# Long Term Maintenance and Monitoring Plan

Sydney Tar Ponds and Coke Ovens
Remediation Project
Open Hearth Park and Harbourside East
Sydney, Nova Scotia

NSLands
nova scotia lands

Nova Scotia Lands. Inc.
Province of Nova Scotia

## REVISION SUMMARY

| Revision | NSE Approval (Date) | Date of Issue | Comments |
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NOTES:

- LTMM Plan to be reviewed annually by April 1 of each year.
- Nova Scotia Environment to review document prior to any re-issue.

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## 1.0 INTRODUCTION

This Long Term Maintenance and Monitoring Plan (LTMM) provides guidance for the long-term Maintenance and Monitoring of the former Tar Ponds and Coke Ovens sites located in Sydney, Nova Scotia. Implementation of the plan will follow the completion for the Sydney Tar Ponds and Coke Ovens Remediation Project that began in fall 2006 and was completed in summer 2013. The majority of work proposed under the future land use plan, was completed by September 2013 and the remaining work will be completed in spring 2014.

A fully integrated iron and steel plant was established in Sydney, Nova Scotia in 1899 and operated for approximately 90 years, at which time it was converted to a "mini mill" based on electric arc furnace technology. The steel plant ceased operations in 2000.

The coke ovens operations were operational between 1901 and 1988 and provided coke for the steel manufacturing, producing by-products such as coal, tar and benzene that were used for manufacturing industrial products. Historic use of the site and waste management practices (i.e. storage of tar in tanks and lagoons, disposal of wastewater to brooks and nearby estuary, backfilling/land reclamation practices) resulted in significant impacts to soil, groundwater, and sediment in Muggah Creek (the "Tar Ponds").

During the 20$^{th}$ century, approximately 60% of Muggah Creek and a portion of Sydney Harbour were infilled with industrial byproducts such as slag to create 70 hectares of land. The Muggah Creek Tidal Estuary (at the onset of the Remediation Project) was estimated to be 34 hectares and contained 700,000 tonnes of polycyclic aromatic hydrocarbon- (PAH) and metals-impacted sediment, with 5% of the sediment containing polychlorinated biphenyls (PCBs) above regulatory guidelines.

The Sydney Tar Ponds and Coke Ovens Remediation Project included the use of solidification and stabilization (S/S) techniques to physically encapsulate contaminants, capping of contaminated material on both the Coke Ovens and Tar Ponds sites; construction of watercourses, and installation of groundwater collection and treatment systems. The project divided into the following Project Elements:

- Cooling Pond Treatment (CPT) - S/S of the Cooling Pond and a pilot test in the North and South Ponds to demonstrate the effectiveness of the treatment process.
- Flow Diversion (TP6A) – the diversion of sources of Coke Ovens Brook and Wash Brook entering the Tar Ponds using temporary pumping facilities and cut-off walls.
- S/S and Channel Construction (TP6B) – In-situ S/S treatment of sediment in the Tar Ponds and construction of new channels.
- Ferry Street Bridge Construction (TP6C) – Construction of a new bridge and widening the channel opening.
- Access Road Construction (TP6D) – Creation of access roads around the Tar Ponds for transportation during work activities.
- Material Processing Facility (TP2) – Washing facility for materials removed from the Tar Ponds and equipment/vehicles used on site.
- Tar Ponds Surface Cap (TP7) – The installation of a multi-layered cap following the completion of S/S treatment at the Tar Ponds.
- Coke Ovens Brook Connector Sediment Removal and Disposal (CO1) – The removal of impacted sediments from the Coke Ovens Brook Connector and protection from ongoing contaminant sources from the former Sysco site.

- Tar Cell Solidification/Stabilization (CO2) – The excavation of contaminated material, S/S treatment and off-site placement.
- Vertical Cut-off Walls (CO5) – Cut-off walls were constructed to manage impacted groundwater flow within the Coke Ovens and prevent clean groundwater from entering impacted areas.
- Coke Ovens Surface Cap (CO6) – The installation of an engineered low permeability cap over the Coke Ovens site.
- Coke Ovens Brook Water Treatment Plant & Groundwater Collection System (CO7/CO8) – A collection system was installed to divert impacted groundwater to the water treatment plant for treatment prior to release to the environment.

Work was managed and implemented by the Sydney Tar Ponds Agency (STPA) with the goals of reducing risks (health and ecological) to the area residents and the environment from known soil, sediment and water contamination, and increasing the development potential of the land to encourage economic investment in the Cape Breton Regional Municipality (CBRM). The STPA will relinquish management of the site to Nova Scotia Lands Inc. (NSLI) upon completion of remedial and development activities.

Environmental Effects Monitoring (EEM) occurred throughout the project to assess impacts (positive and negative) on Valued Ecosystem Components (VEC), including: surface water (regional surface water resources, flow patterns and hydrology); groundwater (geology, hydraulic properties, flow patterns and contaminant distribution); marine ecosystems; and air quality. Cap maintenance was also included since the EEM will be superseded by the LTMM that will be in place for a minimum of 25 years following the completion of remedial activities. The objective of the LTMM is to provide ongoing data for:

- Long term management and maintenance of the Sydney Tar Ponds and Coke Ovens sites; and
- Assessment of compliance commitments to regulatory authorities and other stakeholders.

The Tar Ponds site has been redeveloped into Open Hearth Park. The Park was opened to the general public in September 2013, with the exception of the northern portion, which is expected to be opened in spring 2014. The Coke Ovens site is being redeveloped as part of the Harbourside Commercial Park and has been designated Harbourside East.

## 2.0 ABOUT THE LTMM

### 2.1 Administrative Provenance

The Government of Canada and the Province of Nova Scotia entered into an agreement on March 30, 2012 to provide for future on-going maintenance and monitoring of the Tar Ponds and Coke Ovens Sites (henceforth referred to as Open Hearth Park and Harbourside East, respectively) on or before the completion of all remediation and associated activities. The LTMM Agreement provides detailed administrative and operational provisions for the ongoing long-term maintenance and monitoring of all completed Project Works.

Among other things, the Agreement defines Canada's funding commitment and requires Nova Scotia to hold these funds and make payments for Canada's share of costs for 25 years following Project completion. The Agreement also specifies reporting requirements on the part of Nova Scotia, defines accounting principles and protocols in relation to the expenditure of the federal commitment and generally describes project works subject to the Agreement including:

1. Cap / Monolith Monitoring: Monolith, Battery Point Barrier and Channel(s);
2. Water Quality Monitoring: Surface and Groundwater;
3. Regulatory Monitoring: NSE Permit terms and conditions and any others that may arise;
4. Cap Maintenance: Voids, Maintenance of community open space and Erosion Control;
5. Site Covenants: Construction on Harbourside East and intrusive activities on Open Hearth Park; and,
6. Reporting Requirements.

This LTMM plan complies with the terms, conditions and requirements as laid out in the Agreement, found in Appendix A. The plan incorporates all government partner long-term Maintenance and Monitoring commitments pursuant to Joint Review Panel recommendations. The federal commitment to LTMM is also predicated in part on the Canadian government's regulatory obligations pursuant to the Follow Up provisions of the Canadian Environmental Assessment Act, and LTMM provisions respecting environmental quality monitoring and long term Project efficacy reflect this. Commitments and inclusions regarding LTMM are also guided by government responses to Panel recommendations, by the provincial Environmental Assessment Conditions of Approval, by commitments contained in the Project environmental management and environmental protection plans (EMPs and EPPs) and as a result of Part V Approvals issued by Nova Scotia Environment (NSE) in respect of the Project. The following table summarizes the commitments for monitoring requirements and approvals, as well as all updates approved since the original documentation was completed.

**Table 2-1:**
**LTMM Commitments**

## Table 2-1: Long Term Monitoring and Maintenance Program Summary

| RECOMMENDATION/ACTIVITY | DISCUSSION |
|---|---|
| Panel Recommendation #10: Cap Monitoring Program Addressed in EPP - Monitoring Program to include criteria, frequency, methods, locations, reporting, response and cessation protocols | Addressed in Section 4.1 of LTMM |
| Panel Recommendation #15: Long-term Aquatic Biodiversity Monitoring Study - Addressed in Avifauna study | Not addressed in LTMM |
| Panel Recommendation #18: Ecological Risk Assessment - Not covered in COA or EPP | Not addressed in LTMM |
| Panel Recommendation #19: Long-term Monitoring of Sydney Harbor - Not covered in COA or EPP | Addressed in Section 5.2 of LTMM |
| Panel Recommendation #43: Maintenance of Community Open Space Land Use - Management Plan will address operation and maintenance requirements of trails and open space | Addressed in Section 4.5 of LTMM |
| Panel Recommendation #45: Property Value Protection Program - Addressed in NSLI Property Value Protection Program. Program to be updated as per NSE requirements | Not addressed in LTMM |
| Panel Recommendation #50: Maintenance and Monitoring – Long Term Monitoring and Maintenance Program to be approved by NSE | Addressed by NSE Approval pursuant to Activities Designation Regulations |
| Panel Recommendation #51: Ownership of Remediated Lands - Province to take ownership of lands upon completion | Addressed in Section 2.1 of the LTMM |
| Panel Recommendation #52: Approval of Monitoring Program - LTMM plan to be developed and approved by NSE. | Addressed by LTMM document and NSE Approval |
| EMP Section 7.6: Long term monitoring programs for Cap Monitoring and Maintenance and Groundwater Monitoring, both to continue for twenty-five (25) years and include frequency, methodologies, sampling sites and parameters to be sampled | Addressed in Sections 4.1 and 4.4 of LTMM |
| EPP Section 4.6.2: Groundwater monitoring program that includes criteria, frequency, methods, locations, reporting, response and cessation protocols | Addressed in Section 4.4 of LTMM |
| EPP Section 4.6.3: Marine Environment Monitoring | Addressed in Section 5.2 of LTMM |
| EPP Section 4.6.1: Surface water monitoring program that includes criteria, frequency, methods, locations, reporting, response and cessation protocols | Addressed in Section 4.2 of LTMM |

The LTMM will aid in early identification of issues that fall outside of the requirements of the Agreement such as the potential discovery of the occurrence of significant contamination in or on the sites not known to exist, or due to circumstances not foreseen by, the Parties or a catastrophic impairment of the Project due to natural factors (e.g. major storms, tsunamis, storm surge, seismic activity, etc.). This may also include work, over and above the work set forth in

the Project Description, which may by law, regulation or mandatory directive be required to be performed as a result of issues identified over the course of the inspection protocols of the LTMM program.

## 2.2 Effective Date

The Province will assume responsibility for all groundwater and surface water monitoring under the LTMM plan in 2014. The site will be monitored by trained provincial staff or their designates, on a continuous basis in addition to the scheduled inspections identified in the LTMM plan. Prior to final completion of the Sydney Tar Ponds and Coke Ovens Remediation Project, the Agreement provides for interim federal funding for maintenance of completed site works, cap monitoring, and environmental monitoring.

## 2.3 Organization of the LTMM

The LTMM is organized into the following sections:

Section 1.0 provides background information related to the Sydney Tar Ponds and Coke Ovens Remediation Project.

Section 2.0 provides administrative context for the LTMM including its origins and purpose.

Section 3.0 provides a description of the roles and responsibilities of NSLI personnel, and presents training and orientation requirements for all Site personnel.

Section 4.0 provides an overall description of the LTMM provisions, including inspections, sampling, trending and documentation.

Section 5.0 provides a discussion of alterations made to the LTMM program as originally provided in STPA documentation.

Sections 6.0 and 7.0 provide information on Quality Assurance and Quality Control (QA/QC), and Health and Safety Plans, respectively, for the LTMM.

## 2.4 Purpose of the LTMM

The purpose of the LTMM is to monitor the post-remediation conditions of Open Hearth Park and Harbourside East. Monitoring will consist of the following activities:

- Inspections to ensure that engineering caps constructed over S/S or other impacted material is in good condition and not deteriorating. The caps must divert precipitation and provide a barrier to direct contact between humans and ecological receptors on the one hand and contaminated materials on the other so that risks to human health or the environment are mitigated. Cap inspections will include monitoring for signs of subsidence or frost heaving; erosion rills; unvegetated areas; unauthorized excavation; soft spots; signs of distressed vegetation; shoreline shift and erosion monitoring; seeps; and odours.
- Inspections to ensure that signs of S/S material failure are identified prior to significant issues occurring. Cap inspection is the main source of information to determine the condition of the S/S material. If ongoing or significant issues are present with the cap and any cover material, geotechnical evaluation will be required to assess the S/S

material itself. Monitoring information is available in Table 4-1 and Appendix B (Section 6.7 of the Environmental Contingency Plan).

- Surface water monitoring and sampling to provide both analytical data related to water quality and an opportunity for visual inspection of surface water bodies. Water quality results will be compared to screening criteria to assess risk to aquatic life and will also be used to track quality trends to determine the efficacy of remedial activities (refer to Section 4.2). Inspections of surface water bodies during sampling can identify issues that may not be identified by reviewing analytical results, including the physical improvement of the water body or potential for flooding. Adjustments will be made to the monitoring programs based on information gathered during sampling and monitoring and upon regulatory approval.
- Groundwater monitoring and sampling to provide water quality data that will be compared to screening criteria to evaluate potential environmental impacts and measure trends in groundwater quality (refer to Section 4.4). Water level measurements will also be taken to determine if groundwater conditions change as a result of the remediation project, which will in turn allow potential changes in groundwater flow directions and risks of flooding to be evaluated. Adjustments can be made to the monitoring programs based on information gathered during sampling and monitoring and upon regulatory approval.
- CO8 water treatment sampling and monitoring to identify risks to aquatic receptors from treatment plant effluent and help to identify trends in groundwater quality (refer to Section 4.3). Adjustments can be made to the monitoring programs based on information gathered during sampling and monitoring and upon regulatory approval.
- Education of those working on the site with regards to activities that are not permitted in areas that contain S/S material or engineered caps. This includes utility workers, contractors, consultants and tenants.
- Ensuring that NSLI's commitment to minimizing environmental effects and meeting specific regulatory requirements is met.
- Documenting all LTMM activities for trending purposes. The assessment of trends will be completed annually at a minimum and reported as per Section 4.8.
- Communicating changes in the program through the revision process (see Section 2.5).

As previously stated, the objective of the LTMM is to provide ongoing data for:

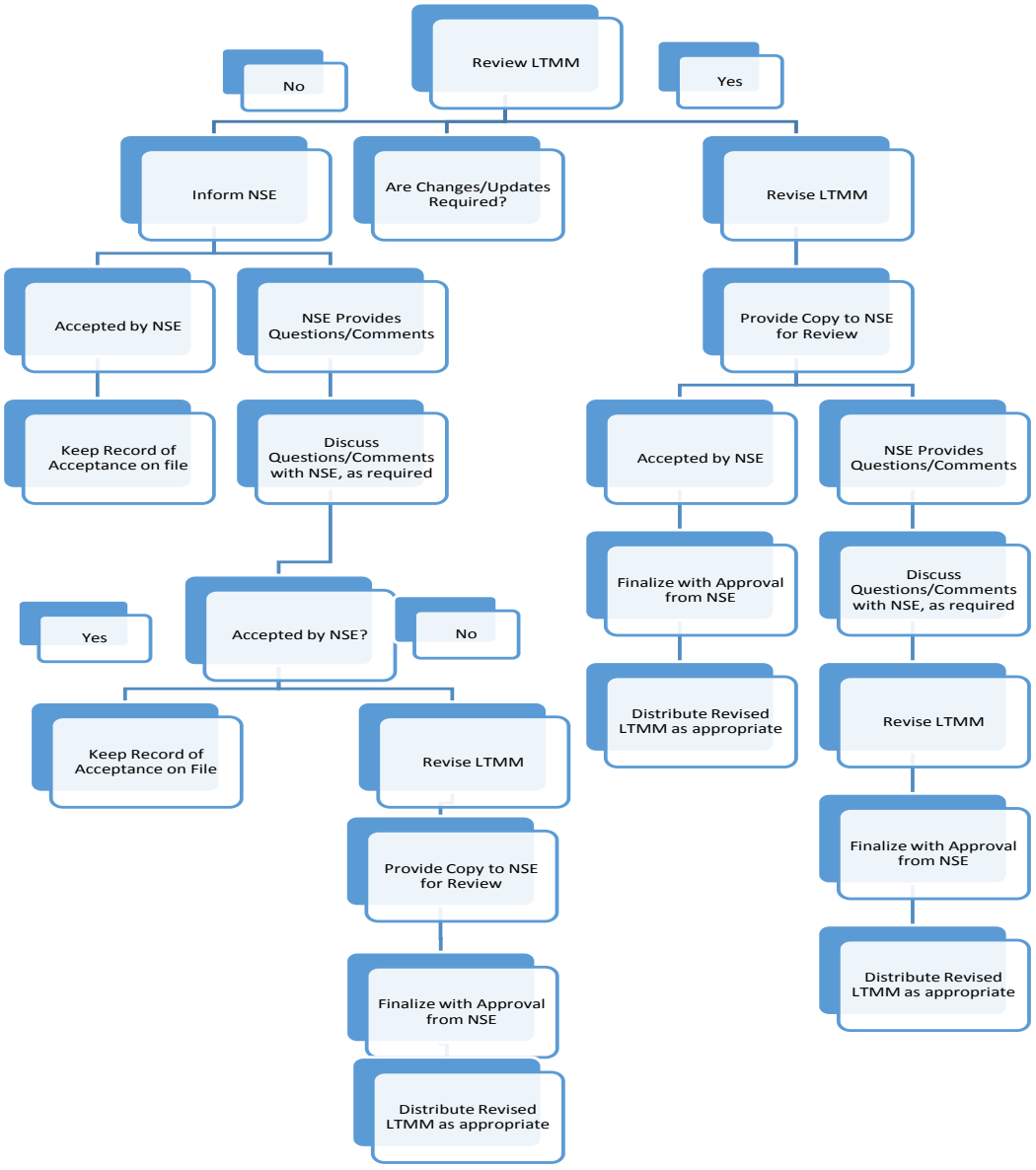
- Long term management and maintenance of the former Sydney Tar Ponds (Open Hearth Park) and Coke Ovens site (Harbourside East); and
- Assessment of compliance commitments to regulatory authorities and other stakeholders.

## 2.5 Maintenance of the LTMM

The LTMM will be reviewed and revised as required on a continuous basis, with mandatory reviews conducted annually (see Figure 1). The document is designed to facilitate such revisions in order to meet the changing environmental protection needs of the Open Hearth Park and Harbourside East and gauge environmental improvement as a result of remedial activities. Maintenance of this LTMM will be the responsibility of the Site Manager. Other responsibilities of the Site Manager are detailed in Section 3.0 of this LTMM, and include providing the most current version of this LTMM to all LTMM Users. This may include site personnel, regulatory agencies, contractors and sub-contractors (including consultants), other interested stakeholders.

The Site Manager or designate will review the progress of the LTMM program and determine if changes are warranted, and then discuss the revision with NSE before it is enacted. The Site Manager will communicate any changes to the LTMM to all LTMM users through electronic or paper communications. The Site Manager will ensure that revisions are made to the LTMM on a timely basis.

All users of the LTMM are encouraged to submit suggestions for amendments to the Site Manager in written form.




**Notes:**
Review will be conducted by NSLI annually (prior to April 1st) at a minimum.
Review can be conducted at any time based on regulatory changes and/or site conditions.
NSE may request a review or changes to the LTMM at any time.
Finalization may include more than one revision of the LTMM prior to approval by NSE.

Figure 1: LTMM Revision Process

## 2.6 NSE Approval Conditions

LTMM activities will be managed in accordance with the conditions and specifications included in this document, which will be subject to an Approval issued by NSE. Additional mandatory conditions may be referenced in the Approval once it is issued.

## 3.0 ROLES AND RESPONSIBILITIES

This section summarizes the roles and responsibilities of HCPI and NSLI personnel, contractors, and the Environmental Management Consultant (EMC). The following figure depicts the environmental management organization.

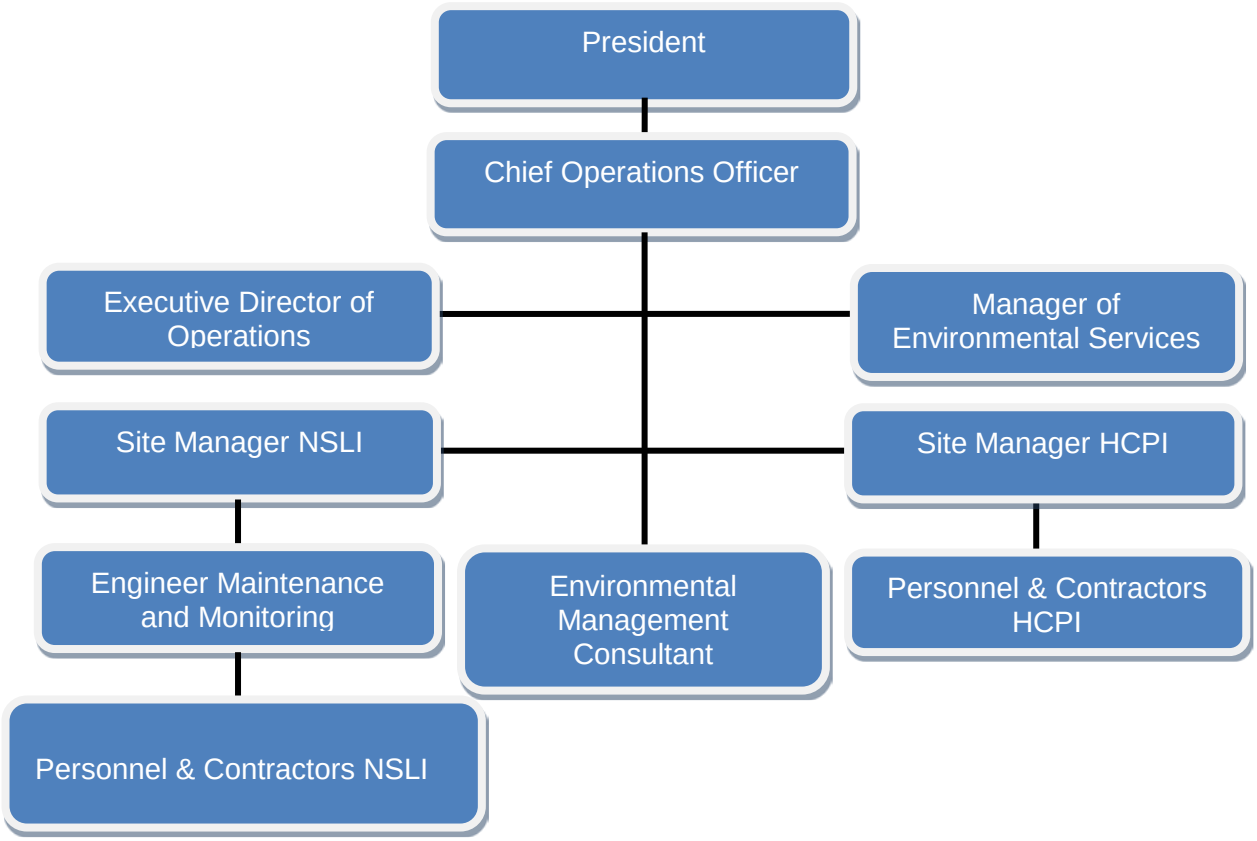



Figure 2: Organizational Chart

### 3.1 HCPI/NSLI President

The President has full executive responsibility for the operation and management of the companies. As such, the President is ultimately responsible for the implementation of the LTMM.

### 3.2 NSLI Chief Operations Officer

The Chief Operations Officer (COO) leads and oversees all aspects of operations and has responsibilities that include human resources, finance, information technology, and administration. In addition, the COO supervises all staff (other than the President) and plans daily operations. With respect to the LTMM, the COO is responsible for ensuring that the Site Manager effectively carries out the duties described in Section 2.5.

### 3.3 Executive Director of Operations

The Executive Director of Operations is accountable for planning and directing projects involved with major contaminated site remediation and redevelopment activities on provincial lands to ensure that they are completed on time, within budget and in compliance with environmental regulations.

### 3.4 Manager of Environmental Services

Reporting to the COO, the manager oversees special projects that NSLI administers. The manager's duties include overseeing project design consultants, tender preparation, contractor selection, contract administration, quality control and quality assurance, environmental monitoring and other related duties.

### 3.5 Site Manager

The Site Manager has primary responsibility for environmental protection on the subject property and in that role will:

- Supervise the Engineer, Maintenance and Monitoring (Section 3.6);
- Minimize environmental impacts by ensuring that adequate plans and resources are in place prior to the start of work;
- Ensure that all activities on the property are compliant with applicable regulations, guidelines, approvals and protocols;
- Ensure completion of Incident Tracking Forms for all environmental incidents on the Site in accordance with the *NSLI Contractor Health and Safety Program*;
- Review reports of environmental incidents and ensure that appropriate remedial actions are taken to address any environmental effects;
- Conduct periodic reviews and updates of the LTMM to ensure that the organizational structures and procedures remain effective tools for carrying out the LTMM's objectives;
- Provide the most current version to all LTMM users. Potential users include Site personnel, regulatory agencies, contractors and sub-contractors (including consultants); and,
- Ensure ongoing communication with regulatory agencies and other stakeholders.

### 3.6 Engineer, Maintenance and Monitoring

The Engineer (Maintenance and Monitoring) is responsible for:

- The implementation of the LTMM program, including monitoring, sampling and data management requirements and communicating significant issues to the Site Manager immediately;
- Assist in preparation and maintenance of the LTMM;
- Advise on contingency plans in the event of unexpected environmental conditions;
- Monitor Site activities and conditions as required in order to identify potential environmental concerns;
- Ensure that monitoring and follow-up studies are conducted as necessary;
- Assist with the implementation of emergency plans as required;
- Liaise with appropriate regulatory agencies and other stakeholders as required; and,
- Organize on-site meetings as required to address site-specific issues.

### 3.7 Environmental Management Consultant

An EMC may be designated by NSLI to assist the Engineer (Maintenance and Monitoring) or Site Manager as required. The EMC will provide expert or professional guidance to NSLI on as-needed basis. Other responsibilities may include execution of the groundwater monitoring program.

### 3.8 NSLI/HCPI Personnel, Consultants, Contractors and Tenants

All NSLI/HCPI personnel, consultants, contractors and sub-contractors will be oriented to the NSLI environmental procedures and expectations as defined in this LTMM. All personnel are required to:

- Comply with all regulations, this LTMM, NSLI policies and procedures, and contractor safety policies and/or procedures that pertain to the operations; and,
- Notify their immediate supervisor or the Site Manager of any incident that results in, or has the potential to result in, injury to personnel, property, or the environment.

Tenants will be oriented to the LTMM and any restrictions that it may impose on the use of their property. A copy of the LTMM will be provided if requested.

### 3.9 Environmental Training and Orientation

The Site Manager will ensure that all NSLI/HCPI personnel and contractors receive orientation to components of the LTMM that is relevant to their work. The orientation will include the following:

- Communication of NSLI's commitment to the LTMM;
- Presentation of specific environmental management procedures and the LTMM checklists;
- Discussion of individual activities and particular environmental concerns associated with planned activities;
- Guidance for reporting unplanned events that require emergency response;
- Maintenance of the LTMM; and,
- Relevant Approvals issued by NSE.

All NSLI/HCPI personnel will be provided with a copy of the LTMM. The Site Manager or designate will provide orientation to the LTMM to all new employees. At the beginning of employment, and annually thereafter, custodial personnel and groundskeepers will be made aware of the general nature and configuration of subsurface features at the site and conditions that could signify subsurface deterioration or unauthorized intrusive activities, as well as the need to communicate this information to the Site Manager.

For contractors, the mechanism for this orientation will be a meeting with the NSLI Health and Safety Officer to discuss safe work permits. As much of the site is located in areas openly accessible to the public, contractors must be made aware of the presence of the cap and be required to obtain written permission from the Site Manager prior to any intrusive work on the site. This clearance would require review of proposed activity and mitigative measures to restore the protective features of the cap. Signs will be posted in strategic locations around the Site advising that clearance is required prior to any intrusive activities.

## 4.0 LONG TERM MAINTENANCE AND MONITORING PROVISIONS

Procedures and protocols for the implementation of the LTMM are provided below. Each section includes a description of the activity and specific procedures for executing the activity.

All work will be completed by NSLI personnel or their designate. Work will be conducted by qualified engineers, geologists, scientists, technologists and technicians with knowledge of the site and remedial activities that have occurred. An Environmental Contingency Plan (ECP) (**Appendix B**) has been developed to aid in addressing issues that may be observed during the execution of the LTMM.

The approach described in this section are widely applied as an accepted means of dealing with environmentally managed sites, and is consistent with the approaches used at the adjacent and previously-remediated former Sysco property, former DEVCO coal mining properties and numerous municipal, provincial and private industrial sites throughout Nova Scotia and the rest of Canada.

### 4.1 Cap / Monolith Monitoring

The engineered cap on the Open Hearth Park site consists of a multilayer cap over the cement-stabilized soils and sediments, covering an area of 31.5 hectares. The cap layers may include (from the bottom up) a grading or bedding layer with a minimum thickness of 0.20 metres, geocomposite drainage layer (GDL), a protective layer (clay/till soil) and a vegetated topsoil layer (refer to **Drawing 1**). The soil layers above the GDL have a minimum total thickness of 1.25 metres to protect the GDL from freeze/thaw damage. The design rational for the cap is to provide surface water diversion drainage and limit surface water infiltration as well as provide a protective covering to the stabilized monolith of impacted soils and sediments.

For Harbourside East, an engineered, 40-hectare, multilayer cap has been installed over the site. Cover layers include (from the bottom up) a low hydraulic conductivity layer (0.3 metres of low hydraulic conductivity soil) and protective layer (0.2 metres of topsoil and vegetation) (refer to Drawing 2). The design rational for the Harbourside East cap is to provide surface water diversion drainage and limit surface water infiltration to the impacted soils and to prevent any interaction between historically impacted soils and the environment.

The objective of the cap monitoring and reporting program is to ensure the integrity of the engineered caps by providing a proactive, preventative maintenance approach to the LTMM. During the course of the program, routine inspection of the caps will ensure early detection of any problems that may arise on the sites. Remedial actions will be immediate and appropriate, depending on the nature of the occurrence. Physical repairs may include excavation and repair of breached or failed liners, replacement of clay and cover materials and reinstatement of vegetative covers. In some instances, engineering investigation and re-design may be necessary. **Appendix C** contains Inspection and Maintenance Log forms for all capped portions of the site, as well as Decision Matrices for the recommendation of maintenance actions associated with seeps, erosion and subsidence.

For both the Open Hearth Park and Harbourside East sites there is a requirement to protect the engineered cap, underlying materials and shoreline barriers from physical and chemical disruption and weathering. **Table 4-1** summarizes monitoring targets, inspection protocols and related actions. Inspection routes and Inspection points for Open Hearth Park and Harbourside East are provided on **Drawing 4** and **Drawing 5**, respectively.

In each case where an observation by the inspector leads to a recommendation for remedial or evaluative action, the Inspector shall revisit the location at an increased frequency determined in conjunction with the Engineer (Maintenance and Monitoring).

The need for the collection and analysis of environmental samples such as leachate from seeps, and air quality monitoring will be assessed using the Decision Matrices. Final decisions will be determined by the Inspector in conjunction with the Engineer (Maintenance and Monitoring). Sampling protocols are described in the SOPs provided in **Appendix D**, and the Environmental Contingency Plan is provided in **Appendix B**.

Elevation surveys will be conducted across the site every five years and in specific locations when significant changes are noted. The survey data will be used to create a drawing of each site that documents infrastructure and property boundary changes, gauge elevation changes, and document areas of concern identified by the LTMM program. The drawings will be prepared and reviewed by a Professional Engineer. Approved 'Confirmation' surveys for Open Hearth Park and Harbourside East will be listed in **Appendix E** as they become available.

## Table 4-1:
## Cap Monitoring Targets and Inspection Protocols

Table 4-1: Cap Monitoring and Inspections Protocols

| Monitoring Target | Inspection Protocol [1] | Preferred Inspection Conditions [2] | Observations of Concern | Remedial Actions |
|---|---|---|---|---|
| Drainage Ways and Shorelines | Visual - Monthly and Following Rain Events (>25mm in 24 hours) | • Low Tide<br>• Within 24 hours of rain event<br>• After grass has been mowed | • Armourstone damage<br>• Erosion<br>• Debris | Physical Repair<br>Erosion Control |
| Perimeter Edges | Visual - Monthly and Following Rain Events (>25mm in 24 hours) | • Within 24 hrs of rain event<br>• After grass has been mowed | • Vandalism<br>• Erosion | Physical Repair as Required<br>Using Soils, Vegetation |
| Side Slope Integrity | Visual - Monthly and Following Rain Events (>25mm in 24 hours) | • Within 24 hrs of rain event<br>• After grass has been mowed | • Erosion<br>• Slumping | Physical Repair |
| Seeps | Visual - Monthly and Following Rain Events (>25mm in 24 hours) | • Within 24 hrs of rain event<br>• After grass has been mowed | • Discoloured Water<br>• | Physical Repair as Required Using Liners, Soils, Vegetation, etc. |
| Fugitive Emissions | Olefactory – Monthly, Following Rain Events (>25mm in 24 hours) or Upon Receipt of Complaints | • Calm Winds | • Unexplained chemical or biological odours | Air Sample collection as Required<br>Physical Repair as Required for Identified Point Sources |
| Areas of Distressed Vegetation, Vegetation Damage or Poor Vegetation Growth | Visual-Monthly, April through October | | • Isolated vegetation die-off | Check Area for Contamination and/or Physical Disruption Repair<br>Re-plant as appropriate |
| Evidence of Animal Intrusion (Burrows) | Visual-Monthly | • After grass has been mowed | • Woody plants over 50 cm high | Humane Animal Removal<br>Burrow Infill |
| Intrusion of Deep Rooting Vegetation (Perennial flowers, shrubs and trees ) in Capped Areas | Visual-Monthly (April – October) | | • Woody Plants over 50 cm high | Vegetation Management<br><br>Soils Repair |
| Formation of Erosion Rills/Gullies | Visual-Monthly | • Within 24 hours of rain event<br>• After grass has been mowed | • Drainage routes cutting into soil | Drainage Management<br>Infilling/ Protection<br>Utilize decision Matrix 3 |

## 4.2 Surface Water

Measuring trends in surface water quality is an important component of the LTMM as surface water and receiving water bodies are key indicators of environmental quality both from a contaminant migration perspective and an ecological health perspective. The objectives of the surface water monitoring program are:

- Observe changes in surface water quality as a result of runoff and leaching;
- Observe changes in surface water quality as a result of groundwater influence;
- Observe trends in surface water quality by annual statistical analysis of analytical data and/or professional judgement;
- Gauge ecological activity in the surface water bodies; and
- Observe physical condition and contaminants (i.e., debris, precipitate).

The surface water monitoring program was initially designed to monitor select phases/locations of the remedial project as per the EPP. Monitoring was completed to review regional surface water resources, flow patterns and hydrology. The environmental effects monitoring (EEM) and LTMM programs were developed to evaluate the effects of the remediation and construction phase. The objectives of the EEM were to assess environmental predictions (negative and positive) related to each design element.

The LTMM is to provide ongoing data for long-term management and maintenance of the design elements and compliance commitments to regulatory agencies and/or stakeholders. The remedial objectives are broken down as described in **Table 4-2**.

**Table 4-2:**
**Surface Water Remedial Objectives**

| Design Element | Remedial Objectives | Predicted Operational Effect | Monitoring Targets |
|---|---|---|---|
| TP6A | To carry inflows from the Coke Oven Brook, Wash Brook and stormwater/sewer overflows into Sydney Harbour at Battery Point. | -Reduced groundwater inflow to the channel will have a positive effect on surface water and sediment quality in the channel. | Surface water chemistry, flow and turbidity at Battery Point. |
| TP6B | To increase strength, and reduce permeability and contaminant mobility. | -No adverse effects. | -Surface water chemistry, flow and turbidity at Battery Point.<br>-Surface water chemistry, flow and turbidity upstream, midstream and downstream of the new channel. |
| TP7 | To limit the migration of contaminants upward to the environment . | - Groundwater discharged to and surface water in the new channel will meet criteria for surface water.<br>- Remedial activities at the Sysco site must not alter or negatively impact the remedial design established for the Project. | - Drainage from trenches in the cap<br>- Surface water chemistry, flow and turbidity at Battery Point.<br>- Surface water chemistry, flow and turbidity upstream, midstream and downstream of the new channel. |

| | | | |
|---|---|---|---|
| CO1 | To reduce human and ecological exposure to sediment in select area of Coke Oven Brook. | - Will reduce contributions to surface water contamination downstream of the Coke Oven Brook Connector.<br>- Remedial activities at the Sysco site must not alter or negatively impact the remedial design established for the Project. | - Surface water chemistry, flow and turbidity upstream, midstream and downstream of CO1 reach of the Coke Oven Brook. |
| CO2 | To increase strength, and reduce permeability and contaminant mobility. | - No adverse effects. | - No surface water targets applicable (groundwater monitoring only). |
| CO5 | To minimize the flow of groundwater onto the Site from the north and south; reduce contaminated groundwater flow off site to the west; and prevent contaminated groundwater within the fill in the Coke Ovens Plant No. 1 area from seeping north and into Frederick Street Brook. | - No adverse effects. | - No surface water targets applicable (groundwater monitoring only). |
| CO6 | To reduce human and ecological exposure to impacts remaining in shallow soil; and reduce infiltration and leaching to the water table. | - Will minimize leachable contamination entering shallow groundwater with the fill; thus reducing contamination inflow to Coke Oven Brooks. | - Surface water chemistry, flow and turbidity upstream, midstream and downstream in the Coke Oven Brook adjacent to the surface cap material. |
| CO7/CO8 | To control contaminated shallow groundwater and DNAPL in the fill and/or bedrock; to treat the collected on-site groundwater for discharge to Coke Ovens Brook; and to reduce human and ecological exposure to impacts remaining in sediments within select areas of Coke Ovens Brook. | - Will reduce or eliminate transport of contaminated groundwater into off-site groundwater and surface water.<br>- Contaminated groundwater will be treated to acceptable concentrations prior to discharge. | - Surface water chemistry, flow and turbidity upstream, midstream and downstream of the groundwater collection system.<br>- Surface water chemistry, flow and turbidity at Battery Point (Compliance Sampling).<br>- Surface water chemistry, flow and turbidity downstream of the WTP (Compliance Sampling). |
| Note: Remedial objectives will continue to be reviewed as part of the LTMM to evaluate the effectiveness of the remedial program and determine if any changes are observed after the EEM program was completed. | | | |

Quarterly surface water and sediment effects monitoring began in April 2009 for physical and chemical parameters at the eight stations listed in **Table 4-3**. Sampling rationale for each station is also provided in **Table 4-3,** as well as the required analytical parameters and screening criteria. Monitoring outcomes over the past 14 quarters have provided sufficient data to facilitate trend analysis and to provide an indication of relative contributions from the various tributary streams to COB and from Wash Brook proper. Recommended long-term monitoring requirements are provided in **Table 4-3** based upon this information. Reduction in sampling frequency will be contingent upon confirmation of anticipated trending in results and NSE approval.

A contingency investigative sampling protocol will be implemented to accommodate any noted deterioration in water quality. This includes visual inspection of feeder streams, and sampling for turbidity as deemed appropriate. Where turbidity exceeds 88 NTUs, a chemistry sample will be taken to determine likely relative contributions as appropriate.

The same parameters and analytical methods will be employed in the surface water monitoring program as are used in the monitoring of effluent from CO8 (see **Section 4.3**). Surface Water Sampling must be conducted as outlined above and as per the Standard Operating Procedures (SOPs) available in **Appendix D**. Screening values for surface water are as follows:

- NSE Tier I Environmental Quality Standards (EQS) for Surface Water (Fresh Water and Marine Water, where applicable).

All applicable surface water results will also be compared to 95% Upper Confidence Limits (UCLs) of the baseline data collected prior to construction and background data collected during the Phase II ESA, and data collected as part of the EEM program. Screening will allow determination of water quality in comparison to post-remediation data for assessment of its effectiveness. An exceedance of the 95% UCL may lead to an investigation and potential corrective action.

For discussion purposes, parameters that do not have NSE Tier 1 EQS concentrations listed may be compared to Canadian Council of Ministers of the Environment (CCME) Freshwater Aquatic Life (FWAL) and Marine Aquatic Life (MAL), as applicable. Nitrite, nitrate, ammonia and pH will be screened against CCME guidelines and exceedances will be reported to NSE and investigations may results.

Screening data is available in **Appendix F**.

**Table 4-3:**
**Surface Water Monitoring Program**

| **Monitoring Station ID** | **Water Body** | **Design Element** | Rationale for Sampling | Analytical Parameters | Screening Criteria | **Frequency** | **Duration** |
|---|---|---|---|---|---|---|---|
| COB-4-SW | Coke Ovens Brook | CO1 | CO1 (downstream)<br>CO6 (downstream)<br>CO7/CO8 (downstream) | Total Metals, PAHs, General Chemistry (RCApMS), Turbidity, BTEX, Mod. TPH, mercury, PCBs | NSE Tier I EQS for Surface Water (Marine and Fresh Water) | Semi-annually | 25 years, with a needs assessment conducted every three (3) years. |
| CB-SW | Cagney Brook | CO6 and CO7 | CO7/CO8 (upstream) | Total Metals, PAHs, General Chemistry (RCApMS), Turbidity, BTEX, Mod. TPH, mercury, PCBs | NSE Tier I EQS for Surface Water (Marine and Fresh Water) | Semi-annually | 25 years, with a needs assessment conducted every three (3) years. |
| SRC-1-SW | South Realigned Channel | CO6 and CO7 | CO7/CO8 (upstream) | Total Metals, PAHs, General Chemistry (RCApMS), Turbidity, BTEX, Mod. TPH, mercury, PCBs | NSE Tier I EQS for Surface Water (Marine and Fresh Water) | Semi-annually | 25 years, with a needs assessment conducted every three (3) years. |
| NRC-1-SW | North Realigned Channel | CO6 and CO7 | CO7/CO8 (upstream) | Total Metals, PAHs, General Chemistry (RCApMS), Turbidity, BTEX, Mod. TPH, mercury, PCBs | NSE Tier I EQS for Surface Water (Marine and Fresh Water) | Semi-annually | 25 years, with a needs assessment conducted every three (3) years. |
| Narrows | North Channel, Open Hearth Park | Channel Liner | Downstream | Total Metals, PAHs, General Chemistry (RCApMS), Turbidity, BTEX, Mod. TPH, mercury, PCBs | NSE Tier I EQS for Surface Water (Marine and Fresh Water) | Semi-annually | 25 years, with a needs assessment conducted every three (3) years. |
| COB-A-SW | Coke Ovens Brook – concrete riffles upstream of Stable Drive | CO6 and CO7 | CO1 (upstream)<br>CO6 (upstream)<br>CO7/CO8 (upstream) | Total Metals, PAHs, General Chemistry (RCApMS), Turbidity, BTEX, Mod. TPH, mercury, PCBs | NSE Tier I EQS for Surface Water (Marine and Fresh Water) | Semi-annually | 25 years, with a needs assessment conducted every three (3) years. |
| WB-1-SW | Wash Brook | TP6A, TP6B, TP7 | TP6B (upstream of channel)<br>TP7 (upstream of channel) | Total Metals, PAHs, General Chemistry (RCApMS), Turbidity, BTEX, Mod. TPH, mercury, PCBs | NSE Tier I EQS for Surface Water (Marine and Fresh Water) | Semi-annually | 25 years, with a needs assessment conducted every three (3) years. |
| BP-1-SW | Battery Point | TP6A<br>TP6B<br>CO1<br>CO8 | TP6A<br>TP6B<br>TP7<br>CO7/CO8 | Total Metals, PAHs, General Chemistry (RCApMS), Turbidity,Mod., BTEX, Mod. TPH, mercury, PCBs | NSE Tier I EQS for Surface Water (Marine and Fresh Water) | Semi-annually at low tide | 25 years, with a needs assessment conducted every three (3) years. |

An important consideration in the evaluation of the surface water monitor results is the influence of contaminants originating off-site, particularly to the east of Harbourside East. Historical activities on some adjacent sites have resulted in degraded environmental conditions that, though addressed through ongoing environmental management programs, may continue to migrate with surface water and groundwater onto the Harbourside East site. Historical monitoring has often shown this to be the case and it is possible that exceedance will be observed in the future that are attributed to off-site impacts. Corrective responses will not be initiated for results that exceed the above criteria and are consistent with historical results associated with offsite impacts.

The surface water monitoring program will be reviewed every three years to evaluate the appropriateness of analytical parameters, monitoring frequency and monitoring locations in order to ensure that the program is capturing the information required to fulfil its objectives in an efficient and effective manner. Time series trends of individual parameters from each monitoring location will be analyzed using the Mann-Kendall statistical test. Monitoring will be discontinued for individual constituents (with the approval of NSE) if either:

a. Results have never exceeded the associated criteria for that parameter; or,

b. Current results are below criteria and statistically exhibit a decreasing or stable trend.

Statistically significant increases in surface water concentrations will be considered a preliminary indication of an adverse effect on surface water. Professional judgment will be used in the application of these statistical analyses, as statistical tests will not be applicable across all cases. If the Mann-Kendall test indicates that a contaminant has an upward trend after the fourth sample for three consecutive samples then a corrective response will be implemented. NSE will be notified of any significant increases in surface water concentrations and corrective response will be initiated through consultation with NSE.

Corrective responses may take several forms including: a) evaluation of potential contaminant sources, b) addition of monitoring location or environmental sampling to identify sources or extent of impacts, c) repair or replacement of remediation caps or other materials and d) diversion or treatment of surface water. Details of the event and any corrective responses will be documented according to the LTMM reporting protocols (see Section 4.8).

The trigger thresholds for turbidity are based on CCME Water Quality Guidelines for the Protection of Aquatic Life – Total Particulate Matter Guidelines. The triggers will be:

- For high or chronically turbid flow (background greater than 8 NTU):
    - Maximum increase of 8NTU from background levels, when background is between 8 and 80NTU.
    - Maximum increase of 10% above background levels when background is >80 NTU.
    - For clear flow (background less than 8 NTU):
    - Maximum increase of 8NTU above background levels, sustained for less than twenty-four (24) hours.
    - Maximum increase of 2NTU above background levels, sustained for a longer term exposure (i.e., Inputs lasting between twenty-four (24) hours and thirty (30) days).

Additional monitoring may be required to monitor the corrective response actions and parameter concentrations in surface water. Corrective response actions will be discontinued once it is demonstrated that surface water quality has been stabilized and the Engineer, Maintenance and Monitoring decides that reasonable certainty exists that water quality will remain stable following

the cessation of corrective response actions. As stated previously, NSE will be consulted regarding corrective action response initiation and cessation.

### *4.2.1 Channel Monitoring*

Construction and re-alignment activities occurred along both the channel and Coke Ovens Brook. The channel also represents the endpoint of liners and capping areas associated with the construction work. Contaminated sediments were removed from the channel, which was then reconstructed in a manner that prevents re-contamination. The channels include a rip rap lining installed along the slopes and embankments angled toward watercourses following the installation of surface caps to minimize excessive disturbance of the soils and resulting erosion.

Channel monitoring will be conducted in association with Cap/Monolith Monitoring (Section 4.1) as the channel forms a portion of the boundary with the cap. Monitoring will include surveys, visual inspections and groundwater elevation monitoring.

An initial survey of the channel will be completed to obtain existing conditions data (located in Appendix E). Survey cross sections should be completed every 15 m and should include, at a minimum, five locations laterally including toe of riprap and top of side slope of channel. The survey will identify both top of rock and top of liner profiles. The survey should also include any other infrastructure within the channel such as bridge abutments, pressure relief wells, outfalls, etc. The limits of the survey should focus on the areas of previous observation of liner uplift, but not be limited to these areas. These areas generally include Wash Brook to Coke Ovens Brook confluence with the main channel and the area of the channel near Ferry Street Bridge from 20m upstream to 40m downstream.

A yearly re-survey, completed the same way as the baseline, will be completed for the first two years after the initial survey. The generated surveys will be used to compare results of the existing conditions data to identify any changes in the profile of the channel rock, side slopes, liner, and other infrastructure. It is expected that the frequency of surveys will be reduced based on the results and conditions encountered.

Visual monitoring of the channel and other infrastructure is required to supplement the survey data. The visual monitoring should be completed quarterly, and after any significant water flows that could impact channel infrastructure (i.e. heavy rain, tidal surges, etc.). Visual monitoring is to be completed during low flow conditions to increase the quality of data obtained. The observations will be photo-logged, with photos taken from the same vantage point during different monitoring events for comparative purposes. The observations will attempt to identify any physical changes to the channel (i.e. shifting rock, damaged or exposed liner, position and disposition of other infrastructure).

Visual monitoring should also include the measurement of static groundwater elevations adjacent to the channel alignment. Groundwater elevations will allow for a better understanding of the profile and fluctuation of the post-construction groundwater table in the area of the channel. Monitor wells selected for quarterly water level measurements as part of the channel monitoring program were selected form monitor wells in the groundwater monitoring program (Section 4.4) and are available in **Table 4-4** and **Drawing 7**. **Appendix C** contains an Inspection and Maintenance Form for Channel and Pressure Relief Well Monitoring. General channel monitoring is included under *geotechnical monitoring* in the Inspection Checklist.

**Table 4-4:**
**Channel Monitoring – Groundwater Elevations**

| Monitor Wells Measured for Groundwater Elevations | |
|---|---|
| • MCWS-113-MWB<br>• MCWS-306-MWB<br>• MCWS-307-MWB<br>• MCWS-309-MW<br>• MCWS-310-MW<br>• MCES-001-MWA and MWB | • MSES 104-MWA<br>• MSES-004-MW<br>• COBC-004-MWB<br>• MSES-012-MWB<br>• COBC-001-MWB<br>• CONPL-202-MWB |

The survey and visual monitoring may identify areas of concern that may or may not be related to the liner elevation (lifting) and displacement of rip rap. Any indication of uplift, shift in riprap, in-channel islands, displaced or deformed wells, tilted bridge abutments or outfalls should be investigated further to determine the root cause and mitigative action. Mitigative measures should focus on root causes.

Mitigation, in addition to corrective action associated with root cause analysis, may also be completed to ensure the integrity of the channel infrastructure in the final, post construction condition. Additional groundwater pressure relief wells, or additional ballast material (riprap of similar size to existing conditions or strategically placed boulders), in the channel would provide additional mitigation, to the initial concerns of liner elevation (lifting) and displacement of rip rap.

#### 4.2.1.1 *Pressure Relief Well Monitoring*

Seventy-six bedrock pressure relief wells and 14 sediment/sand relief wells were installed in the channel, including several in the Coke Oven Brook Alignment near the discharge to the channel. The pressure relief wells were installed to reduce water build-up behind the channel liner, by allowing water to enter the channel through flanged Duckbill backflow preventers on the wells. The wells are spaced approximately 20m apart and are primarily located along the eastern shoreline of the channel. The bedrock pressure relief wells are located on the channel bottom (under water), while the sand pressure relief wells are located on the channel side slopes (in the riprap). The channel will be visually inspected quarterly in conjunction with the channel-monitoring program. Recorded observations for the pressure relief well monitoring will include:

- the presence/absence and amount of flow (i.e. observed to be low/medium/high flow);
- mineralization;
- discolouration in the water near the wells;
- any sheens on the water near the well;
- any other unusual discharge; and
- wells should also be checked for damage, especially during spring monitoring after ice melt.

Observations will be recorded and photo-logged, to document the wells. Any changes observed will be investigated and an assessment completed on any damaged wells. **Appendix C** contains the Inspection and Maintenance Form for Channel and Pressure Relief Well Monitoring.

### 4.3 CO8 Water Treatment Plant

The commissioning of the Coke Ovens Brook water treatment plant and the development of the LTMM program has been running concurrently. Unlike other parts of the construction monitoring

program where trending has guided the development of the long term program, the LTMM component of CO8 has been proposed based on a successful commissioning of the water treatment plant, the establishment of a successful cap on CO6 and cessation of post remediation site redevelopment.

Based on the above, it is intended that compliance sampling of CO8 will be complimentary to the surface water monitoring program that will be implemented above and below the water treatment plant. The objective of the sampling program will be to ensure that aquatic life in the receiving waters is protected. Sampling will consist of 96 hr LC 50 effluent testing on the same schedule as COB-6-SW: monthly for year 1, quarterly for years 2 and 3 with needs assessment at end year 3. Quarterly sampling will likely continue beyond year 3. The contingency investigative sampling protocol will also apply to CO8. SOPs are provided in **Appendix D**.

Details associated with the CO8 sampling program will be established once the current investigations of the CO8 collection system are completed.

### 4.4 Groundwater

The environmental management approach implemented on the sites necessitates that the groundwater monitoring program be the cornerstone of the LTMM program. While many of the site conditions can be monitored utilizing visual triggers, the groundwater aspect must rely on the collection and analysis of samples. Equally important is the difference in trending that is likely to occur on the remediated properties. Whereas some aspects of the site are expected to improve almost immediately after completion of activities (i.e. surface water), the groundwater component will have a much slower response to the various remedial measures. Because of this, trending, both positive and negative, will require monitoring over the long term as well as a robust response plan.

The groundwater monitoring program was initially designed to monitor select phases/locations of the remedial project as per the EPP. Monitoring was completed to review geology, hydraulic properties, groundwater flow patterns and contaminant distribution. The EEM and LTMM programs were developed to evaluate the effects of the remediation and construction phase.

The objectives of the EEM were to assess environmental predictions (negative and positive) related to each design element, while the LTMM was intended to provide ongoing data for long-term management and maintenance of the design elements and compliance commitments to regulatory agencies and/or stakeholders. The remedial objectives are described in **Table 4-5**.

**Table 4-5:**
**Groundwater Remedial Objectives**

| Design Element | Remedial Objectives | Monitoring Outcome Targets |
|---|---|---|
| TP6A | To move surface water sources (Coke Oven Brook, Wash Brook and stormwater/sewer overflows) from the site to Sydney Harbour. | - Groundwater inflow reduction to the channel will positively effect on surface water and sediment quality in the channel.<br>- Contaminated sediments must be removed from the channel and the channel should be reconstructed to ensure it remains clean, while hydraulic conditions are maintained or improved.<br>- Ensure groundwater contamination from the western shore is contained. |
| TP6B | To S/S sediments to increase strength, reduce permeability and decrease contaminant mobility. | - Groundwater quality should improve due to reduced exposure to contaminants.<br>- Surface water in the new channel should meet SSTLs (groundwater discharges into the new channel).<br>- The S/S material may result in mounding of upgradient groundwater levels.<br>- Ensure rate of leaching is acceptable<br>- Ensure activities at the former Sysco site do not impact the remedial design and objectives. |
| CO2 | To reduce human and ecological exposure; eliminate a source of contamination from infiltrating groundwater; and prevent contaminant migration to off-site. | - Will reduce potential future contamination. |
| TP7 | The cap is designed to mitigate the migration of contaminants upward and infiltration of precipitation through the cap | - The cap is a barrier between contamination and human and ecological receptors.<br>- This reduces exposure to contamination will decrease impacts in groundwater.<br>- Surface water in the new channel should meet SSTLs (groundwater discharges into the new channel).<br>- The S/S material may result in mounding of upgradient groundwater levels.<br>- Ensure rate of leaching is acceptable<br>- Ensure activities at the former Sysco site do not impact the remedial design and objectives. |
| CO1 | To reduce human and ecological exposure to impacts in sediment within specific areas of the Coke Ovens Brook. | - Groundwater contamination moving upward through the bed of the brook should be reduced.<br>- Contributions to surface water contamination downstream of the Coke Oven Brook Connector should be reduced.<br>- Ensure DNAPL and contaminated sediment are not present downstream of the main Sysco gate.<br>- Ensure activities at the former Sysco site do not impact the remedial design and objectives. |

| | | |
|---|---|---|
| CO5 | To minimize the flow of groundwater onto the Site from the north and south; reduce contaminated groundwater flow off site to the west; and prevent contaminated groundwater within the fill in the Coke Ovens Plant No. 1 area from seeping north and into Frederick Street Brook. | - Ensure mounding behind walls does not occur.<br>- Ensure DNAPL does not approach the west wall and Coke Ovens Brook. |
| CO6 | To reduce human and ecological exposure to impacts remaining in shallow soil; and reduce infiltration and leaching to the water table. | - Will minimize leachable contamination entering shallow groundwater with the fill; thus reducing contamination inflow to Coke Oven Brooks. |
| CO7/ CO8 | To control contaminated shallow groundwater and DNAPL in the fill and/or bedrock; to treat the collected on-site groundwater for discharge to Coke Ovens Brook; and to reduce human and ecological exposure to impacts remaining in sediments within select areas of Coke Ovens Brook. | - Will reduce or eliminate transport of contaminated groundwater into off-site groundwater and surface water.<br>- Water supplies in the vicinity of the Coke Ovens Brook will not be adversely affected.<br>- Two residential dwellings located at the east end of Frederick Street with potable water wells will not be adversely affected.<br>-Monitor the presence of mobile DNAL approaching the groundwater collection lines.<br>-Contaminated groundwater will be treated to acceptable concentrations prior to discharge. |
| Note: Remedial objectives will continue to be reviewed as part of the LTMM to evaluate the effectiveness of the remedial program and determine if any changes are observed after the EEM program was completed. | | |

**Table G-1** in **Appendix G** presents the list of monitor wells included in the program as well as alternate monitor wells for use in lieu of those identified by NSE. Alternate wells were selected based on the amount of available data, the value of the well as a monitoring location during the EEMSWCP, and observations of groundwater quality and associated trends at these locations. **Table G-2** in **Appendix G** provides the rationale for monitor well selection and defines the monitoring targets (as discussed in **Table 4-4**).

**Table G-2** identifies wells that will be subjected to water level measurements and/or groundwater sampling during the LTMM. The monitor well list is subject to final approval by NSE. See **Drawing 7** for the locations of these wells.

### *4.4.1 Groundwater Sampling and Monitoring*

The groundwater monitoring will be conducted annually until Year 5 of the LTMM and every second year until Year 25. The program will include water level monitoring and DNAPL monitoring conducted annually until Year 25. DNAPL will also be monitored annually in recovery wells RW1 and RW2 (along the Coke Ovens Brook) until Year 25. The DNAPL monitoring will consists of water levels measurements and monitoring with an oil-water interface probe and visual inspection with a clear bailer.

Every five years the LTMM will be reviewed to assess the adequacy of the program. The groundwater monitoring program will be undertaken by a qualified consultant under the direction of NSLI, utilizing approved sampling and analysis methodologies.

All sampling will be completed via low-flow methodologies in accordance with the SOPs found in **Appendix D**.

Groundwater analysis will include BTEX/TPH, PAHs, dissolved metals, mercury, PCBs and General Chemistry parameters.

### *4.4.2 Screening Criteria*

Screening values for groundwater are as follows:

- NSE Tier I EQS for Groundwater, Commercial/Industrial Land Use, coarse-grained soil.

Applicable groundwater results will also be compared to 95% Upper Confidence Limits (UCLs) of the baseline data collected prior to construction and background data collected during the Phase II ESA, and data collected as part of the EEM program. Screening will allow determination of water quality in comparison to post-remediation data and determine its effectiveness. An exceedance of the 95% UCL may lead to an investigation and potential corrective action.

For discussion purposes, parameters that do not have NSE Tier 1 EQS concentrations listed may be compared to CCME FWAL and MAL, specifically for traditional general chemistry parameters (i.e. non-trace metals), such as pH.

Screening data is available in **Appendix F**.

### *4.4.3 Review of Groundwater Monitoring Program*

The groundwater monitoring program will be reviewed every three years to evaluate the appropriateness of analytical parameters, monitoring frequency and monitoring locations in order to ensure that the program is capturing the information required to fulfil its objectives in an efficient and effective manner. It will also assess changes in groundwater flow and contaminant plumes to determine if the LTMM groundwater monitoring program remains appropriate and if changes should be made (i.e. additional wells should be added or removed).

Time series trends of individual parameters from each monitoring location will be analyzed using the Mann-Kendall statistical test. Monitoring will be discontinued for individual constituents if either:

a. Results have never exceeded the associated criteria for that parameter; or,
b. Current results are below criteria and statistically exhibit a decreasing or stable trend.

Statistically significant increases in groundwater concentrations will be considered a preliminary indication that remedial activities are adversely affecting groundwater. Professional judgment will be used in the application of these statistical analyses, as statistical tests will not be applicable across all cases. If the Mann-Kendall test indicates that a contaminant has an upward trend after the fourth sample for three consecutive samples then a corrective response will be implemented. Professional judgement (in consultation with EMC) will be used to determine if statistical increases in groundwater concentrations are significant and to review the data trends prior to collecting enough data to perform Mann-Kendall analysis.

Corrective responses may take several forms including: a) evaluation of potential contaminant sources, b) addition of monitoring location or environmental sampling to identify sources or extent of impacts, c) repair or replacement of remediation caps or other materials and d) diversion or treatment of groundwater. Details of the event and any corrective responses will be documented according to the LTMM reporting protocols.

NSE will be notified of any significant increases in groundwater concentrations and, if required, corrective responses will be initiated in with consultation with NSE.

### *4.4.4 Trigger Thresholds and Anomalies*

A statistically significant increase in groundwater concentrations above baseline conditions would be considered a preliminary indication that remedial activities are adversely affecting groundwater. The Mann-Kendall analysis will be used to determine if there are upward trends in EEM and LTMM groundwater data. If the Mann-Kendall test indicates that a contaminant has an upward trend after the fourth sample for three consecutive samples then response protocols are to be developed and implemented. Professional judgment will be used in the application of these statistical analyses, as statistical tests will not be applicable across all cases. Professional judgement (in consultation with NSE) will be used to determine if statistical increases in groundwater concentrations are significant and to review the data trends prior to collecting enough data to perform Mann-Kendall analysis. Triggers may be identified by professional judgement prior to the collection of enough data to perform Mann-Kendall analyses on.

If trigger thresholds are met, the Contingency Plan (**Appendix B**) documents the process required to deal with the incident (s).

## 4.5 Infrastructure Maintenance

The inspection protocols and remedial actions for the site caps are outlined in Section 4.1. In addition to the maintenance of the site caps, considerable effort will be expended to maintain the infrastructure constructed as part of the post remediation site redevelopment. This infrastructure includes, but is not limited to, roads, walking trails, bridges, playgrounds, water splash pad parks, skating rink, bicycle training facilities, bike racks, dog park, pedestrian benches, amphitheatre, interpretative areas, figurative sculptures, restroom and concession facilities, exercise stations, natural and artificial turf sport fields, sport field lighting, bleachers, parking lots, garbage and recycling receptacles, guide rails, pole lighting, electrical services, water, storm and sanitary services, green space, flower beds, trees, wet meadows and fencing.

## 4.6 Site Covenants

Upon completion of the post remediation site redevelopment works, it is not expected that any form of construction will take place on the Open Hearth Park. The Province of Nova Scotia will control all land activities at the Open Hearth Park and will ensure that no intrusive activities will be allowed that would compromise the engineered site.

Construction at Harbourside East will likely occur in the future and all such activities will need to be designed to ensure compatibility with the engineered collection, diversion, treatment and cap infrastructure. This will be accomplished through site condition reports and site covenants incorporated in all leases and sales agreements administered through the responsible Provincial agency. Site covenants are located in **Appendix H**. The covenants may require additional approval from NSE.

### 4.7 Reengagement of Partners

In the event that unforeseen liability associated with the remedial works is encountered, the Province of Nova Scotia will notify the Minister of Public Works and Government Services Canada in a timely manner. Section 12.01.01 of the Agreement states that Canada and Nova Scotia, in the event that future claims and liabilities arise from the remediation project, will address the issues jointly and any disagreements on any future issue of liability will be resolved in accordance with Section 1.03.05 of the Agreement.

### 4.8 Reporting

Annual reports shall be submitted within 60 days of the end of the calendar year and will include annual groundwater, surface water and cap monitoring activities. Significant maintenance issues or situations where human health and/or the environment have potentially been put at risk will be immediately reported to NSE. Trend analyses and ongoing assessments will also be reported annually.

Significant issues are repeated maintenance issues or exceedances of criteria. Insignificant issues will also be included in the annual report.

The Province shall prepare 12 hard copies and one electronic copy of the draft and final versions of the annual report for distribution. Electronic copies will be provided in PDF (completely bookmarked and written directly for original application) as well as in the original application.

Significant issues and criteria exceedances will be reported to NSE in writing (email) within one week of receiving analytical results from the lab. Corrective response activities will be reported within this time period, if applicable.

### 4.9 Data Management

NSLI will set up and maintain a data management system that meets the anticipated requirements of the LTMM program as well as other future site activities including development of Harbourside East. The data shall be maintained regularly and accessible to NSLI personnel at any time. Information including sample date, analysis date, laboratory, sample name, medium, coordinates, sample depth, concentration, and flow rates shall be stored in this database.

## 5.0 ALTERATIONS TO ORIGINAL LTMM PROGRAM

This document presents an LTMM plan that varies from the original on several issues. Each of these alterations is discussed in the following sections.

## 5.1 Cap Monitoring

A weather station with precipitation monitoring will not be established. Precipitation data will be acquired from Environment Canada for use in determining monitoring and inspection events for the engineered caps at Open Hearth Park and Harbourside East.

## 5.2 Marine Monitoring

The Review Panel recommendations included the establishment of “a permanent water quality-monitoring program at the discharge of the channel to Sydney Harbour.” Since that time, regulatory and administrative changes have resulted in the decision to eliminate future marine monitoring of Sydney Harbour as part of the LTMM.

# 6.0 QUALITY CONTROL/QUALITY ASSURANCE (QA/QC)

The following Quality Assurance/Quality Control (QA/QC) program will be adhered to during the execution of all LTMM activities.

## 6.1 Field QA/QC

All samples are to be collected in accordance with NSLI’s SOPs and industry-accepted protocols to maintain accurate and consistent collection of field data and interpretation of conditions. The following outlines requirements of the QA/QC program for sampling in the field.

To ensure that LTMM sampling and analytical data are meaningful and reproducible, a quality assurance and quality control program must be incorporated into each sampling event. All field quality control samples must be prepared the same as regular investigation samples with regard to sample volume, containers, and preservation.

The following quality control samples shall be collected for each batch of samples (a batch may not exceed 20 samples), and in accordance with the Sampling Plan:

a) Trip blanks - are required for the VOC samples at a frequency of one set per VOC sample cooler.
b) Equipment blanks - shall include the pump and the pump's tubing. Collect equipment blanks after sampling from contaminated wells and not after background wells.
c) Field duplicates - are collected to determine precision of sampling procedure. For this procedure, collect duplicate for each analyte group in consecutive order (VOC original, VOC duplicate, SVOC original, SVOC duplicate, etc.).

QA/QC includes careful collection and labelling of samples, identification of locations, thorough decontamination of equipment and careful, concise field note documentation.

### *6.1.1 Field Notes*

Field notes must document all observations, measurements, equipment, conditions and procedures. The field log book should document the following information for each well sampled:

- Sample location / identification
- Measured field parameters (pH, temperature, etc.) if applicable and methods
- Sampling sequence
- Sample appearance and odours
- Sample volume and types of containers

- Preservatives used
- Analyses requested
- Laboratory used
- Name of collector
- Climatic conditions (temperature and weather)
- Site conditions and any possible issues that may require further work (i.e. repair monitor well cover, note changes in characteristics of a water body, etc.)
- Problems encountered and deviations from sampling protocol

Field notes must be written so anyone other than the sampler can independently determine:

- Exactly what activities were conducted in the field and why.
- Exactly where and when each piece of data was collected.
- The methodology used.

Only factual information should be recorded in the field notes.

### *6.1.2 Follow-up Activities*

Upon completion of the sampling program, the sampler will:

a) Check the workplan to ensure that all samples have been collected
b) Ensure that the sample site(s) is left clean and any access to the site(s)/ sample location is returned to original state (i.e. restricted, if required)
c) Equipment should be thoroughly cleaned
d) Copy field notes and submit to project manager/to file
e) Prepare memo to inform client of work completed
f) Upon receipt of the laboratory analytical reports, interpretation and verification of the QA/QC sample results should be conducted to determine whether data quality objectives have been met.

## 6.2 Sample Labels

Label all sample containers with the laboratory-provided labels and use a pencil for all sample identification information. Write the sample ID number on the lid of each container. Labelling and marking should be done prior to cooling the sample containers to prevent interference caused by condensation.

Sample labels should include the following information:

- Company identification
- Project identification
- Sample location / identification
- Date and time of sample collection
- Parameters to be analyzed

## 6.3 Sample Handling

Always use a new pair of nitrile gloves for each sample collected to prevent cross-contamination and sample as per specific SOPs. After the sample is collected:

a) Immediately place the samples in a sealed cooler with an ice pack; samples must be kept cold (approximately 4°C) but avoid freezing.

b) Complete a Chain-of-Custody (COC) form and submit the cooler and form to the laboratory as soon as possible after sampling. Indicate on the COC any samples where high analyte concentrations are expected based on field observations.
c) Sample holding times vary depending on the analyte. Ensure that samples are received by the lab with sufficient time to be extracted before they expire.
d) Samples shipped by bus or air must be carefully packed so that there is no room for sample movement. Glass containers should be individually wrapped in bubble wrap/styrofoam, etc. Send the COC in a sealed plastic bag (e.g. Ziplock) inside the shipment.

### 6.4 Blind Field Duplicates and Relative Percent Difference

To verify the reproducibility of the laboratory analyses and to demonstrate that the field sampling techniques utilized by sampling personnel are capable of yielding reproducible results, a minimum of 10% of samples collected will have a blind field duplicate (BFD).

A field duplicate is two independent samples that are collected as close as possible to the same point in space and time. While the samples are collected from the same sources, they are stored in separate containers and analyzed independently to document the precision of the sampling process. The samples are to be given unique identifiers so the laboratory is unaware that the samples were taken from the same source.

Based on the results of blind field duplicate, the relative percent difference (RPD) will be calculated as a measure of QA/QC. The RPD is defined as the difference between the duplicate results divided by the mean of the results, expressed as a percentage.

$$\text{BFD RPD (\%)} = ((C1-C2) \div (C1+C2)) \times 100\%$$

Where, C1 = larger of two observed values from the field duplicate analysis

C2 = smaller of two observed values from the field duplicate analysis

Analytical error increases near the method detection limit (MDL); therefore, the RPD is not normally calculated unless the concentrations of both the original and duplicate samples are greater than 5 times the MDL. If the RPD for a sample and its duplicate do not meet RPD standards for the parameters analyzed, an explanation is required to qualify the difference in values.

Alert limits for analytes in water are displayed in **Table 6-1**.

**Table 6-1:**
**Alert limits for Analytes in Water**

| Parameter | Field Blank | Trip Blank | Field Duplicate RPD |
|---|---|---|---|
| BTEX | >5 X MDL | >5 X MDL | >60% |
| Modified TPH | >5 X MDL | >5 X MDL | >60% |
| TPH Fractionation | >5 X MDL | >5 X MDL | >60% |
| Acid Extractables (phenols) | >5 X MDL | >5 X MDL | >60% |
| Dibenzo Dioxins and Furans | >5 X MDL | >5 X MDL | >60% |
| Glycols | >5 X MDL | >5 X MDL | >60% |
| MTBE | >5 X MDL | >5 X MDL | >60% |
| PCBs | >5 X MDL | >5 X MDL | >60% |
| Vinyl Chloride | >5 X MDL | >5 X MDL | >60% |
| VOC scan (with chloriates) | >5 X MDL | >5 X MDL | >60% |
| Metals | >5 X MDL | >5 X MDL | >40% |
| Bromide | >5 X MDL | >5 X MDL | >40% |
| Cyanide (total) | >5 X MDL | >5 X MDL | >40% |
| Fluoride (Total) | >5 X MDL | >5 X MDL | >40% |
| Nitrate | >5 X MDL | >5 X MDL | >40% |
| Nitrite | >5 X MDL | >5 X MDL | >40% |
| pH | >5 X MDL | >5 X MDL | >40% |
| Phenols | >5 X MDL | >5 X MDL | >40% |
| Phosphorous (Total) | >5 X MDL | >5 X MDL | >40% |
| Specific Conductance | >5 X MDL | >5 X MDL | >40% |
| Sulphur (Elemental) | >5 X MDL | >5 X MDL | >40% |
| Total Inorganic Carbon | >5 X MDL | >5 X MDL | >40% |
| Total Organic Carbon | >5 X MDL | >5 X MDL | >40% |

## 6.5 Field Blank Samples

A field blank (or equipment blank) is an aliquot of laboratory-supplied ultrahigh purity (UHP) water. The samples are prepared by the laboratory and shipped for immediate use in the field, where it is treated as an environmental sample in all aspects in both the field and laboratory. This includes the expose to sample collection apparatus, field ambient conditions and the addition of all preservatives in the field. In the lab, the field blank samples undergo exactly the same processing and analysis as any other sample submitted for the analytes of interest.

Field blank analysis is performed to identify contamination resulting from the combination of field sampling techniques, preservatives, sample shipping and laboratory analytical process. Examples of practices that could affect the measured analyte concentrations are:

| Field | Shipping | Laboratory |
|---|---|---|
| • Sampling methodologies;<br>• Sampling equipment used;<br>• Field filtration; and/or<br>• Sample preservation. | • Exposure to contaminant sources during shipping | • Glassware;<br>• Reagents; and/or<br>• Instrumentation. |

Low or non-detectable results in the field blank sample provide assurance that the results reported for samples provide assurance that results reported for samples analyzed in the sample submission associated with the field blank sample are not false positive results.

Alert limits for analytes in water are displayed in Table 6-1.

### 6.6 Trip Blank Sample

A trip blank sample is an aliquot of UHP water provided by the laboratory and shipped to the site with the other sample bottles. The trip blank is to remain unopened at the site and is shipped backed to the laboratory. It is treated as an environmental sample in all aspects in the laboratory, including undergoing exactly the same processing and analysis as any other sample submitted for the analytes of interest.

Trip blanks provide the necessary verification that the levels of analytes found in the samples are attributed to the samples and that the analyte concentrations are not elevated due to container contamination or other sources of transportation-induced contamination (shipping) and/or laboratory analytical process.

For laboratory supplied trip blanks, the laboratory generally retains an aliquot of the trip blank in the lab. If an issue with the result is noted, the laboratory can analyze the retained portion of the trip blank to ascertain whether the contamination originated from the laboratory or the field.

Alert limits for analytes in water are displayed in Table 6-1.

### 6.7 Laboratory Quality Control

The quality of a monitoring program is primarily dependent on the program design and the quality of the samples collected during the implementation of the program. It is also dependent on the quality of the laboratory analysis preformed on the samples. Thus, it is crucial to have both high quality field sampling methodologies and high quality laboratory analyses to obtain reliable data upon which the site conditions can be determined.

The laboratory selected to complete the analyses of samples collected must be certified by the Canadian Association for Laboratory Accreditation (CALA) and Standards Council of Canada (SCC). The laboratory QA/QC program must be followed to ensure that the sampling and analytical data were interpretable, meaningful and reproducible. Method blanks, control standards samples, certified reference material standards, method spikes, replicates, duplicates and instrument blanks are routinely analyzed as part of the QA/QC programs.

As an internal quality control measure, the certified laboratories routinely report the results of laboratory prepared duplicate analyses. The results of the laboratory QA/QC are reported in the laboratory certificates and if these criteria are not met, the laboratory will be asked to either re-analyze the affected samples or qualify the results. Laboratory QA/QC data must be reviewed

and verified to ensure that the laboratory internal QA/QC results fall within the lab's own specified acceptance criteria.

All QA/QC laboratory comments are to be reviewed and determine if the results are considered acceptable.

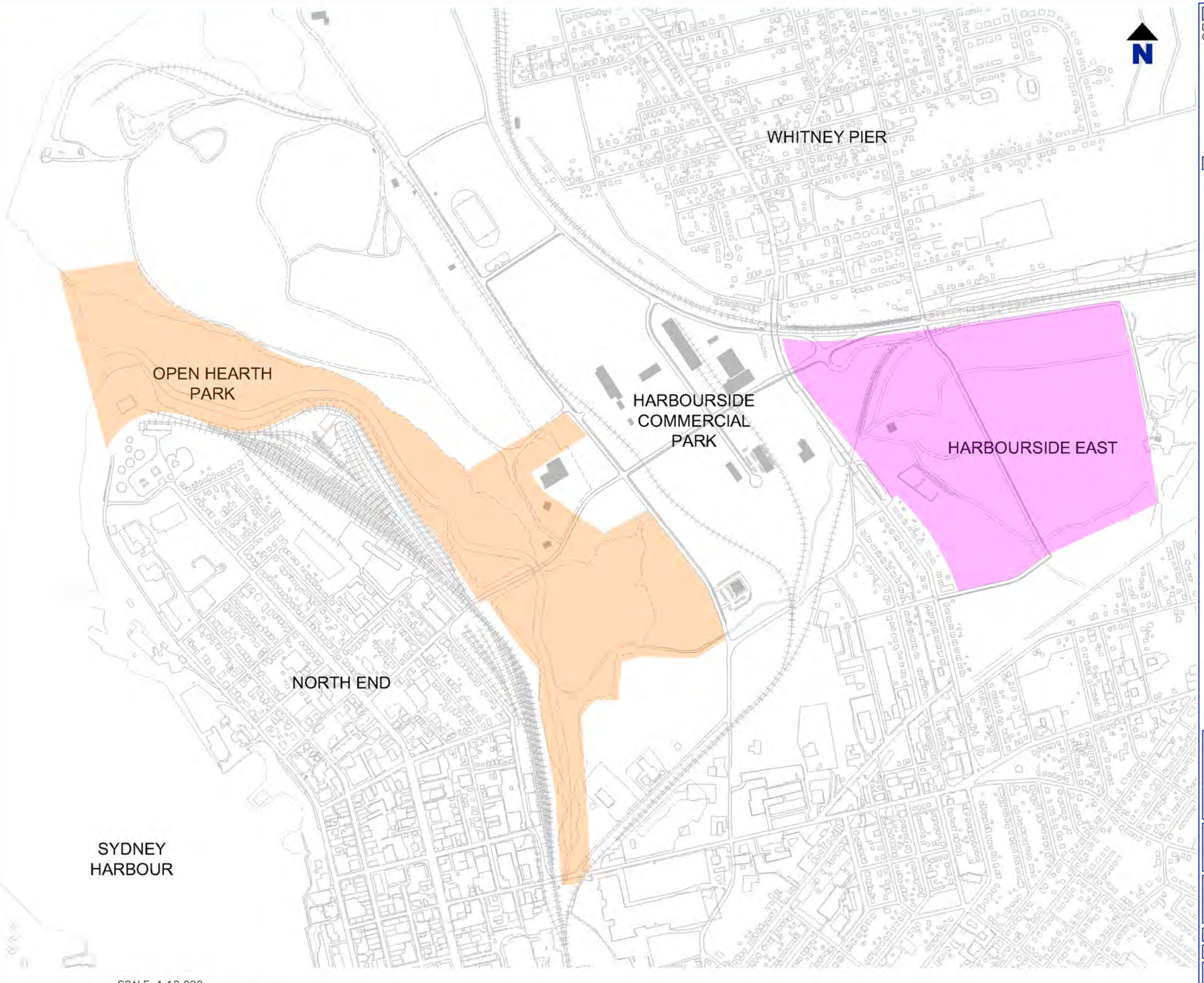
## 7.0 HEALTH AND SAFETY PLAN

The Province has prepared a site specific Assignment Health and Safety Plan (AHASP) conforming to the NSLI Master Health and Safety Plan. This document is available from the NSLI Safety Officer.

**DRAWINGS**

Nova Scotia Lands Inc.
Long Term Monitoring and Maintenance Plan

210.05479.00000.0029




NOTES

DRAWING COMPILED FROM AECOM DRAWING C06-DWG-N-002. REFER TO ORIGINAL DRAWING FOR DETAILS

LEGEND

- HARBOURSIDE EAST SITE INSPECTION BOUNDARY
- OPEN HEARTH PARK SITE INSPECTION BOUNDARY

SCALE 1:10,000
WHEN PLOTTED AT 11 x 17 PAGE SIZE
0 100 200 400 600 m

THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.

NOVA SCOTIA LANDS INC.
SYDNEY, NS

Report: SYDNEY TAR PONDS AND COKE OVENS REMEDIATION PROJECT LONG TERM MAINTENANCE AND MONITORING PLAN

Drawing: SITE PLAN

| Date | Scale | Drawing No. |
|---|---|---|
| August 29, 2013 | AS SHOWN | 1 |
| File Name: S_210-05479-00-VV3 | Project No.: 210.05479.00000 | |

SLR

EXISTING BARRIER

SYDNEY HARBOUR

BATTERY POINT

NORTH POND

MAIN CHANNEL

CNR

NORTH END SYDNEY

FERRY STREET

SPAR ROAD

HARBOURSIDE COMMERCIAL PARK

VICTORIA ROAD

SYSCO SITE

COKE OVEN BRICK CONVEYOR

STABLE DRIVE

NORTH POND

SOUTH POND

FORMER COOLING POND

INGLIS STREET

CNR

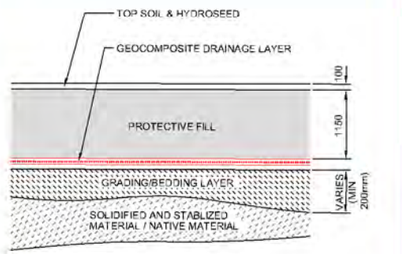
SOUTH PORTION OF EAST BANK OF MAIN CHANNEL

NOTES

DRAWING COMPILED FROM AECOM DRAWING TP7-N-016. REFER TO ORIGINAL DRAWING FOR DETAILS

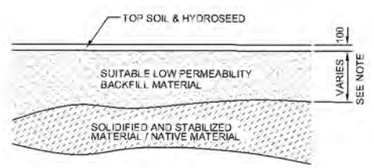
LEGEND

- APPROXIMATE CAP LIMIT
- SURFACE CAP TYPE 1
- SURFACE CAP TYPE 2




SURFACE CAP - TYPE 1

INSET SCALE 1:100




NOTE:
1. MIN. 1.15m THICKNESS OF SUITABLE LOW PERMEABILITY BACKFILL MATERIAL WHERE S/S PRESENT

SURFACE CAP - TYPE 2

INSET SCALE 1:100

SCALE 1:7500
WHEN PLOTTED AT 11 x 17 PAGE SIZE
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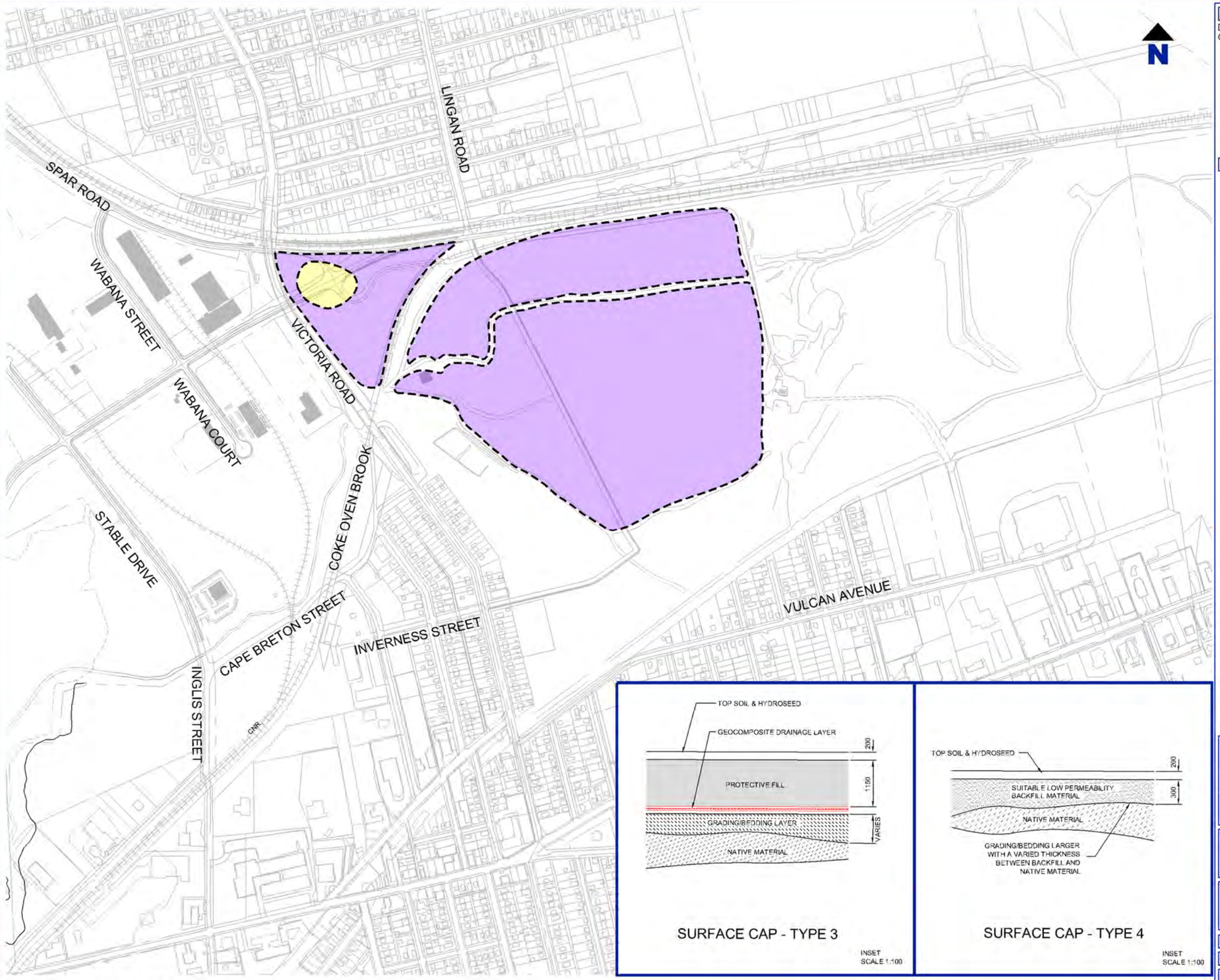
NOVA SCOTIA LANDS INC.
SYDNEY, NS

Report: SYDNEY TAR PONDS AND COKE OVENS REMEDIATION PROJECT LONG TERM MAINTENANCE AND MONITORING PLAN

Drawing: OPEN HEARTH PARK CAPPING DETAIL

| Date | July 12, 2013 | Scale | AS SHOWN | Drawing No. | 2 |
|---|---|---|---|---|---|
| File Name | S_210-05479-00-VV1 | Project No. | 210.05479.00000 | | |

SLR

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SURFACE CAP - TYPE 3

INSET
SCALE 1:100




SURFACE CAP - TYPE 4

INSET
SCALE 1:100

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**NOTES**

DRAWING COMPILED FROM AECOM DRAWING C06-DWG-N-002. REFER TO ORIGINAL DRAWING FOR DETAILS

**LEGEND**

- APPROXIMATE CAP LIMIT
- SURFACE CAP TYPE 3
- SURFACE CAP TYPE 4

NOVA SCOTIA LANDS INC.
SYDNEY, NS

Report: SYDNEY TAR PONDS AND COKE OVENS REMEDIATION PROJECT LONG TERM MAINTENANCE AND MONITORING PLAN

Drawing: HARBOURSIDE EAST CAPPING DETAIL

| | | |
|---|---|---|
| Date: July 18, 2013 | Scale: AS SHOWN | Drawing No.: 3 |
| File Name: S_210-05479-00-VV2 | Project No.: 210.05479.00000 | |

SLR


SCALE 1:7500
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NOTES

DRAWING COMPILED FROM AECOM DRAWING C06-DWG-N-002. REFER TO ORIGINAL DRAWING FOR DETAILS

LEGEND

- OPEN HEARTH PARK SITE INSPECTION BOUNDARY
- STARTING POINT
- INSPECTION POINT
- ROUTE

NOVA SCOTIA LANDS INC.
SYDNEY, NS

Report: SYDNEY TAR PONDS AND COKE OVENS REMEDIATION PROJECT LONG TERM MAINTENANCE AND MONITORING PLAN

Drawing: OPEN HEARTH PARK INSPECTION ROUTE

| | | |
|---|---|---|
| Date: August 29, 2013 | Scale: AS SHOWN | Drawing No.: 4 |
| File Name: S_210-05479-00-VV4 | Project No.: 210.05479.00000 | |

SLR


SCALE 1:7500
WHEN PLOTTED AT 11 x 17 PAGE SIZE
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NOTES

DRAWING COMPILED FROM AECOM DRAWING C06-DWG-N-002. REFER TO ORIGINAL DRAWING FOR DETAILS

LEGEND

- HARBOURSIDE EAST SITE INSPECTION BOUNDARY
- (S) STARTING POINT
- ■ INSPECTION POINT
- ROUTE

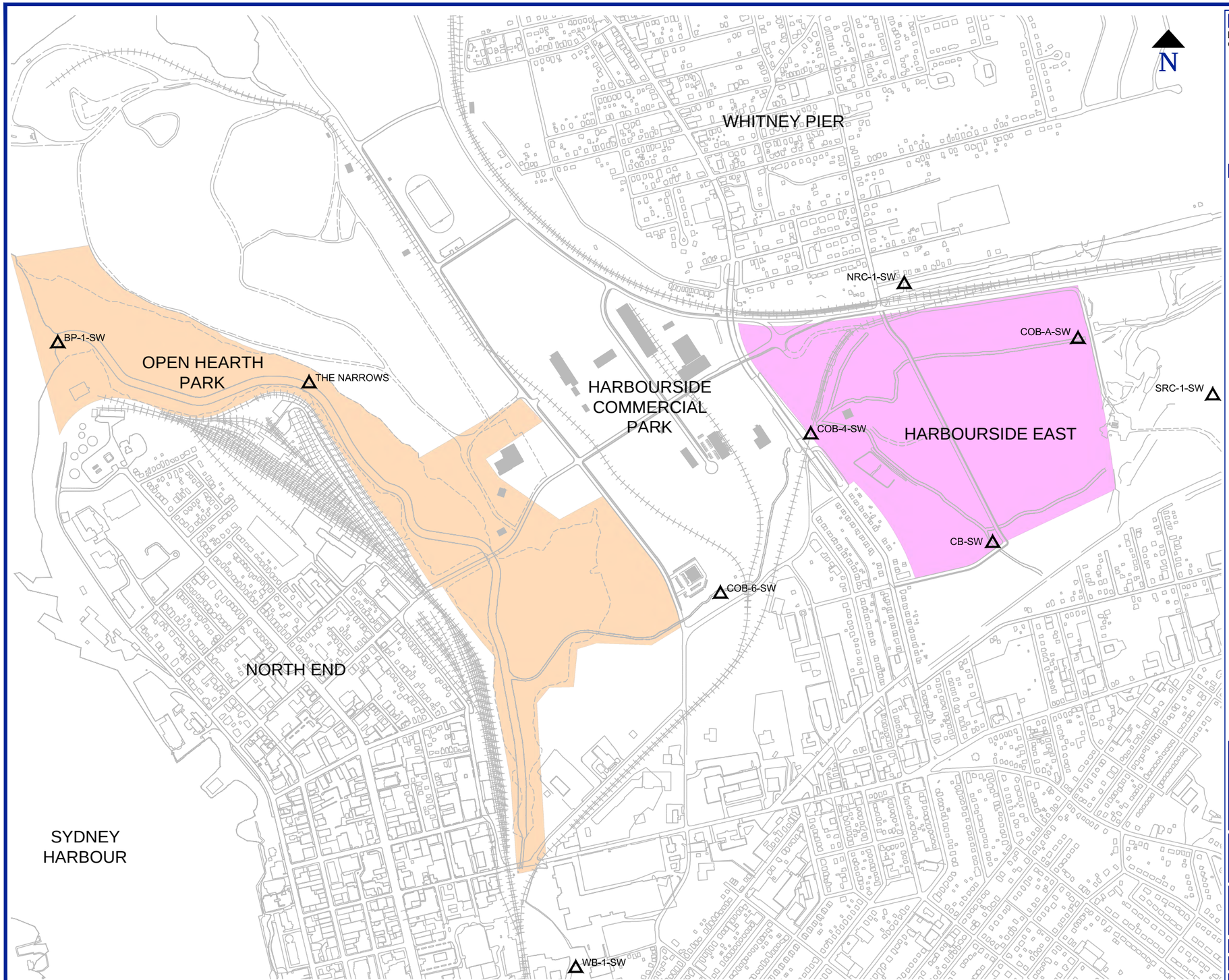
NOVA SCOTIA LANDS INC.
SYDNEY, NS

Report: SYDNEY TAR PONDS AND COKE OVENS REMEDIATION PROJECT LONG TERM MAINTENANCE AND MONITORING PLAN

Drawing: HARBOURSIDE EAST INSPECTION ROUTE

| | | |
|---|---|---|
| Date: August 29, 2013 | Scale: AS SHOWN | Drawing No.: 5 |
| File Name: S_210-05479-00-VV5 | Project No.: 210.05479.00000 | |

SLR

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NOTES

DRAWING COMPILED FROM AECOM DRAWING C06-DWG-N-002. REFER TO ORIGINAL DRAWING FOR DETAILS

LEGEND

- HARBOURSIDE EAST SITE INSPECTION BOUNDARY
- OPEN HEARTH PARK SITE INSPECTION BOUNDARY
- SURFACE WATER SAMPLE LOCATIONS

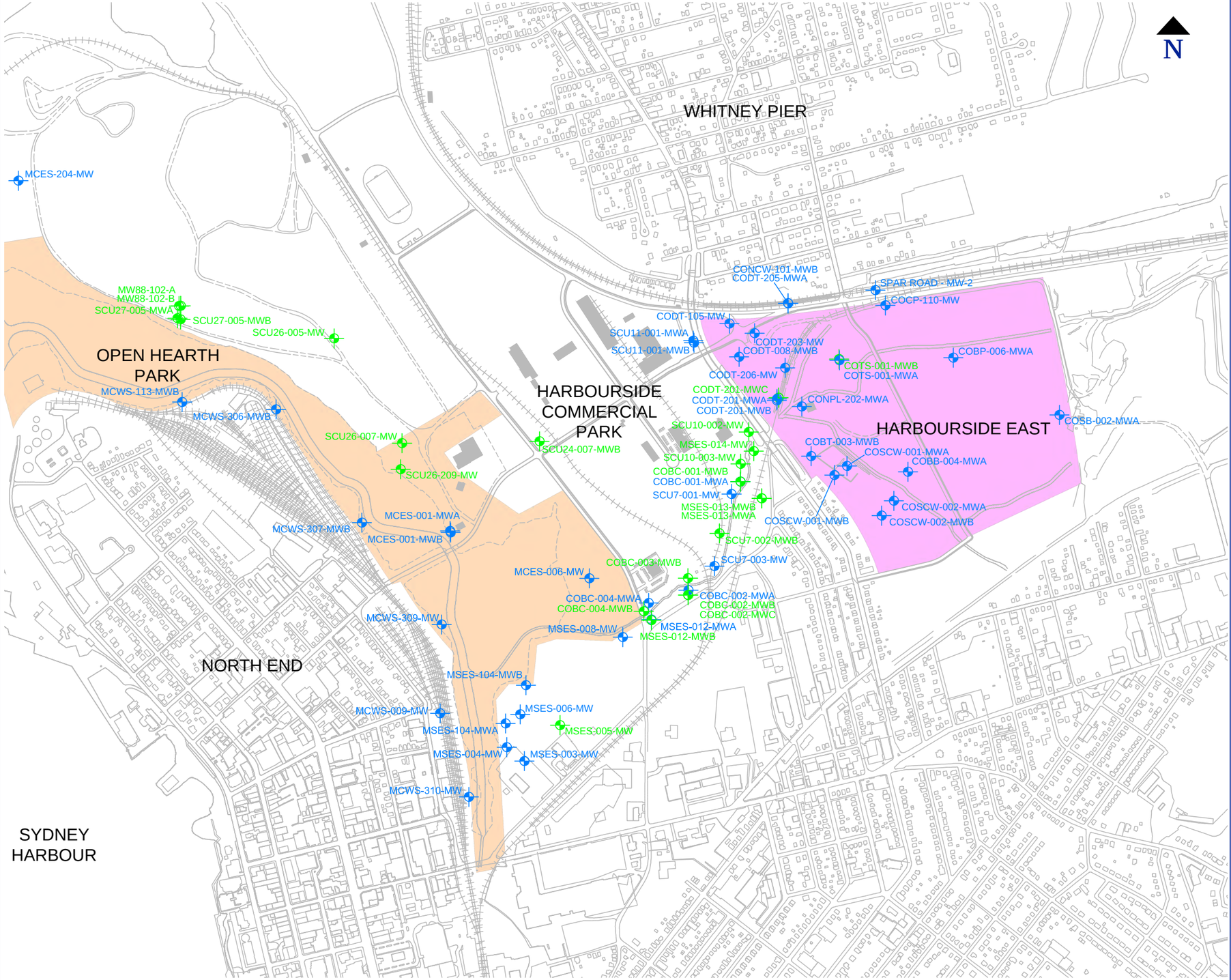
NOVA SCOTIA LANDS INC.
SYDNEY, NS

Report: SYDNEY TAR PONDS AND COKE OVENS REMEDIATION PROJECT LONG TERM MAINTENANCE AND MONITORING PLAN

Drawing: SURFACE WATER SAMPLING LOCATIONS

Date: September 12, 2013
Scale: AS SHOWN
Drawing No.: 6
File Name: S_210-05479-00-VV6
Project No.: 210.05479.00000

SLR




NOTES

DRAWING COMPILED FROM AECOM DRAWING C06-DWG-N-002. REFER TO ORIGINAL DRAWING FOR DETAILS

LEGEND

- HARBOURSIDE EAST SITE INSPECTION BOUNDARY
- OPEN HEARTH PARK SITE INSPECTION BOUNDARY
- SAMPLE
- WATER LEVEL

THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.

SCALE 1:10,000
WHEN PLOTTED AT 11 x 17 PAGE SIZE
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NOVA SCOTIA LANDS INC.
SYDNEY, NS

Report: SYDNEY TAR PONDS AND COKE OVENS REMEDIATION PROJECT LONG TERM MAINTENANCE AND MONITORING PLAN

Drawing: GROUNDWATER MONITORING LOCATIONS

| | | |
|---|---|---|
| Date: September 12, 2013 | Scale: AS SHOWN | Drawing No.: 7 |
| File Name: S_210-05479-00-VV7 | Project No.: 210.05479.00000 | |

SLR

**APPENDIX A**
**Agreement**

Nova Scotia Lands Inc.
Long Term Monitoring and Maintenance Plan

210.05479.00000.0029


# Sydney Tar Ponds and Coke Ovens Remediation Project

## Long Term Maintenance and Monitoring Agreement

March 29, 2012

www.pwgsc-tpsgc.gc.ca

Canada

NOVA SCOTIA

# LONG TERM MAINTENANCE AND MONITORING AGREEMENT

**THIS AGREEMENT made as of the 29th day of March, A.D., 2012**

**Between**

**Her Majesty The Queen in Right of Canada, as represented by the Federal Minister of Public Works and Government Services Canada ("Canada");**

**And**

**Her Majesty The Queen in Right of the Province of Nova Scotia, as represented by the Minister of Transportation and Infrastructure Renewal ("Nova Scotia")**

**WHEREAS:**

A. The Government of Canada and the Province of Nova Scotia, by Memorandum of Agreement executed on May 12, 2004 ["MOA"], agreed to jointly participate in a project for the remediation of the Sydney Tar Ponds and Coke Ovens Sites a profile of which project is described in Schedule "A" attached [referred to herein as the "Project"];

B. After the execution of the MOA the Parties entered into an Interim Cost-Share Agreement [referred to herein as ICSA] on September 9, 2005 and thereafter conducted certain Preliminary and Preventative Works under the ICSA;

C. On May 31, 2007, Treasury Board authorized Canada to enter into an agreement with Nova Scotia in respect to the Project including funding by way of contribution of up to Two Hundred and Eighty Million Dollars [$280,000,000];

D. On July 20, 2007, the Governor in Council for the Province of Nova Scotia by OIC 2007-405 authorized Nova Scotia to enter into an agreement with Canada including funding by way of contribution of One Hundred and Twenty Million Dollars [$120,000,000];

E. Pursuant to the MOA, the Parties entered into a Final Cost Share Agreement ["FCSA"] dated September 27, 2007, which contained the following provisions:

> FCSA Article 4, provisions for a cost shared undertaking of the Project as set forth in Schedule "A" therein and in more detail in Schedule "B" therein [which work is herein referred to as the "Project Works"] and which includes as item number 5

the obligation for: "the provision of future maintenance and monitoring of the Sites".

FCSA Article 7.3(*g*), provisions giving the Project Management Committee [PMC] the authority for: "*amending the terms and conditions of this Agreement and any of the Implementation Agreements to enable the successful completion of the project*;"

And, the PMC has by way of AM 2012-04 dated the 23rd day of March, 2012, amended FCSA Article 11.12, to provide the following provisions:

> *"Prior to the Completion Date, the Parties shall use all reasonable efforts to enter into an agreement describing in detail the provisions for future on-going maintenance and monitoring of the Sites. Upon execution of such agreement on or before the Completion Date, Canada's share or, any portion thereof, of the future on-going maintenance and monitoring costs of the Sites shall be paid in accordance with the said LTMM agreement from Canada's share of its contribution as set forth in Section 4.3 therein, to Nova Scotia and, Nova Scotia shall hold such amount and make payments there from for the payment of Canada's share of such costs for 25 years after the Completion Date."*

F. The PMC has reviewed the project schedule and the progress of the remediation and has concluded that significant portions of the Project have proceeded ahead of schedule and, are complete. As well, pursuant to Section 1.8 of the MOA, specific remediated lands have been transferred to Nova Scotia ahead of schedule. With completion of the transfer of these remediated lands, pursuant to Section 1.8 of the MOA, Nova Scotia is bound to assume all responsibility and liability for the long term maintenance and monitoring of these remediated lands. It is thus fair and equitable to advance partial contribution of the long term maintenance and monitoring funds to Nova Scotia during the fiscal year 2011-2012.

G. The FCSA further provided in Schedules "A" and "C" that Canada is obligated to provide a Fifteen Million Dollar ($15,000,000) contribution to Nova Scotia for the purpose of Nova Scotia carrying out the long term maintenance and monitoring of the Completed Project Works.

H. Pursuant to the obligation in the FCSA [noted in Recital E above], and given that certain Site remediations are complete and that there are certain maintenance and monitoring obligations that have arisen in respect to those Sites and that Nova Scotia has taken title to significant portions of those Sites (noted in Recital F above], the PMC has agreed that Canada shall pay to Nova Scotia Seven Million and Five Hundred Thousand Dollars [$7,500,000] as payment towards its obligations in respect to any remediated portions of the Project Works on the terms and conditions contained herein.

Therefore in consideration of the principles, undertakings and mutual covenants set out

previously in the MOA, and detailed in the FCSA and, the respective reciprocal commitments described herein, Canada and Nova Scotia, agree as follows:

## ARTICLE 1 – DEFINITIONS, SCHEDULES AND INTERPRETATION

### Section 1.0 Definitions

In this Agreement, including the recitals, the following terms shall have the meanings ascribed as follows:

"Activity[ies]" means the work performed and the procurement of the goods and services and those actions to be carried out by Nova Scotia pursuant to this Agreement as identified in the LTMM Project Works described in Schedule "B", as amended from time to time by further agreement of the Parties;

"Agreement" means this Long Term Maintenance and Monitoring Agreement, all agreements incorporated by reference and all Schedules attached to it, as may be amended from time to time by further agreement of the Parties;

"Business Day" means a day other than a Saturday, Sunday or statutory holiday in Nova Scotia;

"Catastrophic Impairment" means a catastrophic event as defined in the MOA;

"Certificate of Project Completion" means the certificate whereby the Independent Engineer certifies all Project Works have been completed, saving and excepting future on-going maintenance and monitoring;

"Coke Ovens Site" means the site, including the Coke Ovens Brook Connector, more particularly described in FCSA Schedule A;

"Completion Date" means the date identified in the FCSA when the Independent Engineer certifies all Project Works have been completed, saving and excepting future on-going maintenance and monitoring;

"Completed Project Works" means those elements of Project Works that have been completed as of March 31, 2014, or earlier;

"Contribution" means a payment for a specified purpose which is subject to being accounted for and audited pursuant to this Agreement;

"Eligible Costs" means any and all of the costs incurred for the Activities comprising the LTMM Project Works described in Schedule "B", costed in Schedule "C", but not including those assets purchased as part of the Project Works;

"FCSA" means the Final Cost Share Agreement entered into between the Parties on the 27th day of September, 2007;

"Federal Minister" means the Federal Minister of Public Works and Government Services Canada;

"Fiscal Year" means a fiscal year from April 01 until March 31;

"Independent Engineer" means the Independent Engineer as defined in the FCSA;

"Independent External Accredited Accountant" means a person who is a professional accountant and is independent of either party to this Agreement;

"Long Term Maintenance and Monitoring Agreement" means this Agreement and any amendments or revisions hereto;

"LTMM Project" means the narrative description of all elements of the long term maintenance and monitoring of the remediated Project lands which the Parties intend to be funded under this Agreement as set forth in Schedules "B" and costed in schedule "C" as amended from time to time;

"LTMM Project Works" means any and all of the Activities described in Schedule "B" which qualify for payment as Eligible Costs in Schedule "C";

"MOA" means the Memorandum of Agreement between Canada and Nova Scotia respecting the Sydney Tar Ponds and Coke Ovens Remediation Project, dated May 12, 2004;

"Party" means either Canada or Nova Scotia, as the case may be;

"Parties" unless specified otherwise, means Canada and Nova Scotia;

"Person" means any individual, company, corporation, partnership, firm, trust, sole proprietorship, government or government agency, authority or entity, however designated or constituted;

"PMC" means the Project Management Committee as established under Section 7 of the ICSA and continued under Section 7 of the FCSA;

"Project" means the project for the remediation of the Sydney Tar Ponds and Coke Ovens Sites which project was the subject of the Treasury Board of Canada approval dated May 31, 2007 and the Project Narrative Description of that TB submission is attached as Schedule A hereto;

"Project Works" means the work generally outlined in Schedule "A" of the FCSA and more particularly described in Schedule "B" of the FCSA;

"Provincial Minister" means the Minister for Transportation and Infrastructure Renewal for the Province of Nova Scotia who is currently also the Provincial Minister responsible for the Sydney Tar Ponds Agency;

"Remediated Sites" means the Sites or portions thereof that are under maintenance and monitoring as of December 31, 2011;

"Sites" means both the former Sydney Tar Ponds Site and the former Coke Ovens Site as defined by Section 1.1 of the MOA and section 1 of the FCSA and in accordance with the spatial boundaries of the Sites subject to the Panel's environmental assessment review; and,

"Sydney Tar Ponds Site" means the site more particularly described in FCSA schedule A.

**Section 1.02 Schedules**

1.02.01 The following schedules are part of this Agreement:

| | |
|---|---|
| Schedule "A" | Profile of the Project from TB Submission and FCSA |
| Schedule "B" | Project Narrative Description for LTMM Project |
| Schedule "C" | Eligible Costs |
| Schedule "D" | Reporting Requirements and Payment Procedures |

(collectively, the "Schedules")

**Section 1.03 Interpretation**

1.03.01 In respect to all aspects of the LTMM Agreement and the maintenance and monitoring of the Completed Project Works and the Remediated Sites, and to no greater extent; this Agreement, subject to the following proviso, shall supersede the provisions of the MOA and the FCSA and otherwise the provisions of the MOA and the FCSA shall continue to apply to the Completed Project Works.

1.03.02 To the extent necessary to give full effect to the long term maintenance and monitoring of the Completed Project Works and the Remediated Sites, in the event of any conflict between this Agreement and the MOA or the FCSA, the priority of the documents for purposes of interpretation and resolving conflicts in meaning shall be [a] this Agreement; [b] the MOA; [c] and the FCSA; [d] provided that where a term or provision of the MOA or the FCSA has clearly and intentionally been restated in this Agreement, the restated term or provision shall govern; otherwise the interpretation of documents shall be governed by the provisions in the FCSA.

1.03.03 Subject to 1.03.01 and 1.03.02 immediately above, in the event of any conflict between any of the Schedules and the main body of this Agreement, the provisions of the main body of this Agreement shall govern.

1.03.04 Subject to 1.03.01 and 1.03.02 immediately above in the event of any conflict between this Agreement, including the Schedules, and any Implementation Agreement, this Agreement shall govern.

1.03.05 In respect of the determination of whether any Activity or Eligible Cost is in the nature of long term maintenance and monitoring Activity or an Eligible Cost, the matter shall be determined between the Deputy Minister of NSTIR, and the Regional Director General, PWGSC.

## ARTICLE 2 – TERM

### Section 2.01 Term of Agreement

2.01.01 This Agreement shall come into effect on the latter of the date of signing or March 31, 2012, and in respect to the Completed Project Works, it shall terminate on March 31, 2039.

## ARTICLE 3 – CONTRIBUTION

### Section 3.01 Contribution

3.01.01 Subject to the terms and conditions of this Agreement, Canada agrees to pay to Nova Scotia, this interim payment due and payable to Nova Scotia for the long term maintenance and monitoring of the Completed Project Works and the Remediated Sites pursuant to; [a] the contractual obligations contained in the FCSA referred to above in the recital "E" , and [b] further to the amendment to the FCSA agreed to by the PMC on March 23, 2012 above, being a Contribution from Canada to Nova Scotia in the amount of Seven Million and Five Hundred Thousand Dollars ($7,500,000) in Canadian currency.

3.01.02 It is agreed that the balance of Canada's long term maintenance and monitoring obligation of Seven Million Five Hundred Thousand Dollars ($7,500,000) shall be paid to Nova Scotia on the Completion Date on the same terms and conditions herein contained, concurrent with the transfer of the remainder of the Sites currently owned by Canada and accompanied by the Certificate of Project Completion.

## ARTICLE 4 – ELIGIBLE COSTS AND PAYMENT

### Section 4.01 Eligible Costs

4.01.01 The Contribution shall only be applied in respect of an expenditure directly related to the Activity identified in the LTMM Project Work identified in Schedule "B" and identified as Eligible Cost in Schedule "C".

**Section 4.02 Ineligible Costs**

4.02.01 Notwithstanding Subsection 4.01.01, expenditures shall not qualify as an Eligible Cost if it is an expenditure:

(a) incurred or paid prior to the commencement of, or incurred after the termination of, this Agreement;

(b) relating to the purchase of land;

(c) in respect of activity which has been committed to prior to the effective date of this agreement or which has been completed subsequent to the completion date of this agreement;

(d) which has been or will be paid for by PWGSC by separate agreement or arrangement between the Parties; or,

(e) which is an expenditure paid to a third party which contains any element of mark-up by, or profit to, Nova Scotia.

**Section 4.03 Payment of Contributions**

4.03.01 The Federal Minister shall pay a Contribution of Seven Million Five Hundred Thousand Dollars ($7,500,000) to Nova Scotia on or before March 31, 2012, pursuant to the provisions of Section 3.01 and, the balance of the Contribution on or before March 31,2014 pursuant to the provisions of Section 11.12 of the FCSA.

4.03.02 Nova Scotia will provide ongoing reports of the maintenance and monitoring Activity to Canada together with an accounting of expenditures in accordance with the provisions of this Agreement including Schedule "D".

**Section 4.04 Acquisition and Disposal of Assets**

4.04.01 Any assets acquired by Nova Scotia, which may be determined to be an Eligible Cost and which are claimed, must be retained by Nova Scotia for purposes related to Activities funded by this Agreement. In the event that they are disposed of, the proceeds of disposition must be reapplied to the Long Term Maintenance and Monitoring fund.

**ARTICLE 5 – ACCOUNTING RECORDS, FINANCIAL REPORTS AND AUDIT**

**Section 5.01 Contribution Kept in Separate Account**

5.01.01 Nova Scotia shall maintain the funds provided on account of the Contribution. Nova Scotia shall, at a minimum, maintain separate ledger accounts for all revenues and

expenditures. Any interest earned on funds paid to Nova Scotia by Canada under the terms of this Agreement is deemed to form a part of the Contribution provided under this Agreement and shall be applied towards Eligible Costs directly related to any Activity being funded by the Contribution.

**Section 5.02 Accounting Records**

5.02.01 Nova Scotia shall ensure that proper and accurate accounts and records are prepared and kept in accordance with generally accepted accounting principles, of the work undertaken pursuant to this Agreement, in particular, by keeping appropriate invoices, statements, receipts and vouchers and shall, upon reasonable notice, make such accounts and records available to Canada for inspection and audit.

5.02.02 Nova Scotia shall provide all facilities required for inspection and audit, and shall make available to the Federal Minister of Public Works and Government Services Canada, the information that the Minister may need for those purposes.

5.02.03 Accounts and records relating to the administration of this Agreement shall be kept for at least three (3) years after the final settling of the LTMM Project accounts.

5.02.04 Canada may audit the amount of all claims for reimbursement relating to a LTMM Project carried out under this Agreement and the accounts and records relating to that LTMM Project.

5.02.05 Nova Scotia warrants that all agreements entered into by it or anyone on its behalf with any 3rd party contractor in fulfillment of its obligations hereunder, shall include clauses binding the 3rd party contractor to the same standards of accountability as identified in this Article 5.

**ARTICLE 6 – VERIFICATION**

**Section 6.01 Verification**

6.01.01 Within 120 days of each fiscal year end, Nova Scotia shall submit, in accordance with Schedule D, their annual report to the Regional Director General, Public Works and Government Services Canada.

6.01.02 At the completion of the LTMM Agreement, Nova Scotia shall certify, in accordance with Schedule D, compliance with the terms and conditions of this Agreement.

## ARTICLE 7 – PARLIAMENTARY APPROPRIATION

### Section 7.01 Contribution Subject to Appropriation

7.01.01 Nothing herein contained shall obligate Canada or the Federal Minister to make any payment under this Agreement unless and until the necessary funds have been voted by Parliament in that behalf.

## ARTICLE 8 – REPAYMENT

### Section 8.01 Cessation of Activity

8.01.01 If, at any time during the period of this Agreement, Nova Scotia ceases to carry on with the Activities or intends to terminate the Activities, Nova Scotia shall remit to Canada an amount equal to the amount of the Contribution paid by Canada under Article 3 less any Eligible Costs paid or payable by Nova Scotia.

### Section 8.02 Early Termination or Default other than under Section 8.01.01

8.02.01 Subject to Subsection 8.01.01, where this Agreement is terminated, prior to the end of the term specified in Article 2, for default under Article 9 for reasons other than ceasing to carry on the Activity, Nova Scotia shall remit to Canada any amount owed under Subsection 8.03.01.

### Section 8.03 Interim Settlement

8.03.01 The Parties acknowledge that the payment to Nova Scotia of the funds identified in Article 3 herein is an interim settlement only of Canada's Contribution under the MOA and the FCSA in respect to the long term maintenance and monitoring obligations Nova Scotia has agreed to accept for the Completed Project Works and the Remediated Sites and the final settlement of all Canada's Contribution under the FCSA including any contribution for future maintenance and monitoring obligations shall be settled upon the Completion Date in accordance with the FCSA and the MOA.

8.03.02 Nova Scotia agrees that upon receipt of

(a) the portion of the Contribution referred to in clause 3.01.01, it shall be responsible for any contemplated future development and any future impact to or on the Remediated Sites from such development as well as all ongoing future maintenance and monitoring of the Remediated Sites; and,

(b) the portion of the Contribution referred to in clause 3.01.02, it shall be responsible for any contemplated future development and any future impact to or on the Sites from such development as well as all ongoing future maintenance and monitoring of the Sites.

8.03.03 Further to the provisions of the MOA the determination of what constitutes a Catastrophic Impairment shall be made by an independent engineer mutually agreed to by the Parties, acting reasonably.

8.03.04 Nova Scotia shall remit to Canada any amount paid on account of an expenditure which is not an Eligible Cost, any unexpended amount of the Contribution and any amount of the Contribution repayable to Canada pursuant to any other agreement between the Parties hereto.

## ARTICLE 9 – DEFAULT

### Section 9.01 Default

9.01.01 If, during the term of this Agreement, Nova Scotia is in default of any provision of this Agreement or of any provision of any other agreement between the parties hereto and such default continues for a period of thirty (30) days after notice by Canada to Nova Scotia specifying the nature of the default and requiring the default to be remedied, Canada may, in addition to any other remedies available to Canada, take any one or more of the following actions:

(i) terminate any obligation of Nova Scotia under this Agreement by giving thirty (30) days notice to Nova Scotia; and,
(ii) require Nova Scotia to repay to Canada forthwith, on demand for payment issued by the Federal Minister, all or any portion of the amount of the Contribution in accordance with Article 8.

## ARTICLE 10 – DEBTS DUE TO CANADA

### Section 10.01 Debts Due to Canada

10.01.01 Any amount owed to Canada under this Agreement shall constitute a debt due to Canada and Nova Scotia shall, on demand for payment issued by the Federal Minister, pay all such amount forthwith to Canada.

### Section 10.02 Interest Due on Debts Due to Canada

10.02.01 In accordance with the *Interest and Administrative Charges Regulations*, SOR/96-188, in all cases where there is a debt due to Canada, interest calculated and compounded monthly at the average bank rate plus three per cent [3%] is payable on that amount and accrues during the period beginning on the due date and ending on the day on which payment is received by Canada or a duly authorized agent of Canada.

**Section 10.03 Set-Off**

10.03.01 Where applicable, and at Canada's sole discretion and in addition to any other remedies available to Canada, the amount of any debt due to Canada may be deducted from or offset against any amounts payable by Canada to Nova Scotia.

## ARTICLE 11 – NO PARTNERSHIP, JOINT VENTURE OR AGENCY

**Section 11.01 No Partnership, Joint Venture or Agency**

11.01.01 Canada and Nova Scotia expressly disclaim any intention to create a partnership, joint venture or agency. It is understood, acknowledged and agreed that nothing contained in this Agreement nor any acts of Canada or Nova Scotia shall constitute or be deemed to constitute Canada and Nova Scotia as partners, joint venturers or principal and agent in any way or for any purpose. Nova Scotia shall not represent or hold itself out to be an agent of Canada. No party shall have any authority to act for or to assume any obligations or responsibility on behalf of the other party.

11.01.02 For greater certainty, Canada assumes no responsibility for any liability arising to Nova Scotia as a result of the act or omission of Nova Scotia or its agents which are the basis for any finding that Nova Scotia or Her agent is a partner of, joint venturer with, or principal of Canada.

## ARTICLE 12 – LIABILITY FOR COMPLETED PROJECT WORKS

**Section 12.01 Future Liability**

12.01.01 Canada and Nova Scotia agree that the future liability, as between them, regardless of the origin of the claim, in respect to the Completed Project Works will be addressed and settled in accordance with the provisions of the MOA and the FCSA as they may apply, *mutatis mutandis,* and the laws of Nova Scotia and Canada; and, in the event of disagreement between them on any future issue of liability the matter shall be resolved in the same manner as disputes referenced in Section 1.03.05 of this Agreement.

## ARTICLE 13 – GENERAL PROVISIONS

**Section 13.01 Environmental Issues and Restrictive Covenants**

13.01.01 Prior to the involvement in any related work or development by any persons, firm, business or other developer, Nova Scotia shall ensure that they are made aware, take account of, and operates within, the limits of [a] all known environmental conditions of the structures; [b] all related infrastructure on the Sydney Tar Ponds and Coke Ovens Sites; [c] as well as any and all geo-technical conditions; [d] institutional limits; or, [e] any restrictive covenants that may be imposed on Nova Scotia or the Completed Project Works pursuant to this Agreement or pursuant

to any conveyancing document or from any other source. In addition, such persons, firm, business or other developer be required by Nova Scotia to conduct the necessary due diligence.

13.01.02 Nova Scotia agrees that it shall take all steps necessary to protect the Completed Project Works from [a] all environmental contamination; [b] Industrial development; [c] as a location temporary or otherwise of any toxic material; and, [d] from any use that would detract from the preservation of the Completed Project Works.

**Section 13.02 Entire Agreement**

13.02.01 This Agreement sets forth the entire agreement between the parties concerning the subject matter hereof and no representation or warranty expressed, implied or otherwise is made by Canada to Nova Scotia or by Nova Scotia to Canada except as expressly set out in this Agreement or in any other agreements referred to in the Agreement.

**Section 13.03 Subdivisions**

13.03.01 Unless otherwise stated, a reference in this Agreement by numerical or alphabetical designation to an Article, Section, Subsection, Paragraph, Subparagraph, Appendix or Schedule shall refer to the Article, Section, Subsection, Paragraph, Subparagraph, Appendix or Schedule bearing that designation in this Agreement.

**Section 13.04 Headings**

13.04.01 The division of this Agreement into Articles, Sections, Subsections, Paragraphs, and Subparagraphs and the insertion of headings are for convenience of reference only and shall not affect the construction or interpretation of this Agreement.

**Section 13.05 Number and Gender**

13.05.01 Words importing the singular number shall include the plural and words denoting the masculine gender shall include the feminine, if the context so requires.

**Section 13.06 Accounting Terms and Principles**

13.06.01 All accounting and financial terms used in this Agreement shall, except where otherwise provided either expressly or by necessary implication in this Agreement, be interpreted and applied in accordance with generally accepted accounting principles and generally accepted auditing standards in Canada as they exist from time to time.

13.06.02 Where the Canadian Institute of Chartered Accountants or any successor thereto includes a statement in its Handbook or any successor thereto on a method or alternative methods of accounting, such statement shall be regarded as the only generally accepted accounting principle and generally accepted auditing standard applicable to the circumstances

that it covers, and references herein to generally accepted accounting principles and generally accepted auditing standards shall be interpreted accordingly.

**Section 13.07 Business Day**

13.07.01 If the day on which any act or payment is required to be done or made under this Agreement is a day which is not a Business Day, then such act or payment shall be duly performed or made if done on the next following Business Day.

**Section 13.08 Schedules**

13.08.01 All capitalized words and phrases used in the attached Schedule shall have the same meanings as defined in this Agreement.

**Section 13.09 Statutes, Regulations and Rules**

13.09.01 Any reference in this Agreement to all or any part of any statute, regulation or rule shall, unless otherwise stated, be a reference to that statute, regulation or rule or the relevant part thereof, as amended, substituted, replaced or re-enacted from time to time.

**Section 13.10 Governing Law**

13.10.01 The Agreement is subject to the federal *Financial Administration Act.*

13.10.02 This Agreement shall be interpreted in accordance with the laws in force in the Province of Nova Scotia, subject always to any paramount or applicable federal laws. Nothing in this Agreement is intended to or shall be construed as limiting, waiving or derogating from any Federal Crown prerogative.

**Section 13.11 Construed Covenants**

13.11.01 All of the provisions and each obligation or agreement of this Agreement, even though not expressed as a covenant, are to be construed as covenants and agreements as though the words importing such covenants and agreements were used in each separate provision hereof.

**Section 13.12 House of Commons and Lobbyists**

13.12.01 No member of the House of Commons shall be admitted to any share or part of this Agreement or to any benefit to arise therefrom.

13.12.02 Any person lobbying on behalf of Nova Scotia would be subject to the provisions of the Lobbyist Registration Act.

**Section 13.13 Conflict of Interest**

13.13.01 No individual, for whom the post-employment provisions of the Conflict of Interest and Post-Employment Code for Public Office Holders (1994) or the Conflict of Interest and Post-Employment Code for Public Service (1985) apply, shall derive a direct benefit from this Agreement unless that individual is in compliance with the applicable post-employment provisions.

**Section 13.14 Notice**

13.14.01 All notices or other communications necessary for the purpose of this Agreement shall be in writing and delivered personally or by courier, or shall be sent by registered mail or by prepaid post or by facsimile, addressed

(a) in the case of the Federal Minister, to:
Regional Director General
Public Works and Government Services Canada
1713 Bedford Row
P.O. Box 2247
Halifax, NS B3J 3C9
Telecopier No.: (902 496-5041)

or to such other address or facsimile number or addressed to such other Person as the Federal Minister may, from time to time, designate in writing to Nova Scotia; and

(b) in the case of Nova Scotia, to:
Deputy Minister
Department of Transportation and Infrastructure Renewal
1672 Granville Street
PO Box 186
Halifax, NS B3J 2N2
Telecopier No.:( 902 424-4036)

or to such other address or facsimile number or addressed to such other Person as Nova Scotia may, from time to time, designate in writing to the Federal Minister .

13.14.02 Any notice or other communication is considered to have been received:

(a) in the case of facsimile, on actual receipt, and

(b) in all other cases, on the date of delivery.

If the postal service is interrupted, or threatened to be interrupted, or is substantially delayed, any notice shall be delivered personally or by facsimile.

**Section 13.15 Amendment**

13.15.01 This Agreement may be amended only by a written agreement signed by the parties.

**Section 13.16 Waiver**

13.16.01 The failure by any party to insist in any one instance upon the strict performance by the other party of obligations under this Agreement does not constitute a waiver or relinquishment of any such obligations as to any other instances, and the same continues in full force and effect.

13.16.02 No covenant or condition of this Agreement may be waived by any party except by the written consent of that party, and forebearance or indulgence by that party in any regard whatsoever and no matter how long does not constitute a waiver of the covenant or condition, and until performed or waived in writing that party is entitled to invoke any remedy available to that party under this Agreement or by law, despite the forebearance or indulgence.

**Section 13.17 Severability**

13.17.01 If, for any reason, any provision of this Agreement, other than any provision which is of fundamental importance to the arrangement between the parties, is to any extent held or rendered invalid or unenforceable, then the particular provision is deemed to be independent of and severed from the remainder of this Agreement, and all the other provisions of this Agreement are nevertheless to continue in full force and effect.

**Section 13.18 Assignment, Successors and Assigns**

13.18.01 Nova Scotia shall not transfer or assign its rights or obligations under this Agreement to any Person without:

(a) the prior written consent of Canada; and,

(b) an agreement executed by the proposed assignee whereby the proposed assignee agrees directly with Canada to be bound by all of the terms, covenants and conditions contained in this Agreement as if such proposed assignee had executed this Agreement, subject to Canada approving the agreement as to form and content.

13.18.02 Notwithstanding any other provision of this Agreement, and notwithstanding any assignment, Nova Scotia shall remain liable for all obligations to Canada under this Agreement.

13.18.03 No rights shall enure to the benefit of any transferee or assignee of Nova Scotia unless the transfer or assignment is consented to by Canada in accordance with Subsection 13.20.01.

13.18.04 This Agreement shall be binding upon and shall enure to the benefit of Canada and Her successors and assigns and Nova Scotia and its successors and permitted assigns.

13.18.05 Nothing expressed or implied in this Agreement or in any other agreement referred to, is intended to or shall be construed to confer on or to give any Person, other than the parties and their respective successors and permitted assigns, any rights or remedies under or by reason of this Agreement or any other agreement referred to.

**Section 13.19 Survival**

13.19.01 The rights and obligations of the parties contained in Articles 6, 7, 9, 11, 12, 13 and 14 shall survive the expiration or early termination of this Agreement.

**Section 13.20 Compliance with Regulatory Authorities**

13.20.01 All work performed by Nova Scotia in carrying out activities contemplated by this Agreement is to be in accordance with all regulatory authorities including relevant legislation pertaining to health and safety. Nova Scotia takes full responsibility for determining and meeting all regulatory compliance responsibilities.

**Section 13.21 Contra Proferentem Rule Not Applicable**

13.21.01 Should any provision of this Agreement require judicial interpretation, mediation or arbitration, it is agreed that the court, mediator or arbitrator interpreting or construing the same shall not apply a presumption that the terms thereof shall be more strictly construed against one party by reason of the rule of construction that a document is to be construed more strictly against the party who itself or through its agent prepared the same, it be agreed that both parties, directly or through their agents, have participated in the preparation hereof.

**IN WITNESS WHEREOF,** Nova Scotia and Canada have executed this Agreement as evidenced by the signatures of their duly authorized directors, officers or representatives as of the day and year hereinabove first written.

**SIGNED, SEALED AND DELIVERED**
in the presence of

Witness

**CANADA**, represented by the Regional Director General of Public Works and Government Services Canada

**NOVA SCOTIA,** as represented by the Deputy Minister of Transportation and Infrastructure Renewal

Witness

**SCHEDULE "A" TO THE LONG TERM MAINTENANCE AND MONITORING AGREEMENT ENTERED INTO BETWEEN CANADA AND NOVA SCOTIA DATED THE 29th DAY OF March, 2012**

## Project Narrative Description

**This Project narrative description is from SCHEDULE "A" of the Final Cost Sharing Agreement between Canada and Nova Scotia dated Sept 27, 2007.**

### A. Project Works

The description of the Project Works is set out in the document entitled "*Revised Alternative Pre-design Report*" dated January 24, 2007, prepared by the Design Engineer. Such description is incorporated by reference herein and is agreed by the Parties to be the "project description", as contemplated by Section 1.3 of the MOA and is further agreed, upon execution of this Agreement, to constitute the implementation agreement related to project description, as contemplated by Section 5.1, third paragraph, of the MOA.

The Project Works to be funded under this Agreement include, generally:

1. The in-place treatment of the contaminated material at the Sites using stabilization and solidification methods;
2. The control of surface water and of ground water at the Sites;
3. The subsequent engineered containment and capping of the surface of the Sites;
4. The restoration and landscaping of the Sites compatible with the natural surroundings and/or the placement of reasonable infrastructure for future uses; and,
5. The provision of future maintenance and monitoring of the Sites.

Upon completion of items 1 through 4 above, the Sites will have been remediated in accordance with the intent of the MOA notwithstanding any other meaning of the word remediation as provided in Section 1.3 of the MOA.

### B. Other Elements of the Project

Other elements of the Project to be funded under this Agreement are:

1. Aboriginal Engagement, as determined by the PMC;
2. Community Engagement, as determined by the PMC;
3. The budgeted operations of the Agency, approved by the PMC; and,
4. Measures to ensure compliance with the accepted Panel recommendations, as determined by the PMC and any other measures which the PMC considers necessary to ensure the successful completion of the Project.

**SCHEDULE "B" TO THE LONG TERM MAINTENANCE AND MONITORING AGREEMENT ENTERED INTO BETWEEN CANADA AND NOVA SCOTIA DATED THE 29th DAY OF March, 2012**

**Long Term Maintenance and Monitoring Requirements of the Project**

Maintenance and monitoring is the framework that confirms that the remediation activities goals are being met. In the case of the Sydney Tar Ponds and Coke Ovens Remediation Project, this includes but is not limited to the following:

1. Cap / Monolith Monitoring
   - Monolith
   - Battery Point Barrier
   - Channel(s)

2. Water Quality Monitoring
   - Surface/Groundwater

3. Regulatory Monitoring
   - NSE Permit
   - Any others that may arise

4. Cap Maintenance
   - Voids
   - Maintenance of community open space
   - Erosion Control

5. Site Covenants
   - Construction on the former Coke Ovens
   - Intrusive activities on the former Tar Ponds

6. Reporting
   - Annual

For greater certainty, the Long Term Maintenance and Monitoring program will be carried out in accordance with applicable standards and established regulatory requirements.

The Province, Nova Scotia Transportation and Infrastructure Renewal, shall develop a detailed Long Term Maintenance and Monitoring Plan on or before March 31, 2013.

**SCHEDULE "C" TO THE LONG TERM MAINTENANCE AND MONITORING AGREEMENT ENTERED INTO BETWEEN CANADA AND NOVA SCOTIA DATED THE March 29th DAY OF March , 2012**

**Eligible Costs**

Schedule C outlines Eligible Costs for maintenance and monitoring activities as they relate generally, but not limited to:

1. regulatory requirements for the LTMM of the Project Works;

2. geo-technical, cap and landscaping considerations where it is integral to the engineering design and ensures the integrity of the Project Works;

3. channels, barriers and infrastructure where it is integral to the engineering design and ensures the integrity of the Project Works;

4. sampling of surface and groundwater where is it integral to the engineering design and ensures the integrity of the Project Works; and,

5. the operation of equipment and infrastructure as it relates to the collection (CO7) and treatment (CO8) of Coke Ovens groundwater.

**SCHEDULE "D" TO THE LONG TERM MAINTENANCE AND MONITORING AGREEMENT ENTERED INTO BETWEEN CANADA AND NOVA SCOTIA DATED THE 29th DAY OF March, 2012**

**Reporting Requirements and Payment Procedures**

1. The annual reports shall include:

   i. The Eligible Costs incurred in the reporting period;
   ii. An account of the maintenance and monitoring activity; and,
   iii. Any extraordinary occurrences or expenditures that bear on the maintenance and monitoring.

2. Nova Scotia shall have an authorized and qualified officer sign each report with a certification clearly indicating that the report is accurate; is supported by the accounts and records of Nova Scotia; that the funds provided have been and will be used for their intended purpose; and, that all financial and non-financial compliance with this Contribution Agreement is being met.

   The detail of the amounts expended shall provide clear evidence of the eligibility of the claimed costs and such detail must be provided in a form satisfactory to the Federal Minister.

**APPENDIX B**
**Environmental Contingency Plan**

Nova Scotia Lands Inc.
Long Term Monitoring and Maintenance Plan

210.05479.00000.0029

**ENVIRONMENTAL CONTINGENCY PLAN**

**SYDNEY TAR PONDS AND COKE OVENS REMEDIATION PROJECT**

**LONG TERM MAINTENANCE AND MONITORING**

**OPEN HEARTH PARK AND HARBOURSIDE EAST**

**SYDNEY, NS**

| Number | Plan Review or Testing | Reviewed By | Date |
|---|---|---|---|
| 001 | ECP Development | | January 15, 2014 |
| | | | |
| | | | |
| | | | |

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# 1.0 INTRODUCTION

The following Environmental Contingency Plan (ECP) has been developed to minimize the potential risk and severity of damage to human health and the environment in the event of an environmental emergency. The plan is to be used during the Long Term Maintenance and Monitoring (LTMM) program.

Environmental emergencies may include accidental spill, release or leak of hazardous liquids, gases or materials, as well as fire, explosions, and/or first aid situations resulting from spills, releases and/or leaks.

The ECP is to supplement the Emergency Response Plan already in service by Nova Scotia Lands Inc. (NSLI) personnel, contractors and tenants of the Harbourside Commercial Park. The ECP will comply with all applicable regulations, including Nova Scotia Environment's (NSE) Emergency Management Regulations and Contaminated Sites Regulations.

## 1.1 Objectives and Scope

The objectives of the ECP are to establish, document and communicate environmental emergency response procedures that are protective of human health, the environment and Open Hearth Park and Harbourside East. Implementation of the ECP will involve annual training for NSLI personnel.

The ECP has been developed, and will be implemented, in line with LTMM Program being conducted at the site for a minimum of 25 years following the remediation of the Tar Ponds and Coke Ovens.

The following Sections are outlined in detail in the ECP:

- Types of Environmental Emergencies (Section 2.0)
- Authority and Responsibility (Section 3.0)
- Incident Notification (Section 4.0)
- First Aid Measures (Section 5.0)
- Environmental Emergency Response Procedures (Section 6.0)
- Training and Document Review Requirements (Section 7.0)
- Emergency Response Contacts (Section 8.0)
- Environmental Emergency Communication Plan (9.0)

## 1.2 Location and Surroundings

The Open Hearth Park is located at the former Tar Ponds, which is located between Sydney Harbour to the north, Stable Drive to the east, Terminal Road to the south and Dodd's Street / Intercolonial Street / Walker Street to the west. The Tar Ponds was remediated through in-situ solidification and stabilization (S/S) of impacted sediment and placement of a multi-layered cap above the S/S material to prevent surface water infiltration and protect the integrity of the S/S and provide a direct contact barrier.

The Open Hearth Park will be opened in September 2013 and the majority of the site will include outdoor space. One building (a concession stand) has been constructed to the south of the Ferry Street Bridge. This building is likely to be operated on a seasonal basis. Park facilities

will include: Prince Street Trail, Inglis Street Trail, pedestrian and shared use pathways, two paved parking lots, a dog park, a bike park, a skating area and warming area, a natural turf multi-use field; lawn areas, a wet meadow and an amphitheatre and outdoor stage.

Harbourside East was the former Coke Ovens site, which is located between SPAR Road to the north, Victoria Road to the west, Vulcan Avenue to the south, and the approximate location of Teak Street to the east. Remediation included excavation and treatment of brook sediments, groundwater collection and treatment, excavation of coal tar-impacted soil and capping of the select locations at the Coke Ovens. The Coke Ovens site was redeveloped as part of the Harbourside Commercial Park for possible commercial space and has been designated Harbourside East. At present, no buildings occupy the site, but commercial development in select areas is approved and additional roadways may be constructed through the site.

The Harbourside Commercial Park (HCP) is located between the Open Hearth Park and Harbourside East. The HCP was the location of the former Sydney Steel Plant and has undergone remediation and redevelopment since 2001. Tenants and land owners at the HCP are commercial and light industrial in nature.

### 1.3 Facilities Overview

As stated previously, the Open Hearth Park will only have one building. The concession stand will be heated by electricity and propane gas will be used for the kitchen operation. No sources of petroleum, chemicals and /or hazardous waste would be stored at the site in any quantity. The expectation would be that there would be cleaning supplies used at the concession stand and that relatively small amounts of possible contaminants may be used as park during operation and maintenance (e.g. gasoline in lawn mowers during landscaping process).

Any new commercial construction at Harbourside East would be unlikely to cause significant environmental concern. The source of heating would likely be the predominant source of a spill or a release (i.e. heating oil).

It would be expected that the chemicals used, handled and/or stored on site are predominately consumer and/or WHMIS labelled products.

Solid waste (refuse, recyclable materials and organic materials) are collected via designated receptacles on site for subsequent disposal by a licensed waste hauler.

## 2.0 TYPES OF ENVIRONMENTAL EMERGENCIES

The following types of environmental emergencies requiring action at Open Hearth Park and Harbourside East may include:

- Accidental spill, release or leaks of petroleum products;
- Accidental spills, releases or leaks of chemicals and/or hazardous wastes;
- Accidental releases or leaks of hazardous gases (i.e., flammable, toxic or corrosive gases, oxygen and/or cryogenics);
- Fire and explosions resulting from above noted spills, releases and/or leaks;
- First aid incidents (i.e., serious injury or illness) resulting from above noted spills, releases and/or leaks;
- Malfunctions and accidents;
- Environmental change (floods, severe weather, seismic events, climate change);

- Erosion/sedimentation to surface water;
- Air Emissions/Odours; and
- Cap integrity issues.

## 3.0 AUTHORITY AND RESPONSIBILITY

The *Site Manager /Safety Coordinator /Chief Operating Officer* shall be responsible for:

1. Responding to health and safety concerns (i.e., non-emergency inquiries and/or emergency situations);
2. Responding in an efficient and timely manner with appropriate action to control the situation, ensure safety of internal and external responders, and provide recovery support;
3. Calling the applicable external resources (i.e., Cape Breton Municipality (CBRM) police or fire) and providing them with the contact and incident information during weekday (working) hours (i.e., M – F 8am-5pm);
1. Act as liaison with internal and external response resources (i.e., CBRM police and fire, etc.);
4. Notifying *Site Management* and any affected areas of environmental emergencies;
5. Following up with *Site Management* following initiation of an evacuation of the applicable area or building in the event of an environmental emergency;
6. Contacting contractors to obtain applicable environmental emergency response supplies (i.e., fire extinguishers, spill kits materials, personal protection equipment (PPE), etc.);
7. Completion of *Incident Report* (if first responder);
8. Being available for applicable incident follow up (if required);
9. Contacting remediation contractors if damaged building materials need to be removed or replaced, disinfected, or in the event of a biohazard;
10. Coordinating with *Site Management*, and remediation contractor;
11. Replenishment and documentation of spill and containment supplies for each required location;
12. Declaring areas safe for re-occupancy;
13. Reviewing applicable *Incident Report* forms and completing follow up (if required); and,
14. Reviewing and amending the EERP as needed.

*Site Duty Management* shall be responsible for:

1. Providing any support services after hours (i.e., weekdays M-F 5pm – 8am, weekends 24 hrs, and holidays);
2. Notifying the *Chief Operating Officer /Safety Coordinator* in the event of an accidental spill or release, fire and/or first aid incident;
3. Initiating an evacuation of the applicable area or building in the event of an environmental emergency;
4. Notifying additional internal and/or external resources to request assistance;
5. Completion of *Incident Report* (if first responder); and
6. Being available for applicable incident follow up (if required).

*Tenants and Contractors* shall be responsible for:

1. Adhering to NSLI's ECP procedures;
2. Immediately notifying *Chief Operating Officer /Safety Coordinator*, or *Security* of an environmental emergency;
3. Assisting to prepare applicable *Incident Report* forms in a timely manner (if first responder); and,
4. Being available to *Chief Operating Officer /Safety Coordinator* during incident follow up (as required).

## 4.0 INCIDENT NOTIFICATION

In the event of an environmental emergency occurring or upon discovery of an accidental spill or release, first aid incident(s), and/or fire(s) related to petroleum products, chemicals and/or hazardous waste:

***On a weekday between 8am-5pm***

Rob Jessome, *Site Manager* shall be contacted immediately at **564-4936** (office), **565-8086** (mobile) or **564-9720** (home).

In the event that there is no answer or *Site Manager* is not available, contact immediately at Sheldon Andrews, *Safety Coordinator*, immediately at **564-7937** (office), **578-4745** (mobile) or **549-1050** (home).

In the event that there is no answer or Sheldon Andrews is not available, contact Joel MacLean, *Chief Operating Officer* **564-7959** (office), **578-3856** (mobile) or **849-2638** (home).

***On a weeknight between 6pm-6am, weekdays or holidays***

*The Duty Manager* shall be contacted immediately at **578-6272** (mobile).

*Security* can be contacted immediately at **564-7900.**

*** If the first responder is not able to contact *Site Manager* (or alternates), *Duty Manager* or *Security* (as listed above), CBRM Fire and Emergency Services shall be contacted immediately at **911** ***

## 5.0 FIRST AID MEASURES

*Swallowing* – Refer to product specific Material Safety Data Sheet (MSDS) for first aid information. Get medical attention immediately. If possible do not leave injured person(s) unattended.

*Inhalation* – Refer to product specific MSDS for first aid information. Remove affected person(s) from exposure and into fresh air or other non-affected area. Do not enter a situation that has caused another person to become unconscious, and then call CBRM Fire and Emergency Services immediately. Administer artificial respiration if breathing has stopped. If breathing is difficult or laboured, call CBRM Emergency Services immediately. Keep affected person warm and at rest until medical attention arrives.

*Eye Contact* – Refer to product specific MSDS for first aid information. Move individual away from exposure and into fresh air or other non-affected area. Take injured person to closest eye wash. Flush eyes with large amounts of water while keeping eyelids open until irritation subsides. If irritation persists or worsens, get medical attention immediately.

*Skin Contact* – Refer to product specific MSDS for first aid information. Remove contaminated clothing, as applicable. Wash exposed area with soap and water provided chemical is not reactive with soap and water. If symptoms persist or worsen, get medical attention. Launder clothing thoroughly before reuse.

## 6.0 ENVIRONMENTAL EMERGENCY RESPONSE PROCEDURES

### 6.1 Spill Response Action Plan

The purpose of this Spill Response Action Plan is to identify procedures and actions to take in event of a small, manageable accidental spill, release and/or leak of petroleum products, gases, chemicals and/or hazardous wastes. Do whatever is reasonable, and within your authority and/or training. **Never place yourself or others in danger**.

1. Determine if there is an immediate threat to human health and safety, or the environment.
2. Turn off sources of ignition.
3. If there are explosive vapours or fire hazards that cannot be removed or dealt with, evacuate persons from area or building.
4. Immediately contact *Chief Operating Officer /Safety Coordinator*, *Site Duty Management*, *Security* or CBRM Fire and Emergency Services (as applicable).
5. Remove vapours and/or hazards (i.e., open windows, turn on ventilation, etc.) if possible and safe to do so.
6. Prevent petroleum products, chemicals and/or hazardous waste from getting into an interior or exterior drain, a body of water or ditch using spill prevention/containment at the area or building.
7. If possible and safe to do so, isolate spill and/or stop leak or release. Initiate clean-up using spill prevention and containment material at area or building.
8. Gather the following data and/or documentation for CBRM Fire and Emergency Services:

    a. Type of spill material (i.e., petroleum product, chemical and/or hazardous waste) and applicable MSDS;
    b. Estimated volume of spilled, leaked or released material, and estimated rate of leakage;
    c. Location and distance of spill, leak or release to closest drain, body of water or ditch;
    d. Action(s) taken to control spill, leak or release; and,
    e. Spill and containment supplies available at department, area or building.

9. Ensure that the leak, spill or release has been stopped prior to completing *Incident Report* forms.
10. Submit a completed *Incident Report* within 24 hrs to *Chief Operating Officer /Safety Coordinator.* List the cause of spill, leak or release, and steps taken to control the situation, while still current.
11. *Safety Coordinator* shall refresh any spill and containment supplies provided by NSLI, and ensure used/contaminated supplies are disposed of in accordance with applicable regulations.
12. *Chief Operating Officer /Safety Coordinator* shall ensure that all required documentation is distributed as required, and a copy is placed and permanently stored in the record files.

If the spill, release or leak is large and/or not easily managed:

1. Determine if there is an immediate threat to human health and safety, or the environment;
2. Turn off source(s) of ignition;
3. Do not use lights or other electrical devices or components;
4. Leave area immediately, and do not let others enter area except for trained internal and/or external responders;
5. Contact *Chief Operating Officer /Safety Coordinator*, *Site Duty Management*, *Security* or CBRM Fire and Emergency Services as soon as possible.
6. Gather the following data and/or documentation for CBRM Fire and Emergency Services:

    a. Type of spill material (i.e., petroleum product, chemical and/or hazardous waste) and applicable MSDS;
    b. Estimated volume of spilled, leaked or released material, and estimated rate of leakage;
    c. Location and distance of spill, leak or release to closest drain, body of water or ditch;
    d. Action(s) taken to control spill, leak or release; and,
    e. Spill and containment supplies available at department, area or building.

7. Submit a completed *Incident Report* within 24 hrs to *Chief Operating Officer /Safety Coordinator*. List the cause of spill, leak or release, and steps taken to control the situation, while still current.
8. *Safety Coordinator* shall refresh any spill and containment supplies provided by NSLI, and ensure used/contaminated supplies are disposed of in accordance with applicable regulations.
9. *Director of Facilities Management* shall ensure that all required documentation is distributed as required, and a copy is placed and permanently stored in the record files.

Schedule A, Reportable Release Amounts (Environmental Emergency Regulations, NS Reg 16/2013) has been attached to outline spill substances/quantities that must be reported to Nova Scotia Environment (NSE).

### 6.2 Release Response Action Plan

The purpose of this Release Response Action Plan is to identify procedures and actions to take in event of a small, manageable release and/or leak of hazardous gases. Do whatever is reasonable, and within your authority and/or training. **Never place yourself or others in danger**.

1. Determine if there is an immediate threat to human health and safety, or the environment.
2. If there are explosive vapours or fire hazards that cannot be removed or dealt with, evacuate persons from area or building.
3. Turn off sources of ignition;
4. Do not use lights or other electrical devices or components;
5. Immediately contact *Chief Operating Officer /Safety Coordinator*, *Site Duty Management*, *Security* or CBRM Fire and Emergency Services (as applicable).
6. Do not use light switches or any other electrical device or component so as to reduce chances of gas ignition;
7. Remove vapours and/or hazards (i.e., open windows, turn on ventilation, etc.) if possible and safe to do so.
8. Isolate release, if possible and safe to do so (i.e., close door to area or building);
9. Gather the following data and/or documentation for CBRM Emergency Services.

a. Type of released material (i.e., hazardous gas name and type) and applicable MSDS;
b. Estimated volume of released or leaked material, and estimated rate of leakage;
c. Location and distance of release or leak to closest air intake or ventilation duct; and,
d. Action(s) taken to control release or leak; and
e. Spill and containment supplies available at department, area or building.

10. Ensure that the release or leak has been stopped prior to completing *Incident Report* forms. Submit a completed *Incident Report* within 24 hrs to *Chief Operating Officer /Safety Coordinator*. List the cause of release or leak, and steps taken to control the situation, while still current.
11. *Chief Operating Officer /Safety Coordinator* shall ensure that all required documentation is distributed as required, and a copy is placed and permanently stored in the record files.

If the release or leak is large and/or not easily managed:

1. Determine if there is an immediate threat to human health and safety, or the environment;
2. Turn off source(s) of ignition;
3. Do not use lights or other electrical devices or components;
4. Shut doors and windows to area or building;
5. Evacuate area immediately;
6. Do not let others enter area except for trained internal and/or external responders;
7. Contact CBRM Fire and Emergency Services as soon as possible.
8. Gather the following data and/or documentation for CBRM Fire and Emergency Services:

a. Type of spill material (i.e., petroleum product, chemical and/or hazardous waste) and applicable MSDS;
b. Estimated volume of released or leaked material, and estimated rate of leakage;
c. Location and distance of release or leak to closest air intake or ventilation duct; and,
d. Action(s) taken to control release or leak; and
e. Spill and containment supplies available at department, area or building.

12. Ensure that the release or leak has been stopped prior to completing *Incident Report* forms. Submit a completed *Incident Report* within 24 hrs to *Chief Operating Officer /Safety Coordinator*. List the cause of release or leak, and steps taken to control the situation, while still current.
13. *Chief Operating Officer /Safety Coordinator* shall ensure that all required documentation is distributed as required, and a copy is placed and permanently stored in the record files.

### 6.3 Fire Response Action Plan

The purpose of this ECP is to identify procedures and actions to take in the event of a fire caused by petroleum products, chemicals, hazardous waste materials and/or gases. Do whatever is reasonable, and within your authority and/or training. **Never place yourself or others in danger**.

If one extinguisher does not put out the fire or if the smoke presents an immediate health and safety concern or hazard, evacuate all people from the building and close the door to contain the fire and limit the spread of fire, smoke and/or soot. No person should attempt to fight a fire if they have not received training in the use of extinguishers, if the fire is too intense, or if the fire could limit egress or block an exit.

In the event of small, manageable fire, extinguish the material (i.e., petroleum product, chemical and/or hazardous waste):

1. Determine if there is an immediate threat to human health and safety, or the environment.
2. Extinguish fire with appropriate fire extinguisher or building fire hose, and as per fire fighting instructions provided on the MSDS.
3. Contact Contact *Chief Operating Officer /Safety Coordinator*, *Site Duty Management*, *Security* or Fire and Emergency Services (as applicable; Section 4.0) as soon as possible.
4. Ensure that the release or leak has been stopped prior to completing *Incident Report* forms. Submit a completed *Incident Report* within 24 hrs to *Chief Operating Officer /Safety Coordinator*. List the cause of release or leak, and steps taken to control the situation, while still current.
5. *Chief Operating Officer /Safety Coordinator* shall ensure that all required documentation is distributed as required, and a copy is placed and permanently stored in the record files.

For large, uncontrolled fires or explosions:

1. Determine if there is an immediate threat to human health and safety, or the environment;
2. Check for injured persons.
3. Shut doors and windows to area or building.
4. Evacuate area immediately.
5. Do not let others enter area except for trained internal and/or external responders.
6. Contact CBRM Fire and Emergency Services as soon as possible.
7. Gather the following data and/or documentation for CBRM Fire and Emergency Services:

   a. Type of spill material (i.e., petroleum product, chemical and/or hazardous waste) and applicable MSDS;
   b. Estimated volume of released or leaked material, and estimated rate of leakage;
   c. Location and distance of release or leak to closest air intake or ventilation duct; and,
   d. Action(s) taken to control release or leak; and
   e. Spill and containment supplies available at department, area or building.

14. Ensure that the release or leak has been stopped prior to completing *Incident Report* forms. Submit a completed *Incident Report* within 24 hrs to *Chief Operating Officer /Safety Coordinator*. List the cause of release or leak, and steps taken to control the situation, while still current.
15. *Chief Operating Officer /Safety Coordinator* shall ensure that all required documentation is distributed as required, and a copy is placed and permanently stored in the record files.

### 6.4 Malfunctions and Accidents Plan

During the course of LTMM work at the site, there is a possibility that the following malfunctions or accidents could occur:

- Onsite and offsite traffic accidents that could result in personal injury, damage to equipment/vehicles and/or fuel spills.

The purpose of this Malfunctions and Accidents Plan is to identify procedures and actions to take in event of a malfunction or an accident. Do whatever is reasonable, and within your authority and/or training. **Never place yourself or others in danger**.

1. Determine if there is an immediate threat to human health and safety, or the environment.
2. Turn off sources of ignition.
3. If there are explosive vapours or fire hazards that cannot be removed or dealt with, evacuate persons from area or building.
4. Immediately contact *Chief Operating Officer /Safety Coordinator*, *Site Duty Management*, *Security* or CBRM Fire and Emergency Services (as applicable).
5. Prevent petroleum products, chemicals and/or hazardous waste from getting into an interior or exterior drain, a body of water or ditch using spill prevention/containment at the area or building.
6. If possible and safe to do so, isolate spill and/or stop leak or release. Initiate clean-up using spill prevention and containment material at area or building.
7. Ensure that the leak, spill or release has been stopped prior to completing *Incident Report* forms.
8. Contact police and insurance providers if required.
9. Submit a completed *Incident Report* within 24 hrs to *Chief Operating Officer /Safety Coordinator.* List the cause of malfunction or accident and steps taken to control the situation, while still current.
10. *Safety Coordinator* shall refresh any spill and containment supplies provided by NSLI, and ensure used/contaminated supplies are disposed of in accordance with applicable regulations.
11. *Chief Operating Officer /Safety Coordinator* shall ensure that all required documentation is distributed as required, and a copy is placed and permanently stored in the record files.

### 6.5 Environmental Change (floods, severe weather, seismic events, climate change)

The purpose of this Environmental Change Plan is to identify procedures and actions to take in event of an environmental change. Do whatever is reasonable, and within your authority and/or training. **Never place yourself or others in danger**.

- Floods:
  - Keep familiar with forecasted weather.
  - Do not store equipment or supplies within 30 m of a water course, low-lying areas, or in areas with poor drainage.
  - Personnel should not enter flooded area.
  - Report any flooding to *Chief Operating Officer /Safety Coordinator*, or *Site Duty Management.*
  - *Chief Operating Officer /Safety Coordinator* will notify personnel when it is safe to return to work.
  - LTMM personnel will inspect the area for damage to caps and surface water.
  - Harmful effects shall be addresses and a restoration plan developed.

- Tidal Surge
  - Keep familiar with forecasted weather events.
  - Refer to http://www.tide-forecast.com/weather_maps/Canada?hr=12 for information on tidal forecasts and wave height map especially when a storm surge or high tides or waves are expected.
  - Do not store equipment or supplies within 30 m horizontally and 4 m vertically of a water course prone to tidal surge.
  - Personnel should not enter flooded areas or areas with energetic wave activity.
  - Report any flooding to *Chief Operating Officer /Safety Coordinator*, or *Site Duty Management.*

- *Chief Operating Officer /Safety Coordinator* will notify personnel when it is safe to return to work.
- LTMM personnel will inspect flooded areas for damage and contamination.
- Harmful effects shall be addresses and a restoration plan developed.

- Severe Weather:
  - Keep familiar with forecasted weather, including high winds (70 km/hr), heavy rainfall (20 mm/24-hours), ice storms, lightening strikes and extreme temperatures.
  - Work should be stopped temporarily during severe weather and personnel should leave any areas that could be hazardous.
  - Report any severe weather to *Chief Operating Officer /Safety Coordinator*, or *Site Duty Management.*
  - *Chief Operating Officer /Safety Coordinator* will notify personnel when it is safe to return to work.
  - LTMM personnel will inspect the area for damage to caps and surface water.
  - Harmful effects shall be addresses and a restoration plan developed.
- Seismic Event:
  - While unlikely to occur, all work should be stopped temporarily if a severe seismic event occurs and personnel should leave any areas that could be hazardous.
  - Report any seismic activity to *Chief Operating Officer /Safety Coordinator*, or *Site Duty Management.*
  - *Chief Operating Officer /Safety Coordinator* will notify personnel when it is safe to return to work.
  - LTMM personnel will inspect the area for damage to caps and surface water.
  - Harmful effects shall be addresses and a restoration plan developed.
- Climate Change:
  - The LTMM is expected to be carried out for 25 years and it is unlikely that this will pose a significant change to the program, as temperatures may rise by approximately 1°C during this time period. Use the plan for extreme weather events if required.

### 6.6 Erosion/Sedimentation to Surface Water

The integrity of erosion control measures and/or slope stability could be compromised by a structural or equipment malfunction, accident, environmental event or vandalism that may lead to surface water sedimentation and increased turbidity. Response measures will depend of the type of contaminants and the comparison of contamination levels against the SSTLs for surface water. The upper level criteria defined as a reportable event for turbidity will be an increase by eight (8) Nephelometric Turbidity Units (NTUs) above background (upstream sampling location), when the background concentration is between 8 and 80 NTU. If background concentrations exceed 80 NTU, then the upper level criteria defined as a reportable event for turbidity, will be 10 % above background. The upper level criteria defined as a If background concentrations exceed 80 NTU, then the upper level criteria defined as a reportable event for turbidity, will be 10 % above background.

In the event that erosion exceeds the provincial and federal approvals/authorizations and/or specifications as outlined above, NSLI shall:

1. Temporarily cease activities that could potentially contribute to the exceedance until concentrations decrease to an acceptable level. During the shut-sown, efforts will be made to rectify the cause of the exceedance.
2. Respond by:
    - Install silt curtains in area in questions.
    - Create/repair silt fences, rip rap and or dams.
3. Conduct monitoring upon completion of the repair (every 15 minutes for 60 minutes) to verify that conditions have abated.
4. Document details regarding the cause and any corrective measures taken.
5. Assess and record sedimentation effects on surrounding wildlife and natural habitats. If environmental impacts are evident, NSLI must inform NSE and provide efforts to restore natural habitats to pre-sedimentation conditions.

## 6.7 Cap Integrity Issues

Cap monitoring is a requirement of the LTMM (Section 4.1). Inspections will be performed in critical areas (i.e. perimeter edges, drainage ways, side slopes and tops) to determine if there is damage (e.g.) erosion rills, unvegetated areas, differential subsidence, frost heaves, water ponding, soft spots, etc.).

### *6.7.1 Cap Maintenance*

Cap maintenance includes vegetation control and repairs that can be accomplished without heavy or specialty equipment.

Vegetation control can include mowing, as well as seeding and fertilizing bare spots. Seeding and fertilizing should be done on an as needed basis. The mowing operation should effectively control any inadvertent establishment of vegetation with a root system that could breach the cap (i.e. trees).

When mowing is required, the following activities should be considered:

- Grass shall be cut to a height of 60 mm when it reaches a height of 75 mm.
- Mowing should not occur if the grass is excessively wet from rain or dew.
- Grass should be dry enough to produce a uniform discharge of clippings from the mower without excessive clumping. The clippings should be allowed to decompose in place to provide nutrients to the vegetative cover, but heavy clippings should be removed or dispersed when present.

Maintenance repairs may include filling in small erosion rills; cutting small drainage ways (approximately 150 mm wide by 100 mm deep) to drain small areas of standing water; filling and seeding of small areas of standing water, etc. Small areas of standing water may indicate differential subsidence. Any damage that extends through the vegetative support layer (300 mm) will be addressed in Section 6.7.2.

Erosion rills can be repaired as follows or in combination of the following:

- Fill the rill with soil then seed. Area may need erosion control matting.
- Place aggregate in the bottom of the rill, then apply soil and seed. The aggregates ‘armours’ the bottom of the rill to slow the water velocity and allows for the vegetative cover an opportunity to recover.

- Secure spruce or fir branches with green foliage in the rill with the trunk end down gradient. The eroding material will clog on the foliage and the rill will natural infill.
- For rills that reappear in the same area, a shallow drainage way should be formed and lined with geotextile and fill with Rip Rap.

Erosion damage is caused by turbulent flow in a preferential flow pathways. Maintenance and/or repair activities not performed properly will be repeated in the same area or can cause damage to an adjacent area as the preferential pathway flow changes.

Maintenance issues are to be addressed within 48-hours of inspection, weather permitting and not including weekends and holidays.

### *6.7.2 Cap Repair*

Monitoring and maintenance activities should eliminate the majority of the potential for repair activities. Unforeseen conditions may arise that will require repair activities to be performed on the cap. Potential causes of damage include erosion, differential subsidence, excavation and vehicular traffic ruts.

Minor erosion rills (<300mm) are handled under cap maintenance as discussed in Section 6.7.1. Erosion troughs that extend into the layer below the vegetative support layer will require over excavation to expose the last layer not compromised and repair similar to the nature of the construction sequence.

Differential subsidence may require removal of cap layers to a layer that can be overbuilt. It may require localized removal of the cap layers to fill (and overbuild the layer beneath the cap minimize future settlement and thus keeping cap integrity) prior to replacing the cap layers.

Frost heaves may also require removal of cap layers to an undamaged layer and reconstruction of the layers to restore the integrity of the cap.

Excavation of the cap is not permitted with the exception of repair activities. Any unauthorized excavations would require over excavation to expose the last layer not compromised and repair as per the construction details.

Vehicles that traverse the cap are limited to mowing equipment, low ground pressure (LPG) tracked equipment and approved light duty vehicles. Heavy wheeled vehicles and some non-LPG tracked equipment may produce ruts that can immediately compromise the cap or initiate degradation of the cap causing it to fail. This is especially true when the ground is wet or saturated.

The drainage layer may have very specific repair methodologies (e.g. a specific gradation for sand, specific welding and/or sewing requirements for repairing geocomposite materials, etc.). Drainage layers may include high transmissivity soil/sand and geocomposite, or a combination of both. Any damage to a drainage layer that includes a geocomposite repairs must be done in accordance to the manufacturer's recommendations. If damage includes a soil/sand layer, repair must restore the layer to the original thickness and composition of the layer.

The low hydraulic conductivity layer has very specific repair methodologies and documentation. This layer may include low hydraulic conductivity soil, geosynthetic clay liner (GCL) and

geomembrane or a combination of all three types. All repairs are to be done in accordance to the manufacturer's recommendations.

Any issues that require repair that are documented during monitoring must:

- Have repairs commenced within five working days; or
- Have temporary controls in place within 48-hours, weather permitting and not including weekends and holidays.

Temporary controls are intended to reduce further cap degradation as a result of the damage. These controls may include: polyethylene sheeting, sand bags, erosion control matting, etc. Temporary controls are only to be used until the appropriate work controls (work plan, EPP, H&S Plan) can be prepared.

Inspection and Maintenance Logs are available in Appendix C of the LTMM.

### 6.8 Air Emissions/Odours

Air emission and odours are not expected during the LTMM as work is not anticipated to breach any impacted material. In the event that odours are observed during monitoring or inspections of the site, the following steps are to be followed:

- Report any odours to the *Site Manager*. In the rare event that unusual, distinct odours are prolonged (exceeding one hour), NSE must be informed immediately.
- Try to determine the type of odours and investigate possible sources, if it is considered safe to do so.
- If the odour is expected to be caused by a volatile substance, use a photoionization detector (PID) to determine if vapours are recordable.
- If vapour is recorded, Drager tubes can be used for further assess any potential for the substance to be harmful. Drager tubes require the source (parameter) of the odours to be known prior to use.
- If an issue is noted using the dragger tubes, the area of the odour should be cleared and the source confirmed and a work plan devised to deal with the issue.
- A volatile compound sample should be collected by means of an evacuated canister to determine the concentrations of the available vapour and ensure that it is within ambient air monitoring criteria. The sample will be collected in a prompt manner to ensure that public health is not at risk. Sample concentrations will be compared to the Ontario Ministry of Environment (OME) Ambient Air Quality Criteria (AAQC) (April 2012) with odour as the limiting effect.

If odours are expected to be harmful, a half-face respirator should be worn during sampling.

### 6.9 Chemical Waste Disposal

Chemicals waste generated and stored at the Open Hearth Park and Harbourside East may include a variety of products (i.e., flammables, corrosives, irritants, and/or other toxic effects). Waste chemicals may be produced through cleaning, maintenance and landscaping. Waste chemical storage at the site is not recommended beyond limited quantities as mentioned above. Any tenant that could require chemical waste storage will have to supply the means for the storage, which should be properly identified.

Waste chemicals can pose a risk to workers and the environment if they are not properly managed. In the event of a spill, the waste chemical should be cleaned up in accordance with applicable MSDS.

All waste containers should be appropriately identified as to the contents and hazards with WHMIS labels (as applicable). Obsolete chemicals (that are not in use or with no future use) should also be disposed accordingly. The disposal of any chemical waste and/or chemical waste contaminated materials must be carried out by a licensed waste disposal contractor. Chemical wastes from any spills or fires should be disposed immediately.

The disposal of any chemical wastes should be coordinated with the *Chief Operating Officer /Safety Coordinator* so that chemical waste inventories (at the Hazmat Storage Room and Departments) can be maintained and updated as required.

## 7.0 TRAINING AND DOCUMENT REVIEW REQUIREMENTS

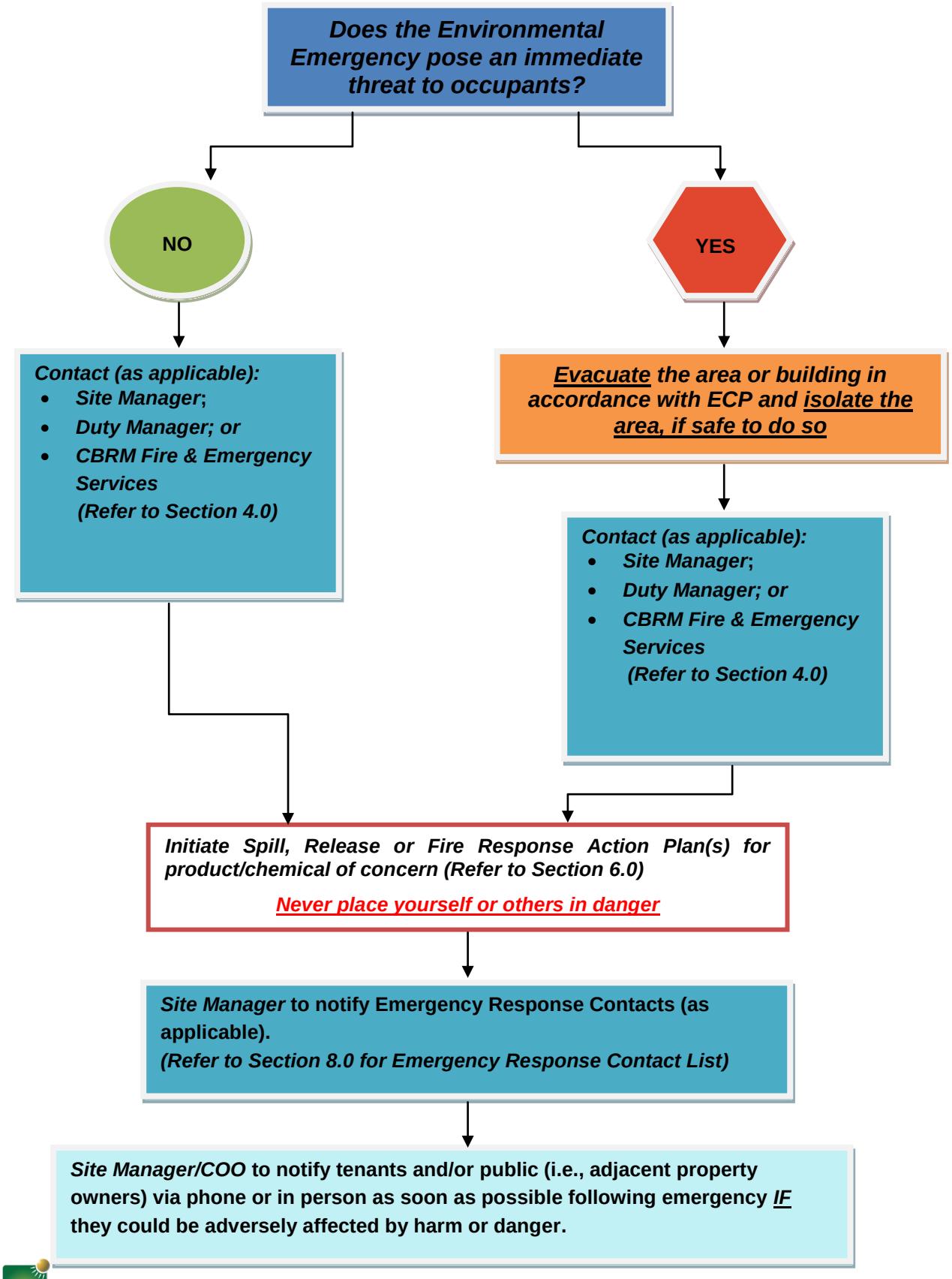
*All NSLI staff* – Review of ECP following each revision/update.

*Contractors* – Review of applicable ECP sections pertaining to equipment/materials they are servicing/disposing as required.

## 8.0 EMERGENCY RESPONSE CONTACTS

| Emergency Response Contact List | |
|---|---|
| ***Local Emergency Services*** | |
| CBRM Regional Fire Department | 911 |
| Emergency Health Services (Ambulance) | 911 |
| CBRM Regional Police | 911 |
| ***Government Contacts*** | |
| Environment Canada Maritimes Regional Office – Canadian Coast Guard, Fisheries and Oceans Canada (*24 hours*) | 902-426-6030 or 1-800-565-1633 |
| Nova Scotia Environment (*Regular working hours*) | 902-563-2100 |
| ***NSLI Contacts*** | |
| Site Manager – Rob Jessome | **564-4936** (office) or<br>**565-8086** (mobile) or<br>**564-9720** (home) |
| Safety Coordinator – Sheldon Andrews (Site Manager Alternate) | **564-7937** (office) or<br>**578-4745** (mobile) or<br>**549-1050** (home) |
| Duty Manager | **578-6272** (mobile) |
| Chief Operating Officer (COO) – Joel MacLean | **564-7959** (office) or<br>**578-3856** (mobile) or<br>**849-2638** (home) |
| ***Licensed Waste Disposal Contactor*** | |
| Mill Creek Environmental Services Inc. | 902-539-6161 |
| Atlantic Industrial Services | 1-800-565-4383 |

## 9.0 ENVIRONMENTAL EMERGENCY COMMUNICATION PLAN



Incident Investigation Report
Nova Scotia Lands
Sydney, Nova Scotia

Inspection Report Number (From Inspection Checklist):_____
Date of Investigation:_____
Time of Investigation:_____
Inspector's Name:_____
Company Name:_____
Weather Conditions:_____
Temperature:_____
Location:_____

**Item of Investigation:**

**General Incident Description:**

**Reporting Requirements:**

1. Location of Concern Area and GPS Point(s):

2. Field Measurements (ie measured size/area or water characteristics):

3. Suspected Root Factor(s)/Cause:

4. Photographs:

Were photos taken of the area of concern? Yes No

5. Other Notes (including suggested corrective action(s)):

**APPENDIX C**
**Inspection and Maintenance Logs**

Nova Scotia Lands Inc.
Long Term Monitoring and Maintenance Plan

210.05479.00000.0029

Decision Matrix A – Subsidence

| Criteria | Scoring | Points | Score |
|---|---|---|---|
| **Size of subsided area** | <5 $m^2$ (50 $ft.^2$) | 1 | |
| | 5-15 $m^2$ (50-150 $ft.^2$) | 4 | |
| | 15-40 $m^2$ (150-400 $ft.^2$) | 12 | |
| | >40 $m^2$ (>400 $ft.^2$) | 15 | |
| **Maximum depth of ponded water** | <5 cm (2 in.) | 1 | |
| | 5-15 cm (2-6 in.) | 4 | |
| | 15-30 cm (6-12 in.) | 12 | |
| | >30 cm (>12 in.) | 15 | |
| **Length of disjointed surface** | <1 m (3 ft.) | 1 | |
| | 1-3 m (3-10 ft.) | 4 | |
| | 3-8 m (10-25 ft.) | 12 | |
| | >8 m (>25 ft.) | 15 | |
| **Height of disjoint** | <2 cm (1 in.) | 1 | |
| | 2-5 cm (1-2 in.) | 4 | |
| | 5-15 cm (2-6 in.) | 12 | |
| | >15 cm (>6 in.) | 15 | |
| | | **Total** | |

**Action:**
**If score is less than 10, recommend continued monitoring.**
**If score is between 10 and 20, recommend re-grading the area and reinstating vegetation.**
**If score is 20 or more, recommend initiation of a professional investigation and analysis, and design modifications if warranted.**

Decision Matrix B – Seeps

| Criteria | Scoring | Points | Score |
|---|---|---|---|
| **Length or Area of Seep** | <2m (6 ft.) or <2m$^2$ (20 sq.ft.) | 2 | |
| | >2m (6 ft.) or >2m$^2$ (20 q.ft.) | 5 | |
| **Is seep visibly flowing?** | Yes | 5 | |
| | No | 1 | |
| **Does the water have a colour or odour?** | Yes | 5 | |
| | No | 0 | |
| | | **Total** | |
| **Action:**<br>**If score is between 0 and 8, recommend continued monitoring.**<br>**If score is 10 or more, conduct further investigation and analysis.** | | | |

Decision Matrix C – Erosion and Slope Stability

| Criteria | Scoring | Points | Score |
|---|---|---|---|
| **Exposed area of soil** | <4 $m^2$ (40 $ft.^2$) | 1 | |
| | 4-6 $m^2$ (40-60 $ft.^2$) | 4 | |
| | >16 $m^2$ (>20 $ft.^2$) | 8 | |
| **Maximum depth of gullying** | <5 cm (<2 in.) | 1 | |
| | 5-15 cm (2-6 in.) | 4 | |
| | >15 cm (>6 in.) | 8 | |
| **Area affected by slumping** | <2 $m^2$ (>20 ft.) | 0 | |
| | 2-10 $m^2$ (20-100 $ft.^2$) | 4 | |
| | >10 $m^2$ (>100 $ft.^2$) | 8 | |
| **Distance from nearest watercourse (only applies if first 3 criteria score >0)** | >100 m (110 yds.) | 1 | |
| | 10-100 m (11-110 yds.) | 4 | |
| | <10 m (<11 yds.) | 8 | |
| | | **Total** | |

**Action:**
**If score is less than 15, recommend regarding and reinstatement of vegetation and armour stone (if applicable), with continued monitoring.**
**If score is 15 or more, conduct assessment of upgradient areas and drainage patterns, assess need for further investigation and analysis. Design modifications to drainage if warranted. Reinstatement vegetation and armour stone (if applicable), and continued monitoring.**

Inspection Checklist
Nova Scotia Lands
Sydney, NS

**Inspection Report No.:**
**Date of Inspection:**
**Inspector's Name:**
**Company Name:**
**Weather condition:**
**Temperature:**
**Location:**
**Coordinates:** **E** **N**
**Comments:**

**Photo Log (reference attachment) e.g. Photo number date location direction:**

| Site Management Requirement | Inspection / Sampling Item | Inspection Considerations | Potential Observations Noted During Inspection | Inspected (Y/N) | Inspection/ monitoring Comments(insert specific comments below (or reference attachments) including suspected root causes and possible corrective action) | Field Comment/ Measurements (i.e. reference attachments e.g. for sketches, pH readings, TDS, turbidity, GPS Coord, Photopoint) |
|---|---|---|---|---|---|---|
| **Cap / Landscaping** | 1) Vegetation distress, damage or poor growth | Acts of vandalism, traffic control barriers | Non-specific | | | |
| | | Potholes | As a guideline: Area < 10 $m^2$ = minor concern. Continued monitoring required. | | | |
| | | Rutting | Area > 10 $m^2$ and healthy vegetation growth is less than 80 percent of the total area of distress = Incident/Inspection Report required. | | | |
| | 2) Animal intrusion (burrows) | | | | | |
| | 3) Erosion rills / gullies | | As a guideline: Erosion rill/gully < 50<br>Erosion rill/gully > 50 mm deep and > | | | |
| | 4) Slope Instability / Seeps | | | | | |
| | 5) Subsidence / standing water / ponded water (indicative of settlement) | | | | | |
| | 6) Other issues (i.e. illegal dumping, ATV trails on landscaped areas) | | | | | |
| **Geotechnical** | 1) Water Channels, Ditches and/or French Drains | Washout | Riprap / gravels / geotextile displaced or removed by velocity of flow | | | |
| | | Erosion | Displacement of the riprap by velocity of flow | | | |
| | | Sediment | Build-up of sediment in ditches that could alter flow resulting in erosion or scour of ditch | | | |
| | | Vegetation | Emergence of vegetation that could alter flow and result in erosion and scour of ditch | | | |
| | | Debris | Debris in ditches that could alter flow and result in erosion and scour of ditch | | | |
| | 2) Culvert outfall protection | Washouts | Removal of riprap | | | |
| | | Sediment Deposition | Sediment load in the adjoining water course at culvert outfalls | | | |
| | | Erosion or scour | Displacement of riprap | | | |
| | 3) Access Roads/Walking Trails/Parking Lot (as applicable) | Washout | Displacement and/or removal of gravels by the velocity of flow | | | |
| **Other Features** | 1) Washroom Building | | | | | |
| | 2) Artificial Turf Field | | | | | |
| | 3) Sports Field (Grass) | | | | | |
| | 4) Playground | | | | | |
| | 5) Skating Area | | | | | |
| | 6) Light Posts | | | | | |
| | 7) | | | | | |
| | 8) | | | | | |
| | 9) | | | | | |

Inspection and Maintenance Form for Channel and Pressure Relief Well Monitoring
Nova Scotia Lands
Sydney, NS

**Inspection Report No.:**
**Date of Inspection:**
**Inspector's Name:**
**Company Name:**
**Tide:**
**Weather condition:**
**Temperature:**
**Location:**
**Coordinates:** **E** **N**
**Comments:**

**Photo Log (reference attachment) e.g. Photo number date location direction:**

**Monitor Well - Groundwater Elevation Monitoring**

| Monitor Wels | Depth to Bottom of Well (m) | Depth to Water Level (m) | Measuring Point Elevation (masl) | Groundwater Elevations (masl) |
|---|---|---|---|---|
| MCWS-113-MWB | 3.16 | | 2.46 | |
| MCWS-306-MWB | 6.43 | | 2.36 | |
| MCWS-307-MWB | 6.47 | | 1.63 | |
| MCWS-309-MW | 4.18 | | 1.96 | |
| MCWS-009-MW | 6.57 | | 2.25 | |
| MCWS-310-MW | 8.49 | | 2.27 | |
| MCES-001-MWA | 11.4 | | 6.22 | |
| MCES-001-MWB | 18.75 | | 6.27 | |
| MSES 104-MWA | 1.78 | | 4.32 | |
| MSES-004-MW | 12.12 | | 9.15 | |
| COBC-004-MWB | 18.88 | | 6.31 | |
| MSES-012-MWB | 19.15 | | 6.07 | |
| COBC-001-MWB | 12.89 | | 8.81 | |
| CONPL-202-MWB | 10.31 | | 15.82 | |

**Monitoring - Pressure Relief Wells**
Bedrock Pressure Relief Wells (PRW-1 to PRW-76)
Sand Relief Wells (SRW-1 to SRW-13)

| | | Comments/Descriptions | Follow-up Required |
|---|---|---|---|
| Were PRW-1 to PRW-76 observed | Yes / No | | |
| Were SRW-1 to SRW-13 observed | Yes / No | | |
| Photos taken at all locations | Yes / No | | |
| Water flow in channel | None / Low / Medium / High | | |
| Mineralization present in the vicinity of PRWs and SRWs | Yes / No | | |
| Discolouration in water in the vicinity of PRWs and SRWs | Yes / No | | |
| Sheen in water in the vicinity of PRWs and SRWs | Yes / No | | |
| Other unusual discharge in the vicinity of PRWs and SRWs | Yes / No | | |
| Damage observed at PRWs and SRWs | Yes / No | | |

Maintenance Log
Nova Scotia Lands
Sydney, Nova Scotia

Maintenance Report Number:_____
Inspection Report Number (From Inspection Checklist if Applicable):_____
Date of Maintenance:_____
Responsible Personnel:_____
Company Name:_____
Weather Conditions:_____
Temperature:_____
Location:_____

**Scope of Maintenance:**

**Maintenance Actions:**

**Status of Maintenance or Results at Completion Date:**

**Recommended Further Maintenance Actions:**

**Photographs:**

Were photos taken during maintenance? Yes No

**Other Notes:**

Signature of Responsible Personnel:_____
Date:_____

**APPENDIX D**
**Standard Operating Procedures (SOPS)**

Nova Scotia Lands Inc.
Long Term Monitoring and Maintenance Plan

210.05479.00000.0029

# WELL VAPOUR MONITORING OF MONITOR WELLS

## 1.0 GENERAL

The measurement of well headspace vapour levels (HSVL) is a basic component of environmental site investigations for assessing the potential presence of subsurface hydrocarbon contamination. This SOP covers the HSVL monitoring procedures in monitoring wells, piezometers or other such wells. Well HSVLs are used as a tool to indicate the degree to which volatile organic contaminants may be present in the water or soil matrix pores.

To provide reliable data, the vapour monitoring program should be performed over as short a time period as possible. Changes in barometric pressure, temperature and humidity may affect HSVL readings. Therefore, it is important that personnel conducting this monitoring note any potential changes in these conditions such as significant weather changes during the monitoring period. In addition, the time of data collection at each station should be recorded. Vapour level monitoring in wells must be conducted prior to water level monitoring or well purging activities.

The typical devices used by NSLI for well headspace vapour monitoring are Organic Vapour Analyzers such as:

- Catalytic Bead Sensor (e.g. Gastech)
- Photoionization Detector (PID)

## 2.0 HEALTH AND SAFETY

### 2.1 General Health and Safety Concerns

The main Health and Safety (H&S) concern during well vapour monitoring is the contaminants of concern at the site. There may be other site-specific concerns associated with the site particularly if it is an active site. Please reference the Health and Safety Plan (HASP) and the project manager for further concerns.

### 2.2 Hazardous Materials

Consultation with the project manager is imperative to define potential hazardous compounds and anticipated exposure levels associated with each site prior to commencing on-site activities. Reference can be made to the National Institute for Occupational Safety and Health (NIOSH) publications for information pertaining to compounds, if required.

### 2.3 Personal Protective Equipment (PPE)/Safety Checklist

The following PPE is required while groundwater monitoring:

- high-visibility safety vest
- steel toed boots/most likely rubber boots

- hardhat (when working near moving equipment)
- disposable gloves

Please reference the HASP for further requirements.

## 3.0 REFERENCE DOCUMENTATION

Table 1 summarizes documentation referenced in this SOP.

**Table 1: Reference Documentation**

| Document Reference Number | Document Title |
|---|---|
| SOP # 05 | PID Calibration |
| SOP #07 | Gastech Calibration |

## 4.0 PLANNING AND PREPARATION

### 4.1 Planning

The following procedures shall be taken before monitoring:

a) Review/prepare Health and Safety Plan (HASP).
b) Sign out all required equipment and gather together with any additional supplies as required by the supply checklist.

c) Review previous site data and determine the number and location of monitoring points.

d) Obtain any keys required to access the site and monitoring wells.

e) Determine the notification requirements with the project manager and ensure the client, landowners or other necessary personnel have been notified at least one day before going into the field to monitor.

f) Arrange for traffic control to monitor wells in roadways, if necessary.

g) Calibrate the headspace monitoring device (Gastech or PID).

### 4.2 Checklist of Equipment and Materials

(In addition to the equipment specified in Section 2.3)

Clean tarp for work area
Vapour monitor (Gastech or PID)
Low volume air pump with volumetric reading
Hex-key set
Disposable nitrile gloves
Socket set and wrench
Spare tubing, fittings, clamps
Turkey baster (or equivalent)
Keys for locked well caps, site access
Site plan
Field book
Screwdriver (flathead)
Spare 9-volt batteries (for probes)

- Cell phone
- Metal detector (to assist in locating wells if applicable)
- Camera
- First Aid Kit
- PPE
- Alconox or other approved cleaning agent
- HASP
- Rinse bucket
- Plastic bags for gastech
- Well plug with valved tube sized to attach to air pump and vapour monitor (eg. ¼")

## 5.0 PROCEDURES

### 5.1 Identify and Inspect Wells

a) Remove the lid of the protective casing (either road box or stick up) if present (usually require a 9/16" socket and a screwdriver to pry off).
b) Remove any water that may have pooled inside the roadbox above the top of the well cap (use a turkey baster or equivalent).
c) Mitigate any surface water inflow to the roadbox.
d) If the well cap or surface seal surrounding the well is in poor condition make a note of it in your field book and in the field report and replace the well cap or make arrangements to conduct any repairs necessary to prevent the infiltration of surface water into the well.

### 5.2 Headspace Vapour Level Monitoring (For Volatile Organic Compounds Only)

There are a variety of instruments that can be used to measure volatile organic vapour levels in a well. Each instrument has its own inherent limitations and these must thoroughly understood for proper instrument selection and operation on the job. Consult with the project manager for selection of the appropriate instrument.

Headspace vapour levels are typically monitored by NSLI using a Gastech or equivalent field-screening device as Photo Ionization Detectors (PIDs) have a limited response to gasoline or diesel contaminants. If the potential contaminants of concern are volatile components other than petroleum hydrocarbons, you may need to monitor with a PID. You must ensure that the PID is equipped with the correct lamp for measuring the contaminants of concern. The instrument should be calibrated as per the manufacturer's instructions just prior to conducting monitoring at the site. When using a Gastech, ensure that the methane-elimination button is engaged.

There are two techniques for monitoring well vapour levels. The method selected depends upon the scope, budget and objectives of the particular investigation and should be determined in consultation with the project manager. Both methods of well vapour monitoring provide a means for assessing the relative vapour levels between wells or within the same well over multiple monitoring events. However, the first method (Method 1) is more simplistic and less reliable than second method and therefore provides more qualitative data. Method 2 provides more defensible data but requires additional time and cost and is generally applicable to high profile and/or legal contaminated sites investigations.

For both methods, begin monitoring with the well suspected of having the lowest vapour levels and work towards those suspected of having the highest vapour levels. After each well is sampled, time must be allowed for the detector to purge itself of all vapours. Use a clean tarp to establish a clean working surface and for resting equipment on the ground. Avoid vapour monitoring in the vicinity of running vehicles (exhaust).

**Method 1**

a) A background reading should be taken at ground level immediately prior to removing the monitoring well top cap.
b) Gently remove the well cap or J-plug.
c) Quickly cover well riser with a clean Nitrile- or Viton-gloved hand or install a tight-fitting well plug drilled and equipped with a valved tube.
d) Create a small opening to slide the end of the Gastech hose (or equipment monitoring equipment) into the monitoring well while trying to neither release any vapours nor draw in water.
e) Record the vapour level as indicated by the instrument and note the time of the reading.
f) Note any odours in field notes. Also note any abnormal readings (e.g. meter peaking after removal from well; low vapours but strong odour; or high vapours but no odour).
g) After completing a monitoring assignment, the exterior of the instrument must be wiped clean.

**Method 2**

The second technique for measuring well vapour levels involves purging a known volume of well vapours prior to collecting a sample and therefore requires the use of a device such as a calibrated air pump to measure the purge rate.

a) Install a tight-fitting well plug drilled and equipped with a valved tube that can be connected to an air pump and vapour monitoring instrument. Install the well plug immediately after removing the top cap.
b) Using a low volume air pump, purge the well of a minimum of one and one-half well casing volumes prior to sampling, or until the vapour level equalizes. The well volume is calculated by multiplying the depth to groundwater in the well by 3.14 times the radius of the well squared.
c) If time and budget permits, allow 24 hours to elapse after well vapour purging prior to measuring the well vapour level.
d) A background reading should be taken at ground level immediately prior to connecting the detector to the tube on the monitoring well plug.
e) Open the valve on the tube installed on the well plug, connect the instrument to the tube and record the peak vapour level reading. Note the time of the reading.
f) Note any odours in field notes. Also note any abnormal readings (e.g. meter peaking after removal from well; low vapours but strong odour; or high vapours but no odour).
g) After completing a monitoring assignment, the exterior of the instrument must be wiped clean.

***5.3 General Notes:***

a) Become familiar with the pump and vapour monitoring instruments before using them.
b) Do not allow the tip of the vapour monitor to come in contact with potentially contaminated surfaces.
c) Do not allow the tip of the vapour monitor to come in contact with water, which may result in spurious readings. Change the Gastech filter immediately if this happens.
d) Caution should be exercised in cold (sub-zero) weather as condensation may form on the instrument and cause spurious readings.
e) Gastechs are sensitive to high humidity in the well, which may give rise to spurious readings. They may also be quenched by low oxygen levels in the well, in which case dilution of the air flow is required (see (g) below).
f) PID readings may also be affected by high soil gas humidity and the presence of methane.
g) It is best practice to conduct vapour sampling with and without dilution, recording both readings. Dilution can be achieved by using an in-line “y” connector with equal diameter openings and tube lengths. This setup will result in vapour readings that are half the actual concentration in the well. Consult with the project manager regarding dilution monitoring requirements.

# GROUNDWATER MONITORING

## 1.0 GENERAL

Groundwater monitoring refers to the measurement and documentation of fluid levels in subsurface formations. The measurement of water levels (hydraulic head) is a basic requirement of environmental site investigations to determine the presence of groundwater and potential non-aqueous phase liquid (NAPL) contaminants at a site. Water level measurements are also used to determine the direction and velocity of groundwater flow, to monitor groundwater extraction systems, to determine the volume of well-purge water required for well development or groundwater sampling and a variety of other purposes. This Standard Operating Procedure (SOP) covers water level and NAPL measurement procedures in monitor wells, piezometers or other specialized wells at sites that are *not* tidally influenced. This document does not cover monitoring for dense non-aqueous phase liquids (DNAPL), which may accumulate below the water table.

To provide reliable data, the monitoring program at a site should be performed over as short a period of time as possible. Barometric pressure may affect groundwater levels, therefore, observation of significant weather changes during the monitoring period should be noted. Tidal fluctuations, navigation controls on rivers, rainfall events, groundwater pumping, trains, large trucks and other heavy equipment parked nearby can also affect groundwater levels. Personnel collecting water level data must note if any of these conditions occur during the monitoring period. It is also important that the time of data collection at each station be accurately recorded. Depth to water monitoring in wells should be conducted after well vapour headspace monitoring, if required but prior to any well purging/sampling activities.

In conjunction with groundwater level measurements, the elevation of adjacent surface water bodies (e.g. ponds, lakes, rivers, lagoons and ditches) should also be monitored (not covered in this SOP). This information is useful for understanding the hydrogeologic setting of the site and the potential influence of such features on groundwater flow.

The typical devices used for fluid level monitoring are:

- Calibrated electronic water level indicators (e.g. Solinist)
- Pressure transducers and data loggers (generally for pumping tests and long-term monitoring)

## 2.0 HEALTH AND SAFETY

### 2.1 General Health and Safety Concerns

The main Health and Safety (H&S) concern during groundwater monitoring is the contaminants of concern at the site. There may be other site-specific concerns associated with the site particularly if it is an active site. Please reference the Health and Safety Plan (HASP) and the project manager for further concerns.

### 2.2 Hazardous Materials

The hazardous material associated with carrying out this procedure is Alconox or other critical cleaning detergents.

In addition to the hazardous material(s) listed above, consultation with the project manager is imperative to define potential hazardous compounds and anticipated exposure levels associated with each site prior to commencing on-site activities to determine personal protective equipment (PPE) for several compounds. Reference can be made to the National Institute for Occupational Safety and Health (NIOSH) publications for information pertaining to compounds.

### 2.3 Personal Protective Equipment (PPE)/Safety Checklist

The following PPE is required while groundwater monitoring:

- high-visibility safety vest
- steel toed boots
- hardhat (when working near moving equipment)
- disposable gloves
- safety glasses

Please reference the HASP for further requirements.

## 3.0 REFERENCE DOCUMENTATION

Table 1 summarizes the documentation referenced in this TGD. Note that well vapour monitoring is typically conducted as part of, and prior to, a groundwater monitoring program. The SOP covering well vapour monitoring procedures is referenced in Table 1, below.

**Table 1: Reference Documentation**

| Document Reference Number | Document Title |
|---|---|
| SOP # 01 | Well Vapour Monitoring |

## 4.0 PLANNING AND PREPARATION

### 4.1 Planning

The following procedures shall be taken before monitoring:

a) Review Health and Safety Plan (HASP).
b) Sign out all required equipment and gather together with any additional supplies as required by the supply checklist. Assess condition of all required equipment.
c) Review previous site data and determine the number and location of monitoring points.
d) Obtain any keys required to access the site and monitoring wells.
e) Determine the notification requirements with the project manager and ensure the client, landowners or other necessary personnel have been notified at least one day before going into the field to monitor.
f) Arrange for traffic control to monitor wells in roadways, if necessary.

### 4.2 Checklist of Equipment and Materials

(In addition to the equipment specified in Section 2.3).

Water or interface probe
Rinse bucket
Cell phone
Alconox or other cleaning agent
Socket set and wrench
Screwdriver (flathead)
Spare nine volt batteries
Hex-key set
Camera
Clean tarp
Product bucket/drum
Turkey baster (or equivalent)
Keys for locked well caps, site access
Site plan
Field book
First Aid Kit
Metal detector (to assist in locating wells if applicable)
HASP
PPE

## 5.0 PROCEDURES

### 5.1 Identify and Inspect Wells

The location and condition of the wells should be noted before monitoring.

a) Remove the lid of the protective casing (either road box or stick up) if present (usually require a 9/16" socket and a screwdriver to pry off).
b) Remove any water that may have pooled inside the roadbox above the top of the well cap (use a turkey baster or equivalent).
c) Mitigate any surface water inflow to the roadbox.
d) If the well cap or surface seal surrounding the well is in poor condition make a note of it in your field book and in the field report and replace the well cap or make arrangements to conduct any repairs necessary to prevent the infiltration of surface water into the well.

## 5.2 Water Level and LNAPL Monitoring

### *5.2.1 General Procedures*

Depth to water and LNAPL monitoring should be conducted on the same day. If there are a large number of wells to monitor, then it is preferable to have two field staff complete the monitoring on the same day using two instruments as opposed to one individual conducting the monitoring over a two-day period. If more than one instrument is used at a site, the readings for each instrument should be calibrated against each other by recording the depth to water in the same well with each instrument.

It is possible at some sites that certain wells may become pressurized. In extreme cases of pressurization, the static water level can be depressed by more than half a meter and the top cap, when loosened, may become a projectile. For this reason, never place any part of your body over the top cap when loosening it. Pressurization tends to occur in wells where the water table is situated above the top of the well screen and significant water level changes have been induced by tidal effects, recent infiltration or other phenomena. To mitigate the effects of pressurization, remove the well cap and allow several minutes to elapse prior to monitoring fluid levels. If you are unsure whether water level equilibrium conditions have been re-established in the well, take two successive readings at least 10 minutes apart to check for transient changes in the water level and if necessary, continue this procedure until the water level reading has stabilized.

### *5.2.2 Pre-monitoring Procedures with the Water Level or Interface Probe*

a) Inspect the conductors on the end of the probe to ensure that they are clean and free of dirt or oxidized particulates. If the sensor requires cleaning, use a Q-tip. Fine sandpaper or emery cloth may be used lightly to remove stubborn particles.
b) Turn the probe on.
c) Test the probe in clean water to make sure it is operating properly. An audible tone should sound when the probe is immersed in water. (Note: some interface probes are light-sensitive and will only work in the dark, i.e. inside the well.) Distilled water may cause the probe not to sound as it may not contain sufficient dissolved solids to complete the circuit.
d) Lay a clean tarp on the ground to provide a clean working surface at each monitoring location.

### *5.2.3 Measuring Depth to Water with the Water Probe*

a) Slowly lower the probe until the tip is immersed in water and the probe begins beeping. If the probe is lowered too quickly, the water table may be displaced higher than the initial static level, giving an erroneous reading.
b) Raise the probe out of the water (until it stops beeping) and then very slowly lower it until the probe senses water again. Water may bridge between the sensor and probe housing, which may cause the unit to keep beeping after the sensor is removed from

water. Gently shake the tape to dislodge the water from the sensor if this occurs. Should this fail, remove the probe and clean the sensor area.

c) Record the depth to the nearest millimeter from the highest point of the well riser. The riser high point is normally marked with a black permanent marker. Mark the highest point of the well if it is not marked.
d) Record the time of the reading.
e) Turn the unit off and use the tape to measure the depth to the bottom of the well. It is usually apparent whether the tip of the probe is on the hard end cap or on soft sediment that sometimes accumulates in the bottom of a well over time. Record this information, as it is relevant for assessing well development requirements and groundwater sample integrity. Note that depth to bottom measurement may not be required for some monitoring events (consult with project manager).
f) Remove probe from well.
g) Clean with an Alconox or other approved cleaning agent and water and then rinse with distilled water.

### *5.2.4 Measuring Depth to Water and Product with the Interface Probe*

a) Slowly lower the probe until it is immersed either in water (beeping, intermittent tone) or non-aqueous phase liquid (steady tone). Lowering the probe too quickly will slug-load the water and may yield an artificially high water level reading in low permeability soils.
b) If the interface probe does not sense a non-aqueous phase liquid (NAPL), then continue to monitor the well as with a water probe (Section 5.3.2) and record "not detected" for the NAPL data entry. If NAPL is encountered:
c) Raise the probe until the steady tone ceases and then very slowly lower it until the probe senses NAPL again.
d) Record the depth to the nearest millimeter from the mark or highest point on the piezometer.
e) Lower the probe very slowly through the NAPL until the probe senses water (intermittent beeping). You may need to shake the line very gently to avoid bridging.
f) Raise the probe very slowly until the probe senses the non-aqueous phase (steady tone).
g) Record the depth to product (nearest millimeter).
h) Record the time of the reading.
i) Turn the unit off and use the tape to measure the depth to the bottom of the well, however, if NAPL is present in the well do not use the probe to measure the bottom of the well. It is usually apparent whether the tip of the probe is on the hard end cap or on soft sediment that sometimes accumulates in the bottom of a well over time. Record this information, as it is relevant for assessing well development requirements and groundwater sample integrity. Note that depth to bottom measurement may not be required for some monitoring events (consult with project manager).
j) Remove the probe from the well.
k) Clean the probe and the tape with an Alconox or other approved cleaning agent and water solution, and then rinse with distilled water.

l) If a marginal amount of NAPL is indicated < 1mm it is suggested that the presence of NAPL be confirmed using a visual method such as a bailer or using hydrocarbon paste (see Section 5.3.4 below).

### 5.2.6 Troubleshooting

Caution should be exercised in cold (sub-zero) weather as condensation may form and then freeze on the sensor prism when the unit is taken outside from a warm vehicle. The probe should be allowed to acclimatize and the sensor should be wiped off when this occurs.

If the sensor beeps erratically or fails to sound, check to make sure the probe sensitivity control has been set properly. If this does not work, the batteries may need to be changed.

If the interface probe has difficulty finding the interface due to a viscous NAPL, remove the probe from the well. Wash the probe with a solution of Alconox or other approved cleaning agent and water. Coat the probe with a concentrated solution of Alconox or other approved cleaning agent and water. Attempt to re-measure the interface. Some heavier fuel oils are too viscous and cannot be measured with an interface probe due to fouling of the sensor. If this occurs, consult with the project manager.

If the interface probe senses NAPL (steady tone) within the well before it is immersed, then try adjusting the sensitivity setting of the instrument. If this does not work, remove the probe, wash it thoroughly, and try again. High moisture and/or vapour levels in a well may give rise to false readings; in this case, allow the well to vent. If in doubt, check with product paste.

If you are unsure whether a NAPL reading is reliable, use a bailer to confirm the presence of free-product and/or use indicator paste to confirm an accurate measurement.

# GROUNDWATER SAMPLING OF MONITOR WELLS

## 1.0 GENERAL

The objective of sampling wells is to obtain groundwater samples that are representative of formation conditions. Groundwater samples may be required for various reasons, such as contaminated site assessments, groundwater supply or compliance monitoring. Important aspects of groundwater sampling include collecting samples that are free of suspended sediments, minimizing the potential loss of volatile constituents, consistency in field procedures and careful handling, transport and documentation procedures. Reliable groundwater data is imperative in an environmental assessment program. Equally important but not covered in this Standard Operating Procedure (SOP) is the laboratory quality assurance and quality control (QA/QC) program and subsequent data validation procedures.

This SOP covers the purging and collection of groundwater samples from standard monitoring wells. It does not cover sample collection from surface water or domestic/municipal supply wells, as there are additional considerations and specific requirements for those procedures. Consult with the project manager for sampling procedures that are beyond the scope of this SOP.

## 2.0 HEALTH AND SAFETY

### 2.1 General Health and Safety Concerns

The main Health and Safety (H&S) concern during well vapour monitoring is the contaminants of concern at the site. There may be other H&S concerns, particularly if the site is active. Ensure that you reference the project-specific HASP and consult with the project manager to define all of the potential hazards at the site.

### 2.2 Hazardous Materials

Consultation with the project manager is imperative to define potential hazardous compounds and anticipated exposure levels associated with each site prior to commencing on-site activities. Reference can be made to the National Institute for Occupational Safety and Health (NIOSH) publications for information pertaining to compounds, if required.

### 2.3 Personal Protective Equipment (PPE)/Safety Checklist

The following PPE is required while groundwater monitoring:

- high-visibility safety vest
- steel toed boots/most likely rubber boots
- hardhat (when working near moving equipment)
- disposable gloves

Please reference the HASP for further requirements.

## 3.0 REFERENCE DOCUMENTATION

Table 1 summarizes documentation referenced in this SOP.

**Table 1: Reference Documentation**

| Document Reference Number | Document Title |
|---|---|
| SOP # 01 | Well Vapour Monitoring |
| SOP # 02 | Groundwater Monitoring |

## 4.0 PLANNING AND PREPARATION

### 4.1 Planning

The following procedures shall be taken before monitoring:

a) Review the work program and site-specific HASP with the project manager.
b) Sign out all the required equipment and assess condition.
c) Assemble all pertinent information, e.g. site plan, borehole logs, and previous sampling event data.
d) Assemble all equipment, sampling jars, preservatives and supplies as listed in the checklist in Section 4.2. Obtain site access or monitoring well keys if required.
e) Notify property owner/operator of the scheduled sampling event and arrange access to site.
f) Determine method of purged groundwater disposal prior to sampling event. Estimate the volume of purged groundwater that may be generated and ensure that sufficient containers are available on site for storage of the water.
g) Review previous analytical data and plan the sequence of sample collection so wells are sampled in the order of “cleanest” to “dirtiest” to reduce potential cross-contamination.

### 4.2 Checklist of Equipment and Materials

(In addition to the equipment specified in Section 2.3)

Clean tarp for work area
Pylons
Graduated containers or buckets
Vapour monitor (Gastech or PID)
Disposable nitrile gloves
Disposable bailers – inertial lift pump (Waterra system) or peristaltic pump
Chain-of-Custody form
Sample bottle labels
Drum labels
Socket set and wrench
Cell phone
Electronic water level/interface probe
Metal tape
Calculator
Cooler and ice packs
Sample bottle packing material
String/twine
Utility knife
Laboratory-prepared sampling jars
Preservatives
Turkey baster (or equivalent)
Keys for locked well caps, site access
Site plan

Filtering device and filters, as required
Metal detector (to assist in locating wells if applicable)
Camera
First Aid Kit
PPE
Field book
Screwdriver (flathead)
Spare 9-volt batteries (for probes)
Alconox or other approved cleaning agent
HASP

## 5.0 PROCEDURES

### 5.1 Identify and Inspect Wells

a) The location and condition of the wells should be noted before monitoring. Confirm that the well has been properly identified by comparing the relative locations of other wells, borehole log details, site plan dimensions, etc. During water level monitoring, confirm that the well completion is consistent with the borehole log. Note if soft sediments are evident at the bottom of the well.
b) Inspect the well to determine whether it is suitable for sampling. Make note of any cracks in the casing or surface seal, or if the well cap or roadbox is missing or damaged.
c) Inform the project manager if well repairs are required.

### 5.2 Well Vapour Monitoring

Measure monitoring well vapour levels as described in SOP #01 Well Vapour Monitoring, prior to monitoring fluid levels and sampling groundwater in the well.

### 5.3 Water Level Monitoring

a) Measure water levels according to methods described in SOP#02 Groundwater Monitoring, prior to commencing groundwater purging/sampling. Do not monitor the depth to well bottom until after sampling has been conducted to minimize the potential for cross-contamination.
b) Compare the monitored depth to bottom with the original well depth on the borehole log (note that discrepancies of 10cm are not uncommon). If significant accumulations of sediment are suspected (sediment can usually be felt as a ‘soft bottom’ with the probe) then the well must be redeveloped.
c) Decontaminate the water level probe with Alconox or other approved cleaning agentbetween each well to avoid cross-contamination.

### 5.4 Well Volume Calculation

As part of the well purging procedure, it is necessary to first determine the volume of standing water within the well. The total volume of standing water includes the water in the well casing and the water contained within the pore space of the filter pack. This has been segregated into two calculations below.

a) First, an estimation for one standing volume of groundwater within the well casing is calculated as follows:

$$V_w = \pi r_i^2 (H) \times 1000$$

Where:

$V_w$ = well casing standing volume
$r_i$ = radius of well (inside of pipe) in metres
H = distance from static water level to bottom of well (metres)

b) The standing volume of water also includes the volume of water stored within the pore space of the filter pack in the annulus of the well. The volume of standing water within the annulus alone can be estimated as follows:

$$V_a = \pi R^2 (H) \times 300 - (\pi r_o^2 (H) \times 300)$$

Where:

$V_a$ = well annulus standing volume
R = radius of borehole in metres
$r_o$ = radius of well (outside of pipe) in metres

c) In total, one standing volume of water = $V_w + V_a$

Note: 1 bailer volume = approximately 1 litre
For a 50 mm diameter well, $V_w = 2H$ litres

## 5.5 Well Purging

Well purging is accomplished through controlled removal of 'stagnant' water from within the well bore and surrounding annulus. Purging is normally accomplished using bailers or pumps. Regardless of the equipment selected for purging, the intent is to minimize agitation of the water column as this may entrain sediment from the bottom and/or induce loss of volatile constituents in the groundwater.

There are two basic methods for establishing that well purging has been sufficiently completed and that groundwater sampling can proceed. The first method is based on the removal of three to five standing well volumes. The second method is based on the stabilization of specific groundwater parameters that are periodically assessed during purging. A standard field sampling form for each of these methods is attached. Consultation with the project manager is required to determine which method is appropriate for each job.

Most groundwater purging is conducted using a bailer or an inertial lift pump (Waterra). If groundwater sampling will subsequently be conducted for volatile constituents, then a bailer or peristaltic pump is the preferred method for well purging.

### *5.5.1 General*

The general procedure for well purging is as follows:

- Purging by bailer: Use a clean dedicated bailer for purging. Slowly lower and extract the bailer to minimize agitation of the groundwater.
- Purging by inertial lift pump or peristaltic pump: During pumping, try to progressively move the foot valve or bottom of tubing so that groundwater extraction occurs from the top area to the lower area of the well screen, particularly in cases where the saturated screen length is greater than 1.0 metres.

### *5.5.2 Well Volume Method*

When purging a well by the Well Volume Method, use the standard NSLI form "Groundwater Sampling Sheet – Well Volume Method" (attachment).

a) Purge a minimum of three well volumes (wellbore and annulus).
b) Avoid purging from the bottom of the well as any accumulated sediment that is disturbed could go into suspension and may clog the bailer or Waterra valves. If accumulated sediments are problematic, then the well may require redevelopment.
c) If after purging three well volumes the groundwater is still not flowing relatively clear and sediment-free, continue purging until at least five well volumes have been removed. If groundwater still has not cleared up, then discontinue purging. Drain the purging equipment and remove it from the saturated zone, then let the groundwater stand undisturbed for a minimum of one half-hour prior to sampling (this is normally long enough for suspended sediments to settle out). If this is not sufficient, the well can be left overnight (to a maximum of 24 hours) prior to sampling. The importance of collecting sediment-free samples cannot be over-emphasized when analyzing for constituents that have a high affinity for adsorption (e.g. many mid- to high-molecular weight organic molecules such as polycyclic aromatic hydrocarbons) as many labs cannot decant samples by regulation. High-suspended sediment content also makes field filtering for dissolved metal samples very difficult and time consuming. In wells where suspended sediment is a problem, well re-development may be necessary to re-establish clear groundwater flow. Low-flow groundwater purging and sampling techniques should be used when sediments are problematic (see Section 5.5.3).
d) In some low permeability formations (e.g. clay) it is possible to purge the well dry after one well volume and purging of three well volumes could potentially require two or more days. This may not be practical due to logistical constraints such as remote location. In this case, consult with the project manager to determine the well purging requirements and consider purging by the field parameter stabilization technique (see Section 5.5.3).
e) Collect the purged groundwater in a bucket and dispose of the groundwater in an on-site, labeled, closed-head drum or as previously determined by the project manager. Try to segregate highly contaminated groundwater from relatively clean water if possible.
f) Notify the project manager when the drum(s) become full so that arrangements can be made for their disposal.

### *5.5.3 Low-Flow Groundwater Purging and Sampling*

Low flow purging and sampling is considered to be the most defensible method for the collection of representative formation water. Low flow purging and sampling is the preferred method for all semi-volatile and non-volatile/inorganic analyses (i.e. C10-50 hydrocarbons, metals). Low flow purging and sampling is also the preferred method for low-permeability formations (i.e. silt, clay, till).

Low flow sampling is defined as:

- Purging groundwater from a well at a rate of less than 1 L/min; and
- Minimization and stabilization of the water level drawdown as quickly as possible.

Both well purging and well sampling are conducted following these guidelines. During the purging process, extracted groundwater is determined to be representative of natural formation water through geochemical parameter stabilization monitoring. Once the geochemical parameters are determined to have stabilized, groundwater samples are subsequently collected.

Low-flow purging offers the following advantages over high-flow purging:

- Typically less groundwater is purged to achieve parameter stabilization compared to the '3 well volume technique' saving time and groundwater disposal costs;
- Samples are more representative of the 'mobile' load of contaminants present due to reduced stress on the formation;
- Samples are collected immediately upon completion of purging, eliminating the potential effects of lag time (between purging and sampling) on sample quality;
- There is usually less mixing of stagnant casing water that may be present;
- Reduced time for filtration of metals samples; and
- Less operator variability, greater operator control and therefore better sample consistency.

In contrast, high-flow purging is typically subject to the following potential problems:

- Often leads to cascading water through the well screen and potential changes in groundwater chemistry arising from aeration and volatilization;
- Draining water from the filter pack may entrap air in pore spaces, with lingering effects on water chemistry; and
- Increased sample turbidity can result from stressing the formation and stirring up sediments and otherwise immobile contaminants at the bottom of the well.

Some disadvantages of the low-flow purging method include:

- Greater setup time in the field;
- Need to transport additional equipment to and from site; and

- Equipment maintenance costs.

The equipment used for low-flow purging and sampling must meet the following requirements:

- Pumping groundwater at an adjustable, definable flow between 0.1 and 1.0 L/min; and
- Consistent operation at these low flow rates.

Bailers and inertial lift foot-valve pumps (Waterra) are inappropriate devices for low-flow sampling. The primary types of pumps recommended for low flow sampling include peristaltic, bladder and submersible pumps. NSLI uses primarily peristaltic pumps, however these pumps are limited to extracting groundwater from depths less than approximately 8 metres below grade.

Where groundwater must be sampled from greater depths, an electric submersible pump (e.g. Grundfos Rediflow-2) is recommended. Disadvantages of submersible pumps include the requirement for pump decontamination between each well sampled and significant mixing of the water column as the pump is lowered down-hole.

Very low permeability formations may require flow rates < 0.1 L/min to avoid purging the well dry and may therefore be technology-limited. The procedure in this case should be pulsed purging/recovery while leaving the equipment in the well. In cases of very low conductivity, it may be necessary to simply evacuate the groundwater and wait for recovery of the first well volume prior to sampling. Should time constraints be an issue, alternative methods may be required for sample collection in very low permeability formations.

Alternative sampling methods to consider (not covered in this guidance document) may include:

- Geoprobe/hydropunch grab sampling methods;
- Passive diffusion samplers

The general procedure for low-flow purging and sampling is as follows:

a) Connect the outlet from the sampling pump to a standard flow-through cell for monitoring geochemical groundwater parameters as per Section 5.5.4. The outlet from the flow-through cell should be directed into a container for subsequent disposal of the wastewater. The preferred low-flow sampling pump used by NSLI is the peristaltic pump. Further details on operation of the peristaltic pump are provided in Section 5.7.3;
b) Lower the pump intake very slowly into the water column to minimize mixing of stagnant casing water and disturbance of any sediment at the well bottom. This will help minimize the purging time and is particularly important for deep/confined wells;
c) Locate the intake near the center of the saturated screen interval (based on the well log). Do not allow the intake to touch the bottom of the well where accumulated sediment may be disturbed and re-suspended. The flow rate should be determined based on the hydraulic performance of each well. The pump flow rate should be between 0.1 and 1.0 L/min;

d) Check the water level periodically to monitor drawdown in the well as a guide to flow rate adjustment;
e) The flow rate should be adjusted to obtain stabilization of the water level in the well as quickly as possible. Lower-end flow rates may reduce the purging time in some instances as higher flow rates may induce re-suspension of sediment and longer time frames for parameter stabilization. Record the drawdown level once it has stabilized; Record the geochemical stabilization parameters on SLR's standard groundwater sampling sheet as per Section 5.5.4. The information recorded and final flow rate used will be required for subsequent sampling events;
f) Collect the groundwater samples. If a peristaltic pump is used, disconnect the flow-through cell and sample from the outlet of the pump (do not sample from the outlet of the flow-through cell);
g) Dispose of collected wastewater in closed-head containers that are appropriately labeled and stored.

Measure the depth to bottom of well only after sampling has been completed. Otherwise, this activity may induce mixing of the water column and suspension of sediments that might have accumulated on the well bottom. If the well consistently produces high turbidity water (>50 NTU) at low pumping rates, then the well should be redeveloped. If turbidity levels still cannot be reduced below 50 NTU after well development, there may be a problem with the well screen design or filter pack. The use of well casing centralizers is recommended during well installation to ensure that the bottom of a well is centered in the borehole, optimizing filter pack efficiency.

If a significant change in the static water level occurs between sampling events, the optimum flow rate may need to be reestablished.

### *5.5.4 Field Parameter Stabilization Method*

When purging a well by the low-flow sampling method, the parameter stabilization method should be used to assess well purging progress. Use the standard SLR Groundwater Sampling Sheet - Field Parameter Stabilization Method (see attachment) to record the monitored parameters.

In the parameter stabilization method, extracted groundwater is passed continuously through a 'flow-through' cell and select geochemical parameters are monitored to assess their stabilization as an indication that representative formation water is being extracted. Parameters typically monitored for stabilization include pH, temperature, specific conductance, redox potential, dissolved oxygen and turbidity. In general, pH, temperature and conductivity will stabilize first. These are the 3 minimum parameters required for stabilization monitoring by SLR.

It is important to follow consistent procedures for each sampling event with respect to flow rate, the drawdown induced and the sampling equipment used. The procedure for parameter stabilization monitoring is as follows:

- Connect the outlet from the sampling equipment to a standard (e.g. SLR-manufactured) flow-through cell.

- While purging, monitor geochemical parameters (pH, temperature and conductivity) every 3 to 5 minutes for stabilization. Use the field log sheet for parameter stabilization monitoring (attachment). The time, flow rate and volume purged should also be recorded and will be used as a guide for future sampling events. Also note observations such as colour, odour, sheen and turbidity.
- Stabilization is considered to be achieved after all parameters have stabilized for 3 successive readings. Stabilization guidelines are as follows:
  - For required monitoring parameters:
    pH: +/- 0.2units
    Temp: +/- 0.1 oC
    Conductivity: +/- 5%
  - Optional monitoring parameters:
    Redox: +/- 20mV
    D/O: +/- 0.2 mg/L
    Turbidity: +/- 10% (ideally <5 NTU)

There may be situations where geochemical parameters will not stabilize (e.g. tidal influence). In this event, continue to use low flow purging but determine the completion of purging based on the well volume technique. If the pH, temperature and conductivity have not stabilized after purging three to five well volumes, then make note of this, discontinue purging and proceed with sampling.

## 5.6 Groundwater Sampling Considerations

### *5.6.1 General*

The appropriate sampling methodology may vary depending upon such factors as well completion details, depth to groundwater or type of contaminant. This SOP covers general sampling procedures using standard equipment used by NSLI. For more specialized sampling considerations, consult with senior technical staff. The following general procedures/considerations apply regardless of sampling methodology.

a) Wells should not be sampled immediately following well development. At least 48 hours should be allowed to pass after well development to allow equilibrium conditions to establish prior to sampling. Allowing 1 week between well development and sampling is optimal.
b) Always plan the sampling program to begin with the least contaminated well and end with the most contaminated well (if known) to minimize the potential for cross-contamination.
c) Monitor wells should normally be allowed to recharge at least 80% of static conditions prior to collecting samples.

d) Samples should be collected within two hours of purging and no more than 24 hours should be allowed to elapse between purging and sampling.
e) In some low permeability formations, it may not be possible to satisfy the conditions in (a) and (d) above and sampling may need to be initiated. Consult with the senior technical staff for further advice
f) If groundwater has been left to stand for some period to allow sediments to settle, sediment can be trapped in the valve and adhere to the walls of the bailer or pump tubing. At sensitive sites, it may be prudent to discard the equipment used for purging and use a new bailer or tubing/foot valve for sampling. Consult with senior technical staff to determine whether this protocol is applicable.
g) New, powderless, disposable Nitrile gloves or equivalent must be worn during each sampling event and changed between wells.
h) Never introduce foreign liquids or materials other than sampling or monitoring equipment into a well.
i) Prior to opening the well cap, ensure that surface runoff or any water trapped within the roadbox cannot run into the well. Either add a temporary extension to the top of the well or remove trapped water using a turkey baster or hand pump.
j) Use a clean tarp to provide a clean working area next to the well. Do not place the unwrapped bailer or any downhole part of the sampling equipment on the ground at any time prior to or during sampling.
k) Dispose of bailers or tubing after each sampling event. Do not leave dedicated sampling equipment in the well as it may interfere with future monitoring activities, can provide a media for biological growth or the adherence of oxidized particulates and may trap sediment in the valve.
l) Depending on the analysis requested, specific sampling jars, volumes and preservatives are required; refer to instructions and protocols required by the laboratory to which the samples will be submitted for analysis. The laboratory that conducts the analysis should provide all sample bottles and preservatives.
m) Preservatives are normally provided by the laboratory either already added to each container or in pre-measured capsules. If preservative is required, first fill the sample container approximately three-quarters full with the groundwater sample before adding the preservative and then top up the container with the remainder of the sample.
n) Do not rinse sample jars with sample water prior to sample collection. Some compounds, e.g. halogenated contaminants may sorb to the sample container. Sample bottles come prepared by the lab and are ready to fill.
o) Keep sample containers closed until they are to be filled. Do not pre-chill sample containers as condensation will form on both the outside and inside of glass containers. Be careful not to touch the rim of the sample containers.
p) In general, it is good practice to fill sample containers as full as possible without overflow. Airspace trapped in the sample container can potentially affect the pH of the sample. Overflow can result in loss of preservative that may have been added for sample preservation.
q) Sample collection flow rates should be less than 0.5 L/min. Use rates similar to purging to fill bottles analyzed for metals and other inorganic parameters. Fill larger sample

bottles first, then reduce the flow rate to approximately 0.1 L/min for volatiles and filtered samples.

### *5.6.2 Specific Considerations – Volatiles and Semi-volatiles*

a) To minimize the potential loss of volatiles through agitation of the water column, sampling for volatiles should be conducted using a peristaltic pump or bailer. The use of inertial lift pumps is not recommended for sampling volatiles.
b) Low-flow purging and sampling should be used for all semi-volatile analyses.
c) Sample containers should be filled until a meniscus forms above the top rim. The lid should be teflon-lined and carefully screwed on to displace any surface bubbles and establish a tight seal. Try to avoid trapping air bubbles in the sample containers when analyzing for volatiles. Check by inverting the bottle and tapping it. If bubbles larger than 1 mm are present, discard the sample and collect another in a new container.
d) Avoid aeration of the groundwater as it is transferred to the sample container. The sample collection rate should be approximately 0.1 L/min.
e) Never filter samples for organic contaminants.
f) Never decant samples for volatiles to eliminate sediment.

### *5.6.3 Specific Considerations – Metals*

- Prior to collecting each sample, the groundwater pH and hardness must be measured or separate samples (no preservative or filtering) must be obtained and analyzed by the laboratory immediately (<24 hours).
- The disturbance and entrainment of sediments in the well bottom or of oxidized particulates adhering to the casing wall can potentially bias the analytical results. Therefore, well purging and sampling should be conducted using low-flow purging and sampling and the field parameter stabilization method (Sections 5.5.3 and 5.5.4).
- Samples for dissolved metals analysis should be filtered in the field. Filter using an in-line filtering device (preferred method) or by pouring the sample into clean filtration equipment provided by the laboratory.
- Use a fresh 0.45 µm filter for each sample and replace as required. Thoroughly decontaminate the filtering apparatus between wells if not using disposable, inline filters.
- Filtering must be conducted prior to adding the preservative. If you are unable to filter samples for dissolved metals in the field, do not add preservative and ensure that the samples are filtered within 24 hours of collection. Ensure that trapped air is minimized within the sample container.

### *5.6.4 Specific Considerations – Free Product*

• Wells that contain free-phase product are assumed to be contaminated and groundwater from these wells is therefore not normally sampled. Consult with the project manager to determine the appropriate course of action. Contaminant concentrations in these wells may be required for forensic interpretation or to assess baseline conditions. Free-product sample collection (not covered in this SOP) may be required to assist in source identification and to characterize the

specific gravity and viscosity of the product. Regardless of whether the well is sampled or not, wells with free-product should be purged to remove the product and stagnant water after the depth to each interface has been recorded.

## 5.7 Groundwater Sampling Procedure

### *5.7.1 Sampling by Bailer*

a) Partially remove plastic from a new, plastic, disposable bailer, attach new string, remove remainder of plastic and lower the bailer gently into the well, minimizing agitation of the water column; do all sampling without letting the bailer touch the ground or without touching the bailer with your bare hands.
b) The bailer's contents should be discharged into a laboratory-prepared sample jar from the bottom of the bailer using the bailer sampling attachments or by slowly decanting from the top of the bailer.
c) Ensure that the string attached to the bailer is untreated (some are treated with fungicide) and do not allow the groundwater to run over the string as it is transferred to the sample container.
d) Record field observations on the appropriate NSLI groundwater sampling form.

### *5.7.2 Sampling by Inertial Lift Pump*

a) Attach a footvalve to the (Waterra) tubing and lower it into the well near the base of the screen but at least 0.3 metres above the bottom, as measured during monitoring. The intention is to minimize potential entrainment of sediments.
b) Discharge slowly from the hose at surface directly into the sample container.
c) If necessary, attach a disposable, inline filter to the end of the tubing. An attachment can be made using flexible silicon (e.g. Masterflex) tubing. Pump a minimum of one litre of groundwater through the filter prior to collecting the sample.
d) Record field observations on the appropriate NSLI groundwater sampling form.

### *5.7.3 Sampling by Peristaltic Pump*

a) For each well attach a new section of silicon tubing (e.g. Masterflex) approximately two feet in length to the head of the peristaltic pump.
b) Cut an appropriate length of tubing to reach the sample collection depth. Food-grade vinyl
c) The depth limitation for extracting groundwater using a peristaltic pump is approximately eight metres below grade.
d) Potential aeration or entrainment of sediment can be minimized by adjusting the pump control to extract at a low flow-rate. When collecting samples for volatile constituents, the pump flowrate should be adjusted downward to less than 200 ml/min.
e) Transfer the groundwater directly from the end of the silicon tubing into the sample container. If necessary, finer control of the flow discharge can be achieved using a smaller diameter tubing.

f) Record field observations on the appropriate NSLI groundwater sampling form.
g) Refer to the owner's manual of the pump for specific operating instructions.

### 5.8 Sample Labels

a) Label all sample containers with the laboratory-provided labels and use a pencil for all sample identification information. Write the sample ID number on the lid of each container. Labelling and marking should be done prior to cooling the sample containers to prevent interference caused by condensation.
b) Sample labels should include the following information:
   - Company identification
   - Project identification
   - Borehole identification
   - Date and time of sample collection
   - Parameters to be analyzed

### 5.9 Sample Handling

a) Immediately place the samples in a sealed cooler with an ice pack; samples must be kept cold (approximately 4°C) but avoid freezing.
b) Complete a Chain-of-Custody (COC) form and submit the cooler and form to the laboratory as soon as possible after sampling. Indicate on the COC any samples where high analyte concentrations are expected based on field observations.
c) Sample holding times vary depending on the analyte. Ensure that samples are received by the lab with sufficient time to be extracted before they expire.
d) Samples shipped by bus or air must be carefully packed so that there is no room for sample movement. Glass containers should be individually wrapped in bubble wrap/styrofoam, etc. At remote sites, it may be prudent to take duplicate samples as insurance in case of breakage. Send the COC in a sealed plastic bag (e.g. Ziplock) inside the shipment.

### 5.10 Quality Assurance/Quality Control (QA/QC)

To ensure that groundwater sampling and analytical data are meaningful and reproducible, a quality assurance and quality control program must be incorporated into each sampling event. All field quality control samples must be prepared the same as regular investigation samples with regard to sample volume, containers, and preservation.

The following quality control samples shall be collected for each batch of samples (a batch may not exceed 20 samples), and in accordance with the Sampling Plan:

a) Trip blanks - are required for the VOC samples at a frequency of one set per VOC sample cooler.

b) Equipment blanks - shall include the pump and the pump's tubing. Collect equipment blanks after sampling from contaminated wells and not after background wells.
c) Field duplicates - are collected to determine precision of sampling procedure. For this procedure, collect duplicate for each analyte group in consecutive order (VOC original, VOC duplicate, SVOC original, SVOC duplicate, etc.).

QA/QC includes careful collection and labelling of samples, identification of locations, thorough decontamination of equipment and careful, concise field note documentation.

### *5.10.1 Field Notes*

Field notes must document all observations, measurements, equipment, conditions and procedures. The field log book should document the following information for each well sampled:

- Well identification
- Condition of well, roadbox, any repairs required
- Monitoring well vapour level
- Static water level depth from top of piezometer
- Presence/thickness of free-phase product
- Depth to bottom of well (if no free-product present)
- Volume of groundwater purged
- Purging/sampling device used
- Date and time purged and sampled
- Measured field parameters (pH, temperature, etc.) if applicable and methods
- Well sampling sequence
- Sample appearance and odours
- Sample volume and types of containers
- Preservatives used
- Analyses requested
- Laboratory used
- Name of collector
- Climatic conditions (temperature and weather)
- Site conditions
- Problems encountered and deviations from sampling protocol

You must assume anyone who reads your field notes can independently determine:

- Exactly what activities were conducted in the field and why.
- Exactly where and when each piece of data was collected.
- The methodology used.

Only factual information should be recorded:

- Do not speculate; e.g. 5cm NAPL measured, not 5cm diesel product

- Do not write unprofessional comments.

**5.11 Follow-up Activities**

a) Check workplan to ensure that all samples have been collected
b) Well caps and roadbox covers should be secured

c) Equipment should be thoroughly cleaned
d) Copy field notes and submit to project manager/to file
e) Prepare memo to inform client of work completed
f) Upon receipt of the laboratory analytical reports, interpretation and verification of the QA/QC sample results should be conducted to determine whether data quality objectives have been met.

If you have any questions regarding groundwater sampling, contact the project manager or senior technical staff.

# SURFACE WATER SAMPLING

## 1.0 GENERAL

Surface water sample collection allows assessing surface water quality and hydrologic properties of the surface water body in which contaminants may exist. Sampling should not alter the medium which is being assessed.

These are standard (i.e., typically applicable) operating procedures which may require changes depending on the site conditions, equipment limitations, or limitations imposed by the procedures themselves. The final procedures employed will be documented.

## 2.0 HEALTH AND SAFETY

### 2.1 General Health and Safety Concerns

The main Health and Safety (H&S) concern during surface water sampling is the contaminants of concern at the site and the water bodies to be sampled (i.e. potential to fall in a stream). There may be other H&S concerns, particularly if the site is active. Ensure that you reference the project-specific HASP and consult with the project manager to define all of the potential hazards at the site.

### 2.2 Hazardous Materials

Consultation with the project manager is imperative to define potential hazardous compounds and anticipated exposure levels associated with each site prior to commencing on-site activities. Reference can be made to the National Institute for Occupational Safety and Health (NIOSH) publications for information pertaining to compounds, if required.

### 2.3 Personal Protective Equipment (PPE)/Safety Checklist

The following PPE is required while groundwater monitoring:

- high-visibility safety vest
- steel toed boots/most likely rubber boots or hip waders, if required
- hardhat (depending on site location)
- disposable gloves
- life jacket if working from a boat

Please reference the HASP for further requirements.

## 3.0 REFERENCE DOCUMENTATION

Table 1 summarizes documentation referenced in this SOP.

**Table 1: Reference Documentation**

| Document Reference Number | Document Title |
|---|---|
| N/A | Operating Manuals for any field equipment/samplers used |

## 4.0 PLANNING AND PREPARATION

### 4.1 Planning

The following procedures shall be taken before sampling:

a) Review the work program and site-specific HASP with the project manager.
b) Sign out all the required equipment and assess condition.
c) Assemble all pertinent information, e.g. site plan and previous sampling event data.
d) Assemble all equipment, sampling bottles, preservatives and supplies as listed in the checklist in Section 4.2. Obtain site access keys if required.
e) Notify property owner/operator of the scheduled sampling event and arrange access to site.
f) Review previous analytical data and plan the sequence of sample collection so wells are sampled in the order of "cleanest" to "dirtiest" to reduce potential cross-contamination.

### 4.2 Checklist of Equipment and Materials

(In addition to the equipment specified in Section 2.3)

Disposable nitrile gloves
Chain-of-Custody form
Sample bottle labels
Cell phone
Filtering device and filters, as required
Sampling tools, as required (e.g. aromatic composite samplers)
Camera
First Aid Kit
PPE
Sampling meters, as required (e.g. pH meter)
Cooler and ice packs
Sample bottle packing material
Laboratory-prepared sampling jars
Preservatives
Site plan
Field book
Batteries (as required)
HASP

## 5.0 PROCEDURES

### 5.1 Surface Water Sampling Considerations

#### *5.1.1 General*

The appropriate sampling methodology may vary depending upon such factors as well recent weather at the time of sampling, weather events, or type of contaminant. This SOP covers general sampling procedures using standard equipment used by NSLI. For more specialized

sampling considerations, consult with senior technical staff. The following general procedures/considerations apply regardless of sampling methodology.

a) New, powderless, disposable Nitrile gloves or equivalent must be worn during each sampling event and changed between locations.
b) Never introduce foreign liquids or materials other than sampling or monitoring equipment into a the sampling location.
c) Use a clean tarp to provide a clean working area next to the sampling location. Do not place any part of the sampling equipment on the ground at any time prior to or during sampling.
d) Depending on the analysis requested, specific sampling bottles, volumes and preservatives are required; refer to instructions and protocols required by the laboratory to which the samples will be submitted for analysis. The laboratory that conducts the analysis should provide all sample bottles and preservatives.
e) Preservatives are normally provided by the laboratory either already added to each container or in pre-measured capsules. If preservative is required, first fill the sample container approximately three-quarters full with the groundwater sample before adding the preservative and then top up the container with the remainder of the sample.
f) Do not rinse sample bottles with sample water prior to sample collection. Some compounds, e.g. halogenated contaminants may sorb to the sample container. Sample bottles come prepared by the lab and are ready to fill.
g) Keep sample containers closed until they are to be filled. Do not pre-chill sample containers as condensation will form on both the outside and inside of glass containers. Be careful not to touch the rim of the sample containers.
h) In general, it is good practice to fill sample containers as full as possible without overflow. Airspace trapped in the sample container can potentially affect the pH of the sample. Overflow can result in loss of preservative that may have been added for sample preservation.

#### *5.1.2 Specific Considerations – Volatiles and Semi-volatiles*

a) Sample containers should be filled until a meniscus forms above the top rim. The lid should be teflon-lined and carefully screwed on to displace any surface bubbles and establish a tight seal. Try to avoid trapping air bubbles in the sample containers when analyzing for volatiles. Check by inverting the bottle and tapping it. If bubbles larger than 1 mm are present, discard the sample and collect another in a new container.
b) Never filter samples for organic contaminants.
c) Never decant samples for volatiles to eliminate sediment.

### 5.2 Surface Water Sampling Procedure

Surface water samples are to be collected as grab samples at a point roughly mid-depth of the water column. For samples that are influenced by the tide, samples should be collected approximately 2 hours before a low tide event to ensure that the most representative samples are collected. Sample collection should commence with the furthest downstream location and

progress upstream to avoid any disturbances to the sample. Field turbidity is to be monitored using an optical backscatter (OBS) nephelometer with an underwater sensor and direct surface readout or another instrument having similar capabilities. Prior to sampling, all equipment and sampling devices are to be calibrated as per manufacturer's recommendations.

Samples should be collected at mid-stream rather than near-shore, if practical. Samples collected from mid-stream reduce the possibilities of contamination (i.e., shore effects - back eddies, seepage from near shore soils, atmospheric components such as pollen concentrating in slow moving water, etc.). Samples should not be taken in back eddies or brackish waters unless required by the monitoring program objectives. The most important issue to consider when deciding where the sample should be collected from is SAFETY. If the flow is sufficiently slow that the collector can wade into the stream without risk, then the sample can be collected at a depth that does not pose a threat (discretion is the key - never wade into water that appears deep or fast flowing). When conditions dictate that the sample be taken from the stream bank, deviations from the standard protocol should be accurately documented in the field log book. Samplers must be wary of non-visible bottoms under turbid conditions.

### *5.2.1 Sampling via Wading into Flow*

The following procedure for "wading into flow" outlined below is for samples to be collected in containers without preservatives. If sample containers require preservatives, add the preservative after the sample has been collected at the sample location.

a) Record field geochemistry parameters (TSS and others as required).
b) Obtain labelled bottles and wade into the river downstream from the point at which you will collect the samples, then wade upstream to the sample site. This ensures that you will not disturb sediments upstream of the sample point. Attach safety line if conditions have any significant risk.
c) Stand perpendicular to the flow and face upstream.
d) With your other hand, grasp the bottle well below the neck. Plunge it beneath the surface in front of you with the opening facing directly down, and then orient the bottle into the current. Avoid collecting surface scum and film.
e) Remove the lid under water into the current.
f) Once the bottle is full, remove it from the water by first replacing the lid then removing the container with both hands to ensure the lid is not lost.

### *5.2.2 Sampling via the Stream Bank*

This sample procedure is applicable for locations where wading into the water is not possible. If sample containers require preservatives, add the preservative after the sample has been collected at the sample location.

a) Record field parameters (TSS and others), as required.
b) Secure yourself to a solid object on shore (with a safety harness and line if necessary). As a safety precaution, the second person must remain nearby while the first is collecting the samples.

c) Hold the bottle well below the neck or secure it to a pole sampler, and hold the lid with the other hand or another pole sampler.
d) Reach out (arm length only) and plunge the bottle under the water with the opening facing directly down and immediately orient it into the current.
e) Once the bottle is full, remove it from the water by first replacing the lid then removing the container with both hands/pole samplers to ensure the lid is not lost.

As an alternative, a peristaltic pump may be used to collect the sample.

**5.3 Sample Labels**

a) Label all sample containers with the laboratory-provided labels and use a pencil for all sample identification information. Write the sample ID number on the lid of each container. Labelling and marking should be done prior to cooling the sample containers to prevent interference caused by condensation.
b) Sample labels should include the following information:
   - Company identification
   - Project identification
   - Borehole identification
   - Date and time of sample collection
   - Parameters to be analyzed

**5.4 Sample Handling**

a) Immediately place the samples in a sealed cooler with an ice pack; samples must be kept cold (approximately 4°C) but avoid freezing.
b) Complete a Chain-of-Custody (COC) form and submit the cooler and form to the laboratory as soon as possible after sampling. Indicate on the COC any samples where high analyte concentrations are expected based on field observations.
c) Sample holding times vary depending on the analyte. Ensure that samples are received by the lab with sufficient time to be extracted before they expire.
d) Samples shipped by bus or air must be carefully packed so that there is no room for sample movement. Glass containers should be individually wrapped in bubble wrap/styrofoam, etc. At remote sites, it may be prudent to take duplicate samples as insurance in case of breakage. Send the COC in a sealed plastic bag (e.g. Ziplock) inside the shipment.

**5.5 Quality Assurance/Quality Control (QA/QC)**

To ensure that groundwater sampling and analytical data are meaningful and reproducible, a quality assurance and quality control program must be incorporated into each sampling event. All field quality control samples must be prepared the same as regular investigation samples with regard to sample volume, containers, and preservation.

The following quality control samples shall be collected for each batch of samples (a batch may not exceed 20 samples), and in accordance with the Sampling Plan:

a) Trip blanks - are required for the VOC samples at a frequency of one set per VOC sample cooler.
b) Equipment blanks - shall include the pump and the pump's tubing. Collect equipment blanks after sampling from contaminated wells and not after background wells.
c) Field duplicates - are collected to determine precision of sampling procedure. For this procedure, collect duplicate for each analyte group in consecutive order (VOC original, VOC duplicate, SVOC original, SVOC duplicate, etc.).

QA/QC includes careful collection and labelling of samples, identification of locations, thorough decontamination of equipment and careful, concise field note documentation.

### *5.5.1 Field Notes*

Field notes must document all observations, measurements, equipment, conditions and procedures. The field log book should document the following information for each well sampled:

- Sample location and approximate flow rate of streams
- Date and time sampled
- Measured field parameters (pH, temperature, etc.) if applicable and methods
- Equipment calibration records, if applicable
- Sample location sequence
- Sample appearance and odours
- Sample volume and types of containers
- Preservatives used
- Analyses requested
- Laboratory used
- Name of collector
- Climatic conditions (temperature and weather) and tidal information
- Site conditions and surface water condition (i.e. floating oil or debris, gassing)
- Problems encountered and deviations from sampling protocol

You must assume anyone who reads your field notes can independently determine:

- Exactly what activities were conducted in the field and why.
- Exactly where and when each piece of data was collected.
- The methodology used.

Only factual information should be recorded:

- Do not speculate
- Do not write unprofessional comments.

### 5.6 Follow-up Activities

a) Check workplan to ensure that all samples have been collected
b) Equipment should be thoroughly cleaned
c) Copy field notes and submit to project manager/to file
d) Prepare memo to inform project manager of work completed
e) Upon receipt of the laboratory analytical reports, interpretation and verification of the QA/QC sample results should be conducted to determine whether data quality objectives have been met.

If you have any questions regarding surface water sampling, contact the project manager or senior technical staff.

# PHOTOIONIZATION DETECTOR (PID) CALIBRATION

## 1.0 GENERAL

Calibration is necessary prior to sampling to ensure that accurate vapour readings in the field are obtained. To calibrate a PID only one calibration gas, Isobutylene, is used. Calibration is conducted every time the instrument is taken into the field and can be completed in the office or on site.

The PID that was used to develop this SOP is called the Micro TIP MP1000. This protocol is specifically for this unit, however the general principals and the health and safety issues addressed would easily apply to any other PID. A different PID should be calibrated with the operations manual that is supplied with it.

## 2.0 HEALTH AND SAFETY

### 2.1 General Health and Safety Concerns

The main Health and Safety (H&S) concern is the use of compressed gases to calibrate the PID. Observe proper handling techniques for all gases as outlined below. All compressed gases are potentially hazardous due to the high pressure inside the cylinder. Avoid proximity to heat to reduce the chance of cylinders rupturing.

### 2.2 Hazardous Materials

Hazardous materials that are associated with carrying out this procedure are listed below.

Reference can be made to the National Institute for Occupational Safety and Health (NIOSH) publications for information pertaining to compounds, if required.

**Material**

Isobutylene

### 2.3 Personal Protective Equipment (PPE)/Safety Checklist

- Ensure the work area is well ventilated.

## 3.0 REFERENCE DOCUMENTATION

Table 1 summarizes documentation referenced in this SOP.

**Table 1: Reference Documentation**

| Document Reference Number | Document Title |
|---|---|

## 4.0 PLANNING AND PREPARATION

### 4.1 Planning

- Ensure that the MicroTIP or PID battery is fully charged.
- Use a pressure gauge to check that the span gas cylinder contains span gas.

### 4.2 Checklist of Equipment and Materials

- MicroTIP Calibration Kit
- Span Gas (Isobutylene)

## 5.0 PROCEDURES

a) Turn on the MicroTIP or PID and allow it to warm up.
b) Connect the supplied regulator with a brass fitting and a hose attached to one end, to the span gas cylinder.
c) Attach tedlar bag and fill with the span gas. DO NOT overfill tedlar bag.
d) Make sure that the span gas gets turned off.
e) Press “SETUP” on the MicroTIP and select the desired range (typically 2000 ppm) with the arrow keys and press “ENTER”.
f) Press “CAL” and enter the desired response factor as outlined in Table 2 on page 21 of the MicroTIP Users Manual. For mixed compounds such as gasoline or diesel enter 1.00.
g) Connect the hydrophobic filter to MicroTip prior to calibrating. To zero, expose MicroTIP to ambient (zero) air and press “ENTER”.
h) Enter the known value listed on the span gas container then attach tedlar bag to filter connected to MicroTIP using the tedlar bag adapter, marked with duct tape as Calibration Only.
i) Allow for a delay of about 10 sec. and then press “ENTER”
j) When MicroTIP's display stabilizes at calibration concentration, calibration is complete.
k) For more information refer to the MicroTIP Users Manual.

# PHOTOIONIZATION DETECTOR (PID) OPERATION

## 1.0 GENERAL

A Photoionization Detector (PID) is used as a field gas-monitoring instrument. It can be used to collect headspace vapour levels in soil samples, monitoring wells, shallow vapour wells and many more applications. The PID detects chemicals that are photoionized by an utraviolet (UV) lamp. Since the ability to detect a chemical depends on the ability to ionize it, the ionizing potential (IP) of a chemical to be detected must be lower than the energy generated by the UV lamp of the instrument. Dependent upon the lamp energy of the PID a wide range of contaminants can be detected which may include aromatics, double-bonded aliphatics and several inorganics.

PIDs generally have a very low sensitivity to contaminants, but they only read to about 2000 ppm for hydrocarbons and a gastech can read into the 90 LEC range. High methane concentrations and condensation can effect the sensitivity of the PID.

## 2.0 HEALTH AND SAFETY

### 2.1 General Health and Safety Concerns

The only direct Health and Safety (H&S) concern with using a PID would be the contaminants within the vapour which is being monitored. However, since PIDs are used as a field-screening instrument on contaminated sites, any of the site concerns would apply.

Consult with the project manager for the site and the site-specific Health and Safety Plan (HASP) for all of the concerns associated with the site.

### 2.2 Hazardous Materials

Hazardous materials that are associated with carrying out this procedure are listed below.

Reference can be made to the National Institute for Occupational Safety and Health (NIOSH) publications for information pertaining to compounds, if required.

**Material**

Isobutylene

Isobutylene is used to calibrate the PID. Calibration may be required on site. There are no other direct hazardous materials associated with air monitoring.

### 2.3 Personal Protective Equipment (PPE)/Safety Checklist

The following PPE is required at minimum:

- hard hat
- steel-toed boots
- high visibility safety vest

Please consult the project specific HASP for further requirements.

## 3.0 REFERENCE DOCUMENTATION

Table 1 summarizes documentation referenced in this SOP.

**Table 1: Reference Documentation**

| Document Reference Number | Document Title |
|---|---|
| SOP #02 | Groundwater Monitoring |
| SOP #05 | PID Calibration |

## 4.0 PLANNING AND PREPARATION

### 4.1 Planning

a) Review the site-specific HASP and works previously completed at the site which may be of relevance.
b) Ensure that the PID battery has been fully charged.
c) Ensure that the calibration procedure is completed prior to beginning fieldwork. Refer to SOP #05 PID Calibration for general calibration procedures to be followed.

### 4.2 Checklist of Equipment and Materials

- PID (e.g. MicroTIP Mp-1000)
- Battery charger
- Calibration gas

## 5.0 PROCEDURES

a) Check the battery power. DO NOT OPERATE WITH A LOW BATTERY.
b) Connect the sampling probe to the PID to ensure that it is clean and calibrated.
c) Proceed to insert sampling probe into sample vessel, (i.e. monitoring well), as per SOP #02, as appropriate. Do not push the sampling probe into the water which is being monitoring, only into the air space.
d) Allow reading to stabilize, and take the maximum reading directly from the instrument display.

e) Once reading has been recorded, remove sampling probe from sampling vessel. Allow ambient air to be drawn into the instrument. Display should once again read zero. Continue with additional readings.
f) Try to keep the instrument warm and dry, by keeping it in the car, if it is raining out or if the temperature is cold (check the manual for optimum working temperatures). To help keep the instrument dry, place it in a plastic bag, however ensure that the sample probe does not touch the plastic.
g) For more information refer to the referenced PID Instruction Manual.

# GASTECH MODEL 1238
# PORTABLE GAS ANALYZER CALIBRATION

## 1.0 GENERAL

Calibration of Gastech Model 1238 ME (methane elimination) is necessary to ensure the field readings are consistent and accurate and must be conducted each time the instrument is used in the field. It should be calibrated at the beginning of the day and each time the calibration is compromised. Ensure that the instrument is kept dry in the field.

If a different Gastech unit is used, consult the owner's manual for instructions.

## 2.0 HEALTH AND SAFETY

### 2.1 General Health and Safety Concerns

Observe proper handling techniques for calibration gases. All compressed gases are potentially hazardous due to the high pressure stored inside the cylinder. They are stable at normal temperatures. Vapours are flammable therefore be sure to avoid heat to reduce the chance of cylinders rupturing.

### 2.2 Hazardous Materials

Hazardous material associated with carrying out this procedure is hexane/balance air (400 ppm and 40% LEL).

In addition to the hazardous material mentioned above, consultation with the project engineer is imperative to define potential hazardous compounds and anticipated exposure levels associated with each site prior to commencing on-site activities. Reference can be made to the National Institute for Occupational Safety and Health (NIOSH) publications for information pertaining to compounds, if required.

### 2.3 Personal Protective Equipment (PPE)/Safety Checklist

- Ensure the work area is well ventilated.

## 3.0 REFERENCE DOCUMENTATION

Table 1 summarizes documentation referenced in this SOP.

**Table 1: Reference Documentation**

| Document Reference Number | Document Title |
|---|---|
| 71-0114C Version 930610 | Gastech Model 1238ME Instruction Manual |
| | User Manual for selected PID |

## 4.0 PLANNING AND PREPARATION

### 4.1 Planning

a) Ensure that the Gastech battery has been fully charged.
b) Use a pressure gauge to check that the span gas cylinder contains span gas.
c) Gastech Model 1238ME is a two-point calibration.

### 4.2 Checklist of Equipment and Materials

- Gastech Calibration Kit
- Span Gas (Hexane)

## 5.0 PROCEDURES

a) Turn on the Gastech.
b) Ensure that the “Methane Elimination” switch is active.
c) Check the hydrophobic filter on the sampling probe to ensure that there is no liquid trapped and check the cotton filter for the presence of dirt and liquid. If either of the filters is fouled, change it before proceeding.
d) Connect the sampling probe to the Gastech and using the flow meter supplied with the Gastech Calibration Kit, check the flow. The flow rate should be approximately 1.5–2.0 scfh. If less than 1 scfh seek technical assistance as the pump may require maintenance. If the flow rate is acceptable, then proceed.
e) Fill two tedlar bags with calibration gas; one with 400 ppm and one with 40% LEL hexane.
f) Ensure that the Gastech is in the LEL mode and using the zero adjustment on the outside, adjust the zero on the analog meter. If the meter will not zero, center the outside knob and use the coarse adjustment potentiometer to zero.
g) Connect the tedlar bag with the LEL calibration gas to the sampling probe, allow the needle on the analog to stabilize and then using the LEL potentiometer on the inside board, adjust the analog meter to correspond to the calibration gas concentration.
h) Once calibration for the LEL gas is completed, switch the Gastech to the ppm mode. Allow a couple of minutes to stabilize and readjust the zero if necessary.
i) Calibrate the Gastech for ppm in the same manner as described in above, except that ppm calibration gas is used. After calibration is completed, switch off the Gastech and confirm that both regulators on the calibration gas cylinders are turned off.

For more information, refer to the Gastech Instruction Manual.

# GASTECH MODEL 1238
# PORTABLE GAS ANALYSER) OPERATION

## 1.0 GENERAL

The Gastech hydrocarbon vapour analyser is used as a field-screening instrument to measure the concentration of a combustible vapour or gas in air. NSLI uses the Gastechs mainly to monitor hydrocarbon vapours in soil and groundwater.

Gastechs measure the concentration of a combustible vapour or gas in air, indicating the results as either a percentage of the lower explosive limit (LEL) or as parts per million (ppm) by volume. The LEL of a combustible gas or vapour is the minimum concentration in air that will produce a flame on contact with an ignition source. The upper explosive limit (UEL) is the maximum concentration. Concentrations between the LEL and UEL are considered flammable.

Gastechs are generally not appropriate for conducting air-monitoring programs intended for personal hygiene since they have very poor sensitivity. Most of the Gastechs used by NSLI have a sensitivity to approximately 25 ppm. The probe sensitivity can also become inaccurate by high vapour readings, lead compounds, silicon and others. A Gastech is very useful on hydrocarbon sites as they can obtain higher readings than most of the organic vapour monitors. The vapour levels may be present in soil samples, monitoring wells, excavations, buildings or any confined space.

## 2.0 HEALTH AND SAFETY

### 2.1 General Health and Safety Concerns

The only direct concern with using a Gastech would be the contaminants within the vapour being monitored. However, since Gastechs are used as a field-screening instrument on contaminated sites any of the site concerns would apply.

Consult with the project manager for the site and the site-specific Health and Safety Plan (HASP) for all of the concerns associated with the site.

### 2.2 Hazardous Materials

Compressed hexane is used to calibrate the Gastech.

Other than the material listed above no other hazardous materials are required for soil sampling or groundwater monitoring. Consultation with the project manager and the HASP is imperative to define potential hazardous compounds and anticipated exposure levels associated with each site prior to commencing on-site activities. Reference can be made to the National Institute for

Occupational Safety and Health (NIOSH) publications for information pertaining to compounds, if required.

### 2.3 Personal Protective Equipment (PPE)/Safety Checklist

The following PPE is required at minimum:

- hard hat
- steel-toed boots
- high visibility safety vest

Please consult the project specific HASP for further requirements.

## 3.0 REFERENCE DOCUMENTATION

Table 1 summarizes documentation referenced in this SOP.

**Table 1: Reference Documentation**

| Document Reference Number | Document Title |
|---|---|
| SOP #02 | Groundwater Monitoring |
| SOP #07 | Gastech Calibration |

## 4.0 PLANNING AND PREPARATION

### 4.1 Planning

a) Review the site-specific HASP and works previously completed at the site which may be of relevance.
b) Ensure that the Gastech battery has been fully charged.
c) Ensure that the calibration procedure is completed prior to beginning fieldwork. Refer to SOP #07 Gastech Calibration for general calibration procedures to be followed.

### 4.2 Checklist of Equipment and Materials

- Gastech 1238ME Portable Gas Analyser
- Nitrile gloves
- Sample jars or bags (if applicable)
- Extra hydrophobic filter and cotton balls
- Battery charger

## 5.0 PROCEDURES

a) Turn the Gastech on by pressing the POWER button. Ensure that the METHANE ELIMINATION switch is active. Press the BATT CK (battery check) button. The needle on the display should pass the “BATT CK” line near the 80% LEL mark. DO NOT OPERATE WITH A LOW BATTERY.

b) Check the hydrophobic filter on the sampling probe to ensure that there is no liquid trapped and check the cotton filter for the presence of dirt and liquid. If either of the filters is fouled, change before proceeding.
c) Connect the sampling probe to the Gastech; normal flow should be approximately 2 scfh. If less than 1 scfh seek technical assistance as the pump may require maintenance. If the flow rate is acceptable, proceed.
d) Ensure that the instrument is in parts per million by volume mode (PPM) to begin. Zero the instrument by adjusting the ZERO key and allowing ambient air to pass through the instrument. Continue to adjust until the instrument reads zero ppm/LEL.
e) Proceed to insert sampling probe into sample vessel, (i.e. monitoring well), as per SOP #002, as appropriate. Do not push the sampling probe into the water being monitoring, only into the air space. Check the cotton filter frequently to ensure that the probe has not been being pushed in too far.
f) Allow the reading to stabilize, and read the maximum reading directly from the instrument display. Change display mode by pressing PPM/LEL button if readings exceed the ppm range or if readings are to be recorded in percentage LEL (instead of ppm) if necessary.
g) Once the reading has been recorded, remove the sampling probe from the sampling vessel. Allow ambient air to be drawn into the instrument. The display should once again read zero. If the display does not lower to zero, re-zero instrument and continue with additional readings.
h) Try to keep the instrument warm and dry, by keeping it in the car, if it is raining out or if the temperature is cold (check the manual for optimum working temperatures). To help keep the instrument dry, place it in a plastic bag, however ensure that the sample probe does not touch the plastic. If the plastic bag gets sucked into the sample probe by the Gastech pump, the pump will get damaged.

For more information refer to the referenced Gastech Instruction Manual.

**APPENDIX E**
**Final Confirmation Surveys**

Nova Scotia Lands Inc.
Long Term Monitoring and Maintenance Plan

210.05479.00000.0029

List of Surveys

| Drawing Name | Drawing No | Date | Company | General comments |
|---|---|---|---|---|
| Muggah Creek North Channel Survey | CO1 | Oct. 2014 | CBCL | Survey of channel bottom |
| Open Hearth Park | 2095 | Feb. 4, 2014 | CRA | Original topo survey |
| | | | | |
| | | | | |

**APPENDIX F**
**Screening Criteria and 95% UCL Data**

Nova Scotia Lands Inc.
Long Term Monitoring and Maintenance Plan

210.05479.00000.0029

**Table F-1: Surface Water Screening Values**

| Parameters | Units | NSE Tier 1 EQS Fresh Water | NSE Tier 1 EQS Marine Water | Battery Point/ Narrows 95% [UCL] | Pre-Construction/ Baseline 95% [UCL] | Upstream 95% [UCL] | CCME FWAL | CCME MAL |
|---|---|---|---|---|---|---|---|---|
| **Polyaromatic Hydrocarbons and Polychlorinated Biphenyls** | | | | | | | | |
| 1-Methylnaphthalene | ug/L | 2 | 1 | --- | --- | --- | --- | --- |
| 2-Methylnaphthalene | ug/L | 2 | 2 | --- | --- | --- | --- | --- |
| Acenaphthene | ug/L | 5.8 | 6 | --- | --- | --- | 5.8 | NV |
| Acenaphthylene | ug/L | 4.6 | 6 | --- | --- | --- | NV | NV |
| Anthracene | ug/L | 0.012 | NV | --- | --- | --- | 0.012 | NV |
| Benzo(a)anthracene | ug/L | 0.018 | NV | --- | --- | --- | 0.018 | NV |
| Benzo(a)pyrene | ug/L | 0.015 | 0.01 | 0.06 | 0.05 | --- | 0.015 | NV |
| Benzo(b)fluoranthene | ug/L | 0.48 | NV | --- | --- | --- | --- | --- |
| Benzo(g,h,i)perylene | ug/L | 0.17 | NV | --- | --- | --- | --- | --- |
| Benzo(k)fluoranthene | ug/L | --- | --- | --- | --- | --- | --- | --- |
| Chrysene | ug/L | 1.4 | 0.1 | --- | --- | --- | NV | NV |
| Dibenz(a,h)anthracene | ug/L | 0.26 | NV | --- | --- | --- | --- | --- |
| Fluoranthene | ug/L | 0.04 | 11 | --- | --- | --- | 0.04 | NV |
| Fluorene | ug/L | 3 | 12 | --- | --- | --- | 3 | NV |
| Indeno(1,2,3-cd)pyrene | ug/L | 0.21 | NV | --- | --- | --- | --- | --- |
| Naphthalene | ug/L | 1.1 | 1.4 | NV | 1.8 | --- | 1.1 | 1.4 |
| Perylene | ug/L | --- | --- | --- | --- | --- | --- | --- |
| Phenanthrene | ug/L | 0.4 | 4.6 | --- | --- | --- | 0.4 | NV |
| Pyrene | ug/L | 0.025 | 0.02 | --- | --- | --- | 0.025 | NV |
| PCBs | ug/L | NV | NV | --- | --- | --- | NV | NV |
| **Petroleum Hydrocarbons** | | | | | | | | |
| Benzene | ug/L | 2100 | 2100 | NV | 0.009 | | 370 | 110 |
| Toluene | ug/L | 770 | 770 | --- | --- | --- | 2 | 215 |
| Ethylbenzene | ug/L | 320 | 320 | --- | --- | --- | 90 | 25 |
| Xylene (Total) | ug/L | 330 | 330 | --- | --- | --- | --- | --- |
| C6 - C10 (less BTEX) | ug/L | --- | --- | --- | --- | --- | --- | --- |
| C10-C21 Hydrocarbons | ug/L | --- | --- | --- | --- | --- | --- | --- |
| C21-C32 Hydrocarbons | ug/L | --- | --- | --- | --- | --- | --- | --- |
| Modified TPH (Tier1) | ug/L | --- | --- | --- | --- | --- | --- | --- |
| Modified TPH (Gas) | ug/L | 1500 | 1500 | --- | --- | --- | --- | --- |
| Modified TPH (Fuel) | ug/L | 100 | 100 | --- | --- | --- | --- | --- |
| Modified TPH (Lube) | ug/L | 100 | 100 | --- | --- | --- | --- | --- |
| **Inorganic Chemistry** | | | | | | | | |
| Sodium (Na) | ug/L | --- | --- | --- | --- | --- | --- | --- |
| Potassium (K) | ug/L | --- | --- | --- | --- | --- | --- | --- |
| Calcium (Ca) | ug/L | --- | --- | --- | --- | --- | --- | --- |
| Magnesium (Mg) | ug/L | --- | --- | --- | --- | --- | --- | --- |
| Alkalinity (Total as CaCO3) | mg/L | --- | --- | --- | --- | --- | --- | --- |
| Sulphate (SO4) | mg/L | --- | --- | 2180 | 84 | --- | --- | --- |
| Chloride (Cl) | mg/L | --- | --- | --- | --- | --- | 120000 | NRG |
| Silica (SiO2) | mg/L | --- | --- | --- | --- | --- | --- | --- |
| Orthophosphate (OPO4) | mg/L | --- | --- | --- | --- | --- | --- | --- |
| Phosphorus (P) | ug/L | --- | --- | --- | --- | --- | Guidance Framework | Guidance Framework |
| Nitrate (NO3) | mg/L | --- | --- | --- | --- | --- | 13000 | 200000 |
| Nitrite (N02) | mg/L | --- | --- | --- | --- | --- | 60 | NV |
| Nitrite + Nitrate (NO2 - NO3) | mg/L | --- | --- | --- | --- | --- | | |
| Ammonia (NH3) | mg/L | --- | --- | --- | --- | --- | 19 | NV |
| Colour | TCU | --- | --- | --- | --- | --- | Narrative | NV |
| Total Organic Carbon (TOC) | mg/L | --- | --- | --- | --- | --- | --- | --- |
| Turbidity | NTU | --- | --- | 88 (80 in tanle C-3) | --- | --- | Narrative | Narrative |
| Conductivity | uS/cm | --- | --- | --- | --- | --- | --- | --- |
| pH | pH | --- | --- | --- | --- | --- | 6.5 to 9.0 | 7.0 to 8.7 & Narrative |
| Hardness (CaCO3) | mg/L | --- | --- | --- | --- | --- | --- | --- |
| Bicarb. Alkalinity (calc. as CaC | mg/L | --- | --- | --- | --- | --- | --- | --- |
| Carb. Alkalinity (calc. as CaCO | mg/L | --- | --- | --- | --- | --- | --- | --- |
| TSS | mg/L | --- | --- | --- | --- | --- | Narrative | Narrative |
| Calculated TDS | mg/L | --- | --- | --- | --- | --- | --- | --- |
| Anion Sum | me/L | --- | --- | --- | --- | --- | --- | --- |
| Ion Balance (% Difference) | % | --- | --- | --- | --- | --- | --- | --- |
| Langelier Index (@ 20C) | N/A | --- | --- | --- | --- | --- | --- | --- |
| Langelier Index (@ 4C) | N/A | --- | --- | --- | --- | --- | --- | --- |
| Saturation pH (@ 20C) | N/A | --- | --- | --- | --- | --- | --- | --- |
| Saturation pH (@ 4C) | N/A | --- | --- | --- | --- | --- | --- | --- |
| Aluminum (Al) | ug/L | 5 | NV | --- | --- | 220 | variable | NV |
| Antimony (Sb) | ug/L | 20 | 500 | --- | --- | --- | --- | --- |
| Arsenic (As) | ug/L | 5 | 12.5 | NV | 1.98 | 1.6 | 5.00 | NV |
| Barium (Ba) | ug/L | 1000 | 500 | --- | --- | --- | --- | --- |
| Beryllium (Be) | ug/L | 5.3 | 100 | --- | --- | --- | --- | --- |
| Bismuth (Bi) | ug/L | --- | --- | --- | --- | --- | --- | --- |
| Boron (B) | ug/L | 1200 | 1200 | --- | --- | --- | 1500 | NRG |
| Cadmium (Cd) | ug/L | 0.01 | 0.12 | --- | --- | 0.1 | Equation | 0.12 |
| Chromium (Cr) | ug/L | NV | NV | --- | --- | 8.3 | --- | --- |
| Cobalt (Co) | ug/L | 10 | NV | 0.9 | 1.3 | --- | --- | --- |
| Copper (Cu) | ug/L | 2 | 2 | --- | --- | --- | Equation | NV |
| Iron (Fe) | ug/L | 300 | NV | 190 | 1,900 | 3,318 | 300 | NV |
| Lead (Pb) | ug/L | 1 | 2 | --- | --- | 1.2 | Equation | NV |
| Lithium (Li) | ug/L | --- | --- | 148 | 6.7 | --- | --- | --- |
| Manganese (Mn) | ug/L | 820 | NV | 70 | 800 | --- | --- | --- |
| Mercury (Hg) | ug/L | 0.026 | 0.016 | 0.189 | --- | --- | 0.026 | 0.016 |
| Molybdenum (Mo) | ug/L | 73 | NV | --- | --- | --- | 73 | NV |
| Nickel (Ni) | ug/L | 25 | 8.3 | --- | --- | --- | Equation | NV |
| Selenium (Se) | ug/L | 1 | 2 | --- | --- | 0.7 | 1.0 | NV |
| Silver (Ag) | ug/L | 0.1 | 1.5 | --- | --- | --- | 0.1 | NV |
| Strontium (Sr) | ug/L | 21000 | NV | 7000 | 210 | --- | --- | --- |
| Sulphur (S) | ug/L | --- | --- | --- | --- | --- | --- | --- |
| Thallium (Tl) | ug/L | 0.8 | 21.3 | --- | --- | --- | 0.80 | NV |
| Tin (Sn) | ug/L | NV | NV | --- | --- | --- | --- | --- |
| Titanium (Ti) | ug/L | | | --- | --- | --- | --- | --- |
| Uranium (U) | ug/L | 300 | 100 | --- | --- | --- | 15 | NRG |
| Vanadium (V) | ug/L | 6 | 50 | --- | --- | --- | --- | --- |
| Zinc (Zn) | ug/L | 30 | 10 | --- | --- | --- | 330.0 | NV |

Notes:

mg/L - milligrams per litre

me/L - millogram equivalents per liter

ug/L - micrograms per litre

% - Percent

TCU - True Colour Unit

NTU - Nephelometric Turbidity Units

uS/cm - microsiemens/centimeter

NRG - no recommended guideline

NV - no value

--- - no information provided

NSE Tier 1 EQS - Environmental Quality Standards for Surface Water

Battery Point/ Narrows 95% [UCL] - 95% Upper Confidence Limit (to be applied to surface water collected from Battery Point only)

CCME FWAL - CCME Environmental Quality Guidelines for the Protection of Aquatic Life (Freshwater)

CCME MAL - CCME Environmental Quality Guidelines for the Protection of Aquatic Life (Marine)

CCME Equations, Guidance Framework, Narrative and Variable concentrations can be found in http://ceqg-rcqe.ccme.ca/

95% [UCL] data provided by **Surface Water Compliance Monitoring Program Monthly Monitoring Report for July 2012**, Dillon Consulting Limited (October 2012)

**Table F-2: Groundwater Screening Values**

| Parameters | Units | NSE Tier 1 EQS | 95% [UCL] | | | | | | CCME FWAL | CCME MAL |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | TP2/ TP6/ TP7 | CO1 | CO2 | CO5 | CO6 | CO7 | | |
| **Polyaromatic Hydrocarbons and Polychlorinated Biphenyls** | | | | | | | | | | |
| 1-Methylnaphthalene | ug/L | 38000 | --- | --- | --- | --- | --- | --- | --- | --- |
| 2-Methylnaphthalene | ug/L | 38000 | --- | --- | --- | --- | --- | --- | --- | --- |
| Acenaphthene | ug/L | NV | --- | --- | --- | --- | --- | --- | 5.8 | NV |
| Acenaphthylene | ug/L | 750 | --- | --- | --- | --- | --- | --- | NV | NV |
| Anthracene | ug/L | NV | --- | --- | --- | --- | --- | --- | 0.012 | NV |
| Benzo(a)anthracene | ug/L | NV | --- | --- | --- | --- | --- | --- | 0.018 | NV |
| Benzo(a)pyrene | ug/L | NV | 0.1 | 0.04 | 5.18 | 3.38 | 3.06 | 2.28 | 0.015 | NV |
| Benzo(b)fluoranthene | ug/L | NV | --- | --- | --- | --- | --- | --- | --- | --- |
| Benzo(g,h,i)perylene | ug/L | NV | --- | --- | --- | --- | --- | --- | --- | --- |
| Benzo(k)fluoranthene | ug/L | NV | --- | --- | --- | --- | --- | --- | --- | --- |
| Chrysene | ug/L | NV | --- | --- | --- | --- | --- | --- | NV | NV |
| Dibenz(a,h)anthracene | ug/L | NV | --- | --- | --- | --- | --- | --- | --- | --- |
| Fluoranthene | ug/L | NV | --- | --- | --- | --- | --- | --- | 0.04 | NV |
| Fluorene | ug/L | NV | --- | --- | --- | --- | --- | --- | 3 | NV |
| Indeno(1,2,3-cd)pyrene | ug/L | NV | --- | --- | --- | --- | --- | --- | --- | --- |
| Naphthalene | ug/L | 7000 | 27.1 | 563.1 | 5000 | 2.9 | 2,710 | 940 | 1.1 | 1.4 |
| Perylene | ug/L | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Phenanthrene | ug/L | NV | --- | --- | --- | --- | --- | --- | 0.4 | NV |
| Pyrene | ug/L | NV | --- | --- | --- | --- | --- | --- | 0.025 | NV |
| PCB | ug/L | 180 | --- | --- | --- | --- | --- | --- | NV | NV |
| **Petroleum Hydrocarbons** | | | | | | | | | | |
| Benzene | mg/L | 20 | 0.008 | 0.022 | 0.866 | 0.001 | 0.506 | 0.130 | 0.37 | 0.11 |
| Toluene | mg/L | 20 | --- | --- | --- | --- | --- | --- | 0.002 | 0.215 |
| Ethylbenzene | mg/L | 20 | --- | --- | --- | --- | --- | --- | 0.09 | 0.025 |
| Xylene (Total) | mg/L | 20 | --- | --- | --- | --- | --- | --- | --- | --- |
| C6 - C10 (less BTEX) | mg/L | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| C10-C21 Hydrocarbons | mg/L | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| C21-C32 Hydrocarbons | mg/L | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Modified TPH (Tier1) - Gas/Fuel/Lube | mg/L | 20 | NV | NV | NV | NV | NV | NV | --- | --- |
| **Inorganic Chemistry** | | | | | | | | | | |
| Sodium (Na) | ug/L | NV | --- | --- | --- | --- | --- | --- | --- | --- |
| Potassium (K) | ug/L | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Calcium (Ca) | ug/L | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Magnesium (Mg) | ug/L | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Alkalinity (Total as CaCO3) | mg/L | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sulphate (SO4) | mg/L | --- | 770 | 470 | 99 | 370 | 280 | 450 | --- | --- |
| Chloride (Cl) | mg/L | NV | --- | --- | --- | --- | --- | --- | 120000 | NRG |
| Silica (SiO2) | mg/L | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Orthophosphate (OPO4) | mg/L | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Phosphorus (P) | ug/L | --- | --- | --- | --- | --- | --- | --- | Guidance Framework | Guidance Framework |
| Nitrate (NO3) | mg/L | --- | --- | --- | --- | --- | --- | --- | 13000 | 200000 |
| Nitrite (N02) | mg/L | --- | --- | --- | --- | --- | --- | --- | 60 | NV |
| Nitrite + Nitrate (NO2 - NO3) | mg/L | --- | --- | --- | --- | --- | --- | --- | | |
| Ammonia (NH3) | mg/L | --- | --- | --- | --- | --- | --- | --- | 19 | NV |
| Colour | TCU | --- | --- | --- | --- | --- | --- | --- | Narrative | NV |
| Total Organic Carbon (TOC) | mg/L | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Turbidity | NTU | --- | --- | --- | --- | --- | --- | --- | Narrative | Narrative |
| Conductivity | uS/cm | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| pH | pH | --- | --- | --- | --- | --- | --- | --- | 6.5 to 9.0 | 7.0 to 8.7 & Narrative |
| Hardness (CaCO3) | mg/L | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bicarb. Alkalinity (calc. as CaC | mg/L | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Carb. Alkalinity (calc. as CaCO3 | mg/L | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Calculated TDS | mg/L | --- | 4,759 | 1,434 | 538 | 538 | 647 | 868 | --- | --- |
| Anion Sum | me/L | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Ion Balance (% Difference) | % | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Langelier Index (@ 20C) | N/A | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Langelier Index (@ 4C) | N/A | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Saturation pH (@ 20C) | N/A | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Saturation pH (@ 4C) | N/A | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Aluminum (Al) | ug/L | --- | --- | --- | --- | --- | --- | --- | variable | NV |
| Antimony (Sb) | ug/L | NV | --- | --- | --- | --- | --- | --- | --- | --- |
| Arsenic (As) | ug/L | NV | 9.1 | 8.3 | 18.2 | 92.1 | 9.8 | 8.8 | 5.00 | NV |
| Barium (Ba) | ug/L | NV | --- | --- | --- | --- | --- | --- | --- | --- |
| Beryllium (Be) | ug/L | NV | --- | --- | --- | --- | --- | --- | --- | --- |
| Bismuth (Bi) | ug/L | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Boron (B) | ug/L | NV | --- | --- | --- | --- | --- | --- | 1500 | NRG |
| Cadmium (Cd) | ug/L | NV | --- | --- | --- | --- | --- | --- | Equation | 0.12 |
| Chromium (Cr) | ug/L | NV | --- | --- | --- | --- | --- | --- | --- | --- |
| Cobalt (Co) | ug/L | NV | 20.9 | 2.8 | 1.2 | 14.9 | 2.3 | 28.6 | --- | --- |
| Copper (Cu) | ug/L | --- | --- | --- | --- | --- | --- | --- | Equation | NV |
| Iron (Fe) | ug/L | --- | 9,600 | 6,100 | 5,300 | 26,600 | 20,300 | 47,800 | 300 | NV |
| Lead (Pb) | ug/L | NV | --- | --- | --- | --- | --- | --- | Equation | NV |
| Lithium (Li) | ug/L | --- | 65.7 | 14.6 | 12.6 | 22.1 | 20.4 | 23.3 | --- | --- |
| Manganese (Mn) | ug/L | --- | 13,400 | 4,300 | 2,380 | 6,490 | 4,940 | 12,940 | --- | --- |
| Mercury total (Hg) | ug/L | NV | --- | --- | --- | --- | --- | --- | 0.026 | 0.016 |
| Molybdenum (Mo) | ug/L | NV | --- | --- | --- | --- | --- | --- | 73 | NV |
| Nickel (Ni) | ug/L | NV | --- | --- | --- | --- | --- | --- | Equation | NV |
| Selenium (Se) | ug/L | NV | --- | --- | --- | --- | --- | --- | 1.0 | NV |
| Silver (Ag) | ug/L | NV | --- | --- | --- | --- | --- | --- | 0.1 | NV |
| Strontium (Sr) | ug/L | NV | 11,100 | 9,200 | 556 | 1,030 | 600 | 660 | --- | --- |
| Sulphur (S) | ug/L | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Thallium (Tl) | ug/L | NV | --- | --- | --- | --- | --- | --- | 0.80 | NV |
| Tin (Sn) | ug/L | NV | --- | --- | --- | --- | --- | --- | --- | --- |
| Titanium (Ti) | ug/L | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Uranium (U) | ug/L | NV | --- | --- | --- | --- | --- | --- | 15 | NRG |
| Vanadium (V) | ug/L | NV | --- | --- | --- | --- | --- | --- | --- | --- |
| Zinc (Zn) | ug/L | NV | --- | --- | --- | --- | --- | --- | 330.0 | NV |

Notes:

mg/L - milligrams per litre

me/L - millogram equivalents per liter

ug/L - micrograms per litre

% - Percent

TCU - True Colour Unit

NTU - Nephelometric Turbidity Units

uS/cm - microsiemens/centimeter

NRG - no recommended guideline

NV - no value

--- - no information provided

NSE Tier 1 EQS - Environmental Quality Standards for Non-Potable Groundwater, Commercial/Industrial Land Use (Coarse-Grained Soil)

95% [UCL] - 95% Upper Confidence Limit (to be applied to groundwater collected from specificied locations only)

CCME FWAL - CCME Environmental Quality Guidelines for the Protection of Aquatic Life (Freshwater)

CCME MAL - CCME Environmental Quality Guidelines for the Protection of Aquatic Life (Marine)

CCME Equations, Guidance Framework, Narrative and Variable concentrations can be found in http://ceqg-rcqe.ccme.ca/

95% [UCL] data provided by **Year 4 Construction/Remediation 2nd Quarter Groundwater Monitoring Event - Draft Report**, Dillon Consulting Limited (July 2013)

**APPENDIX G**
**Summary of LTMM Groundwater Monitor Wells**

Nova Scotia Lands Inc.
Long Term Monitoring and Maintenance Plan

210.05479.00000.0029

Table G-1 Monitor Well Selection and Summary

| Proposed Well for LTMM | | | Wells Propsed to be sampled during EEM (as | | | | Monitor Wells Sampled during EEM | | | Rationale for Inclusion in LTMM |
|---|---|---|---|---|---|---|---|---|---|---|
| **Monitor Well ID** | Analyses | | **Well** | **Unit** | Analyses | | Analyses | | Conditions as per EEM | |
| COBB-004-MWA | S | W | COBB-004-MWA | FILL | S | W | S | W | Change to sampling well. This well previously displayed increasing or potentially increasing trends for manganese, cadmium, copper and zinc. | CO6 - Coke Ovens Cap (same as EEM)<br>(Also additional data for CO5 and CO7/CO8) |
| COBC-001-MWA | S | W | COBC-001-MWA | FILL | S | W | S | W | This well previously displayed increasing or potentially increasing trends for arsenic, cadmium and zinc. | CO1 - along both sides of the Coke Ovens Brook Connector (West Side) |
| COBC-001-MWB | | W | COBC-001-MWB | IRx | | W | | W | | CO1 - along both sides of the Coke Ovens Brook Connector (West Side) |
| COBC-002-MWA | S | W | COBC-002-MWA | FILL | S | W | S | W | This well previously displayed increasing or potentially increasing trends for arsenic, copper and zinc. | CO1 - along both sides of the Coke Ovens Brook Connector (East Side) |
| COBC-002-MWB | | W | COBC-002-MWB | SRx | | W | | W | | CO1 - along both sides of the Coke Ovens Brook Connector (East Side) |
| COBC-002-MWC | | W | COBC-002-MWC | IRx | | W | | W | | CO1 - along both sides of the Coke Ovens Brook Connector (East Side) |
| COBC-003-MWB | | W | COBC-003-MWB | SRx | | W | | W | | CO1 - along both sides of the Coke Ovens Brook Connector (West Side) |
| COBC-004-MWA | S | W | COBC-004-MWA | FILL | S | W | S | W | This well previously displayed increasing or potentially increasing trends for naphthalene, total PAHs, lithium, manganese, strontium, sulphate, TDS, cadmium and zinc. | TP7 - Tar Ponds Cap (same as EEM)<br>CO1 - along both sides of the Coke Ovens Brook Connector (West Side; water level only) |
| COBC-004-MWB | | W | COBC-004-MWB | IRx | | W | | W | | TP7 - Tar Ponds Cap (same as EEM)<br>CO1 - along both sides of the Coke Ovens Brook Connector (West Side) |
| COBP-006-MWA | S | W* | COBP-006-MWA | TILL | SS | W | S | W | This well previously displayed increasing or potentially increasing trends for benzo(a)pyrene, arsenic, cobalt and zinc. | CO6 - Coke Ovens Cap (same as EEM)<br>CO7/CO8 - Coke Ovens Groundwater Collection System (same as EEM) |
| COBT-003-MWB | S | W | COBT-003-MWB | DRx | | W | S | W | This well previously displayed increasing or potentially increasing trends for iron, lithium, strontium and zinc. | CO5 - South wall |
| COCP-110-MW | S | W | COCP-110-MW | FILL | | W | S | W | Added to chemistry for CO5. | CO5 - North wall (Also additional data for CO6) |
| CODT-008-MWB | S | W | CODT-008-MWB | SRx | S | W | S | W | This well previously displayed increasing or potentially increasing trends for copper. | CO2 - under and around the perimeter of the Tar Cell (same as EEM)<br>(Also additional data for CO7/CO8) |
| CODT-105-MW | S | W* | CODT-105-MW | FILL | S | W | S | W | This well previously displayed increasing or potentially increasing trends for copper. | CO2 - under and around the perimeter of the Tar Cell (same as EEM)<br>CO5 - North wall<br>CO7/CO8 - Coke Ovens Groundwater Collection System (same as EEM)<br>(Also additional data for CO6) |
| CODT-201-MWA | S | W* | CODT-101-MWA | FILL | S | W | S | W | Damaged and replaced with CODT-201-MWA. This well previously displayed increasing or potentially increasing trends for copper and zinc. | CO1 - along both sides of the Coke Ovens Brook Connector (West Side)<br>CO2 - under and around the perimeter of the Tar Cell (same as EEM)<br>CO5 - South wall<br>CO7/CO8 - Coke Ovens Groundwater Collection System (same as EEM)<br>(Also additional data for CO6) |

Notes:
W - Water Level Monitoring
S - Groundwater Quality Monitoring
* - product may be observed in wells
[1] - monitor wells not listed in EPP but were selected for LTMM sampling as they were sampled during the EEM and water chemistry was available

| | |
|---|---|
| IRx | intermediate bedrock well |
| SRx | shallow bedrock well |
| DRx | deep bedrock well |
| E/T | estuarine sand/till |

Table G-1 Monitor Well Selection and Summary

| Proposed Well for LTMM | | | Wells Propsed to be sampled during EEM (as | | | | Monitor Wells Sampled during EEM | | | Rationale for Inclusion in LTMM |
|---|---|---|---|---|---|---|---|---|---|---|
| **Monitor Well ID** | Analyses | | **Well** | **Unit** | Analyses | | Analyses | | Conditions as per EEM | |
| CODT-201-MWB | S | W* | CODT-101-MWB | FILL | S | W | S | W | Damaged and replaced with CODT-201-MWB | CO1 - along both sides of the Coke Ovens Brook Connector (West Side; water level only)<br>CO7/CO8 - Coke Ovens Groundwater Collection System (same as EEM)<br>(Also additional data for CO2 and CO6) |
| CODT-201-MWC | | W | PN88-5C | TILL | S | W | S | W | Replaced with CODT-201-MWC. This well previously displayed increasing or potentially increasing trends for benzene, modified TPH, naphthalene and total PAHs. | CO1 - along both sides of the Coke Ovens Brook Connector (West Side) |
| CODT-203-MW | S | W | North Wall - 1 | FILL | N/A | N/A | S | W | This well is located within the former Domtar area and is likely influenced by the groundwater collection system. Monitoring of this well may provide information on the effect of the collection system. This well previously displayed increasing or potentially increasing trends for sulphate. | CO5 - North wall<br>(Also additional data for CO6) |
| CODT-205-MWA | S | W | CODT-005-MWA | SRx | | W | S | W | Added to chemistry; Replaced with CODT-205-MWA (installed in 2011). This well previously displayed increasing or potentially increasing trends for arsenic and strontium. | CO5 - North wall<br>CO6 - Coke Ovens Cap (same as EEM) |
| CODT-206-MW [1] | S | W | | | N/A | N/A | S | W | New well installed 2011. This well previously displayed increasing or potentially increasing trends for zinc. | CO1 - along both sides of the Coke Ovens Brook Connector (West Side; water level only)<br>CO2 - under and around the perimeter of the Tar Cell (same as EEM) |
| CONCW-101-MWB | S | W | | | N/A | N/A | S | W | Installed in 2011 (North Wall - 2). This well previously displayed increasing or potentially increasing trends for lithium and cadmium. | CO2 - under and around the perimeter of the Tar Cell (same as EEM)<br>CO5 - North wall |
| CONPL-202-MWA | S | W | CODT-002-MWB | SRx | | W | | W | | CO1 - along both sides of the Coke Ovens Brook Connector (East Side) |
| COSB-002-MWA | S | W | COSB-002-MWA | FILL | S | W | S | W | This well previously displayed increasing or potentially increasing trends for strontium, sulphate, TDS, nickel and zinc. | CO6 - Coke Ovens Cap (same as EEM)<br>(Also additional data for CO5 South wall) |
| COSCW-001-MWA(T) | S | W | South Wall-1 | | N/A | N/A | S | W | | CO5 - South wall |
| COSCW-001-MWB(T) | S | W | South Wall-2 | | N/A | N/A | S | W | This well previously displayed increasing or potentially increasing trends for arsenic, iron, lithium, strontium, sulphate, TDS and cadmium. | CO5 - South wall |
| COSCW-002-MWA(T) | S | W | South Wall-3 | | N/A | N/A | S | W | This well previously displayed increasing or potentially increasing trends for TDS and cadmium. | CO5 - South wall |

Notes:
W - Water Level Monitoring
S - Groundwater Quality Monitoring
* - product may be observed in wells
[1] - monitor wells not listed in EPP but were selected for LTMM sampling as they were sampled during the EEM and water chemistry was available

| | |
|---|---|
| IRx | intermediate bedrock well |
| SRx | shallow bedrock well |
| DRx | deep bedrock well |
| E/T | estuarine sand/till |

Table G-1 Monitor Well Selection and Summary

| Proposed Well for LTMM | | | Wells Propsed to be sampled during EEM (as | | | | Monitor Wells Sampled during EEM | | | Rationale for Inclusion in LTMM |
|---|---|---|---|---|---|---|---|---|---|---|
| **Monitor Well ID** | Analyses | | **Well** | **Unit** | Analyses | | Analyses | | Conditions as per EEM | |
| COSCW-002-MWB(T) | S | W | South Wall -4 | | N/A | N/A | S | W | This well previously displayed increasing or potentially increasing trends for arsenic and cadmium. | CO5 - South wall |
| COTS-001-MWA | S | W* | COTS-001-MWA | FILL | S | W | S | W | NAPL checks/measurements previously completed on well. | CO6 - Coke Ovens Cap (same as EEM)<br>CO7/CO8 - Coke Ovens Groundwater Collection System (same as EEM)<br>(Also additional data for CO2) |
| COTS-001-MWB | | W* | COTS-001-MWB | SRx | | W | | W | | CO7/CO8 - Coke Ovens Groundwater Collection System (same as EEM) |
| MCES-001-MWA | S | W | MCES-001-MWA | FILL | S | W | S | W | This well previously displayed increasing or potentially increasing trends for arsenic, lithium, strontium, TDS, cadmium, copper, lead and zinc. | TP7 - Tar Ponds Cap (same as EEM) |
| MCES-001-MWB | S | W | MCES-001-MWB | SRx | S | W | S | W | This well previously displayed increasing or potentially increasing trends for naphthalene, arsenic, cobalt, iron, lithium, manganese, strontium, TDS, cadmium, chromium, lead, nickel, and zinc. | TP7 - Tar Ponds Cap (same as EEM) |
| MCES-006-MW | S | W | MCES-006-MW | SRx | S | W | S | W | This well previously displayed increasing or potentially increasing trends for lithium and cadmium. | TP7 - Tar Ponds Cap (same as EEM) |
| MCES-204-MW | S | W | MCES-004-MW | FILL | S | W | S | W | Replaced with MCES-204-MW. This well previously displayed increasing or potentially increasing trends for iron, lithium, strontium, copper and nickel. | TP7 - Tar Ponds Cap (same as EEM) |
| MCWS-009-MW | S | W | MCWS-009-MW | SRx | S | W | | W | | TP6A - monitoring West shoreline of channel (as per EPP) |
| MCWS-113-MWB | S | W | MCWS-002-MWB | IRX | S | W | | | Could not locate well; switched to MCWS-113-MWB. This well previously displayed increasing or potentially increasing trends for arsenic, cadmium and zinc. | TP6A - monitoring West shoreline of channel (as per EPP) |
| MCWS-306-MWB | S | W | MCWS-106-MWB* | TILL | S | W | S | W | Replaced with MCWS-206-MWB; access restricted to MCWS-206-MWB during construction and replaced with MCWS-306-MWB | TP6A - monitoring West shoreline of channel (as per EPP) |
| MCWS-307-MWB | S | W | MCWS-107-MWB* | TILL | S | W | S | W | Replaced with MCWS-207-MWB; access restricted to MCWS-207-MWB during construction and replaced with MCWS-307-MWB. This well previously displayed increasing or potentially increasing trends for zinc. | TP6A - monitoring West shoreline of channel (as per EPP) |

Notes:
W - Water Level Monitoring
S - Groundwater Quality Monitoring
* - product may be observed in wells
[1] - monitor wells not listed in EPP but were selected for LTMM sampling as they were sampled during the EEM and water chemistry was available

| | |
|---|---|
| IRx | intermediate bedrock well |
| SRx | shallow bedrock well |
| DRx | deep bedrock well |
| E/T | estuarine sand/till |

Table G-1 Monitor Well Selection and Summary

| Proposed Well for LTMM | | | Wells Propsed to be sampled during EEM (as | | | | Monitor Wells Sampled during EEM | | | Rationale for Inclusion in LTMM |
|---|---|---|---|---|---|---|---|---|---|---|
| **Monitor Well ID** | Analyses | | **Well** | **Unit** | Analyses | | Analyses | | Conditions as per EEM | |
| MCWS-309-MW | S | W | MCWS-109-MW | FILL | S | W | S | W | Replaced with MCWS-209-MW; MCWS-209-MW destroyed and replaced with MCWS-309-MW | TP6A - monitoring West shoreline of channel (as per EPP) |
| MCWS-310-MW | S | W | MCWS-010-MW | SRx | S | W | S | W | Replaced with MCWS-210-MW; MCWS-210-MW destroyed and replaced with MCWS-310-MW | TP6A - monitoring West shoreline of channel (as per EPP) |
| MSES-003-MW | S | W | MSES-003-MW | SRx | S | W | S | W | This off-site well has exhibited increasing PAH concentrations trends. This well previously displayed increasing or potentially increasing trends for naphthalene, sulphate, cadmium and zinc. | TP7 - Tar Ponds Cap (same as EEM) |
| MSES-004-MW | S | W | MSES-004-MW | SRx | S | W | S | W | This well previously displayed increasing or potentially increasing trends for arsenic and zinc. | TP7 - Tar Ponds Cap (same as EEM) |
| MSES-005-MW | | W | MSES-005-MW | FILL | | W | | W | | TP7 - Tar Ponds Cap (same as EEM) |
| MSES-006-MW | S | W | MSES-006-MW | SRx | | W | S | W | This well previously displayed increasing or potentially increasing trends for cobalt, manganese, strontium, sulphate, TDS, cadmium, nickel and zinc. | TP7 - Tar Ponds Cap (same as EEM) |
| MSES-008-MW | S | W | MSES-008-MW | FILL | | W | S | W | This well previously displayed increasing or potentially increasing trends for cobalt, iron, lithium, manganese, strontium, cadmium, nickel and zinc. | TP7 - Tar Ponds Cap (same as EEM)<br>CO1 - along both sides of the Coke Ovens Brook Connector (East Side; water level only) |
| MSES-012-MWA | S | W | MSES-012-MWA | FILL | S | W | S | W | This well previously displayed increasing or potentially increasing trends for arsenic and cadmium. | TP7 - Tar Ponds Cap (same as EEM)<br>CO1 - along both sides of the Coke Ovens Brook Connector (East Side) |
| MSES-012-MWB | | W | MSES-012-MWB | IRx | | W | | W | | TP7 - Tar Ponds Cap (same as EEM)<br>CO1 - along both sides of the Coke Ovens Brook Connector (East Side) |
| MSES-013-MWA | | W | MSES-013-MWA | SRx | | W | | W | | CO1 - along both sides of the Coke Ovens Brook Connector (East Side) |
| MSES-013-MWB | | W | MSES-013-MWB | IRx | | W | | W | | CO1 - along both sides of the Coke Ovens Brook Connector (East Side) |
| MSES-014-MW | | W | MSES-014-MW | SRx | | W | | W | | CO1 - along both sides of the Coke Ovens Brook Connector (East Side) |
| MSES-104-MWA | S | W | MSES-104-MWA | FILL | S | W | S | W | This well previously displayed increasing or potentially increasing trends for modified TPH, benzo(a)pyrene, naphthalene, total PAHs and cadmium. | TP7 - Tar Ponds Cap (same as EEM) |
| MSES-104-MWB | S | W | MSES-104-MWB | TILL | S | W | S | W | This well is downgradient of the former landfill and close to S/S monolith. This well previously displayed increasing or potentially increasing trends for benzene, modified TPH, naphthalene, total PAHs and arsenic. | TP7 - Tar Ponds Cap (same as EEM) |

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|---|---|
| IRx | intermediate bedrock well |
| SRx | shallow bedrock well |
| DRx | deep bedrock well |
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Table G-1 Monitor Well Selection and Summary

| Proposed Well for LTMM | | | Wells Propsed to be sampled during EEM (as | | | | Monitor Wells Sampled during EEM | | | Rationale for Inclusion in LTMM |
|---|---|---|---|---|---|---|---|---|---|---|
| **Monitor Well ID** | Analyses | | **Well** | **Unit** | Analyses | | Analyses | | Conditions as per EEM | |
| MW88-102-A | | W | MW88-102-A | SRx | | W | | W | | TP7 - Tar Ponds Cap (same as EEM) |
| MW88-102-B | | W | MW88-102-B | FILL | | W | | W | | TP7 - Tar Ponds Cap (same as EEM) |
| SCU10-002-MW | | W* | SCU10-002-MW | FILL | S | W | | W | | CO1 - along both sides of the Coke Ovens Brook Connector (West Side) |
| SCU10-003-MW | | W | SCU10-003-MW | FILL | S | W | | W | | CO1 - along both sides of the Coke Ovens Brook Connector (West Side) |
| SCU11-001-MWA [1] | S | W | | | N/A | N/A | S | W | | CO2 - under and around the perimeter of the Tar Cell (same as EEM) |
| SCU11-001-MWB [1] | S | W | | | N/A | N/A | S | W | | CO2 - under and around the perimeter of the Tar Cell (same as EEM) |
| SCU24-007-MWB | | W | SCU24-007-MWB | | N/A | N/A | | W | | TP7 - Tar Ponds Cap (same as EEM) |
| SCU26-005-MW | | W | SCU26-005-MW | DRx | | W | | W | | TP7 - Tar Ponds Cap (same as EEM) |
| SCU26-007-MW | | W | SCU26-007-MW | FILL | | W | | W | | TP7 - Tar Ponds Cap (same as EEM) |
| SCU26-209-MW | | W | SCU26-009-MW | FILL | | W | | W | Replaced with SCU26-209-MW | TP7 - Tar Ponds Cap (same as EEM) |
| SCU27-005-MWA | | W | SCU27-005-MWA | E/T | | W | | W | | TP7 - Tar Ponds Cap (same as EEM) |
| SCU27-005-MWB | | W | SCU27-005-MWB | SRx | | W | | W | | TP7 - Tar Ponds Cap (same as EEM) |
| SCU7-001-MW | S | W | SCU7-001-MW | FILL | S | W | | W | | CO1 - along both sides of the Coke Ovens Brook Connector (West Side) |
| SCU7-002-MWB | | W | SCU7-002-MWB | SRx | | W | | W | Damaged | CO1 - along both sides of the Coke Ovens Brook Connector (West Side) |
| SCU7-003-MW | S | W | SCU7-003-MW | E/T | S | W | S | W | Well flush mount broken. This well previously displayed increasing or potentially increasing trends for zinc. | CO1 - along both sides of the Coke Ovens Brook Connector (West Side) |
| Spar Road - MW2 [1] | S | W | | | N/A | N/A | SS | W | | CO5 - North wall |

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**APPENDIX H**
**Site Covenants**

Nova Scotia Lands Inc.
Long Term Monitoring and Maintenance Plan

210.05479.00000.0029

## Schedule "B"

## Harbourside Commercial Park Restrictive Covenants

These restrictive covenants bind the lands described in Schedule "A" (the "lands") to this Indenture between the Grantor and the Grantee. In these covenants the capitalized term "Grantor" includes Lessor and the capitalized term "Grantee" includes Lessee, as the context requires.

### 1.0 Erection of Buildings

1.1 No building, structure or any addition shall be erected on the lands unless the Grantee has obtained all necessary municipal, provincial and federal government permits and approvals and written approval has been received from the Grantor. Applications for approval from the Grantor must include (a) a site plan and specifications showing dimensions and area of the lands; all proposed improvements, with their dimensions and relative location; rail spur lines if appropriate; and proposed landscaping, signs and lighting; and (b) building drawings and specifications showing the building floor plan, all elevations and description of exterior finishes and colour; and the location and description of all ancillary mechanical facilities and services for the building.

1.2 All plans and specifications submitted must be prepared by a registered architect or engineer.

1.3 Approval of plans and specifications by the Grantor shall be based on considerations such as operations and uses, adequacy of the site plan, adequacy of structural design, harmony of external building and landscaping design with neighbouring sites, relation of topography, grade and finished ground elevation of the site to that of neighbouring sites and conformity of the plans and specifications generally to the advancement and quality of the Harbourside Commercial Park.

1.4 If the lands are vacant, the Grantee covenants and agrees to complete erection of an industrial building on the lands within 24 months of the date of closing unless previous authorization is received from the Grantor. If the building is not started and completed within this period, the Grantee may be given notice in writing to complete the construction within 3 months and if not completed within such extended period the Grantee shall reconvey the lands to the Grantor at the original selling price without interest.

### 2.0 Use of Land, Buildings or Structures

2.1 No lands, buildings or structures shall be used for any purposes other than manufacture, fabrication, processing, offices, distribution, transportation, assembly, repair or storage of products and ancillary services, as permitted by the municipal zoning and land use by-laws in existence from time to time.

2.2 No part of the lands, buildings or structures shall be used as a dwelling, hotel, motel or place of residence of any nature.

2.3 The lands or any part thereof, any building or structures erected or placed thereon shall not be used for any purpose or in any manner which will be a nuisance to the occupants or owners of any neighbouring lands or buildings by reason of emissions from the lands, buildings or structures such as odours, gases, dust, smoke, noise, fumes, cinders, soot, waste, radiation or vibration or be contrary to regional, provincial or federal legislation controlling pollution, in the sole opinion of the Grantor, whereupon with notice by the Grantor to the Grantee, the nuisance shall immediately cease.

**3.0 Landscaping**

3.1 Those portions of the site between buildings and front and side lots which are not covered by buildings, structures, parking and loading areas or driveways will be sodded and landscaped by the Grantee.

3.2 Sodded areas, trees, shrubbery and gardens shall be kept neat and orderly in appearance at all times.

**4.0 Fences**

4.1 Fences shall not be erected by the Grantee without the prior written approval of the Grantor. If erected, fences shall be maintained at all times in a good state of repair.

**5.0 Refuse**

5.1 A central refuse storage area shall be provided and maintained by the Grantee. The refuse storage area shall be at the same level as parking and driveways and shall be suitably screened with trees, hedges, fences or walls or a combination of them, in order to ensure that the store area is not visually objectionable when viewed from neighbouring properties or from public thoroughfares, which shall be determined in the sole discretion of the Grantee.

**6.0 Parking, Driveways and Loading Areas**

6.1 The Grantee shall provide and maintain accessible off-street loading, driveway and parking facilities as required for the property. All loading, driveways and parking areas shall be covered with asphalt or concrete paving. Loading, driveway and parking areas shall be maintained by the Grantee in a proper state of repair.

6.2 No truck receiving or shipping door shall face the street on the front of the building. Truck receiving and shipping facilities will be placed to the rear of the front half of the depth of the building, except where in the opinion of the Grantor, the contours of the land dictate otherwise. When loading is carried out wholly within the building itself, these restrictions will not apply.

**7.0 Signs**

7.1 No signs, billboards, notices or other advertising material of any kind shall be placed on any part of the land or on any building or structure, or on any fence or tree on the land without the prior approval in writing of the Grantor.

**8.0 Maintenance**

8.1 All buildings and structures erected on the lands and all undeveloped portions of the site shall be maintained in good order and repair at all times which shall be determined in the sole opinion of the Grantor.

**9.0 Change of Use**

9.1 The Grantee shall not change the use of the lands without the prior written approval of the Grantor.

**10.0 Enforcement**

10.1 The Grantee covenants and agrees the Grantor may provide to the Grantee written notice of the breach or violation by the Grantee of any provision of these covenants, following which the Grantee shall have 20 days to rectify the breach or violation. If the Grantee fails to rectify the breach or violation within 20 days following the provision of the notice, the Grantor may, without limiting any other remedy available to the Grantor rectify the breach or violation at its own expense and recover the cost of doing so from the Grantee as a debt due to the Grantor, sue for an injunction to require the Grantee rectify or stop the breach or violation, and/or sue for damages.

10.2 The Grantor and Grantee agree that these covenants are binding on the parties, their respective successors, including successors in title and assigns and are intended to bind and run with the lands.

**11.0 Indemnity**

11.1 The Grantee covenants to hold the Grantor harmless from any claim by third parties for any reason including damages or personal injury due to a breach of any of these covenants by the Grantee.

Acknowledged by the Grantee

Per: _____