OPERATION AND MANAGEMENT PLAN
SOIL TREATMENT FACILITY

Document presented to:

and

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SOIL TREATMENT FACILITY

Document presented to:

NUNAVUT WATER BOARD

AND

NUNAVUT IMPACT REVIEW BOARD

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TABLE OF CONTENTS

LIST OF ABBREVIATIONS

BTEX:	Benzene, toluene, ethylbenzene and xylenes
CO_2:	Carbon dioxide
HDPE:	High-density polyethylene
m.t.:	Metric tonne
MAH:	Monocyclic aromatic hydrocarbons
O_2:	Oxygen
PAH:	Polycyclic aromatic hydrocarbons
pH:	Measure of acidity or alkalinity
PHC:	Petroleum hydrocarbons
psi:	Pounds per square inch
psig:	Pounds per square inch gage
PVC:	Polyvinyl chloride
T:	Temperature

1. INTRODUCTION

1.1 General

This facility was developed based on a need arising from clients with hydrocarbon contaminated soils resulting mainly from heating oil spills (e.g., from storage tanks and furnaces). The impacted soils will be transported to the facility for treatment.

This manual describes the operation of a treatment facility designed to serve primarily Iqaluit, with the potential of eventually serving other smaller communities in Nunavut. The treatment facilities are designed to provide an economical solution for the management of soils contaminated by petroleum hydrocarbons.

The process brings about a permanent solution to contamination issues. The contaminants are destroyed primarily through biological mineralization; but may also be treated by chemical oxidation. Physical treatment steps (e.g., screening and rock washing) will also be used to reduce volumes of soils to biotreated.

The treatment facility will use biopiles or landfarming to effect the elimination of contaminants and improve the overall quality of soils for re-use.

The soils to be treated will arrive by truck. Upon arrival, the soils will be directed either to the treatment pad or to the interim storage area.

If a weigh scale is available for the trucks, then empty trucks will be weighed at the beginning and end of each work day (or at the beginning and end of the work) to determine an average empty weight. All the trucks carrying soils/waste will be weighed prior to entering the Site to document the tonnage of materials received and processed at the treatment facility, for the purpose of reporting to regulatory authorities and invoicing. If a weigh scale is unavailable, then the volume of the truck box will be measured and invoicing will be based on the percentage of the filled truck box.

The treatment facility design is derived from the know-how of Qikiqtaaluk Environmental Inc.'s (QE) partner Sanexen Environmental Services Inc. (Sanexen) through their 22 years of experience in the execution of biotreatment projects, and from the combined experience of its shareholders and senior employees. Sanexen has performed on-site biotreatment projects for many clients over this period and manages and operates a permanent biotreatment facility in Saint-Amable, Quebec (*Solum Environnement (2010)*).

The target contaminants are mostly PHCs, including BTEX, MAHs and PAHs.

The treatment facility design is organized for optimal production, effectiveness, and simplicity. The selection of durable, long-life materials, involving greater capital costs, is a design choice that confers many operational advantages over the mid- and long-term. Such design choices translate into assets for effective operations.

The base scenario is for a treatment capacity of 1,000 m.t. per year. The facility includes a treatment pad and a storage/processing area. The latter will also be used for pre-treatment (i.e., screening, rock washing, separation of metals and debris, etc.) if necessary.

The system is designed to be operational during the summer and early fall seasons.

1.2 Location

The facility is located on a property in northwestern Iqaluit. The approximate coordinates of the centre of the property are:

Latitude: 63°44'38.22″ N
Longitude: 68°32'58.59″ W

2. DESCRIPTION OF SYSTEM COMPONENTS

Air is generally withdrawn from the biopiles using a piping network connected to a water recovery and circulation system. Air (heated or not) may also be pushed into the biopiles. A circulation of air is thereby established through the soils with blowers and the piping network. The piping network is composed of secondary aeration pipes (slotted or perforated) beneath the biopiles, and of main plain pipes that direct the fluids toward the water recovery system.

The air withdrawn from the biopiles is directed to an air/water separator. The collected water is transferred to a storage pond.

An underground leachate (water leached and drained from the soil/waste) catchment basin is used to collect water from the biopiles. A submersible pump in this catchment basin directs the water to the storage pond.

2.1 System Components

Below is a list of the system's main components:

- Marine container with a blower, an electrical panel and fan for internal aeration;
- Water/air separator with automated water transfer to the storage pond;
- Submersible pumps;
- Water collection pond;
- Main plain pipe, 8'' diameter with unions and caps (PVC, Schedule 40);
- Secondary pipes, plain and slotted, or perforated, with unions and caps (PVC, Schedule 40);
- Semi-permeable liners for covering the soil piles;
- Straps and anchors to hold the covering liners in place;
- Hot wire anemometer;
- Thermocouples and a digital reader.

A description is presented in the following sections.

2.1.1 Container with the Blower

The treatment of soils in biopiles requires an air circulation system that is sufficiently powerful to force the air through the semi-permeable liner, the soils and the piping. A calibration of the flowrate provided by the blowers is necessary to obtain the desired treatment performance; valves will help to adjust this flowrate according to the needs.

2.1.2 Air/Water Separator and Water Collection Pond

Some water will drain from the soils undergoing treatment and will be collected with the air withdrawn from the biopiles. More water is collected at the beginning of treatment. A cylindrical concrete catchment basin (a sewer-type concrete cylindrical manhole) is adapted to effect this task. Water is collected by gravity at the bottom, while air is drawn from an outlet at the top. A submersible pump, activated by a float, with a check valve at the discharge, periodically transfers the water to the storage pond where the water will be re-used to condition the soils. The air/water separator is positioned underground to allow gravity flow to it and to prevent freezing during cold weather operations.

A water collection pond is installed at the low point between the treatment pad and the processing/storage area. The pond is equipped with a submersible pump to direct water back onto the soil piles or to direct excess water to the water treatment unit.

2.1.3 Water Storage Pond

The water storage pond is watertight and constructed of a minimum 30 mil thick HDPE liner, or similar, covered and underlain by a protective geotextile liner. The water storage pond has a capacity of 41 m^3 to store enough water in the case of major precipitation. The leachate water from the soil pile and water from the air/water separators discharges to this pond.

The biopile normally operates with a deficit of water because of the moisture entrainment by the air that is circulated through the soils. However, a sufficient buffer capacity is needed for water because:

- Soils received may occasionally be wet;
- Soils are exposed to rain when the covers are removed during mechanical handling;
- A sufficient quantity of water is needed to condition the soils.

It should be noted that the mixing soils with amendments and the additive solution is normally delayed in the event of rain. In the event of excess water in the pond, water is sprayed on the drier soils during the following days. Excess water may also be directed to the water treatment unit.

2.1.4 Secondary Air Piping

Secondary air pipes are positioned at the base of the soil pile. The 2'' diameter perforated pipes have a predetermined profile and are made of PVC approved for temperatures up to 60°C. The sections are joined with synthetic rubber unions. These unions allow the desired flexibility and resilience for the assembly, particularly with respect to contraction and expansion due to temperature fluctuations. The perforation profile is designed to equalize the airflow rates across the width of the biopile.

The secondary pipes are covered with ¾'' gravel that acts as a ''plenum'', or a transition between the soils and pipes and allow better air distribution.

2.1.5 Treatment Pad

The maximum practical height for a biopile is 2 to 3 m. Piling soils higher than 3 m will lead to a faster compaction of the soils and a loss of efficiency (because of the loss of soil permeability to air and moisture), forcing a remixing of the soils (or more frequent remixing of the soils if the treatment period is long) for bulking purposes.

The treatment pad is watertight and constructed using a minimum 30 mil thick HDPE liner or similar, covered and underlain by a protective geotextile liner and further protected by a 0.3 m thick layer of clean gravel.

The outer edge of the treatment pad will have an elevated berm around the perimeter (6'' above the interior grade) to prevent soil or water loss. The base of the treatment pad is built with a slight slope toward a water collection drain. The water is collected with a corrugated plastic agricultural drain that is installed in a depression along the berm. The drain is surrounded and covered with ¾'' gravel and directs the collected water/leachate toward the water collection pond.

2.1.6 Storage and Processing Area

The soil storage and processing area is used for the temporary storage and screening of soils as well as rock washing. This processing area may also be used for containerization of non-treatable soils prior to off-site shipment for disposal in authorized facilities.

The storage and processing area is also watertight and made of a minimum 30 mil thick HDPE liner, or similar, covered and underlain by a protective geotextile liner and further protected by a 0.3 m thick layer of clean gravel.

The outer edge will be composed of an elevated berm (6'' above the interior grade) around the perimeter to prevent soil or water loss. The fourth side is elevated with respect to the opposite side so that leachate (water draining from the contaminated soils) flows by gravity toward the water collection pond.

The base of the pad is built with a slight slope toward a water collection drain. The water is collected with a corrugated plastic agricultural drain that is installed in a depression along the berm. The drain is surrounded and covered with ¾'' gravel and directs the collected water/leachate toward the water collection pond.

2.1.7 Covering Liners

Semi-permeable liners are used to cover the soils in treatment. One reason for using a cover is to ensure the confinement of contaminants, especially dust, that would otherwise be carried by wind erosion. The liner also acts as a vapour barrier for volatile contaminants. The pressure gradient across the liner, with the air moving downward through the interstices, prevents the loss of volatiles. Another important reason is to allow an even and appropriate diffusion, to the top of the biopiles, of air, to properly oxygenate the soils, and water, to maintain the desired moisture content in the soils.

The liners are woven to allow the infiltration of air and, as needed, a limited quantity of water for the biotreatment.

The black colour helps to absorb heat from sunlight and to maintain proper soil temperatures. The liners are also instrumental in preventing the soils from becoming too wet, which may slow or completely stop the treatment process.

2.1.8 Storage Containers

Marine containers present on-site are used to store tools, spare pipes, fittings and various equipment necessary for the proper operation of the soil treatment facility.

3. DESCRIPTION OF TREATMENT OPERATIONS

The soil treatment facility operation requires the coordination of several aspects to optimize efficiency and throughput. Soils received by road would have a transport manifest completed in compliance with the regulatory and commercial requirements for the facility. An authorization number must be issued by the site manager or his delegate prior to transportation and prior to receipt of soils at the centre. This number allows for the tracking of the origin, anticipated quantities, type(s) of contamination and other relevant information concerning the soils. The shipper should notify the treatment centre a minimum 24 hours prior to site work. This delay is important to avoid the double handling of soils upon arrival. Without an authorization, the load of soils cannot be accepted and must be held over until it is accepted or returned. The person responsible for issuing the authorization should make the necessary arrangements with the shipment supervisor to adequately plan the receipt and acceptance of future soil shipments.

Once through the gate of the treatment facility, after the vehicle has been weighed, the truck driver remits the manifest to the foreman, or his designated alternate, so that the soils can be directed to the proper location according to nature and contaminants. The truck unloads the soils; alternately a backhoe transfers the load of soils. If insufficient information is known about the soils, the load is placed in the interim storage area. The interim storage area may also be used if the treatment pads are full. In all instances, the soil is inspected upon discharge to check for the nature of the soils, the extent of the contamination, the presence of mixed waste and/or debris, and any anomalies. Representative soil samples are taken and analyzed.

If enough information is known about the soils, they are immediately conditioned with the appropriate amendments and nutrient solution. The Site supervisor will log the location where the soils are unloaded and will create space allotments for soils of a similar nature to monitor large batches.

Finally the empty truck is weighed to obtain the net quantity of soils received.

During piling, composite samples are taken for each batch[1] of soils received. This composite sample is analyzed for internal purposes to obtain an average initial concentration for the soil undergoing treatment. A duplicate is refrigerated and stored and may be further analyzed for quality control purposes.

The conditioned soils are covered with a semi-permeable cover and, if there is a sufficient quantity of soils (more than ~500 m^3), the blower is started to establish the desired air circulation through the soils.

1. A batch normally represents a quantity of soils of the same origin and nature; a batch can be 10 truckloads, for example.

After a treatment period pre-determined in accordance with the concentrations and other soil characteristics, the batches are again sampled and analyzed. Depending on the results, the soils will either be sampled according to the official protocol for declassification that denotes the end of treatment, or will be subjected to further treatment.

The system has been designed to operate 24 hours per day and 7 days per week.

3.1 Installation and Commissioning

The installation of the various structures and equipment is fairly straightforward. The treatment and storage pads, as well as the water collection pond, are first constructed with proper slopes and peripheral berms. The air/water separator is positioned partly below ground, with the inlet positioned to respect the slope and orientation of the treatment pad's main air pipe.

The blower container is positioned and connected with 8'' diameter main PVC piping for the processing of air. It is important to install drains at low points to prevent water accumulation and problems due to freezing. The piping is connected by screwing the threaded extremities, or the use of a union or a flange with a gasket.

The pumps and associated piping and valves are installed to direct the water to the collection pond and to circulate/pump out the water from the pond. Drains are installed at the low points of the circuit and vents at the high points of the circuit, again to empty the lines and prevent freezing, when necessary. A small air compressor may also be used to displace water from the lines, when necessary, with an air connection just downstream of the check valves.

The isolation valves, drain and vent valves, pressure and temperature gauges and tracing and insulation are installed where required.

Before system start-up, each of the components of the system is individually verified, and for each mode. A training period is also necessary with respect to health and safety at the site and to familiarize personnel with the system and the operating procedures, including spill response and other emergency response procedures. A hazop[1] study may also be conducted as part of the preparation (e.g., understanding what happens under conditions of low flow/high flow/no flow at various locations under various conditions and what problems/hazards may follow. The same can be performed for pressures, levels, concentrations, etc.).

1. Hazard and operability

3.2 Procedures for System Operation

The training program must be carried out so that operational procedures are well understood and subsequently implemented for the efficient operation of the treatment system. The system should be balanced to minimize pressure loss through the equipment train and ensure proper water drainage. System operation focuses primarily on the air blower, air/water separator, but also on the secondary piping and air control valves.

3.3 Sampling and Analytical Procedures

Typically, one representative composite sample per 250 m^3 of treated soils, composed of 5 subsamples, will be collected for testing by a certified laboratory to quantify the concentrations of the target contaminants, with 10% duplicates for quality control, for acceptance of a batch of soils.

Daily or weekly sampling and testing may be performed on water and soils using on-site detectors, testing kits and other analytical instruments.

3.4 Treatment Procedures

When running a soil treatment facility, operational principles and procedures should be respected to avoid compromises and errors that may occur with repeated arrivals. Interpretation of the results, piling, mixing, treatment and re-use/disposal are all operations that require a great deal of coordination.

3.4.1 Assessment of the Results

A proper assessment of the results is key to making good treatment decisions. Biological indicators (CO_2, T, bacterial count, pH, nutrients, and moisture) should be monitored to ensure that operating conditions are optimal. Interim measurements of contaminant concentrations will help to plan if and where an additional treatment effort, such as the remixing of some soils with or without amendments, is warranted and o plan final sampling for the acceptance and removal of treated soils.

3.4.2 Pile Preparation

Piling simply consists of the reception of soils on the treatment pad, regardless of the origin of the soils. The soils are placed on a section of the pad, using the excavator, one load after another. This step is crucial for treatment and should be performed with care. The success of the treatment is largely due to the quality of piling. Taking the time to adequately place/position the contaminated soils in the pile decreases the possible requirement of repeatedly remixing the soils thereafter.

Piling is performed by section, between 2 secondary conduits. The excavator starts in one corner, on the side of the first section at the back of the treatment pad (where the 6" berm is located). The excavator fills the section up to the front of the treatment pad and continues to place another row of soil by starting at the back again.

The steps to properly set up a pile are the following:

- Prepare in advance the nutrients (powder or solution) and the pump and hose system to spray the liquid suspension on the soils;
- Place the organic amendment within reach of the excavator for a section on the pad to facilitate mixing the amendment with the soils;
- Sample a composite of the soils prior to conditioning;
- Add the nutrients. If the soils are too wet for spraying, place the solid fertilizer alongside the organic amendment for mixing into the soils; the fertilizer may be mixed beforehand with part of the organic amendment;
- Remove any large debris (metal, concrete, wood, etc.);
- Using the excavator, pick up the contaminated soils, with amendment laid on its surface, and place it in the designated area or section,
- Drop the contaminated soils from a height of approximately 3 m to fracture lumps and distribute/mix additives (amendments, nutrients);
- Pile soils to a maximum height of 3 m and flatten the top of the pile (3,2 m high because 0,2 m serves to fill depressions);
- Open the 2'' valves on the secondary conduits when each 450 m³ pile of contaminated soil has been placed in position in a section;
- Repeat these operations until the end of soil reception or until all spaces on the treatment pads are occupied.

Once the soils are in place, heavy machinery must not roll over the soils so as to maintain good bulking and to prevent soil compaction (thus reducing the circulation of air and the transfer of oxygen).

3.4.3 Covering Liners

When enough soils have been placed in piles, a covering liner is installed. The liner is installed using the excavator and 2 to 3 labourers. Sand bags are placed on the liner (top and base of the pile) to secure the liner and prevent the wind from displacing or tearing it.

Installing or removing the liners when there is a strong and/or unpredictable wind may constitute a safety hazard. If a liner is loose or has folds, the risk of tears is high. It is also why the top of the biopile should be as straight and as flat as possible.

The supervisor should be aware of the direction of the strong prevailing winds. The liners should be superposed over a one-metre width and in a way such that the wind will not enter the junction and lift a liner. The liners can be knit if there is a tear and can be repaired with glue-on patches if there is a hole.

3.4.4 Treatment

3.4.4.1 Biological Treatment

Treatment begins when the soils are conditioned and forced aeration is initiated in the biopile. Much water is withdrawn from the soils during the first days of biotreatment. The collection pond should be maintained at approximately half level, if possible. It should not be completely emptied, as water will be needed during a dry period. If too full, there is a risk of overflow. Taking into account weather forecasts and the water inventory, it is possible to schedule the soil conditioning events so as to receive as much water as possible from the biopiles.

The soil temperature should increase significantly during the first week following conditioning. To monitor the evolution of bacteriological activity, daily temperature measurements are taken in the air withdrawn from the pile. A main goal is to increase microbial activity, associated with the growth (using hydrocarbons and nutrients) and internal metabolism (using mostly hydrocarbons) of the bacteria, so they use as many organic contaminants as possible as a source of carbon and food.

To obtain optimal treatment, the following conditions must be met:

- A constant supply of oxygen;
- Optimum moisture content;
- Ideal temperature;
- A sufficient initial population of micro-organisms; and
- A sufficient amount of nutrients (nitrate and phosphate).

The bacteria will consume the oxygen, nutrients (nitrate will also be used as an alternate oxidizer in parts of the soils that may not be sufficiently aerated) and the hydrocarbons or other contaminants to be biodegraded. The biological reaction will in turn generate additional biomass, heat and CO_2.

The presence of CO_2 is a positive sign of biological activity. A 4-Gas detector is used to take readings of O_2 and CO_2 concentrations at connections along each valve of a secondary conduit.

3.4.4.2 Chemical Treatment

Treatment of soils by chemical oxidation consists of adding and mixing an oxidizing agent (i.e., sodium persulfate) into the contaminated soil pile. The soil pile is then covered and left for a few weeks to passively treat. No air circulation is required.

3.4.5 Sampling

After the anticipated treatment period, a batch of soils is subjected to sampling for internal monitoring. The covering liner(s) are removed. Each section is sampled by collecting 5 subsamples at varying locations and depths to make up a composite sample. The composite is homogenized in a metal pan. For volatiles, grab sampling is used (no subsamples and no compositing) to avoid loss of volatiles during handling. Coarse materials should be removed as per the sampling requirements of the regulatory agency. Duplicate samples are taken during final sampling. Washing/cleaning of the sampling tools is performed as per the requirements of the regulatory agency. Surgical-type nitrile gloves are used and, if they have touched the soils, changed before proceeding to the next section.

Organoleptic indications are documented (noting the appearance and odour of the soils in terms of contamination) and a portable instrument, such as a UV photo-ionization detector, or PID, is used to check for the presence of contaminants. The samples are brought to a table where an experienced technician (ideally the same technician for any given sampling campaign), within the hour, documents the observations and the PID readings.

This interim internal sampling and testing helps to determine which sections need to be mixed and conditioned again and which sections can be subjected to the final certified sampling.

When results indicate that all sections should be remixed/reconditioned, it is carried out as soon as possible.

When the final results indicate that the soils have met the clean-up criteria, the liners are again withdrawn to remove the treated soils.

3.4.6 Soil Mixing

The methods of soil mixing are as diverse as there are operators, but some basic rules should prevail:

- Do mix each m^3 of the pile, but do not mix the same m^3 twice (unless it is very clayey <u>and</u> contaminated, in which case double handling is warranted);

- The excavator should not sit on mixed conditioned soils; if this occurs, the compacted soils should be bulked/mixed to a depth of 1 m;
- Remove significant sized debris or boulders;
- Do not mix together soils from separate soil batches;
- Do not mix together soils from different sections.

The most appropriate method for mixing and bulking the soils is for the excavator to back away from the mixed soils and onto soils that have yet to be mixed.

3.4.7 Re-use or Disposal of the Soils

When the soils reach the treatment objectives, they are directed to their site of re-use (site of origin or other) or disposal (as daily soil cover for sanitary landfill sites, for example). While the soils are loaded on trucks, a visual inspection of the soils is nevertheless performed. Undesirable materials, debris or lumps of soil with leftover contamination may be segregated at that point. Debris may be disposed of separately while soils that may require further treatment are returned to the biopile.

3.5 Waste Management

Waste materials separated from the soils (segregated through screening or otherwise, when it is possible or practicable to do so) should be characterized according to the applicable regulations and should be handled and disposed of accordingly.

Hazardous and non-hazardous waste that cannot be cost-effectively dealt with through biodegradation are shipped off-site to an authorized facility.

3.6 Maintenance and Calibration

The system components require very little maintenance. The instruments and control devices, such as the gauges (pressure, temperature, level), the 4-Gas detector, PID and anemometer should be checked and/or calibrated every year (by the supplier or by a competent technician) or as per the supplier’s recommendations. Spare equipment should be available (in stock or rented) to compare readings and verify the exactness of measurements.

3.6.1 Equipment Maintenance

To maintain the efficiency and the safety of the biopile treatment system, all equipment must be inspected on a regular basis to confirm that it is in good operating condition.

The specifications, drawings and manuals pertaining to the various equipment, pumps, blowers, instruments and controls, valves, filters and so on, should be kept at the facility and at the office. Relationships must be established with critical suppliers (blowers) and subcontractors (electrician for example) to allow for rapid troubleshooting, repairs and replacement.

3.6.2 Instrument Calibration

Pressure gauges, for example, are checked against a similar instrument (the standard) whose exactness and accuracy have been verified and certified by the supplier. For example, if a reading of between 38 and 42 psig is obtained when the standard instrument indicates 40 psig, the pressure gauge is accepted for a tolerance of ± 2 psi. The zero is also verified (with the gauge disconnected). The readings obtained are recorded in the calibration log with the date and the initials or signature of the technician. An instrument is normally verified against a value that corresponds to a normal operating condition.

3.7 Monitoring and Management

The monitoring of each batch of soils is important to plan and optimize handling and to ensure conformity with the permitting requirements. Each load of soils received is recorded and monitored from the beginning to the end of processing. The records and documentation at the facility allow for the tracking of each m^3 of soils according to its origin. A digital database is used to manage and document the projects (each transaction with a client), soil movement, forms used for receiving and disposal, invoicing, the certificates of analysis and the treatment timetable. The use of different forms helps to trace pertinent information and becomes more important as the transactions grow in numbers.

The traceability of soils and the quality of records are hallmarks of a professional operation and are particularly important for facilitating inspections by the regulatory agency and client audits.

3.7.1 Reception of Soils

Regardless of the origin and the mode of transportation (truck or ship) of incoming soils, the transporter should have a manifest approved by the treatment facility. This manifest indicates the authorization number necessary for the acceptance of the soils, the origin of the soils, the types of contaminants, the expected levels of contamination (according to the classification corresponding to the invoicing unit rates), the approximate quantity, the nature of the soils and waste/debris that may be present, the sample numbers corresponding to laboratory analyses and the transporter's (and/or consultant's, if applicable) identification.

The project manager or client notifies the treatment facility supervisor 24 hours in advance of the shipments to be received on a given day. Proper planning minimizes double handling and standby expenditures.

The employee at the gate records the weight of the loaded truck upon entry at the weigh scale and signs the manifest. After he is notified, he supervisor confirms the area to which the truck driver should go, according to the nature of the soils. The supervisor meets the truck driver, checks and confirms the information, documents on the manifest where the soils were unloaded and signs once unloading has been completed.

The supervisor defines batches according to the origin and nature of the soils and the contaminants and level of contamination. For example, sand contaminated by VOCs will be segregated in a different batch from clay with heavy hydrocarbons, even if the soils originate from the same site.

At the conclusion of the day, personnel will compile all manifests, verify the conformity of the information in the reception log and complete/update the log used to follow soil batches. Mistakes can easily occur when more than a hundred trucks enter and exit the site over the course of a single day.

3.7.2 Uncharacterized Soils

Soils with no analytical results can sometimes enter the facility, as in the case of a spill response requiring immediate disposal. A different reception log is used for uncharacterized soils. These soils are directed to the interim storage pad. A trained technician inspects and samples the soils in accordance with the permit requirements and applicable regulations. The samples are accumulated in different piles according to origin and nature and according to the nature and concentrations of the contaminants. Each pile is covered until the laboratory results are obtained and the destination of the materials has been confirmed.

When the analytical results are obtained, the soils are classified. Soils that do not meet the facility's acceptance criteria are sent off-site to an authorized facility for treatment or elimination. Acceptable soils are directed to the treatment pad. These soils are then entered in the log for characterized soils, the same project number being maintained for soils of a given origin.

A colour code is used to identify the different piles on the interim storage pad. Each pile is identified with a wooden stake, coloured with spray paint, and the origin of soils is written with a permanent marker. Soils that do not meet the permit requirements and/or cannot be cost-effectively treated at the facility are disposed of.

Proper management of uncharacterized soils will contribute significantly to the facility's profitability.

3.7.3 Treatment

For monitoring and treatment management, 2 important tools are the *Treatment Schedule* and the *Batch Description* forms.

The *Treatment Schedule* shows a top view of the treatment pads. Each rectangle in a treatment pad represents a section between 2 aeration conduits. In each section, the batch number, level of contamination and the colour denoting the current step in the treatment process are indicated (*undergoing treatment*, *to be sampled*, *to be conditioned*, *accepted* and *to be removed*).

Each rectangle is linked to the *Batch Description* form. This form is used to show past and present information for a given batch. Analytical results (contaminant concentrations, moisture, pH, nutrients in leachate) are given, as well as pertinent data (amendments used, nutrients and biomass added, organoleptic indications, temperature and CO_2). This information facilitates decision-making for the treatment strategy.

3.7.4 Re-use or Disposal

When it is time to remove soils that have met the desired criteria, the supervisor issues a manifest to the transporter and completes a disposal log for each outgoing shipment.

The manifest is the form that documents the return of the soils to the site of origin or to the designated site for re-use. Alternatively, it is the form used by the disposal site (for example, the sanitary landfill site that uses treated soils for daily cover over garbage). The batch number and sample identification (indicating soil acceptability) are provided on the form. Data is entered in the disposal log upon each shipment. The compilation of the data at the conclusion of each work day allows to closely monitor a given batch and to proceed with invoicing. The *Treatment Schedule* and the *Batch Description* are updated daily, establishing a good line communication between the treatment facility and the office. Monitoring of a given batch ends when all corresponding soils have been treated, accepted and transported to the re-use or disposal site.