



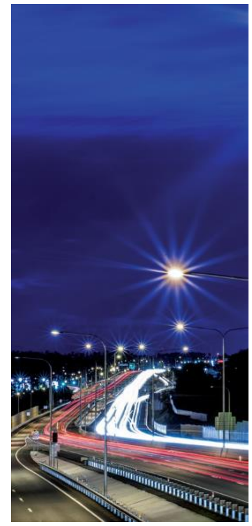

Laboratory Treatability Study

Boat Harbour Remediation Planning and Design
Pictou Landing, Nova Scotia

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1. Introduction

The Boat Harbour Effluent Treatment Facility (BHETF) consists of the wastewater effluent pipeline, twin settling basins, aeration stabilization basin (ASB), and the Boat Harbour stabilization lagoon (BH). Effluent from Boat Harbour discharges through a dam into the estuary before being released to the Northumberland Strait. Prior to the construction of the twin settling basins and ASB, effluent was routed by open ditch from the pipeline on the east side of Highway 348 to a natural wetland area (Former Ponds 1, 2, and 3) before being discharged into the stabilization lagoon.

Remediation includes addressing Site areas that have been impacted from the operation of the BHETF. At the core of remediation will be removal of impacted sludge/sediment and managing all associated effluents including treatment prior to disposal or discharge. A Laboratory Treatability Study (Study) was performed to identify the optimum technologies for treatment of sediment, surface water, and dewater water from the BHETF. Treatment strategies tested included:

- Removal of sediments in the wet
- Excavation of sediments in the dry
- Do nothing

Under each strategy, the following testing was performed:

- Removal of sediments in the wet
  - Testing of geotubes for dewatering of sediment (dewatering study would also be applicable to filter press or centrifuge dewatering)
  - Testing for determination of required treatment for dewater water
  - Leach testing of dewatered sediment
  - Stabilization of non-dewatered sediment
- Excavation of sediments in the dry
  - Testing for determination of required treatment for surface water pumped off
  - Dewatering of sediment
  - Stabilization and leach testing of dewatered and non-dewatered sediment
- Do nothing
  - Leach testing on untreated sediment

This report presents the objectives and methodology and findings from the Study.

2. Laboratory Treatability Study

2.1 Objectives

The primary objectives of the Study were to gather the data necessary to:

1. Determine the optimum treatments for removal of sediments in the wet including dewatering and required treatment of dewater water and dewatered sediment.
2. Determine the optimum treatments for excavation in the dry including treatment of surface water, dewatering of excavated sediment, and treatment of excavated sediment.
3. Determine whether untreated sediment can be landfilled without treatment.

2.2 Sample Acquisition

The Study was performed using sediment (sludge/sediment) and surface water samples collected from three distinct areas of the Site; a sample from the ASB, a sample from the Boat Harbour stabilization lagoon (BH), and a sample from the estuary (EST). A total of 30 gallons (~115 litres) of sediment and 110 gallons (~420 litres) of water was collected per sample. The samples were shipped to GHD's laboratory in Niagara Falls, New York under the terms specified in GHD's United States Department of Agriculture (USDA) soil permit and received at the laboratory on November 28, 2017.

2.3 Standards Used

Laboratory analytical results were compared to provincial criteria. For parameters where provincial criteria were not available, federal criteria were referenced.

Analytical results for surface water (including dewater water generated by the testing) were compared to the Nova Scotia Environment (NSE) Tier 1 Environmental Quality Standards (EQSs) for Surface Water (Marine Water Values) as referenced in the 2013 NSE Contaminated Site Regulations (CSRs). In the absence of a surface water Tier 1 EQS for the dioxins and furans toxicity equivalent (TEQ), the groundwater Tier 1 EQS for this parameter has been applied as a screening level to evaluate human health exposure via the potable drinking water pathway. Similarly, in the absence of a Tier 1 EQS for chromium, the Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for the Protection of Aquatic Life (Marine Value) for trivalent chromium has been applied to evaluate total and dissolved chromium levels.

The analytical results for the initial sediment characterization were compared to the NSE Tier 1 EQSs for Sediment (Marine Sediment Values) as referenced in the 2013 NSE CSRs. The CCME Sediment Quality Guidelines for the Protection of Aquatic Life (Marine Values) have also been referenced, however it is noted that these values are the same as the NSE Tier 1 EQSs for sediment. In the absence of applicable Tier 1 EQS or CCME guidelines for organic compounds, applicable guidelines were developed based on the 2003 United States Environmental Protection Agency (USEPA) Equilibrium Partitioning Sediment Benchmarks (ESBs) Approach for the Protection of Benthic Organisms. ESB calculation assumed a fraction of organic carbon content of 0.01 (1 percent) and fraction of solids being 0.5 (50 percent).

For evaluation of suitability of off-site landfill disposal, analytical results for sediment (solids and leachate) were compared to the Acceptance Parameters for Contaminated Soil as referenced in the 1992 NSE Guidelines for Disposal of Contaminated Solids in Landfills (Attachment B for Total Analysis and Attachment C for Leachate Results). It is noted that since this document does not reference an applicable guideline for dioxins and furans, therefore:

- For sediment solids the NSE Tier 1 EQS for soil has been carried as a screening level to evaluate acceptance criteria for the dioxins and furans TEQ results.
- For sediment leachate, the criteria for dioxins and furans (TEQ) was carried based on Schedule 6 Hazardous Constituents Controlled Under Leachate Test and Regulated Limits from the Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations (SOR/2005-149).

2.4 Task 1 | Initial Characterization

The untreated sediment and surface water for each area was analyzed to determine the level of treatment required.

Surface water samples were analyzed for:

1. pH
2. Total Cyanide
3. Volatile organic compounds (VOC)
4. Semi-volatile organic compounds (SVOC)
5. Petroleum hydrocarbon fractions
6. Total and dissolved metals
7. Total Polychlorinated biphenyls (PCB)
8. Polychlorinated dibenzodioxins/Polychlorinated dibenzofurans (PCDD/PCDF)

Sediment samples were analyzed for:

1. pH
2. Percent Solids
3. VOC
4. SVOC
5. Petroleum hydrocarbon fractions
6. Total metals
7. Total PCB
8. PCDD/PCDF
9. Toxicity Characteristic Leaching Procedure (TCLP) SVOC
10. TCLP petroleum hydrocarbons

11. TCLP metals
12. Synthetic precipitation leaching procedure (SPLP) SVOC
13. SPLP petroleum hydrocarbons
14. SPLP metals

2.4.1 Initial Surface Water Sample Characterization

For the surface water sample collected from the EST, the pH was neutral at 7.19 standard units (S.U.). Concentrations above the NSE Tier 1 EQSs were observed for total cyanide at 15 micrograms per liter (µg/L), total petroleum hydrocarbons at 0.514 milligrams per liter (mg/L), total zinc at 51.9 µg/L and dissolved zinc at 30.8 ug/L. The metals were generally observed in their particulate forms with dissolved concentrations being lower than the total metals values. The toxicity equivalent (TEQ) for PCDD/PCDF was 1.41 picograms per liter (pg/L). No VOCs, SVOCs, or PCBs were detected in this sample.

For the surface water sample collected from BH, the pH was neutral at 7.19 S.U. Concentrations above the NSE Tier 1 EQSs were observed for total cyanide at 21 µg/L, total petroleum hydrocarbons at 0.335 mg/L, total zinc at 64.4 µg/L and dissolved zinc at 53.4 ug/L. The metals were generally observed in their particulate forms with dissolved concentrations being lower than the total metals values. The TEQ for PCDD/PCDF was 0.257 pg/L. No VOCs, SVOCs, or PCBs were detected in this sample.

For the surface water sample collected from the ASB, the pH was neutral at 6.68 S.U. Concentrations above the NSE Tier 1 EQSs were observed for total cyanide at 19 µg/L, total petroleum hydrocarbons at 0.202 mg/L, total zinc at 97.9 µg/L and dissolved zinc at 60.7 ug/L. The metals were generally observed in their particulate forms with dissolved concentrations being lower than the total metals values. The TEQ for PCDD/PCDF was 0.329 pg/L. No VOCs, SVOCs, or PCBs were detected in this sample. The initial surface water sample characterization results are shown in Table 1.

2.4.2 Initial Sediment Sample Characterization

For the sediment sample collected from the EST, the pH was neutral at 7.19 S.U. and percent solids were at 21.9 percent weight per weight (w/w). Concentrations of all parameters were within the applicable criteria. The TEQ for PCDD/PCDF was 2.73 pg/g. No VOCs, SVOCs, or PCBs were detected in this sample. Leach testing was performed for PAHs, petroleum hydrocarbons and metals and no exceedances of the landfill disposal criteria were observed.

For the sediment sample collected from BH, the pH was neutral at 6.86 S.U. and percent solids were at 10.1 percent (w/w). Concentrations above the applicable criteria were observed for total cadmium at 11.3 mg/kg, total silver at 4.17 mg/kg, total zinc at 1230 mg/kg, petroleum hydrocarbons at 221 mg/kg and the TEQ for PCDD/PCDF at 170 pg/g. No VOCs, SVOCs, or PCBs were detected in this sample. Leach testing was performed for PAHs, petroleum hydrocarbons, and metals and no exceedances of the landfill disposal criteria were observed.

For the sediment sample collected from the ASB, the pH was neutral at 6.93 S.U. and the percent solids were at 11.3 percent (w/w). Concentrations above the applicable criteria were observed for total cadmium at 12.6 mg/kg, total mercury at 0.82 mg/kg, total silver at 3.35 mg/kg, total zinc at 955 mg/kg, petroleum hydrocarbons at 259 mg/kg and the TEQ for PCDD/PCDF at 402 pg/g. No VOCs, SVOCs, or PCBs were detected in this sample. Leach testing was performed for PAHs, petroleum hydrocarbons, and metals and no exceedances of the landfill disposal criteria were observed. The initial sediment sample characterization data are shown in Table 2.

These initial characterization data were used as baseline conditions for the treatability study.

2.5 Task 2 | Removal of Sediments in the Wet

2.5.1 Geotube Testing

Bench scale geotubes were used to assess the effectiveness of geotubes for dewatering of sediment removed in the wet (i.e., dredged sediment). The results from the geotube dewatering tests are also applicable to dewatering by filter press or centrifuge.

For each sample, surface water and sediment were mixed to make a slurry containing 5 percent solids (w/w). This slurry was assumed to be representative of what will be removed during dredging. Test tube and jar testing were performed on the slurry prior to placing the slurry in geotubes to determine the optimum polymer and/or coagulant additives to enhance dewatering of the sediments. Polymers and coagulants were mixed with the slurry in test tubes and then examined visually for floc formation and settling of the floc. The reagents tested are listed below:

Polymers

- Nalco Core Shell 71301
- Nalco Nalclear 7768

Coagulants

- Ferric Chloride
- Polyaluminum Chloride
- Nalco Ultraion 8186 (clarification agent)

2.5.1.1 Polymer Screening

A 10 milliliter (mL) aliquot of the 5 percent solids mixture of each sample was placed in each of four test tubes for each reagent to be screened. Three different doses of each reagent were tested along with a control tube containing the mixture only which was used as a reference. A stock solution for each of the polymers was prepared using distilled water. The solutions of the polymer were prepared at a concentration of 5,000 milligrams (mg) of coagulant for per liter (L) of distilled water.

Each solution was added to three test tubes containing the water/sediment mixture and at concentrations between 10 mg/L and 2,000 mg/L. The control test tube was left untreated. These concentrations were selected as a starting point based on previous experience with settling sludge. Following addition of the reagents, the tubes were capped and inverted gently repeatedly for

60 seconds to mix the samples. Once the samples were mixed, they were allowed to settle, and the settling rate was observed. The reagents producing the most effective settling, as determined by visual observation of settling rate, clearness of the supernatant, and volume of solids produced, were noted. This process was repeated for each of the polymers. One polymer was tested at a time. If sufficient settling was not observed after 1 minute, it is unlikely that the polymer dose is effective and testing of that polymer/dose was discontinued.

2.5.1.2 Coagulant Screening

Coagulant screening followed the same procedure as the polymer screening. A 5,000 mg/L stock solution of each polymer was prepared, and added to the test tubes containing the samples at concentrations between 10 mg/L and 2,000 mg/L.

2.5.1.3 Combined Testing

After testing the coagulants and polymers individually, the most effective coagulant was mixed with the most effective polymer doses and tested as specified above to determine whether addition of both a polymer and coagulant produced a faster settling rate or clearer supernatant than treatment with a single reagent. If any coagulant/polymer combinations appeared to produce better settling than either the polymer or coagulant alone, then the ratios of polymer and coagulant were varied to determine the most effective ratio to enhance settling.

2.5.1.4 Jar Testing

The reagents and doses showing the best flocculation and settling in the test tube tests were scaled up to jar tests for dose optimization. The selected reagents/doses/combinations were retested using 500 mL jar tests. Five-hundred milliliters of the 5 percent solids sediment/surface water mixture was placed in each jar, and doses of coagulants and/or polymers as determined in the screening tests were added to the jars. The jars were mixed for 2 minutes using a Phipps and Bird Model 7790-400 mechanical mixer with paddle attachments at 100 revolutions per minute (rpm) for mixtures with coagulant(s) and at 50 rpm for mixtures with a polymer only. For mixtures containing coagulant(s) and polymer, the coagulant was added and mixed at 100 rpm for 2 minutes, and the mixing was reduced to 50 rpm, and the polymer was added and mixed for 2 minutes. The mixtures was allowed to settle for 5 minutes.[1]

The optimum combinations of polymers and/or coagulants for each of the sediment mixtures were as follows:

- EST: 600 parts per million (ppm) of Nalco 71301
- BH: 1,000 ppm Nalco 8186 and 150 ppm Nalco 7768
- ASB: 1,250 ppm Nalco 8186 and 100 ppm Nalco 7768

[1] Standard procedures for jar testing of polymers and coagulants vary the mixing speeds to enhance mixing of the water soluble coagulants while avoiding shearing of the larger polymer materials.

2.5.1.5 Geotube Testing

Once the optimum polymer/coagulant doses were determined, geotubes were set up using the following treatments:

Table 2.1 Geotube Treatments

Estuary (EST)	Boat Harbour (BH)	ASB
Control (no additions)	Control (no additions)	Control (no additions)
Polymer only:600 ppm of Nalco 71301	Polymers/Coagulant only: 1,000 ppm Nalco 8186 and 150 ppm Nalco 7768	Polymers/Coagulant only:1,250 ppm Nalco 8186 and 100 ppm Nalco 7768
Polymer + Lime: 600 ppm of Nalco 71301 and 4 grams (g) of Lime to pH 8 – 8.5 S.U.	Polymers/Coagulant + Lime and powdered activated carbon (PAC):1,000 ppm Nalco 8186; 150 ppm Nalco 7768, 12 g of Lime to pH 8 – 8.5 S.U., and 2 percent PAC	Polymers/Coagulant + Lime and PAC: 1,250 ppm Nalco 8186 and 100 ppm Nalco 7768, 82 g of Lime to pH 8 – 8.5 S.U., and 2 percent PAC
	Polymers/Coagulant + Lime and RemBind: 1,000 ppm Nalco 8186 and 150 ppm Nalco 7768, 12 g of Lime to pH 8 – 8.5 S.U., and 2 percent RemBind	Polymers/Coagulant + Lime and RemBind:1,250 ppm Nalco 8186 and 100 ppm Nalco 7768, 82 g of Lime to pH 8 – 8.5 S.U., and 2 percent RemBind

The 5 percent solids sediment slurries and reagents were mixed in 5-gallon (~19 L) buckets using an IKA RW 20 Digital Laboratory Stirrer at 300 rpm. The mixing speed was determined visually as a speed that was able to move the entire volume of the bucket without splashing the material out of the bucket. Once all of the reagents were homogenized (approximately 30 minutes of mixing) in the buckets, the mixture was poured through a funnel attached to the geotube. This process was repeated for all geotubes.

2.5.1.6 Geotube Dewatering Rate

The rates of geotube dewatering were recorded and are shown in Table 3. For the EST samples, dewatering was complete within the first 24 hours. For the BH samples, dewatering was largely complete after 48 hours, and for the ASB samples, dewatering occurred over a 72 hour period. Samples of the dewater water from each geotube were collected and analyzed as described below.

2.5.2 Quality of Dewater Water

Dewater water was collected and analyzed for pH, total and dissolved metals, petroleum hydrocarbons, PCDD/PCDF, and cyanide. Analytical results were compared to the NSE Tier 1 EQSs for Surface Water (Marine Water Values) and supplemental criteria as noted in Section 2.3, which best represents the post remediation environment. The EST samples contained cyanide, mercury and zinc concentrations above the applicable criteria in the control test. For the EST geotubes that received polymer or lime and polymer, total cyanide exceeded the applicable criteria. Concentrations of petroleum hydrocarbons in the water from all EST geotubes exceeded the applicable criteria. TEQ values were within the applicable criteria.

For the BH geotubes, petroleum hydrocarbons, total cyanide and total zinc exceeded applicable criteria in all four samples. The control sample also contained a total vanadium concentration that exceeded the applicable criteria. The control sample and the polymer only sample also exceeded applicable criteria for total mercury and TEQ. It is noted that geotubes that received PAC and RemBind, which are both activated carbon based products that bind large organic molecules, did not exceed the applicable criteria for TEQ or total mercury.

For the ASB samples, petroleum hydrocarbons, total cyanide and total zinc exceeded applicable criteria in all four samples. The control sample also contained total chromium, total copper and total vanadium concentrations that exceeded the applicable criteria. The control sample and the polymer only sample also exceeded applicable criteria for total mercury and TEQ. It is noted that geotubes that received PAC and RemBind, which are both activated carbon based products that bind large organic molecules, did not exceed the applicable criteria for TEQ or total mercury. The sample that received lime, polymer and RemBind also contained a copper concentration above applicable criteria.

The geotube dewater water data are shown in Table 4.

2.5.3 Quality of Geotube Solids

Toxicity Characteristic Leaching Procedure (TCLP) and Synthetic Precipitation Leaching Procedure (SPLP) leaches were performed on the dewatered geotube solids, and the leachate was analyzed for metals, cyanide and petroleum hydrocarbons. Total PCDD/PCDF was analyzed in the dewatered solids with TCLP and SPLP PCDD/PCDF performed on one selected sample.

Leaching above landfill disposal standards was not observed for metals, petroleum hydrocarbons, or cyanide for any of the geotube solids from any of the areas. TCLP and SPLP PCDD/PCDF analysis was performed on the ASB control geotube solids which would represent the "worst case" leaching of PCDD/PCDF. The TCLP and SPLP TEQ values were below the applicable criteria.

For total PCDD/PCDF TEQ concentrations (i.e., solids), results for the EST geotubes were within applicable criteria; however, the PCDD/PCDF TEQ concentrations exceeded applicable criteria for all of the BH and ASB geotubes.

The geotube solids analyses are shown in Table 5.

2.5.4 Dewater Water Treatment Testing

Treatment of dewater water was performed on dewater water from the BH and ASB geotubes that received lime, polymer, and 2 percent PAC. The water from these geotubes was selected because these geotube amendments were the most effective in decreasing concentrations of metals, petroleum hydrocarbons and PCDD/PCDF in the dewater water. One litre of the dewater water from the geotubes was mixed with 2 percent PAC for 30 minutes. After the mixing, samples were filtered through a 1.5 micron glass fiber filter and then bottled for sample analyses. The samples were analyzed for chemical oxygen demand (COD), total cyanide, total petroleum hydrocarbons, total metals, and dissolved metals. COD for both samples was found to be low (less than 20 mg/L) and both samples were non-detect for total cyanide. Total and dissolved metals data for both samples were below the applicable criteria. The water from the BH geotube was slightly above the applicable criteria for total petroleum hydrocarbons at 0.178 mg/L while the ASB geotube sample was below the applicable criteria. The analytical results are shown in Table 6.

Since the quality of the dewater water was weak enough that treatment through a simple treatment process reduced all parameters to below Tier 1 standards and leach testing of the geotube did not show leaching above landfill disposal standards, further stabilization of the geotube solids was not required and was not tested.

2.5.5 Stabilization of Non-Dewatered Sediment

Stabilization testing of material removed "in the wet" without dewatering was tested using Cetco clay products, distributed by Claytech Services Inc. The vendor recommended a dose of 4.5 percent Liquisorb 2000 for a 5 percent solids mixture. Since the ASB sediment had the highest concentration of chemicals of concern and was the most difficult to dewater using geotubes, this sample was selected for testing as it would represent "worst case" conditions. Treatment of a slurry of ASB sediment and surface water containing 5 percent solids with 4.5 percent Liquisorb 2000 was tested. After 24 hours, the stabilized material was tested for paint filter test, percent solids, bulking, TCLP metals, TCLP petroleum hydrocarbons, and TCLP PCDD/PCDF. The material passed the paint filter test and contained 12.8 percent solids (w/w). Bulking was not observed in this sample. TCLP metals, TCLP cyanide, and TCLP PCDD/PCDF were below landfill disposal standards, however, TCLP total petroleum hydrocarbons were above the standard at 6.5 mg/L. These data are shown in Table 7.

2.6 Task 3 | Excavation of Sediments in the Dry

Stabilization of sediments "in the dry" was tested. Excavation of sediments in the dry would involve bulk dewatering prior to excavation. The surface water that was removed may require treatment prior to discharge therefore treatment of the surface water was tested.

2.6.1 Treatment of Surface Water

Surface water treatment testing was performed on BH and ASB surface water samples as received. One-litre of each sample was pH adjusted to greater than 10 S.U. using lime. After pH adjustment, the samples were mixed for 2 minutes. Suspended solids were observed which did not appear to settle within a short period of time. Ferric chloride (250 ppm) and Nalco polymer 7768 (1 ppm) were added to each of the samples and mixed for 2 minutes to enhance the settling of suspended solids. After mixing, both samples were allowed to settle for 5 minutes. The supernatant from each test was analyzed for COD, total cyanide, total petroleum hydrocarbons, and total and dissolved metals. The COD for both samples were greater than that of the dewater water from the geotube testing. Both samples exceeded the applicable criteria for total petroleum hydrocarbons, total lead, and total zinc.

The supernatant from the lime tests was mixed with 2 percent PAC for 30 minutes. After mixing, both samples were filtered through a 1.5 micron glass fiber filter. These samples were again analyzed for COD, total cyanide, total petroleum hydrocarbons, and total and dissolved metals. The results from the analyses showed that the COD had been reduced by 78-90 percent by the PAC treatment. The total cyanide remained below detection limit. The total petroleum hydrocarbons and total and dissolved metal concentrations were all reduced to levels within applicable criteria. The data are shown in Table 8.

2.6.2 Treatment of Sediment

The sediment as received was used for these tests as it is expected to represent sediments that would be excavated in the dry. As shown in Table 2, the EST sediment had a percent solids content of 21.9 percent (w/w), while the BH and ASB sediments contained percent solids contents of 10.1 and 11.3 percent (w/w) respectively. Initial stabilization testing involved mixing of the sediments with combinations of Portland cement (up to 15 percent w/w), PAC (2 percent w/w), and agricultural lime (20 percent w/w). Free water was observed on the top of all solidified sediment treatments. The tests were left to stand for 72 hours to determine whether the free water would be absorbed as the cement became hydrated, however the free water remained. Further doses of up to 20 percent Portland cement and 60 percent lime were then tested. This resulted in less standing water, however an approximate 50 percent bulking of the samples was observed. Bulking of 50 percent is considered unacceptable from a waste management perspective. Based on these findings, it was determined that the moisture content of the sediments was too high for stabilization using Portland cement and lime alone without excessive bulking.

Therefore, the following alternate options were tested:

1. Gravity dewatering
2. Geotube dewatering

Additional polymer testing was performed to refine the polymer doses determined for the mixture containing 5 percent solids during the geotube testing. Since these mixtures contained more solids than the "in the wet" mixtures, a slightly different polymer dose was found to be optimal. The same procedures were followed for screening tests and combined tests as described above in the Section 2.5.1. Based on the testing, the following doses were determined:

- EST 2,000 ppm of Nalco 71301
- BH 2,000 ppm Nalco 8186 and 1,000 ppm Nalco 7768
- ASB 2,500 ppm Nalco 8186 and 1,500 ppm Nalco 7768

The sediments were mixed with these polymer doses. For gravity dewatering, the mixed sediment was placed in a beaker, and free water rising to the top of the sediment was pipetted off. After 72 hours, none of the samples passed the paint filter test. Therefore, it was determined that dewatering by settling of solids and removal of free water from the top of the material was not a viable dewatering mechanism.

For geotube dewatering, the sediment mixed with polymer/coagulant at the doses listed above were placed on filter fabric obtained from the geotube vendor and allowed to dewater. The rate of dewatering was noted and is shown in Table 9. The dewatered sediment from all three areas passed the paint filter test.

Solidification tests were set up on the dewatered sediment. The following treatments were set up for each of the three areas:

- Control
- Lime, 2 percent PAC
- Lime, 2 percent RemBind
- 5 percent Portland cement, 2 percent PAC

Stabilized sediments were tested for percent solids, TCLP metals, and TCLP petroleum hydrocarbons. For all samples in all tests, the TCLP metals and TCLP petroleum hydrocarbons were below the applicable standard. Bulking of the material for all tests was observed to be less than 11 percent. For all areas the percent solids were greatest with 5 percent Portland cement with 2 percent PAC at 38.7 percent for EST, 19.4 percent for BH, and 19.6 for ASB. These data are shown in Table 10.

Cetco clay products were again tested for stabilization of material removed "in the dry". Initial stabilization screening testing involved mixing of the sediments with clay products at 1 percent, 1.5 percent, and 3 percent at a fast mixing rate and then placed in molds. The clay products tested were Liquisorb 1000, Liquisorb 2000, and X-Dry 1000 OES. After 24 hours, the 3 percent Liquisorb 2000 dose passed paint filter testing with less than 7 percent bulking. The other clay products did not pass paint filter testing after 24 hours. The following larger scale stabilization tests were set up for each area:

- 3 percent Liquisorb 2000 alone
- 3 percent Liquisorb 2000, 2 percent PAC

After the stabilization tests were allowed to set up for at least 24 hours, the stabilized sediment was tested for percent solids, TCLP cyanide, TCLP metals, and TCLP petroleum hydrocarbons. For all areas the percent solids increased slightly over the untreated sediment. The TCLP testing did not show leaching of any metals or cyanide above landfill disposal standards. TCLP petroleum hydrocarbons exceeded landfill disposal standards for all areas except for EST and BH samples that received 3 percent Liquisorb 2000 with 2 percent PAC. In addition, the BH sample that received 3 percent Liquisorb 2000 was analyzed for TCLP PCDD/PCDF and had a TCLP TEQ of 2.64 pg/L which is below applicable criteria. These data are shown in Table 11.

3. Discussion

3.1 Removal of Sediments in the Wet

Options for dewatering of sediments removed in the wet include:

- Geotube
- Centrifuge
- Gravity

- Stabilization without Dewatering

3.1.1 Geotube

The Study has shown that geotube treatment would be effective for dewatering of sediments removed in the wet. Polymer and/or coagulant doses have been developed for all three sediments that cause "clumping" of the fine particulate and allow the sediment to be retained by the geotube while water runs out. After 2 weeks percent solids in geotubes treated with polymer averaged approximately 35 percent solids for the EST, 28 percent solids for the BH and 20 percent solids for the ASB. Geotube solids did not leach metals, cyanide or petroleum hydrocarbons in excess of landfill disposal criteria. The initial sediment and surface water samples did not contain VOC or PAH, therefore these compounds would not be present in the leachate from these samples. The solids contained PCDD/PCDF such that the TEQ was higher than the applicable criteria, however leaching of PCDD/PCDF was below the applicable leachate criteria for hazardous materials. At this time, it is not clear which standard would apply to this material. Geotube dewater water would require treatment for TPH, metals and cyanide. If carbon or RemBind are not added to the geotube, dewater water would also require treatment for PCDD/PCDF. Testing showed that a relatively simple process consisting of pH adjustment with lime and filtration through activated carbon would be sufficient for treatment.

3.1.2 Gravity

Laboratory results for gravity dewatering showed that BH and ASB sediments did not settle or dewater by gravity while EST sediments settled quickly when treated with a polymer. Therefore gravity dewatering would not be effective for the BH and ASB sediments removed in the wet but may be effective for EST sediments removed in the wet.

3.1.3 Centrifuge

Centrifugation applies a greater force of gravity to the material, however since gravity settling was not effective for BH or ASB sediments collected in the wet, it is unlikely that centrifugation would be effective for these sediments. Centrifugation may be effective for EST sediments collected in the wet.

3.1.4 Stabilization

Stabilization was performed using Cetco clay products distributed by Claytech Services Inc. The use of Liquisorb 2000 at a dose of 4.5 percent by weight resulted in a material that was workable and would pass paint filter. No significant bulking was observed using this dose. The stabilized material did not leach metals in excess of landfill disposal criteria or PCDD/PCDF TEQ in excess of applicable leachate criteria, however leaching of TPH in excess of landfill criteria was observed. Therefore stabilization using Cetco clay would be a viable option for sediment excavated in the wet without dewatering, however a binding agent such as activated carbon would need to be mixed in to prevent leaching of petroleum hydrocarbons.

3.2 Excavation of Sediments in the Dry

3.2.1 Treatment of Surface Water

The Study indicates that the BH and ASB surface water would need to be treated to decrease total petroleum hydrocarbons and metals. Testing showed that a relatively simple process consisting of pH adjustment with lime and filtration through activated carbon would be sufficient for treatment.

3.2.2 Geotube

The laboratory study has shown that geotube treatment would be effective for dewatering of sediments excavated in the dry. Polymer and/or coagulant doses similar to those used for geotube treatment "in the wet" were developed for all three sediments. Geotube dewatering for all three sediments produced a material that would pass the paint filter test. Percent solids for solids treated with polymer and dewatered with geotubes averaged approximately 34 percent solids (w/w) for the EST, 16 percent solids (w/w) for BH and 17 percent solids for the ASB. The dewatered solids did not leach metals, cyanide or petroleum hydrocarbons in excess of landfill disposal criteria.

3.2.3 Gravity

Gravity dewatering would not be effective for any of the three sediments removed in the dry. Testing showed that although a small amount of free water was produced when sediments were treated with polymers, the settled solids would not pass a paint filter test.

3.2.4 Centrifuge

Based on the gravity dewatering tests, centrifugation would not be effective for sediments removed in the dry from either the EST, BH, or ASB areas.

3.2.5 Stabilization

Stabilization using Portland cement with lime as a bulking agent was not effective for the stabilization of sediments removed in the dry. The water content of these sediments was too high and stabilization such that a material was obtained that would pass the paint filter test could not be obtained using Portland cement and lime without bulking the sediment by over 50 percent.

Stabilization was also performed using Cetco clay products distributed by Claytech Services Inc. The use of Liquisorb 2000 at a dose of 3 percent by weight resulted in a material that was workable and would pass paint filter. Seven percent bulking was observed using this dose. The stabilized material did not leach metals in excess of landfill disposal criteria or PCDD/PCDF TEQ in excess of federal criteria, however leaching of TPH in excess of landfill criteria was observed for EST, BH, and ASB sediments. The addition of powdered activated carbon eliminated leaching of TPH for the EST and BH sediments but not for the ASB sediments. A higher activated carbon dose would be required for the ASB sediments. Therefore stabilization using Cetco clay would be a viable option for sediment excavated in the dry without dewatering, however a binding agent such as activated carbon would need to be mixed in to prevent leaching of petroleum hydrocarbons.

The stabilization testing showed that stabilization of sediments removed in the dry with Portland cement and lime is not viable without excessive bulking, however stabilization using a clay product is a viable option.

Stabilization testing was also performed on sediment collected in the dry but dewatered using geotubes. Stabilization of the dewatered sediment was not required.

3.3 Geotube Dewatering Rates

3.3.1 Removal in the Wet

The geotubes were filled with 40 L (0.04 cubic metres (m^3)) of a sediment/water mixture containing 5 percent solids.

For the EST a total of 26.5 L of water was recovered from each of the geotubes. This volume was recovered during the first 24 hours after the geotube was filled. The rate of dewatering decreased over the 24 hour period. If linear rates are fitted to the different time ranges than the dewatering rate over the first 6 hours was 2.7 liters per hour, the second 6 hours was 0.54 liters per hour and over the following 12 hours was 0.3 liters per hour. Since 40 L (0.04 m^3) of sludge was placed in the geotube the dewatering rate during the first 6 hours can be converted to 67.5 L/m^3 of sludge; the dewatering rate during the second 6 hours was 13.5 L/m^3 and the dewatering rate during the following 12 hours was 7.5 L/m^3 of sludge.

A full size geotube 100 m long and 5 m in diameter would hold 1,964 m^3 of sediment so during the first 6 hours 132,570 L of water per hour would be recovered from the geotube so over the first 6 hours 795,420 L (795 cubic m) of water would be recovered. This means that 40 percent of the volume of the geotube would dewater within the first 6 hours and additional 795 m^3 could be pumped into the geotube.

The corresponding numbers for the BH and ASB geotubes are shown in the table below:

Table 3.1 Geotube Dewatering Rates in the Wet

Geotube	Dewater Rate for first 6 hours; second 6 hours; following 12 hours	Percent reduction in Geotube Volume	Dewater Rate per Cubic Meter of Soil for first 6 hours; second 6 hours; following 12 hours	Dewater Rate for 1,964 m^3 geotube for first 6 hours; second 6 hours; following 12 hours	Volume of water recovered from 1,964 m^3 geotube during first 6 hours; second 6 hours; following 12 hours
EST (all three geotubes)	2.7 L/h; 0.54 L/h; 0.3 L/h	66.25%	67.5 L/h; 13.5 L/h; 7.5 L/h	133 m^3/h; 26.5 m^3/h; 14.7 m^3/h	795 m^3; 159 m^3; 177 m^3
BH Control	1.35 L/h; 0.29 L/h; 0.13 L/h	39.4%	33.7 L/h; 7.27 L/h; 3.24 L/h	66.3 m^3/h; 14.3 m^3/h; 6.4 m^3/h	398 m^3; 85.6 m^3; 76.5 m^3
BH Polymer/ CoagulantOnly	2.01 L/h; 0.43 L/h; 0.19 L/h	56.8%	50.3 L/h; 10.8 L/h; 4.8 L/h	98.8 m^3/h; 21.3 m^3/h; 9.5 m^3/h	593 m^3; 128 m^3; 114 m^3

Table 3.1 Geotube Dewatering Rates in the Wet

Geotube	Dewater Rate for first 6 hours; second 6 hours; following 12 hours	Percent reduction in Geotube Volume	Dewater Rate per Cubic Meter of Soil for first 6 hours; second 6 hours; following 12 hours	Dewater Rate for 1,964 m^3 geotube for first 6 hours; second 6 hours; following 12 hours	Volume of water recovered from 1,964 m^3 geotube during first 6 hours; second 6 hours; following 12 hours
BH Polymer/Coag, Lime + PAC	2.5 L/h; 0.54 L/h; 0.24 L/h	53.2%	62.8 L/h; 13.5 L/h; 6.03 L/h	123 m^3/h; 26.5 m^3/h; 11.8 m^3/h	739 m^3; 159 m^3; 142 m^3
BH Polymer/Coag, Lime + RemBind	1.79 L/h; 0.39 L/h; 0.17 L/h	51.0%	44.7 L/h; 9.6 L/h; 4.3 L/h	87.8 m^3/h; 18.9 m^3/h; 8.4 m^3/h	527 m^3; 113 m^3; 101 m^3
ASB Control	0.6 L/h; 0.15 L/h; 0.098 L/h	32.0%	15.1 L/h; 3.77 L/h; 2.45 L/h	29.6 m^3/h; 7.4 m^3/h; 4.8 m^3/h	178 m^3 44.4 m^3; 57.8 m^3
ASB Polymer/Coag Only	1.5 L/h; 0.38 L/h 0.24 L/h	43.2%	37.6 L/h; 9.39 L/h; 6.10 L/h	73.8 m^3/h; 18.4 m^3/h; 12.0 m^3/h	443 m^3; 111 m^3; 144 m^3
ASB Polymer/Coag, Lime + PAC	1.4 L/h; 0.35 L/h; 0.23 L/h	40.9%	34.9 L/h; 8.73 L/h; 5.67 L/h	68.6 m^3/h; 17.1 m^3/h; 11.1 m^3/h	412 m^3; 103 m^3; 134 m^3
ASB Polymer/Coag, Lime + RemBind	1.0 L/h; 0.25 L/h; 0.16 L/h	37.7%	25.1 L/h; 6.28 L/h; 4.08 L/h	45.4 m^3/h; 12,3 m^3/h; 8.0 m^3/h	296 m^3; 74.0 m^3; 96.2 m^3

Notes:

- Dewatering occurred in the ASB and BH geotubes after the first 24 hours, however the amounts were fairly negligible so only the volumes for the first 24 hours were used in the calculations above
- Calculation parameters:
  - Volume of sediment mixture placed in bench scale geotubes: approximately 40 L (0.04 m^3)
  - Surface area of bench scale geotubes: approximately 4,100 square cm (0.21 m^2)
  - Ratio of surface area to volume of the bench scale geotube was 5.25 m^2/m^3

3.3.2 Removal in the Dry

Geotubes were not set up for the removal in the dry option, however sediment was placed on geotube filter fabric and the rates at which water was recovered from the sediment mixture were measured. Dewatering of all three sediments was complete after 150 minutes. Similar to the "in the wet" geotubes, the greatest amount of dewatering was observed immediately after the sediment was placed on the filter fabric – in this case in the first 20 minutes. When dewatering rates for "in the dry" are graphed over time the curve as a similar shape to those for "in the wet" above therefore it appears it would be valid to use the rates in the table above that were developed for the "in the wet" geotubes for "in the dry". For the ASB and the BH, the "in the dry" material contains 10 percent solids and the "in the wet" material contains 5 percent solids therefore the similarity is expected.

Only dewatering using polymer was performed for the "in the dry" tests. In the table below an attempt has been made to scale the rates observed during the 150 minutes filtration to what would be seen in geotubes based on the fact that 2 L of sediment were used in the filters compared with 40 L in the getubes. The numbers are similar to the "in the wet" numbers in part because the "in the wet" rates were used in the scale up calculation.

Table 3.2 Geotube Dewatering Rates in the Dry

Geotube	Dewater Rate for first 6 hours; second 6 hours; following 12 hours	Dewater Rate per Cubic Meter of Soil for first 6 hours; second 6 hours; following 12 hours	Dewater Rate for 1,964 m^3 geotube for first 6 hours; second 6 hours; following 12 hours	Volume of water recovered from 1,964 m^3 geotube during first 6 hours; second 6 hours; following 12 hours
EST (all three geotubes)	2.5 L/h; 0.5 L/h; 0.28 L/h	64 L/h; 13 L/h; 7 L/h	125 m^3/h; 25 m^3/h; 14 m^3/h	750 m^3; 150 m^3; 170 m^3
BH Polymer/Coag Only	2 L/h; 0.4 L/h; 0.18 L/h	48 L/h; 10 L/h; 4.5 L/h	94 m^3/h; 20 m^3/h; 9 m^3/h	560 m^3; 120 m^3; 108 m^3
ASB Polymer/Coag Only	1.4 L/h; 0.36 L/h; 0.23 L/h	36 L/h; 9 L/h; 6 L/h	70 m^3/h; 17 m^3/h; 11 m^3/h	420 m^3; 105 m^3; 136 m^3

4. Conclusion and Recommendation

Based on this testing removal in the wet and removal in the dry are both viable options for treatment of the EST, BH, and ASB areas of the Site. Pilot testing of these technologies is recommended.

4.1 Removal in the Wet

For removal in the wet viable options for management of the dredged material are treatment using geotubes and stabilization without dewatering using Cetco clay and activated carbon.

4.1.1 Geotube Treatment

For geotube treatment the sediment would be mixed with polymer and/or coagulant as follows:

- EST: 600 ppm of Nalco 71301
- BH: 1,000 ppm Nalco 8186 and 150 ppm Nalco 7768
- ASB: 1,250 ppm Nalco 8186 and 100 ppm Nalco 7768

The addition of lime or activated carbon is not required to prevent leaching of metals, cyanide or organics from the geotube solids, however the addition of lime and PAC to the geotubes produces dewater water that requires less treatment. Therefore the addition of lime to pH 10 and 2 percent PAC may be considered, however it may be more feasible to do some additional treatment of the dewater water than add additional solids to the geotubes. Dewater water would be treated using lime and activated carbon.

4.1.2 Stabilization

For stabilization the non-dewatered dredged material would be mixed with Cetco Liquisorb 2000 at a concentrations of 4.5 percent by weight. Samples from the BH area would also be mixed with 2 percent activated carbon and samples from the ASB area would be mixed with 4 percent activated carbon.

4.2 Excavation in the Dry

For removal in the dry viable options for management of the excavated material are also geotubes and stabilization without dewatering using Cetco clay and activated carbon.

Surface water would be removed from the treatment areas and treated using lime and activated carbon.

4.2.1 Geotube Treatment

For geotube treatment the sediment would be mixed with polymer and/or coagulant as follows:

- EST 2,000 ppm of Nalco 71301
- BH 2,000 ppm Nalco 8186 and 1,000 ppm Nalco 7768
- ASB 2,500 ppm Nalco 8186 and 1,500 ppm Nalco 7768

The addition of lime or activated carbon is not required to prevent leaching of metals, cyanide or organics from the geotube solids, however the dewater water will be similar to that produced "in the wet" therefore the addition of lime and PAC to the geotubes will produce dewater water that requires less treatment. Therefore the addition of lime to pH 10 and 2 percent PAC may be considered however it may be more feasible to do some additional treatment of the dewater water than add additional solids to the geotubes. No stabilization of the dewatered solids is necessary.

4.2.2 Stabilization

For stabilization the non-dewatered dredged material would be mixed with Cetco Liquisorb 2000 at a concentration of 3 percent by weight. Samples from the BH area would also be mixed with 2 percent activated carbon and samples from the ASB area would be mixed with 4 percent activated carbon.

All of Which is Respectfully Submitted,

GHD

for Sophia Dore

Sophia Dore, Ph.D.

Christine Skirth, C.E.T., PMP

Table 1

Initial Surface Water Sample Characterization Results
Laboratory Treatability Study
Boat Harbour Remediation Planning and Design
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Parameters	Units	Criteria (1)	EST	BH	ASB
General Chemistry					
pH	S.U.	b	7.19	7.19	6.68
Total Cyanide	µg/L	1	15	21	19
Volatile Organic Compounds (VOCs)					
2-Butanone	µg/L		ND (5)	ND (5)	ND (5)
2-Hexanone	µg/L		ND (5)	ND (5)	ND (5)
4-Methyl-2-pentanone	µg/L		ND (5)	ND (5)	ND (5)
1,2-Dibromo-3-chloropropane	µg/L		ND (2)	ND (2)	ND (2)
1,2-Dibromoethane	µg/L		ND (2)	ND (2)	ND (2)
1,2-Dichlorobenzene	µg/L	42	ND (2)	ND (2)	ND (2)
1,3-Dichlorobenzene	µg/L	19.7	ND (2)	ND (2)	ND (2)
1,4-Dichlorobenzene	µg/L	19.7	ND (2)	ND (2)	ND (2)
1,1-Dichloroethane	µg/L	1130	ND (2)	ND (2)	ND (2)
1,1-Dichloroethene	µg/L	2240	ND (2)	ND (2)	ND (2)
1,2-Dichloroethane	µg/L	1130	ND (2)	ND (2)	ND (2)
1,2-Dichloropropane	µg/L	3040	ND (2)	ND (2)	ND (2)
1,1,2,2-Tetrachloroethane	µg/L	90.2	ND (2)	ND (2)	ND (2)
1,2,4-Trichlorobenzene	µg/L		ND (2)	ND (2)	ND (2)
1,1,1-Trichloroethane	µg/L	312	ND (2)	ND (2)	ND (2)
1,1,2-Trichloroethane	µg/L	312	ND (2)	ND (2)	ND (2)
1,1,2-Trichloro-1,2,2-trifluoroethane	µg/L		ND (2)	ND (2)	ND (2)
Acetone	µg/L		ND (5)	ND (5)	ND (5)
Benzene	µg/L	2100	ND (2)	ND (2)	ND (2)
Bromochloromethane	µg/L		ND (2)	ND (2)	ND (2)
Bromodichloromethane	µg/L	6400	ND (2)	ND (2)	ND (2)
Bromoform	µg/L	6400	ND (2)	ND (2)	ND (2)
Bromomethane (Methyl bromide)	µg/L	6400	ND (2)	ND (2)	ND (2)
Carbon disulfide	µg/L		ND (2)	ND (2)	ND (2)
Carbon tetrachloride	µg/L	500	ND (2)	ND (2)	ND (2)
Chlorobenzene	µg/L	25	ND (2)	ND (2)	ND (2)
Chloroethane	µg/L		ND (2)	ND (2)	ND (2)
Chloroform (Trichloromethane)	µg/L	6400	ND (2)	ND (2)	ND (2)
Chloromethane (Methyl chloride)	µg/L	6400	ND (2)	ND (2)	ND (2)
cis-1,2-Dichloroethene	µg/L	2240	ND (2)	ND (2)	ND (2)
cis-1,3-Dichloropropene	µg/L		ND (2)	ND (2)	ND (2)
Cyclohexane	µg/L		ND (2)	ND (2)	ND (2)
Dibromochloromethane	µg/L	6400	ND (2)	ND (2)	ND (2)
Dichlorodifluoromethane	µg/L		ND (2)	ND (2)	ND (2)
Ethylbenzene	µg/L	320	ND (2)	ND (2)	ND (2)
Isopropylbenzene	µg/L		ND (2)	ND (2)	ND (2)
Methyl acetate	µg/L		ND (2)	ND (2)	ND (2)
Methylcyclohexane	µg/L		ND (2)	ND (2)	ND (2)
Methylene chloride	µg/L	6400	ND (2)	ND (2)	ND (2)
Methyl tert-butyl ether	µg/L	5000	ND (2)	ND (2)	ND (2)
Styrene	µg/L		ND (2)	ND (2)	ND (2)
Tetrachloroethene	µg/L	450	ND (2)	ND (2)	ND (2)
Toluene	µg/L	770	ND (2)	ND (2)	ND (2)
trans-1,2-Dichloroethene	µg/L	2240	ND (2)	ND (2)	ND (2)
trans-1,3-Dichloropropene	µg/L		ND (2)	ND (2)	ND (2)

Table 1

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Parameters	Units	Criteria [1]	EST	BH	ASB
VOCs-Continued					
Trichlorofluoromethane	µg/L		ND (2)	ND (2)	ND (2)
Trichloroethene	µg/L	20	ND (2)	ND (2)	ND (2)
m/p-Xylenes	µg/L	330	ND (2)	ND (2)	ND (2)
o-Xylene	µg/L	330	ND (2)	ND (2)	ND (2)
Vinyl chloride	µg/L		ND (2)	ND (2)	ND (2)
Semi-volatile Organic Compounds (SVOCs)					
1-Methylnaphthalene	µg/L	1	ND (2)	ND (2)	ND (2)
2-Methylnaphthalene	µg/L	2	ND (2)	ND (2)	ND (2)
Acenaphthene	µg/L	6	ND (2)	ND (2)	ND (2)
Acenaphthylene	µg/L	6	ND (2)	ND (2)	ND (2)
Anthracene	µg/L		ND (2)	ND (2)	ND (2)
Benzo(a)anthracene	µg/L		ND (2)	ND (2)	ND (2)
Benzo(b)fluoranthene	µg/L		ND (2)	ND (2)	ND (2)
Benzo(k)fluoranthene	µg/L		ND (2)	ND (2)	ND (2)
Benzo(g,h,i)perylene	µg/L		ND (2)	ND (2)	ND (2)
Benzo(a)pyrene	µg/L	0.01	ND (2)	ND (2)	ND (2)
Chrysene	µg/L	0.1	ND (2)	ND (2)	ND (2)
Dibenz(a,h)anthracene	µg/L		ND (2)	ND (2)	ND (2)
Fluoranthene	µg/L	11	ND (2)	ND (2)	ND (2)
Fluorene	µg/L	12	ND (2)	ND (2)	ND (2)
Indeno(1,2,3-cd)pyrene	µg/L		ND (2)	ND (2)	ND (2)
Naphthalene	µg/L	1.4	ND (2)	ND (2)	ND (2)
Phenanthrene	µg/L	4.6	ND (2)	ND (2)	ND (2)
Pyrene	µg/L	0.02	ND (2)	ND (2)	ND (2)
Total Petroleum Hydrocarbons					
Total Petroleum Hydrocarbons (C6-C10)	mg/L		ND (0.01)	ND (0.01)	ND (0.01)
Total Petroleum Hydrocarbons (>C10-C16)	mg/L		ND (0.02)	ND (0.02)	0.016 J
Total Petroleum Hydrocarbons (>C16-C21)	mg/L		0.051	0.046	0.023
Total Petroleum Hydrocarbons (>C21-C32)	mg/L		0.463	0.288	0.163
Total Petroleum Hydrocarbons - Modified - Tier 1	mg/L	0.1	0.514	0.335	0.202
Polychlorinated Biphenyls (PCBs)					
Total PCBs	µg/L		ND (0.06)	ND (0.06)	ND (0.06)
Dioxins and Furans					
2,3,7,8-TCDD	pg/L		ND (9.5)	ND (9.5)	ND (13)
1,2,3,7,8-PeCDD	pg/L		ND (47)	ND (48)	ND (48)
1,2,3,4,7,8-HxCDD	pg/L		ND (47)	ND (48)	ND (48)
1,2,3,6,7,8-HxCDD	pg/L		ND (47)	ND (48)	ND (48)
1,2,3,7,8,9-HxCDD	pg/L		ND (47)	ND (48)	ND (48)
1,2,3,4,6,7,8-HpCDD	pg/L		89	ND (48)	ND (48)
OCDD	pg/L		2900 B	30 JB	40 JB
2,3,7,8-TCDF	pg/L		ND (9.5)	ND (11)	ND (15)
1,2,3,7,8-PeCDF	pg/L		ND (47)	ND (48)	ND (48)
2,3,4,7,8-PeCDF	pg/L		ND (47)	ND (48)	ND (48)
1,2,3,4,7,8-HxCDF	pg/L		ND (47)	ND (48)	ND (48)
Dioxins and Furans-Continued					
1,2,3,6,7,8-HxCDF	pg/L		ND (47)	ND (48)	ND (48)
2,3,4,6,7,8-HxCDF	pg/L		ND (47)	ND (48)	ND (48)
1,2,3,7,8,9-HxCDF	pg/L		ND (47)	ND (48)	ND (48)
1,2,3,4,6,7,8-HpCDF	pg/L		22 J B	25 JB	32 JBq
1,2,3,4,7,8,9-HpCDF	pg/L		ND (47)	ND (48)	ND (48)
OCDF	pg/L		71 Jq B	39 JB	47 JB
TEQ	pg/L	120 [2]	1.4071	0.2569	0.3287

Table 1

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Parameters	Units	Criteria [1]	EST	BH	ASB
Total Metals					
Total Aluminum	µg/L		977	1220	1320
Total Antimony	µg/L	500	ND (50)	ND (50)	ND (50)
Total Arsenic	µg/L	12.5	ND (50)	ND (50)	ND (50)
Total Barium	µg/L	500	168	208	210
Total Beryllium	µg/L	100	ND (25)	ND (25)	ND (25)
Total Cadmium	µg/L	0.12	ND (25)	ND (25)	ND (25)
Total Calcium	µg/L		77600	29800	33700
Total Chromium	µg/L	56 (trivalent) [3]	ND (25)	ND (25)	ND (25)
Total Cobalt	µg/L		ND (50)	ND (50)	ND (50)
Total Copper	µg/L	2	ND (50)	ND (50)	ND (50)
Total Iron	µg/L		345	395	461
Total Lead	µg/L	2	ND (50)	ND (50)	ND (50)
Total Magnesium	µg/L		154000	5240	4460
Total Manganese	µg/L		1030	1480	2020
Total Mercury	µg/L	0.016	ND (0.2)	ND (0.2)	ND (0.2)
Total Nickel	µg/L	8.3	ND (50)	ND (50)	ND (50)
Total Potassium	µg/L		57900	22600	86800
Total Selenium	µg/L	2	ND (100)	ND (100)	ND (100)
Total Silver	µg/L	1.5	ND (50)	ND (50)	ND (50)
Total Sodium	µg/L		1370000 E	312000	284000
Total Thallium	µg/L	21.3	ND (100)	ND (100)	7.10 J
Total Vanadium	µg/L	50	ND (50)	ND (50)	ND (50)
Total Zinc	µg/L	10	51.9	64.4	97.9

Table 1

Initial Surface Water Sample Characterization Results
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Nova Scotia Lands

Parameters	Units	Criteria [1]	EST	BH	ASB
Dissolved Metals					
Dissolved Aluminum	µg/L		746	1070	1110
Dissolved Antimony	µg/L	500	ND (50)	ND (50)	1.68 J
Dissolved Arsenic	µg/L	12.5	ND (50)	ND (50)	ND (50)
Dissolved Barium	µg/L	500	164	190	207
Dissolved Beryllium	µg/L	100	ND (25)	ND (25)	ND (25)
Dissolved Cadmium	µg/L	0.12	ND (25)	ND (25)	ND (25)
Dissolved Calcium	µg/L		75900	3100	20300
Dissolved Chromium	µg/L	56 (trivalent) [3]	ND (25)	ND (25)	ND (25)
Dissolved Cobalt	µg/L		ND (50)	ND (50)	ND (50)
Dissolved Copper	µg/L	2	ND (50)	ND (50)	ND (50)
Dissolved Iron	µg/L		215	290	308
Dissolved Lead	µg/L	2	ND (50)	ND (50)	ND (50)
Dissolved Magnesium	µg/L		167000	5310	4490
Dissolved Manganese	µg/L		794	1270	2010
Dissolved Mercury	µg/L	0.016	ND (0.2)	ND (0.2)	ND (0.2)
Dissolved Nickel	µg/L	8.3	ND (50)	ND (50)	ND (50)
Dissolved Potassium	µg/L		76400	74800	23900
Dissolved Selenium	µg/L	2	ND (100)	ND (100)	ND (100)
Dissolved Silver	µg/L	1.5	ND (50)	ND (50)	ND (50)
Dissolved Sodium	µg/L		1490000 E	30900	285000
Dissolved Thallium	µg/L	21.3	ND (100)	ND (100)	ND (100)
Dissolved Vanadium	µg/L	50	ND (50)	ND (50)	ND (50)
Dissolved Zinc	µg/L	10	30.8	53.4	60.7

Notes:
[1] Nova Scotia Environment (NSE) 2013 Tier 1 Environmental Quality Standards (EQSs) for Surface Water (Marine Water Values), Table 3, July 6, 2013.
[2] NSE 2013 Tier 1 EQSs for Groundwater (Potable Groundwater Values), Table 4, July 6, 2013.
[3] Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for the Protection of Aquatic Life (Marine
ND (x) - Not detected at reporting limit
J - Estimated value
E - Above calibration range
- Exceeds Applicable Criteria
S.U. - Standard Units
q - Possible interference
B - Compound detected in blank
CN - Cyanide

Table 2

Initial Sediment Sample Characterization Results
Laboratory Treatability Study
Boat Harbour Remediation Planning and Design
Nova Scotia Lands

Parameters	Units	Criteria (1)	Criteria (3)	Criteria (4)	EST	BH	ASB
General Chemistry							
pH	S.U.				7.19	6.86	6.93
Percent Solids	%				21.9	10.1	11.3
Volatile Organic Compounds (VOCs)							
2-Butanone	µg/kg				ND (125)	ND (125)	ND (125)
2-Hexanone	µg/kg				ND (125)	ND (125)	ND (125)
4-Methyl-2-pentanone	µg/kg				ND (125)	ND (125)	ND (125)
1,2-Dibromo-3-chloropropane	µg/kg				ND (50)	ND (50)	ND (50)
1,2-Dibromoethane	µg/kg				ND (50)	ND (50)	ND (50)
1,2-Dichlorobenzene	µg/kg	10000	50	50	ND (50)	ND (50)	ND (50)
1,3-Dichlorobenzene	µg/kg	10000	50	50	ND (50)	ND (50)	ND (50)
1,4-Dichlorobenzene	µg/kg	10000	90		ND (50)	ND (50)	ND (50)
1,1-Dichloroethane	µg/kg	50000		7910 (5)	ND (50)	ND (50)	ND (50)
1,1-Dichloroethene	µg/kg	50000		6340 (5)	ND (50)	ND (50)	ND (50)
1,2-Dichloroethane	µg/kg	50000		23000 (5)	ND (50)	ND (50)	ND (50)
1,2-Dichloropropane	µg/kg	50000		13100 (5)	ND (50)	ND (50)	ND (50)
1,1,2,2-Tetrachloroethane	µg/kg	50000			ND (50)	ND (50)	ND (50)
1,2,4-Trichlorobenzene	µg/kg	10000			ND (50)	ND (50)	ND (50)
1,1,1-Trichloroethane	µg/kg	50000	170		ND (50)	ND (50)	ND (50)
1,1,2-Trichloroethane	µg/kg	50000	170		ND (50)	ND (50)	ND (50)
1,1,2-Trichloro-1,2,2-trifluoroethane	µg/kg	50000			ND (50)	ND (50)	ND (50)
Acetone	µg/kg				ND (50)	ND (50)	ND (50)
Benzene	µg/kg	5000	1200		ND (50)	ND (50)	ND (50)
Bromochloromethane	µg/kg	50000		8210 (5)	ND (50)	ND (50)	ND (50)
Bromodichloromethane	µg/kg	50000			ND (50)	ND (50)	ND (50)
Bromoform	µg/kg		650		ND (50)	ND (50)	ND (50)
Bromomethane (Methyl bromide)	µg/kg			54700 (5)	ND (50)	ND (50)	ND (50)
Carbon disulfide	µg/kg				ND (50)	ND (50)	ND (50)
Carbon tetrachloride	µg/kg	50000	1200		ND (50)	ND (50)	ND (50)
Chlorobenzene	µg/kg	10000			ND (50)	ND (50)	ND (50)
Chloroethane	µg/kg	50000		13300 (5)	ND (50)	ND (50)	ND (50)
Chloroform (Trichloromethane)	µg/kg	50000		13300 (5)	ND (50)	ND (50)	ND (50)
Chloromethane (Methyl chloride)	µg/kg	50000		29300 (5)	ND (50)	ND (50)	ND (50)
cis-1,2-Dichloroethene	µg/kg	50000		7960 (5)	ND (50)	ND (50)	ND (50)
cis-1,3-Dichloropropene	µg/kg	50000			ND (50)	ND (50)	ND (50)
Cyclohexane	µg/kg				ND (50)	ND (50)	ND (50)
Dibromochloromethane	µg/kg	50000		29500 (5)	ND (50)	ND (50)	ND (50)
Dichlorodifluoromethane	µg/kg	50000			ND (50)	ND (50)	ND (50)
Ethylbenzene	µg/kg	50000	1200		ND (50)	ND (50)	ND (50)
Isopropylbenzene	µg/kg				ND (50)	ND (50)	ND (50)
Methyl acetate	µg/kg				ND (50)	ND (50)	ND (50)
Methylcyclohexane	µg/kg				ND (50)	ND (50)	ND (50)
Methylene chloride	µg/kg			29500 (5)	ND (50)	ND (50)	ND (50)
Methyl tert-butyl ether	µg/kg				ND (50)	ND (50)	ND (50)
Styrene	µg/kg	50000			ND (50)	ND (50)	ND (50)
Tetrachloroethene	µg/kg	50000	530		ND (50)	ND (50)	ND (50)
Toluene	µg/kg	30000	1400		ND (50)	ND (50)	ND (50)
trans-1,2-Dichloroethene	µg/kg	50000		10340 (5)	ND (50)	ND (50)	ND (50)
trans-1,3-Dichloropropene	µg/kg	50000			ND (50)	ND (50)	ND (50)
Trichlorofluoromethane	µg/kg	50000		5610 (5)	ND (50)	ND (50)	ND (50)
Trichloroethene	µg/kg	50000			ND (50)	ND (50)	ND (50)
m/p-Xylenes	µg/kg	50000	1300		ND (50)	ND (50)	ND (50)
o-Xylene	µg/kg	50000	1300		ND (50)	ND (50)	ND (50)
Vinyl chloride	µg/kg	50000		16000 (5)	ND (50)	ND (50)	ND (50)

Table 2

Initial Sediment Sample Characterization Results
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Parameters	Units	Criteria (1)	Criteria (3)	Criteria (4)	EST	BH	ASB
Semi-volatile Organic Compounds (SVOCs)							
1-Methylnaphthalene	µg/kg	10000	201	201	ND (100)	ND (100)	ND (100)
2-Methylnaphthalene	µg/kg	10000	201	201	ND (100)	ND (100)	ND (100)
Acenaphthene	µg/kg	10000	88.9	88.9	ND (100)	ND (100)	ND (100)
Acenaphthylene	µg/kg	10000	128	128	ND (100)	ND (100)	ND (100)
Anthracene	µg/kg	10000	245	245	ND (100)	ND (100)	ND (100)
Benzo(a)anthracene	µg/kg	10000	693	693	ND (100)	ND (100)	ND (100)
Benzo(b)fluoranthene	µg/kg	10000	4500		ND (100)	ND (100)	ND (100)
Benzo(k)fluoranthene	µg/kg	10000	4500		ND (100)	ND (100)	ND (100)
Benzo(g,h,i)perylene	µg/kg	10000	3200		ND (100)	ND (100)	ND (100)
Benzo(a)pyrene	µg/kg	10000	763	763	ND (100)	ND (100)	ND (100)
Chrysene	µg/kg	10000	846	846	ND (100)	ND (100)	ND (100)
Dibenz(a,h)anthracene	µg/kg	10000	135	135	ND (100)	ND (100)	ND (100)
Fluoranthene	µg/kg	10000	1494	1494	ND (100)	ND (100)	ND (100)
Fluorene	µg/kg	10000	144	144	ND (100)	ND (100)	ND (100)
Indeno(1,2,3-cd)pyrene	µg/kg	10000	880		ND (100)	ND (100)	ND (100)
Naphthalene	µg/kg	10000	391	391	ND (100)	ND (100)	ND (100)
Phenanthrene	µg/kg	10000	544	544	ND (100)	ND (100)	ND (100)
Pyrene	µg/kg	10000	1398	1398	ND (100)	ND (100)	ND (100)
Total Petroleum Hydrocarbons							
Total Petroleum Hydrocarbons (C6-C10)	mg/kg		15-500		ND (0.25)	ND (0.25)	ND (0.25)
Total Petroleum Hydrocarbons (>C10-C16)	mg/kg		25-500		ND (1)	ND (1)	ND (1)
Total Petroleum Hydrocarbons (>C16-C21)	mg/kg		43-500		4.39	27.9	38.7
Total Petroleum Hydrocarbons (>C21-C32)	mg/kg		43-500		28.5	193	220
Total Petroleum Hydrocarbons - Modified - Tier 1	mg/kg	150	500		32.9	221	259
Polychlorinated Biphenyls (PCBs)							
Total PCBs	µg/kg	50000	189		ND (3)	ND (3)	ND (3)
Dioxins and Furans							
2,3,7,8-TCDD	pg/g				1.1 J	94	93
1,2,3,7,8-PeCDD	pg/g				.13 Jq	5.7 Jq	6.4 J
1,2,3,4,7,8-HxCDD	pg/g				ND (9.4)	2 J	2.3 J
1,2,3,6,7,8-HxCDD	pg/g				0.78 Jq	25 J	9.1 Jq
1,2,3,7,8,9-HxCDD	pg/g				0.6 Jq	15 J	9.1 J
1,2,3,4,6,7,8-HpCDD	pg/g				12	52	92
OCDD	pg/g				220 B	630 B	910 B
2,3,7,8-TCDF	pg/g				12	610	2800
1,2,3,7,8-PeCDF	pg/g				ND (9.4)	12 J	25
2,3,4,7,8-PeCDF	pg/g				ND (9.4)	7.3 J	35
1,2,3,4,7,8-HxCDF	pg/g				ND (9.4)	2.5 Jq	4.3 Jq
1,2,3,6,7,8-HxCDF	pg/g				ND (9.4)	ND (26)	1.6 Jl
2,3,4,6,7,8-HxCDF	pg/g				ND (9.4)	ND (26)	2.2 J
1,2,3,7,8,9-HxCDF	pg/g				ND (9.4)	ND (26)	ND (21)
1,2,3,4,6,7,8-HpCDF	pg/g				1.5 J B	7 JB	11 JB
1,2,3,4,7,8,9-HpCDF	pg/g				ND (9.4)	ND (26)	2.0 J
OCDF	pg/g				3 J B	12 JB	21 JB
TEQ	pg/g	4 (2)	21.5	21.5	2.73	170	402

Table 2

Initial Sediment Sample Characterization Results
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Parameters	Units	Criteria [(1)]	Criteria [(3)]	Criteria [(4)]	EST	BH	ASB
Total Metals							
Total Aluminum	mg/kg				8550	9070	8220
Total Antimony	mg/kg	40			ND (5)	ND (5)	ND (5)
Total Arsenic	mg/kg	50	41.6	41.6	3.46 J	7.25	2.86 J
Total Barium	mg/kg	2000			76	40.4	44.3
Total Beryllium	mg/kg	8			ND (2.5)	ND (2.5)	ND (2.5)
Total Cadmium	mg/kg	20	4.2	4.2	3.46	11.3	12.6
Total Calcium	mg/kg				4710	24000	36200
Total Chromium	mg/kg	800	160	160	14.7	19.9	78.2
Total Cobalt	mg/kg	300			10.5	6.64	6.42
Total Copper	mg/kg	500	108	108	17.4	91.1	90
Total Iron	mg/kg				19200	11400	12100
Total Lead	mg/kg	1000	112	112	63.6	72.7	86.1
Total Magnesium	mg/kg				6860	7470	3980
Total Manganese	mg/kg				426	1540	2010
Total Mercury	mg/kg	10	0.7	0.7	0.035 J	0.59	0.82
Total Nickel	mg/kg	500			18	27.4	28.2
Total Potassium	mg/kg				1540	1030	860
Total Selenium	mg/kg	10			ND (10)	ND (10)	ND (10)
Total Silver	mg/kg	40	2.2		ND (5)	4.17 J	3.35 J
Total Sodium	mg/kg				18700	17900	8140
Total Thallium	mg/kg	1			ND (10)	ND (10)	ND (10)
Total Vanadium	mg/kg	200			23.4	74.5	70.5
Total Zinc	mg/kg	1500	271	271	148	1230	955
TCLP-Total Petroleum Hydrocarbons							
TCLP-Total Petroleum Hydrocarbons (C6-C10)	mg/L				NA	NA	NA
TCLP-Total Petroleum Hydrocarbons (>C10-C16)	mg/L				ND (0.02)	ND (0.02)	ND (0.02)
TCLP-Total Petroleum Hydrocarbons (>C16-C21)	mg/L				0.0377	0.0816	0.1575
TCLP-Total Petroleum Hydrocarbons (>C21-C32)	mg/L				ND (0.02)	0.080	0.109
TCLP-Total Petroleum Hydrocarbons - Modified - Tier 1	mg/L	1.5			0.0377	0.162	0.266
SPLP-Total Petroleum Hydrocarbons							
SPLP-Total Petroleum Hydrocarbons (C6-C10)	mg/L				NA	NA	NA
SPLP-Total Petroleum Hydrocarbons (>C10-C16)	mg/L				ND (0.02)	ND (0.02)	ND (0.02)
SPLP-Total Petroleum Hydrocarbons (>C16-C21)	mg/L				0.0348	0.550	0.420
SPLP-Total Petroleum Hydrocarbons (>C21-C32)	mg/L				0.0295	1.36	2.10
SPLP-Total Petroleum Hydrocarbons - Modified - Tier 1	mg/L				0.0643	1.91	2.52
TCLP Semi-volatile Organic Compounds							
TCLP 1-Methylnaphthalene	µg/L				ND (2)	ND (2)	ND (2)
TCLP 2-Methylnaphthalene	µg/L				ND (2)	ND (2)	ND (2)
TCLP Acenaphthene	µg/L				ND (2)	ND (2)	ND (2)
TCLP Acenaphthylene	µg/L				ND (2)	ND (2)	ND (2)
TCLP Anthracene	µg/L				ND (2)	ND (2)	ND (2)
TCLP Benzo(a)anthracene	µg/L				ND (2)	ND (2)	ND (2)
TCLP Benzo(b)fluoranthene	µg/L				ND (2)	ND (2)	ND (2)
TCLP Benzo(k)fluoranthene	µg/L				ND (2)	ND (2)	ND (2)
TCLP Benzo(g,h,i)perylene	µg/L				ND (2)	ND (2)	ND (2)
TCLP Benzo(a)pyrene	µg/L				ND (2)	ND (2)	ND (2)
TCLP Chrysene	µg/L				ND (2)	ND (2)	ND (2)
TCLP Dibenz(a,h)anthracene	µg/L				ND (2)	ND (2)	ND (2)
TCLP Fluoranthene	µg/L				ND (2)	ND (2)	ND (2)
TCLP Fluorene	µg/L				ND (2)	ND (2)	ND (2)
TCLP Indeno(1,2,3-cd)pyrene	µg/L				ND (2)	ND (2)	ND (2)
TCLP Naphthalene	µg/L				ND (2)	ND (2)	ND (2)
TCLP Phenanthrene	µg/L				ND (2)	ND (2)	ND (2)
TCLP Pyrene	µg/L				ND (2)	ND (2)	ND (2)
PAHs (total)	µg/L	10			ND (2)	ND (2)	ND (2)

Table 2

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Parameters	Units	Criteria (1)	Criteria (3)	Criteria (4)	EST	BH	ASB
SPLP Semi-volatile Organic Compounds							
SPLP 1-Methylnaphthalene	µg/L				ND (2)	ND (2)	ND (2)
SPLP 2-Methylnaphthalene	µg/L				ND (2)	ND (2)	ND (2)
SPLP Acenaphthene	µg/L				ND (2)	ND (2)	ND (2)
SPLP Acenaphthylene	µg/L				ND (2)	ND (2)	ND (2)
SPLP Anthracene	µg/L				ND (2)	ND (2)	ND (2)
SPLP Benzo(a)anthracene	µg/L				ND (2)	ND (2)	ND (2)
SPLP Benzo(b)fluoranthene	µg/L				ND (2)	ND (2)	ND (2)
SPLP Benzo(k)fluoranthene	µg/L				ND (2)	ND (2)	ND (2)
SPLP Benzo(g,h,i)perylene	µg/L				ND (2)	ND (2)	ND (2)
SPLP Benzo(a)pyrene	µg/L				ND (2)	ND (2)	ND (2)
SPLP Chrysene	µg/L				ND (2)	ND (2)	ND (2)
SPLP Dibenz(a,h)anthracene	µg/L				ND (2)	ND (2)	ND (2)
SPLP Fluoranthene	µg/L				ND (2)	ND (2)	ND (2)
SPLP Fluorene	µg/L				ND (2)	ND (2)	ND (2)
SPLP Indeno(1,2,3-cd)pyrene	µg/L				ND (2)	ND (2)	ND (2)
SPLP Naphthalene	µg/L				ND (2)	ND (2)	ND (2)
SPLP Phenanthrene	µg/L				ND (2)	ND (2)	ND (2)
SPLP Pyrene	µg/L				ND (2)	ND (2)	ND (2)
TCLP Metals							
TCLP Aluminum	µg/L	500000			522	489	290
TCLP Antimony	µg/L				4.55 J	1.51 J	ND (50)
TCLP Arsenic	µg/L	5000			10.3 J	15.7 J	ND (50)
TCLP Barium	µg/L	100000			436	670	483
TCLP Beryllium	µg/L	10000			ND (25)	ND (25)	ND (25)
TCLP Cadmium	µg/L	500			ND (25)	ND (25)	ND (25)
TCLP Calcium	µg/L				41600 E	69400 E	106000 E
TCLP Chromium	µg/L	5000			ND (50)	ND (50)	0.0369 J
TCLP Cobalt	µg/L	5000			2.27 J	ND (50)	ND (500
TCLP Copper	µg/L	100000			ND (50)	ND (50)	ND (50)
TCLP Iron	µg/L				27100	1320	1810
TCLP Lead	µg/L	5000			41.0 J	ND (50)	ND (50)
TCLP Magnesium	µg/L				34200	17500	9080
TCLP Manganese	µg/L				1730	3130	5440
TCLP Mercury	µg/L	100			ND (0.2)	ND (0.2)	ND (0.2)
TCLP Nickel	µg/L	20000			ND (50)	ND (50)	ND (50)
TCLP Potassium	µg/L				12200	4610	3720
TCLP Selenium	µg/L	1000			4.55 J	ND (100)	ND (100)
TCLP Silver	µg/L	5000			ND (50)	ND (50)	ND (50)
TCLP Sodium	µg/L				1230000 E	1200000 E	1090000 E
TCLP Thallium	µg/L				ND (100)	ND (100)	ND (100)
TCLP Vanadium	µg/L	10000			ND (50)	ND (50)	ND (50)
TCLP Zinc	µg/L	500000			431	1410	1210
SPLP Metals							
SPLP Aluminum	µg/L	500000			126	263	725
SPLP Antimony	µg/L				ND (50)	ND (50)	ND (50)
SPLP Arsenic	µg/L	5000			ND (50)	ND (50)	ND (50)
SPLP Barium	µg/L	100000			182	149	241
SPLP Beryllium	µg/L	10000			ND (25)	ND (25)	ND (25)
SPLP Cadmium	µg/L	500			ND (25)	ND (25)	ND (25)
SPLP Calcium	µg/L				12900 E	17200 E	20800 E
SPLP Chromium	µg/L	5000			ND (50)	ND (50)	ND (50)
SPLP Cobalt	µg/L	5000			ND (50)	ND (50)	ND (50)
SPLP Copper	µg/L	100000			ND (50)	ND (50)	0.967 J
SPLP Iron	µg/L				538	378	781
SPLP Lead	µg/L	5000			ND (50)	ND (50)	ND (50)
SPLP Magnesium	µg/L				21300	10400	5240
SPLP Manganese	µg/L				182	150	721
SPLP Mercury	µg/L	100			ND (0.2)	0.097J	0.065 J
SPLP Nickel	µg/L	20000			ND (50)	ND (50)	ND (50)
SPLP Potassium	µg/L				9980	3800	3640
SPLP Selenium	µg/L	1000			ND (100)	ND (100)	ND (100)
SPLP Silver	µg/L	5000			ND (50)	ND (50)	ND (50)
SPLP Metals-Continued							
SPLP Sodium	µg/L				215000 E	80300 E	44300 E
SPLP Thallium	µg/L				ND (100)	ND (100)	ND (100)

Table 2

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Parameters	Units	Criteria [1]	Criteria [3]	Criteria [4]	EST	BH	ASB
SPLP Vanadium	µg/L	10000			ND (50)	ND (50)	ND (50)
SPLP Zinc	µg/L	500000			65.1	111	180

Notes:
[1] Nova Scotia Environment and Labour Guidelines for Disposal of Contaminated Solids in Landfills, Acceptance Parameters for Contaminated Soil (Attachment B for Total Analysis and Attachment C for Leachate Results), 1992.
[2] Nova Scotia Environment (NSE) 2013 Tier 1 Environmental Quality Standards (EQSs) for Soil, Table 1A/1B, July 6, 2013.
[3] NSE 2013 Tier 1 EQSs for Sediment (Marine Sediment Values), Table 2, July 6, 2013.
[4] Canadian Council of Ministers of the Environment (CCME) Sediment Quality Guidelines for the Protection of Aquatic Life (Marine Probable Effect Levels) (http://www.ccme.ca/ - Online, 2018).
[5] Equilibrium Partitioning Sediment Benchmarks (ESBs) Approach for the Protection of Benthic Organisms (USEPA, 2003; DiToro et al., 2000; van Leeuwen and Vermeir, 2007). ESB calculation assumed a fraction of organic carbon content of 0.01 (1%) and fraction of solids being 0.5 (50%).
ND (x) - Not detected at reporting limit
J - Estimated value
E - Above Calibration Range
S.U. - Standard Units
TCLP - Toxicity Characteristic Leaching Procedure
SPLP - Synthetic Precipitation Leaching Procedure
q - Possible interference
B - Compound detected in blank
l - Estimated maximum possible concentration
(grey shading) - Exceeds Applicable Criteria

Table 3

Geotube Dewatering Rates - In the Wet
Laboratory Treatability Study
Boat Harbour Remediation Planning and Design
Nova Scotia Lands

Geotube Treatment	Date Setup	Volume in Geotube (L)	Volume after 24 hours (L)	Volume after 48 hours (L) (Cumulative)	Volume after 72 hours (L) (Cumulative)	Volume after 96 hours (L) (Cumulative)	Volume after 1 week (L) (Cumulative)
EST - 5% Solids-Lime and Polymer	1/5/2018	40	26.5				
EST - 5% Solids-Polymer Only	1/4/2018	40	26.5				
EST - 5% Solids-Control	1/4/2018	40	26.5				
BH - 5% Solids-Lime, Polymer, and 2% PAC	1/16/2018	40	21.2	21.3			
BH - 5% Solids-Lime, Polymer, and 2% RemBind Plus	1/15/2018	40	15.1	20	20.4		
BH - 5% Solids-Polymer Only	1/10/2018	40	17	22.7			
BH - 5% Solids-Control	1/10/2018	38.1	11.4				15
ASB - 5% Solids-Lime, Polymer, and 2% PAC	1/16/2018	39.1	13.2	15.2	16		
ASB - 5% Solids-Lime, Polymer, and 2% RemBind Plus	1/16/2018	35.3	9.5	12.1	13.3		
ASB - 5% Solids-Polymer Only	1/16/2018	40	14.2	16.4	17.3		
ASB - 5% Solids-Control	1/15/2018	37.2	5.7	9.5	11.1	11.9	

Notes:
PAC - Powdered Activated Carbon
Lime - Calcium Hydroxide added to reach pH 8-8.5 Standard Units
EST Polymer - 71301 at 600 ppm
BH Polymer - 8186 at 1000 ppm and 7768 at 150 ppm
ASB Polymer - 8186 at 1250 ppm and 7768 at 100 ppm

Table 4

Geotube Dewater Water Analyses - In the Wet
Laboratory Treatability Study
Boat Harbour Remediation Planning and Design
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Parameters	Units	Criteria [1]	EST - 5% Solids Control	EST - 5% Solids Polymer Only	EST - 5% Solids Lime and Polymer	BH - 5% Solids Control	BH - 5% Solids Polymer Only	BH - 5% Solids Lime, Polymer, and 2% PAC	BH - 5% Solids Lime, Polymer, and 2% RemBind Plus	ASB - 5% Solids Control	ASB - 5% Solids Polymer Only	ASB - 5% Solids Lime, Polymer, and 2% PAC	ASB - 5% Solids Lime, Polymer, and 2% RemBind Plus
pH	S.U.		7.7	7.19	6.68	8.15	7.89	8.47	8.25	8.57	8.41	8.84	8.44
Total Cyanide	µg/L	1	6.7 J	11	31	19	43	5.2 J	7.5 J	6.0 J	6.8 J	4.1 J	4.1 J
Total Petroleum Hydrocarbons													
Total Petroleum Hydrocarbons (C6-C10)	mg/L		ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
Total Petroleum Hydrocarbons (>C10-C16)	mg/L		ND (0.02)	5.7	4.7	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)
Total Petroleum Hydrocarbons (>C16-C21)	mg/L		0.602	0.042	0.043	3.61	0.843	0.303	1.57	1.26	1.36	0.198	0.715
Total Petroleum Hydrocarbons (>C21-C32)	mg/L		7.21	0.044	ND (0.02)	19.9	4.67	1.64	9.34	8.71	8.69	1.4	4.62
Total Petroleum Hydrocarbons - Modified - Tier 1	mg/L	0.1	7.81	5.79	4.74	23.5	5.51	1.94	10.9	9.97	10.1	1.6	5.34
Total Metals													
Total Aluminum	µg/L		7250	131	105	10800	2160	434	1670	9850	2650	848	2260
Total Antimony	µg/L	500	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)
Total Arsenic	µg/L	12.5	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)
Total Barium	µg/L	500	387	175	165	390	187	154	202	246	143	39.6	73.5
Total Beryllium	µg/L	100	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)
Total Cadmium	µg/L	0.12	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)
Total Calcium	µg/L		68300 E	67600 E	77500 E	55400 E	44800	49000 E	63900 E	67700 E	61900 E	49000 E	63800 E
Total Chromium	µg/L	56 (trivalent) [2]	ND (25)	ND (25)	ND (25)	21.7 J	ND (25)	ND (25)	ND (25)	74.6	25.8	ND (25)	ND (25)
Total Cobalt	µg/L		ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)
Total Copper	µg/L	2	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	50	ND (50)	ND (50)	22.6 J
Total Iron	µg/L		6230	157	ND (100)	9150	2860	210	1180	8140	2350	410	1110
Total Lead	µg/L	2	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)
Total Magnesium	µg/L		123000 E	125000 E	122000 E	69700 E	41100 E	53900 E	40800 E	25700 E	23300 E	11600 E	11900 E
Total Manganese	µg/L		972	845	526	2675	1890	882	1330	3320	2890	402	484
Total Mercury	µg/L	0.016	0.15 J	ND (0.2)	ND (0.2)	0.58	0.23	ND (0.2)	ND (0.2)	0.47	0.15 J	ND (0.2)	ND (0.2)
Total Nickel	µg/L	8.3	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)
Total Potassium	µg/L		86700 E	85300 E	82800 E	42400 E	26800 E	34500 E	26400 E	35300	31300 E	27000 E	27000 E
Total Selenium	µg/L	2	ND (100)	ND (100)	ND (100)	ND (100)	ND (100)	ND (100)	ND (100)	ND (100)	ND (100)	ND (100)	ND (100)
Total Silver	µg/L	1.5	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)
Total Sodium	µg/L		1790000 E	1820000 E	1790000 E	886000 E	531000 E	737000 E	513000 E	572000 E	516000 E	481000 E	473000 E
Total Thallium	µg/L	21.3	ND (100)	ND (100)	ND (100)	ND (100)	ND (100)	ND (100)	ND (100)	ND (100)	ND (100)	ND (100)	ND (100)
Total Vanadium	µg/L	50	24 J	ND (50)	ND (50)	101	20 J	ND (50)	21.4 J	79.5	34.7 J	26.4 J	27.9 J
Total Zinc	µg/L	10	187	ND (50)	ND (50)	729	90.8	31.4 J	82.8	528	197	41.1 J	87.8
Dissolved Metals													
Dissolved Aluminum	µg/L		423	62.8	82.5	206	72.4	82.9	70.3	559	153	228	501
Dissolved Antimony	µg/L	500	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)
Dissolved Arsenic	µg/L	12.5	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)
Dissolved Barium	µg/L	500	211	169	165	131	147	127	136	37.1	48.9	26	27
Dissolved Beryllium	µg/L	100	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)
Dissolved Cadmium	µg/L	0.12	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)
Dissolved Calcium	µg/L		70900 E	68900 E	78300 E	42800 E	43400 E	47700 E	60300 E	54400 E	57200 E	52010 E	49800 E
Dissolved Chromium	µg/L	56 (trivalent) [2]	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)	ND (25)
Dissolved Cobalt	µg/L		ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)
Dissolved Copper	µg/L	2	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)
Dissolved Iron	µg/L		784	ND (100)	ND (100)	280	ND (100)	ND (100)	ND (100)	404	ND (100)	ND (100)	ND (100)
Dissolved Lead	µg/L	2	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)
Dissolved Magnesium	µg/L		128000 E	124000 E	124000 E	64500 E	40600 E	51500 E	39100 E	23200 E	22700 E	11600 E	12200 E
Dissolved Manganese	µg/L		790	827	534	1390	1440	690	890	1675	2060	290	273
Dissolved Mercury	µg/L	0.016	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
Dissolved Nickel	µg/L	8.3	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)
Dissolved Potassium	µg/L		92000 E	84300 E	82100 E	39300 E	26800 E	32100 E	25100 E	32400 E	22700 E	26800 E	28100 E
Dissolved Selenium	µg/L	2	ND (100)	ND (100)	ND (100)	ND (100)	ND (100)	ND (100)	ND (100)	ND (100)	ND (100)	ND (100)	ND (100)
Dissolved Silver	µg/L	1.5	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)
Dissolved Metals-Continued													
Dissolved Sodium	µg/L		1900000 E	1820000 E	1780000 E	875000 E	539000 E	696000 E	498100 E	549000 E	505000 E	480000 E	496000 E
Dissolved Thallium	µg/L	21.3	ND (100)	ND (100)	ND (100)	ND (100)	ND (100)	ND (100)	ND (100)	ND (100)	ND (100)	ND (100)	ND (100)
Dissolved Vanadium	µg/L	50	ND (50)	ND (50)	ND (50)	43.4 J	ND (50)	ND (50)	ND (50)	42.7	18.7	23.8 J	20.3 J
Dissolved Zinc	µg/L	10	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)

Table 4

Geotube Dewater Water Analyses - In the Wet
Laboratory Treatability Study
Boat Harbour Remediation Planning and Design
Nova Scotia Lands

Parameters	Units	Criteria [(1)]	EST - 5% Solids Control	EST - 5% Solids Polymer Only	EST - 5% Solids Lime and Polymer	BH - 5% Solids Control	BH - 5% Solids Polymer Only	BH - 5% Solids Lime, Polymer, and 2% PAC	BH - 5% Solids Lime, Polymer, and 2% RemBind Plus	ASB - 5% Solids Control	ASB - 5% Solids Polymer Only	ASB - 5% Solids Lime, Polymer, and 2% PAC	ASB - 5% Solids Lime, Polymer, and 2% RemBind Plus
Dioxins and Furans													
2,3,7,8-TCDD	pg/L		ND (9.5)	ND (9.4)	ND (9.5)	110	25	2.0 Jq	15	120	29	5.1 J	14
1,2,3,7,8-PeCDD	pg/L		ND (47)	1.1 Jq	ND (47)	12 J	1.3 Jq	ND (47)	3.0 J	7.1 Jq	2.3 Jq	3.1 J	8.5 J
1,2,3,4,7,8-HxCDD	pg/L		ND (47)	ND (47)	ND (47)	1.9 J	1.1 Jq	ND (47) I	1.2 Jq	3.4 Jq	0.79 Jq	ND (47)	2.5 J
1,2,3,6,7,8-HxCDD	pg/L		ND (47)	ND (47)	ND (47)	35 J	6.3 J	1.1 J	4.2 J	12 Jq	3.7 Jq	0.66 Jq	7.5 J
1,2,3,7,8,9-HxCDD	pg/L		ND (47)	ND (47)	ND (47)	22 J	3.0 Jq	0.68 J	6.2 J	9.5 J	3.2 Jq	0.84 Jq	5.0 Jq
1,2,3,4,6,7,8-HpCDD	pg/L		ND (47)	ND (47)	ND (47)	44 J	14 Jq	2.6 J	23 J	92	30 J	6,4 J	15 Jq
OCDD	pg/L		1.1 JB	9.1 JqB	2.0 JBq	520 B	280 B	28 JB	62 JB	820	250 B	46 JB	150 B
2,3,7,8-TCDF	pg/L		ND (9.5)	ND (9.4)	ND (9.5)	1400	890	40	260	4900	1100	170	590
1,2,3,7,8-PeCDF	pg/L		ND (47)	ND (47)	ND (47)	14 J	7.1 J	ND (47)	ND (47)	24 J	4.8 J	ND (47)	2.8 Jq
2,3,4,7,8-PeCDF	pg/L		ND (47)	ND (47)	ND (47)	12 J	7.5 J	0.36 Jq	2.8 J	40 J	8.9 J	1.2 Jq	3.5 Jq
1,2,3,4,7,8-HxCDF	pg/L		ND (47)	ND (47)	ND (47)	ND (48)	ND (47)	ND (47)	ND (47)	5.3 J	ND (47)	ND (47)	ND (47)
1,2,3,6,7,8-HxCDF	pg/L		ND (47)	ND (47)	ND (47)	ND (48)	ND (47)	ND (47)	ND (47)	ND (47)	ND (47)	ND (47)	ND (47)
2,3,4,6,7,8-HxCDF	pg/L		ND (47)	ND (47)	ND (47)	ND (48)	ND (47)	ND (47)	ND (47)	3.5 J	ND (47)	ND (47)	ND (47)
1,2,3,7,8,9-HxCDF	pg/L		ND (47)	ND (47)	ND (47)	ND (48)	ND (47)	ND (47)	ND (47)	ND (47)	ND (47)	ND (47)	ND (47)
1,2,3,4,6,7,8-HpCDF	pg/L		ND (47)	ND (47)	ND (47)	6.1 JBq	2.8 JBq	ND (47)	1.5 JB	9.8 J	3.4 JB	1.8 JqB	4.0 JB
1,2,3,4,7,8,9-HpCDF	pg/L		ND (47)	ND (47)	ND (47)	ND (48)	ND (47)	ND (47)	ND (47)	ND (47)	ND (47)	1.7 JqB	ND (47)
OCDF	pg/L		ND (95)	2.2 JB	ND (95)	15 JB	5.0 JB	1.1 JSBq	ND (95)	24 JB	6.1 J1SB	6.0 JB	11 JB
TEQ	pg/L	120 [(3)]	0.00011	1.10	0.0002	275	121	6.39	46.8	643	147	26.1	85.1

Notes:
[(1)] Nova Scotia Environment (NSE) 2013 Tier 1 Environmental Quality Standards (EQSs) for Surface Water (Marine Water Values), Table 3, July 6, 2013.
[(2)] Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for the Protection of Aquatic Life (Marine Values)
[(3)] NSE 2013 Tier 1 EQSs for Groundwater (Potable Groundwater Values), Table 4, July 6, 2013.
ND (x) - Not detected at reporting limit
J - Estimated value
E - Above Calibration Range
PAC - Powdered Activated Carbon
Lime - Calcium Hydroxide added to reach pH 8-8.5 Standard Units
(grey shading) - Exceeds Applicable Criteria
S.U. - Standard Units
EST Polymer - 71301 at 600 ppm
BH Polymer - 8186 at 1000 ppm and 7768 at 150 ppm
ASB Polymer - 8186 at 1250 ppm and 7768 at 100 ppm

Table 5

Geotube Solids Analyses - In the Wet
Laboratory Treatability Study
Boat Harbour Remediation Planning and Design
Nova Scotia Lands

Parameters	Units	Criteria [(1)]	EST - 5% Solids Control	EST - 5% Solids Polymer Only	EST - 5% Solids Lime and Polymer	BH - 5% Solids Control	BH - 5% Solids Polymer Only	BH - 5% Solids Lime, Polymer, and 2% PAC	BH - 5% Solids Lime, Polymer, and 2% RemBind Plus	ASB - 5% Solids Control	ASB - 5% Solids Polymer Only	ASB - 5% Solids Lime, Polymer, and 2% PAC	ASB - 5% Solids Lime, Polymer, and 2% RemBind Plus
Percent Solids	%		47.7	36.5	34.8	16.4	34.0	24.6	25.9	10.0	18.5	20.2	19.9
TCLP Cyanide	mg/L	20	ND (0.01)	ND (0.01)	ND (0.01)	0.0089 J	ND (0.01)	ND (0.01)	0.0039 J	ND (0.01)	ND (0.01)	ND (0.01)	0.0046 J
TCLP Metals													
TCLP Aluminum	mg/L	500	0.538	0.521	0.48	0.412	0.532	0.645	0.37	0.233	0.285	0.481	0.216
TCLP Antimony	mg/L		ND (0.05)	ND (0.05)	ND (0.05)	0.00303 J	ND (0.05)	0.0045 J	0.00618 J	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
TCLP Arsenic	mg/L	5	ND (0.05)	ND (0.05)	0.00951 J	0.00407 J	ND (0.05)	0.00464 J	ND (0.05)	ND (0.05)	ND (0.05)	0.0108	0.00122
TCLP Barium	mg/L	100	0.230	0.305	0.293	0.784	0.656	0.803	0.943	0.626	0.667	0.765	0.718
TCLP Berylium	mg/L	10	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)
TCLP Cadmium	mg/L	0.5	0.000933 J	0.000897 J	0.000967 J	0.00363 J	0.00113 J	0.00343 J	0.00311 J	0.00102 J	ND (0.025)	0.00184 J	ND (0.025)
TCLP Calcium	mg/L		11.7 E	8.87	114 E	95.8	355 E	224 E	216 E	218 E	221 E	259 E	161 E
TCLP Chromium	mg/L	5	0.000106 J	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	0.000171 J	ND (0.025)	ND (0.025)	ND (0.025)
TCLP Cobalt	mg/L	5	0.00922 J	0.0114 J	0.00905 J	ND (0.05)	0.00261 J	0.000761 J	0.00219 J	ND (0.05)	ND (0.05)	ND (0.05)	0.0013 J
TCLP Copper	mg/L	100	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	0.0238	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
TCLP Iron	mg/L		1.04	15.5	10.6	4.02	8.72	0.538	0.150	0.749	1.7	0.422	0.101
TCLP Lead	mg/L	5	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	0.00971 J	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	0.00815 J	ND (0.05)
TCLP Magnesium	mg/L		51.9	44.4	38.3	19.4	16.7	23.5	25.9	7.62	8.34	8.86	8.42
TCLP Manganese	mg/L		4.49	4.29	4.78	4.66	8.41	4.81	5.31	6.1364	7.48512	6.46514	7.11874
TCLP Mercury	mg/L	0.1	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)
TCLP Nickel	mg/L	20	0.00826 J	0.011 J	0.00888 J	0.00848 J	0.0141 J	0.00551 J	0.00846 J	0.00558 J	0.00606 J	0.00296 J	0.00218 J
TCLP Potassium	mg/L		12.4	11.4	10.2	4.37	4.03	4.56	4.52	3.88	3.54	3.57	3.52
TCLP Selenium	mg/L	1	ND (0.1)	ND (0.1)	0.00442 J	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	0.0131 J	ND (0.1)	0.000487 J
TCLP Silver	mg/L	5	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
TCLP Sodium	mg/L		1470	1490	1480	1480 E	1440 E	1400 E	1500 E	1420 E	1370 E	1360 E	1440 E
TCLP Thallium	mg/L		0.0113 J	0.00204 J	0.0116 J	0.00686 J	0.00872 J	0.0254 J	ND (0.1)	0.0044 J	0.00503 J	0.0212 J	0.00177 J
TCLP Vanadium	mg/L	10	0.000351 J	0.000885 J	0.000654 J	0.0219 J	0.00155 J	0.00604 J	0.0103 J	0.0121 J	0.00857 J	0.00879 J	0.00584 J
TCLP Zinc	mg/L	500	0.908	0.512	0.788	1.94	1.52	1.64	2.38	1.42	1.07	1.52	0.964
TCLP Total Petroleum Hydrocarbons													
TCLP Total Petroleum Hydrocarbons (C6-C10)	mg/L		ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
TCLP Total Petroleum Hydrocarbons (>C10-C16)	mg/L		ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)
TCLP Total Petroleum Hydrocarbons (>C16-C21)	mg/L		0.0128 J	0.0190	0.0129 J	0.0476	0.005 J	ND (0.02)	ND (0.02)	0.062	0.05	ND (0.02)	ND (0.02)
TCLP Total Petroleum Hydrocarbons (>C21-C32)	mg/L		0.027	ND (0.02)	ND (0.02)	0.293	ND (0.02)	ND (0.02)	ND (0.02)	0.09	ND (0.02)	ND (0.02)	ND (0.02)
TCLP Total Petroleum Hydrocarbons - Modified - Tier 1	mg/L	1.5	0.0398	0.0190	0.0129 J	0.341	0.005 J	ND (0.02)	ND (0.02)	0.152	0.05	ND (0.02)	ND (0.02)
Dioxins and Furans													
2,3,7,8-TCDD	pg/g		0.55 Jq	0.76 Jq	0.92 J	81	72	33	39	100	90	46	62
1,2,3,7,8-PeCDD	pg/g		ND (4.9)	ND (5.9)	ND (6.5)	7.0 J	4.7 J	2.1 Jq	3.0 J	6.2 Jq	5.9 J	2.7 J	3.9 J
1,2,3,4,7,8-HxCDD	pg/g		0.25 J	ND (5.9)	0.23 Jq	1.6 Jq	0.90 Jq	0.60 Jq	0.89 Jq	3.3 Jq	2.9 J	0.65 Jq	1.5 J
1,2,3,6,7,8-HxCDD	pg/g		0.67 Jq	0.61 Jq	0.77 Jq	26	15	8.0 Jq	8.1 Jq	9.8 J	13 J	4.6 Jq	5.6 J
1,2,3,7,8,9-HxCDD	pg/g		0.54 Jq	0.66 J	0.53 Jq	18 J	9.2 J	4.2 Jq	5.6 J	10 J	10 J	3.7 J	5.0 J
1,2,3,4,6,7,8-HpCDD	pg/g		12	12	12	46	38	12	30	95	95	27	45
OCDD	pg/g		260 B	250 B	240 B	680 B	860 B	150 B	630	830	730 B	160 B	450 B
2,3,7,8-TCDF	pg/g		12	15	14	1300	2500	700	1100	3800	2600	2100	2400
1,2,3,7,8-PeCDF	pg/g		ND (4.9)	ND (5.9)	ND (6.5)	13 J	16	4.0 Jq	8.4 J	22 J	19	11 J	14
2,3,4,7,8-PeCDF	pg/g		ND (4.9)	ND (5.9)	ND (6.5)	12 J	24	5.4 J	11	35	25	18	21
1,2,3,4,7,8-HxCDF	pg/g		ND (4.9)	ND (5.9)	ND (6.5)	2.7 Jq	4.3 J	1.1 J	1.5 Jq	5.7 J	5.2 J	2.3 J	3.5 J
1,2,3,6,7,8-HxCDF	pg/g		ND (4.9)	ND (5.9)	ND (6.5)	ND (20)	0.88 Jq	ND (11)	ND (10)	ND (24)	ND (16)	0.76 Jq	ND (14)
2,3,4,6,7,8-HxCDF	pg/g		ND (4.9)	ND (5.9)	ND (6.5)	ND (20)	1.8 J	ND (11)	ND (10)	ND (24)	ND (16)	1.5 J	ND (14)
1,2,3,7,8,9-HxCDF	pg/g		ND (4.9)	ND (5.9)	ND (6.5)	ND (20)	ND (11)	ND (11)	ND (10)	ND (24)	ND (16)	ND (14)	ND (14)
1,2,3,4,6,7,8-HpCDF	pg/g		2.5 JB	1.9 JB	1.5 JBq	7.0 JB	7.1 JB	1.5 JBq	3.8 JB	11 JB	10 JB	2.6 JqB	6.0 JB
1,2,3,4,7,8,9-HpCDF	pg/g		ND (4.9)	ND (5.9)	ND (6.5)	ND (20)	ND (11)	ND (11)	ND (10)	ND (24)	ND (16)	ND (14)	ND (14)
OCDF	pg/g		4.3 JB	2.9 JB	3.3 JB	9.8 JBq	13 JB	3.1 JB	5.4 JBq	20 JB	18 JB	5.7 JB	10 JqB
TEQ	pg/g	4 [(2)]	2.07	2.55	2.63	230	343	110	160	509	374	270	319

Table 5

Geotube Solids Analyses - In the Wet
Laboratory Treatability Study
Boat Harbour Remediation Planning and Design
Nova Scotia Lands

Parameters	Units	Criteria [1]	EST - 5% Solids Control	EST - 5% Solids Polymer Only	EST - 5% Solids Lime and Polymer	BH - 5% Solids Control	BH - 5% Solids Polymer Only	BH - 5% Solids Lime, Polymer, and 2% PAC	BH - 5% Solids Lime, Polymer, and 2% RemBind Plus	ASB - 5% Solids Control	ASB - 5% Solids Polymer Only	ASB - 5% Solids Lime, Polymer, and 2% PAC	ASB - 5% Solids Lime, Polymer, and 2% RemBind Plus
TCLP Dioxins and Furans													
TCLP 2,3,7,8-TCDD	pg/L									ND (9.5)			
TCLP 1,2,3,7,8-PeCDD	pg/L									ND (47)			
TCLP 1,2,3,4,7,8-HxCDD	pg/L									ND (47)			
TCLP 1,2,3,6,7,8-HxCDD	pg/L									ND (47)			
TCLP 1,2,3,7,8,9-HxCDD	pg/L									ND (47)			
TCLP 1,2,3,4,6,7,8-HpCDD	pg/L									54			
TCLP OCDD	pg/L									1200			
TCLP 2,3,7,8-TCDF	pg/L									8.9			
TCLP 1,2,3,7,8-PeCDF	pg/L									ND (47)			
TCLP 2,3,4,7,8-PeCDF	pg/L									ND (47)			
TCLP 1,2,3,4,7,8-HxCDF	pg/L									ND (47)			
TCLP 1,2,3,6,7,8-HxCDF	pg/L									ND (47)			
TCLP 2,3,4,6,7,8-HxCDF	pg/L									ND (47)			
TCLP 1,2,3,7,8,9-HxCDF	pg/L									ND (47)			
TCLP 1,2,3,4,6,7,8-HpCDF	pg/L									7.9			
TCLP 1,2,3,4,7,8,9-HpCDF	pg/L									ND (47)			
TCLP OCDF	pg/L									39			
TCLP TEQ	pg/L	1500 [3]								1.63			
SPLP Cyanide	mg/L	20	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	0.0042 J	0.0032 J	ND (0.01)	0.0036 J	ND (0.01)	ND (0.01)
SPLP Metals													
SPLP Aluminum	mg/L	500	0.211	0.252	0.0736	0.613	0.0505	0.221	0.121	0.686	0.256	1.26	0.352
SPLP Antimony	mg/L		0.00614 J	ND (0.05)	0.00484 J	0.00372 J	0.0111 J	0.0116 J	0.0177 J	0.00279 J	0.0182 J	0.00179 J	0.00722 J
SPLP Arsenic	mg/L	5	0.00406 J	0.0178 J	0.00989 J	0.00985 J	0.0154 J	0.00958 J	0.00139 J	0.00437 J	0.00190 J	0.0161 J	0.00317 J
SPLP Barium	mg/L	100	0.100	0.098	0.0882	0.203	0.117	0.171	0.101	0.185	0.145	0.224	0.206
SPLP Berylium	mg/L	10	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)
SPLP Cadmium	mg/L	0.5	ND (0.025)	ND (0.025)	ND (0.025)	0.000122 J	ND (0.025)	ND (0.025)	ND (0.025)	0.000296 J	ND (0.025)	0.000149	ND (0.025)
SPLP Calcium	mg/L		69.9	66.9	72.2	20.4 E	49.3 E	9.77	32.4 E	14.3 E	22.8 E	6.13	15.1 E
SPLP Chromium	mg/L	5	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	ND (0.025)	0.00785 J	0.00105 J	0.00345 J	0.00212 J
SPLP Cobalt	mg/L	5	ND (0.05)	0.00249 J	0.0024 J	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
SPLP Copper	mg/L	100	ND (0.05)	0.0130 J	ND (0.05)	0.00830 J	ND (0.05)	ND (0.05)	ND (0.05)	0.0121 J	ND (0.05)	0.0188 J	0.0258 J
SPLP Iron	mg/L		0.363	1.04	0.114	1.00	0.0759 J	0.149	0.109	0.891	0.317	0.659	0.381
SPLP Lead	mg/L	5	ND (0.05)	ND (0.05)	ND (0.05)	0.0208 J	0.0121 J	0.0113 J	ND (0.05)	0.0167 J	0.00397 J	0.0233 J	0.0206 J
SPLP Magnesium	mg/L		52.3	45.1	25.5	9.13	8.66	5.47	10.6	2.65	3.51	1.07	2.44
SPLP Manganese	mg/L		1.87	2.64	2.03	0.288	0.675	0.0	0.107	0.456	0.671	0.14	0.237
SPLP Mercury	mg/L	0.1	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)
SPLP Nickel	mg/L	20	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
SPLP Potassium	mg/L		16.9	12.3	7.88	3.02	2.75	3.32	3.36	2.96	3.47	3.21	3.34
SPLP Selenium	mg/L	1	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	0.00668 J	ND (0.1)	ND (0.1)	ND (0.1)	0.00164 J	0.00346 J
SPLP Silver	mg/L	5	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
SPLP Sodium	mg/L		229	179	93.6	52.5 E	20.6 E	52.1 E	41.7 E	33.6 E	36.3 E	34.6 E	37.6 E
SPLP Thallium	mg/L		ND (0.1)	ND (0.1)	0.00514 J	ND (0.1)	ND (0.1)	0.00337 J	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
SPLP Vanadium	mg/L	10	0.00233 J	0.00191 J	0.00192 J	0.0144 J	0.00244 J	0.0135 J	0.00321 J	0.0187 J	0.0133 J	0.0621	0.0128 J
SPLP Zinc	mg/L	500	0.115	0.222	0.167	167	0.0247 J	0.0363 J	0.0341 J	0.149	0.0995	0.136	0.108
SPLP Total Petroleum Hydrocarbons													
SPLP Total Petroleum Hydrocarbons (C6-C10)	mg/L		ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
SPLP Total Petroleum Hydrocarbons (>C10-C16)	mg/L		ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)
SPLP Total Petroleum Hydrocarbons (>C16-C21)	mg/L		0.0240	ND (0.02)	ND (0.02)	0.899	0.03	0.022	ND (0.02)	0.314	0.253	0.157	0.097
SPLP Total Petroleum Hydrocarbons (>C21-C32)	mg/L		ND (0.02)	ND (0.02)	ND (0.02)	5.56	0.075	0.221	0.101	1.81	1.49	1.46	0.889
SPLP Total Petroleum Hydrocarbons - Modified - Tier 1	mg/L	1.5	0.0240	ND (0.02)	ND (0.02)	6.46	0.105	0.243	0.101	2.12	1.74	1.62	0.986

Table 5

Geotube Solids Analyses - In the Wet
Laboratory Treatability Study
Boat Harbour Remediation Planning and Design
Nova Scotia Lands

Parameters	Units	Criteria [1]	EST - 5% Solids Control	EST - 5% Solids Polymer Only	EST - 5% Solids Lime and Polymer	BH - 5% Solids Control	BH - 5% Solids Polymer Only	BH - 5% Solids Lime, Polymer, and 2% PAC	BH - 5% Solids Lime, Polymer, and 2% RemBind Plus	ASB - 5% Solids Control	ASB - 5% Solids Polymer Only	ASB - 5% Solids Lime, Polymer, and 2% PAC	ASB - 5% Solids Lime, Polymer, and 2% RemBind Plus
SPLP Dioxins and Furans													
SPLP 2,3,7,8-TCDD	pg/L									ND (9.5)			
SPLP 1,2,3,7,8-PeCDD	pg/L									ND (47)			
SPLP 1,2,3,4,7,8-HxCDD	pg/L									ND (47)			
SPLP 1,2,3,6,7,8-HxCDD	pg/L									ND (47)			
SPLP 1,2,3,7,8,9-HxCDD	pg/L									ND (47)			
SPLP 1,2,3,4,6,7,8-HpCDD	pg/L									16 JBq			
SPLP OCDD	pg/L									290 B			
SPLP 2,3,7,8-TCDF	pg/L									170			
SPLP 1,2,3,7,8-PeCDF	pg/L									ND (47)			
SPLP 2,3,4,7,8-PeCDF	pg/L									ND (47)			
SPLP 1,2,3,4,7,8-HxCDF	pg/L									ND (47)			
SPLP 1,2,3,6,7,8-HxCDF	pg/L									ND (47)			
SPLP 2,3,4,6,7,8-HxCDF	pg/L									ND (47)			
SPLP 1,2,3,7,8,9-HxCDF	pg/L									ND (47)			
SPLP 1,2,3,4,6,7,8-HpCDF	pg/L									ND (47)			
SPLP 1,2,3,4,7,8,9-HpCDF	pg/L									ND (47)			
SPLP OCDF	pg/L									9.7 HBq			
SPLP TEQ	pg/L	1500 [3]								17.2			

Notes:
[1] Nova Scotia Environment and Labour Guidelines for Disposal of Contaminated Solids in Landfills, Acceptance Parameters for Contaminated Soil (Attachment C for Leachate Results), 1992.
[2] Nova Scotia Environment (NSE) 2013 Tier 1 Environmental Quality Standards (EQSs) for Soil, Table 1A/1B, July 6, 2013.
[3] Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations (SOR/2005-149), Schedule 6 Hazardous Constituents Controlled Under Leachate Test and Regulated Limits
ND (x) - Not detected at reporting limit
J - Estimated value
E - Above Calibration Range
PAC - Powdered Activated Carbon
Lime - Calcium Hydroxide added to reach pH 8-8.5 Standard Units
S.U. - Standard Units
EST Polymer - 71301 at 600 ppm
BH Polymer - 8186 at 1000 ppm and 7768 at 150 ppm
ASB Polymer - 8186 at 1250 ppm and 7768 at 100 ppm
- Exceeds Applicable Criteria

Table 6

Dewater Water Treatment Testing Analyses - In the Wet
Laboratory Treatability Study
Boat Harbour Remediation Planning and Design
Nova Scotia Lands

Parameters	Units	Criteria (1)	BH - 5% Solids Lime, Polymer, and 2% PAC	ASB - 5% Solids Lime, Polymer, and 2% PAC
General Chemistry				
COD	mg/L		16	18
Total Cyanide	µg/L	1	ND (10)	ND (10)
Total Petroleum Hydrocarbons				
Total Petroleum Hydrocarbons (C6-C10)	mg/L		ND (0.01)	ND (0.01)
Total Petroleum Hydrocarbons (>C10-C16)	mg/L		ND (0.02)	ND (0.02)
Total Petroleum Hydrocarbons (>C16-C21)	mg/L		0.023	ND (0.02)
Total Petroleum Hydrocarbons (>C21-C32)	mg/L		0.155	ND (0.02)
Total Petroleum Hydrocarbons - Modified - Tier 1	mg/L	0.1	0.178	ND (0.02)
Total Metals				
Total Aluminum	µg/L		125	236
Total Antimony	µg/L	500	ND (50)	ND (50)
Total Arsenic	µg/L	12.5	ND (50)	ND (50)
Total Barium	µg/L	500	89.8	27.5 J
Total Beryllium	µg/L	100	ND (25)	ND (25)
Total Cadmium	µg/L	0.12	ND (25)	ND (25)
Total Calcium	µg/L		46300	41300
Total Chromium	µg/L	56 (trivalent) (2)	ND (25)	ND (25)
Total Cobalt	µg/L		ND (50)	ND (50)
Total Copper	µg/L	2	ND (50)	ND (50)
Total Iron	µg/L		ND (100)	ND (100)
Total Lead	µg/L	2	ND (50)	ND (50)
Total Magnesium	µg/L		63900	9520
Total Manganese	µg/L		458	73.0
Total Mercury	µg/L	0.016	ND (0.2)	ND (0.2)
Total Nickel	µg/L	8.3	ND (50)	ND (50)
Total Potassium	µg/L		32000	26800
Total Selenium	µg/L	2	ND (100)	ND (100)
Total Silver	µg/L	1.5	ND (50)	ND (50)
Total Sodium	µg/L		798000	528000
Total Thallium	µg/L	21.3	ND (100)	ND (100)
Total Vanadium	µg/L	50	ND (50)	ND (50)
Total Zinc	µg/L	10	ND (50)	ND (50)
Dissolved Metals				
Dissolved Aluminum	µg/L		107	224
Dissolved Antimony	µg/L	500	ND (50)	ND (50)
Dissolved Arsenic	µg/L	12.5	ND (50)	ND (50)
Dissolved Barium	µg/L	500	84.7	ND (50)
Dissolved Beryllium	µg/L	100	ND (50)	ND (25)
Dissolved Cadmium	µg/L	0.12	ND (25)	ND (25)
Dissolved Calcium	µg/L		51800	52500
Dissolved Chromium	µg/L	56 (trivalent) (2)	ND (25)	ND (25)
Dissolved Metals-Continued				
Dissolved Cobalt	µg/L		ND (50)	ND (50)
Dissolved Copper	µg/L	2	ND (50)	ND (50)
Dissolved Iron	µg/L		ND (100)	ND (100)

Table 6

Dewater Water Treatment Testing Analyses - In the Wet
Laboratory Treatability Study
Boat Harbour Remediation Planning and Design
Nova Scotia Lands

Parameters	Units	Criteria (1)	BH - 5% Solids Lime, Polymer, and 2% PAC	ASB - 5% Solids Lime, Polymer, and 2% PAC
Dissolved Lead	µg/L	2	ND (50)	ND (50)
Dissolved Magnesium	µg/L		67100	9970
Dissolved Manganese	µg/L		486	75.2
Dissolved Mercury	µg/L	0.016	ND (0.2)	ND (0.2)
Dissolved Nickel	µg/L	8.3	ND (50)	ND (50)
Dissolved Potassium	µg/L		36000	33000
Dissolved Selenium	µg/L	2	ND (100)	ND (100)
Dissolved Silver	µg/L	1.5	ND (50)	ND (50)
Dissolved Sodium	µg/L		835000	629000
Dissolved Thallium	µg/L	21.3	9.58 J	ND (100)
Dissolved Vanadium	µg/L	50	ND (50)	ND (50)
Dissolved Zinc	µg/L	10	ND (50)	ND (50)

Notes:

(1) Nova Scotia Environment (NSE) 2013 Tier 1 Environmental Quality Standards (EQSs) for Surface Water (Marine Water Values), Table 3, July 6, 2013.

(2) Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for the Protection of Aquatic Life (Marine Values) (http://www.ccme.ca/ - Online, 2018).

ND (x) - Not detected at reporting limit
J - Estimated value
E - Above Calibration Range
PAC - Powdered Activated Carbon
Lime - Calcium Hydroxide added to reach pH 8-8.5 Standard Units
- Exceeds Applicable Criteria
S.U. - Standard Units
BH Polymer - 8186 at 1000 ppm and 7768 at 150 ppm
ASB Polymer - 8186 at 1250 ppm and 7768 at 100 ppm

Table 7

Stabilization of Non-Dewatered Sediment - In the Wet
Laboratory Treatability Study
Boat Harbour Remediation Planning and Design
Nova Scotia Lands

Parameters	Units	Criteria [1]	ASB - 4.5% Liquisorb 2000
Percent Solids	%		12.8
Bulking	%		0
Density	g/mL		1.05
TCLP Cyanide	mg/L	20	ND (0.01)
TCLP Metals			
TCLP Aluminum	mg/L	500	8.64
TCLP Antimony	mg/L		ND (0.05)
TCLP Arsenic	mg/L	5	0.0111 J
TCLP Barium	mg/L	100	0.582
TCLP Berylium	mg/L	10	0.000128 J
TCLP Cadmium	mg/L	0.5	0.00659 J
TCLP Calcium	mg/L		77.3
TCLP Chromium	mg/L	5	0.0539
TCLP Cobalt	mg/L	5	0.00156 J
TCLP Copper	mg/L	100	0.0145 J
TCLP Iron	mg/L		22.2
TCLP Lead	mg/L	5	0.204
TCLP Magnesium	mg/L		6.10
TCLP Manganese	mg/L		3.67
TCLP Mercury	mg/L	0.1	0.00016 JB
TCLP Nickel	mg/L	20	ND (0.05)
TCLP Potassium	mg/L		4.20
TCLP Selenium	mg/L	1	ND (0.1)
TCLP Silver	mg/L	5	ND (0.05)
TCLP Sodium	mg/L		158
TCLP Thallium	mg/L		0.00733 J
TCLP Vanadium	mg/L	10	0.0363 J
TCLP Zinc	mg/L	500	1.36
TCLP Total Petroleum Hydrocarbons			
TCLP Total Petroleum Hydrocarbons (C6-C10)	mg/L		ND (0.01)
TCLP Total Petroleum Hydrocarbons (>C10-C16)	mg/L		ND (0.02)
TCLP Total Petroleum Hydrocarbons (>C16-C21)	mg/L		0.952
TCLP Total Petroleum Hydrocarbons (>C21-C32)	mg/L		5.57
TCLP Total Petroleum Hydrocarbons - Modified - Tier 1	mg/L	1.5	6.52
TCLP Dioxins and Furans			
TCLP 2,3,7,8-TCDD	pg/L		2.70
TCLP 1,2,3,7,8-PeCDD	pg/L		ND (51)
TCLP 1,2,3,4,7,8-HxCDD	pg/L		ND (51)
TCLP Dioxins and Furans - Continued			
TCLP 1,2,3,6,7,8-HxCDD	pg/L		ND (51)
TCLP 1,2,3,7,8,9-HxCDD	pg/L		ND (51)
TCLP 1,2,3,4,6,7,8-HpCDD	pg/L		5.3 J

Table 7

Stabilization of Non-Dewatered Sediment - In the Wet
Laboratory Treatability Study
Boat Harbour Remediation Planning and Design
Nova Scotia Lands

Parameters	**Units**	**Criteria [1]**	**ASB - 4.5% Liquisorb 2000**
TCLP OCDD	pg/L		37 JB
TCLP 2,3,7,8-TCDF	pg/L		110.00
TCLP 1,2,3,7,8-PeCDF	pg/L		ND (51)
TCLP 2,3,4,7,8-PeCDF	pg/L		ND (51)
TCLP 1,2,3,4,7,8-HxCDF	pg/L		ND (51)
TCLP 1,2,3,6,7,8-HxCDF	pg/L		ND (51)
TCLP 2,3,4,6,7,8-HxCDF	pg/L		ND (51)
TCLP 1,2,3,7,8,9-HxCDF	pg/L		ND (51)
TCLP 1,2,3,4,6,7,8-HpCDF	pg/L		ND (51)
TCLP 1,2,3,4,7,8,9-HpCDF	pg/L		ND (51)
TCLP OCDF	pg/L		11 JB
TCLP TEQ	pg/L	1500 [2]	13.8

Notes:
[1] Nova Scotia Environment and Labour Guidelines for Disposal of Contaminated Solids in Landfills, Acceptance Parameters for Contaminated Soil (Attachment C for Leachate Results), 1992.
[2] Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations (SOR/2005-149), Schedule 6 Hazardous Constituents Controlled Under Leachate Test and Regulated Limits
ND (x) - Not detected at reporting limit
J - Estimated value
E - Above Calibration Range
PAC - Powdered Activated Carbon
Lime - Calcium Hydroxide added to reach pH 8-8.5 Standard Units
[shaded] - Exceeds Applicable Criteria

Table 8

Surface Water Treatment Testing Analyses
Laboratory Treatability Study
Boat Harbour Remediation Planning and Design
Nova Scotia Lands

Parameters	Units	Criteria [1]	BH - pH>10 with Lime	BH - pH>10 with Lime 2% PAC	ASB - pH>10 with Lime	ASB - pH>10 with Lime 2% PAC
General Chemistry						
COD	mg/L		170	16	140	31
Total Cyanide	µg/L	1	ND (10)	ND (10)	ND (10)	ND (10)
Total Petroleum Hydrocarbons						
Total Petroleum Hydrocarbons (C6-C10)	mg/L		ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
Total Petroleum Hydrocarbons (>C10-C16)	mg/L		ND (0.02)	0.028	ND (0.02)	ND (0.02)
Total Petroleum Hydrocarbons (>C16-C21)	mg/L		0.025	0.0107	0.0104	ND (0.02)
Total Petroleum Hydrocarbons (>C21-C32)	mg/L		0.539	0.057	0.183	ND (0.02)
Total Petroleum Hydrocarbons - Modified - Tier 1	mg/L	0.1	0.564	0.068	0.193	ND (0.02)
Total Metals						
Total Aluminum	µg/L		786	280	944	399
Total Antimony	µg/L	500	ND (50)	ND (50)	ND (50)	ND (50)
Total Arsenic	µg/L	12.5	ND (50)	ND (50)	ND (50)	5.14 J
Total Barium	µg/L	500	40.6 J	46.6 J	23.9 J	61.3
Total Beryllium	µg/L	100	ND (25)	ND (25)	ND (25)	ND (25)
Total Cadmium	µg/L	0.12	ND (25)	ND (25)	ND (25)	ND (25)
Total Calcium	µg/L		38600	13600	29200	15900
Total Chromium	µg/L	56 (trivalent) [2]	23.0 J	ND (25)	22.5 J	ND (25)
Total Cobalt	µg/L		ND (50)	ND (50)	ND (50)	ND (50)
Total Copper	µg/L	2	ND (50)	ND (50)	1.96 J	ND (50)
Total Iron	µg/L		3000	3000	39900	5050
Total Lead	µg/L	2	93.3	ND (50)	103	ND (50)
Total Magnesium	µg/L		3740	2700	3410	2550
Total Manganese	µg/L		566	38.8	915	114
Total Mercury	µg/L	0.016	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
Total Nickel	µg/L	8.3	ND (50)	ND (50)	ND (50)	ND (50)
Total Potassium	µg/L		14300	12800	12600	13500
Total Selenium	µg/L	2	ND (100)	ND (100)	ND (100)	ND (100)
Total Silver	µg/L	1.5	ND (50)	ND (50)	ND (50)	ND (50)
Total Sodium	µg/L		275000	263000	246000	263000
Total Thallium	µg/L	21.3	ND (100)	ND (100)	ND (100)	ND (100)
Total Vanadium	µg/L	50	ND (50)	ND (50)	ND (50)	ND (50)
Total Zinc	µg/L	10	32.7 J	ND (50)	27.2 J	ND (50)

Table 8

Surface Water Treatment Testing Analyses
Laboratory Treatability Study
Boat Harbour Remediation Planning and Design
Nova Scotia Lands

Parameters	Units	Criteria [1]	BH - pH>10 with Lime	BH - pH>10 with Lime 2% PAC	ASB - pH>10 with Lime	ASB - pH>10 with Lime 2% PAC
Dissolved Metals						
Dissolved Aluminum	µg/L		146	192	155	248
Dissolved Antimony	µg/L	500	ND (50)	ND (50)	ND (50)	ND (50)
Dissolved Arsenic	µg/L	12.5	ND (50)	ND (50)	ND (50)	ND (50)
Dissolved Barium	µg/L	500	79.0	ND (50)	72.1	ND (50)
Dissolved Beryllium	µg/L	100	ND (25)	ND (25)	ND (25)	ND (25)
Dissolved Cadmium	µg/L	0.12	ND (25)	ND (25)	ND (25)	ND (25)
Dissolved Calcium	µg/L		29500	31000	24400	31000
Dissolved Chromium	µg/L	56 (trivalent) [2]	41.9	ND (25)	ND (25)	ND (25)
Dissolved Cobalt	µg/L		ND (50)	ND (50)	ND (50)	ND (50)
Dissolved Copper	µg/L	2	ND (50)	ND (50)	ND (50)	ND (50)
Dissolved Iron	µg/L		3530	ND (100)	3340	ND (100)
Dissolved Lead	µg/L	2	ND (50)	ND (50)	ND (50)	ND (50)
Dissolved Magnesium	µg/L		3240	3060	3240	2570
Dissolved Manganese	µg/L		280	ND (25)	280	ND (25)
Dissolved Mercury	µg/L	0.016	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
Dissolved Nickel	µg/L	8.3	ND (50)	ND (50)	ND (50)	ND (50)
Dissolved Potassium	µg/L		15300	17300	15600	16300
Dissolved Selenium	µg/L	2	ND (100)	ND (100)	ND (100)	ND (100)
Dissolved Silver	µg/L	1.5	ND (50)	ND (50)	ND (50)	ND (50)
Dissolved Sodium	µg/L		337000	347000	275000	250000
Dissolved Thallium	µg/L	21.3	ND (100)	ND (100)	ND (100)	ND (100)
Dissolved Vanadium	µg/L	50	ND (50)	ND (50)	ND (50)	ND (50)
Dissolved Zinc	µg/L	10	ND (50)	ND (50)	ND (50)	ND (50)

Notes:
[1] Nova Scotia Environment (NSE) 2013 Tier 1 Environmental Quality Standards (EQSs) for Surface Water (Marine Water Values), Table 3, July 6, 2013.
[2] Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for the Protection of Aquatic Life (Marine Values) (http://www.ccme.ca/ -
ND (x) - Not detected at reporting limit
J - Estimated value
E - Above Calibration Range
PAC - Powdered Activated Carbon
S.U. - Standard Units
- Exceeds Applicable Criteria

Table 9

Geotube Fabric Dewatering Rates - In the Dry
Laboratory Treatability Study
Boat Harbour Remediation Planning and Design
Nova Scotia Lands

Time	Volume for EST (L) Polymer 71301 at 2000 mg/kg	Volume for BH (L) Polymer 8186 at 2000 mg/kg Polymer 7768 at 1000 mg/kg	Volume for ASB (L) Polymer 8186 at 2500 mg/kg Polymer 7768 at 1500 mg/kg
10 min	100	192	140
20 min	150	234	175
30 min	175	260	200
40 min	190	280	220
50 min	200	300	240
60 min	210	316	250
90 min	255	346	276
120 min	275	366	292
150 min	285	-	315

Notes:
Volumes are cumulative

Table 10

Solidification Tests on Dewatered Sediment - In the Dry
Laboratory Treatability Study
Boat Harbour Remediation Planning and Design
Nova Scotia Lands

Parameters	Units	Criteria [1]	EST Control	EST - 2% PAC 5% PC	EST - 2% RemBind Lime	EST - 2% PAC Lime	BH Control	BH - 2% PAC 5% PC	BH - 2% RemBind Lime	BH - 2% PAC Lime
Percent Solids	%		30.4	38.7	32.3	32.3	12.8	19.4	13.8	14.9
Bulking	%		-	0	3.4	10.3	-	2.9	2.4	7.4
Density	g/mL		1.24	1.30	1.20	1.13	1.06	1.12	1.04	1.00
TCLP Cyanide	mg/L	20	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
TCLP Metals										
TCLP Aluminum	mg/L	500	0.381	5.08	0.306	0.506	0.409	5.92	0.618	0.314
TCLP Antimony	mg/L		0.0302 J	0.0164 J	ND (0.05)	ND (0.05)	0.00805 J	0.0159 J	0.00760 J	0.00213 J
TCLP Arsenic	mg/L	5	ND (0.05)	0.00985 J	ND (0.05)	ND (0.05)	0.00198 J	0.0117 J	ND (0.05)	0.00166 J
TCLP Barium	mg/L	100	0.247	0.814	0.596	0.699	0.600	1.16	0.709	0.748
TCLP Berylium	mg/L	10	ND (0.025)	0.000806 J	ND (0.025)	ND (0.025)	ND (0.025)	0.00116 J	ND (0.025)	ND (0.025)
TCLP Cadmium	mg/L	0.5	0.000567 J	0.00737 J	0.005.25 J	0.00715 J	0.00168 J	0.00813 J	0.00241 J	0.00200 J
TCLP Calcium	mg/L		45.7	981	73.5	69.1	88.3	976	110	97.7
TCLP Chromium	mg/L	5	ND (0.025)	0.0.0129 J	ND (0.025)	ND (0.025)	ND (0.025)	0.0110 J	ND (0.025)	ND (0.025)
TCLP Cobalt	mg/L	5	0.00429 J	0.0159 J	0.00411 J	0.00611 J	ND (0.05)	0.0107 J	ND (0.05)	0.000364 J
TCLP Copper	mg/L	100	ND (0.05)	0.0193 J	ND (0.05)	ND (0.05)	ND (0.05)	0.00449 J	ND (0.05)	ND (0.05)
TCLP Iron	mg/L		11.6	41.6	49.8	68.2	4.88	3.49	3.99	0.769
TCLP Lead	mg/L	5	ND (0.05)	0.00556 J	0.0805 J	0.144	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
TCLP Magnesium	mg/L		35.3	83.5	42.5	42.9	19.1	58.2	21.0	20.2
TCLP Manganese	mg/L		2.61	4.64	3.08	3.22	4.46	6.78	4.83	4.65
TCLP Mercury	mg/L	0.1	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)
TCLP Nickel	mg/L	20	0.00775 J	ND (0.05)	ND (0.05)	0.00951 J	0.00505 J	ND (0.05)	0.00346 J	0.00523 J
TCLP Potassium	mg/L		14.2	25.7	14.9	15.2	3.66	14.8	3.94	4.11
TCLP Selenium	mg/L	1	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	0.00356 J
TCLP Silver	mg/L	5	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
TCLP Sodium	mg/L		1350 E	212	1540 E	1580 E	1370 E	79.3	1530 E	1380 E
TCLP Thallium	mg/L		0.00408 J	ND (0.1)	ND (0.1)	0.00540 J	0.00213 J	ND (0.1)	ND (0.1)	0.00579 J
TCLP Vanadium	mg/L	10	0.0000853 J	0.0244 J	0.00470 J	0.00770 J	0.0178 J	0.0497 J	0.0177 J	0.0135 J
TCLP Zinc	mg/L	500	0.544	1.34	0.352	0.226	1.44	3.18	1.66	1.92
TCLP Total Petroleum Hydrocarbons										
TCLP Total Petroleum Hydrocarbons (C6-C10)	mg/L		ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
TCLP Total Petroleum Hydrocarbons (>C10-C16)	mg/L		ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)
TCLP Total Petroleum Hydrocarbons (>C16-C21)	mg/L		ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	0.11	ND (0.02)	ND (0.02)	ND (0.02)
TCLP Total Petroleum Hydrocarbons (>C21-C32)	mg/L		ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	0.599	ND (0.02)	ND (0.02)	ND (0.02)
TCLP Total Petroleum Hydrocarbons - Modified - Tier 1	mg/L	1.5	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	0.709	ND (0.02)	ND (0.02)	ND (0.02)

Notes:
[1] Nova Scotia Environment and Labour Guidelines for Disposal of Contaminated Solids in Landfills, Acceptance Parameters for Contaminated Soil (Attachment C for Leachate Results), 1992.
ND (x) - Not detected at reporting limit
J - Estimated value
E - Above Calibration Range
PAC - Powdered Activated Carbon
Lime - Calcium Hydroxide added to reach pH 8-8.5 Standard Units

Table 10

Solidification Tests on Dewatered Sediment - In the Dry
Laboratory Treatability Study
Boat Harbour Remediation Planning and Design
Nova Scotia Lands

Parameters	Units	Criteria [1]	ASB Control	ASB - 2% PAC 5% PC	ASB - 2% RemBind Lime	ASB - 2% PAC Lime
Percent Solids	%		12.5	19.6	13.4	19.0
Bulking	%		-	0.0	1.0	2.3
Density	g/mL		1.02	1.05	1.02	0.97
TCLP Cyanide	mg/L	20	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
TCLP Metals						
TCLP Aluminum	mg/L	500	0.164	5.24	0.43	0.875
TCLP Antimony	mg/L		0.00920 J	0.0214 J	0.00302 J	0.000274 J
TCLP Arsenic	mg/L	5	ND (0.05)	0.00389 J	ND (0.05)	ND (0.05)
TCLP Barium	mg/L	100	0.415	0.914	0.532	0.464
TCLP Berylium	mg/L	10	ND (0.025)	0.000139 J	ND (0.025)	ND (0.025)
TCLP Cadmium	mg/L	0.5	ND (0.025)	0.00360 J	0.000604 J	ND (0.025)
TCLP Calcium	mg/L		142	1020	169	145
TCLP Chromium	mg/L	5	0.000680 J	0.187	0.000815 J	0.0637
TCLP Cobalt	mg/L	5	0.00101 J	0.00820 J	0.000921 J	ND (0.05)
TCLP Copper	mg/L	100	ND (0.05)	0.186	ND (0.05)	0.0395 J
TCLP Iron	mg/L		5.63	5.76	3.04	1.63
TCLP Lead	mg/L	5	0.0124 J	0.0596	0.0151 J	0.0104 J
TCLP Magnesium	mg/L		8.54	49.0	10.9	8.86
TCLP Manganese	mg/L		6.09	8.58	7.37	6.19
TCLP Mercury	mg/L	0.1	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)
TCLP Nickel	mg/L	20	0.00367 J	ND (0.05)	0.00481 J	0.0199 J
TCLP Potassium	mg/L		3.30	15.9	4.29	3.62
TCLP Selenium	mg/L	1	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
TCLP Silver	mg/L	5	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
TCLP Sodium	mg/L		1310 E	54.2	1570 E	1410 E
TCLP Thallium	mg/L		0.00593 J	ND (0.1)	0.00647 J	0.00287 J
TCLP Vanadium	mg/L	10	0.00396 J	0.0244 J	0.00914 J	0.00389 J
TCLP Zinc	mg/L	500	0.796	2.30	1.28	0.811
TCLP Total Petroleum Hydrocarbons						
TCLP Total Petroleum Hydrocarbons (C6-C10)	mg/L		ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
TCLP Total Petroleum Hydrocarbons (>C10-C16)	mg/L		ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)
TCLP Total Petroleum Hydrocarbons (>C16-C21)	mg/L		0.03	ND (0.02)	ND (0.02)	ND (0.02)
TCLP Total Petroleum Hydrocarbons (>C21-C32)	mg/L		0.16	ND (0.02)	0.071	ND (0.02)
TCLP Total Petroleum Hydrocarbons - Modified - Tier 1	mg/L	1.5	0.19	ND (0.02)	0.071	ND (0.02)

Notes:
[1] Nova Scotia Environment and Labour Guidelines for Disposal of Contaminated Solids in
ND (x) - Not detected at reporting limit
J - Estimated value
E - Above Calibration Range
PAC - Powdered Activated Carbon
Lime - Calcium Hydroxide added to reach pH 8-8.5 Standard Units

Table 11

Solidification Tests on Sediment as Received - In the Dry
Laboratory Treatability Study
Boat Harbour Remediation Planning and Design
Nova Scotia Lands

Parameters	Units	Criteria (1)	EST - 3% Liquisorb 2000	EST - 3% Liquisorb 2000 2% PAC	BH - 3% Liquisorb 2000	BH - 3% Liquisorb 2001 2% PAC	ASB - 3% Liquisorb 2000	ASB - 3% Liquisorb 2000 2% PAC
Percent Solids	%		29.6	31.4	15.4	27.8	16.0	17.2
Bulking	%		0	1	0	3	6	11.0
Density	g/mL		1.18	1.18	1.02	1.10	0.97	0.99
TCLP Cyanide	mg/L	20	ND (0.01)	ND (0.01)	ND (0.01)	0.00041 J	0.00049 J	0.00042 J
TCLP Metals								
TCLP Aluminum	mg/L	500	4.33	4.89	8.66	7.33	5.62	4.44
TCLP Antimony	mg/L		0.00721 J	0.0345 J	0.00978 J	0.00196 J	0.00138 J	0.00335 J
TCLP Arsenic	mg/L	5	ND (0.05)	ND (0.05)	0.0193 J	0.0351 J	ND (0.05)	ND (0.05)
TCLP Barium	mg/L	100	0.639	0.564	0.612	0.509	0.485	0.397
TCLP Berylium	mg/L	10	ND (0.025)	ND (0.025)	0.000346 J	0.000298 J	ND (0.025)	ND (0.025)
TCLP Cadmium	mg/L	0.5	0.00985 J	0.00971 J	0.00522 J	ND (0.025)	0.00439 J	0.00346 J
TCLP Calcium	mg/L		50.0	42.7	97.6	169	187.0	141
TCLP Chromium	mg/L	5	0.00562 J	0.00368 J	0.0102 J	ND (0.025)	0.0277 J	0.0181 J
TCLP Cobalt	mg/L	5	0.00158 J	0.000921 J	0.00373 J	ND (0.05)	0.00260 J	0.00150 J
TCLP Copper	mg/L	100	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
TCLP Iron	mg/L		84.6	75.3	35.7	429	0.941	38.4
TCLP Lead	mg/L	5	0.176	0.156	0.129	0.153	0.125	0.106
TCLP Magnesium	mg/L		41.2	38.6	23.3	13.4	10.8	8.35
TCLP Manganese	mg/L		2.10	2.05	4.33	5.20	6.90	5.30
TCLP Mercury	mg/L	0.1	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
TCLP Nickel	mg/L	20	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
TCLP Potassium	mg/L		14.9	15.1	5.20	3.88	5.23	4.03
TCLP Selenium	mg/L	1	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
TCLP Silver	mg/L	5	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
TCLP Sodium	mg/L		17120 E	1650 E	1670 E	1420 E	1620 E	1370 E
TCLP Thallium	mg/L		ND (0.1)	ND (0.1)	0.00769 J	0.0136 J	ND (0.1)	0.00447 J
TCLP Vanadium	mg/L	10	0.0356 J	0.0200 J	0.0479 J	0.0248 J	0.0206 J	0.008672 J
TCLP Zinc	mg/L	500	0.156	0.148	1.12	0.607	0.800	0.830
TCLP Total Petroleum Hydrocarbons								
TCLP Total Petroleum Hydrocarbons (C6-C10)	mg/L		ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
TCLP Total Petroleum Hydrocarbons (>C10-C16)	mg/L		1.2	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)
TCLP Total Petroleum Hydrocarbons (>C16-C21)	mg/L		0.062	0.065	1.29	0.164	0.35	0.227
TCLP Total Petroleum Hydrocarbons (>C21-C32)	mg/L		1.05	0.94	6.74	1.01	2.25	1.68
TCLP Total Petroleum Hydrocarbons - Modified - Tier 1	mg/L	1.5	2.31	1.01	8.03	1.17	2.6	1.91
TCLP Dioxins and Furans								
TCLP 2,3,7,8-TCDD	pg/L				ND (10)			
TCLP 1,2,3,7,8-PeCDD	pg/L				ND (50)			
TCLP 1,2,3,4,7,8-HxCDD	pg/L				ND (50)			
TCLP 1,2,3,6,7,8-HxCDD	pg/L				ND (50)			
TCLP 1,2,3,7,8,9-HxCDD	pg/L				ND (50)			
TCLP 1,2,3,4,6,7,8-HpCDD	pg/L				3.6 J			
TCLP OCDD	pg/L				16 JqB			
TCLP 2,3,7,8-TCDF	pg/L				26			
TCLP 1,2,3,7,8-PeCDF	pg/L				ND (50)			
TCLP 2,3,4,7,8-PeCDF	pg/L				ND (50)			

Table 11

Solidification Tests on Sediment as Received - In the Dry
Laboratory Treatability Study
Boat Harbour Remediation Planning and Design
Nova Scotia Lands

Parameters	**Units**	**Criteria [1]**	**EST - 3% Liquisorb 2000**	**EST - 3% Liquisorb 2000 2% PAC**	**BH - 3% Liquisorb 2000**	**BH - 3% Liquisorb 2001 2% PAC**	**ASB - 3% Liquisorb 2000**	**ASB - 3% Liquisorb 2000 2% PAC**
Percent Solids	%		29.6	31.4	15.4	27.8	16.0	17.2
Bulking	%		0	1	0	3	6	11.0
Density	g/mL		1.18	1.18	1.02	1.10	0.97	0.99
TCLP Cyanide	mg/L	20	ND (0.01)	ND (0.01)	ND (0.01)	0.00041 J	0.00049 J	0.00042 J
TCLP 1,2,3,4,7,8-HxCDF	pg/L				ND (50)			
TCLP 1,2,3,6,7,8-HxCDF	pg/L				ND (50)			
TCLP 2,3,4,6,7,8-HxCDF	pg/L				ND (50)			
TCLP 1,2,3,7,8,9-HxCDF	pg/L				ND (50)			
TCLP 1,2,3,4,6,7,8-HpCDF	pg/L				ND (50)			
TCLP 1,2,3,4,7,8,9-HpCDF	pg/L				ND (50)			
TCLP OCDF	pg/L				2.6 JqB			
TCLP TEQ	pg/L	1500 [2]			2.64			

Notes:
[1] Nova Scotia Environment and Labour Guidelines for Disposal of Contaminated Solids in Landfills, Acceptance Parameters for Contaminated Soil (Attachment C for Leachate Results), 1992.
(2) Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations (SOR/2005-149), Schedule 6 Hazardous Constituents Controlled Under Leachate Test and Regulated Limits
ND (x) - Not detected at reporting limit
J - Estimated value
E - Above Calibration Range
PAC - Powdered Activated Carbon
Lime - Calcium Hydroxide added to reach pH 8-8.5 Standard Units
- Exceeds Applicable Criteria

Appendices

Appendix A
Treatability Testing Photographs

Photo 1: Mixing of sample with amendments for geotube

Photo 2: Geotube filling

Treatability Testing Photographs

Photo 3: Geotube filling

Photo 4: Geotube dewatering

Treatability Testing Photographs

Photo 5: Geotube dewatering

Photo 6: Geotube dewatering

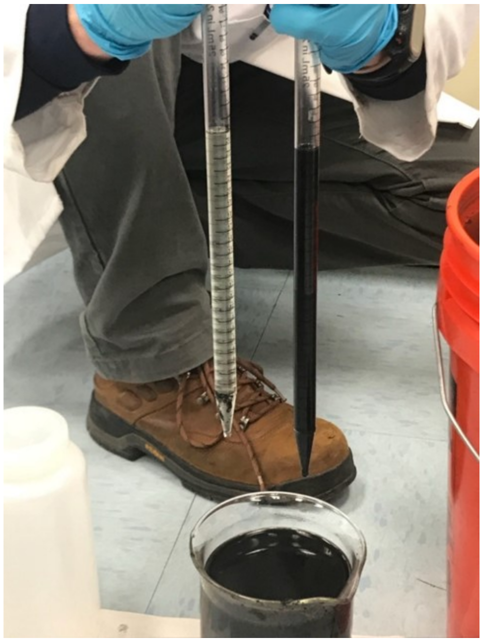

Photo 7: Water clarity before (right) and after (left) geotube

Photo 8: Dewatered geotubes

Treatability Testing Photographs

Photo 9: Dewatered solids from geotube

Photo 10: Dewatered solids from geotube

Photo 11: Samples after gravity dewatering

Photo 12: Samples after gravity dewatering

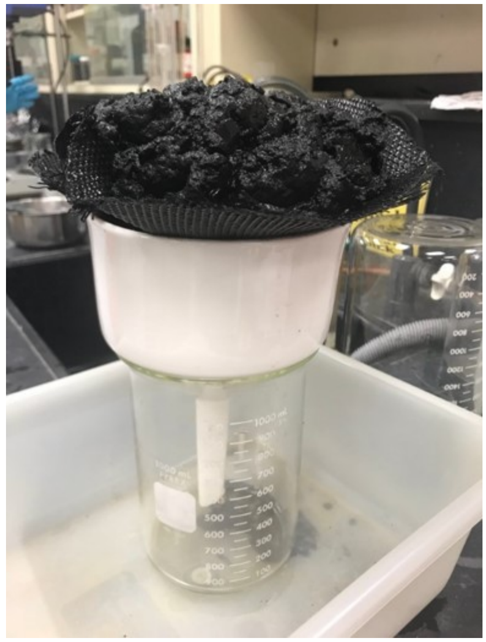

Photo 13: Samples after fabric dewatering

Photo 14: Samples after fabric dewatering

Photo 15: Sample before Liquisorb 2000

Photo 16: Sample after Liquisorb 2000

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