



**HAY RIVER
PETROLEUM CONTAMINATED SOILS
TREATMENT FACILITY**

OPERATIONS PLAN

Draft October 2003

Prepared by WasteWorks Inc.

Based on the Hazardous Waste Receiver Registration Permit – October 2003
Addendum from GNWT Environmental Protection Service.

WASTEWORKS

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Introduction

The Hay River Treatment Facility (HRTF) is designed to remediate petroleum-contaminated soil (PCS). Contaminated soils are delivered to the facility and stored in the lined, run-off controlled treatment cell. Access to the HRTF is controlled, and hours of operation are 10:00 – 18:00 daily. Other hours of operation by appointment only.

The Hay River Treatment Facility is located within the Hay River Municipal Solid Waste (MSW) Disposal Facility. Access to the facility is through the yard of the MSW facility. The Town of Hay River and WasteWorks have a partnership in place to share the access, though the control and management of the HRTF are the exclusive purvey of WasteWorks Inc.

Characteristics of the facility

- One bermed storage and treatment cell. The treatment cell is constructed with 0.6 m clay liner. Storage and treatment cells are constructed completely above ground and graded to direct precipitation to the leachate control pond.
- The main leachate storage pond is designed with an HDPE liner underlain by low-conductivity native clay.
- Sub-soil berms surrounding the site divert clean water from running on to the facility.
- Treatment capacity of 25,000 metric tonnes (mt) at one time
- PCS for remediation shall be placed in windrows, piles or spread in thin lifts as conditions dictate.
- PCS shall be held in the treatment area until the PCS has been cleared for use as clean alternative cover for the Town of Hay River MSW landfill based on current CCME guidelines.
- Weigh scales at the NTCL and Town of Hay River works yards will be used for the detailed tracking of inventory processed.
- The HRTF is within the Hay River MSW Facility which is gated and locked outside of operating hours.

Construction of the treatment cell

- The liner is constructed of native low permeability compacted clay with a permeability not exceeding 1×10^{-7} cm/s.
- Compaction meets or exceeds 95% of the standard proctor maximum dry density of the material.
- Moisture content of the liner material is +/- 1% - 5% of optimal.
- The material selected for liner construction does not contain organic matter, frozen lumps, weeds, sod, roots, stumps or any other unsuitable liner material.
- The material selected for liner construction contains less than ten percent by volume of stone or rock fragments larger than 100 mm.

- The treatment pad dimensions are 50 m x 100m.

Employees and Responsibilities

Site manager

The site manager is responsible for the development and implementation of standard operating procedures on site. The site manager oversees the operations at the HRTF and co-ordinates communication with the GNWT Environmental Protection Service (EPS) and Department of Indian and Northern Affairs (DIAND) on issues pertaining to the operation and monitoring programs. The site manager designs the treatment program for specific remediation projects.

Site supervisor

The site supervisor is responsible for the day to day operations at the HRTF. These include implementing the treatment program in place for each waste project and ensuring the acceptance and screening program is executed according to WasteWorks standard operating procedures. The supervisor is also the first responder to any emergencies on site and will co-ordinate any action with emergency response teams.

Material handling procedure

Every project destined for treatment at the Hay River Treatment Facility (HRTF) is subject to the waste acceptance and screening program (see Waste Acceptance procedures).

Approved projects are delivered to the facility in bulk. Trucks are weighed at either 1) the GNWT highway scale at Enterprise (for out of town projects), 2) NTCL scale located at the NTCL cargo dock on Vale Island or 3) the Town of Hay River truck scales located at the Town Yard in Hay River. Tickets are issued for each load recording the gross, net and tare weights of the vehicles. The contaminated soil is delivered to Initial Receiving Area on the west side of the Treatment Cell. Debris or rocks are removed by handpicking, mechanized rock pickers or by screening, depending on the quality and quantity of waste.

Initial Receiving Area

All incoming waste will be initially dumped in the west side of the treatment cell and moved with a tracked dozer or excavator either into biopiles or spread in a 15 cm lift. If waste is accepted in an emergency situation, prior to the receipt of independent, third party analytical, the project is directed to the Initial Receiving Area. If necessary, confirmatory samples are taken to ensure the suitability of the soil for the facility.

Treatment Cell

All soil treatment takes place in the treatment cell. Depending on the type and quantity of waste, soil may be either placed in windrows, biopiles, or spread in thin lifts for maximum aeration. Treatment and processing takes place with heavy equipment available on site. This includes excavators, rubber tire loaders, power roto-tillers and crawler tractors.

Waste Tracking and Monitoring

Depending on the characteristics and level of contamination of the soil, a treatment schedule is estimated. The remediation process may be evaluated on site with PID monitors, in addition to sampling and analysis of the waste at independent, third party laboratories. Frequency of monitoring depends on the time of year, and the availability of cell space for more waste. Testing of the material may include:

- CCME total hydrocarbons (F1 to F4)
- Other parameters depending on the waste site history

Treatment results are kept on file at the WASTEWORKS Calgary Office, and at the facility shack at the HRTF.

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Treatment Objectives

For release of the waste as alternative cover to the Town of Hay River Landfill, all contaminated soils must meet the NWT criteria for alternative cover for MSW landfills or the CCME criteria for Industrial sites. The final release analysis is reviewed by the HRTF Manager, and the Manager of Operations for WASTEWOR~~K~~S. Copies of the release report are forwarded to the Town of Hay River Director of Public Works prior to release of the material.

Description of treatment process

Petroleum Contaminated Soils (PCS) eligible for treatment include a variety of soil matrices that are suitable for treatment through the enhancement of hydrocarbon breakdown. The breakdown of the contaminants is achieved through aeration activities including discing, turning the piles, processing with an ALLU excavator attachment. Treatment may also include the addition of suitable amendments to enhance the natural activity of indigenous hydrocarbon degrading micro organisms.

Waste Acceptance Procedures

The Hay River Treatment Facility is permitted to accept petroleum-contaminated soil suitable for bioremediation treatment.

Common sources of acceptable waste include:

- Service station decommission projects
- Truck spills and roll overs
- Aboveground and underground tank fuel storage tank leaks
- Other fuel or similar-type hydrocarbon contaminated soils

Prohibited wastes include:

- Biomedical wastes
- Explosive waste
- Radioactive waste
- Waste that is unsuitable for bioremediation
- Waste that does not meet the definition of soils

The industrial waste generator is responsible for providing the waste generating process information, independent analysis and supporting documentation required to make a reasonable assessment of the suitability of their waste for acceptance at the HRTF. At a minimum, the following information about each waste disposal project will be collected prior to approval and acceptance of the waste:

- Generator name / Location / Contact information;
- Waste type / Description / Process history / Quantities;
- Physical properties / Chemical characteristics;
- Laboratory reports / Material Safety Data Sheets / Process knowledge letters
- Generator certification

The Waste Approvals Group at WasteWorks reviews the information supplied by the generator and approves or rejects the waste. Each approved project is issued an approval code unique to a particular waste stream, location, and generator. Each load of approved waste delivered to the landfill must be accompanied by a 'Waste Docket'. This multiple copy form identifies the unique waste approval code, the generator, the transporter, and the intended disposal facility. These waste dockets will be distributed throughout the disposal event to these same identified parties, and will serve to provide waste chain of custody documentation and waste disposal certification.

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Waste screening at the facility

Employees are trained to look for evidence of potentially unacceptable wastes. Such evidence includes the following:

- Wastes with strong and unusual odours
- Sludges
- Any load with unusual or unfamiliar paperwork

If a waste is delivered that is of concern at the facility, or is considered suspicious, the following procedure will be implemented:

- A waste discrepancy report will be completed. This report contains information with respect to the nature of the waste, where it came from and the generator's name and telephone number.
- The load will be directed a quarantine area located in the treatment cell.
- The facility supervisor will be notified immediately, and the customer may be contacted to obtain further information or clarification of the nature of the waste.
- Confirmatory samples will be taken.

If, after confirmatory samples, the waste is deemed unacceptable for treatment the generator will be immediately advised. An alternate action plan will then be developed, taking into account the specifics of the waste. Alternative disposal plans will include shipment to a Class II landfill in Alberta or the Swan Hills Hazardous Waste Treatment Facility in Alberta.

Surface Water and Leachate Management

Surface water at the HRTF can be categorized in two ways;

1. Non-Impacted Water ("clean")

This water is the result of precipitation falling on non-impacted areas of the disposal site. These areas would include roads, clean soil stockpiles, and unused areas among others. This water is considered clean water, and will not have come into contact with any of the waste stockpiled on the pad.

2. Impacted Water ("leachate")

This water is the result of precipitation falling on or draining near impacted soil. This water may or may not be impacted by the waste material it contacts.

Clean surface water

All clean surface water is diverted from the HRTF by one (1) metre sub-soil berms surrounding the facility.

Impacted water

The site is designed and managed in such a way as to prevent the loss or discharge of impacted water into the surrounding environment. The generation of impacted water is minimized by prohibiting the disposal of bulk liquids and by managing the surface water.

The following activities may be used to manage the impacted water:

- Impacted water is re-applied to impacted soil using a sprinkler system. This will allow for re-absorption of the water into the soil. This process enhances the treatment process, and helps to control any dust from contaminated soil piles.
- Excess impacted water may be treated with an on-site water treatment plant that is installed within the treatment pad.
- Impacted water is sent for disposal at an approved facility off site.
- If the quality is sufficient, impacted water is used for dust control on the treatment pad.

Modifications to the management plan may be warranted from time to time as site conditions change, new technologies are developed or regulations change.

All discharged water will meet CCME criteria for background water quality.

Closure plan

Final closure of the soil treatment facility will involve the decommissioning of the clay lined bioremediation cell, the lined impacted water run-off pond, and the removal of fencing and security installations associated with the site.

Final closure and decommissioning of the landfill will begin with the release of any soil remaining in treatment for use as alternate daily cover in the adjacent MSW landfill. In the event that closure of the facility is required before all contaminated soil has completed the treatment program, the waste will be transported to a suitable facility for further treatment or secure disposal.

Following release or removal of all soil from the treatment facility, the clay liner of the bioremediation cell will be excavated and stockpiled. The clay will be ultimately used as a low permeability final capping layer for landfill cells. Long term monitoring of the landfill area will continue during the active life of the adjacent landfill disposal facility and following the final closure of the landfill. As the soil treatment facility is not the end disposal site for any waste, there are no long term effects expected following decommissioning of the facility.



Safety and Emergency Response Plans

The operations at the HRTF involve the use of heavy equipment to process the waste stored for remediation on the pads, and of heavy truck traffic. The wastes handled on site consist of soils with varying levels of hydrocarbon contamination. The only liquids handled include the clean and impacted runoff water storage ponds.

The HRTF is operated in conjunction with the WASTEWORX Occupational Health and Safety Program. All personnel on site are required to wear basic personal protective equipment: hard hat, high visibility vest or striping, safety footwear. Other PPE requirements are specific to the tasks undertaken by the employees on site.

Refer to the HAZCO Occupational Health and Safety Manual

Emergency Contact Information for Hay River Treatment Facility

Police	(867) 874-6555
Fire	(867) 874-2222
Ambulance	(867) 874-9333
WASTEWORX 24 hour Emergency	1-800-667-0444

Fire Prevention and Control

The purpose of this plan is to provide information to landfill employees in the event that a fire occurs at or near the landfill. Specifically, the plan establishes who is responsible for various aspects of the fire control procedure.

General Guidelines

DO NOT PANIC, the greatest danger lies not in fighting the fire, but in the panic that arises from a fire. Spend a few minutes getting a grip of the situation. Go through the steps of notifying the appropriate authorities and follow the basic steps in the fire control plan.

- Notify any other nearby employees.
- Notify the Site Manager immediately. Follow his instructions.
- Notify the Fire Department. Tell them the location and type of fire and whether it looks like it will spread out of the immediate area.
- Notify surrounding property owners, particularly if it appears that the fire could spread beyond the facility.
- When the Fire Department arrives, follow their instructions.
- Do not fight a fire alone.
- Do not place yourself or others in danger while fighting the fire.

Electrical Storms

During any electrical storm, office personnel and scale checkers should stay indoors. While indoors, keep away from doors, windows, radiators, stoves, metal pipes, sinks or other metallic objects. Disconnect electrical appliances such as computers and radios. Do not handle any electrical equipment or the telephone.

Outside workers should relocate to an indoor location, staying away from any metal objects such as fences, metal pipes, or rails that may conduct electricity. Heavy equipment operators should get off and away from their equipment and move indoors. If not possible, stay inside the cab and move to an area of lower elevation.

If you are in a vehicle, stay there, as it will provide protection from lightning. Pull away from any trees or other objects that have the potential to fall on the vehicle.

Extreme Winds or Tornadoes

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During high windstorms (potentially occurring between May and September) take shelter immediately. If heavy equipment operators cannot evacuate, move to lower elevations. Workers can take shelter underneath the weigh scale, or underneath the compactor. Do not stay in the scale trailer or the workshop in the case of a tornado. As a last resort, lie flat on the ground in a ditch, excavation or culvert.

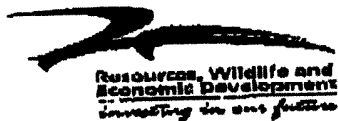
Spill Response Plan

For the purposes of this plan, a spill is the accidental or purposeful discharge of a liquid waste (listed herein) or contaminated soil in a location or manner that will allow it being washed, carried, or flow into a natural or man-made watercourse that could potentially result in groundwater or surface water contamination now or in the future.

Most potential spill sources will only be present during normal facility working hours. As a result, adequate personnel and equipment is available to respond to any spill-related emergency. With equipment at the facility, it is possible to respond immediately to the site of any spill for necessary spill containment and cleanup. The immediate requirement will be to construct temporary earth berms around the spill area to contain any free liquids. The on site crew will then initiate other necessary control and cleanup measures as directed by the Site Manager and the Hazardous Material Response Team (if applicable).

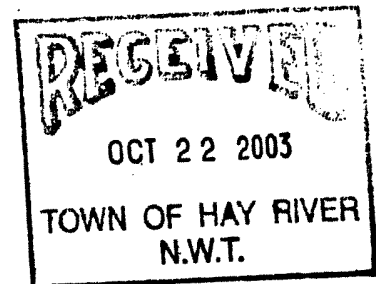
The Spill Response Plan addresses spills of:

- Fuels and oils from landfill equipment
- Soils contaminated with any of the above
- Liquids from the storage ponds



FAX TRANSMISSION

Date: October 21, 2003
Pages: 3 Including Cover
To: Mr. Todd Pittman
 Director of Public Works & Planning
 Town of Hay River
 (867) 874-3237



From: Don Helfrick
 Hazardous Waste Specialist
 Environmental Protection Service
 Resources, Wildlife and Economic Development
 Government of the Northwest Territories
 600, 5102 - 50th Avenue
 Yellowknife NT X1A 3S8

Telephone: (867) 920-8044
 Fax: (867) 873-0221

Subject: Hazardous Waste Receiver Registration

I have attached a file copy of the confirmation letter for Hazardous Waste Generator and Hazardous Waste Receiver Registration Numbers provided to the Town in 1994. These registration numbers remain in effect.

Landfarming of hydrocarbon contaminated soils is an approved activity under Receiver Registration providing the guideline issued by Environment Canada is followed. The guideline, TECHNICAL GUIDANCE ON THE LAND TREATMENT OF PETROLEUM HYDROCARBON CONTAMINATED SOILS AT FEDERAL GOVERNMENT FACILITIES OR ON FEDERAL CROWN LAND, has been sent to you by surface mail.

Treatment standards for the treated soils should comply with the Guideline for Contaminated Site Remediation. A copy has also been sent by mail but is also available on our web site at <http://www.gov.nt.ca/RWED/eps/leg.htm>.

My direct number is (867) 920-8044 should you have any questions.

The transmission and the documents accompanying this transmission contain confidential information intended for a specific individual and purpose. The information is private and is legally protected by law. If you are not the intended recipient, you are hereby notified that any disclosure, copying, distribution or taking of action in reference to the contents of this telecommunicated information is strictly prohibited. If you have received this communication in error, please notify the Environmental Protection Service immediately by telephone and return the original to us by regular mail, postage due.

30 May 1994

Walter Hornby
Director Public Works & Planning
Town of Hay River
Bag Services 5000
Hay River NT X0E 0R0

Dear Mr. Hornby:

Hazardous Waste Receiver Registration - Household Hazardous Waste Collection

This will confirm assignment of a Hazardous Waste Generator and Hazardous Waste Receiver Number to the Town of Hay River. The Waste Receiver registration is for waste asbestos only. Asbestos disposal, handling and transport should comply with the Asbestos Disposal Guidelines that we have attached.

Your Hazardous Waste Generator Number is NTG 000062.

Your Hazardous Waste Receiver Number is NTB 000023.
Waste Receiving Location: Hay River Landfill.

This Receiver Number is site specific for the above location, effective date of registration is May 2, 1994.

Hazardous Waste Receiver Registration is issued for the following purposes:

1. Temporary storage of waste dangerous goods pending transport to licensed disposal, treatment or recycling facilities.
2. Disposal or recycling of waste dangerous goods utilizing a process, facility, or location approved by the Environmental Protection Division.

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Disposal of hazardous waste in the Northwest Territories requires prior approval from the Environmental Protection Division under the authority of the *Environmental Protection Act, EPA*. All parties involved, the generator, the carrier, and the receiver must be registered and provided with a Registration Number. These numbers will also facilitate waste manifest completion for waste transport as required by the *Transportation of Dangerous Goods Act* and Regulations.

Handling of hazardous waste must be undertaken in a safe manner as prescribed by Occupational Health and Safety, Safety and Public Services, GNWT.

The Spill Contingency Planning and Reporting Regulations of the EPA requires the preparation and filing of a Spill Contingency Plan from a person storing contaminants. You may be required to file a contingency plan with EPD in accordance with the Regulations. Further actions, by way of guidelines and regulations, are currently being considered to manage hazardous waste in the NWT. A contact list providing sources of information and regulatory requirements is attached.

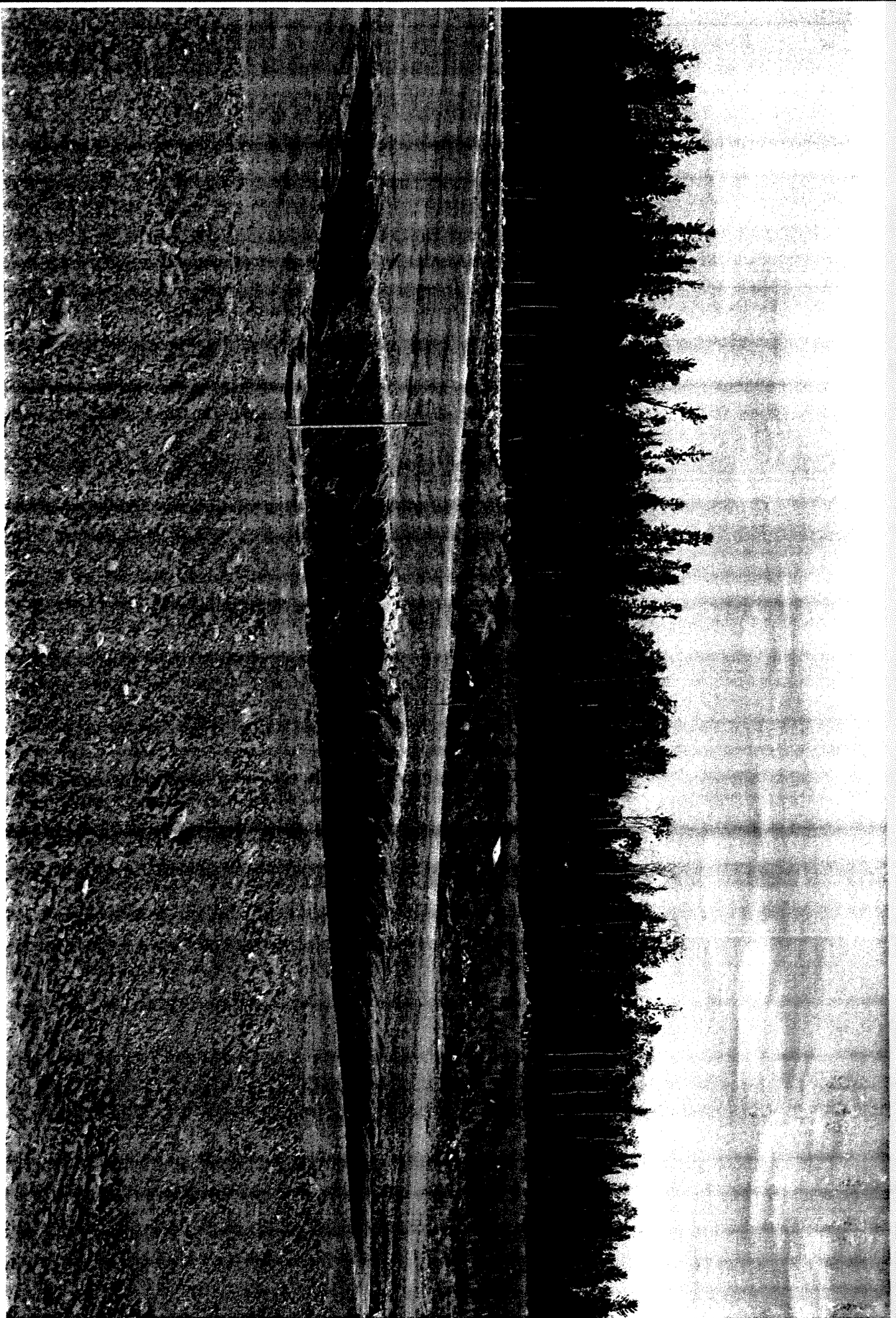
As stated in our conversation regarding Household Hazardous Waste collection, HHW, our Division is anxious to assist the Town of Hay River prevent waste household chemicals from entering its landfill. We can provide technical assistance and training at a HHW day provided that we receive advance notice of the date as soon as possible as other collection events will also be taking place across the NWT. We also suggest that the Town appoint persons to run the event that have received or will receive Transportation of Dangerous Goods training.

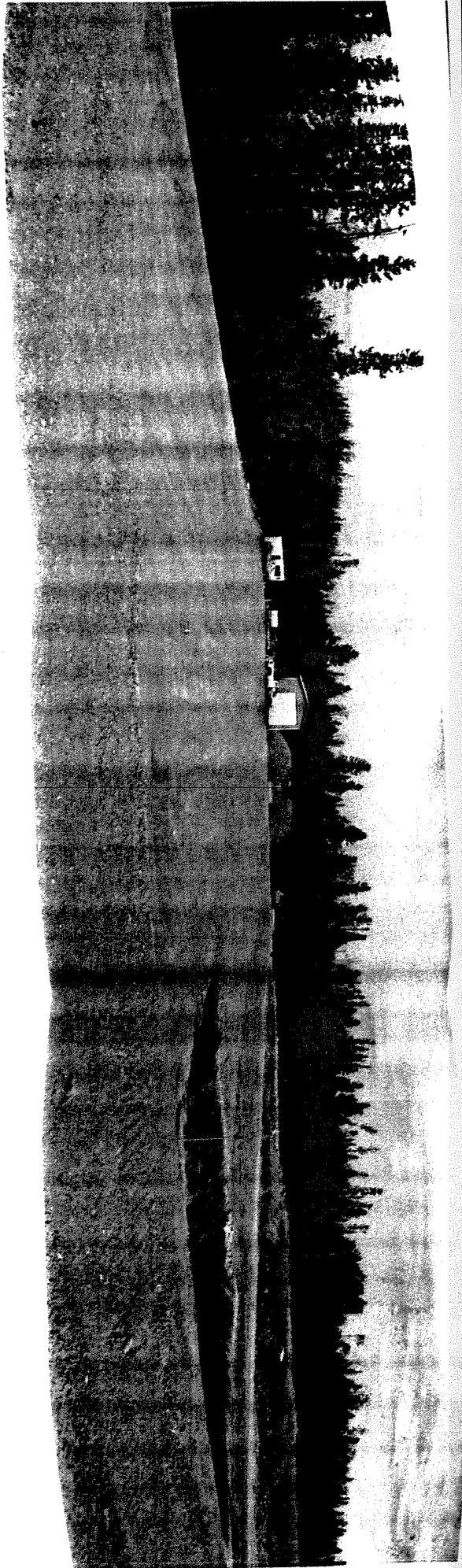
Please call 873-7654 if additional information or clarification is required.

Yours sincerely,

Donald Helfrick
Hazardous Waste Specialist
Environmental Protection Division

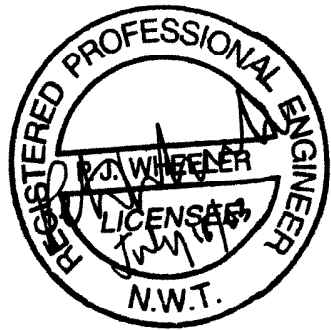
Attachment:







**BIOPAD FOR SOIL TREATMENT
2003 EARTHWORKS CONSTRUCTION – HAY RIVER, NWT
DETAILED SPECIFICATIONS**



July, 2003

1.0 GENERAL**1.1 Purpose, References and Definitions:**

- 1.1.1 This section is intended to provide direction and guidance for the construction, testing, inspection, finishing and reporting activities related to the construction of the Compacted Clay Liner ("CCL").
- 1.1.2 Refer to all appropriate ASTM Standards and CGSB Standards relative to quality control and quality assurance activities and confirmatory testing. These Standards shall apply to all grain size, compaction, moisture content, plasticity and other such testing as is required to determine quality and workmanship of the CCL.
- 1.1.3 The CCL shall be constructed from select cohesive, low permeability local soil material(s) to the lines and grades, thickness, moisture contents, compaction requirements and other quality parameters specified herein. The constructed CCL shall have an in-place permeability of less than 1×10^{-7} cm/sec.
- 1.1.4 The CCL shall be constructed in the areas delineated for the BioPad to be used for soil treatment, and to the lines and grades as defined on dwg's HR-1 to HR-4 inclusive.

2.0 PRODUCTS**2.1 Low Permeability Soil Material:**

- 2.1.1 Soil material used for fill shall be excavated from the limits of the BioPad, BioPad Runoff Containment Pond or from a suitable, local borrow source. The soil material shall be of medium to high plasticity, with a Plasticity Index (PI) of greater than 15 and shall be classified a CI to CH soil material according to the Modified Unified Soil Classification System. Material used as fill shall:
- Not contain organic matter, frozen lumps, vegetation, roots, waste materials or any other unsuitable material; and
 - Contain no more than ten percent (10%) by volume of stone or rock fragments and shall not contain any stone or rock fragments larger than 50 mm.

3.0 EXECUTION**3.1 Subgrade Inspection:**

3.1.1 The subgrade shall be inspected by a 3rd Party testing firm ("the Monitor") to ensure that all unsuitable material(s) have been removed. The inspection observations shall be documented.

3.1.2 Areas of the subgrade which deform easily and are soft, wet and compressible shall be subexcavated to a depth of 300 mm (12") below the bottom elevation of the CCL and to a sufficient lateral extent as to completely remove the unsuitable material zone.

3.1.3 Subexcavated areas shall be backfilled in accordance with the specifications for CCL construction.

3.2 CCL Construction:

3.2.1 Construction of the CCL shall not commence until all areas of unsuitable material have been removed and replaced. The CCL shall only be constructed from Low Permeability Soil Material as defined herein.

3.2.2 The CCL shall be constructed in uniform lifts that do not exceed 200 mm (8") of uncompacted thickness. The soil material shall be moisture conditioned, by drying or by adding water, to obtain an in-place moisture content that is greater than two percent (> 2 %) above the Optimum Moisture Content (OMC) of the soil. This moisture conditioning requirement is specifically selected in the context that the local clay soil materials, to be obtained from a pre-selected borrow source, are highly plastic (CH) deltaic clays that possess a Plastic Limit (PL) of 22 %, a Liquid Limit (LL) of 66 % and an OMC of 24 %.

3.2.3 The soil material shall be blended, mixed, moisture conditioned and uniformly spread and compacted to an in-place density of not less than ninety-two percent (92%) of the Maximum Dry Density.

3.2.4 Only suitably large and ballasted static sheepsfoot or vibratory/static padfoot compaction equipment shall be used to provide the compactive effort.

3.2.5 Stones or rock fragments larger than 50 mm (2") shall be removed from the lifts of soil material used to construct the CCL.

3.2.6 Each lift shall be bonded to the underlying lift during the compaction process. If the previous lift has become desiccated, saturated or frozen, it

shall be scarified to the full depth of the desiccation or saturation, or removed if frozen, moisture conditioned and re-compacted so that a bond can be established with the subsequent lift of soil material.

- 3.2.7 The CCL shall be constructed in a uniform manner with no horizontal laminations or vertical joints.
- 3.2.8 The finished surface of the CCL shall be trimmed and graded to a smooth and uniform surface. The CCL final grade shall be completed to a tolerance of +/- 50 mm (2").
- 3.3 **CCL Quality Assurance (QA) & Quality Control (QC) Testing:**
- 3.3.1 The CCL construction shall be observed and monitored by a 3rd party Monitor on an ongoing and continuous basis, insofar as is practical.
- 3.3.2 The Monitor shall record, compile and provide comprehensive documentation of all significant construction activities, physical measurements and test data to facilitate the characterization and performance of the CCL.
- 3.3.3 All areas not meeting the specifications shall be reworked in a timely manner and as required in order to comply with this specification.
- 3.3.4 QA & QC testing shall be performed and completed as outlined below:

Prior to the Commencement of Construction:

- Atterberg Limits (ASTM D4318), one (1) test for each borrow location or material type;
- Grain Size Distribution (ASTM D422), one (1) test for each borrow location or material type;
- Moisture-Density Relationship (ASTM D698), one (1) test for each borrow location or material type; and
- Determine the Classification of the Low Permeability Soil Material in accordance with the Modified Unified Soil Classification System, one (1) determination for each borrow location or material type.

During Construction:

- ◆ Observe changes in the soil materials being excavated to ensure that only soil materials that meet this specification are used to construct the CCL;
- ◆ Observe construction activities to ensure that specified procedures and industry accepted practices are being followed;

- ◆ Observe compaction techniques, methods and procedures to ensure that the specified procedures and industry accepted practices are being followed;
- ◆ Moisture Content and Material Density (ASTM D2922), by nuclear gauge (confirmed by oven dry moisture tests), one (1) test per 225 cubic metres (m³) or four (4) per lift, whichever is greater;
- ◆ Moisture Content (ASTM D2216), by oven drying, one (1) test for each borrow location or material type; and
- ◆ Hydraulic Conductivity (ASTM D5084), one (1) test in-situ by Air Entry Permeameter procedure for each 500 mm (20") increment in thickness perpendicular to the surface of completed sections of the CCL (Option 1), or;
- ◆ Hydraulic Conductivity (ASTM D5084-90), obtain one (1) sample of in-place Compacted Clay Liner, by using a standard shelby tube, for each 600 mm (24") increment in thickness and perform a Constant Head Permeability Test using a flexible wall Permeameter (Option 2) for the purpose of confirming the in-situ condition of completed sections of the CCL.

3.4 QA & QC Documentation:

3.4.1 The following information shall be recorded, compiled and presented by the Monitor in the form of a Quality Assurance & Quality Control Report:

- ❖ Subgrade Inspection and Acceptance record(s);
- ❖ Daily Inspection Reports;
- ❖ Subgrade Survey;
- ❖ Final CCL Grade Survey;
- ❖ Confirmation of lift thicknesses;
- ❖ Pre-construction test data and determinations;
- ❖ Construction test data and determinations (moisture contents, densities, etc.);
- ❖ Hydraulic Conductivity test data and determinations; and
- ❖ A Statement of Opinion as to the quality and acceptability of the completed CCL.

END OF SECTION

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1.0 GENERAL

1.1 Purpose, References and Definitions:

- 1.1.1 This section is intended to provide direction and guidance for the installation, testing, inspection and reporting activities related to the construction of the Geomembrane Liner ("Liner").
- 1.1.2 Refer to the Manufacturer's specification and test standards. Refer to all appropriate ASTM Standards, as referenced by the Manufacturer's specification, relative to manufacturing quality control and quality assurance activities and confirmatory testing.
- 1.1.3 Refer to all appropriate ASTM Standards relative to quality control and confirmatory testing during the installation of the Liner.
- 1.1.4 The Geomembrane Liner (Liner), for the purpose of executing the Work, is a 1.0 mm (40 mil) thick, smooth Linear Low Density Polyethylene (LLDPE) geomembrane. The Liner shall be factory fabricated into one or more panels sized to fit the Pond configuration and geometry. Field seams, to join field installed panels together, shall be eliminated whenever possible. It is intended that only one (1) panel be used to line the BioPad Runoff Containment Pond.
- 1.1.5 The Liner Manufacturer ("Manufacturer") shall be defined as the company that manufactures the LLDPE roll stock product. The Manufacturer may employ a distributor or agent ("Supplier") in order to market and/or sell the LLDPE product. For the purpose of this Specification, the terms Manufacturer and Supplier are interchangeable.
- 1.1.6 The Liner Fabricator ("Fabricator") shall be defined as the company that renders the roll stock product into a factory fabricated panel by shop welding together individual sub-panels of roll stock material.
- ### **1.2 Submittals:**
- 1.2.1 The Fabricator is required to provide and submit a Shop Test Report(s) to demonstrate that the quality of both the roll stock and the fabricated product meets the standards and requirements specified herein and that the factory (shop) seaming has been executed and tested in accordance with the best available industry practices.

1.3 Fabricator's Experience:

1.3.1 The Fabricator shall have at least ten (10) years of continuous experience in the shop fabrication of Liner panels.

1.4 Warranties:

1.4.1 The Manufacturer and/or Fabricator of the Liner shall provide a Material Weathering Warranty within fifteen (15) days of the delivery and installation of the Liner panel(s). This Warranty shall cover a minimum period of ten (10) years.

1.5 Liner Panel Identification:

1.5.1 The Fabricator shall ensure that each Liner panel is appropriately tagged and suitably marked prior to leaving the plant.

1.5.2 Panel identification is to include, but not be limited to, the thickness and type of the material, the panel dimensions, deployment directions, the date of production and the name of the fabricator.

2.0 PRODUCTS

2.1 Geomembrane Liner:

2.1.1 The Geomembrane Liner (Liner) is to be a nominal gauge 1.0 mm (40 mil) thick Linear Low Density Polyethylene (LLDPE) geomembrane.

2.1.2 The Liner material is to be manufactured with a minimum of ninety percent (90%) virgin resin. The formulation shall also include two to three percent (2% - 3%) carbon black and trace amounts of anti-oxidants and heat stabilizers. No other additives, fillers or extenders shall be included.

2.1.3 The Liner material shall be free of all surface and internal defects and shall only contain a maximum of ten percent (10%) of reworked material originating only from within the manufacturing plant.

2.1.4 The 1.0 mm (40 mil) LLDPE Geomembrane Liner shall be manufactured to meet or exceed the following specifications and parameters:

<u>Tested Property</u>	<u>Test Method</u>	<u>Property Value</u>
• Thickness, (nominal)	ASTM D1593	1.0 mm (40 mil)
• Density	ASTM D792	0.938 g / cm ³

<u>Tested Property</u>	<u>Test Method</u>	<u>Property Value</u>
• Tensile Strength	ASTM D638	
Strength @ Break		26.0 N / mm
Elongation @ Break		800 %
• Tear Resistance	ASTM D1004	98 N
• Puncture Resist.		320 N
• Low Temp. Impact	ASTM D746	- 56 ° C
• Dimensional Stability	ASTM D1204	1.5 %

3.0 EXECUTION

3.1 Liner Subgrade Inspection:

- 3.1.1 The Liner subgrade surface(s) shall be prepared in accordance with clauses 3.1.8, 3.1.9 and 3.1.10 of Specification Section C "Miscellaneous Earthworks".
- 3.1.2 Any deficiencies in the subgrade observed or found shall be reported immediately and directly to the Owner or his agent(s).
- 3.1.3 If required, the Owner or his agent(s) shall effect repairs to the subgrade and shall do so in accordance with Section C "Miscellaneous Earthworks" of this Specification.

3.2 Liner Panel Deployment:

- 3.2.1 Deployment and installation operations shall be performed under the supervision of the Owner's representative.
- 3.2.2 The methods and equipment used to deploy the Liner panel shall not in any way scratch, crimp, mark or otherwise damage the Liner material.
- 3.2.3 The deployment of the Liner material shall be executed in such a fashion as to allow for the incorporation of slack to compensate for installation thermal expansion and contraction. The amount and location of slack shall be in accordance with the Manufacturer's and/or Fabricator's recommendations and the best practices of the industry.

3.3 Factory Seam Strength:

3.3.1 Factory Seams shall meet the following specifications:

- Shear Strength - 70 PPI (pounds / inch width) min.; or
 - 12.2 N / mm ; and
 - Film Tear Bond ("FTB");

- Peel Strength - 60 PPI min.; or
 - 10.5 N / mm; and
 - FTB;

- Test Standard is ASTM D4545, for 25.4 mm (1") wide sample coupons.

END OF SECTION

1.0 GENERAL

1.1 Purpose, References and Definitions:

1.1.1 This section is intended to provide direction and guidance for the construction, testing, inspection, finishing and reporting activities related to the construction of the following miscellaneous components of the Work:

- Containment Dykes;
- Geomembrane Liner (Liner) Anchor Trench;
- Runoff Collection Ditches
- Access Ramps; and
- Culverts.

1.1.2 Refer to all appropriate ASTM Standards and CGSB Standards relative to quality control and quality assurance activities and confirmatory testing.

1.1.3 Containment Dykes shall be constructed from cohesive soil material to the moisture content and compaction requirements and other quality parameters specified herein, and at the locations, lines and grades shown on dwg's HR-1 to HR-4 inclusive.

1.1.4 Embankment Fill shall be used to construct the: a) Access Ramp(s); and b) Containment Dyke(s).

1.1.5 Anchor trenches and ditches shall be excavated to the lines, grades and locations shown on the drawings.

1.1.6 Low Permeability Fill shall be used to backfill the Liner anchor trench.

2.0 PRODUCTS

2.1 Embankment Fill:

2.1.1 Soil material used for Embankment Fill shall be excavated from the limits of the BioPad, BioPad Runoff Containment Pond or from a suitable local borrow source. The soil material shall be fine grained, of medium to high plasticity and have a Plasticity Index (PI) of greater than 15 and shall not contain organic matter, frozen lumps, vegetation, roots, waste materials or any other unsuitable material.

2.2 Low Permeability Fill:

2.2.1 Soil material used for Low Permeability Fill shall be excavated from the limits of the BioPad, BioPad Runoff Containment Pond or from a suitable

local borrow source. The soil material shall be of medium to high plasticity, have a Plasticity Index (PI) of greater than 15 and shall be classified as a CI to CH material according to the Modified Unified Soil Classification System. Material used as fill shall:

- Not contain organic matter, frozen lumps, vegetation, roots, waste materials or any other unsuitable material; and
- Contain less than ten percent (10%) by volume of stone or rock fragments larger than 50 mm.

2.3 HDPE Culvert:

2.3.1 Pipe intended for installation in the Access Ramps shall be a minimum 200 mm (8") diameter, unless noted otherwise on the project drawings, non-perforated corrugated (annular) HDPE pipe manufactured to meet or exceed the requirements of the AASHTO M294, Type S specification. A smooth walled culvert interior is preferred, but not necessary.

2.3.3 Culvert pipe joints shall be made in accordance with the manufacturer's recommended methods and/or coupling materials.

2.3.4 Corrugated Steel Pipe (C.S.P.) culverts meeting suitable and equivalent manufacturing standards shall be acceptable as alternatives, subject to a review of the pipe manufacturer's specifications.

3.0 EXECUTION

3.1 Containment Dyke Construction:

3.1.1 All standing, free water shall be removed from areas where Containment Dykes are to be constructed. Dewatering efforts shall be initiated sufficiently in advance of the fill placement so that the area being dewatered can dry to a point where no free water remains. Soft, residual soil materials shall be excavated to a depth and magnitude that will allow Embankment Fill lift placement to proceed in accordance with this Specification.

3.1.2 Topsoil shall be stripped from all embankment foundation surfaces prior to the placement of Embankment Fill. Areas of unsuitable material shall be subexcavated and backfilled / compacted with Embankment Fill material. Backfilling of the subexcavated areas shall be conducted and completed in accordance with the specifications for Embankment construction.

- 3.1.3 Embankment Fill shall be used to construct the Containment Dykes, Access Ramps and to backfill culvert pipe trenches.
- 3.1.4 Embankment Fill lifts shall not exceed 300 mm (12") in thickness. Fill materials shall be moisture conditioned, by drying or by adding water, to obtain an in-place moisture content that will allow for the consolidation of the soil material to occur without excessive lateral displacement and for the required density to be achieved by the application of a reasonable amount of compactive effort.
- 3.1.5 Embankment Fill for Containment Dykes shall be compacted to an in-place density of not less than ninety-two percent (92%) of the Maximum Dry Density.
- 3.1.6 Embankment Fill for Access Ramps and Culverts pipe trenches shall be compacted to an in-place density of not less than ninety-five percent (95%) of the Maximum Dry Density.
- 3.1.7 Stones, rock and rock fragments larger than 150 mm (6") shall be removed from the Embankment Fill, unless otherwise noted on the drawings or these Specifications.
- 3.1.8 Each lift shall be bonded to the underlying lift during the compaction process by scarifying, drying or wetting of the underlying lift prior to the placement of the subsequent lift.
- 3.1.9 The final surface of the Containment Dykes, Access Ramps and the BioPad Runoff Containment Pond shall be trimmed and graded to a smooth and uniform surface. The final grade of these Embankments shall be completed to a tolerance of +/- 50 mm (2").
- 3.1.10 For the purposes of the installation of the 40 mil Linear Low Density Polyethylene (LLDPE) Geomembrane Liner (Liner) in the BioPad Runoff Containment Pond, subgrade preparation of the surface to be lined shall consist of, as a minimum:
- Trimming the earthen surfaces to smooth, neat lines;
 - Hand raking and rockpicking to remove any potentially damaging particles; and
 - Excavation of soft, unsuitable soil materials and replacement and re-compaction of Embankment Fill materials to match the surrounding grade.

3.1.11 Under no circumstances will the integrity of the Liner be compromised by the presence of sharp, protruding objects, soil lumps and/or incomplete subgrade preparation.

3.2 Low Permeability Fill:

3.2.1 Low Permeability Fill shall be used to backfill the Liner anchor trench.

3.2.2 Low Permeability Fill shall be moisture conditioned to the same standard as Compacted Clay Liner (CCL) construction.

3.2.3 Only manually operated mechanical or hand tampers shall be used to provide the compactive effort when backfilling the Liner anchor trench.

3.2.4 Low Permeability Fill for the Liner anchor trench shall be compacted to not less than ninety-two percent (92%) of the Maximum Dry Density.

3.2.5 Stones or rock fragments larger than 50 mm (2") shall be removed from the Low Permeability Fill material.

3.2.6 The final surface of backfilled anchor trenches shall be constructed and trimmed to smooth and neat lines and be made to match the finished surface of the surrounding earthworks.

3.3 Runoff Collection Ditch:

3.3.1 The Runoff Collection Ditch shall be constructed by excavating the ditch section at the locations and to the lines and grades shown on dwg's HR-1 to HR-4 inclusive.

3.3.2 The ditch inside and outside slopes shall be cut to 3H:1V in all areas, unless otherwise noted.

3.3.3 The Runoff Collection Ditch shall be situated along the downgradient edge of the BioPad, inside the Containment Dyke. The Ditch shall slope at a grade of 0.50 %, west to east, so that runoff from the BioPad can be directed to and outlet into the Containment Pond located in the northeast corner of the BioPad.

3.3.4 Allowances shall be made for additional thickness of CCL in the area below the CCL along the centreline of the Ditch so that, once excavated to the design lines and grades, the thickness of the CCL is maintained at a minimum of 0.60 m (24").

3.4 Culvert Installations:

- 3.4.1 The base of the Culvert pipe trench shall be shaped so that the curved underside surface of the Culvert can fully contact the prepared ground.
- 3.4.2 The width of the Culvert trench shall be no more than three (3) times the pipe diameter (3 x D).
- 3.4.3 Embankment Fill shall be used to backfill Culvert pipe trenches.
- 3.4.4 Embankment Fill used to backfill the Culvert pipe trench shall be compacted to not less than ninety-five percent (95%) of the Maximum Dry Density.
- 3.4.5 Stones or rock fragments larger than 50 mm (2") shall be removed from the Embankment Fill material.
- 3.4.6 Culvert pipe trench backfill for the pipe zone shall be hand tamped with man-operated impact tampers (jumping jacks) or plate tampers. The use of self-propelled, mechanical equipment will not be permitted in the pipe zone. The pipe zone is defined as the area immediately below (bedding) and adjacent (haunch) to the Culvert and to a point 300 mm (12") above the crown.

END OF SECTION