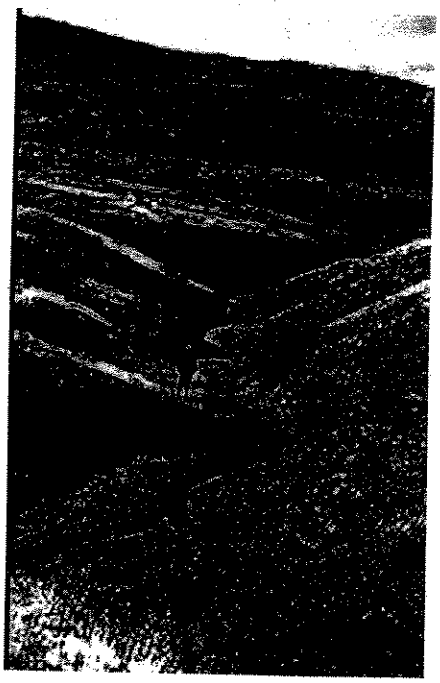
*FORMER MILITARY FACILITY CLEAN UP*
*IQALUIT AIRPORT*
*IQALUIT, NUNAVUT*

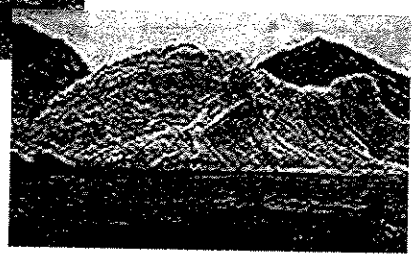
*SOLICITATION No.: E0213-04C018/A*

Transport Canada

Prairie and Northern Region
Environmental Affairs
3-344 Edmonton Street
P.O. Box 8550
Winnipeg, MB R3C 0P6

# TECHNICAL AND PROJECT TEAM PROPOSAL







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ENVIRONMENTAL SERVICES

**WINNIPEG ENVIRONMENTAL REMEDIATIONS INCORPORATED**

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December 13, 2004

Dear Transport Canada Representative:

Winnipeg Environmental Remediations Incorporated (WERInc), also referred to as the Contractor, is pleased to submit this document in response to the Request for Proposal (RFP) issued for the remedial project at Iqaluit Airport, Iqaluit, Nunavut Territories (Solicitation No.: E0213-04C018/A). The Consultant certifies that no less than 80% of the bid price for the goods and/or services being offered for this project consists of Canadian content.

This document has been completed as per the terms outlined in the RFP issued by Public Works & Government Services Canada (PWGSC). Documents submitted by the Contractor include the Technical & Project Team Proposal (4 copies) and the Price Proposal (1 copy), which has been submitted in a separate envelope.

The Consultant has completed numerous projects with activities very similar to those outlined as part of the Iqaluit Airport remediation project. The Consultant is committed to meeting the requirements of the client. The Consultant is also devoted to providing a safe working environment for the safety of its workers, the workers of the airport and the general public.

The Consultant has committed the following personnel and subcontractors for the successful completion of the project:

| Personnel | Role |
|---|---|
| Miles Antony | Project Manager, LTU Construction/Maintenance Specialist |
| Dennis Antony, B.Sc., R.R.D., CPESC | Alternate PM, Environmental Scientist, Safety Officer |
| Art Brown | Construction Supervisor |
| Clark Hryhoruk, M.Sc., P.Eng. | Environmental Engineer |
| Arthur Magri, B.Sc. | Environmental Technician |
| Victor Lee, M.L.A., CPESC | Landscape Architect, Erosion Control Specialist |

| Subcontractors | Role |
|---|---|
| RL Hanson Construction Limited (Iqaluit) | Heavy Equipment Rental and General Labour |
| Enviro-Test Laboratories | Laboratory Analyses |

We look forward to hearing from you and thank you in advance for providing us with the opportunity of submitting this proposal.

Sincerely,

David Antony

David Antony, President
Winnipeg Environmental Remediations Incorporated

# TECHNICAL AND PROJECT TEAM PROPOSAL

## FORMER MILITARY FACILITY CLEAN-UP
## IQALUIT AIRPORT
## IQALUIT, NUNAVUT
## SOLICITATION No.: E0213-04C018/A

Submitted to:

PUBLIC WORKS & GOVERNMENT SERVICES CANADA
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December 2004

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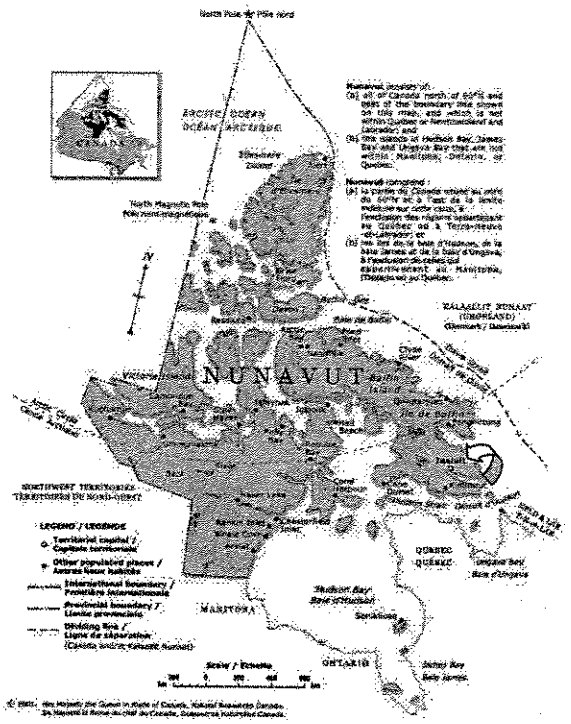
# EXECUTIVE SUMMARY




This proposal is for the supply of environmental remediation services to be undertaken at Iqaluit Airport, Iqaluit, Nunavut by Winnipeg Environmental Remediations Incorporated (WERI), also referred to as the Contractor. The Technical and Project Team Proposal is being submitted in response to the Request for Proposal (RFP) issued by Public Works & Government Services Canada (PWGSC) (Solicitation No.: E0213-04C018/A) on behalf of Transport Canada (TC), also referred to as the Client. A Price Proposal has been submitted in conjunction with the Technical and Project Team Proposal, which was presented in a separate envelope, as per the requirements of the RFP. This document will detail the methodology that the Contractor will implement to complete the technical requirements of the project and it will introduce the project team members that have been assigned to this project.

The remedial work required by TC at Iqaluit Airport includes the ex-situ treatment of petroleum hydrocarbon contaminated soil removed from two sites, namely, the former military site adjacent to runway 18-36 and the two existing cells of the Land Treatment Unit (LTU) at the Fire Training Area (FTA). An LTU lined with a geomembrane liner will be commissioned by the Contractor to contain the petroleum hydrocarbon contaminated soil removed from the former military site and the LTU sites. The LTU will be designed to contain 5000 $m^3$ of contaminated soil with a treatment layer depth of 1 m. The base of the LTU will be lined with a polyvinyl Arctic Liner®, supplied by the Client, to prevent contaminants from leaching into the subsoil beneath the base. Three (3) groundwater monitoring wells will be installed at the LTU site to monitor site conditions during the treatment of the contaminated soil.

The contaminated areas at the former military site include a stockpile of previously excavated contaminated soil and an area with surficial staining of soil that is located in the vicinity of two concrete pads. It is estimated that 700 $m^3$ of stockpiled and in-situ (beneath the stockpile) petroleum hydrocarbon contaminated soil is to be removed from the stockpile area and placed in the newly commissioned LTU. An additional 300 $m^3$ of petroleum hydrocarbon contaminated soil will be excavated from five surface stained locations in vicinity of the concrete pads, which is also to be placed in the LTU. The petroleum hydrocarbon contaminated soil from the stockpile area may contain various pieces of debris such as cables, wiring, rebar and general debris. The waste shall be

sorted during contaminated soil removal and disposed accordingly at the local Government of Nunavut licensed landfill. A silt fence will be erected in an area between the contaminated soil stockpile and the adjacent river to prevent contaminants from reaching the nearby waterway.

Field screening and confirmatory soil sampling will be conducted during contaminated soil excavation. The field screening will be used to direct excavating activities and confirmatory soil sampling will be conducted on the sidewalls and base of the excavated areas to ascertain that the remaining soil does not contain hydrocarbon concentrations in excess of the applicable industrial criteria of the Government of the Northwest Territories (GNWT) and the Canadian Council of Ministers of the Environment (CCME). If water is encountered during the excavation process it will be sampled as well and submitted along with the soil samples to an accredited laboratory for analysis. Any contaminated water encountered will be pumped out of the excavated area and treated or disposed in an approved manner.

Upon completion of contaminated soil removal, the excavated areas will be restored to pre-existing conditions. The excavations will be backfilled and compacted with clean fill, and the sites will be graded to match surrounding drainage patterns. Backfilled material will be placed in lifts of 150 mm and compacted to 90% Standard Proctor.

Furthermore, the Contractor will also remove 2500 $m^3$ of petroleum hydrocarbon contaminated soil from the two previously commissioned cells of the LTU at the FTA. This soil will be placed in the newly commissioned LTU. The existing LTU cells will remain in place at the FTA site.

Additional work to be conducted at the former military site includes the removal and disposal of chain link fencing near the abandoned transformers; removal and disposal of several telephone poles; removal of non-polychlorinated biphenyl (PCB) oil contained within the three transformers; and removal and disposal of the transformers.

All laboratory testing will be conducted by an accredited laboratory. A report detailing the remedial activities conducted by the Contractor at Iqaluit Airport, and the results of the sampling programs will be provided to TC upon completion of site work. All results will be presented in table format

This work is to be done in conjunction with TC' s commitment to bring Iqaluit Airport in compliance with current Canadian environmental regulations. The work requires a team that is experienced in the remediation, testing, sampling and analysis of soil and water along with an understanding of airport procedures and operations. The Contractor has successfully completed several projects with TC and other clients that have involved exactly this type of work in similar locales and conditions. The Contractor has carefully reviewed the RFP to assist TC with the undertaking of the remedial activities at Iqaluit Airport and offers the following proposal.

# 1.0 INTRODUCTION

## 1.1 Understanding of the Project

As part of the airport transfer agreement between TC and the Government of Nunavut Environmental Site Assessments (ESAs) were conducted at Iqaluit Airport to identify outstanding environmental issues that existed prior to the airport transfer. As a result of the findings of the ESAs a Remedial Action Plan (RAP) was developed that included the ex-situ treatment of petroleum hydrocarbon contaminated soil at the former military facility and the existing cells of the Land Treatment Unit (LTU) at the Fire Training Area (FTA). Additionally, the RAP also identified other remedial work that was required, which included the removal and disposal of transformers and telephone poles. TC is obligated to remediate all hazardous substances that are the department' s responsibility as identified in the previous site assessments that do not comply with applicable Canadian environmental laws.

An LTU lined with a synthetic geomembrane liner will be commissioned by the Contractor to treat the excavated contaminated soil locally. Management of the LTU is to be conducted until the impacted soil has undergone sufficient treatment to be used as fill for industrial sites. Field screening and confirmatory sampling will be conducted during site excavation. Sampling results will be compared with the most current environmental remediation criteria of GNWT and CCME for industrial sites.

## 1.2 Scope of Work

The remediation project at Iqaluit Airport will be conducted during the 2005 field season. The objectives of the remediation project include but are not necessarily limited to:

- provision of all approvals, permits, labour and equipment required to commission the LTU and excavate petroleum hydrocarbon contaminated soil;
- construction of an LTU lined with a synthetic geomembrane liner capable of containing 5000 $m^3$ of contaminated soil;
- commissioning of three (3) groundwater monitoring wells at the LTU site;
- installing a drainage culvert and filling in ditch to gain access to the work area;
- excavation of approximately 700 $m^3$ of petroleum hydrocarbon contaminated soil from the stockpile area of the former military facility;
- excavation of approximately 300 $m^3$ of petroleum hydrocarbon contaminated soil from the five (5) surface stained areas near the two concrete pads at the former military facility;
- removal and separation of general construction debris from the stockpiled soil;
- erecting a silt fence south of the existing contaminated soil stockpile to protect the nearby body of water;
- completion of a soil sampling program during excavation, which will include field screening and the submission of confirmatory soil samples from the sidewalls and base of each excavation to an accredited laboratory;

- removal of approximately 2500 $m^3$ of the contaminated soil from the existing cells of the LTU at the FTA and placement in the newly constructed LTU;
- restoration of excavated sites including backfilling with clean fill and site grading;
- removal and disposal of approximately 25 m of chain link fencing and associated posts;
- removal and disposal of several telephone poles near the transformers area;
- removal and disposal of three (3) abandoned transformers, including cribbing; and
- preparation of a closure report detailing site activities pertaining to the LTU construction and remediation work, including sampling results.

All work will be conducted in a safe and efficient manner. Activities will be coordinated with the Transport Canada Project Manager (TCPM) and the Iqaluit Airport Manager to minimize interruptions to airport activity. The safety of the workers, airport staff and the general public will be maintained throughout the remedial project.

As part of the Scope of Work, one copy of each of the following documents will be maintained on site:

i. Contract
ii. Drawings
iii. Specifications
iv. Addenda
v. Change Orders
vi. Other modifications to contract
vii. Copy of Contractor' s Health and Safety Plan (HASP)
viii. Permits, licenses and land use regulations
ix. Transportation of Dangerous Goods (TDG) certification
x. Copy of the RFP
xi. Copy of the Contractor' s Technical and Project Team Proposal

The Contractor will also record all off site removal of materials and provide the following information regarding these materials to the TCPM:

i. Time and date of removal
ii. Type of material
iii. Weights and quantity of materials
iv. Final destination of materials
v. All bills of lading concerning the material taken off site
vi. Headspace hydrocarbon vapour monitoring results

# 2.0 TECHNICAL PROPOSAL

## 2.1 Project Management

| Task 1: | Project Management, Quality Control and Cost/Budget Control |
|---|---|

Objectives

The objectives of this task are:

- to ensure that the timing, quality, coordination, assignment of staff resources and overall execution of the work are conducted to TC standards;
- to provide regular progress reports of the project throughout its duration; and
- to ensure that all requirements are maintained for TC.

Methodology

The Project Manager assigned to this project (Mr. Miles Antony) is an experienced individual who has conducted many other similar environmental remediation projects at several TC sites, including Iqaluit Airport. Mr. Antony has also managed several environmental remedial work projects for PWGSC, Nav Canada, Department of National Defence (DND), Manitoba Hydro, Manitoba Highways, Northland Petroleum Limited and several First Nation communities. To assist the Project Manager in maintaining quality control (QC) the Contractor will implement the following:

1. The Contractor has committed additional staff in the form of Safety Advisors, Environmental Engineers/Geoscientists and Hazardous Materials Safety Advisors. These technical advisors can be called to the site at any time to aid the Project Manager with any issue that may arise.
2. The Contractor will maintain communication with all site staff through a daily toolbox meeting conducted at the beginning of each work shift to ensure that all project concerns are addressed immediately. If problems are prevented or dealt with immediately the work process will continue with minimal interruptions.
3. A proposed project time-line will be implemented to ensure the project remains on schedule. Where possible, long lead times will be used to schedule subcontractors, utility searches, *etc*, to maintain efficient scheduling. In addition, detailed scheduling will be developed to minimize down-time for work crews or subcontractors. The project schedule will be reviewed regularly to anticipate potential delays and ensure milestones are achieved.
4. Once on site, the Contractor will provide a revised project schedule to the Iqaluit Airport Manager, if required, so that airport personnel will be aware of the activities being conducted and the anticipated duration of the project.
5. A tracking system will be used to ensure timely delivery of materials and machinery.
6. Daily equipment maintenance routines will be observed to reduce breakdowns and avoid unnecessary delays.
7. The Project Manager has a highly competent and motivated project team, which has been assembled to efficiently and safely complete all associated activities with this project. One project team with alternates will be assigned to the project for maximum continuity.

8. The Contractor has produced a work plan flow chart that illustrates a smooth task-by-task progression, demonstrating the ability to complete work in an orderly manner.
9. The Project Manager will keep the TCPM informed daily regarding site activities. Minutes of these meetings will be recorded and distributed to concerned parties.
10. Site work will be conducted expeditiously with the highest regard possible for keeping the site clean and orderly.
11. Electronic submissions will be used, where practical, to expedite the review process for reporting.
12. Any additional costs will be negotiated with TC.
13. The Contractor will ensure that adequate financial and employee resources are available to complete work safely and on time. WERI' s Chief Financial Officer will utilize a computerized accounting program that will allow the Contractor to analyze project costs and make appropriate decisions with regards to employee resources and equipment allocation to expedite project activities. As an established company with financial security, WERI has sufficient resources to overcome unforeseen delays and/or changes/additions to the scope of work.
14. The Contractor has committed an Environmental Technician who will monitor job progress, keep accurate field notes and track the job schedule to ensure the project is completed on time.
15. In the event of inclement weather or other unforeseeable disruption to the work schedule, the Contractor will work extended hours (12-hour days, Saturdays, Sundays and holidays) and bring in additional equipment and personnel to maintain project schedule. Daylight hours are longer during the field season, which will allow the Contractor to continue operations later in the day, if required. In order to avoid worker fatigue, two shifts will be used during extended hours. Additional lighting can be set up for work during night hours.

| Task 2: | Procuring all Permits and Approvals |
|---|---|

Objective

The procurement of all required approvals and permits will be done before the start of the remediation project.

Methodology

The Project Manager and WERI office staff will procure/compile all approvals and permits from local authorities and the local airport manager prior to commencement of site activities. The Employer Safety Plan will be submitted to the TCPM for approval prior to the commencement of site activities.

Not GNWT Nunavut

The Contractor has conducted environmental remediation work at Iqaluit Airport and is familiar with the permit requirements of GNWT. Currently, there is not a ~~permit~~ process for conducting excavation ~~work and~~ commissioning LTUs. However, GNWT and CCME regulations/guidelines for contaminated site remediation and the design and construction of landfarming facilities will apply and will be followed and exceeded by the Contractor.

| Task 3: | Mobilizing all Labour and Equipment Necessary to Complete Project |
|---|---|

Objective

All labour and equipment needed to complete the project will be transported to the site.

Methodology

WERI personnel and sampling equipment will be mobilized to the site. A local subcontractor will be hired for the supply of heavy equipment and labour to reduce mobilization costs and provide economic benefits to the local community. The subcontractor (RL Hanson Construction Limited) is an Inuit owned and operated company. The Contractor ensures that no less than 70% of the equipment and labour required to complete the project at Iqaluit Airport will consist of Inuit content. A list of equipment to be used during remedial activities is provided in Section 3.6 (Table 11).

| Task 4: | Quality Assurance/Quality Control |
|---|---|

WERI has adopted the principles of the *Total Quality Core Program* as developed by Work System Associates, Incorporated (1993). WERI views total quality as a commitment to a different approach to managing an organization. The definition of quality must be broadened to include all the processes, operations and activities of the organization and not just the final goods or services created. All the processes of the organization must be looked at to see how business is conducted. Clear standards or requirements must be established for all phases of the operation. A commitment must be made to continuous improvement throughout the organization.

The total quality system adopted by WERI includes:

- use of proven and appropriate remedial/investigation methods by trained field personnel;
- care and calibration of all field equipment, sampling apparatuses and instruments to ensure they are clean and in good working condition;
- documentation of all field activities so that sample results may be evaluated correctly with respect to site conditions, sample collection, handling methods and sample analyses;
- use of field quality control (QC) measures that require duplicate sample analyses to document analysis precision;
- coordination with the analytical laboratory for the preparation of sampling containers and for the preservation, packaging, shipping and receipt of samples to ensure that meaningful data will result from timely analyses of samples;
- ongoing highly visible support from senior management;
- active participation by a large number of employees from all levels;
- a defined infrastructure to support continuous improvement;
- a clearly established process, which is applied to all improvement efforts;
- comprehensive quality improvement training of all employees; and
- ongoing measurements to assess performance in all areas of the organization.

WERI accomplishes this through several major interventions, which include:

- Senior Management Total Quality Vision Setting
- Goal and Measurement Setting
- Structured Coaching Process
- Total Quality Awareness Training
- Train-the-Trainer Sessions
- Team Leader and Facilitator Training
- Team Building Sessions
- Audits, Checklists and Inventory Controls
- The Construction Manual with Policies and Procedures for Administrative and Field Work

The work outlined for the remedial works project will be performed in accordance with the following codes, standards and guidelines as a minimum:

NOT GNWT

- Canadian Environmental Protection Act
- GNWT/Canada Transportation of Dangerous Goods Regulation
- National Fire Code, 1995
- Underwriters' Laboratories of Canada
- National Building Code, 1995 (with all current amendments)
- CCME Guidance Manual on Sampling, Analysis and Data Management for Contaminated Sites, 1993, Volumes I & II
- Workplace Hazardous Materials Information System (WHMIS) regulation
- CCME Recommended Canadian Soil Quality Guidelines, 1997
- CCME Canadian Environmental Quality Guidelines, 2003
- CCME Canada-Wide Standards for Petroleum Hydrocarbons (PHCs) in Soil, 2001
- GNWT Environmental Protection Act
- GNWT Environmental Guideline for General Management of Hazardous Waste, 1998
- GNWT Guideline for Contaminated Site Remediation, 2003
- The regulations and standards of other local governing agencies
- Other provincial/territorial criteria if GNWT criteria does not cover certain parameters

In case of conflict or discrepancy, the more stringent requirements shall apply. The project team will meet or exceed the requirements of the contract documents as well as the specified standards, codes and referenced documents. The Contractor will examine all drawings, related documents and labour conditions prior to beginning the remedial activities. The Contractor will inspect the sites and ensure complete familiarity with site conditions prior to commencing remedial work.

## 2.2 Detailed Work Plan

The following section will describe the Contractor's work plan and sampling program for the remediation project at Iqaluit Airport. To fully ensure that we meet and respond to the needs of TC the Contractor has assigned project team members with several

years of environmental remedial experience. In addition, alternate representative personnel and subcontractors have been selected to assist the Contractor in maintaining a high level of professional service and effective on site representation. Figure 1 shows the organization of the project team selected for the remediation project (Appendix A).

The work plan will remain flexible throughout the project. Unforeseen delays caused by inclement weather, changes/additions to the scope of work, equipment failure, *etc*, can alter the work schedule and project activities will have to be adjusted to maintain project efficiency and reduce costs to the Client. The maintenance of a flexible approach will be the most effective means of addressing difficulties, should they arise.

*Special Considerations*

The TCPM is responsible for all matters concerning the technical content of the work according to the terms set out in the RFP and any other documents to follow pertaining to this project. Any proposed changes to the scope of work will only be undertaken upon approval of the TCPM through a Change Order from PWGSC. All work undertaken within the scope of work will be administered in such a way as to be non-disruptive to airport activities. Any activities that may cause some form of disruption will have to be approved by the TCPM and the local airport manager prior to commencement. The Contractor will not unreasonably encumber the work site with materials or equipment that could interfere with airport activities and the TCPM will be notified if any problems are encountered during site work. The Contractor' s Project Manager will always be on site to manage site activities.

## *Activity 1: Site Information Review and Reconnaissance*

Objective

The Contractor will arrange the site in preparation of the remedial process, including the removal of contaminated soil, management of the LTUs and decommissioning of the LTU sites after removal of the treated soil. The Contractor has site-specific knowledge of Iqaluit Airport from remedial activities conducted in 1999 and 2000.

Methodology

1. The Contractor will review records of all information provided by TC.
2. Records review should provide information including but not limited to:
    - Site location
    - Site description
    - Site topography
    - Surface drainage
    - Site geology
    - Pertinent historical land use activities information (such as other possible sources of contamination)

3. The Contractor will make arrangements with the local airport manager and the TCPM to conduct site inspections. The Contractor will use a detailed checklist to ensure that all pertinent information is gathered.

   The on site investigation will involve the following:
   - Detailed site tour
   - Comprehensive review of documentation
   - Interviews with support staff (current and, possibly, former personnel) for complete historical review
   - Photographs
   - Review of management directions
   - Identification of potential sources of environmental contamination

   The site meeting will discuss the types of activities conducted as well as historical operations, hazardous and non-hazardous waste management, fuel handling and storage practices. The Contractor will use written notes and electronic equipment such as cameras and other recording equipment to document activities.
4. The Contractor will develop a site-specific remedial plan.
5. The remedial plan will be discussed with the TCPM and any changes as a result of this discussion will be implemented.
6. Implementation of the remedial plan.

## *Activity 2: Conducting a Utilities Search*

### Objective

The Contractor will locate service lines with the assistance of local utility companies before excavation occurs to avoid risk of injury, damage to infrastructure and the inconvenience of disruption of service.

### Methodology

1. The Contractor will visit the site and review all associated plans and drawings locating all telephone, communication, electrical, water and other utilities with airport staff and the TCPM. Any lines identified in these documents will be corroborated in the field.
2. Local utility companies, as shown in Table 1, will be contacted to conduct line locates. The Project Manager will meet with service representatives to indicate search area.

**Table 1: Contact Information for Line Locating Services in Iqaluit**

| *Name of Utility Company* | *Service Lines Located* | *Contact Information* |
|---|---|---|
| Northwest Tel Incorporated | Communication cables (telephone) | (800) 661-0745 |
| Northline Utilities | Electrical (power) | (867) 874-6845 |
| Northwest Territories Power Company | Electrical (power) | (867) 874-5200 |
| Nav Canada | All cables associated with the operation of Nav Canada facilities | (867) 669-9717 |
| Iqaluit Airport Manager | All cables associated with the operation of airport facilities | (867) 979-5224 |

3. The Contractor will also use a line locating instrument (TraceMaster™) in conjunction with searches provided by the utility companies and in the event that utility companies are not available for consultation. The TraceMaster™ is capable of establishing the presence of underground cables or piping and associated depths below ground surface.
4. Lines will be marked on ground with paint or staked with markers.
5. The sites will be sketched showing various lines and utilities.
6. The Contractor will contact utility companies if any unknown lines are detected.
7. The Contractor will consult with airport authorities whenever excavating in a sensitive area to indicate possibility of disruption to service.
8. Manual excavation will be conducted by personnel when marked locations are approached.
9. Deactivation of fire hydrants will only be conducted when absolutely necessary and after approval from the local fire department.
10. Nav Canada will be consulted to ensure that essential services are not disrupted.
11. The removal, relocating or rerouting of lines will only be conducted upon approval of the TCPM and the local airport manager. The Contractor will arrange to have these activities conducted by utility companies. Drawings showing new line locations will be provided to the airport manager.
12. In the event that utility lines are disconnected the Contractor will arrange for their reinstatement immediately. The cost for reinstatement will be borne by the Contractor.

## *Activity 3: Construction of LTU*

### Task 3.1: Site Layout

Site Layout

The Contractor will establish the location of the LTU with approval from the TCPM and the airport manager at Iqluit Airport and stake out the perimeter.

Methodology

The LTU at Iqaluit Airport will be located south and adjacent to the main aviation apron in a relatively flat and secluded area that is not easily accessible to the general public. The specific location will be determined in the field upon consultation with the airport manager and the TCPM. After the site location is approved, the perimeter of the treatment area will be staked for precise location and site surveying will be conducted to determine the slope of the selected site in order to locate the sump area.

Dimensions of the treatment area of the LTU will be 100 m in length with a width of 50 m, giving it an area of 5000 $m^2$, as shown in Figure 2. The sump area located down-gradient will have the same length as the width of the treatment area and it will have a width of 5 m. Assuming a treatment layer of 1 m, as shown in Figure 3, the LTU will be capable of containing approximately 5000 $m^3$ of petroleum hydrocarbon contaminated soil.

| Task 3.2: | Construction of LTU |
|---|---|

Objective

The Contractor will construct the LTU in preparation of receiving contaminated soil from the sites being remediated.

Methodology

Once the perimeter of the LTU is staked out the Contractor will begin excavating the treatment area. The LTU will be excavated to a depth of 1 m below grade and it will be sloped down-gradient towards the sump area and towards the centre of the treatment area. Regular surveying will be conducted using a grid layout during the excavation process to ensure that the proper depth and slopes of the LTU are established accurately. The base of the LTU will have a 1% slope towards the sump area and a 2% slope towards the centre of the treatment area. Extreme care will be taken not to exceed the recommended slope down-gradient since this would place undue stress on the sump berm and containment could be breached, possibly releasing contaminants to the adjacent area. The final surveying results will be provided to the TCPM for approval.

The perimeter berm will be built above grade to prevent water from entering and leaving the LTU. The top of the perimeter berm will be approximately 1.75 m above the base of the LTU, as shown in Figure 4. The berms will be compacted and shaped to maintain the integrity of their design for the duration of the LTU management program, which will be designed to sustain a 1-in-10 year storm event. Since the LTU is to be managed for more than one field season, additional reinforcement will be provided for the berm toe located down-gradient since considerable more pressure can be sustained if the sump area becomes filled with water after a significant rain event and from snow melt runoff in the spring.

Finally, three (3) above grade mount groundwater monitoring wells will be installed, as shown in Figure 5. One monitoring well will be installed up-gradient and two monitoring wells will be installed down-gradient. The monitoring wells will extend 0.3 m into the permafrost and 1 m above the existing grade. Each well will consist of 50 mm solid and slotted PVC pipe. The solid pipe will be surrounded with bentonite at varying depths before the slotted section. The slotted pipe will be capped to prevent plugging. The top of the monitoring wells will be capped with protective metal casing.

| Task 3.3: | Installation of Geomembrane Liner |
|---|---|

Objective

A synthetic geomembrane liner will be installed on the base of the LTU as a primary containment barrier since a sufficient clay base is not available in Iqaluit. The geomembrane liner will prevent contaminants contained within the soil being treated from leaching into the subsoil.

## Methodology for Geomembrane Installation

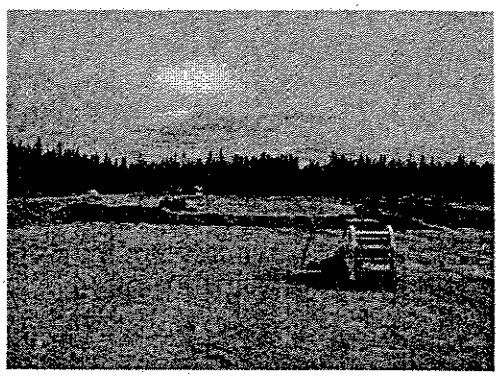
### *Selection of Geomembrane*

There are many types of geomembrane liners available for environmental remediation projects. Selection of an appropriate geomembrane is based upon many considerations including the type of contaminants being contained, the duration of the project and budget constraints. The remediation project at Iqaluit Airport is a multi-year project in a sub-arctic environment. For this reason, the liner selected for the LTU will be the 30 mil unsupported polyvinyl Layfield Arctic Liner®, which is being supplied by the Client. Arctic Liner® is a carefully formulated alloy for hydrocarbon containment that combines chemical resistance with ease of installation. This liner has a tensile strength of 57 ppi, a minimum elongation of 500% and has been specially formulated to withstand chemical deterioration and harsh climatic conditions. As its name suggests, Arctic Liner® is suitable for multi-year hydrocarbon remediation projects in arctic and sub-arctic environments because of its chemical resistance properties and its resistance to extreme cold temperatures (<-40°C). The Contractor will allow for sufficient liner material to account for thermal contraction.

### *Site Preparation Considerations*

Earthworks are used to support, cover, protect, drain and separate components of a geosynthetic lining system. A properly prepared base is critical as the founding surface for the lining system. Long term liner integrity is dependent upon a properly prepared base. The following should be considered when preparing a base:

- Most soils can be used as base material including sand, silty sand, clay and clay silt.
- The prepared surface should be uniform and well compacted. It should also be free of rock or sharp rock fragments, stones, tree roots, construction debris, metallic objects, or any other objects that could potentially puncture the geomembrane.
- Protrusions should not be left above base.



*Preparation of base with sandy material.*

- If the base surface cannot be prepared from existing material, imported suitable material or geotextiles should be substituted.
- Compaction of base should prevent deformation, which will prevent liner failure.
- Finished surface should ensure gentle slope grades to prevent liner stress.
- Any damage from weather or vehicle traffic needs to be repaired before liner installation.
- Base must be protected from freezing, desiccation, flooding or mechanical damage.

- The base of the LTU will be graded and compacted to the density of the surrounding native soil.

*Liner Storage*

The liner will be shipped directly from the Layfield shop in Edmonton, Alberta. The Contractor will use the following guidelines as a minimum when handling and storing the liner:

- The liner will be installed as per manufacturer's specifications.
- During storage the liner will be protected from direct sunlight, ultraviolet rays, excessive heat, mud, dirt, dust and rodents.
- The liner will be stored above ground level.
- The area of installation will be cleared of water and/or snow accumulations.
- All areas of excessively soft supporting material beneath the liner will be repaired.
- The liner will not be installed when the ambient temperature is above 40°C, during any precipitation, in the presence of excessive moisture or high winds.
- The Contractor will minimize wrinkles, scratches, crimps and avoid damage to supporting material.
- The Contractor will protect the installed liner from displacement, damage or deterioration before, during and after placement of material layers.
- Repairs to the liner, if necessary, will be performed at the Contractor's expense.
- Vehicles will not be allowed on the liner at any time.
- The TCPM will approve the installed liner before placing material in the LTU.

*Liner Installation*

WERI personnel have extensive experience pulling various covers and liners, including the Arctic Liner® selected for this project. Arctic Liner® is folded like an accordion and rolled during shipment. After it is unrolled, the liner is carefully unfolded before being pulled. If the liner is pulled prior to being unfolded, ripping the liner at the edges is possible due to its significant weight and the characteristics of the polyvinyl material, which does not separate as freely as other geomembrane materials, such as polyethylene.

It becomes very challenging and dangerous to pull the liner on hot, windy days. The polyvinyl material adheres better in hot conditions, making it difficult to unfold and pull without damaging the liner. Conversely, excessive wind can blow the geomembrane off site, causing potential damage to equipment and adjacent structures, as well as posing safety concerns to site workers and others within vicinity of the work site. Therefore, the liner will be pulled on a relatively calm, dry and cool day. The Contractor is prepared to work in the early hours of the morning, when the wind is typically calmer and conditions are cooler, in order to pull the liner safely and efficiently.

The Contractor has devised 1.2 m rubber pulling clamps for pulling synthetic covers and liners, which spread force over the edge of the liner to minimize potential damage to the liner' s edge. The clamps are attached to the liner, which are pulled by towing equipment. The towing equipment will be kept off the base during the pull. In the event that towing equipment will be needed inside the LTU the Contractor will select machinery with low ground pressure, such as a rubber tracked skid steer. An anchor trench will be established on the perimeter berm to keep liner secure. The liner will be anchored over the berm and the Project Manager will inspect the liner with the TCPM.

*Seam Welding*

Due to the size of the treatment area of the LTU at Iqaluit Airport the Arctic Liner® will consist of more than one panel. Seam welding will be required in the field with a wedge welder. A field technician will be on site to perform seam welding and to conduct seam tests. The following describes the methodology that the Contractor will use during field welding:

A. Approved processes for seaming are double wedge fusion welding for general seaming and extrusion welding for patching.

i. Fusion Welding—The seam shall be produced by self propelled wedge welding apparatus. The apparatus shall be equipped with gauges to monitor weld temperature. Weld temperature and machine speed shall be varied according to ambient conditions in order to maintain and demonstrate a consistent acceptable weld. All welding surfaces shall be kept clean and dry.

The membrane shall have an overlap of approximately 150 mm. The area shall be prepared by wiping the area with a clean dry cloth to remove any foreign matter. The welder shall be inserted in one end of the seam, then the pressure rollers are to be clamped down and the wedge engaged and drive motor turned on. If the welder is interrupted during the seaming process, the area affected shall be marked and repaired.

ii. Extrusion Welding—The seam shall be produced by extruding molten resin at the edge of two overlapped sheets of geomembrane to effect a homogenous bond. The extrusion apparatus shall be equipped with gauges to monitor extrudate temperature. Temperature and flow rate shall be carried according to ambient conditions to maintain and demonstrate a consistent acceptable weld. The extruder shall be purged of all heat degraded or cooled extrudate prior to the commencement of each seaming sequence.

The weld area shall be prepared by sanding or grinding to a depth of less than 0.02 mm in the sheet surface to be in contact with the extrudate. Grinding required along a seam shall be done concurrent with or within 20 minutes of the seaming operation and shall not damage the geomembrane.

Membrane shall be overlapped a minimum of 75 mm prior to seaming. The weld area shall be kept clean and dry during this process. Installer shall determine when preheating of the area to be seamed is required. Artificially induced cooling of extrusion welds, by water or any other means, shall not be allowed. Care should be taken during vacuum testing that extrusion welds being vacuum tested are at ambient temperatures.

B. The Installer shall maintain at least one spare operable seaming unit of each type on site at all times.
C. Compensation for thermal contraction of the geomembrane shall be provided as necessary during the liner installation as determined by the on site supervisor.
D. Where conditions warrant, the Installer shall be allowed to use a temporary support surface between geomembrane and the subgrade to achieve proper support during the seaming operation.
E. Seaming shall be a continuous process with minimum interruptions along any given seam.
F. Any geomembrane area showing injury due to excessive scuffing, puncture, or distress from any cause shall be repaired or replaced with an additional piece of geomembrane.
G. Cross Seams—The top and bottom excess overlap shall be removed and the top and bottom edge of the cross seam shall be ground to a smooth transition prior to seaming. If the cross seam is welded by means of fusion apparatus, the cross seam shall still be cut back to the edge of the fusion weld and have a bead of extrusion applied 100 mm in all directions from the confluence of the two seams to form a " T" .
H. Seams shall run parallel to the slope.

Quality Control During Installation

An intensive control program is used by WERI' s field technicians to monitor the condition of the geomembrane during the installation process. The QC program will include the following forms, which will be completed by a technician on site (see Appendix B for copies of the forms):

- Certificate of Final Inspection and Acceptance
- Certificate of Acceptance of Soil Sub-base Surface
- Geosynthetics Inventory Log
- Geomembrane Trial Seam Log
- Geomembrane Seam Log
- Geomembrane Vacuum/Air Lance Test Log
- Geomembrane Seam Pressure Test Log
- Geomembrane Defect/Repair Log
- Geomembrane Destructive Test Report