of the Environment (CCME) Canadian Soil Quality Guidelines (2001).

Shading indicates guideline exceedence

TABLE 3: Soil Sample Analytical Results (PAHs)

Parameter	Unit	Detection Limit	TP106-SS2 1.4 - 1.9 m 10-Oct-01	TP107-SS2 1.3 - 1.9 m 10-Oct-01	TP110-SS3 1.0 - 1.75 m 10-Oct-01	Guideline Criteria
Naphthalene	mg/kg	0.05	3.3	49	0.31	22
2-Methylnaphthale	mg/kg	0.05	2.2	67	< (0.4)	-
1-Methylnaphthale	mg/kg	0.05	6.4	46	< (0.2)	-
Acenaphthylene	mg/kg	0.05	3.8	< (2.0)	< (0.1)	-
Acenaphthene	mg/kg	0.05	7.2	2.3	<	-
Fluorene	mg/kg	0.05	11	9.4	0.28	-
Phenanthrene	mg/kg	0.05	34	20	0.61	50
Anthracene	mg/kg	0.05	11	< (1)	<	-
Fluoranthene	mg/kg	0.05	39	19	0.24	-
Pyrene	mg/kg	0.05	31	16	0.21	100
Benzo(a)Anthrace	mg/kg	0.05	14	7.1	0.09	-
Chrysene	mg/kg	0.05	15	9.3	0.12	15
Benzo(b)Fluoranth	mg/kg	0.05	8	6.1	<	10
Benzo(k)Fluoranth	mg/kg	0.05	8	6.1	<	10
Benzo(a)pyrene	mg/kg	0.05	9.8	7.1	<	0.7
Perylene	mg/kg	0.05	2.3	1.9	<	-
Indeno(1,2,3,-c,d)I	mg/kg	0.05	7.3	7	<	10
Dibenzo(a,h)Anthr	mg/kg	0.05	1.5	1.3	<	10
Benzo(g,h,i)peryle	mg/kg	0.05	6.4	5.5	<	-

Notes:

Laboratory analysis completed by Philip Analytical Services Corporation of St. John's, Newfoundland.

Detection Limit is the lowest limit that can be quantified with confidence

< = parameter below detection limit

Guideline Criteria = Canadian Council of Ministers of the Environment (CCME) Canadian Soil Quality Guidelines (2001).

Shading indicates guideline exceedence