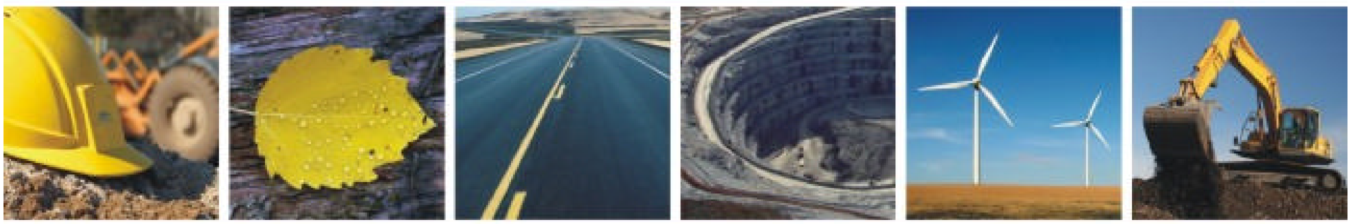
SHEAR DIAMONDS LTD.

LANDFARM MANAGEMENT PLAN
JERICHO DIAMOND MINE, NUNAVUT



REPORT

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APPENDICES

ACRONYMS & ABBREVIATIONS

AA	Atomic Absorption Spectrophotometry
ABA	Acid Base Accounting
ACM	Asbestos-containing Material
AEM	Aquatic Effects Monitoring
AIA	Aquatic Impact Assessment
AIRS	Adaptation and Impacts Research Section
ANCOVA	Analysis of Covariance
ANFO	Ammonium Nitrate Fuel Oil Explosives
ANOVA	Analysis of Variance
APEC	Areas of Potential Environmental Concern
ARD	Acid Rock Drainage
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
BACI	Before-after-control-impact
CALA	Canadian Association for Laboratory Accreditation
CCME	Canadian Council of Ministers of the Environment
CDA	Canadian Dam Association
CPK	Coarse Processed Kimberlite
DIAND	Department of Indian Affairs and Northern Development
DFO	Department of Fisheries and Oceans
DO	Dissolved Oxygen
EBA	EBA, A Tetra Tech Company
EC	Electric Conductivity
EIS	Environmental Impact Statement
EOC	Emergency Operations Centre
EPP	Emergency Preparedness Plan
ERP	Emergency Response Plan
ESA	Environmental Site Assessment
FSCF	Fuel Storage Containment Facility
FPK	Fine Processed Kimberlite
GC/FID	Gas Chromatograph - Flame Ionization Detector
GTC	Ground Temperature Cable
Hazmat	Hazardous Materials
HDPE	High Density Polyethylene
HVAS	High Volume Air Sampling
HWTA	Hazardous Waste Transfer Area
ICP-MS	Inductively Coupled Plasma – Mass Spectrometry
IDLH	Immediately Dangerous to Life and Health
INAC	Indian and Northern Affairs Canada
KIA	Kitikmeot Inuit Association
LBP	Lead-based Paint
LPRM	Long-term Post-reclamation Monitoring
MANOVA	Multivariate Analysis of Variance

MSDS	Material Safety Data Sheets
NIRB	Nunavut Impact Review Board
NP	Neutralization Potential
NWB	Nunavut Water Board
PHC	Petroleum Hydrocarbons
PKCA	Processed Kimberlite Containment Area
PPE	Personal Protection Equipment
QA	Quality Assurance
QC	Quality Control
RBC	Rotating Biological Contactor
RCM	Reclamation Construction Monitoring
ROM	Run of Mine
RPD	Relative Percent Difference
RRPK	Recovery Rejects Processed Kimberlite
SCBA	Self-contained Breathing Aparatus
Shear	Shear Diamonds (Nunavut) Corp.
SOP	Standard Operating Procedure
SPRM	Short-term Post-reclamation Monitoring
TDC	Tahera Diamonds Corporation
TDGR	Transportation of Dangerous Goods Act (RSNWT 1988) and Regulations
TDS	Total Dissolved Solids
TKN	Total Kjeldahl Nitrogen
TSS	Total Suspended Solids
WSCC	Workers' Safety and Compensation Commission of the Northwest Territories and Nunavut
WHMIS	Workplace Hazardous Materials Information System
WWTP	Wastewater Treatment Plant

2011 Water Licence Renewal Documents

AEMP	Aquatic Effects Monitoring Plan
AQMP	Air Quality Management Plan
CAMP	Care and Maintenance Plan
CMP	Contingency Management Plan
EP-RP	Emergency Preparedness and Response Plan for Dam Emergencies
GMP	General Monitoring Plan
ICRP	Interim Closure and Reclamation Plan
LDP	Preliminary Landfill Design Plan
LMP	Landfill Management Plan
LFDP	Preliminary Landfarm Design Plan
LFMP	Landfarm Management Plan
OMS	Operations, Maintenance, and Surveillance Manual
PKMP	PKCA Management Plan
SWMP	Site Water Management Plan
WEMP	Wildlife Effects Management Plan

WMP	Waste Management Plan
WRMP	Waste Rock Management Plan
WTMP	Wastewater Treatment Management Plan

1.0 INTRODUCTION

1.1 General

The Jericho Landfarm Management Plan (LFMP) has been developed to provide operating guidelines for the remediation of petroleum hydrocarbon (PHC) impacted soils generated on site. It also provides guidelines for the disposal of contaminated snow resulting from PHC spills occurring in the winter months.

The plan fulfills the requirements as specified in Part G and H of the Jericho Mine Water Licence NWB1JER0410 (issued December 21, 2004). However, this plan is being submitted to the Nunavut Water Board (NWB) in the absence of complete historical information as Shear Diamonds (Nunavut) Corp. (Shear) only assumed control of the project in August 2010. Since that time, Shear has discovered that detailed information on the present site conditions is limited. Comprehensive historical site monitoring records were not well maintained under previous ownership and management, and the available information is incomplete or lacking detail.

The LFMP has been based on existing records and the best available information at the time of report preparation. The plan has been redeveloped for the current regulatory requirements and to reflect Shear's commitment to the best practices in environmental stewardship. Once Shear has had an opportunity to investigate the site and gather information in 2011, the LFMP will be revised (if required). Subsequent revisions of the LFMP will be submitted for review and approval prior to resuming mining operations or commencing closure and reclamation activities.

1.2 Objective of the Landfarm Management Plan

The primary objective of the LFMP is to provide Shear and their designated contractors with operational guidelines for the proper handling, remediation, and disposal of PHC-impacted soils generated during site activities. This plan also includes provisions for handling PHC-contaminated snow, although contaminated snow volumes (and resulting meltwater) are expected to be significantly smaller than contaminated soil volumes.

At the time of the water licence renewal application, mining operations have been suspended, and the site is under care and maintenance. This document therefore reflects an estimation of the existing contaminated soil volumes on site, with provision for future spills during resumed operations. In addition to being a management tool, the LFMP was developed to assist Shear and the regulatory agencies with mine closure planning and the development of the Jericho Interim Closure and Reclamation Plan (EBA 2011e).

The LFMP includes:

- A discussion of landfarm processes;
- A summary of the landfarm design;
- A summary of criteria to evaluate soil remediation;
- Guidelines for landfarm management including soil acceptance criteria, landfarm operation, monitoring and disposal;

- Recommended safety procedures; and
- A discussion of research opportunities.

1.3 Background Information

The Jericho Mine Site is located approximately 260 km southeast of Kugluktuk, NU, and 30 km north of Lupin Mine. The Jericho Mine was constructed and operated by Tahera Diamond Corporation (TDC) between 2004 and 2008. In January 2008, mining operations were suspended by TDC, and the site was placed under care and maintenance. Shortly thereafter, Indian and Northern Affairs Canada (INAC) assumed control of the care and maintenance activities for the site. In August 2010, Shear purchased the Jericho Mine Site and its assets and assumed responsibility for the site.

Presently, the mine remains under care and maintenance as Shear evaluates the mineral resource. Once the evaluation is complete, a mine plan and operations schedule for the project will be established.

1.4 Linkages to Other Plans

The LFMP is part of the site wide management system. Other management plans that are related to or refer to the LFMP include:

- Aquatic Effects Monitoring Plan (AEMP);
- General Monitoring Plan (GMP);
- Waste Rock Management Plan (WRMP);
- Wastewater Treatment Management Plan (WTMP);
- Interim Closure and Reclamation Plan (ICRP); and
- Care and Maintenance Plan (CAMP) during periods where mining and processing operations are suspended.

2.0 LANDFARM PROCESSES AND PRINCIPLES

Landfarm treatment is an ex situ bioremediation treatment that uses naturally occurring microorganisms (predominantly aerobic) to metabolize and breakdown PHC in affected sediments or soils. Remediation is achieved by spreading impacted soils in a thin layer across the landfarm area. Stimulation of microbial growth and activity for PHC removal is accomplished primarily through the addition of air and nutrients. End products of bioremediation are microorganism protein, carbon dioxide, and water.

Volatilization also remediates PHC-impacted soil in landfarm treatment because PHCs are transferred from the soil to the air as a result of low PHC boiling points.

Cold climates decrease biodegradation rates, generating longer landfarm treatment times; however, PHC biodegradation is known to occur even in temperatures below 0°C (Rike et al. 2003).

Expected landfarm remediation time for contaminated soils at Jericho is six months to two years (Paudyn et al. 2007), but may be longer if optimal biodegradation conditions are not achieved. The effectiveness of landfarm treatment depends on three main parameters:

- Soil characteristics;
- Type of PHC; and
- Climatic conditions.

Soil characteristics include particle size, soil texture, bulk density, moisture content, and permeability. Soil nutrient composition is also important since nutrients are required for effective biodegradation. Microorganisms that break down PHCs in soil work best in an aerobic environment; therefore, introducing oxygen into the soil is important.

Climatic conditions influence landfarm efficiency. Climatic factors include rainfall, snow, wind effects, and temperature. Rain and snowmelt will change the moisture content of the remediating soil, and runoff can cause soil erosion. Landfarm soil erosion can also occur during windy periods particularly during tilling or plowing operations.

Temperature affects the rate of remediation because bacterial metabolism rates are typically reduced at very low temperatures. However, bacteria on site are acclimatized and subsequently better adapted to the cold environment, maintaining metabolic activity at colder temperatures.

3.0 DESIGN OVERVIEW

3.1 Landfarm Location

A landfarm was not constructed under the previous mine ownership. Shear will construct a landfarm, but the landfarm location has not yet been determined. Landfarm locations will be investigated in 2011 and incorporated into the final design for the facility. Shear does not anticipate constructing a landfarm until 2012 at the earliest.

3.2 Contaminated Soil/Snow Containment

Conceptually, the Jericho landfarm design consists of a lined, bermed enclosure that provides an up-gradient area for remediation of hydrocarbon-impacted soils and a down-gradient sump area to collect runoff. The liner system consists of a 60 mil HDPE liner sandwiched between nonwoven geotextile for protection. A minimum 600 mm of cover will be maintained over the liner system to preserve liner integrity. The liner and facility design is documented in the Jericho Preliminary Landfarm Design Plan (EBA 2011o).

The landfarm has been sized to accommodate approximately 3,500 m^3 of contaminated soil and limited quantities of contaminated snow. Staged remediation is planned for the estimated contaminated soil volume on site (6,500 m^3), which will be confirmed this year during a site investigation, as well as future contamination (estimated to be 2,500 m^3).

The landfarm has been designed with a centreline crown, which allows contaminated soils to be separated on either side of the facility. Runoff from each side is collected separately in two downstream, recessed sumps. These two graded areas allow for hydrocarbon-impacted soils to be segregated, depending on their contamination level and the remediation options being employed.

3.3 Security, Signage, and Fencing

The landfarm requires perimeter fencing to demarcate the landfarm limits and restrict entrance to the facility. Fencing should be of sufficient quality to:

- Prohibit wildlife and personnel from entering into the contaminated soil or sump areas, and
- Limit snow drifting within the landfarm area.

The landfarm facility must have warning signs, posted in both English and the local dialect, noting that:

- Dumping of materials without the permission of the VP Operations and/or Site Manager is prohibited, and
- The dangers and risks the facility poses to Jericho Mine personal and visitors.

Signage must also denote the responsible authority (VP Operations), operating period, and type of hazard (slip/trip, PHC-contaminated material, open water). The sump area should be clearly demarcated at the start and end of the season to warn personnel when snow cover may conceal underlying thin ice.

Ponding of PHC-contaminated water in the landfarm facility is a concern for possible bird landings. Sumps will be covered with ropes at two-metre intervals with flagging tape applied at one-metre intervals; sump areas will be monitored once per day during spring freshet and after rainfall events, and weekly at other times, to verify the effectiveness of bird deterrents.

4.0 SAFETY PROCEDURES

In addition to adherence to the Jericho Mine Health and Safety Plan, personnel in charge of operating the landfarm must have valid *Workplace Hazardous Materials Information System* (WHMIS) and *Transportation of Dangerous Goods* (TDG) training. They must also be trained in the procedures associated with landfarm operation, including the use of safety equipment (first aid supplies, eyewash station, fire extinguisher, spill response materials, etc.), emergency response procedures, soil tilling, record-keeping, soil and water sampling, and groundwater monitoring. Activities involving contaminated soils should be conducted under the supervision of site personnel having a 40-hour *Hazardous Waste Operations and Emergency Response Standard* (HAZWOPER) or *Canadian Hazardous Waste Workers Program* certificate.

Prior to landfarm operation, personnel must be provided with a clear explanation of the nature of the contamination at the facility and the site-specific personal protective equipment (PPE) required to complete the assigned tasks. If the nature or degree of contamination is such that respiratory equipment is required, personnel must be provided with task-appropriate respiratory protection and properly fit-tested prior to starting work at the landfarm facility. The selection of PPE is the responsibility of the site Occupational Hygienist, Corporate Safety Officer, or equivalent.

Personnel should be trained in how to decontaminate equipment and PPE. Washing hands prior to eating, smoking, etc., and showering at the end of the work day is mandatory after handling PHCs.

Personnel are encouraged to watch for and immediately report any unsafe conditions or damages to the landfarm facility, especially tears in the liner that could result during operations such as tilling.

5.0 REMEDIATION OBJECTIVES AND REFERENCE STANDARDS

5.1 Soil

Soil sampling to verify the completion of landfarm treatment includes testing for benzene, toluene, ethylbenzene and xylenes (BTEX) and the F1 to F4 hydrocarbon fractions. Other soil sample parameters, such as polycyclic aromatic hydrocarbons (PAHs), may be included for fuel wastes such as diesel fuels, heating oils, or other known PAH containing substances. Testing for metals is not required since soils will be tested for metals prior to acceptance to the landfarm and any landfarm treatment additives will have known metal chemistry.

Remediation objectives for BTEX and the F1 to F4 hydrocarbon fractions will depend on the subsequent use of the treated soils. Unless there are specific justifications to adjust values, soils will be treated to generic Tier 1 Criteria for PHC as provided by the Nunavut Guideline for Contaminated Site Remediation, 2009 (Government of Nunavut, 2009).

Without a site-specific risk assessment, agriculture/wildland Tier 1 Criteria for BTEX, fractions F1 to F4 hydrocarbons and PAHs must be met if the soils are to return to the environment, or upon mine closure.

Soils that do not respond to bioremediation treatment may be disposed of off site or, with prior approval, may be used as intermittent fill within an engineered on-site facility.

5.2 Water

Contact water resulting from contaminated snowmelt or runoff from the upstream landfarm area will be sampled and tested for several parameters, as listed in Appendix A, prior to discharge. The contact water shall meet the discharge criteria as defined in the water licence before it can be discharged to the processed kimberlite containment area (PKCA).

Parameters including temperature, pH, and electrical conductivity (EC) will also be measured in the field as well as at the laboratory.

The analytical results of BTEX will be compared with the *Canadian Water Quality Guidelines for the Protection of Aquatic Life*. Since no federal water quality guidelines for PHC F1 to F4 have been developed, the *Ontario Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act* will be adopted.

6.0 LANDFARM MANAGEMENT

6.1 Management Responsibility

The VP Operations and/or designate will be responsible for managing the landfarm, adhering to the Jericho Mine Health and Safety Plan, and following the Safety Procedures outlined in Section 3.0 while the mine remains on care and maintenance.

The site Environmental Health and Safety Manager or equivalent is responsible for the selection of personal respiratory PPE.

6.2 Spill Reporting

As per the Jericho Contingency Management Plan (EBA 2011c), spills of PHC products will be reported immediately by the person who caused the spill to their supervisor.

Upon notification of the spill event, the supervisor will arrange for:

- Cessation of the spill source, if not already done so by the person who caused the spill. Additional resources will be assigned to this task if required.
- Notification of the spill to the VP Operations or designate.
- Application of spill response materials and installation of containment barriers to prevent spill spread.
- Collection and transportation of contaminated soil, rock, snow, or ice to a location determined by the VP Operations and/or Site Manager.
- Completion of the Spill Log Report. The spill log report shall include:
  - Spill incident number
  - Date and time of incident
  - Date and time of notification
  - Location of spill
  - Product spilled
  - Estimated volume spilled
  - Receptor (soil, rock, snow, ice)
  - Names of witnesses to spill
  - Analytical conducted
  - Clean-up undertaken
  - Destination of contaminated material
  - Date report completed

– Name and signature

Upon notification of the spill event, the VP Operations and/or Site Manager will:

- Determine if analytical testing of soil, rock, snow, or ice within the spill area is required, and arrange for suitable testing. The recommended testing based on suspected soil contamination is summarized in Table 1.
- Decide the location where the soil, rock, snow, or ice will be transported to, managed, and stored.

Table 1: Recommended Analytical Based on Suspected Soil Contamination

Suspected Soil Contamination	Recommended Analytical Parameters						
	PHC Fractions	BTEX	TPH (calculated)	Total Metals*	PCBs	Phenols	PAHs
Unleaded gasoline	X	X	X	X			
Leaded gasoline, aviation gasoline	X	X	X	X			
Fuel oil, diesel, kerosene, jet fuel, mineral oil/spirits, motor oil	X	X	X	X			X
Petroleum solvents	X		X		X		
Crude oils, hydraulic fluids	X		X	X			X
Waste petroleum products	X	X	X	X	X	X	X

*Total metals - CCME metals as provided by the Nunavut Guideline for Contaminated Site Remediation, 2009.

6.3 Acceptance of Contaminated Soils

6.3.1 Soil Lithology

Contaminated soils for landfarm treatment should be less than 40 mm in diameter. Rocks exceeding 40 mm in diameter are not suitable for landfarm treatment and will not be accepted into the landfarm area.

Contaminated soils containing rock exceeding 40 mm in diameter may require screening or sorting prior to landfarm acceptance. Oversized material will be treated as directed by the site and environment managers, and placed in a segregated area of the waste rock stockpile.

6.3.2 Soil Chemistry

PHC are described by laboratory analysis as lubricating oil and grease, fuel oil, diesel, and/or gasoline.

Contaminated soils will be deemed treatable or untreatable through submission of one composite sample obtained from five discrete soil samples representative of a 100 m^3 soil volume. For small batches of soil samples (less than 10 samples), at least one blind duplicate should be analyzed per batch of samples. For larger batches of soil samples (greater than 10 samples), 10% duplicates should be analyzed.

To avoid microorganism toxicity and/or accumulation of materials that cannot be remediated in the landfarm, PHC-impacted soils shall have less than 3% total petroleum hydrocarbons (TPH), or approval of the VP Operations and/or Site Manager, for acceptance to the landfarm treatment facility.

In addition, the PHC-impacted soils accepted to the landfarm treatment facility shall be up to, but not exceed, Tier 1 agricultural values or natural background concentrations for the following parameters:

- F3/F4 hydrocarbon fractions,
- Electrical Conductivity (EC),
- Sodium Adsorption Ratio (SAR),
- pH, and
- CCME metals.

Natural background concentrations should be determined with a site-specific risk assessment.

Contaminated soils exceeding the landfarm acceptability criteria above, or not approved for landfarm treatment by the VP Operations and/or Site Manager, should be considered hazardous waste and disposed accordingly.

Chlorinated hydrocarbons and heavy fraction PHC (lubricating oil and grease, hydraulic oil, tar, asphalt) are not suitable for landfarm treatment because they are difficult to biodegrade without enhancement.

Treatability studies are not required for F1/F2 hydrocarbon fractions since both have been successfully biodegraded in cold climates in a variety of soil types.

6.4 Landfarm Operation

6.4.1 Cell Development and Soil Thickness

After contaminated soil is excavated and transported to the landfarm area, soils should be dumped in one of two lined graded areas as specified by the VP Operations and/or Site Manager. Soil placement should maintain a minimum 1.5 m offset from the inside berm toe. Soils should be spread with a front-end loader or bulldozer until a layer approximately 0.3 m to 0.45 m deep is formed; the soil layer should not exceed a depth of 0.5 m at any location. Soil should be hauled to the landfarm using trucks with a maximum tire pressure of 350 kPa. Tandem axle haul trucks may be unsuitable for this purpose.

During deposit, the contaminated soil should be tilled with a backhoe, disk, or rototiller to disperse soil clumps and mix and aerate the soil material. Only tilling equipment should be permitted on the landfarm soil during tilling. Trucks or other vehicles should not drive on the landfarm soil because this will pack the soil, making it more difficult to handle, and may prolong the soil remediation timeframe.

If the graded areas in the landfarm are covered in ice or snow, the landfarm soil base is saturated, or the landfarm is at capacity, transported contaminated soil should be placed in soil piles (biopiles), not exceeding 2 m to 3 m in height, within the lined upgradient area of the facility. Concrete barriers, or other suitable barriers, should be placed between biopiles from different contaminant sources and/or spill dates, and each biopile area labelled with the:

- Type of contaminant;
- Spill date; and
- Spill incident number.

Once the graded area is dry and/or the remediated landfarm soils are removed, the biopiled material can be transferred to one of the graded areas.

Spills from different contaminant sources or spill dates should only be combined if specified to do so by the VP Operations and/or Site Manager.

6.4.2 Contaminated Snow and Ice

Contaminated snow and ice should be trucked directly to the landfarm and placed in one of two sump areas, as directed by the VP Operations and/or Site Manager. Snow can be dumped on a soilless portion of the upstream landfarm area and pushed into the sump with a bulldozer, or other equipment. Meltwater, generated from the contaminated snow, will be accommodated using the water management procedures outlined in Section 6.5.

6.4.3 Winter Landfarm Management

For the winter months, contaminated soils excavated from site can be biopiled within the upstream landfarm area to minimize contact with freshet water and spread during following spring/summer. Biopiles should not exceed 3 m in height.

Before spring thaw, snow and ice accumulated within the landfarm area can be removed and placed outside the landfarm facility to melt, if it has not come in contact with the underlying contaminated soil. Landfarm soils should not be disturbed during the snow removal process and approximately 100 mm of contact snow cover should remain on all surfaces. If the landfarm soils are disturbed, contact snow should remain in the landfarm area and be deposited in the sump to melt. Similarly, snow accumulation within the sump area should be removed to within 100 mm of the ice surface.

6.4.4 Soils Testing

At the start of the landfarm treatment season, soils should be evaluated for optimal nutrient, moisture, and pH content to achieve most efficient microbial biodegradation of PHC conditions. Soils in the landfarm area should have:

- A carbon:nitrogen:phosphorous (C:N:P) nutrient concentration ratio between 100:10:1 and 100:1:0.5 calculated from the bulk density and total hydrocarbon concentration,
- A soil moisture content between 40% and 85% field capacity[1], and
- A soil pH between 6 and 8.

[1] Field capacity is the maximum %-weight of moisture the unconfined, gravity-drained soil can retain. An example would be a sandy soil with a field capacity of 50%, meaning a maximum of 500 g of water retained in 1,000 g (dry weight) of unconfined soil.

If testing indicates soil conditions differ from those above, soil bioremediation products can be added for ampling (as discussed in Section 6.4.5). Additional nutrient, moisture, or pH testing should occur during the summer season if soil conditions are suspected to differ from the start of the landfarm treatment season, or at the discretion of the environment manager.

Soil sampling to verify interim treatment includes collecting samples for BTEX and F1 to F4 hydrocarbon fraction analysis. Periodic measurement of hydrocarbon vapour emissions, by measuring headspace with a photoionization detector (PID), is a useful indicator of remediation progress but should not be substituted for remediation verification sampling.

Biodegradation rates can slow or cease due to excessive salt content, PHC concentrations, etc. If biodegradation is suspected to be stalled, a microbial population density test can be conducted after a freeze or drought. The minimum heterotrophic plate count should be at least 10^3 CFU/g (colony forming units/gram). However, it is highly unlikely that there will be insufficient microorganisms in the accepted soil to initiate effective bioremediation unless soils are chemically unsuitable for microorganism growth. For this reason, heterotrophic plate count analysis is generally not necessary.

6.4.5 Bioremediation Product Addition (Ampling)

Landfarm treatment time can be reduced by maintaining optimal soil conditions for microbial PHC biodegradation. The following are suggestions for amending landfarm soil conditions if testing does not indicate optimum remediation conditions are present in the landfarm:

- Soil lithology: Bulking agents such as gypsum or sawdust can be added to clayey soils to increase soil surface area for microorganism growth.
- Nutrients: Fertilizer can be applied in solid form during tilling or in liquid form during irrigation to increase nitrogen and phosphorous concentrations. Choosing a slow-release fertilizer will reduce application frequency. Fertilizer can, however, lower pH and increase salt concentrations harmful to biodegradation.
- Moisture: To increase moisture retention, organic matter can be tilled into the landfarm soil. Irrigating with sump water, freshwater, or application of fresh snow are also acceptable means of increasing soil moisture content. Recycled water from the sump should preferably not contain any PHC sheen, which could be removed by using absorbents, or avoided by drawing water from beneath the water surface.
- pH: The addition of lime will increase soil pH. Conversely, the addition of elemental sulphur will decrease pH.
- Microbial population density: Cold-adapted microorganisms native to arctic and sub-arctic regions are not readily available, and the addition of non-indigenous bacteria to the landfarm is not recommended due to limited success in Canada. Of note, biotechnology products containing microorganisms, biochemicals (enzymes), or biopolymers, may be subject to the New Substances Notification (NSN) Regulations of the Canadian Environmental Protection Act, 1999.

6.4.6 Tilling and Aeration

Most soil microorganisms degrade PHC better in an aerobic environment. Tilling should therefore be conducted weekly in the summer months to aerate the soil and enhance microbial activity.

Emissions controls must be implemented for lighter hydrocarbon volatilization. Tilling should therefore only be conducted when prevailing winds direct landfarm vapours away from activities at Jericho.

Weekly tilling should occur when the soil moisture content is within the optimal field capacity of 40% to 85%. Very dry soils should not be tilled until after irrigation to avoid dust generation. Wet soils do not benefit from tilling due to compaction of the soil by passing equipment. If soils appear muddy, or stick to the tires of the equipment, it is too wet to till.

Tilling should only be carried out by an experienced, trained operator. Only the contaminated soils layer (0.3 m to 0.45 m depth) should be tilled as tilling can damage the underlying liner. Any damage of the underlying liner, surrounding berms, or sump area must be reported to the VP Operations and/or Site Manager immediately.

6.4.7 Equipment and Rock Washing

All equipment in contact with contaminated materials must be washed before further use. This equipment includes, but is not limited to, contaminated material collection equipment, transport vehicles, sorters, and tilling equipment. Rock, larger than 40mm in diameter, can also be washed at the discretion of the VP Operations and/or Site Manager. All washing can occur on a soilless portion of the upstream landfarm area, and runoff collected in the sump. Special care should be taken to not saturate nearby landfarm soils.

6.5 Contact Water

Contact water is considered all irrigation water, precipitation, and snowmelt that collects in the landfarm sumps. The landfarm sumps have been designed to accommodate the annual 1:10 year precipitation event; however, to reduce the risk of inundating landfill soils, the landfarm sump contact water should be removed prior to freeze up. During the frost-free months, and only if contact water is present in the sump, one or two sets of water samples will be collected and submitted to an accredited laboratory for analysis. The water will be tested against the parameters outlined in Section 5.0.

Impound water meeting the applicable discharge criteria will be discharged to the Processed Kimberlite Containment Area (PKCA).

Water that does not meet discharge criteria will require on-site treatment or off-site disposal. On-site treatment may involve PHC separation units or a metal extraction system. PHC separation units would facilitate natural separation of PHC and water via stagnation. Absorbent material at the liquid surface would remove separated PHC from the system. Water would be transferred from the base of the first PHC separation unit to a second unit where the process would be repeated, followed by an industrial metal extraction system.

6.6 Summary of Inspections and Reporting

Monitoring and inspection is required as part of successful landfarm operation. Table 2 provides a summary of inspections and reporting associated with the operation of the landfarm.

Table 2: Monitoring Summary and Documentation

Item	Purpose	Frequency	Type of Record(s)
Landfarm Treatment Operations Inspection	Record keeping of treatment operations and berm performance for due diligence.	Once per day during spring freshet and after rainfall events. Weekly at other times.	▪ Inspection checklist and field notes including date, weather, and facility condition including any repairs required, odour noted, quantity of water in sump and amount of freeboard. ▪ Record of berm performance with emphasis on observations of cracking or any signs of instability. ▪ Check soils to see if they are too dry or too wet to till. ▪ Record of any unauthorized discharges and follow-up action taken. ▪ Photographic record.
Pooled Water Area Inspection	To determine effectiveness of bird deterrents.	Once per day during spring freshet and after rainfall events. Weekly at other times.	▪ Document number and species of bird landings in pooled water area(s). ▪ Photographic record.
Soil Sampling for Soils Acceptance at Facility	To determine if soils are acceptable for treatment at facility.	For this purpose-built facility, only one time per year at the start of season. Otherwise as circumstances require.	▪ Soils origin and associated spill report number. ▪ Field notes including frequency of sampling, soil texture, moisture content, colour, odour. ▪ Laboratory-issued reports including QA/QC. ▪ Summary tabulation of results. ▪ Documentation of fate of rejected soils. ▪ Record of any treatability tests done.
Soil Sampling for Remediation Progress Monitoring	To provide interim indications of remediation progress.	Monthly during the frost-free months.	▪ Field notes and sketch of location and depth of samples taken. ▪ Photographic record. ▪ Laboratory-issued reports including QA/QC and chain of custody. ▪ Summary tabulation of results. ▪ Analysis of percent removal of hydrocarbon constituent treated and treatment time; evaluation should include weather information, soil texture, and soil moisture.

Table 2: Monitoring Summary and Documentation

Item	Purpose	Frequency	Type of Record(s)
Soil Sampling for Verification of Remediation	To determine if remedial objectives have been met.	For this purpose-built facility, only one time per year at the end of season. Otherwise as circumstances require.	▪ Field notes and sketch of location and depth of samples taken. ▪ Photographic record. ▪ Laboratory-issued reports including QA/QC ▪ Summary tabulation of results. ▪ Analysis of percent removal of hydrocarbon constituent treated and treatment time. ▪ Documentation of fate of treated soils. ▪ Annual quantities in cubic metres of all soil and types of contaminants.
Contact Water Sampling During Remediation	Due diligence operations monitoring.	One or two times per treatment season	▪ Field notes and observations made at time of sampling. ▪ Laboratory-issued reports including QA/QC and summary tabulation of results.
Contact Water Sampling prior to Discharge	To conform to Water Licence Requirements.	As required prior to discharge.	▪ Document notification of INAC Inspector (written notification at least 10 days prior to discharge). ▪ Record depth of water in sump. ▪ Calculate approximate water volume to be discharged. ▪ Laboratory-issued reports including QA/QC and summary tabulation of results.
Groundwater Monitoring and Sampling	Date, time, weather, water level, in-well parameters (temperature, pH, electrical conductivity), visual observations of water colour and turbidity, odour.	Water sampling one time per year, between mid-August and mid September.	▪ Laboratory-issued reports including QA/QC and summary tabulation of results, trend analysis (after a minimum of four years of data, if applicable).
Construction Summary Report	As-built and construction report as per Water Licence.	Submit to Nunavut Water Board within 90 days of completion of construction	▪ Construction field notes and observations ▪ Record and as-built drawings ▪ Monitoring well installation details. ▪ Summary of any geotechnical testing, compaction, moisture content, particle size analysis.

Table 2: Monitoring Summary and Documentation

Item	Purpose	Frequency	Type of Record(s)
Site Safety Inspections	To identify any new or previously unnoticed physical/chemical hazards.	Monthly, or when conditions change, or when an unsafe condition is reported by a worker.	▪ Any unsafe condition/near-miss/ incident reports and records. ▪ Any unsafe conditions reported by workers must be reported to the Site Manager immediately for prompt action.
Geotechnical Inspection	To ensure facility has not been degraded or damaged, and to identify any maintenance requirements.	Annually	▪ Inspection of geotechnical performance of facility. ▪ Document recommendations of any repair/maintenance work. ▪ Record of any repair work made to the facility.

6.7 Research

For larger spills that occupy both graded areas of the landfarm, opportunities exist for research and development, modifying the above methodology. The site and environment managers may choose to alter any one of the optimal conditions above, keeping the adjacent graded cell constant to observe changes in microbial biodegradation efficiency.

One suggested research and development area is using treated wastewater for irrigation. Irrigation is used to increase soil moisture or to suppress dust within the landfarm area during dry periods, and add nutrient amendments. Treated wastewater is potentially a valuable source of nutrients (especially nitrogen), and reclaimed water irrigation of the landfarm could reduce or possibly eliminate dry chemical nutrient amendment requirements. In addition to reducing freshwater consumption, recycling nutrients already available in treated sewage benefits the environment by offsetting greenhouse gas emissions that would otherwise be generated in the production and shipment of dry chemicals to the mine.

Such use of reclaimed water would require authorization from the NWB and other stakeholders. The water would need prior characterization for suitability, including the C:N:P ratios and routine chemistry parameters.

If reclaimed wastewater is used during the treatment process, contact water discharge parameters would need to meet the BOD_5 maximum average concentration of 15.0 mg/L, oil and grease concentration of 3.0 mg/L, and faecal coliforms of 10 CFU/100 mL in addition to the standard water licence discharge requirements.

6.8 Groundwater Monitoring

Groundwater monitoring will be implemented to evaluate any changes in groundwater quality resulting from potential landfarm releases. The monitoring method depends on the foundation conditions of the landfarm and local topography. If the landfarm is constructed on a large waste rock pad or on the waste rock pile, monitoring wells may not effectively evaluate groundwater quality, so surface testing from the pad toe may prove more effective. Shear will evaluate the monitoring method once the landfarm location has been determined.

Groundwater will be monitored once per year in mid-August to mid-September, or when free water is available for sampling. Samples collected will be submitted to an accredited laboratory for analysis. In accordance with the water licence, the parameters for analysis of groundwater samples are included in Appendix A. Parameters including temperature, pH, TDS, and electrical conductivity will be measured in the field as well as the laboratory.

For groundwater samples, a blind duplicate and field blank sample will be collected and analyzed with each batch of samples tested.

The analytical results of BTEX will be compared with the *Canadian Water Quality Guidelines for the Protection of Aquatic Life*. Since no federal water quality guidelines for PHC F1 to F4 have been developed, the *Ontario Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act* will be adopted.

Any groundwater parameter exceeding applicable guidelines will be reported to the Environment Protection Division (EPD) immediately.

6.9 Landfarm Closure

The landfarm will be decommissioned at mine closure. The liner system will be removed and the berms graded to promote positive drainage across the site. Remediated soils remaining in the landfarm can either be graded with the landfarm facility or removed for other site applications.

Details pertaining to the landfarm closure are provided in the Jericho Interim Closure and Reclamation Plan (EBA 2011e).

7.0 QUALITY CONTROL MONITORING

The general quality assurance and quality control are to follow *QA/QC Guidelines for Use by Class "B" Licensees in Meeting SNP Requirements* (INAC 1996). All samples are to be collected using best industry practices and shall be submitted under a chain-of-custody protocol.

Sampling protocols adhered to include the following:

- Disposable sampling gloves are to be worn during the collection of samples and discarded between sampling events. Sampling tools are to be decontaminated between sampling points.
- Any sampling and inspection events should be documented in field notes including identification of the person conducting the work. It is beneficial to photograph any work that is conducted.
- Samples collected for laboratory analysis are to be placed in coolers and transported to the laboratory via courier.
- Sample holding times are to be adhered to, and water samples are to be preserved for specific analyses.
- All water and soil samples are to be collected in laboratory-supplied bottles and jars, and analyzed at a Canadian Association of Laboratory Accreditation (CALA) accredited laboratory. All analytical reports are to include QA/QC reports.

8.0 CLOSURE

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PERMIT TO PRACTICE
EBA ENGINEERING CONSULTANTS LTD.
Signature
Date Feb 28, 2011
PERMIT NUMBER: P 018
NWT/NU Association of Professional Engineers and Geoscientists

Reviewed by Shear Diamonds Ltd.

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2011 WATER LICENCE RENEWAL DOCUMENTS

Management Plans

EBA, A Tetra Tech Company (EBA), 2011a. Aquatic Effects Monitoring Plan, Jericho Diamond Mine, Nunavut. Prepared for Shear Diamonds Ltd., February 2011.

EBA, A Tetra Tech Company (EBA), 2011b. Care and Maintenance Plan, Jericho Diamond Mine, Nunavut. Prepared for Shear Diamonds Ltd., February 2011.

EBA, A Tetra Tech Company (EBA), 2011c. Contingency Management Plan, Jericho Diamond Mine, Nunavut. Prepared for Shear Diamonds Ltd., February 2011.

EBA, A Tetra Tech Company (EBA), 2011d. General Monitoring Plan, Jericho Diamond Mine, Nunavut. Prepared for Shear Diamonds Ltd., February 2011.

EBA, A Tetra Tech Company (EBA), 2011e. Interim Closure and Reclamation Plan, Jericho Diamond Mine, Nunavut. Prepared for Shear Diamonds Ltd., February 2011.

EBA, A Tetra Tech Company (EBA), 2011f. Landfarm Management Plan, Jericho Diamond Mine, Nunavut. Prepared for Shear Diamonds Ltd., February 2011.

EBA, A Tetra Tech Company (EBA), 2011g. Landfill Management Plan, Jericho Diamond Mine, Nunavut. Prepared for Shear Diamonds Ltd., February 2011.

EBA, A Tetra Tech Company (EBA), 2011h. Processed Kimberlite Management Plan, Jericho Diamond Mine, Nunavut. Prepared for Shear Diamonds Ltd., February 2011.

EBA, A Tetra Tech Company (EBA), 2011i. Site Water Management Plan, Jericho Diamond Mine, Nunavut. Prepared for Shear Diamonds Ltd., February 2011.

EBA, A Tetra Tech Company (EBA), 2011j. Waste Management Plan, Jericho Diamond Mine, Nunavut. Prepared for Shear Diamonds Ltd., February 2011.

EBA, A Tetra Tech Company (EBA), 2011k. Waste Rock Management Plan, Jericho Diamond Mine, Nunavut. Prepared for Shear Diamonds Ltd., February 2011.

EBA, A Tetra Tech Company (EBA), 2011l. Wastewater Treatment Management Plan, Jericho Diamond Mine, Nunavut. Prepared for Shear Diamonds Ltd., February 2011.

Design Reports

EBA, A Tetra Tech Company (EBA), 2011m. C1 Diversion Construction Summary, Jericho Diamond Mine, Nunavut. Prepared for Shear Diamonds Ltd., February 2011.

EBA, A Tetra Tech Company (EBA), 2011n. Fuel Storage Containment Facility Design Plan, Jericho Diamond Mine, Nunavut. Prepared for Shear Diamonds Ltd., February 2011.

EBA, A Tetra Tech Company (EBA), 2011o. Preliminary Landfarm Design Plan, Jericho Diamond Mine, Nunavut. Prepared for Shear Diamonds Ltd., February 2011.

EBA, A Tetra Tech Company (EBA), 2011p. Preliminary Landfill Design Plan, Jericho Diamond Mine, Nunavut. Prepared for Shear Diamonds Ltd., February 2011.

Additional Plans

EBA, A Tetra Tech Company (EBA), 2011q. Operations, Surveillance, and Maintenance Manual, PCKA Dams, Jericho Diamond Mine, Nunavut. Prepared for Shear Diamonds Ltd., February 2011.

EBA, A Tetra Tech Company (EBA), 2011r. Emergency Preparedness and Emergency Response Plan for Dam Emergencies at the Jericho Diamond Mine, Nunavut. Prepared for Shear Diamonds Ltd., February 2011.

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Canadian Council of Ministers of the Environment, 2008, Canada-Wide Standards for Petroleum Hydrocarbons in Soil (CWS-PHC). Winnipeg, Manitoba.

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APPENDIX A

APPENDIX A PARAMETERS FOR ANALYSIS OF GROUNDWATER SAMPLES

Analyzed Water Parameters and Detection Limits

Analytical Package	Parameters	Detection Limits	Unit
Total and Dissolved Metals (ICP-T, ICP-D)	Aluminum (Al)	0.0002	mg/L
	Antimony (Sb)	0.000005	mg/L
	Arsenic (As)	0.00002	mg/L
	Barium (Ba)	0.00002	mg/L
	Beryllium (Be)	0.000002	mg/L
	Bismuth (Bi)	0.000005	mg/L
	Boron (B)	0.005	mg/L
	Cadium (Cd)	0.000005	mg/L
	Calcium (Ca)	0.05	mg/L
	Chromium (Cr)	0.00005	mg/L
	Cobalt (Co)	0.00005	mg/L
	Copper (Cu)	0.00005	mg/L
	Iron (Fe)	0.01	mg/L
	Lead (Pb)	0.000005	mg/L
	Lithium (Li)	0.0002	mg/L
	Magnesium (Mg)	0.05	mg/L
	Manganese (Mn)	0.000005	mg/L
	Mercury (Hg)	0.00005	mg/L
	Molybdenum (Mo)	0.00005	mg/L
	Nickel (Ni)	0.00005	mg/L
	Phosphorus (P)	0.05	mg/L
	Potassium (K)	0.2	mg/L
	Selenium (Se)	0.00004	mg/L
	Silicon (Si)	0.05	mg/L
	Silver (Ag)	0.000005	mg/L
	Sodium (Na)	0.2	mg/L
	Strontium (Sr)	0.00001	mg/L
	Thallium (Tl)	0.000002	mg/L
	Tin (Sn)	0.00002	mg/L
	Titanium (Ti)	0.00005	mg/L
	Uranium (U)	0.000002	mg/L
	Vanadium (Va)	0.00001	mg/L
	Zinc (Zn)	0.0001	mg/L

Analytical Package	Parameters	Detection Limits	Unit
Routine Parameters (R)	Alkalinity ($CaCO_3$)	5	mg/L
	Acidity ($CaCO_3$)	5	mg/L
	Chloride	0.5	mg/L
	Carbonate (Co_3)	5	mg/L
	Bicarbonate (HCO_3)	5	mg/L
	Total Hardness ($CaC0_3$)	1	mg/L
	Hydroxide (OH)	5	mg/L
	Sulphate (SO_4)	0.05	mg/L
	Total Suspended Solids (TSS)	3	mg/L
	Total Dissolved Solids (TDS)	5	mg/L
	Total Organic Carbon (TOC)	1	mg/L
	Total Inorganic (TIC)	1	mg/L
	pH	0.1	-
	Conductivity (uS/cm)	0.2	uS/cm
	Turbidity	0.1	NTU
Nutrients (N)	Nitrate (NO_3)	0.006	mg/L
	Nitrite (NO_2)	0.002	mg/L
	Ammonia (NH3)	0.005	mg/L
	Orthophosphate	0.001	mg/L
	Total Phosphorus	0.001	mg/L
Biological (B)	Biochem Oxygen Demand	5	mg/L
	Fecal Coliforms	1	CFU/100 mL
	Oil & Grease	1	mg/L
Petroleum Hydrocarbons (PHCs)	Benzene	0.0005	mg/L
	Ethylbenzene	0.0005	mg/L
	Toluene	0.0005	mg/L
	o-Xylene	0.0005	mg/L
	m+p-Xylene	0.0005	mg/L
	Xylenes	0.0005	mg/L
	F1(C6-C10)	0.1	mg/L
	F1-BTEX	0.1	mg/L
	F2 (>C10-C16)	0.25	mg/L
	F3 (C16-C34)	0.25	mg/L
	F4 (C34-C50)	0.25	mg/L

Note:
1. The detection limits are provided by ALS Laboratory Group.