

Guidance Document

Title: **Guidelines for Construction and Operation of
Facilities Using Ex-Situ Bioremediation for the
Treatment of Petroleum Contaminated Soil**

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1.0 INTRODUCTION

1.1 Subject

This document provides guidance for the construction and operation of permanent and temporary facilities for the ex-situ bioremediation of petroleum contaminated soils (PCS). Deviation from this policy may be considered provided equal or greater environmental protection is maintained. A waste management system (WMS) Certificate-of-Approval (C-of-A) must be obtained prior to construction and operation which will provide more specific requirements.

Products considered for use in bioaugmentation may be subject to the *New Substances Notification Regulations* under the Canadian Environmental Protection Act. For additional information on these regulations contact Environment Canada at (902) 426-9674.

Approval to conduct ex-situ PCS bioremediation at a location shall not be interpreted to imply the site is also acceptable for other soil treatment technologies, such as thermal based processes.

Also, it should be noted that this document is **not a land farming policy**.

1.2 Objectives

The objectives of this document are to outline:

- the application process for permanent (commercial, industrial) and temporary (commercial, private, pilot scale) facilities;
- site selection criteria;
- environmental baseline study requirements;
- minimum design criteria and operating standards;
- monitoring requirements;
- financial assurance requirements; and
- Certificate-of-Completion requirements.

2.0 DEFINITIONS

In this document:

- **BTEX** means benzene, toluene, ethylbenzene and xylene, respectively. BTEX are benchmark parameters used as indicators to assess concentrations of a larger number of similar hydrocarbon compounds;
- **bioaugmentation** means the application of specific organisms or groups of organisms which have been isolated and manufactured;
- **bioremediation (or biodegradation)** means the spontaneous or managed process in which microbes become catalysts in the complete degradation of petroleum hydrocarbon compounds to the basic mineral constituents, carbon dioxide and water;
- **CAC** means Concrete Association of Canada;
- **C-of-A** means a Certificate-of-Approval;

- **Department** means the Department of Environment and Conservation or it's successor;
- **DTW** means the Newfoundland Department of Transportation and Works;
- **environmental audit** means a tool used to identify areas of non-compliance with environmental legal requirements, policies and best management practices;
- **FAL** means the CCME Freshwater Aquatic Guidelines to be applied to ground water that may discharge to fresh water bodies;
- **geocomposite** means geotextiles, geogrids, geonet, and/or geomembranes in laminated or composites form;
- **geosynthetic clay liner** means a factory-manufactured hydraulic barrier consisting of a layer of bentonite clay or other very low permeability material supported by geotextiles and/or geomembranes, and mechanically held together by needling, stitching, or chemical adhesive;
- **geomembrane** means an essentially impermeable membrane used as a liquid or vapour barrier with foundation, soil, rock, earth, or any other geotechnical engineering-related material as an integral part of a human-made project, structure, or system;
- **geosynthetic** means synthetic material used in geotechnical engineering applications; it includes geotextiles, geogrids, geonets, geomembranes and geocomposites;
- **geotextile** means any permeable textile used with foundation, soil, rock, earth; or any other geotechnical engineering-related material as an integral part of a human-made project, structure, or system;
- **GSC** means Government Service Centre. The GSC acts as an agent for the Department;
- **HDPE liner** means high density polyethylene liner;
- **land farming** means operations which deliver air (oxygen) via mechanical mixing of soil which is spread over large areas in thin layers;
- **landfill ban zone(s)** means the zone(s) designated by the Minister of the Department in which PCS's are banned from disposal at landfills as per the June 20, 2001 Ministerial Order or it's successor;
- **MAL** means CCME Marine Aquatic Life guidelines to be applied where ground water may discharge into a marine environment;
- **PAH** means polycyclic or polynuclear aromatic hydrocarbons;
- **PCS** means petroleum contaminated soil;
- **permanent commercial** means ex-situ bioremediation facilities which provide treatment services to the general public. All items in this guidance document apply to this type of facility;
- **permanent industrial** means an ex-situ bioremediation treatment facilities owned by an industrial operation which accepts and treats soil from that operation. The facility must be located on land owned by the operator and cannot accept nor treat contaminated soils from

outside sources unless approved by the Department. All items in this policy apply with the exception of Section 9;

- **pilot scale** means ex-situ bioremediation treatment facility which treat up to a maximum of 12 m³ of soil and are intended for single use, single batch treatment, followed by complete decommissioning after a maximum of two years (two summers) of operation. Sections 5, 7, 8, 9, 13 and 17 of this policy do not apply to pilot scale facilities. A letter of project notification shall be submitted to the Department a minimum of 30 days prior to commencement of treatment. The letter shall describe the entire project and shall include a description of the site closure procedures/plan;
- **Professional Engineer** means an individual or company that is a member in good standing with the Professional Engineers and Geoscientists of Newfoundland and Labrador (PEGNL) licensed to practice engineering in a field related to the task performed;
- **QA/QC** means Quality Assurance/Quality Control;
- **site professional (engineer)** means a professional engineer with professional errors and omissions liability insurance coverage for environmental work of at least \$1,000,000 individually or through a registered company;
- **temporary commercial** means an ex-situ bioremediation facility that shall be decommissioned after a maximum of two years (i.e. two summers) of operation. Sections 8, 9 and 13 of this document do not apply to this type of facility. A site closure plan shall be submitted with the application for a C-of-A. These will be restricted to areas outside the landfill ban zone to proponents that have been in current continuous compliance for 3 years. However, an owner of a permanent facility within the landfill ban zone who is currently in continuous compliance for 3 years may be approved for these in the landfill ban zone in extenuating circumstances (e.g. health and safety; highway restrictions; excessive trucking distance; inaccessibility; local permanent facility is at or near capacity; etc.) as long as it doesn't undermine the business of a nearby permanent facility. Prior to granting an approval for this type of facility the permanent facilities shall be inspected by the Department to confirm non-compliance and compliance, respectively;
- **temporary private** means an ex-situ bioremediation facility owned by a private entity intended for single use, single batch treatment, followed by complete decommissioning after a maximum of two years (two summers) of operation. Sections 8, 9, 13 of this document do not apply to this type of facility. A site closure plan shall be submitted with the application for a Certificate-of-Approval;
- **third party site professional (engineer)** means a site professional engineer who is not an employee of the proponent;
- **TPH** means total petroleum hydrocarbons; and
- **WMS** means waste management system.

3.0 LEGISLATIVE AUTHORITY

Environmental Protection Act

Storage and Handling of Gasoline and Associated Products Regulations NLR 58/03

Environmental Assessment Regulations NLR 54-03

Water Resources Act

Environmental Control Water & Sewage Regulations NLR 65/03

4.0 SOIL DISPOSAL BAN

4.1 Landfill Ban Zone(s)

The landfill ban zone(s) is defined in Section 2.0. The current ban is attached; however, it is advisable to contact the Department for the latest version as this document is revised from time-to-time.

4.2 Landfill Disposal Outside Ban Zone(s)

Where landfill disposal of PCS is permitted outside the landfill ban zone(s) volumes of soil greater than 10 tandem dump truck loads or 160 tonnes shall be transported to an approved PCS treatment facility or treated onsite in a manner approved by the Department.

When PCS enters landfills, GSC officers will require (wherever it is deemed reasonable and possible) the PCS owner to arrange for the spreading of the PCS in thin layers (maximum 460 mm/18in.) over a suitable area on site. The PCS owner will also arrange to have the PCS agitated weekly (for aeration) for 6 consecutive weeks between June 15 and September 15.

5.0 APPLICATION PROCESS

A WMS C-of-A is required for the siting, construction and operation of a PCS bioremediation facility. This approval shall be in place before construction commences. An application for a WMS approval is required when developing a **new** facility or when altering or modifying **existing** facilities. Plans certified by a **Professional Engineer** shall be provided with the letter of application. The requirement for a C-of-A is defined in Sections 16b and 78 of the *Environmental Protection Act*. Other requirements include:

- screening under the *Environmental Assessment Regulations* to determine if registration is required;
- written approval from the municipal authority;
- written approval from the Department of Natural Resources for a quarry material site;
- consideration of general aesthetics (visual), adjacent land use, potential odour, and noise problems;
- submission of plans, specifications, and a description of the work;
- posting of a public notice in a local newspaper once per week for three consecutive weeks; or serving notice by registered mail on the occupiers of property situated within one mile of the proposed site. The notice shall be provided to the Department for approval before posting or distribution. A municipal plan amendment notice may serve as the public notice of intent to establish a soil treatment facility;
- a surety bond, a sum of money, or guaranteed letter of credit in an amount of at least \$20,000, in a form deemed acceptable to the Department;
- proof of Environmental Liability Impairment Insurance of at least \$1 million;
- a description of any other soil treatments that are likely to be considered in the future;

- any other information required by the Department; and
- applicable processing fee.

Processing of an application for a C-of-A will normally take 30 to 60 days.

6.0 FACILITY CLASSIFICATION AND LOCATION

The C-of-A application shall identify the classification of the proposed facilities as follows:

Permanent

- permanent commercial;
- permanent industrial;

Temporary and Pilot

- temporary commercial;
- temporary private; or
- pilot scale.

These are defined in Section 2.0.

7.0 SITING

A 1 kilometre separation distance shall be maintained from residences, institutions, commercial buildings, and 200 metres from any surface water body. The facility should be located in areas where the underlying native soil consists of relatively low permeability deposits ($<10^{-5}$ cm/sec). Siting of pads in local depressions or on sloping ground with gradients greater than 5% should be avoided. Separation distance between the surface grade and the maximum ground water elevation shall be a minimum of 2 metres.

8.0 BASELINE STUDY

An environmental baseline study of the proposed site will be required prior to construction to establish initial hydrogeological conditions. A minimum of 6 monitoring wells shall be installed; at least one(1) of which and a maximum of two(2) shall be installed hydraulically up gradient of the receiving and treatment pads. **An outline of the study shall be presented to the Department for approval before implementation.** The study shall identify ground water and soil characteristics such as; elevation, flow direction, water quality, conductivity, soil texture, and other characteristics. The Canadian Council of Ministers of the Environment (CCME) report, *Subsurface Assessment Handbook for Contaminated Sites (March 1994)* shall be used as a guide in developing and implementing the baseline study. Parameters which shall be assessed include but are not necessarily limited to: BTEX, TPH, metals, and PAH. Monitoring wells shall be installed such that they can be effective if needed to function as recovery wells in the event subsurface impacts occur.

9.0 RECEIVING/ STORAGE PAD

The receiving/storage pad is a dual liner system (primary and secondary liners) with leachate collection and interstitial leak detection system and shall be designed by a Professional Engineer to withstand heavy equipment activity in accordance with the *CAC Concrete Design Handbook* and *DTW Highway Design Specification Book*.

Primary Liner

The primary (top) liner with drainage controls may consist of either:

- geomembrane of a minimum of a 40 mil HDPE or 30 mil Enviro Liner, or equivalent, overlain with a protective layer of sand. The manufacturers performance specifications and QA/QC installation procedure shall be provided to the Department;
- reinforced concrete with a minimum thickness of 100mm and may have retaining walls; or
- asphalt pavement with a minimum thickness of 75mm.

All of these pads shall be sloped (e.g. 1-5%) and have a maximum permeability of 10^{-7} cm/s.

Secondary Liner

The secondary (bottom) liner with drainage controls and leak detection may consist of:

- same as those listed in the *Primary Liner* sub-section.

The secondary liner shall be overlain with a leak detection system and shall have incorporated into its design a means to observe, sample and remove accumulated liquids. Preferably, the system should be designed such that it provides some information as to the location of a leak in the primary liner. Drainage controls would normally involve berming. All leachate shall be collected and directed to a holding tank or a lined collection pond.

10.0 TREATMENT PAD

The treatment pad is a single liner system with leachate collection and interstitial leak detection system. The treatment pad shall be constructed similar to the primary liner of the receiving/storage pad.

Aeration

If perforated piping is used to aerate a biopile, a negative (vacuum) or positive pressure shall be applied through the piping to supply an oxygen source to soil microbes. Passive air flow systems are not permitted. Air flow rates shall not exceed 110% of the flow necessary to supply sufficient oxygen to maintain biodegradation rates. Flow rates beyond that required to supply sufficient oxygen to achieve peak biodegradation rates will increase the rate of volatilization. Biodegradation, and not volatilization, shall be the primary means of reduction of contaminant concentrations.

Alternative aeration processes, including mechanical mixing, may be considered providing it is demonstrated that sufficient oxygen will be delivered to promote aerobic degradation of the petroleum hydrocarbons.

Upon start-up of treatment, hydrocarbon contaminated air removed from the biopiles via aeration piping under vacuum shall be routed back into the biopile. Once the initial volatile contaminant levels decrease and stabilize, discharge directly to the atmosphere may be permitted depending on location. Treatment of exhaust gases may be required and will be determined on a case by case basis.

Combined Receiving and Treatment Pads

Treatment and receiving/storage pads may be combined into one pad provided that:

- a divider is used to separate the receiving area from the treatment area. This divider shall be designed to prevent leachate and material contained in the receiving/storage area from mixing with the material and leachate contained in the treatment area, and vice versa;
- a minimum of 2 meters is maintained between the toe of slope of the material in the receiving/storage area and the material in the treatment area (ie. a meter on each side of the divider); and

- the combined pad is designed and constructed to meet the minimum specifications of both a receiving/storage pad and a treatment pad. Where these minimum standards conflict, the more stringent of the two shall apply.

11.0 LEACHATE

The receiving/storage and treatment pads shall be designed to collect leachate. All leachate shall be directed to a holding tank or a lined holding pond. The leachate collection system shall be designed, as a minimum, on a 10 minute duration 1:100 year return period rainstorm and the capacity of the holding pond/tank shall be based, as a minimum, on a 1:25 year 24 hour duration rainstorm.

In the case of temporary facilities, a tarpaulin may be used to completely cover PCS and eliminate leachate generation and the need of a leachate collection system.

Waste water discharges shall meet the limits established for parameters in Schedules of the *Environmental Control Water and Sewage Regulations*. For those parameters not included in a Schedule of the W&S Regulations, the limits established for the protection of aquatic life (i.e. FAL or MAL) in the latest edition of the *CCME Environmental Quality Guidelines* apply. In addition, a maximum TPH concentration of 15 ppm has been applied for release of wastewater to the environment.

12.0 CERTIFICATE OF COMPLETION

Upon completion the Professional Engineer shall issue a Certificate-of-Completion that supports that the facility had been constructed as per plans and specification and all applicable standards and codes.

13.0 GROUND WATER MONITORING

Parameters and sampling frequency requirements for operational sites and systems will be outlined in the approval. The Department recommends the use of the latest edition of the Canadian Council of Ministers of the Environment (CCME) report, *Subsurface Assessment Handbook for Contaminated Sites* as a guide to installation, sampling and maintenance of monitoring wells. Monitoring wells are to be installed such that they can be effective if needed to function as recovery wells in the event subsurface impacts occur.

14.0 SOIL SAMPLING REGIME

Soil testing requirements will be outlined as terms and conditions of the certificate of approval. Sampling will be required for soils entering and leaving the site. Clean soils are defined as those having a TPH level of 1000 mg/kg (ppm) or less and having BTEX concentrations at or below limits prescribed in the latest edition of the *CCME Environmental Quality Guidelines* for soil in commercial land use areas.

15.0 TREATED SOIL HANDLING

Treated soil may be used as cover material at approved municipal landfills with the permission of the site owner/operator. A letter of approval from the landfill owner will be required. Approval from the Department is required prior to the re-use of the treated soil for any purpose other than landfill cover. Such requests will be addressed on a case-by-case basis and shall be submitted to the Department.

16.0 ANNUAL REPORTS

Reporting details will be outlined in the certificate of approval. Annual reports shall be provided to the Department for soil delivery, soil treated, soil discharged, treated soil destination, ground water monitoring and other information as required. Detailed year end soil accounting balances are required.

17.0 SURETY BONDS AND INSURANCE

The requirement to have surety bonds and environmental liability impairment insurance will be outlined as a prerequisite to the issuance of certificate of approval to construct and operate a soil treatment facility.

It should be noted the insurance policies are null and void unless there is an approval in-place.

18.0 COMPANY BACKGROUND

A background of the treatment facility owner/operator shall be included in the letter of application. The following information shall be provided;

- legal company title;
- company registration numbers;
- company owner;
- primary contact for the application;
- site operator and respective qualifications and experience in the operation of a bioremediation facility;
- primary line of business;
- work experience on petroleum hydrocarbon contaminated soil treatment;
- letter(s) of reference from municipality of prior operation;
- company personnel with technical expertise on sampling and analysis; and
- technical background and experience of personnel involved with facility operations.

19.0 INTERIM LETTERS OF APPROVAL

The Department will not issue interim letters of approval for operation. However, these may be issued for construction related to an existing permanent facility.

20.0 FEES

The fees for treatment facilities are outlined in the table below.

Facility type	New	Renewal for new design	Renewal
Permanent	\$5000	\$2500	\$1700
Temporary	\$2000	n/a	n/a

21.0 AUDITS

The GSC will be responsible for conducting field audits although a Department official may be involved. GSC should forward a copy of the completed audit report to the Director of the Department. The Department is responsible for administering the approval process, developing design and operating standards and the audit report form. Annually, the Department should compile a summary of the audits and indicate any non-compliance. The summary should recommend changes, if any, to the approval, audit form or this guidance document.