Environmental Assessment Registration Addendum - Envirosoil Facility: Addition of Stabilization/Solidification Technology

Project No. 121413511

Prepared for:
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August 2015

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LIST OF ACRONYMS

CCME	Canadian Council of Ministers of the Environment
CEAA, 2012	*Canadian Environmental Assessment Act, 2012*
EA	Environmental Assessment
EC	Electrical Conductivity
EQS	Environmental Quality Guidelines
LTTD	Low Temperature Thermal Desorption
MW	Monitoring Well
NSE	Nova Scotia Environment
S/S	Stabilization/Solidification
USEPA	United States Environmental Protection Agency

1.0 Proponent and Project Identification

1.1 PROPONENT INFORMATION

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1.2 PROJECT INFORMATION

Name of the Undertaking:	Addendum - Environmental Assessment Registration for the Envirosoil Facility: Addition of Stabilization/Solidification Technology
Location of the Undertaking:	Bedford, Halifax County, Nova Scotia

2.0 INTRODUCTION

Envirosoil Limited (Envirosoil), was founded in 1992 in Bedford, Nova Scotia. Envirosoil designed and constructed a facility to provide a solution for the treatment and disposal of contaminated soil. The facility operates under Industrial Approval No. 2002-026440-R01 from Nova Scotia Environment (NSE) which prescribes the criteria for material acceptance, treatment and reuse of treated material.

The facility initially provided bio-remediation services for contaminated soils. In 1995, permission was received to operate the Low Temperature Thermal Desorption (LTTD) unit. In 2003, an Environmental Assessment (EA) Approval was received to treat soils contaminated with perclororethylene from dry cleaning fluids and related products. Additional information on the facility is provided in the 2003 EA.

Envirosoil has requesting the following amendments to Industrial Approval No. 2002-026440-R01:

- Amendment to add Stabilization/Solidification (S/S) technology to allow treatment of materials with inorganic metals and low level organics; and
- Amendment to allow for the acceptance and treatment by S/S technology materials containing elevated levels of Electrical Conductivity (EC) and Sodium Adsorption Ratio (SAR) (or, salt impacted materials).

Because these amendments are considered modifications to the existing facility, Envirosoil was required to register this Project as a Class I Undertaking pursuant to the Nova Scotia *Environment Act* and Environmental Assessment Regulations.

The proposed project was registered by Envirosoil under the Environmental Assessment Regulations on May 26, 2015. On July 15, 2015 a decision was provided by the Minister of the Environment, the Honourable Randy Delorey. In the provided decision, it was determined that additional information was required to fully evaluate the potential environmental effects that may be caused by the undertaking described in the EA.

This report contains the additional information requested by NSE.

3.0 Additional Information Requested

Additional information related to six topics regarding the proposed undertaking was requested by the NSE in the July 15 Decision Letter. The points have been assigned numbers for ease of identification in this document, and are as follows:

1. Additional information must be provided regarding the geology under the proposed Treated Soil Fill Area (TSFA);
2. Additional safeguard measures must be provided to ensure the design of the TSFA is adequate to prevent contaminants from leaching into the environment. Contingency measures must also be provided in the event of the TSFA failure;
3. Additional evidence (e.g., studies) must be provided to demonstrate that the Stabilization & Solidification Technology is able to manage salt impacted materials.
4. Contingency measures must also be provided in the event that salt and/or other factors compromise the treatment results;
5. Additional information must be provided regarding the performance testing method for the treated materials (e.g., the proposed statistical method and the lack of hydraulic testing in the field are examples of information gaps); and,
6. The proposed monitoring plan to monitor water resources must be expanded to address potential risk to the environment including endangered Atlantic Whitefish (*Coregonus huntsman*).

A meeting between the Envirosoil and NSE's technical reviewers was held July 21, 2015 to provide NSE reviewers the opportunity to further discuss and define the specific information that was requested in the above six points.

Responses to each of these points are provided in this document within the following sub-sections. As per the EA process, information contained within this document is limited to that required to address the six points. For a more complete discussion of this project, please see the complete Environmental Assessment Registration for more information (https://www.novascotia.ca/nse/ea/envirosoil-facility.asp).

3.1 ADDITIONAL INFORMATION – POINT 1 (GEOLOGY)

NSE Requested Information:

Additional information must be provided regarding the geology under the proposed Treated Soil Fill Area (TFSA).

Envirosoil's Response:

Physiography and Drainage

The Envirosoil facility is located the watershed of Rocky Lake (5.11 km^2). The TFSA is located near the watershed divide along the southwest border of the Lake William watershed (22 km^2) and is within a sub-catchment of Marshall Brook. Local elevations range from 53 to 61 m. Lake William is one of the headwater lakes for the Shubenacadie Canal System and receives water from Rocky Lake and six other inlets along the south and west shores.

The Surface topography is primarily bedrock controlled.

Surficial Geology

Surficial geology within the vicinity of the TFSA at higher elevations primarily consists of a thin veneer of glacial till and exposed bedrock outcrop. A quartzite till surrounds the till veneer and is approximately 1-10 m thick along Rocky Lake Road. The quartzite till consists of a light bluish-grey, loose matrix of angular clasts comprised of approximately 80% sand, 15% silt and 5% clay with large cobbles(Stea and Fowler, 1981). Detailed Quaternary mapping of the area (Utting, 2011) shows thin glacial veneer overlying most of the area, with small zones of glacial till immediately northeast and southwest of the fill materials between the bedrock ridges.

Recent drilling near the proposed TFSA indicates variable glacial till thickness, ranging from nil along bedrock ridges to approximately 6 m along intervening swale.

Bedrock Geology

The bedrock in the vicinity of the TFSA consists of Cambrian-Ordovician aged (510 to 545 million years) fractured meta-sandstone (greywacke) and minor slate of the Goldenville Formation of the Meguma Group(Keppie, 2000). This bedrock is described as a greywacke and minor slate turbidite sequence laid down in a continental rise prism sub-aqueous depositional environment, and is in places metamorphosed to schist and gneiss, and is commonly described as greenish-gray greywacke and minor slate**Error! Bookmark not defined.**.

The bedrock structure in the TFSA consists of a series of tightly folded, northeast to southwest trending anticlines and synclines. The TFSA is situated on the southeast limb of the Bedford Syncline. The dominant direction of bedding (and bedrock ridge) strike is northeast along the structural trend, with bedding dips averaging 30 degrees to the northwest in the immediate area of the TFSA. No major faulting or fracture trends are noted from available topographic and Lidar mapping.

Bedrock in the TFSA dominates the local topography, forming a series of northeast to southwest trending rock ridges with intervening glacial till infilled swales. The highly detailed LIDAR mapping of the area clearly shows the dominance of these ridges. The ridges are comprised of

more competent meta-sandstones and can locally control drainage and surface water features. The TFSA is bordered to the north and south by such ridges (the intervening swale is being filled) which extend 730 m southwest to Anderson Lake and northeast to Marshall Brook.

The Goldenville Formation is not generally considered to be acid generating, except in the vicinity of mineralized zones in Gold Districts where natural arsenic, in the form of arsenopyrite is well known and documented (Grantham 1976, Grandtham and Jones, 1977). The Goldenville formation hosts the numerous Gold Districts of Nova Scotia, which tend to occur along the crests of anticline axis. Arsenopyrite mineralization associated with extension fracturing along the mineralized anticlines results in arsenic concentrations in groundwater above the Canadian Drinking Water Guideline of 10 micrograms per litre (Bottomley, 1984; Nova Scotia Department of Health 1986; Nova Scotia Department of Natural Resources, 2005). The nearest gold mining area is located at Waverley 5.3 km to the north, and at Montague Gold Mines, 7.4 km to the east (Nova Scotia Department of Natural Resources, 2005)

Mineralized zones may also occur near contacts between Meguma bedrock and the granite intrusive, where local bedrock is more highly altered. The nearest contact with granite occurs 7.8 km to the northeast (north end of Lake Major) and 10 km to the north (Long Lake). The combination of bedrock structure in the immediate area (syncline), distance to granite contacts (> 7.5 km) and absence of apparent mineralized zones (nearest Gold District >5 km from site) suggest a low probability of encountering mineralized zones.

Bedrock Permeability

In this terrain we typically consider three hydrostratigraphic units when conducting a high level assessment of bedrock permeability. The top unit is the glacial till. In this case the till is considered to be a sand-phase (hydraulic conductivity is expected to be 1×10-6 to 1×10-5 m/s, which is a low typical hydraulic conductivity for surface bedrock in this geological domain). The unit below is weathered bedrock which may have enhanced permeability due to glaciation. In many cases the permeability of the till and weathered bedrock are about the same.

The lower unit is the competent bedrock which is of lower permeability (geometric mean of hydraulic conductivity from 100s of individual pumping tests in the Meguma Terrain is 2.5×10-7 m/s) derived from the Nova Scotia pumping test inventory (Nova Scotia Department of Natural Resources, 2015). Fracturing is dominantly sub-vertical and poorly inter-connected, hence the lower yield in bedrock wells in this terrain.

3.2 ADDITIONAL INFORMATION – POINT 2 (SAFEGUARD MEASURES AND CONTINGENCY MEASURES)

NSE Requested Information:

Additional safeguard measures must be provided to ensure the design of the TSFA is adequate to prevent contaminants from leaching into the environment. Contingency measures must also be provided in the event of the TSFA failure.

Envirosoil's Response:

The TSFA is not the mechanism by which soil is treated and contaminants are immobilized. It is the S/S treatment process that prevents the contaminants from leaching out of the monoliths, not the design of the TSFA; the monoliths are the containment mechanism. The TSFA is not a component of the treatment process, it is simply a location that contains soils. The TFSA area was designed to minimize moisture and temperature cycling and temperature cycling for S/S treated materials.

To accomplish this, S/S treated materials will be placed at minimum >1m above the bedrock surface to prevent contact with groundwater. Groundwater levels will be confirmed via monitoring well installations prior to material placement, to ensure that the materials is placed at minimum >1m above the groundwater table. This is an extra safety measure, as the monoliths are fully capable of being submerged while maintaining containment (in marine or inland waters); subaqueous placement is a common practice in other locations where this treatment method has been used (see Section 3.3 for references).

The S/S treated materials will be placed vertically within the TSFA, within trenches dug to contain treated materials. As the material is deposited, it will be compacted in approximately 30 – 50 cm lifts. The trench and surrounding fill material will be dynamically contoured to promote drainage as material is placed, to minimize standing water contact time with S/S treated materials. In addition, S/S operations will not take place during heavy rain events. At the end of each production season the deposited materials will be backfilled/covered with a minimum 1.2 m of fill to prevent frost cycling.

The deposition location for each homogenized batch of materials will be surveyed and recorded. This will ensure there is an accurate record of the locations of deposited materials, in the unlikely circumstance that the ongoing monitoring of the Envirosoil facility identifies an issue.

There are three key contingency measures proposed within the EA that provide assurance contaminated materials will be successfully treated using S/S technology thus minimizing the risk of leaching into the environment. They are as follows:

1. Strict Acceptance Criteria;
2. Treatment and Performance Criteria; and,
3. TFSA Design.

The acceptance criteria for materials are listed within Table 1 of the submitted EA. The criteria for the acceptance of this material is based on Envirosoil's current approval, the Nova Scotia Contaminated Site Regulations (NSE, 2013) Tier 1 Environmental Quality Guidelines for soil at a Non-Potable fine grained, industrial site and the Nova Scotia Guidelines for Contaminated Solids in Landfills, Attachment C – Acceptance Parameters for Contaminated Soil (Leachate Results).

The above referenced criteria are considered inherently conservative for the following reasons:

- The Nova Scotia Guidelines for Contaminated Solids in Landfills, Attachment C – Acceptance Parameters for Contaminated Soil (Leachate Results) are based on disposal to an unlined, first generation landfill. The material will be treated through solidification/stabilization, which is treatment in excess of the landfill disposal requirements.
- NSCSR Tier 1 Environmental Quality Guidelines (EQS) for soil at a Non-Potable fine grained, industrial site which have been proposed by Envirosoil as a standard for material acceptance. Tier 1 EQS guidelines were derived by the NSSAM Working Group after a careful review of all relevant guidelines, legislation and benchmarks. The NSSAM Working Group have stated that these guidelines are "…adequately conservative and protective in nature and are thereby considered appropriate for use as EQS in Nova Scotia. Furthermore, the adoption of such guidelines into regulatory standards follows what is considered to be common industry practice currently in place in Nova Scotia."

As such the material being treated by Envirosoil will be less contaminated than material that is typically successfully treated by S/S technologies, providing an extra safety factor to the proposed treatment process. A major remediation project in Canada has recently used S/S technology to successfully remediate a site to parkland standards that was contaminated far in excess of Tier 1 Environmental Quality Guidelines, while having a lower standard of performance criteria applied.

The treatment and performance criteria proposed within the submitted EA (located in Tables 3 and 4 respectively) are consistent with industry best practices and exceed best practices in several key ways. This is discussed in detail within Section 3.4 and 3.5 of this document.

As discussed above, the goal of the TSFA design is not to contain contaminants, but to limit the amount of groundwater in contact with S/S treated materials and to prevent moisture and temperature cycling. The conservative design features of the TSFA such as the minimum depth

to groundwater for the deposition of treated materials and the covering S/S materials with soil at the end of the season ensures that the TSFA performs as expected.

Further discussion regarding contingency measures related to the S/S treatment process is discussed within Section 3.5 of this document.

3.3 ADDITIONAL INFORMATION – POINT 3 (ADDITIONAL EVIDENCE)

NSE Requested Information:

Additional evidence (e.g., studies) must be provided to demonstrate that the Stabilization & Solidification Technology is able to manage salt impacted materials.

Envirosoil's Response:

The use of S/S to treat contaminated soil is a mature and proven technology, which has been used at 30% of all of Superfund sites in the United States. The USEPA has identified S/S as a Best Demonstrated Available Technology for more than 50 major industrial waste types and contaminants. The contaminants proposed to be treated via S/S at the Envirosoil facility have been successfully treated at many other sites using this methodology, including severely contaminated dredged materials with elevated chlorides and salinity. Table 1 has been provided as a reference to applicable studies demonstrating successful applications of S/S technology in treating salt impacted materials.

Table 1 Studies and Reports

Study/Report	General Description	Salt Containing Soils Successful Treated?
Controlled Treatment of TBT – Contaminated Dredged Sediments for the Beneficial Use in Infrastructure Applications. Case: Aurajoki-Turku, Finland. Life06 ENV/FIN/000195, STABLE. Technical Final Report.	A case study of three successful applications of the S/S treatment of contaminated sediments at saline ports within Europe.	Yes
K. Loest, C.M. Wilk. 1998. Brownfield Reuse of Dredged New York Harbor Sediment by Cement-based Solidification/Stabilization. Proceedings of the 91st Annual Meeting & Exhibition, Air and Waste Management Association.	Over 4 million cubic yards of salt impacted sediments contaminated with heavy metals, dioxins, polychlorinated biphenyls and other contaminants were treated using S/S technology.	Yes

Study/Report	General Description	Salt Containing Soils Successful Treated?
United Kingdom Environmental Agency. 2004. Guidance on the use of Stabilisation/Solidification for the Treatment of Contaminated Soil.	A report that examines the use of hydraulic binder systems designed to provide both leaching and physical improvements to contaminated materials. A selection of 42 case studies were examined, including the use of S/S technology to stabilize contaminated marine sediments.	Yes
D.W Wang, N.E Abriak, R.Zentar, W. Xu. 2012. Solidification/stabilization of dredged marine sediments for road construction. Environmental Technology, Vol 33, Iss. 1.	An examination of the feasibility of using solidified marine sediments as road construction materials. It was found that marine sediments could be solidified to a sufficient strength to be used as road materials.	Yes
United States Environmental Protection Agency. 2000. Solidification/Stabilization Use at Superfund Sites	A summary provided by the US. Environmental Protection Agency detailing information about S/S technology that has been applied to Superfund Remediation sites.	Yes
US Army Corp of Engineers. 1997. An Evaluation of Solidfication/Stabilzation for Treatment of NewYork/New Jersey Harbor Sediments. Technical Report EL-97-10.	A study conducted to evaluate whether S/S techniques can be applied to New York/New Jersey Harbor sediment to reduce the potential contaminant impact on the environment. It was found that S/S technology could be applied safely while being environmentally protective.	Yes
US. Environmental Protection Agency. 2009. Technology Performance Review: Selecting and Using Solidification/Stabilization Treatment for Site Remediation. EPA/600/R-09/148.	A summary of considerations for selecting and using S/S technologies on contaminated sites, with case studies of S/S treatment programs provided for reference.	Yes

Study/Report	General Description	Salt Containing Soils Successful Treated?
R. Zentar , N.-E. Abriak , V. Dubois , M. Miraoui. 2009. Beneficial use of dredged sediments in public works. Environmental Technology Vol. 30, Iss. 8.	A study of the use of dredged marine sediments for use in road construction. Cement/lime-based solidification was found to be an environmental sound solution.	Yes
P. Lahtinen, J.Forsman, P.Kiukkonen, K. Kref-Burman, V. Niutanen. 2014. Mass Stabilisation as a Method of Treatment of Contaminated Sediments. Proceedings of the South Baltic Conference on Dredged Materials in Dike Construction.	Contains a summary of three large scale stabilization projects that were applied to contaminated marine dredgeate at international ports.	Yes

3.4 ADDITIONAL INFORMATION – POINT 4 (TREATMENT AND TREATMENT CONTINGENCY)

NSE Requested Information:

Contingency measures must also be provided in the event that salt and/or other factors compromise the treatment results.

Envirosoil's Response:

In the highly unlikely event that Envirosoil cannot successfully treat the materials using S/S or existing approved treatment methods, then the materials will be sent to an approved, offsite facility for final treatment/disposal. Envirosoil will also maintain the appropriate bonding and security required by NSE to ensure that sufficient financial resources are available to handle any unforeseen circumstances.

To assess if the treatment will be successful, Envirosoil has committed to complete a testing and treatability program for each homogenized batch of materials that will be treated using S/S technology. This will be followed by a rigorous performance testing program for treated materials (which is discussed further within Section 3.5. The testing and treatability program will ensure that the final selected treatment reagents and binders will allow the successful treatment of contaminated materials. The objective of the testing and treatability program is to assess the following:

- Selection of correct reagent(s);

- Optimization of the reagent(s) dosages and ratios;
- Identification of material handling issues;
- Assess the volume increase due to addition of reagent(s);
- Conformance to the treatability and performance criteria (i.e., strength, leachability, etc.) as outlined in the EA; and,
- Treated material physical parameters (e.g., moisture content, slump, etc.).

To assess the above items, the following general tasks will be undertaken

- Analytical testing of initial contaminant concentrations – both mass and leachate generation potential of untreated soil (using composite sampling);
- Prepare various candidate mix designs to evaluate physical and chemical properties
- Test the strength of the candidate mix designs;
- Evaluating the hydraulic conductivity and leachate generation potential of the optimal mix design; and,
- Develop final mix design based on the results of the above activities.

The proposed treatment design criteria and the acceptable variability in these criteria are located within Table 3 of EA Registration. The treatment performance criteria are located within Table 4 of the submitted EA Registration. These criteria are consistent with industry best practices, and regulatory guidance provide by the U.S. Environmental Protection agency. Further discussion regarding the selection of these performance criteria is provided in Section 3.5 below.

3.5 ADDITIONAL INFORMATION – POINT 5 (S/S PERFORMANCE TESTING)

NSE Requested Information:

Additional information must be provided regarding the performance testing method for the treated materials (e.g., the proposed statistical method and the lack of hydraulic testing in the field are examples of information gaps).

Envirosoil Response:

All material will be treated to the performance criteria listed in Table 4 of the submitted EA Registration, or it will be disposed of at an appropriate offsite location. The performance criteria listed in Table 4 are consistent with industry best practice standards, and guidance given by the USEPA (USEPA, 2009) and The Wastewater Technology Centre (Stegemann, and Cote, 1996). Table 2 below illustrates typical performance criteria recommended by the USEPA for the major performance criteria of interest, which are consistent with the values chosen by Envirosoil.

Table 2 USEPA Typical Parameters for S/S treatment.

Parameter	Units	Average Value (1)	Test Method
Unconfined Compressive Strength	Pounds per Square Inch	>50	ASTM D1633
Hydraulic Conductivity	Centimeters per Second	$<1x10^{-6}$	ASTM D5084
Leaching Tests	Milligrams per Liter	Site Specific	TCLP and SPLP
[1] - Usually stated as "the average value of all treated must equal" (usually a 20% allowance is permitted for individual samples.			
TCLP - Toxicity Characteristic Leashing Procedure SPLP - Synthetic Precipitation Leashing Procedure			

As shown in Table 2, footnote 1 above, the USEPA states that it is industry best practice to allow 20% of individual samples to be less than the recommended $1x10^{-6}$ cm/s criteria (USEPA, 2009). This statistical approach recommended by the USEPA is consistent guidance offered by The Interstate Technology & Regulatory Council Solidification/Stabilization Team (The Interstate Technology and Regulatory Council, 2011).

This allows for the minor variability inherent to the treatment of soils, while maintaining a high overall performance standard. Envirosoil has exceeded industry standards in the selection of performance criteria by proposing to use a hard performance testing criteria that no sample can fail (selected to be one order of magnitude less than the average criteria of each parameter). This is addition to the average performance criteria for each of the parameters. This provides an additional contingency measure to ensure the performance of S/S treated materials.

Industry standard is to conduct performance testing on two of the major three performance criteria listed in Table 2 above. Envirosoil had committed to testing for unconfined compressive strength and leachability in the EA. In response to public comments, and to raise the level of confidence relevant stakeholders have with the performance assessment of the S/S treatment method, *Envirosoil hereby commits to conducting performance testing for unconfined compressive strength, hydraulic conductivity and leaching tests for each homogenized batch of S/S treated materials.* This performance testing will be completed upon samples collected during the S/S treatment process. This is a level of performance testing in excess of the industry best practice, which typically use a limited performance testing program coupled with a consistency testing program that uses testing such as slump analysis and visual observations to ensure S/S treatment consistency (The Interstate Technology and Regulatory Council, 2011). Sample collection will be undertaken as described within Section 2.4.3 of the submitted EA Registration. The testing methods used to assess the performance criteria will be undertaken as follows:

<u>Compressive Strength</u>

The cylinders will be tested using the *ASTM Method 39, Standard Test Method For Compressive Strength of Cylindrical Concrete Specimens* to evaluate the compressive strength of each candidate mix design. Multiple cylinders will be prepared to assess compressive strengths.

Hydraulic Conductivity

Cylindrical specimens will also be prepared for hydraulic conductivity tests using a uniaxial flow permeameter (flexible wall method). This apparatus was first developed by CANMET in the early 1980's (Canadian Journal of Civil Engineering, 1984) and was designed to accommodate portions of 150 mm diameter cylindrical concrete specimens. To facilitate these smaller diameter specimens in the apparatus, the soil mixture specimens will be placed in the centre of 150 mm diameter polypropylene cylindrical molds and the resulting annulus filled with a rapid setting high strength concrete repair material. After setting and curing, the resulting concrete cylinder will be assembled in the permeability cell.

The construction of the cell is such that water can flow only uniaxially through the specimen. Water at 1,000 kPa (150 psi) is introduced into the top of the permeability cell and allowed to saturate the soil sample. The quality of the surrounding concrete is considered impermeable relative to the stabilized soil mixture. Once water begins to flow through the sample, it will be collected in a sealed container where the volume per unit time is measured and recorded. Given the water pressure, the sample height and diameter, and the water volume per unit time, the hydraulic conductivity of the selected stabilized soil mixtures can be calculated.

Chemical testing (Leachability)

Following solidification leachate chemistry will be compared to pre-treatment leach chemistry to assess effectiveness using the toxicity characteristic leaching procedure (TCLP, EPA Method 1311).

In the highly unlikely event that Envirosoil cannot successfully treat the materials using S/S or existing approved treatment methods, then the materials will be sent to an approved, offsite facility for final treatment/disposal. Envirosoil will maintain the appropriate bonding and security required by NSE to ensure that sufficient financial resources are available to handle any unforeseen circumstances. S/S will not be deposited in the TFSA unless the S/S treatment process has proven adequate based on the testing and treatability program.

The hydrogeology monitoring program for the TFSA has been described in detail within Section 5.2.2.2 of the EA Registration. An additional commitment has been made by Envirosoil to install an additional deep well (15 m in depth) at between the TFSA and Anderson Lake. Combined with the shallow wells that have already been proposed to be installed in this location, it will result in a well nest with both shallow and deep intervals that will assist with monitoring groundwater quality around the TFSA, which will allow the swift detection of any potential water quality issues.

As stated in Section 5.2.2.2 of the EA Registration, in the unlikely event that concentrations of parameters indicate potential leaching after on-site activity commences, appropriate

interception contingency measures will be taken if site monitoring indicates a potential issue with the exceedance of relevant groundwater quality guidelines. Contingency measures will need to be dynamic to properly respond to an issue. In the unlikely event of contaminant impacts to groundwater, the following contingency measures may be used if required to ensure there is no contaminant migration off-site:

- Low-permeability capping;
- Groundwater interception and management;
- Physical removal of materials from the TFSA;
- Ditching, swaling and ground contouring to collect surface water.

Due to the strict acceptance criteria for soil, the selected treatment and performance criteria; and the TFSA design, it is considered extremely unlikely the above measures would have to be enacted. If required and depending on the nature and extent of the impacts, the contingency measure best suited to intercepting and containing the contaminant migration would be chosen, and discussions regarding preferred strategies would occur with NSE if such measures were required.

3.6 ADDITIONAL INFORMATION – POINT 6 (WATER RESOURCE MONITORING)

NSE Requested Information:

The proposed monitoring plan to monitor water resources must be expanded to address potential risk to the environment including endangered Atlantic Whitefish (Coregonus huntsman).

Response:

Envirosoil has committed to selecting and sampling three (3) locations between the Treated Soils Fill Area and Anderson Lake for parameters that will be treated via S/S prior to the deposition of treated materials. Prior to the deposition of materials, the results of this sampling and analysis will be provided to the NSE. Soil sampling and analysis for the same parameters will be completed every three (3) years in the same locations.

The hydrogeology monitoring program has been described in detail within Section 5.2.2.2 of the EA Registration. An additional commitment has been made by Envirosoil to install an additional deep well (15 m in depth) at between the TFSA and Anderson Lake. Combined with the shallow wells that have already been proposed to be installed in this location, it will result in a well nest with both shallow and deep intervals that will assist with monitoring groundwater quality and flow direction between Anderson Lake and the Treated Soils Fill Area. The proposed monitoring well network is displayed within Figure 1 in Appendix A of this document. The monitoring wells between Anderson Lake and the site are more than adequate to capture any potential impacts to Anderson Lake.

In addition to the adhering to performance criteria and comprehensive monitoring ensuring contaminants do not migrate off-site, Anderson Lake is located in the Wrights Brook Watershed, while the Envirosoil Facility and the proposed Treated Soils Fill Area are located in the Shubenacadie River Watershed. As such, water leaving the facility will not enter the Wright Brook watershed. This fact, coupled with the rigorous monitoring program proposed and being undertaken by Envirosoil, ensures that there is no potential risk Atlantic Whitefish (Coregonus huntsman) resident in Anderson Lake from any potential effluents from the TFSA.

4.0 Closing

Envirosoil appreciates the opportunity to provide further information regarding the proposed undertaking, and is available for discussion if there are any other specific comments or questions regarding proposed activities.

5.0 References

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Utting, D. J. 2011: Surficial geology map, part of the Halifax Claim Reference Sheet 11D/12D, Halifax County, Nova Scotia; Nova Scotia Department of Natural Resources, Open File Map ME 2011-009, scale 1:25 000.

APPENDIX A – FIGURES

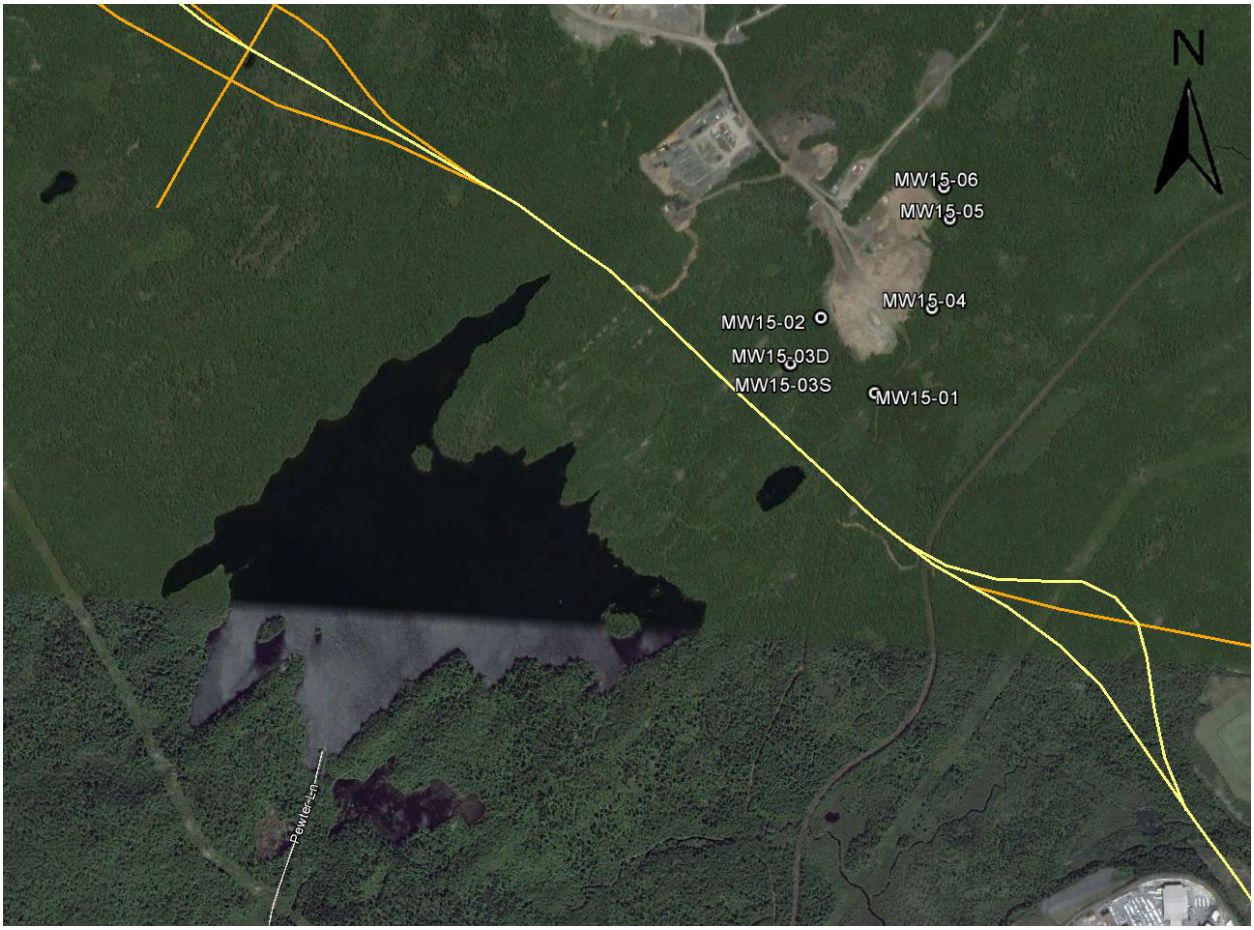

Figure 1 Proposed Monitoring Well Locations for the TSFA.