PHASE I & II ENVIRONMENTAL SITE ASSESSMENT AT JOHNSON POINT, NT

Prepared for:

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EXECUTIVE SUMMARY

IEG Environmental (IEG) was contracted by the Contaminants and Remediation Directorate (CARD) of Indian and Northern Affairs Canada (INAC) to conduct a Phase I and II Environmental Site Assessment of the former oil and gas staging area at Johnson Point, Banks Island, Northwest Territories. Field activities were completed in late September and early October. Field activities consisted of shallow soil sampling, inventory of onsite infrastructure, hydrocarbon sampling and quantification, and subsurface geophysical investigation.

Soil samples were collected down-gradient of the tank farm located at the site. Shallow boreholes were advanced using a gas powered auger. Samples were field screened and later forwarded to the laboratory for confirmatory analysis.

An inventory of all onsite infrastructures was conducted. The inventory consisted of the collection of physical dimensions, estimated weights, physical description, photographic records, and physical position (via GPS).

Hydrocarbon samples were collected from all onsite POL tanks. Samples were collected and forwarded to the laboratory for analysis. Tank dimensions, and other physical properties were recorded.

A subsurface geophysical investigation was completed at the site using an EM61 unit. The EM 61 detects subsurface metal, which can be used as indication of potential landfill locations.

The field crew was present at the site for 7 days. A tent camp was used for shelter, and a full time cook and wildlife monitor accompanied the crew.

Analytical data, geophysical data, complete site inventory, and recommendations are provided in this report.

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1.0 INTRODUCTION

1.1 Project Background

Johnson Point is located on the eastern coast of Banks Island in the Northwest Territories. Johnson Point was used in the 1970's and early 1980's as a staging site for exploration of oil and natural gas throughout Banks Island. The site was abandoned when exploration ceased in the area. The site and its contents, including environmental liabilities, became the property of Indian and Northern Affairs Canada (INAC). Potential environmental liabilities at the site include: POL tanks, contaminated soil, buildings, and landfills.

Local stakeholders have raised concerns with INAC regarding hydrocarbon storage in POL tanks at the site and possible leakage into the environment, along with other contaminants such as PCBs and asbestos. INAC entered into a contract with IEG Environmental (IEG) to conduct a comprehensive Phase I/II ESA of the Johnson Point site.

1.2 Site Reconnaissance

A site reconnaissance visit was conducted in July, 2005 by IEG and INAC personnel to:

- Inspect the condition of the airstrip to optimize the type of aircraft chosen to mobilize field crew and equipment to the site;
- Collect fuel samples for laboratory analysis to ensure compliance with NWT Environmental Protection Act Used Oil and Waste Fuel Management Regulations;
- Visually inspect the site in the presence of the INAC Project Officer; and
- Revise the Work Plan to suit site conditions.

1.3 Scope of Work

The main objective of this study was to inventory on site volumes of petroleum hydrocarbons from the POL tanks as well as the volume/weight of other hazardous materials at the site. The second objective was to determine if hydrocarbon contaminants were migrating away from the tank farm located at the site. The third objective was to identify any sources of buried metal and/or potential landfill sites.

The scope of work specified the following field activities and deliverables:

- POL tank inventory and inspection;
- Collection and analysis of hydrocarbon samples;
- Geophysical (electro-magnetic) survey;
- Visual inspection of all on-site infrastructure;
- Collection and analysis of soil and shallow groundwater samples;
- Detailed inventory of hazardous and non-hazardous debris and preliminary volume estimates;
- Production of detailed site plans;
- Detailed photographic records; and,
- Final report.

2.0 PHYSICAL SETTING

2.1 Site Location

Johnson Point (the Site) is a remote site, located on the east coast of Banks Island, approximately 270 kilometres northeast of Sachs Harbour, NT, at 72°45'10" N, 118°30'00" W (INAC, 1992). Johnson Point was named such in 1954 but the origin of the name is unknown (Prince of Wales Geographic Names Database). Figure 1 in Appendix A shows the location of Johnson Point. An overall site plan is depicted in Figure 2.

The Site is bound to the east by the Prince of Wales Strait, to the north by an unnamed river, and to the south and west by open tundra. In total, the footprint of the Site encompasses approximately 2.5 km^2. The landscape is typical of high arctic low relief terrain comprising bare tundra with limited vegetative cover.

Johnson Point falls within the Northern Arctic Ecozone, which extends over most of the non-mountainous areas of the arctic islands from Banks Island to Baffin Island.

2.2 Geology and Soils

Johnson Point, like much of the Northern Arctic Ecozone consists of low rolling plains covered with highly weathered soil and rock debris left by glaciers. Surface soils are granular, and the underlying geology can be described as frost-shattered sedimentary deposits of limestone, and sandstone several thousand metres deep (INAC, 1995). The study team observed that the entire site consisted of gravelly sand typical of glacio-fluvial deposits in the high arctic.

2.3 Climatic Information

Long, cold winters, a short cool summer, and low annual precipitation characterize the area. Other climatic considerations are the extreme cold and lack of daylight in winter.

Climate data for Johnson Point is only available from 1972 to 1976. Based on the data collected during that period, the mean annual temperature at Johnson Point is approximately -16°C. Mean monthly temperatures in the winter (October-March) average approximately -30°C. Recorded winter temperature extremes have ranged from an extreme maximum of near 0°C to an extreme minimum of -54°C. Mean monthly temperature in the summer (April-September) averages approximately -5°C. Summer temperature extremes have been recorded to a maximum of 17°C (Environment Canada, Historical Weather Station Data, Johnson Point). Climate data for both Sachs Harbour and Holman is available from 1971 to 2001. The table below compares the Johnson Point data to the Sachs Harbour and Holman data. A climograph for Johnson Point can be found below, while climographs for Sachs Harbour and Holman can be found in Appendix B.

Parameter	Johnson Point (1972-1976)	Sachs Harbour (1971-2001)	Holman (1971-2001)
Mean Annual Temperature (°C)	-16	-13	-11
Mean Monthly Winter Temperature (Oct-Mar)	-30	-24	-23

(°C)			
Maximum Winter Temperature (°C)	0	4	5
Minimum Winter Temperature (°C)	-54	-52	-49
Mean Monthly Summer Temperature (Apr-Sep) (°C)	-5	-3	0
Maximum Summer Temperature (°C)	17	24	29
Minimum Summer Temperature (°C)	-42	-43	-42

Strong winds occur during winter, creating severe wind chill effects. Wind data for Johnson Point shows winds reaching maximum gusts of 97 km/hour.

Johnson Point has a mean annual precipitation of 142mm for the years where data exist. Snow may fall any month of the year and generally remains on the ground from September to June.

The period from May to August has 24 hours of daylight.

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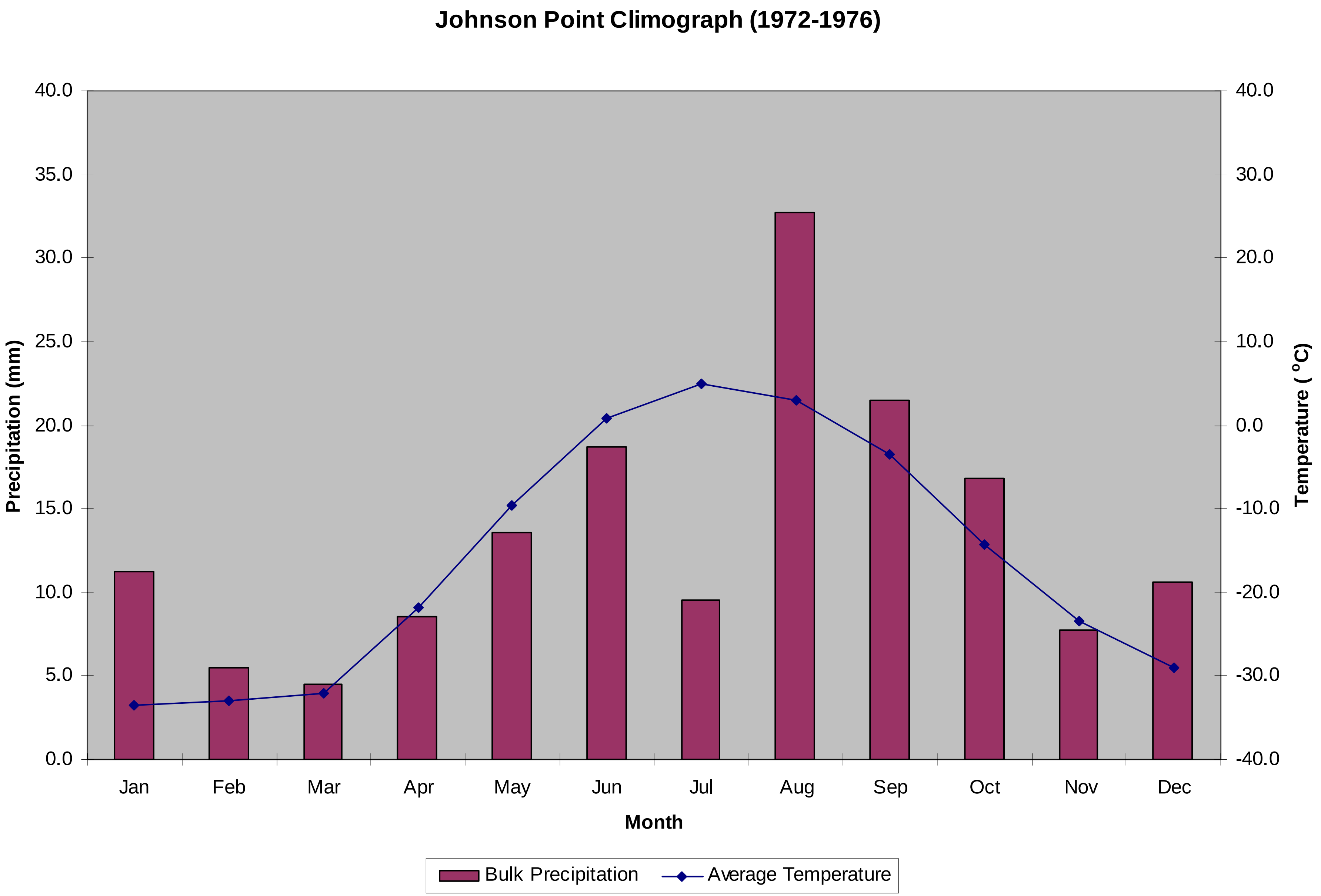

Johnson Point Climograph (1972-1976)
Precipitation (mm)
Temperature (°C)
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
40.0
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Bulk Precipitation
Average Temperature

2.4 Hydrology Overview

A broad, shallow pond comprises the only major surface water expression on site. Direct measurement of the pond depth was not undertaken but is estimated to be less than approximately 2m. Due to the shallow depth and absence of permanent links (maybe connected to other aquatic systems during spring runoff) to other water bodies (i.e. the pond can be considered 'off-line') it is not expected that the pond supports fish life.

A river bounds the site to the north, this river is unnamed on topographic maps. The river has been referred to as the Johnson Point River by some local residents of Sachs Harbour (Grayhound Information Services 1997). The catchment area of this river is estimated to be 210 km^2. Further investigation of river flow (discharge) should be undertaken during future site activities to aid in the estimation of both habitat assessment and contaminant migration.

The surface drainage network within the study area consists primarily of a series of intermittent drainage ways. There are several erosional features present on site indicating periods of intense surface water runoff and entrainment of surface soils. Rill and gully features predominate surface water drainage pathways across the site.

Due to the occurrence of permafrost, groundwater is expected to be confined to the shallow active layer that develops by seasonal thawing. Groundwater flows occur, as conditions permit through the active layer, between topographically higher areas into terrain depressions.

The rate and direction of groundwater flow are currently unknown, but are assumed to follow the natural relief of the site. If this assumption is correct, the inferred flow direction would be to the north toward the unnamed river and east toward the ocean. Perennially frozen ground will prevent groundwater flow for most of the year, excepting a brief period during the summer. This factor will tend to slow the migration of spills, but will make the monitoring and sampling of groundwater difficult.

2.5 Permafrost Conditions

Johnson Point is located within the continuous permafrost zone. Permafrost is known to extend to a depth of nearly 1000 m in the northern arctic ecozone (CCEA). Above the permafrost layer is a thin active layer, which freezes in winter and thaws each summer. The depth of the active layer varies with location due to changes in soil type, moisture content and climate (Grayhound Information Services 1997). The active layer thickness can vary from one season to another due to variations in summer warmth and the length of the thaw season (Grayhound Information Services 1997). At the time of the 2005 ESA, the active layer was frozen and the depth could not be measured. Experience at similar sites suggests that the active layer thicknesses can be expected to extend approximately one meter below ground surface in well-drained, undisturbed areas. For comparison purposes, the active layer thickness in Sachs Harbour, Holman, and Aulavik National Park were determined. The active layer in Sachs Harbour extends from depths of 0.5 m in poorly drained areas to as much as 1.8 m in well drained sandy/gravelly areas (Thurber Consultants, 1986; Agra, 1992). The active layer in Holman is 0.6 m thick in dry gravel, and 0.9 m thick in other areas (INAC 2005). In Aulavik National Park the active layer depths range from 0.2 m on peaty soils to 0.8 cm on well drained granular soils (Grayhound Information Services 1997). The active layer is suspected of reaching its maximum depth during the month of August.

2.6 Vegetation and Wildlife

Despite its dry cold climate, Banks Island supports at least 13 species of liverworts (*Hepaticae*), approximately 200 species of mosses, 90 lichens, and over 250 vascular plants (Grayhound Information Services 1997). The distribution of plant life on Banks Island is controlled by several environmental factors including but not limited to: geology (soil chemistry, soil texture, and pH,), and climate (temperature, and moisture) (Grayhound Information Services 1997).

Banks Island supports a number of both invertebrates and vertebrate wildlife. For the invertebrate's parasitic worms, spiders, mites, springtales, and insects are found on the island, while various species of fish, birds and mammals make up the vertebrate population (Grayhound Information Services 1997).

Six species of freshwater fish have been identified in the Thomsen River of Aulavik National Park, these include lake cisco (*Coregonus artedii*), least cisco (*C. sardinella*), arctic char (*Salvelinus alpinus*), lake trout (*S. namaycush*), ninespine stickleback (*Pungitus pungitius*), and fourhorn sculpin (*Myoxocephalus quadricornis*) with the lake trout being the only species found exclusively in freshwater (Grayhound Information Services 1997). Marine species that have been identified around Castel Bay on the islands north coast include arctic cod (*Boreogadus saida*), arctic sculpin (*M. scorpioides*), gelatinus snailfish (*Liparis fabricii*), and kelp snailfish (*L. tunicatus*) (Grayhound Information Services 1997).

There are numerous species of birds found on Banks Island, these include yellow-billed loon (*Gravia adamsi*), pacific loon (*G. pacifica*), red-throated loon (*G. stelata*), whistling swan (*Olor columbianus*), Canada goose (*Branta canadensis*), black brant (*B. nigricans*), snow goose (*Anser caerulescens*), pintail (*Anas acuta*), oldsquaw (*Clangula hyemalis*), common eider (*Somateria mollissima*), king eider (*S. spectabilis*), rough-legged hawk (*Buteo lagopus*), gyrfalcon (*Falco rusticolus*), peregrine falcon (*F. peregrinus*), willow ptarmigan (*Lagopus lagopus*), rock ptarmigan (*L. mutus*), sandhill crane (*Grus Canadensis*), semipalmated plover (*Charadrius semipalmatus*), American golden plover (*Pluvialus dominica*), black-bellied plover (*Squatarola squatarola*), ruddy turnstone (*Arenaria interpres*), purple sandpiper (*Calidris melanotos*), Pectoral sandpiper (*C. melanotos*), white-rumped sandpiper (*C. fusicollis*), bairds sandpiper (*C. bairdii*), semipalmated sandpiper (*C. pusilla*) buff-breasted sandpiper (*Tryngites subruficollis*), sanderling (*C. alba*), red phalarope (*Phalaropus fulicarus*), Pomarine jaeger (*Sterconrarius pomarinus*), parasitic jaeger (*S. parasiticus*), long-tailed jaeger (*S. longicaudus*), glaucous gull (*Larus hyperboreus*), ivory gull (*Pagophila eburnean*), thayers gull (*L. thayeri*), sabines gull (*Xema sabini*), arctic tern (*Sterna paradisea*), black guillemot (*Cepphus grylle*), snowy owl (*Nyctea scandiaca*), horned lark (*Eremophila alpestris*), raven (*Corvus corax*), water pipit (*Anthus spinoletta*), Lapland longspur (*Calcarius lapponicus*), and snow bunting (*Plectophenax nivalis*) (Grayhound Information Services 1997). Most bird species found on Banks Island are migrants, while the rock and willow ptarmigan, raven, and snowy owl can be found year round (Grayhound Information Services 1997).

The mammals of Banks Island are composed of lemmings, arctic hare, arctic fox, wolf, ermine (short tailed weasel), Peary Caribou, muskoxen (Grayhound Information Services 1997). Grizzly bear, wolverine, and red fox have been observed on the southern portion of Banks Island, but it is believed that a permanent population of each does not exist on the island (Grayhound Information Services 1997). Marine mammals that are found in the waters surrounding Banks Island include polar bear, ringed seal, bearded seal, beluga and bowhead whales (Wildlife Division GNWT 2006). The gray whale, killer whale, and narwhal maybe occasionally present in the waters of the Beaufort Sea near Banks Island (Wildlife Division GNWT 2006).

During the site visit lemmings, arctic hare, snowy owl, and raven were all observed at Johnson Point. Polar bear tracks were observed at site near the camp.

2.7 Development History and Land Tenure

Johnson Point was originally constructed as a staging area and base for oil and gas exploration for the north end of Banks Island. The first well on Banks Island was drilled in 1971, with the most recent of the 11 that have been drilled on the island being completed in 1982 (INAC, 1995). Although no wells discovered hydrocarbons, several did encounter reservoir quality porous rock. The site has been abandoned since drilling activities were completed.

INAC files indicate that Environment Canada holds a land reserve on a portion of the site located southwest of the airstrip, approximately 280 m from the shore. The status of the land reserve has not yet been confirmed but Environment Canada has been contacted for clarification of the land reserve status.

Although INAC records show there are no current mineral leases/claims at the site, several companies have exploration interests in the surrounding areas as indicated below:

- Diamonds North Resources Ltd. – operating northeast of the Site on Banks Island
- Majescor Resources Inc. – in joint venture with Diamonds North Resources Ltd.
- De Beers – exploration interests south of the site
- De Beers – operating on Victoria Island in an area extending north and south of the site
- Great Northern Mining and Exploration (GNME) Inc. – operating in the western/central portion of Victoria Island
- Other companies include:
    - Navigator Exploration Corporation
    - Strongbow Exploration Incorporated
    - Victoria Exploration and Mining Company Limited

While these companies do not currently hold leases/claims at Johnson Point, the airstrip has been used as an alternate landing location (in case of poor weather conditions at intended site) and the site has been used as a staging area for exploration further inland.

2.8 Traditional History

The eastern side of Banks Island has historically been an important area for the Inuvialuit. Traditionally the area has been used by people who traveled to Banks Island from Victoria Island via the Prince of Wales Strait (Grayhound Information Services 1997). Inuvialuit would travel from Victoria Island to hunt polar bear, musk ox, caribou, and seals (Grayhound Information Services 1997).

Beluga whales have been documented in the area by a local hunter, James Amos in 1947. Amos traveled from the east coast from Johnson Point to De Salis Bay and reported seeing Beluga traveling north. Amos noted that the whales would swim in the middle of the Prince of Whales Strait until they reached Johnson Point, where they would move near shore at the mouth of the Johnson Point River (Grayhound Information Services 1997). De Salis Bay has been identified as a potential Beluga hunting area and is included as a potential 1B Marine Protected Area. Satellite tags on Beluga show that they migrate into the Prince of Wales Strait.

Recent graffiti at the site indicates local people from both Sachs Harbour and Holman do visit the site occasionally. The most recent graffiti suggests that a group of Rangers from Holman conducting a sovereignty patrol were the most recent visitors in 2003.

The Sachs Harbour Community Conservation Plan (2000) does not mention Johnson Point with the exception of the area from Johnson Point to Headwater Lake which is an important area for lake trout and/or arctic char residents and migrants.

2.9 Access and Logistics

Access to Johnson Point is via fixed wing or rotary wing aircraft from Inuvik via Sachs Harbour for refueling. The original airstrip at Johnson Point was approximately 1500 m long. Erosion of the airstrip by surface runoff and/or other environmental processes has shortened the airstrip by approximately 500 m (IEG 2005 Survey) to 1000 m. Based on the dimensions of the erosion channel, it is estimated that approximately 1900 m^3 of granular material would be required to repair the airstrip. The airstrip can accommodate both Twin Otter (with tundra tires) and DC-3 aircraft depending on local environmental conditions at the site. Aklak Air of Inuvik has confirmed that they have landed at the airstrip, using both Twin Otter and DC-3 without incident. During spring runoff when the airstrip is saturated with water the only access is via rotary wing aircraft which would require the placement of fuel caches, and onsite fuel for refueling. Aklak Air has successfully landed at the site in mid July, August, September, and October. A plane equipped with ski gear could land at the site in March, April, and May when snow conditions are acceptable. Aklak Air has recently acquired a DC-3 with ski gear; as well their Twin Otters have ski gear available. Environmental conditions such as fog, and blowing snow at the site can reduce visibility and prohibit landings.

Access of heavy equipment to the site is possible via barge. Exportation companies originally staged equipment at different locations on Banks Island using barge and tug boats. The major barging constraint at the site would be sea ice. Accurate ice reporting would be required before attempting to mobilize/demobilize equipment to the site. Ice conditions and tidal conditions are available for the area through Environment Canada and Fishers and Oceans respectively. Navigational charts of the area are also available.

2.10 Site Infrastructure

For the purposes of this report, and to ensure consistency with past reports, the site has been divided into the same areas used in the 1992 INAC report. The study areas are overlaid on the site plan in Figure 3. Areas 1 through 8 are depicted in Figures 4 through 12, respectively.

Figure 13 in Appendix A shows the site and all Site Inventory Features. The following is a brief overview of all onsite facilities, structures, and manmade features:

- 1 Nodwell, 2 Nodwell Trailers, and 9 Nodwell Camp Units

The Nodwell camps are located in two separate areas of the site. Three of the units are located in Area 2 near the airstrip, while the other 6 units are located at Area 8 along with the Nodwell and two Nodwell trailers. The ATCO camp units are located together mid-site at Area 7 (Figure 7).

- 5 Fuel Sloops (containing 500gallon fuel tanks)

Fuel sloops are constructed of a steel frame with wooden decking and steel skis. At Johnson there are two sloops with 4 tanks, two sloops with five tanks, and one fuel sloop with only one tank. Generally, tanks mounted on fuel sloops are piped in series, however the viability of the valves on the individual tanks that are connected in series should not be taken for granted. For the present study tanks were accessed only from the top. If fuel is transferred/removed from the fuel tanks, it should be done so by pumping through the top of the tank, as use of the current piping/valves may result in accidental fuel spillage. Fuel sloops that contain only 4 tanks have a wooden shed in the middle of the sloop. The wooden shed in most cases contained hoses, sorbents, and other fuel related materials. Fuel sloops were located in Areas 2 and 3 (Figures 5 and 6, respectively).

- 1 Aircraft Navigational Aid

The Aircraft Navigational Aid (NavAid) is located at the southern end of the Airstrip (Figure 12). The NavAid is a circular structure constructed of bolted steel panels, and is insulated with Styrofoam. The NavAid was likely decommissioned as no instrumentation is present within the NavAid. The NavAid is supported on a wooden platform by nine wooden piles, the wooden piles were visually inspected and did not appear to be treated. There are several wooden fence posts surrounding the NavAid. A power line extends from maintenance shed in Area 3 to the NavAid.

- 1500 m Gravel Airstrip (no runway lights)

Johnson Point is accessible by a 1500 m (5000 ft) unmaintained airstrip (Figures 1, 2 and 4). The strip is constructed parallel to the coastline, and is approximately 1 meter above sea level. The strip is constructed of coarse-grained granular material, which is common at the site. A major washout divides the airstrip, as detailed in Section 2.9, limiting the type and size of aircraft that can access the site. As indicated in Section 2.9, both Twin Otter and DC-3 aircraft have landed at the site during the summer months without incident. Aircraft tire tracks indicate that all aircraft traffic at the site use the northern section of the airstrip.

- 2 Excavated Ponds

Two square water filled excavations are located near the maintenance shed in Area 3 (Figure 6). It is unknown if these are sumps, lagoons, or borrow sources which subsequently filled with water. Power poles and lights in the vicinity of the excavations indicate that these were likely used during site operations at Johnson Point. Sediment and water samples were collected at each.

- 4 Suspected Landfills

During the geophysical survey four areas returned elevated instrument response, indicating the possible presence of buried metal debris. Pending further geophysical investigation to determine the depth of the buried debris and the excavation of test pits at each location, these have been labeled as anomalies A-D, respectively. Anomaly A is located in Area 3 immediately west of the maintenance shed. Anomalies B and C are located between Area 5 and Area 8 (Figures 8 and 11, respectively). Anomaly D is located at the end of the road extending south from Area 8. The locations of anomalies A-D are shown in Figure 2 of the Komex report, included as Appendix B.

- 19 Vertical POL tanks contained within soil berm

The tank farm has 19 vertical Petroleum Oil and Lubricant (POL) tanks located inside a large 1 metre high earth berm (Figure 7). Twelve (12) of the tanks are constructed of bolted steel panels, while seven (7) are constructed of welded steel panels. The tank farm is approximately 7 meters above sea level. The berm appears to be unlined but this could not be confirmed. Based on aerial photos and site sketches made by INAC and Parks Canada it appears that several of the tanks within the berm have shifted position during the past few years. The tanks are of varying heights and volumes. Approximately 25,000L of fuel and an additional 40,000L of sludge are estimated to be contained within the 19 POL tanks. Two above ground pipelines connect the tank farm to the beach/airstrip area. The pipelines are constructed of 5" inch steel pipe and are laid on 45-gallon drums. The two pipelines run parallel to each other, while the distance separating the lines varies, and is less than a meter over the entire section.

- 6 Horizontal POL tanks on skids

Six horizontal POL tanks are located in Area 3 outside the berm near the tank farm (Figure 6). Five of these tanks are situated adjacent to each other, while the sixth is located immediately adjacent to the maintenance shed. Where applicable, tanks were labeled in a manner that was consistent with the labeling system employed in the 1992 INAC site assessment. Tank locations and numbers are indicated on Figure 14. Tanks 20-24 have a combined capacity of 232,679L, and contain approximately 10,000L of low quality fuel. Tank 25, located next to the maintenance shed, has a capacity of 22,192L and contains approximately 20,000L of high quality fuel.

- Roadways

A network of defined roads is present at the site leading from the airstrip to the tank farm, and to Areas 7 and 8 (Figures 10 and 11, respectively). In several places culverts constructed of welded 45-gallon drums were installed to aid drainage. During site activities the road network did not inhibit travel by ATV, several areas contained minor erosion issues. It is anticipated that only minor road repairs would be required for access of trucks/heavy equipment at the site.

- Barrel Stockpile

A stockpile of approximately 200 45-gallon drums is located adjacent to the airstrip in Area 1 (Figure 4). The majority of the drums are empty, but some do contain product. Five-gallon pails of industrial oil and several pressurized gas cylinders are located near the stockpiled barrels.

2.11 Regulatory Regime

Several federal and territorial acts, regulations and guidelines affect project activities such as site cleanup. INAC has requested that IEG adopt the Abandoned Military Site Remediation Protocol (INAC, 2005), where possible, to apply to the cleanup of Johnson Point.

The site is located within the Inuvialuit Settlement Region (ISR) on federal crown land.

Future work at Johnson Point may require a land use permit from the INAC District Office, screening through the Inuvialuit Environmental Impact Screening Committee, and potentially a water license through the NWT Water Board.

3.0 BACKGROUND REVIEW

3.1 Previous Studies

In 1992, the Inuvik District Office of Indian and Northern Affairs Canada (INAC) conducted a detailed site inventory. During the 1992 field program, the following activities were conducted:

- 45 Gal (205L) drums, batteries, pressurized tanks, oils and other loose debris were collected and stored near the airstrip;
- Combustible materials were burnt;
- Fuel storage tanks were checked for volume and contents;
- An inventory of the site was recorded.

The matter of environmental conditions at Johnson Point came to the attention of the Inuvialuit Regional Corporation (IRC) directly from the community of Sachs Harbour. IRC brought the issue to the Inuvialuit Final Agreement Implementation Coordinating Committee which has representatives of IRC, the Inuvialuit Game Council (IGC), and the federal and territorial governments. On April 8, 2005 the Inuvialuit Game Council passed a resolution to have the IFA-ICC priority list for abandoned sites to be cleaned up in the Inuvialuit Settlement Region (ISR) re-ordered so that Johnson Point became the top priority for the next site to be assessed and cleaned up (IGC, 2005).

In 2000 the Holman Hunters and Trappers Committee reported the presence of leaking tanks at Johnson Point to Fisheries and Oceans Canada and Indian and Northern Affairs Canada (Parks Canada, 2002). The Sachs Harbour Hunters and Trappers Committee asked Aulavik National Park Staff to visit Johnson Point to check for pollution. Various local residents of Sachs Harbour suspected that the site was unsafe and that contaminants had the potential to be leaking into the ocean. In 2002 a brief investigation was conducted by Parks Canada. The site was inspected for visual evidence of pollution, distressed plant or animal life, and evidence of land or water degradation. Several areas of localized suspected hydrocarbon impacts were identified and reported to the Sachs Harbour Hunters and Trappers Committee.

In both studies, potential environmental impacts at the Site were identified. The key potential impact identified was hydrocarbon contamination of soils in the vicinity of the tank farm as a result of spills or leaking tanks. The likelihood and the expected degree of contamination were identified as high (Parks Canada, 2003). Specific concerns include the discharge of unknown quantities of fuel from the aging tanks and lines. Additional concern exists over the unprotected stockpiles of batteries, transformers, and scrap metal and other potentially hazardous materials located onsite.

The on-site fuel storage containers have been suspected of releasing hydrocarbons into the environment. In order to address this concern, IEG Environmental (IEG) was retained by INAC to design and implement an Environmental Site Assessment program to quantify potential environmental impacts at the Site. Initial efforts were geared toward the incineration of onsite waste fuel, however due to problems with the manufacturing of the incinerator, project delays, and the onset of inclement weather the scope of work was redesigned to include site assessment activities as the primary focus and for use in planning future assessment and remediation activities.

3.2 General Approach

This study specifically focuses on the preliminary delineation of contaminated soil, the presence and approximate volumes of hazardous and non-hazardous materials presently stored onsite, and the quantification and characterization of onsite waste fuel.

INAC has identified petroleum hydrocarbons as the primary contaminant of concern from the perspective of potential impacts on terrestrial and aquatic resources at the site. This study also covers a full range of other potential contaminants of concern, including metals, PCBs, and asbestos.

To complete site assessment activities at Johnson Point several tasks were undertaken concurrently. Field crews with appropriate specialization were assigned to complete each specific task. To this end, a geophysical survey was conducted using a Geonics EM61 interfaced with a handheld GPS unit. An experienced technician from Komex International conducted the geophysical survey. IEG personnel completed the Site Inventory and recorded GPS coordinates of all features, which were used to create the site plan. Dowland Contracting was retained by IEG to complete the Tank Inventory and Inventory of Onsite Waste Fuel. Together with the INAC site representative the Dowland contractor visited every onsite tank to collect fuel samples and record information pertinent to the eventual decommissioning of onsite tank infrastructure. IEG personnel conducted the soils survey with assistance from various members of the field crew. Samples were collected from areas where there was known surface staining, or suspected potential impacts based on visual and olfactory evidence. For the purposes of this report, and to remain consistent with previous studies, the site has been divided into the same areas used in the 1992 INAC report. These areas are indicated in Figure 3.

4.0 CAMP / LOGISTICS

The field crew mobilized to Johnson Point on September 29 from Inuvik via Twin Otter and DC-3. The twin otter was used as a personnel carrier, while the DC-3 was used to transport field equipment. The camp, which was already present at the site, consisted of two 10' x 12' canvas wall tents, one 12' x 12' canvas wall tent, and one 12' x 14' weather haven. The three wall tents were used for sleeping, and the weather haven was used as the kitchen/dining area. Each wall tent had the appropriate number of cots for sleeping, while the kitchen contained a propane range, and cooking utensils. Stove oil furnaces heated all tents and the weather haven.

All drinking water was transported to the site in 18.5 L plastic containers; wash water was collected from the nearby creek, when available. When freshwater was unavailable due to freezing conditions a hole was drilled through the sea ice approximately 50m from shore and water was collected from the Prince of Wales Strait. An onsite privy was used for human waste. All combustible waste was burned on-site in a 205 L drum. All non-combustible waste was transported back to Inuvik for disposal. Stove fuel for furnaces and gasoline for the camp services generator and ATV's was stored in accordance with best practices. Spill response capability was maintained at all times. All refueling activities (ATV and furnaces) were undertaken after breakfast each morning. Refueling activities were supported by two spill kits, and one drip tray located immediately adjacent to the drums of stove fuel and gasoline.

Safety meetings were held each morning prior to commencement of work activities. An initial site specific safety meeting was held on September 29 outlining radio operations and protocols, muster areas, wildlife encounters, ATV use, and daily activities. On-site personnel carried radios at all times to maintain contact in the event of an incident. IEG staff made a routine safety check in with the IEG office in Calgary at noon everyday, with the exception of one day where the call was made in the early evening.

On October 6, upon completion of site assessment activities the Twin Otter demobilized camp personnel samples, sensitive instrumentation, and personal gear to Inuvik. Due to mechanical problems on take-off from Inuvik, the DC-3 was not dispatched to Johnson Point until October 7 to demobilize equipment. Two field crew, two pilots and two aircraft maintenance engineers traveled to Johnson Point to demobilize the ATV's, tent camp, and all other remaining equipment.

Timber tent frames, the hot water shower structure, and the privy were left onsite as the camp outfitter (Lakes and Rivers Consulting) will provide camp facilities for mineral exploration companies during the 2006 field season.

5.0 GEOPHYSICAL PROGRAM

5.1 Approach and Methods

To remediate environmental problems related to hazardous waste sites, knowledge of the distribution of buried materials is essential. Electromagnetic (EM) methods respond to the electrical conductivity of the ground. EM measurements provide information about the location, depth and shape of conductive objects. EM methods can also detect subsurface contaminant plumes produced by conductive fluids leaking from buried containers.

In the literature, particular attention has been paid to the use of electromagnetic geophysical techniques in permafrost regions, where, due to the nature and fragility of Arctic environments there exist certain difficulties when characterizing contaminated sites. In these permafrost regions, collecting samples from any depth is difficult and almost always necessitates the use of mechanical drilling equipment, which is not only costly, but poses a further risk of fuel spills and physical damage to the site and may violate land-use regulations. In permafrost regions it is common to encounter unpredictable distribution of ground ice and inadequate subsurface data, which have a direct influence on local hydrology and are hence related to the direction and rate of contaminant transport. Under these conditions, the interest in geophysical exploration techniques in permafrost regions is obvious (Scott et al., 1990).

As most camps do not have the capability to analyze samples beyond a rudimentary level, another barrier to effective management of fuel spills in the Arctic is the long turnaround time between collection of samples and the receipt of useable results. This delay may hinder efficient short-term containment and remediation measures.

The utility of permafrost geophysics depends on selection of a technique which is appropriate for the problem to be solved (Scott et al., 1990), but geophysical techniques have been widely used in northern permafrost areas (Pettersson and Nobes, 2003) and provide a cost-effective, noninvasive, nondestructive technique for environmental investigations, with almost immediate results.

Soils contaminated with hydrocarbons can provide a good contrast in the electrical properties, namely electrical conductivity and dielectric permittivity, when compared to clean soil (Pettersson and Nobes, 2003). While it is generally expected that hydrocarbon-contaminated soils will be more resistive than the clean areas due to the high resistivity of hydrocarbons, site-specific background research is required to confirm the expected response and develop a general model for the geophysical response of contaminated ground before these techniques can be used for practical applications (Pettersson and Nobes, 2003).

The instruments used in EM surveys induce currents in the ground by emitting an electromagnetic field. This primary field generates eddy currents in the subsurface which in turn generate a secondary electromagnetic field which is received and recorded by the instruments receiver. Eddy current strength and the corresponding magnitude of the secondary field depend upon the conductivity of the ground: the more conductive the ground, the larger the secondary field. These instruments have the capability to record not only the magnitude of the secondary field, but also its phase. The types of conductive elements in the ground affect the phase of the secondary field. By utilizing this phase information, it can be determined if the source of any conductive anomalies is metallic or nonmetallic.

Based on the design principles of inductive electromagnetics, the Ground Conductivity Meters (such as the EM38) and Metal Detectors (e.g. EM61) provide high-sensitivity, non-invasive methods for measurement of subsurface conductivity and magnetic susceptibility. Ground contact is avoided and with these instruments it is possible to map terrain conductivity as fast as the operator(s) can walk, facilitating dense data collection and, consequently, excellent spatial resolution – and over most geologic environments, including conditions of highly resistive surface materials such as sand and gravel.

At Johnson Point, a Geonics Limited EM61-MK2 metal detection device (EM61) and experienced operator were sub-contracted from Komex International (now Worley Parsons) to complete a geophysical survey at the site to search for buried metal debris. The presence of such material would indicate the likelihood of a metal dump or landfill site.

The EM61 is a one-man portable, high-sensitivity metal detector recognized as a standard sensor technology within the environmental community. It is suitable for applications in the detection of both ferrous and non-ferrous metal, insensitive to common sources of both geologic and cultural noise, and can be operated without compromise to data quality in most survey environments. The instrument has an effective penetration depth of 5.5 m, depending on target characteristics. This instrument was selected because of its common application in the detection of environmental hazards such as drums, underground storage tanks (USTs); utilities and infrastructure; and, construction and industrial waste.

The EM61 is a time-domain high-resolution metal detector which delineates both ferrous and non-ferrous metals. It uses a powerful transmitter that generates a pulsed primary magnetic field in the earth, and induces eddy currents in nearby metallic objects. The eddy current decay produces a secondary magnetic field measured by the receiver coil. Since the amplitude of the response is highly dependent on the distance between the target and the receiver coil, small near surface anomalies will often produce a response orders of magnitude greater than much larger but deeper targets. By processing the output of the two coils in differential mode, this masking effect from near surface material was drastically reduced. The EM61 is designed such that the differential response to a target at surface is 0 millivolts. In this manner the calculated differential response is used to highlight the deeper targets while reducing the effect of near surface targets.

EM61 data was collected and then stored in a datalogger interfaced with a Canadian Differential (CD) Global Positioning System (GPS) device in order to accurately map areas of elevated instrument response. EM61 data was processed in the field, and ground truthing was completed to obtain higher resolution data.

A draft report including figures summarizing the geophysical survey can be found in Appendix B.

This site covers a very large aerial extent. An attempt to survey the entire area covered by the site would be far in excess of the scope of this investigation. Therefore, limiting criteria were required in the selection of areas to be surveyed with the geophysical equipment. To this end, the following assumptions were made:

- Those areas exhibiting no evidence of historical ground disturbance were unlikely to conceal subsurface metal.
- Certain features, including the roads and POL Tank Farm area would not likely obscure subsurface metal caches.
- The availability of granular material at the site would not require the addition of debris fill, as is common at other arctic sites.

In addition the GPS was unable to receive satellite signals within the tank farm area due to the height of the tanks preventing an EM survey of the area.

5.2 Results – Geophysical Survey

Figure 2 of the Komex report (Appendix C) illustrates the areas covered during the survey. The EM61 survey returned indications of four major isolated anomalies and several smaller expressions of elevated instrument response which were further characterized as surface debris. The four isolated anomalies were each investigated until their spatial extent was determined.

Anomaly A is an area with much surficial metal visible. It appears that this is the edge of the large gravel pad upon which Area 3 is built. There are pipelines running along the surface in this area. There are six discreet anomalies in this dataset ranging in size from 10 m by 15 m to 75 m by 25 m. The total area of this anomaly is 2720 m^2. In the southwest portion of this area are two ponded excavations that were not surveyed directly; but, metallic debris was observed through the ice.

This anomaly appears to be an accumulation of refuse produced by operations in the nearby buildings. Many pieces of metal were noted on the ground surface, however the instrument response indicated much larger quantities of buried metal debris. The anomalies appeared perpendicular to the edge of the gravel pad suggesting that there may have been successive backfilling events to cover debris.

Anomaly B, shown in Figure 4 of the Komex report, is a 30 m by 30 m topographical high. The total area of the anomaly is approximately 400 m^2. Upon inspection, a steel cable was noted to be sticking out of the ground. Both the topographical high and the surrounding area were surveyed.

This anomaly resembles a landfill as the feature exceeds the natural topography and has relatively angular shape. It appears that this area may have been used and subsequently covered with a layer of cover material. Nearby topographic highs were also surveyed, however none were found to contain metallic debris.

Figure 5 of the Komex report presents Anomaly C, between Area 5 and Area 7. The total area of this anomaly is approximately 1500 m^2. This anomaly is approximately 100 m in length and between 4 m and 30 m in width, and possibly represents a buried pipeline or other similar linear feature. There was no noted surface expression suggesting buried materials associated with this anomaly.

Anomaly D, represented in Figure 6 of the Komex report, is located on the southwestern-most corner of the site. There is a road which continues southwest from the area of the anomaly. The dimensions of the anomaly are 20 m by 30 m, with a total area of 600 m^2.

To facilitate presentation of the findings, the surveyed area has been subdivided into five different maps:

- Komex Figure 3 – Area A;
- Komex Figure 4 – Area B;
- Komex Figure 5 – Area C;
- Komex Figure 6 – Area D; and
- Komex Figure 7 – Navigational Aid.

5.3 Recommendations

The EM61 is a high resolution tool that acquires data straight down. The coarse line spacing could have easily missed smaller targets. If there is a concern about smaller deposits such as individual drums/barrels, then further investigation utilizing the EM31 and EM38 would be useful instruments to use for a broader scan of the area with wider spacing. The 31 collects data from a much larger volume. If a barrel was missed with a given line spacing using the EM61, it would likely be picked up by the 31 at the same spacing. The EM38 can help further constrain the position of objects found by the EM31.

Historical data and aerial photographs may provide insight into which areas warrant further investigation. Additional geophysical investigations should also include Electrical Resistivity Tomography (ERT) to constrain the depth boundaries of the known anomalies (the ERT gives a vertical cross section compared to the horizontal cross section produced by other EM survey instruments).

The advantages and abilities of each geophysical unit is summarized below:

- EM31 - Broader scan area, good for oil drums and smaller objects <5 m below ground surface
- EM38 - Same as above but shallower depth. Good for high resolution, near surface debris.
- ERT - Constrains depth boundaries of buried deposits.
- Further EM61 - Other target areas, if identified.

The decision to proceed with further geophysical investigation is dependent upon the level of resolution desired. The two-dimensional extent of suspected landfills were identified to a high degree of resolution within the survey boundary. Barrels or small waste deposits could have been missed due to the limitations of the instrument and the large spatial scale of the site. Additionally, with EM31/EM38/ERT instruments it is possible to conduct contaminant mapping which may be useful around the tank farm.

For more detailed geophysical site characterization ERT sections can be collected over each EM conductivity anomaly of significant size. The ERT survey provides cross-sectional electrical imaging of the subsurface. This type of data, in combination with the plan view EM conductivity maps, can be used to provide a fully three-dimensional sense of the extent and volume of subsurface inorganic impact with out the need for intrusive sampling.

Given the successful use of electromagnetic (EM) techniques in locating hydrocarbon contaminated areas in temperate regions, the portability and noninvasive survey and the short time between collection of data and production of results, this methods is being chosen as a suitable method to investigate contaminated soils in Arctic Canada. Highlights of these techniques include:

- EM surveys can be conducted with minimal mobilization time, and due to the portability of the equipment, relatively low mobilization costs – especially compared to the costs associated with mobilizing mechanical drilling equipment to remote sites.
- The survey can be conducted by one person essentially as fast as the operator can walk, and post processing the data can be almost immediate, allowing for this method to be used to locate the most effective locations for monitoring wells.
- The method is non-destructive, non-invasive, and high sensitivity.
- Electromagnetic methods can provide information on the location, depth and shape of subsurface features, including geologic features, permafrost characteristics, man-made features, and contaminant plumes.
- The survey method provides extremely high data densities which lead to much greater spatial resolution than can be achieved with intrusive testing.
- Due to the improved spatial resolution, EM methods can be used for locating contaminant pathways, and monitoring contaminant migration.
- The equipment described above is relatively insensitive to cultural interferences such as buildings, fences and power lines.
- The data collected are time stamped and interfaced with concurrently collected GPS data to accurately relocate areas of elevated instrument response and to aid in the production of maps of terrain conductivity using commercially available software.

6.0 SITE DRAWINGS

Prior to conducting the inventory a base map of the site was built using the GPS. The base map consisted of such features as the airstrip, roads, creek, coastline, powerline, and pipeline. During the Site Assessment layers of features were continuously added to the Site drawings. The Johnson Point AES Cleanup Report, (DIAND, 1992), divided the site into eight Areas. To the extent possible the same nomenclature was used in the current study. Appendix A includes all drawings which have been prepared to represent locations of on site features.

In addition to these figures Komex International created a set of figures to accompany the geophysical (electromagnetic) survey completed at the site. Komex figures can be found in Appendix B.

Site features that are shown on the drawings include:

- All buildings, dumps, site infrastructure (former roads, abandoned airstrip, etc.), and areas of debris;
- Airstrip areas;
- Selected major drainage pathways;
- Location of each geophysical anomaly/suspected landfill; and
- Approximate areas that exceed hydrocarbon guidelines.

7.0 SITE INSPECTION

The following section includes the Site Inspection, the Inventory and Quantification of Non-Hazardous Debris, and the Inventory and Quantification of Hazardous Debris.

7.1 Approach and Methods

An onsite inventory of all features, including surface debris, mechanical equipment, and other non-natural features was completed according to the Terms of the contract. An ATV was used to access and inventory all non-natural site features. A systematic approach was followed while conducting the onsite inventory, where all features in a given area were inventoried prior to advancing to a new area. In some circumstances, snow cover may have obscured certain onsite objects. The inventory was conducted over five consecutive days between September 30 and October 5, 2005. Each feature was assigned a numerical identifier, which was recorded in the field notes. Each feature was also photographed, described in detail in the field notes, measured, and classified as either hazardous or non-hazardous. The location of each feature was recorded on the base map using a GPS. When similar items were stored together (e.g. 45 gallon drums) these were recorded as one feature. Hazardous materials that were to be identified on the site included mercury arc lights or switches, asbestos, PCB containing materials (paint and electrical units), lead acid batteries, chlorofluorocarbons (CFC's), and lead paint. On site quantities of Petroleum Hydrocarbons were identified and inventoried by a separate field crew as part of the Inventory of On-Site Waste Fuel and are reported in Section 12 of this document. Where it was deemed necessary and possible, samples of paint were collected for analysis of metals (e.g. lead) and PCB's to determine whether or not the material should be classified as hazardous. At the end of each survey day field notes were entered into an electronic format, and digital photographs were uploaded to a laptop.

7.2 Analytical Parameters and Methods

During the Site inventory four paint samples were collected for chemical characterization. Paint samples were collected from features where paint pealing was observed. Attempts were made to collect paint samples from all surfaces but due to the thin layering on the exterior of buildings and/or tanks, time constraints, and inappropriate field tools/personal protective equipment (PPE) the collection of adequate volumes for analytical analysis was not possible. Paint samples were collected by hand, while the sampler wore nitrile gloves, and placed in a laboratory supplied container. For multiple items, such as the Atco trailers, only one sample was collected as all items are suspected to have been manufactured at the same time using similar paint products. Paint field tests are temperature dependant and were not employed during this project. Several of the camp units contained unpainted walls and hence were not sampled. Samples were submitted to ETL for analysis of metals and PCB's. No duplicate samples were collected as the standard 1:10 ratio of duplicates to samples was not attained. All paint samples were analyzed for the following parameters:

- Metals (Ag, Al, As, Ba, Be, Ca, Cd, Cr, Co, Cu, Fe, Hg, K, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Sn, Sr, V, W, Zn, Zr) by ICP-MS,
- Polychlorinated biphenyls (PCB's) by GC.

In addition to the four paint samples collected, one sample of a suspected asbestos containing material was collected and submitted to the laboratory for characterization. The asbestos sample was collected by hand, while the sampler wore nitrile gloves. The material was covered with a small piece of plastic, to avoid releasing asbestos fibers into the air, samples were broken off and placed in laboratory supplied containers. No other items were encountered which appeared to contain asbestos.

7.3 Results – Site Inspection

7.3.1 Infrastructure

In total 91 features were identified at Johnson Point, including, but not limited to:

- Portable camp units, on both skis and tracks;
- Fuel sloops;
- 45 gallon drums;
- Fuel tanks;
- Drilling equipment;
- Nodwells;
- Bull Dozer;
- Geophysical / Seismic exploration equipment;
- Navigation aid;
- Fuel caches;
- Incinerators, and;
- Assorted debris.

All 91 site features are described in Table 1. The table lists the following:

- Item number;
- Area on-site where the feature is located (Areas were predetermined by DIAND during 1992 site assessment);
- 1992 DIAND Inventory number;
- Photographic number,
- Description of the feature;
- Materials contained within the feature;
- Dimensions, and;
- Whether it is hazardous or not.

Power poles at the site were mapped using the GPS but were not included in the site inventory. The power poles lead from the maintenance shed to the Navaid and along the pipeline route from the maintenance shed to the airstrip area. None of the power poles appeared to be treated. The pipeline was not included in the inventory. The pipeline consists of 2 parallel 5” steel pipes. The pipeline is above ground, with the exception of 15 m near the maintenance shed. The pipe is laid on both the ground surface and empty 45 gallon drums. The pipeline starts near the airstrip area, and terminates near the maintenance shed.

Table 1 of Appendix E provides an inventory of all debris/infrastructure present at the site. Photographs of all items listed in Table 1 can be found in Appendix D1.

7.3.2 Paint Sampling

One paint sample (silver metallic color) was collected from the exterior wall of a horizontal POL Tank (Item 44), a second paint sample (white) was collected from the ceiling of one of the "ATCO" trailer units (Item 68), a third paint sample (white) was collected from the ceiling of one of the Nodwell camp units (Item 86), and a forth paint sample (light blue) was collected from the wall of another Nodwell camp unit (Item 87). No paint samples were collected from the Nodwell camp located in Area 2 (Items 8 and 9) because the internal walls were covered with unpainted wall board.

If additional paint samples are collected during future work at Johnson Point, IEG suggests field screening samples with Lead Paint test kits, and submitting lead containing materials to an accredited laboratory for the purposes of conducting the Toxicity Characteristic Leachate Procedure to determine the appropriate method of disposal.

Sample Location	Parameter	
	Lead (> 500 mg/kg)	PCBs (> 50 mg/kg))
POL Tank (Item #44)	√	
ATCO Trailer (Item #68)		
Nodwell Camp (Item #86)	√	√
Nodwell Camp (Item #87)	√	

The Canadian Environmental Protection Act (CEPA) classifies all materials containing greater than 50 ppm of PCB's as PCB Waste. Laboratory results indicate that Sample #86 contains 60 ppm total PCB's. The data indicate that the other paint samples submitted all contain concentrations of PCB's below the CEPA Guideline.

Complete analytical results of the paint characterization are summarized in Table 2.

7.3.3 Asbestos Sampling

Only one suspected asbestos-containing material was encountered during the site inventory. A sample was collected from a sheet of fibrous insulation separating a furnace from the eating area of a camp trailer, item #8. None of the other camp units were noted to contain this type of building material during the Site Inventory. Laboratory analysis of the sample collected from item #8 indicates the material contains between 25 - 50 % Chrysotile fibres by weight.

Waste asbestos is defined as Asbestos which is no longer useable for its intended purpose and is intended for storage, recycling or disposal. It includes any type of material with greater than 1% asbestos by weight but not asbestos that is immersed or fixed in a natural or artificial binder or included in a manufactured product (GNWT 1998)

Chrysotile fibres at Johnson Point are non-friable. Friable is described as, a material which when dry can be crumbled, pulverized or reduced to powder by hand pressure (GNWT 1998). Non-friable asbestos is less difficult to remove and handle than friable asbestos.

Analytical results of the characterization of suspected asbestos containing materials are summarized in Table 3.

7.3.4 Other Waste

Approximately ten lead-acid batteries were observed on site. Several of these batteries are stored in Area 1, while the others are located inside sheds, and as part of mechanical equipment.

Other possible hazardous materials encountered during the inventory include CFC refrigerants and PCB light ballast. Refrigerator units could not be inspected as all were bolted to the walls of the camp units. CFC's were used extensively in refrigerator units prior to the 1990's, thus it is likely that CFC's may be present at the site.

Only one florescent light unit was located at the site, it was found in the aircraft navigation aid (item 30). No model number, or manufacturer could be located on the unit. Prior to 1980 PCBs were used in light ballast or electrical capacitors. Hence it is possible that PCB's are present in this single light ballast.

The limited number of transformers onsite (several near the airstrip on a power pole, and one at the NavAid) did not warrant sampling due to the location of the transformers, insufficient PPE, and lack of sampling procedures. During future cleanup activities these items should be examined and possibly sampled. Standard sampling procedures and PPE requirements should be investigated before attempting to sample these transformers.

No mercury containing substances were encountered at the site.

7.4 Hazardous Material Volume/Weight Estimate

The estimated demolished volume and weight of each contaminate of concern at the Johnson Point site are listed below. The entire site inventory can be found in Table 1 of Appendix E provides information on the individual volumes and weights of each item.

Contaminant	Media/Container	Estimated Volume (m^3)	Estimated Weight (kg)
PCBs	Paint*	160	198500
PCBs	Transformers	0.5	200
PCBs	Light Ballast	0.001	0.5
Asbestos	Paneling	0.001	1.0
Metals	Paint*	160	198500
Hydrocarbons	Tanks/Drums	90	75650
Lead	Batteries	0.1	140
Lead	Paint*	160	198500
Mercury	N/A	0	0
Pressurized Gas	100 Lbs Tanks	0	1400
Total**		600	672900

* Volume and weight assumes both paint and associated building material. Assumes all painted camp units contain PCBs, metals, and Lead.

** Total rounded up to nearest 100th.

7.5 Non-Hazardous

The estimated demolished volume of all non-hazardous materials at the Johnson Point site is 230 m^3. The estimated weight of all non-hazardous materials at the Johnson Point site is 180,000 kg. These volumes and weights do not include painted building materials or POL tanks. The estimated weight of steel contained in all the POL tanks is 520,000 kg, based on the weight of standard POL tanks today.

8.0 PHOTOGRAPHIC RECORDS

Detailed photographic records were collected at the Site, recording:

- An overall photographic record,
- Photographs to substantiate and document evidence of all features noted in the Site Inspection;
- A representative number of soil sample locations; and
- Tank conditions.

As discussed above, Table 1 summarizes feature notes and clearly references each photograph, which was taken to document the Site Inventory. Additional photographs were taken to document the Tank Inspection and Inventory of On-Site Waste Fuel.

Thumbnails of each photograph are located in Appendix C. Digital copies are available on the accompanying CD.

9.0 SOIL SAMPLING PROGRAM

9.1 Approach and Methods

At Johnson Point the key issues in terms of the potential risks to humans and/or the environment, are the impact of hydrocarbon contamination from any of the POL Tanks on site, and the potential impact of leachable contaminants (metals, PCBs) that may be present in the onsite landfills which have been identified by the presence of buried metal debris.

The program was designed to include both soil sampling and groundwater sampling as the key monitoring components. Due to relatively freezing temperatures, and frozen ground conditions at the site, collection of groundwater was not possible. Soil sampling, however, was completed in a manner to provide data representative of areas of known or suspected impact. Soils with the potential for exposure to either hydrocarbons or leachable contaminants were targeted.

The main focus of the sampling program was the area immediately surrounding the tank farm, as this area represented the greatest risk of potential exposure to petroleum hydrocarbons. Other areas that were sampled for hydrocarbon analysis included any isolated fuel storage areas or small earth berms. Areas that were targeted for potential metals contamination included all anomalies discovered during the electromagnetic survey.

In general, the components of the site assessment provide quantitative analytical chemical data for soil, incorporating quality assurance/quality control (QA/QC) measures.

Samples were analyzed for potential contaminants of concern (COC) including benzene, toluene, ethylbenzene and xylenes (BTEX), petroleum hydrocarbons in the F1(C_6 to C_{10}), F2(C_{10} to C_{16}), F3(C_{16} to C_{34}), and F4(C_{34} to C_{50}) fractions, and metals identified in the DEW Line Cleanup Criteria (DLCU) including arsenic (As), cadmium (Cd), chromium (Cr), cobalt (Cu), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni) and zinc (Zn). Polychlorinated biphenyls (PCBs) were also identified as potential COC by INAC and were included as analytical parameters. Moisture content and grain size analysis were also determined.

In order to optimize the effectiveness of the soil sampling program, available relevant information was reviewed prior to the development of the program methodology. Various documents were reviewed in order to identify site characteristics that may have bearing on the program design. These documents included Johnson Point AES Cleanup (DIAND, 1992), Johnson Point Site Investigation (Parks Canada, 2002) and miscellaneous aerial photographs.

In addition to site-specific information, established protocols for soil sampling and monitoring (e.g. the Abandoned Military Site Remediation Protocol (INAC, 2005); Environmental Guidelines for Contaminated Site Remediation (GNWT, 2003); Jones and Case, 1990; and SSSA, 1987) were also considered in the design of the monitoring program. These protocols are designed to ensure that soil monitoring is conducted in a manner that produces reliable and representative data.

Sampling locations were selected at and around sources of potential contamination. The five monitoring areas selected include the area surrounding the tank farm, and each of the four areas of elevated instrument response identified as Anomalies A-D, respectively, during the electromagnetic survey. The location of major soil monitoring areas is depicted in Figure 15.

In the area surrounding the tank farm, soil samples were collected between 0-15 cm depth below ground surface (bgs). Soil samples could not be collected at depths greater than 15 cm bgs due to frozen ground conditions. Outside areas where there was a clear indication of potential contamination soil samples were collected at the nodes of a 10 m x 10 m grid in order to systematically cover large areas of the site.

On the afternoon of 29 September, a reconnaissance of the entire site was completed in order to investigate the tank farm area for soil type, drainage patterns and pathways, signs of surface staining, and to identify potential sampling locations. Sampling itself was initiated the following day (30 September) on the flood plain north of the tank farm. Sampling was initiated through the establishment of a 'baseline' transect from which to base the rest of the 10m-grid. Sampling of the north-south and east-west transects was conducted over two days (30 September and 1 October).

Following establishment of the 10 m-grid soil samples were collected in the "near-field" portion of the flood plain immediately adjacent to the tank farm berm. This sampling was completed on 2 October.

On 3 and 4 October, soil sampling was conducted to the west of the tank farm. At present, there is a significant drainage pathway approximately 20m west of the tank farm berm, and some exposure to hydrocarbons is suspected through drainage from inside the tank farm. To account for possible contamination of soils through these drainage pathways the 10m-grid was extended for the entire length of the western side of the tank farm berm between the berm itself and the drainage channel.

On 5 October, soil sampling was conducted to the east of the tank farm. At present there is a deep drainage channel that divides the tank farm area from the large gravel pad immediately adjacent. Samples were collected approximately 10m apart for the entire length of the drainage channel.

Each sampling location was marked with a wooden stake, and the coordinates of the stake were obtained using handheld differential global positioning system (GPS) equipment to facilitate the use of the same sampling locations in future sampling events, if necessary. In total, 71 sampling locations were established in the area immediately adjacent to the tank farm for the collection of representative soil data (Figure 15).

Soil samples were collected for the purpose of chemical analysis at each sampling location. A single grab sample was collected at each location and placed directly into laboratory supplied 120 ml clear glass sample jars with Teflon lined caps. Soil samples were also placed in laboratory supplied pre-labeled plastic zip-loc style bags for analysis of VOC's using a Rae Systems Mini-Rae 2000 photoionization detector (PID). Samples were collected by hand using disposable nitrile gloves. Due to freezing conditions encountered at the site samples were collected using a gas powered auger with a four inch continuous flight auger stem. The soil auger was cleaned between plots using a brush to remove any loose soil adhering to the auger. Further decontamination using water and water-soluble soap was not practical due to freezing conditions. The depth of soil sampling at all locations was established to represent the upper rooting zone (i.e., 0-15 cm below ground surface (bgs)) for risk assessment purposes. Freezing ground conditions prevented collection of samples at greater depth below ground surface.

Each day after the samples had been warmed to room temperature inside the sleeping tents, the samples were analyzed for volatile organic carbons in the headspace of the sample bag using a MiniRae 2000 Photoionization Detector calibrated to 100 ppm isobutylene.

9.2 Quality Assurance/Quality Control Measures

To ensure the collection of reliable and representative data, a Quality Assurance/Quality Control (QA/QC) program was designed and implemented as part of the Environmental Site Assessment field program. The QA/QC program included both field and laboratory measures.

To meet the field-based QA/QC requirements, field duplicates of soil samples were collected for analysis at a rate representing approximately 10% of the total sample count. Field duplicate samples are used to assess the precision of the sampling and analytical procedures. The duplicate samples were collected by splitting a representative sample into two parts, labeling one duplicate with the true sample code and the other duplicate with a designated blind code.

Duplicates were collected in the same manner as the other samples, as described in Sections 3.3.1. Blind codes (non-recognizable by the lab) were assigned to all quality control samples. The meaning of the blind codes and the station at which each quality control sample was taken were recorded in the field book.

To evaluate the variability associated with sampling and analytical methods, the analytical results for the paired field duplicates were used to calculate relative percent difference (RPD). The RPD was calculated using the following formula (US EPA, 1994):

$$RPD = \left(\frac{(C1 - C2)}{(C1 + C2)/2} \right) \Big/ 100\%$$

Where: RPD is the relative percent difference (%);

C1 is parameter concentration in the original sample; and

C2 is parameter concentration in the sample duplicate.

When the analytical result for either the original sample or its duplicate was less than the method detection limit (MDL), or if the results for both the original and duplicate were below the MDL, the RPD was not calculated. In these instances, the analytical results were automatically assumed to have a high degree of similarity.

Soil is an inherently variable medium. RPDs of 35% or less are considered to be acceptable for soil parameters such as hydrocarbons, metals, pH and major ions. For all parameters detected at low concentrations, near or below the MDL, relatively high RPD values (i.e., > 35 %) are not unexpected. In evaluating possible causes and subsequent implications of observed differences between sample-duplicate pairs, a weight-of-evidence approach is used. All analytical parameters, especially key elements of concern, including hydrocarbons, the RPD values show good overall agreement and the data set can be considered to be reliable.

The RPD's are presented in Table 4 in Appendix D.

- EnviroTest Laboratories (ETL) in Edmonton analyzed all soil samples. ETL is accredited by the Standards Council of Canada (SCC) in partnership with the Canadian Association For Environmental Analytical Laboratories (CAEAL). ETL Edmonton currently has six full-time staff dedicated to quality management functions, and has developed a quality management system that is designed to provide data of known quality. This includes many steps that ensure the integrity and validity of the analytical results, and guarantees that the results will meet the data quality objectives of the project.

Laboratory Certificates of Analysis and the ETL Quality Control Report documenting the analytical QA/QC procedures and results are located Appendix E.1 and Appendix E.2 respectively.

9.3 Sample Handling

At the end of each day of sample collection, soil samples were placed and subsequently maintained under freezing conditions until the time of submission to the analytical laboratory.

Chain-of-custody records were maintained for all samples that were submitted for analysis. Completed Chain of Custody forms can be found in Appendix E.3.

Soil samples were kept frozen ultimately transported from Johnson Point to Inuvik for forward to Edmonton and submission to ETL.

9.4 Analytical Parameters and Methods

All soil samples were analyzed for the following parameters:

- Petroleum Hydrocarbons in the F1(C_6 to C_{10}), F2(C_{10} to C_{16}), F3(C_{16} to C_{34}), and F4(C_{34} to C_{50}) fractions using the following method: CCME CWS-PHC Dec-2000 Pub#1310;

Selected soil samples were analyzed for the following additional parameters :

- Benzene, Toluene, Ethylbenzene and Xylenes (BTEX) using the following method: CCME CWS-PHC Dec-2000 Pub#1310,
- Metals identified in the DEW Line Cleanup Criteria (DLCU) including (As, Cd, Cr, Co, Cu, Pb, Hg, Ni, and Zn) using EPA Method 6020;
- Polychlorinated biphenyls (PCBs) using EPA Method 3510/8082.

9.5 Results – Soil Chemistry

The soil sampling program at Johnson Point can be divided into three main investigations. The first, and most significant in terms of effort is the sampling program that was undertaken in Area 4 immediately adjacent to the Tank Farm. The second soil investigation included the collection of samples from on or near each of the anomalies identified during the geophysical (EM) survey. The third investigation included the collection of sediment samples from each of the three major surface water expression located onsite. Each of these investigations will be discussed in detail in this section.

For the purpose of a comparative reference, the CCME Canada Wide Standard for Petroleum Hydrocarbons in Soil was reviewed and used as the basis for the development of a screening criteria to be used in the current assessment of soil chemistry results. The standards chosen apply to coarse soils for Residential/Parkland and Commercial/Industrial properties. While both standards have been included in the summary tables of analytical results, the data were compared to the more conservative of the two screening criteria – Residential/Parkland. The standard establishes the following values for each hydrocarbon fraction:

- Fraction 1 (C6-C10) – 30 mg/kg
- Fraction 2 (C10-C16) – 150 mg/kg

- Fraction 3 (C16-C34) – 400 mg/kg
- Fraction 4 (C34-C50) – 2800 mg/kg
- Total Hydrocarbons (C6-C50) – 3380 mg/kg

Appendix C of INAC's Abandoned Military Site Remediation Protocol 2005, discusses the application of site specific information to allow for adjustments to standard Tier 1 levels. The information provided in Table 2 *CCME Residential/Parkland Tier 1 Levels (mg/kg) Applicable Pathways* of Appendix C of the Protocol establishes applicable exposure pathways at typical DEW Line sites. Further, due to the limitations of the field analytical equipment available for in-field screening and delineation, two different criteria are provided:

- 150 ppm PHC impacted soils close to fisheries sensitive environments
- 5000 ppm PHC impacted soils in other areas

Fisheries sensitive environments are defined as areas that lie within 10 m of life supporting water bodies (INAC 2005). At arctic military sites fisheries sensitive environments typically include beach POL facilities, and shoreline staging areas (INAC 2005). Soil samples at Johnson Point collected within the flood plain of the river, down-gradient of the tank farm, would be considered a fisheries sensitive environment since it is within the 10 m zone at certain times of the year (eg. spring breakup, intense rainfall).

The standard upon which the chosen screening criteria (Total Hydrocarbons 3380 mg/kg) are conservatively set to protect both human health and ecological receptors, typically with a significant margin of safety. The soil standard that has been considered herein is intended as general guidance for the protection, maintenance, and improvement of specific land or land-based resources. Revision of the screening criteria will have a direct effect on the volume estimate of contaminated soil at Johnson Point.

9.5.1 Tank Farm

In total 71 samples were collected, however only 32 (excluding 6 field duplicates) were submitted for analysis. The results of the analytical characterization of soil samples from this area are presented in Table 5. Figure 16 graphically depicts locations where hydrocarbon concentrations currently exceed the selected screening criteria.

The surface soils in the area surrounding the tank farm can be categorized as light brown to yellowish orange coarse-grained mineral soils, comprising fine and coarse gravel in a medium to coarse sand matrix. The area is notably void of any surface vegetation, likely due to seasonal flooding during the spring freshet. The areas to the north and west of the tank farm where the majority of the samples were collected dip gently away from the tank farm. The inferred flow direction in this area is to the north where the floodplain meets the river (located approximately 200 m to the north (Figure 2).

At the majority of soil sampling locations the hydrocarbon concentrations were well below the screening criteria. However, many of the samples did return results in one or more of the hydrocarbon fractions analyzed, and several returned concentrations in excess of the screening criteria. For the most part, detections occurred in the F2 and F3 fractions, which is consistent with suspected diesel fuel contamination. Detections range from the method detection limit to 5700 mg/kg for F2. Similarly, detections for F3 range from the detection limit to 2000 mg/kg. Notably, the sample collected from inside Berm 2(S) returned results of 24,000 mg/kg for F3 and 11,000 mg/kg for F4.

Several samples exceeded the screening criteria in the area immediately northeast of the tank farm. This area showed surface evidence of hydrocarbon staining and several of the smaller surface drainage features contained red staining during both the 2002 Parks Canada site visit and the 2005 site reconnaissance visit undertaken as part of the current study. Additionally, this area is immediately down gradient from the northeast corner of the tank farm where tanks are strongly suspected of shifting. In 2002 Parks Canada reported that tanks 1-3 each contained 'at least 2 m of hydrocarbon fluids' (Parks Canada, 2003). The depth of product was determined through visual inspection (where personnel could gain access to the top of the tank), tapping the tank sides, and measuring the condensation lines present on the exterior of the tanks (Pers. Comm. Alan Fehr, Parks Canada). Visual inspection was believed to have been performed on tanks 1-3 (Pers. Comm. Alan Fehr, Parks Canada). During the 2005 Inventory of Onsite Waste Fuel IEG measured less than 10cm of product and sludge in each of the three tanks in question. Based on those measurements collected in the present study, Tanks 1-3 contained approximately 12,000L at the time of sampling. Based on these two measurements there are two obvious possible explanations for the missing 463,000 L of fuel. The first explanation is that the fuel has spilled from the three tanks into the environment. The second possible explanation is that the volumes were erroneously or inaccurately reported. Further investigation of both possibilities is warranted. Representing approximately 2000 m^2, and assuming the active layer extends less than one meter below ground surface, this area represents approximately 2000m^3 of contaminated soil.

Further, the sample (TFNE) collected between 0-15cm bgs in the northeast corner of the tank farm inside the earth berm at the location where the tanks are expected to have been situated prior to shifting returned results exceeding the selected screening criteria for F1, F2, F3, and Total Hydrocarbons. It was impossible to ascertain the condition of the tank bottoms during the 2005 ESA.

One sample (80S100W) exceeded the screening criteria on the west side of the tank farm. Results for TFSW, collected inside the berm, indicate hydrocarbons in the F2 range that exceed the established screening criteria. The area represented by this sample could total approximately 100m^2. Assuming the active layer extends less than one meter below ground surface this area could represent approximately 100m^3 of contaminated soil.

The laboratory results for Berm 1(N), collected from inside a small earth berm located immediately east of the tank farm (Figure 16), indicate elevated concentrations in the F2 fraction. Berm 2(S), located east of the tank farm and approximately 100m south of Berm 1(N) is a very small earth berm measuring only approximately 3m x 3m. The sample collected from this area returned results markedly higher than at any other location onsite. The areas inside the earth berms showed evidence of surface staining. The elevated responses were recorded in the F3 and F4 ranges.

It is impossible to calculate the volume of hydrocarbon contaminated soil at the site due to the lack of data related to the depth of contamination. Based on the levels of petroleum hydrocarbons measured in surface soil samples an area of approximately 2100m^2 of soil is contaminated by petroleum hydrocarbons.

To the west of the tank farm, outside the earth berm, there are indications of an ephemeral stream that drains from the western side of the tank farm in a northward direction but appears to be dry/reduced flow for a significant portion of the year. The sediments in the bottom of this small stream and on the floodplain to the north of the site consist of fine to silty sand in their most distal parts. Rilling is evident in several locations near the tank farm and a large gully is forming to the east of the tank farm berm effectively separating the berm from the gravel pad to which it appears to have once been attached. This gully on the eastern side of the tank farm was observed to contain a reddish orange staining and a very small amount of running water during the Site reconnaissance visit in July. Associated with the staining was the sheen typical of hydrocarbon contamination. During the Site Assessment (in October) there was surface water frozen in the bottom of the channel but evidence of staining or a sheen were no longer evident. Due to surface cover by snow, no surface staining was observed in the small surface water drainage pathways or rills leading down gradient from the berm.

9.5.2 Geophysical Anomalies

The EM61 survey discussed above returned indications of four major anomalies, which were each investigated until their spatial extent was established precisely. Appendix B contains the results of the Geophysical Survey and the associated figures. Samples from each of the four Areas were collected and submitted to the laboratory for analysis of hydrocarbons and metals. Figure 17 shows sampling locations in each area. Results for all parameters (i.e. hydrocarbons and metals) were below the selected screening criteria. Results of the laboratory analysis can be found in Table 6. Investigation of the potential for metal contamination of subsurface soil and groundwater in the vicinity of the geophysical anomalies is suggested, as only composite samples from 10-15 cm below ground surface were collected, while it is anticipated that there will likely be saturated flow within the active layer which is estimated to be approximately 1 m thick.

9.5.3 Sediment Samples

During on-site activities several large surface water bodies were encountered. Once sufficient ice depth was ascertained, sediment samples were collected by drilling through the ice. The hole was allowed to 'rest' for several minutes while sample vessels were prepared to allow time for disturbed sediment to settle and clear the water column. No background samples were collected. Sediment samples were collected for analysis of the following parameters:

- Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX);
- Petroleum Hydrocarbons in the F1-F4 fractions;
- CCME Metals (Ag, As, Ba, Be, Cd, Co, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Sn, Tl, U, V, Zn)
- Polychlorinated Biphenyls (PCBs)

Figure 18 shows sampling locations at each feature (Sump 1, Sump 2 and Lake). Results for all parameters for which guidelines exist (i.e. metals and PCBs) were below the Interim Sediment Quality Guidelines for freshwater sediment. Analytical data are presented in Table 7.

10.0 SURFACE AND GROUNDWATER SAMPLING

10.1 Surface Water

During on-site activities several large surface water bodies were encountered. Once it was ascertained that the ice covering these surface water expressions was sufficiently safe to walk on samples were collected by drilling through the ice. The hole was allowed to ‘rest’ for several minutes while sample vessels were prepared to allow time for sediment to settle and clear the water column. Surface water samples were collected for analysis of the following parameters:

- Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX) using EPA Methods 5030/8015 & 8260;
- Petroleum Hydrocarbons in the F1-F4 fractions using EPA Methods 8260/8015/8000;
- Routine water parameters (Cl, Ca, K, Mg, Na, SO_4, Ion Balance, TDS, Hardness, Nitrate+Nitrite-N, Nitrate-N, Nitrite-N, pH, EC, HCO_3, CO_3, OH, and Alkalinity) using APHA Methods 5310/4500/3120/1030/2540/2130;
- Total Major Metals (Ca, K, Mg, Na, Fe, and Mn) using EPA Method 200.7;
- Total Trace Metals (Ag, Al, As, B, Ba, Be, Cd, Co, Cr, Cu, Hg, Li, Mo, Ni, Pb, Sb, Se, Sn, Ti, Tl, U, V, and Zn) using EPA Method 6020;
- Polychlorinated Biphenyls (PCBs) using EPA Methods 3510/8082

Analytical data are presented in Table 8. Canadian Environmental Quality Guidelines for the Protection of Aquatic Life (Freshwater) were selected as appropriate screening criteria. For all parameters where environmental quality guidelines exist the laboratory reported results less than the guideline value. In the cases of Silver (Ag) and Cadmium (Cd) the method detection limit was greater than the recommended guideline values. BTEX, F1-F4 hydrocarbons and PCBs were all reported less than the respective detection limit for each analyte.

Specific QA/QC procedures enacted during the analyses of water samples for this study include the following:

- Analysis and reporting of Laboratory Duplicates
- Analysis and reporting of Laboratory Control Samples (derived from sub sets of the original sample following standard laboratory approved methods)
- Analysis and reporting of Process Recovery (% recovery),
- Reporting of data associated with Matrix Spikes, and
- Reporting of data associated with Method Blanks.

10.2 Groundwater

Due to freezing conditions encountered at Johnson Point, proposed groundwater monitoring was not completed. At a minimum, IEG suggests the installation of a row of drivepoints parallel to the creek located at the north end of the site.

11.0 TANK INVENTORY

11.1 Approach and Methods

The objective of the Tank Inventory was to collect data that could be used to develop and evaluate disposal options for the POL tanks located onsite.

An inventory of details pertinent to the onsite POL tanks was completed between September 30 and October 5, 2005. During the inventory every effort was made to visually observe and photograph all onsite tanks and barrels. Where applicable, tanks were labeled in a manner that was consistent with the labeling system employed in the 1992 INAC site assessment. Tanks were accessed from the top and product thickness, if applicable, was measured with a standard weighted dip tape. While the depth of product in each tank was measured during the Tank Inventory these data are relevant to the Inventory of On-Site Waste Fuel which is presented in Section 12 below. Tank labels were recorded by GPS (See Figure 14). Specific tank details were recorded on standardized Tank Inventory field forms, which have been included in Appendix F.

11.2 Results

In total 69 tanks were inventoried on-site. This includes 19 large POL tanks ranging in size from 90,000 L to 1,600,000 L located inside the bermed area of the Tank Farm, 10 standard 205 L barrels, and 40 smaller horizontal tanks ranging in size from 2000 L to 60,000 L.

Class of Tank	Number of Tanks on Site	Volume of Fuel Present (L)
205 L barrels	10	2050
2,000 – 60,000 L tanks	40	24905
> 60,000 L tanks	19	62712
Totals	**69**	**89,667**

With the exception of the 10 barrels, all onsite tanks are constructed of bolted or welded steel walls. Specific details of each tank including location, wall construction type, orientation, size of openings, and dimensions have been summarized in Table 9.

11.3 Recommendations

Incineration is an option for disposal of waste fuel at Johnson Point. An Incineration Plan can be found in Appendix J. The following fuel transfer and tank cleaning program should accompany the Incineration Plan.

11.3.1 Fuel Transfer

The contents of each tank should be transferred allowing each tank to be systematically cleaned and inspected.

If tank nozzles are too high to permit direct suction of fuel out of the tank, a floating suction assembly can be introduced through the lower manway to remove the fuel via a hose assembly flanged to a suction line outside the tank.

Prior to pumping fuel to the receiving tank, the tank will be carefully inspected and once integrity is confirmed then pumping can commence. During the pumping process there will be regular inspection of the hoses and lines to ensure there are no leaks. The crew members operating the pump and inspecting the hoses/lines will be equipped with two-way radios to ensure immediate communication will be possible in the event of a leak. This procedure should apply whenever fuel is being transferred.

Attention is drawn to the possible hazard due to electrostatic charges which may be present in the fuel. Electrostatic charges occur, in particular, with static accumulator liquids, i.e. liquids which have low conductivity of 50 picoSiemens/metre (pS/m) or less.

It is very important that equipment/instruments be grounded to the tank before being introduced into the tank and remain grounded until after complete withdrawal from the tank.

Dowland maintains a portable 2” fuel transfer pump for this purpose.

11.3.2 Tank Cleaning

Safe work procedures for confined space and hydrogen sulfide (H_2S) must be followed. For safety reasons, all personnel must be certified in H_2S and confined space entry. Tank Cleaners will be certified and experienced in Confined Space Entry, Lock-out/Tag-out procedures, and working in dangerous atmospheres. Daily tailboard meetings should be held prior to the commencement of work. These meetings should be a forum to discuss the day’s proposed activities as well as a chance to review safety procedures so that all members of the crew have a clear understanding of the work planned for the day and how it will be executed. Emergency procedures should be reviewed and roles for all crewmembers should be confirmed. Standard Tank Cleaning Procedure Checklists and Hot/Cold work permits for work inside the tanks should be issued at these daily meetings.

Hot work permits are used when heat or sparks are generated by work such as welding, burning, cutting, riveting, grinding, drilling, and where work involves the use of non-explosion proof electrical equipment (lights, pumps, tools, and heaters).

Three types of hazardous situations need to be considered when performing hot work:

- the presence of flammable materials in the equipment;
- the presence of combustible materials that burn or give off flammable vapours when heated; and
- the presence of flammable gas in the atmosphere, or gas entering from an adjacent area.

Cold work permits are used in hazardous maintenance work that does not involve “hot work”. Cold work permits are issued when there is no reasonable source of ignition, and when all contact with harmful substances has been eliminated or appropriate precautions taken.

Confined space entry permits are used when entering any confined space such as a tank, pit or sump. The permit should be used in conjunction with a “Standard Operating Procedure” which describes all important safety aspects of the operation.

Tank cleaning activities generally require a crew of 6 personnel, including the following:

- Tank Cleaner/Project Foreman
- Tank Cleaning Supervisor
- Tank Cleaner
- Fresh Air Blower Monitor
- Safety Person
- Wildlife Monitor

General tank cleaning procedure is as follows:

- Tank entry – assess LEL levels inside tank – open tank vents
- Pump out any fuel or residues on tank bottom
- Wash tank with steam/hot water – pump out waste water
- Rinse tank – wash & rinse procedure may have to be repeated if tank very dirty
- Pump out rinse water & dry tank bottom and sides with clean white rags
- Confirm LEL level OK for tank inspection – leave tank well vented

Tank Cleaners should be provided with rain gear to minimize contamination of clothing. Only one tank-cleaner will be in any tank at one time unless rescue is required.

Manways will be opened to provide access and ventilation for tank cleaning operations. Manways that will be re-sealed will have new gaskets installed as well as any flanges that are taken apart. Disturbed gaskets should be replaced. Gasket material to be used for manways should be Durlon 8500 material. Any flange gaskets disturbed should be replaced with Garlock Blue-Gard Style 3000 2" ring gaskets. Studs and nuts will also be replaced on all disturbed fittings and connections. A supply of spare parts should be brought to the site to maintain equipment and to effect minor repairs should they be required. Equipment should be maintained in excellent condition to keep the likelihood of breakdown minimal. Fire extinguishers must be available for emergency use at all times.

Water or sludge at the bottom of any tank can be pumped into barrels. The tank will then be cleaned, inspected, and ready for disassembly.

Residues from tank-cleaning operations will be put into UN certified 45-gallon tight-head drums. Hydrophobic oil spill materials, filtration materials and dirty rags from tank cleaning will be placed in 'open-head' drums. Labeling of drums will be as per TDG specifications. Barrels will be left in containment dykes. At the conclusion of the project copies of completed TDG Hazardous Goods Waste Management Forms and standard drum inventory forms will be filed for inclusion in the project documentation.

The contaminated water from tank cleaning operations should have organic material removed by agitation with an oil absorbent material. The water can then be analyzed for Cadmium, Chromium and Lead according to the DEW Line Cleanup Protocol for Barrels. If metals are present at acceptable levels the water may be discarded on land that is a minimum of 30m from natural drainage courses.

11.4 Recommended Reading

The following documentation may prove useful in the development of Technical Specifications for fuel transfer and tank cleaning.

ANSI/API Standard 2015, *Requirements for Safe Entry and Cleaning of Petroleum Storage Tanks*, is intended for use by companies to develop safe practices for planning, managing, and conducting tank cleaning work in atmospheric and low pressure storage tanks.

ANSI/API Recommended Practice 2016, *Guidelines and Procedures for Entering and Cleaning Petroleum Storage Tanks*, provides guidance and additional information specific aspects of tank cleaning preparation, hazard awareness, decommissioning, emptying, isolating, vapour and gas freeing, degassing, ventilating, atmospheric testing, inspecting, cleaning, entry, safe (cold) work, and hot work.

These documents are intended to be consistent with Title 29 of the *U.S. Code of Federal Regulations, Occupational Safety and Health Administration Standards*, Part 1910, 'General Industry,' and Part 1926 'Construction.' These standards are also intended to be consistent with US National Fire Protection Association Codes and Standards applicable to the entry and cleaning of aboveground petroleum storage tanks. The standards are not intended to conflict with statutory or regulatory requirements or to function as a substitute for applicable Canadian or Territorial regulations, codes, standards, or employer practices and procedures, all of which must be reviewed in their entirety to determine their applicability to the site, its location, the tanks involved, and the proposed work.

12.0 INVENTORY OF ON-SITE WASTE FUEL

12.1 Approach

An inventory of all fuel stored on-site was completed in conjunction with the tank inventory described above. The inventory of on-site waste fuel included details specific to the approximate volume, and type, of all fuel stored on site, and an analytical program to determine the fuel quality. The inventory included dipping each tank and barrel on site, to measure the depth of product in each tank. Using the depth of product data and the physical dimensions of the tank it was possible to calculate an estimate of the total volume of onsite waste fuel. Tank volumes were calculated using the following formulae:

Vertical Tanks

$$V = \pi \cdot r^2 h$$

Where: V = Volume

r = *radius of tank*

h = *height of product*

Horizontal Tanks

$$V = L\left(\left[r^2 \cos^{-1}\left(\frac{r-h}{r}\right)\right] - \left[\sqrt{(2rh-h^2)}(r-h)\right]\right) \Big/ 1000$$

Where: V = *volume*

L = *Length of tank*

r = *radius of tank*

h = *height of product*

The inventory also included determining the type and quality of the fuel contained in each tank. Representative samples were collected from each tank and submitted to an accredited laboratory for analysis. Samples were forwarded to EnviroTest Laboratories and the Alberta Research Council.

12.2 Quality Assurance/Quality Control Measures

To ensure the collection of reliable and representative data, a Quality Assurance/Quality Control (QA/QC) program was implemented as part of the Environmental Site Assessment field program. The QA/QC program only included laboratory measures.

Field duplicates of on site fuel were not collected. All fuel samples were submitted to the rigor of the quality management programs in place at the EnviroTest Laboratories and the Alberta Research Council respectively.

ETL is accredited by the Standards Council of Canada (SCC) in partnership with the Canadian Association For Environmental Analytical Laboratories (CAEAL). ETL Edmonton currently has six full-time staff dedicated to quality management functions, and has developed a quality management system that is designed to provide data of known quality. This includes many steps that ensure the integrity and validity of the analytical results, and guarantees that the results will meet the data quality objectives of the project. Specific QA/QC procedures enacted during the analyses of fuel samples for this study include the following:

- Analysis and reporting of Laboratory Duplicates
- Analysis and reporting of Laboratory Control Samples
- Analysis and reporting of Process Recovery (% recovery),
- Reporting of data associated with Matrix Spikes, and
- Reporting of data associated with Method Blanks.

The analytical QA/QC procedures and results are documented in the ETL Quality Control Report (Appendix E.2).

The Fuels and Lubricants Group at the Alberta Research Council participates in an International Quality Exchange Program. The Laboratory receives approximately 100 proficiency test samples per year. The testing on these samples includes Acid Number and Density among other parameters. Acid Number has a QC standard which must be analyzed prior to analyzing the proficiency test samples. QA results are then recorded on a control chart to ensure compliance. Fuels and Lubricants Group is accredited by the Standards Council of Canada ISO 17025.

12.3 Sample Handling

Representative samples were collected from each tank in disposable weighted plastic bailers and decanted into laboratory supplied 250mL amber glass sample containers. Effort was taken not to overfill the sample bottles to prevent breakage during transport or as a result of temperature changes. Samples were stored outside, at ambient temperature below the freezing point until transport to Inuvik. Minimal breakage did occur during shipping and handling. Upon arrival in Inuvik samples were stored in a secure well-ventilated storage space at ambient outdoor temperature (at or near freezing) pending shipment to the laboratory. Dangerous goods declarations were completed prior to shipment. Chain-of-custody records were maintained for all samples that were submitted for analysis.

12.4 Analytical Parameters and Methods

Fuel samples were stored outside under cool to cold ambient conditions and ultimately transported to Inuvik for submission to EnviroTest Laboratories (ETL). A subset of composite fuel samples representing the largest volumes of fuel on site was submitted to the Alberta Research Council Fuel and Lubricants Group for the following analyses:

- Hydrocarbon Characterization (C1-C60 scan by GC-FID);
- Inorganic elements – Total concentrations: (As, Cd, Cr, Co, Cu, Pb, Ni, Zn, Hg by ICP-OES)

Due to workload and the specialization of the analysis, ETL further subcontracted the following analysis to Core Labs:

- Flashpoint (Pensky-Martens Closed Cup method)
- Total Chlorine (Neutron Activation)

In addition to understanding the metals content, flashpoint and total chlorine in the fuel samples collected, specific samples were submitted to ARC to undergo a rigorous set of analyses addressed by American Society for Testing and Materials (ASTM) D975 – *Standard Specification for Diesel Fuel Oils*.

D975 indicates the standard test methods that are to be used to measure the values of each fuel property. Each of these tests is listed below and the standard methods are described in Appendix G.

- Acid Number;
- Accelerated Stability;
- Appearance;
- Ash, Mass %;
- Cetane Number;
- Cloud Point;
- Copper Corrosion;
- Carbon Residue;
- Distillation;
- Electrical Conductivity;
- Flashpoint;
- Density;
- Lubricity (High Frequency Reciprocating Rig);
- Wear Scar Diameter;
- Metals (ICP-AES);
- Pour Point;
- High Temperature Stability;
- Sulphur, Mass %;
- Kinematic Viscosity; and
- Water and Sediment, Volume %

12.5 Results

12.5.1 Tank Contents

In total 69 on site tanks were inventoried. Of these, 19 were large, vertical tanks located inside the berm at the tank farm (Area 4). Seven of these tanks were found to be empty, while the remainder contained an average of approximately 2000L of fuel. Five of the tanks contained a separate phase of product on the tank bottom, which is assumed to be sludge. The table below summarizes the total volume of specific hydrocarbons at the site:

	Product				
	Diesel	**Jet B**	**AvGas**	**Glycol**	**Gasoline**
Volume (L)	78095	10342	205	410	615

The remaining tanks range in size, shape and contents, and are found at various locations across the site. Of these, it is suspected that the majority contain diesel fuel, while many of the barrels contain gasoline, Jet fuel (potentially Jet B and Av-gas). One barrel is known to contain motor oil. Another is suspected of containing transmission fluid, and there are three drums on site which are likely to contain glycol. One of the suspected glycol drums was opened and a sample was collected to confirm the contents. The other two drums of suspected glycol were not sampled.

The total volume of waste fuel on site is estimated to be in the order of 90,000L. In addition to the waste fuel, it is also estimated that approximately 25,000L of sludge may be present in the bottoms of the tanks. Tank 18 was found to contain a tank liner (representing an additional 20 000L of waste) collapsed on the bottom of the tank. The total volume of each tank, and volumes of both product and sludge are tabulated in Table 10.

Samples were collected from each tank that was possible to access, and which contained sufficient volume of product to recover a sample. All samples were analyzed for flashpoint and metals. Selected samples were analyzed for glycols and total chlorine where the tank was not labeled and could not be established based on visual and/or olfactory evidence at the time of sampling.

The flashpoints of all samples was greater than the minimum value of 40 ^{o}C set for diesel. Samples from Tank 43 had a flashpoint of 110. Glycol analyses confirmed that this sample was predominantly ethylene glycol. Tank 38, Tank 40, Tank 41, Tank 42 and Tank 57 all returned flashpoints less than the detection limit of -7^{o}C. The field notes for each of these samples indicate that at the time of sampling visual and olfactory evidence suggested the barrels contained Jet B. Jet B is a wide-cut fuel, which, essentially, is a hydrocarbon mixture spanning the gasoline and kerosene boiling ranges. Gasoline is known to have a flashpoint that is generally less than –30 ^{o}C. These samples were further characterized by gas chromatography equipped with a flame ionization detector and all five samples eluted mass fractions that fell primarily in the C6-C11 range, with trace fractions in four of the five samples extending to C59 or greater. Histograms representing the results of the C1-C60 GC/FID scan are included in Appendix H. The carbon fractions for these samples fall outside the typical range for diesel. Incineration of these volumes of fuel could pose significant health and safety concerns.

Four composite samples, representing the largest volumes of diesel on site, were created and submitted for fuel specification. The results of the fuel specification on each of the composite samples are included in the following sections.

Analytical results are presented in Table 11.

12.5.2 Automobile Low Sulphur Diesel Fuel Specifications (CAN/CGSB 3.517-2000)

All samples were clear and light brown in colour at 21^{o}C, with the exception of the Comp28-31, which was clear and light yellow. All samples contained a trace quantity of particulate material, and no visual water.

Electrical conductivity is an important property of fuel. The ability of a fuel to dissipate charge that has been generated during pumping and filtering operations is controlled by its electrical conductivity, which depends upon its content of ion species. If the conductivity is sufficiently high, charges dissipate fast enough to prevent their accumulation and dangerously high potentials in a receiving tank are avoided. There was insufficient sample to analyze the electrical conductivity of Comp25 and Comp28-31. The electrical conductivity of both Comp7-13 and Comp59-63 failed the CGSB specification. The CGSB specification for automotive low sulphur diesel fuel (CAN/CGSB 3.517-2000) states that:

- The electrical conductivity at the point, time and temperature of delivery to purchaser shall not be less than 25 pS/m;
- Due to the depletion of fuel conductivity during commingling, storage, and distribution, or at low temperatures, the fuel should be sufficiently treated with conductivity improver additive to ensure that the electrical conductivity requirement is met;
- The temperature at the point of use and the method of distribution could require a substantially higher conductivity level than 25 pS/m at the point of additive treatment.

The electrical conductivity results obtained on Comp7-13 and Comp59-63 do not comply with the specified limiting values of the CGSB specification for automotive low sulphur diesel fuel (CAN/CGSB 3.517-2000).

The results of the lubricity tests for all samples were greater than the recommended maximum wear scar diameter (WSD) of 0.46 mm. Lubricity is not a specified limiting value, however lubricity problems may become a concern if this fuel is used. The fuel can be additized with a lubricity improver to help correct any potential problems.

All samples failed the kinematic viscosity specification, which correlates with low lubricity. The CGSB specification for Automotive Low Sulphur Diesel Fuel (CAN/CGSB-3.517-2000) states that the kinematic viscosity shall not be less than 1.30 cSt at 40^{o}C. The kinematic viscosity results obtained on these sample does not comply with the specified limiting values of the CGSB specification for automotive low sulphur diesel (CAN/CGSB-3.517-2000 Type A-LS).

The CGSB specification states that the low-temperature flow properties of the fuel shall be designed to give satisfactory performance at the temperatures indicated by the 2.5% low-end design temperature data for the month and location of intended use. The Government of the Northwest Territories specifies the cloud point to be -47°C or colder in the Banks Island region. The cloud point of the fuel is colder than -47°C. There is no density specification, however for quality control the Government of the Northwest Territories specifies a range of 775 to 850 kg/m3 @ 15°C. All samples sample fall within this range.

The results of the high temperature stability tests performed on Comp7-13 and Comp59-63 were positive. The samples each returned a reflectance value of 100%. ASTM D6468 indicates increasing stability with increasing % reflectance values. Interpretation of the results is as follows:

% Reflectance	Relative Stability
85-100	Excellent
71-84	Good
62-70	Fair
53-61	Marginal
32-52	Poor
0-31	Very Poor

There was insufficient sample to perform the high temperature thermal stability test for Comp25 and Comp28-31.

There was also insufficient volume of Comp25 to determine Ash Content by ASTM D482 or to perform Cetane Number by ASTM D613, therefore the cetane number was calculated as per ASTM D976, however the value obtained is less than the CGSB minimum specification of 40. ASTM D976 states that one of the limitations of the Calculated Cetane Index equation which must be recognized is that it is not applicable to fuels containing additives for raising cetane number. It is unknown if the fuel contains a cetane-improver additive. If the fuel contains a cetane-improver additive, it would likely pass the cetane engine test (ASTM D613) but additional sample volume would be required to run that test. The cetane index result obtained on this sample is below the CGSB minimum requirement of 40, however if the fuel contains a cetane-improver additive cetane number would have to be determined by ASTM D613.

Comp25 was found to contain unusually high levels of calcium, phosphorous, and zinc, which indicates that the fuel may be contaminated with an additive enhanced product such as automotive engine oil. Petroleum based lubricant additives may contain zinc, calcium, copper, boron, phosphorous, sulphur, chlorine, lead, molybdenum, silicones, fats, polymers and soap like compounds.

Comp28-31 has a low sulphur content which disagrees with the suspected age of the fuel. Typically fuels used in the North have sulphur values closer to the maximum CGSB specification value of 500 mg/kg. Low sulphur also correlates with low lubricity. Paragraph 8.2.2 of CGSB states some processes used to desulphurize diesel fuel, if severe enough, can also reduce the natural lubricating qualities of the diesel fuel. Since engines require the diesel fuel to act as a lubricant for their injection systems, diesel fuel must have sufficient lubricity to give adequate protection against excessive injection system wear. Additives are available that can improve diesel lubricity. Lubricity additives may have unwanted side effects particularly when used at excessive concentrations or in combination with other additives.

For the analyses performed, with the exception of kinematic viscosity and electrical conductivity, the results obtained on Comp7-13 comply with the specified limiting values of the CGSB specification for automotive low sulphur diesel fuel (CAN/CGSB-3.517-2000 Type A-LS).

For the analyses performed, with the exception of kinematic viscosity and cetane index, the results obtained on Comp 25 comply with the specified limiting values of the CGSB specification for automotive low sulphur diesel fuel (CAN/CGSB-3.517-2000 Type A-LS).

For the analyses performed, with the exception of kinematic viscosity, the results obtained for Comp28-31 comply with the specified limiting values of the CGSB specification for automotive low sulphur diesel fuel (CAN/CGSB-3.517-2000 Type A-LS).

For the analyses performed, with the exception of kinematic viscosity and electrical conductivity, the results obtained on Comp59-63 comply with the specified limiting values of the CGSB specification for automotive low sulphur diesel fuel (CAN/CGSB-3.517-2000 Type A-LS).

Analytical results are presented in Table 12.

12.6 Recommendations

The purpose of the fuel sampling program during the 2005 ESA was to confirm the amount of waste fuel contained in the POL tanks onsite, to determine the quality of the onsite waste fuel, and to confirm the presence or absence of contaminants that would prevent incineration.

According to the NWT Used Oil and Waste Fuel Management Regulations, “waste fuel” means a flammable or combustible petroleum hydrocarbon, with or without additives, that is unsuitable for its intended purpose due to the presence of contaminants or the loss of original properties, and includes gasoline, diesel fuel, aviation fuel, kerosene, naptha and fuel oil, but does not include paint, solvent or propane. The regulation further stipulates that a representative sample be collected for the analysis for the determination of flashpoint and the existence and amount of each impurity listed below:

Item	Impurity	Maximum level allowed in used oil	Maximum level allowed in waste derived fuel
1	Cadmium	2 ppm	2 ppm
2	Chromium	10 ppm	10 ppm
3	Lead	100 ppm	100 ppm
4	Total Organic Halogens (as Chlorine)	1000 ppm	1500 ppm
5	Polychlorinated Biphenyls	2 ppm	2 ppm
6	Ash Content		0.6% by weight

The results of the samples collected at Johnson Point satisfy the requirements of the regulation for all impurities listed. As a result, in the absence of a Federal Regulation superceding the NWT regulations, it is recommended that waste fuel at Johnson Point be incinerated according to the Used Oil and Waste Fuel Regulation.

Based on the results of the Inventory of Onsite Waste Fuel IEG recommends that onsite volumes of waste fuel be disposed of according to the following table:

Tank ID	Suspected Contents	Incinerate (L)	Additize or Incinerate (L)	Manifest / Dispose offsite (L)	Clean tank / decommission (Tanks)
Tank 1-6	Diesel	9742			6
Tank 7-13	Diesel		15162		7
Tank 14-19	Empty				6
Tank 20-21	Diesel	5502			2
Tank 22	Empty				1
Tank 23-24	Diesel	4470			2
Tank 25	Diesel		19894		1
Tank 26-27	Diesel	2893			2
Tank 28-31	Diesel		8772		4
Tank 32-36	Diesel	317			5
Tank 37	Empty				1
Tank 38-44	Various Drums			1255	
Tank 45	Diesel	153			1
Tank 46	Empty				1
Tank 47	Diesel	168			1
Tank 48-51	Empty				4
Tank 52-54	Diesel	5190			3
Tank 55	Heavy Motor Oil			100	
Tank 56	Diesel	153			1
Tank 57-58	Gasoline			615	
Tank 59-63	Diesel		9932		5
Tank 64	Diesel	2058			1
Tank 65	Empty				1
Tank 66-69	Diesel	3291			4
Total		**33937**	**53760**	**1970**	**59**

13.0 CONCLUSIONS

13.1 Major Findings

The EM61 response indicated the presence of significant quantities of buried metal in four main areas. Anomaly A is an area with much surficial metal visible. There are six discreet anomalies in this dataset representing a total combined area of 2720m^2. In the southwest portion of this area are two sumps where metallic debris was observed through the ice. Anomaly B is a topographic high representing approximately 400m^2. There were no surface expressions suggesting buried metals, but Anomaly C represents approximately 1500m^2 and is suspected to conceal a buried pipeline or other similar linear feature. There were no visible signs of disturbed soil at Anomaly D, however, approximately the EM61 recorded nearly 600m^2 of elevated instrument response. Soil samples collected in the vicinity of each anomaly did not indicate the presence of contaminants of concern at concentrations exceeding the selected screening criteria.

The soil sampling conducted in the vicinity of the tank farm suggests that approximately 2000m^3 of soil could be contaminated by petroleum hydrocarbons from a suspected leak inside the bermed area. For the most part, detections occurred in the F2 and F3 fractions, which is highly consistent with suspected diesel fuel contamination. Hydrocarbon impacts were also discovered to the west of the tank farm, outside the bermed area, however this area represented less that 100m^3. Soil samples collected from two smaller berms (Berm 1(N) and Berm 2(S)) east and southeast of the Tank Farm, respectively, also indicated the presence of hydrocarbons at levels exceeding the selected screening criteria.

Tanks 1-3, located in the northeast corner of the tank farm were reported to contain approximately 450,000L of fuel by Parks Canada officials in July 2002. During the 2005 study IEG measured only 12,000L in these three tanks. This volume represents the largest potential source of hydrocarbon contamination discovered during the 2005 ESA.

Laboratory analysis of water and sediment samples collected on site did not indicate levels of contamination in excess of the selected screening criteria.

During the site inventory paint samples were collected for analysis of lead and PCBs. Lead was detected in all four paint samples at levels ranging from 9-6620 mg/kg. CEPA classifies all materials containing greater than 50 ppm of PCBs as PCB Waste. Laboratory results indicate that Sample #86 contains 60 ppm total PCBs. The data indicate that the other paint samples submitted all contain concentrations of PCBs below the CEPA Guideline.

As part of the Tank Inventory, 69 tanks were inventoried on-site. This includes 19 large POL tanks ranging in size from 90,000 L to 1,600,000 L located inside the bermed area of the Tank Farm, 10 standard 205 L drums and 40 horizontal tanks ranging in size from 2000 L to 60,000 L. With the exception of the 10 drums, all onsite tanks are constructed of bolted or welded steel walls.

The total volume of waste fuel on site is estimated to be in the order of 90,000L. In addition to the waste fuel, it is also estimated that approximately 25,000L of sludge may be present in the bottoms of the tanks.

The analysis of the fuel samples, with the exception of kinematic viscosity (all samples) electrical conductivity (Tanks 7-13 and Tanks 59-63), and Cetane Index (Tank 25), the results obtained comply with the specified limiting values of the CGSB specification for automotive low sulphur diesel fuel (CAN/CGSB-3.517-2000 Type A-LS).

It would appear, according to the NWT regulation regarding the incineration of waste fuel, and the results of the Inventory of Onsite Waste Fuel that incineration is a viable option for the disposal of waste fuel at Johnson Point.

13.2 Recommendations

Based on the findings described above IEG recommends the following:

13.2.1 Preliminary Remediation/Incineration

Waste Fuel Incineration:

- Implement fuel transfer and tank cleaning program described in this document;
- Incinerate Onsite Waste Fuel

13.2.2 Assessment

Geophysical Survey

- Complete test-pitting at all anomalies uncovered during 2005 geophysical survey
- If desired, expand geophysical investigation with EM31/EM38 and ERT to locate smaller targets and delineate contaminant plumes (if present).

Hazardous and Non-Hazardous Materials

- Conduct onsite lead and PCB sample analysis using field test kits
- Submit samples of lead and PCB containing materials to an analytical laboratory for Toxicity Characteristic Leachate Procedure testing
- Develop appropriate methods for handling lead and PCB contaminated materials onsite.

Soil Sampling Program:

- Determine appropriate methods for the collection of samples at depth.
- Collect samples at or near the maximum depth of active layer (i.e. at the interface with the permafrost layer)
- Extend soil sampling grid further north (e.g. rows of samples at 10N, 20N, 30N);
- Extend soil sampling grid further east for rows 0N, 10S, and 20S to confirm the presence/absence of hydrocarbon contamination in that area;
- Conduct a step-out soil sampling program around Berm 1(N) and Berm 2(S) to further delineate hydrocarbon contamination in those areas;
- Field screen all samples (with PetroFlag) and continue sampling until verification samples return results below the established screening criteria;
- Compare the results of the GC-FID scan conducted on the sample collected at Berm 2(S) to known reference standards to gain better understanding of the type of contamination and its expected migration behaviour in the subsurface;
- Attempt to measure the depth to permafrost at each soil sample location. Data can be entered into a GIS or manipulated with software such as Surfer® to generate surfaces can calculate accurate volumes of contaminated soil
- Install monitoring wells/drivepoints at locations chosen to help understand groundwater flow direction, rate, and the level of contamination (if any);
- Collect soil samples in areas of surface staining (not snow cover)

Surface Water:

- Sample any other standing water not observed during 2005 ESA due to snow cover, if any;

- Ascertain conditions of tank bottoms for Tanks 1-3 to support hypothesis of these tanks leaking

Groundwater:

- Monitoring wells (or drivepoints) be installed to quantify and more accurately estimate groundwater flow direction and rate through the active zone.

Other:

- Complete a vegetation survey/scat count to quantify the presence/absence of terrestrial receptors
- Conduct general fish and benthic survey to quantify the presence/absence of aquatic receptors

13.2.3 General Remediation

Hazardous and Non-Hazardous Materials

- Transport a small barrel crusher to Johnson Point to reduce the volume of waste onsite. Crushed barrels can be removed on 'backhaul' flights to Inuvik or Sachs Harbour.
- Manifest hazardous materials for removal to Inuvik by charter aircraft. Attention should be given to the type of containers approved for air transport of each of the following:
    - Glycol;
    - Jet fuel;
    - Transformers; and
    - Lead-Acid Batteries
- Begin hand demolition of onsite non-hazardous debris:
    - Remove powerline
    - Hand demolition of ATCO trailers, maintenance shed etc.
    - Removal of asbestos by placing the insulation sheet in a double bag system and removing to an approved facility. The individual removing the asbestos would wear the following PPE: disposable Tyvek coveralls, safety glasses, gloves, and a particulate respirator.

14.0 INUVIALUIT BENEFITS REPORTING

The Inuvialuit Benefits reports, as required under the Inuvialuit Final Agreement, are included in Appendix J.

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Appendix A

Figures

Appendix B

Climate Normals

1972-1976 Climate Data from Holman, Victoria Island, Northwest Territories.

Month	Mean Max Temp	Mean Temp	Mean Min Temp	Extr Max Temp	Extr Min Temp	Total Rain	Total Snow	Total Precip	Snow Grnd Last Day	Dir of Max Gust	Spd of Max Gust	
	°C	°C	°C	°C	°C	mm	cm	mm	cm	10's Deg	km/h	
Jan	M	M	M	M	M	M	M	M	M		<31	
Feb	M	M	M	M	M	M	M	M	M		<31	
Mar	M	M	M	M	M	M	M	M	M		<31	
Apr	-20.8	-24.6	-28.3	-10.6	-37.8	0	5.8	5.8	20	7	61	
May	-8.4	-11.9	-15.4	1.7	-21.1	0	38.1	38.1	33	7	72	
Jun	1.8	-0.9	-3.6	10	-13.3	8.9	T	8.9	0	36	61	
Jul	8.6	5.2	1.7	15.6	-1.1	1	T	1	0	34	85	
Aug	5	2.5	-0.1	10.0S	-2.8S	9.9	0.8	10.7	0	7	64	
Sep	-2.2	-4.4	-6.6	3.3	-15.6	8.9	18	23.9	8	11	55S	
Oct	-12.4	-16.3	-20.2	0	-30.6	0	36.1	21.8	18	32	80	
Nov	-22.2	-25.5	-28.8	-10	-42.8	0	14	7.9	20	32	97	
Dec	-23.7	-27.5	-31.3	-7.8	-40.6S	0	25.4	18.3	30	32	72	
Sum						M	M	M				
Avg	M	M	M									
Xtrm				M	M					32	97	
Mean Max Temp	Mean Temp	Mean Min Temp	Extr Max Temp	Extr Min Temp	Total Rain	Total Snow	Total Precip	Snow Grnd Last Day	Dir of Max Gust	Spd of Max Gust		Mean Max Temp
°C	°C	°C	°C	°C	mm	cm	mm	cm	10's Deg	km/h		°C
-27.9	-31.5	-35.1	-8.9	-44.4	0	28.7	20.6	41	32	97		-27.1
-30	-33.4	-36.8	-10.0S	-44.4	0	12.7	9.1	51	32	84		-31
-32.1	-35.1	-38	-21.7	-43.9S	0	1	0.5	48	34	61		-29.7
-18.2	-22.3	-26.3	-5	-31.7	0	8.9	6.1	41	7	63		-22.1
-5.2	-8.4	-11.6	3.9S	-23.3S	2	7.1	7.4	20	7	64S		-7.4
6.4	3.4	0.4	12.8	-3.9S	26.2	1.5	26.9	0	7	51		0.2
8	5.1	2.2	16.7	-0.6	21.3	0.5	21.8	0	23	40		7.1
6.2	4	1.8	15.6	-1.1S	49.8	T	49.8	0	7	48		4.7
1.4	-0.7	-2.8	7.8	-14.4	14.2	8.6	22.9	3	7	31		-1.9
-6.4	-9.1	-11.8	-0.6	-23.9	T	21.6	21.6	13	32	48S		-15.8
-15.6	-18.5	-21.4	-6.7	-30	0	6.1	5.8	13	11	71		-22.4
-21.1	-24.3	-27.5	-11.7	-33.3	0	13.2	13	20	34	63		-30.7
					113.5	109.9	205.5					
-11.2	-14.2	-17.2										-14.7
			16.7	-44.4					34	97		
Mean Temp	Mean Min Temp	Extr Max Temp	Extr Min Temp	Total Rain	Total Snow	Total Precip	Snow Grnd Last Day	Dir of Max Gust	Spd of Max Gust		Mean Max Temp	Mean Temp
°C	°C	°C	°C	mm	cm	mm	cm	10's Deg	km/h		°C	°C
-30.4	-33.7	-6.7S	-41.1S	0	10.4	9.9	23	32	93		-35.2	-38
-33.6	-36.2	-23.3	-42.2	0	1.3	1.3	23		<31		-28.1	-31.3
-32.5	-35.3	-23.9	-41.7	0	T	T	23	34	56S		-26.4	-29.4
-25.8	-29.4	-14.4	-35.6	0	T	T	20	34	84		-15	-18.5
-10	-12.6	0.6	-22.2S	T	5.1	5.1	10	34	56S		-5.1	-7.9
-2	-4.1	3.9	-13.9S	18.5	19.6	38.1	3	7	61		5.2	2.8
4.5	1.9	13.3	-1.1S	5.8	T	5.8	0	32	64S		8.3	5.1
2.4	0.1	14.4	-5	10.4	27.2	37.6	0	34	85		M	M
-4.1	-6.3	6.7	-16.1	3.8	14.5	18.3	3	34	77		-1.9	-4.6
-18.3	-20.7	-10	-29.4	0	14	14	5	7	56		-10.3	-13.5
-25.7	-28.9	-11.1	-37.2	0	11.4	11.4	13	7	56S		-21.6	-24.5
-34	-37.3	-21.1S	-43.3	0	6.4	6.4	18	7	72		-27.1	-30.2
				38.5	109.9	147.9						
-17.5	-20.2										M	M
		14.4	-43.3					7	93			
Mean Min Temp	Extr Max Temp	Extr Min Temp	Total Rain	Total Snow	Total Precip	Snow Grnd Last Day	Dir of Max Gust	Spd of Max Gust		Mean Max Temp	Mean Temp	Mean Min Temp
°C	°C	°C	mm	cm	mm	cm	10's Deg	km/h		°C	°C	°C
-40.7	-25.6S	-53.9	0	11.4	11.4	28	7	89		-31.1	-34.4	-37.6
-34.4	-14.4	-40.6S	0	6.1	6.1	33		<31		-31	-33.9	-36.7
-32.3	-17.2	-37.8S	0	3.8	3.8	36	34	56S		-28.6	-31.7	-34.8
-22	-2.8	-32.2	0	11.4	11.4	43	7	58		-14.8	-18.4	-22
-10.7	2.2	-16.7S	0	3.6	3.6	18	7	64		M	M	M
0.4	15	-2.8	T	0.8	0.8	0	7	51		M	M	M
1.8	12.2	M	M	M	M	M	27	66		M	M	M
M	M	M	M	M	M	M		<31		M	M	M
-7.2	5.0S	-18.3S	7.1	13.7	20.8	3		<31		M	M	M
-16.7	-1.1S	-31.7	0	9.9	9.9	8		<31		M	M	M
-27.3	-10	-33.9	0	5.8	5.8	13	32	56		M	M	M
-33.3	-14.4S	-40.6	0	4.8	4.8	15	32	71		M	M	M
			M	M	M							
M										M	M	M
	M	M					32	89				
Extr Max Temp	Extr Min Temp	Total Rain	Total Snow	Total Precip	Snow Grnd Last Day	Dir of Max Gust	Spd of Max Gust					
°C	°C	mm	cm	mm	cm	10's Deg	km/h					
-17.2	-45	0	3	3	15	7	61					
-21.7	-43.3	0	5.3	5.3	15	11	89					
-20	-45.6S	0	9.1	9.1	20	32	98					
-5.6S	-30.6	0	10.9	10.9	23	5	58					
M	M	M	M	M	M	M	M					
M	M	M	M	M	M	M	M					
M	M	M	M	M	M	M	M					
M	M	M	M	M	M	M	M					
M	M	M	M	M	M	M	M					
M	M	M	M	M	M	M	M					
M	M	M	M	M	M	M	M					
M	M	M	M	M	M	M	M					
		M	M	M								
M	M					M	M					

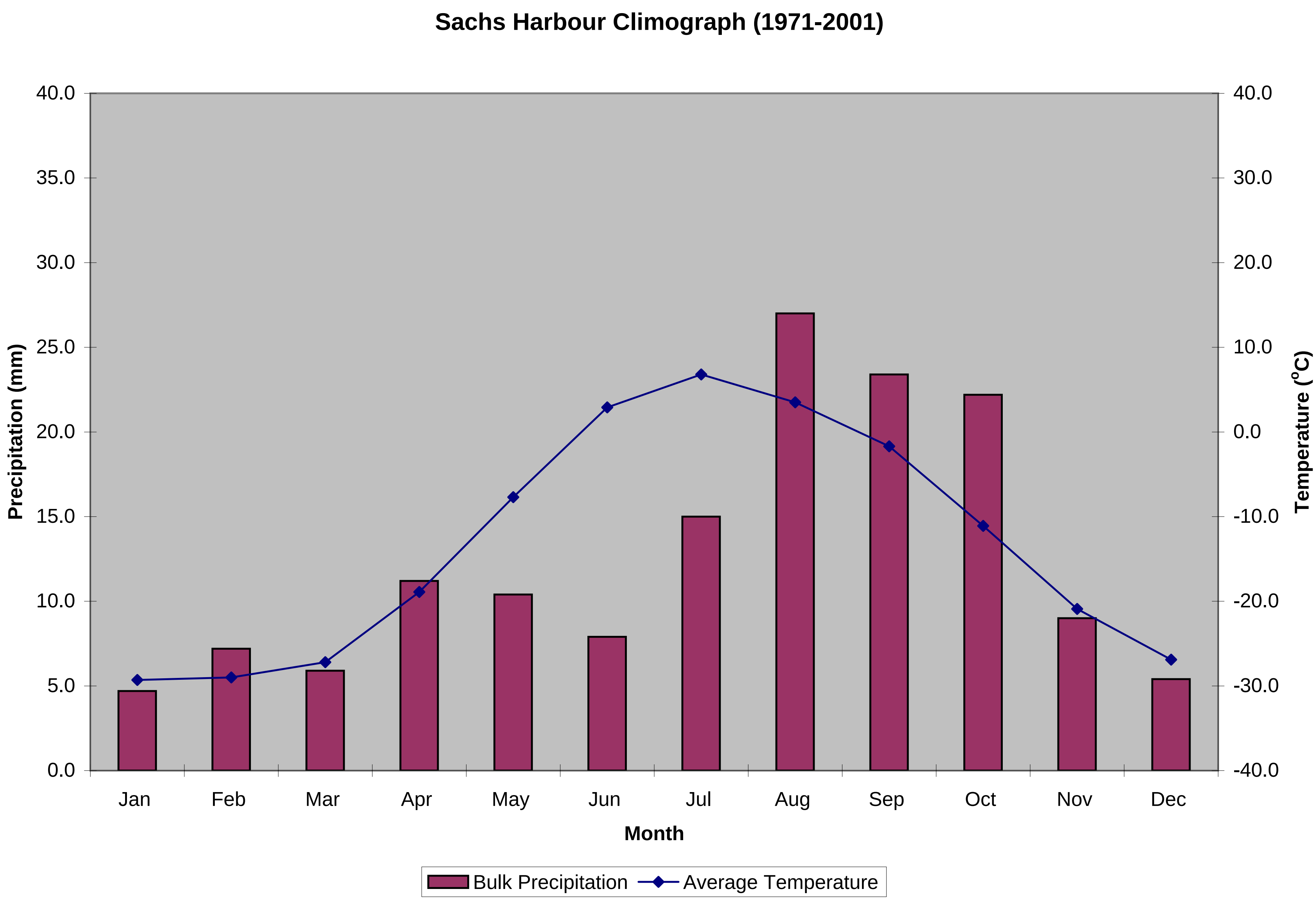
Legend
[empty] = No data available
M = Missing
E = Estimated
B = More than one occurrence and estimated
* = The value displayed is based on incomplete data
S = More than one occurrence
T = Trace

1971-2001 Climate Data from Sachs Harbour, Banks Island, Northwest Territories.

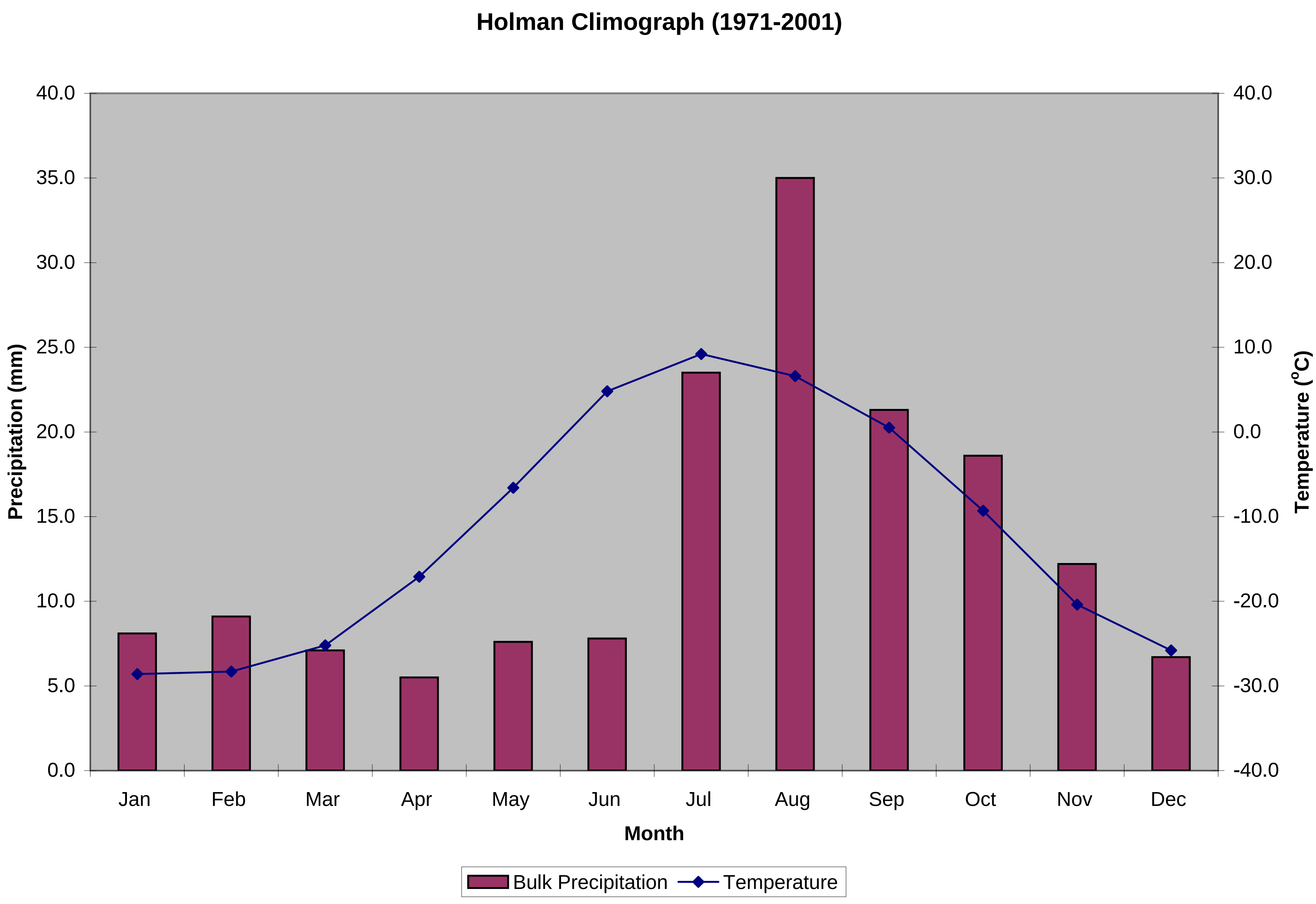
Temperature:	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Daily Average (°C)	-29.3	-29	-27.2	-18.9	-7.7	2.9	6.8	3.5	-1.7	-11.1	-20.9	-26.9	
Standard Deviation	4.1	3.7	3.5	3.4	2.4	2.5	1.9	1.8	2.4	3.3	3.9	3.6	
Daily Maximum (°C)	-25.7	-25.2	-23.5	-15.2	-4.6	5.9	10.3	6.3	0.6	-8	-17.4	-23.3	
Daily Minimum (°C)	-32.9	-32.8	-30.8	-22.7	-10.8	-0.2	3.3	0.7	-4.1	-14.2	-24.4	-30.4	
Extreme Maximum (°C)	-4.4	-4.5	-4	2.2	10	20.5	24.2	21.5	15.6	4.4	1.7	-1.7	
Date (yyyy/dd)	1974/02+	1989/05	1988/13	1960/25	1994/25	1977/21+	1982/06	2000/01	1957/06	1969/11	1970/01	1960/03	
Extreme Minimum (°C)	-52.2	-50.2	-48.4	-43	-26.7	-16.5	-4	-11	-22.8	-35.5	-42.8	-45	
Date (yyyy/dd)	1975/10+	1985/15	1979/04	1997/01	1958/03	1978/05	1994/29	1995/28	1975/30	1996/28	1972/20	1957/23+	
Precipitation:													
Rainfall (mm)	0	0	0	0	0.7	5.5	13.9	21.8	9.8	0.5	0	0	
Snowfall (cm)	5.2	7.6	6.6	11.7	10.5	2.6	1.2	5.4	14.1	23.7	10.3	6.5	
Precipitation (mm)	4.7	7.2	5.9	11.2	10.4	7.9	15	27	23.4	22.2	9	5.4	
Average Snow Depth (cm)	13	14	14	14	13	2	0	0	1	8	13	12	
Median Snow Depth (cm)	13	14	14	14	13	2	0	0	1	8	13	11	
Snow Depth at Month-end (cm)	14	14	16	14	8	0	0	0	4	11	13	13	
Extreme Daily Rainfall (mm)	1	0	0	0	7.6	17.8	21.8	20.1	13.5	2.8	0.2	0	
Date (yyyy/dd)	1981/20	1956/01+	1956/01+	1956/01+	1973/11	1964/25	1959/13	1972/20	1985/10	1988/04	1985/12	1955/01+	
Extreme Daily Snowfall (cm)	8	9.4	11.4	26	20.6	15	5.3	13	20	21.1	21.3	16	
Date (yyyy/dd)	1989/22	1978/07	1984/31	1990/26	1979/16	1990/11	1966/26	1990/24	1980/30	1973/02	1968/04	1996/23	
Extreme Daily Precipitation (mm)	8	8.4	8.6	26	19.6	18	21.8	20.1	21.6	21.1	10.8	8	
Date (yyyy/dd)	1989/22	1978/07	1984/31	1990/26	1979/16	1964/25	1959/13	1972/20	1980/30	1973/02	1999/09	1996/23	
Extreme Snow Depth (cm)	43	46	48	48	56	51	3	5	16	28	36	41	
Date (yyyy/dd)	1960/14+	1960/05+	1960/06+	1960/01+	1960/30	1960/01	1966/20	1978/27+	1992/27+	1959/27+	1959/25+	1959/27+	
Days with Maximum Temperature:													
<= 0 °C	31	28.3	31	30	25.5	3.9	0	2	12.8	29.8	30	31	
> 0 °C	0	0	0	0	5.5	26.1	31	29	17.2	1.2	0	0	
> 10 °C	0	0	0	0	0	7	15.1	6	0.15	0	0	0	
> 20 °C	0	0	0	0	0	0.13	0.29	0.04	0	0	0	0	
> 30 °C	0	0	0	0	0	0	0	0	0	0	0	0	
> 35 °C	0	0	0	0	0	0	0	0	0	0	0	0	
Days with Minimum Temperature:													
> 0 °C	0	0	0	0	0.54	12.8	22.7	15.6	4.1	0.13	0	0	
<= 2 °C	31	28.3	31	30	30.9	21.9	14.4	21.5	28.8	31	30	31	
<= 0 °C	31	28.3	31	30	30.5	17.2	8.3	15.4	25.9	30.9	30	31	
< -2 °C	31	28.3	31	30	28.7	8.2	0.91	6.2	18.3	30.4	30	31	
< -10 °C	31	28.3	31	28.7	15.8	0.39	0	0	3.2	21.2	29.3	31	
< -20 °C	29.7	27	29.2	19.7	1.5	0	0	0	0.2	6.3	21.7	28.5	
< - 30 °C	21.6	19	18.3	5.3	0	0	0	0	0	0.3	6.5	17.2	
Days with Rainfall:													
>= 0.2 mm	0.03	0	0	0	0.41	3	7	9.8	4.8	0.6	0.03	0	
>= 5 mm	0	0	0	0	0.04	0.13	0.72	1.2	0.5	0	0	0	
>= 10 mm	0	0	0	0	0	0.04	0.17	0.24	0.04	0	0	0	
>= 25 mm	0	0	0	0	0	0	0	0	0	0	0	0	
Days With Snowfall:													
>= 0.2 cm	5.8	6.1	5.4	4.7	5.9	1.8	0.86	3.9	8.6	13.6	8	5.8	
>= 5 cm	0.07	0.28	0.23	0.58	0.5	0.12	0	0.15	0.56	0.92	0.31	0.15	
>= 10 cm	0	0	0.04	0.31	0.15	0.04	0	0.04	0.07	0.17	0.08	0.07	
>= 25 cm	0	0	0	0.04	0	0	0	0	0	0	0	0	
Days with Precipitation:													
>= 0.2 mm	5.6	6.1	5.4	4.7	6	4.8	7.5	13.3	12.4	13.9	7.8	5.7	
>= 5 mm	0.04	0.21	0.12	0.58	0.46	0.17	0.76	1.5	1.1	0.83	0.27	0.12	
>= 10 mm	0	0	0	0.31	0.15	0.08	0.17	0.28	0.11	0.17	0.08	0	
>= 25 mm	0	0	0	0.04	0	0	0	0	0	0	0	0	
Days with Snow Depth:													
>= 1 cm	31	28.3	31	30	30.7	8.8	0.07	0.81	9.2	29.6	30	31	
>= 5 cm	30.2	27.6	29.6	28.6	27.4	4.4	0	0.07	2.9	22.4	30	30.8	
>= 10	19.7	19.8	25.1	24.5	17.8	2.3	0	0	1.2	11.7	24	15.4	
>= 20	3.7	3.9	6.6	4.3	4.6	0.6	0	0	0	0.11	3.5	2.3	
Wind:													
Maximum Hourly Speed	80	97	72	89	74	69	72	66	72	78	80	87	
Date (yyyy/dd)	1965/12+	1965/25	1971/08+	1960/05	1957/04+	1962/05	1964/11	1974/11	1962/04	1981/03+	1972/29	1981/19	
Direction of Maximum Hourly Speed	SE	N	SE	NE	SE	SE	NE	S	NW	N	NW	E	N
Maximum Gust Speed	113	77	70	79	64	58	72	100	71	85	105	84	
Date (yyyy/dd)	1973/28	1973/09	1977/25	1972/30	1973/08+	1972/28+	1974/28	1974/11	1974/03+	1973/03	1972/29	1971/04	
Direction of Maximum Gust	E	NW	SE	SE	SE	SE	SE	S	NW	NE	NW	NE	E
Degree Days:													
Above 24 °C	0	0	0	0	0	0	0	0	0	0	0	0	
Above 18 °C	0	0	0	0	0	0	0	0	0	0	0	0	
Above 15 °C	0	0	0	0	0	0	1	0	0	0	0	0	
Above 10 °C	0	0	0	0	0	3.1	16.7	2.5	0	0	0	0	
Above 5 °C	0	0	0	0	0.1	29	80.9	27.1	1.2	0	0	0	
Above 0 °C	0	0	0	0	4.3	106.8	204.4	115.7	24.5	0.4	0	0	
Below 0 °C	917.2	822.3	854.9	577.8	238.1	19.7	0.1	7.5	74.3	343.5	626.3	841.3	
Below 5 °C	1072.2	963.7	1009.9	727.8	388.9	91.9	31.6	73.9	200.9	498.1	776.3	996.3	
Below 10 °C	1227.2	1105.2	1164.9	877.8	543.8	216.1	122.4	204.3	349.8	653.1	926.3	1151.3	
Below 15 °C	1382.2	1246.7	1319.9	1027.8	698.8	362.9	261.7	356.8	499.8	808.1	1076.3	1306.3	
Below 18 °C	1475.2	1331.5	1412.9	1117.8	791.8	452.9	353.7	449.8	589.8	901.1	1166.3	1399.3	
Bright Sunshine:													
Total Hours			160		295.7	361.6		178.4	83.6	37			
Days with measureable			25.5		26.6	28.3		24.5	19	10.3			
% of possible daylight hours			44.7		41	50.2		29.2	20.4	13.8			
Extreme Daily	1.9	8	10.8	18.1	24	24	24	20.6	14.6	9.1	3.6		
Date (yyyy/dd)	1972/28	1977/23	1985/24	1975/30	1972/28+	1971/17+	1972/15+	1979/01	1978/01+	1985/02	1985/06		
Humidex:													
Extreme Humidex	-4.4	-6.1	-5.6	1.1	9.4	22.1	26	23.7	16.3	3.9	1.1	-4.3	
Date (yyyy/dd)	1974/02	1957/01	1967/16	1960/25	1971/30	1996/28	2000/29	2000/01	2001/01	1969/11	1970/01	1983/24	
Wind Chill:													
Extreme Wind Chill	-71.6	-68.1	-64.8	-58.4	-40.3	-21.1	-10.3	-20.4	-31.2	-44.9	-56.4	-64.1	
Date (yyyy/dd)	1975/12	1985/15	1979/03	1964/09	1971/05	1958/01	1964/13	1991/20	1961/30	1963/30	1991/14	1974/20	
Humidity:													
Average Relative Humidity - 0600LST (%)					88.4	86.4	87.2	92.5	91.7				
Radiation:													
Extreme Global (RF1)	0.2	3.5	13.9	24.8	31.8	32.9	31.5	23	13.5	5.8	1	0	
Date (yyyy/dd)	1983/31	1982/27	1971/31	1974/30	1985/30	1974/04	1986/04	1979/02	1984/01	1975/02	1974/01	1970/01+	

1971-2001 Climate Data from Holman, Victoria Island, Northwest Territories.

Temperature:	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Daily Average (°C)	-28.6	-28.3	-25.2	-17.1	-6.6	4.8	9.2	6.6	0.5	-9.3	-20.4	-25.8	-11.7
Standard Deviation	2.4	3.4	3	2.9	2.9	1.8	2.2	2.1	1.4	2.1	3.7	4	1.8
Daily Maximum (°C)	-24.7	-24.3	-20.9	-12.5	-3.1	8.1	13	9.6	2.6	-6.6	-17.1	-22.3	-8.2
Daily Minimum (°C)	-32.3	-32.2	-29.3	-21.6	-9.9	1.6	5.3	3.6	-1.8	-11.9	-23.5	-29.3	-15.1
Extreme Maximum (°C)	-4	-6.5	-5	4.5	11.5	22.5	29	23.5	15.8	5	1.1	-3	
Date (yyyy/dd)	1981/21	1980/07	1988/12	1989/27	1994/24	1982/29+	1989/15	1989/02	2001/01	1998/01	1998/03	1992/03	
Extreme Minimum (°C)	-47.5	-49	-45	-42.1	-26.5	-12.5	-3.5	-5.5	-15.5	-36.8	-37.5	-42.8	
Date (yyyy/dd)	1993/26	1985/12	1991/05	1997/01	1989/07	1986/03	1989/03	1995/28	1993/30	1996/27	1986/22	1997/31	
Precipitation:													
Rainfall (mm)	0	0	0	0	1.3	6.5	23.3	32.5	13.3	0.7	0	0	
Snowfall (cm)	8	9.1	7.1	5.5	6.3	1.4	0.2	2.5	8	17.9	12.6	6.9	
Precipitation (mm)	8.1	9.1	7.1	5.5	7.6	7.8	23.5	35	21.3	18.6	12.2	6.7	
Average Snow Depth (cm)						1	0	0	1	4	9		
Median Snow Depth (cm)						1	0	0	0	3	9		
Snow Depth at Month-end (cm)	12	13	13	14	6	0	0	1	2	6	9	11	
Extreme Daily Rainfall (mm)	0.2	0	0	0	12.4	12.4	19.2	45	17.4	6.6	0	0	
Date (yyyy/dd)	1993/14	1980/01+	1980/01+	1981/01+	1994/28	1994/02	1982/27	2000/06	1989/01	1998/04	1979/01+	1979/01+	
Extreme Daily Snowfall (cm)	8	8	14	11.6	6.6	3.6	2.2	7	10.4	15	11	6.2	
Date (yyyy/dd)	2000/02	2000/01	1982/01	1984/17	1986/27	2001/04	1990/22	1995/30	1989/17	1982/03	2000/15	1993/10	
Extreme Daily Precipitation (mm)	8	8	14	11.6	14.1	12.4	19.2	45	17.4	15	8	6.2	
Date (yyyy/dd)	2000/02	2000/01	1982/01	1984/17	1994/28	1994/02	1982/27	2000/06	1989/01	1982/03	1993/21	1993/10	
Extreme Snow Depth (cm)	25	31	34	57	40	29	0	10	24	20	21	22	
Date (yyyy/dd)	1984/19+	1984/21+	1984/23+	1984/18+	1984/01	2000/03	1981/01+	1995/31	1992/28+	1992/14+	1983/29+	1993/14+	
Days with Maximum Temperature:													
<= 0 °C	31		31	29.5	22.9	1.1	0	0	7.7	28.4	29.9	31	
> 0 °C	0		0	0.5	8.1	28.9	31	31	22.4	2.6	0.13	0	
> 10 °C	0		0	0	0.19	11.4	22.6	13.3	0.29	0	0	0	
> 20 °C	0		0	0	0	0.25	2.1	0.27	0	0	0	0	
> 30 °C	0		0	0	0	0	0	0	0	0	0	0	
> 35 °C	0		0	0	0	0	0	0	0	0	0	0	
Days with Minimum Temperature:													
> 0 °C	0		0	0	1.3	19.3	28.2	24.9	9.7	0.31	0	0	
<= 2 °C	31		31	30	30.7	17.9	7.1	11.5	26.3	30.9	30	31	
<= 0 °C	31		31	30	29.8	10.7	2.8	6.1	20.3	30.6	30	31	
< -2 °C	31		31	30	27.3	4	0.27	0.4	11.2	29.6	30	31	
< -10 °C	31		31	28.2	13.2	0.12	0	0	1.1	17.5	28.8	30.9	
< -20 °C	30.2		27.6	16.5	1.3	0	0	0	0	2.8	21.7	27.6	
< - 30 °C	22		15.2	3.2	0	0	0	0	0	0.31	5.5	15	
Days with Rainfall:													
>= 0.2 mm	0.05	0	0	0	0.63	3.9	7.9	10.4	6.2	0.59	0	0	
>= 5 mm	0	0	0	0	0.05	0.3	1.4	1.7	0.67	0.09	0	0	
>= 10 mm	0	0	0	0	0.05	0.1	0.5	0.62	0.05	0	0	0	
>= 25 mm	0	0	0	0	0	0	0	0.19	0	0	0	0	
Days With Snowfall:													
>= 0.2 cm	4.5	5.1	4.4	3.3	3.9	1.2	0.19	1	4	9.5	7	4.3	
>= 5 cm	0.28	0.29	0.2	0	0.28	0	0	0.14	0.38	0.67	0.5	0.16	
>= 10 cm	0	0	0.05	0	0	0	0	0	0.05	0.05	0.05	0	
>= 25 cm	0	0	0	0	0	0	0	0	0	0	0	0	
Days with Precipitation:													
>= 0.2 mm	4.6	5.1	4.4	3.3	4.4	4.7	7.9	11	9.7	9.7	7	4.2	
>= 5 mm	0.28	0.29	0.2	0	0.33	0.3	1.4	1.9	1	0.76	0.45	0.16	
>= 10 mm	0	0	0.05	0	0.06	0.1	0.5	0.62	0.19	0.05	0	0	
>= 25 mm	0	0	0	0	0	0	0	0.19	0	0	0	0	
Days with Snow Depth:													
>= 1 cm						6.8	0	0.32	3.8				
>= 5 cm						2.9	0	0.16	1.9				
>= 10						1.5	0	0.05	0.74				
>= 20						0.47	0	0	0.16				
Wind:													
Maximum Hourly Speed	69	59	72	74	78	63	52	63	72	69	74	72	
Date (yyyy/dd)	1991/03	1992/03+	1993/29	1999/16	1994/28	1992/01	2000/27	1988/02	1988/22	1988/13	1988/21	1987/09	
Direction of Maximum Hourly Speed	NW	E	E	E	N	E	E	NW	N	E	E	E	N
Degree Days:													
Above 24 °C			0	0	0	0	0	0	0		0	0	
Above 18 °C			0	0	0	0	0.9	0	0		0	0	
Above 15 °C			0	0	0	0.2	6	0.4	0		0	0	
Above 10 °C			0	0	0	8.9	44.8	13.1	0		0	0	
Above 5 °C			0	0	0.6	54.3	146.1	75.5	3.8		0	0	
Above 0 °C			0	0.1	8.4	160.8	291.7	206	51.7		0	0	
Below 0 °C			784.4	502.3	198	6.9	0	0.2	38.2		613.3	787.3	
Below 5 °C			939.4	652.3	345.2	50.4	9.4	24.7	140.2		763.3	942.3	
Below 10 °C			1094.4	802.3	499.6	155	63.1	117.2	286.5		913.3	1097.3	
Below 15 °C			1249.4	952.3	654.6	296.3	179.3	259.5	436.5		1063.3	1252.3	
Below 18 °C			1342.4	1042.3	747.6	386.1	267.2	352.2	526.5		1153.3	1345.3	
Humidex:													
Extreme Humidex	-7.2	-9.4	-7.6	3.5	10.6	21.5	27.9	24.5	17.1	3.5	0.1	-3.2	
Date (yyyy/dd)	1993/14	1993/17	1999/12	1989/27	1994/24	1988/23	1998/08	1989/03	2001/01	1988/03+	1998/04	1992/03	
Wind Chill:													
Extreme Wind Chill	-59.8	-59.2	-61.9	-45.3	-31	-18.3	-6.8	-11.1	-21.9	-44.7	-48.3	-51.2	
Date (yyyy/dd)	1989/30	1988/12	1991/04	1997/01	1992/06	2000/01	2002/08	1995/29	1993/29	1996/28	1991/15	1993/17	



Sachs Harbour Climograph (1971-2001)
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Precipitation (mm)
40.0
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
Temperature (°C)
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Bulk Precipitation
Average Temperature


Holman Climograph (1971-2001)
Precipitation (mm)
Temperature (°C)
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
40.0
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Bulk Precipitation
Temperature

Appendix C

Komex Geophysical Survey

Appendix D

Photographic Record

Appendix D.1

Site Inventory Photos

Appendix D.2

Soil Sampling Photos

Appendix D.3

Soil Sampling Photos – Geophysical Anomalies

Appendix D.4

Tank Farm Area

Appendix D.5

Tank Inventory

Appendix D.6

Site Reconnaissance Visit Photos

Appendix E

Tables

Appendix E.1

Table 1 – Site Inventory

Item Number	Area	5	Photo Number(s)	Description	Materials	Dimensions (m)			Present Volume (m^3)	Demolished Volume (m^3)	Approximate Weight (Kg)	Hazardous Material
						Length	Width	Height				
1	2	01	001	Steel sleigh with bulldozer blade and bucket.	Steel/Wood	12.5	2.7	0.5	16.88	3.375	3650[a]	
2	2	02	002 003	Wooden fuel sloop (tanks 66, 67, 68 and 69) with small wooden shed. Hoses and valves in shed.	Steel/Wood	6.7	2.8	1.0	18.76	3.752	4500[b]	
3	2	03	004	Steel sleigh with metal debris (eg. extra hitch, chains, "I" beams).	Steel/Wood	12.5	3.7	0.5	23.13	4.625	3650[a]	
4	2	04	005 006	Wooden storage shed (contains valves, metal debris, pipe).	Wood	1.9	2.4	2.0	9.12	1.824	1400[a]	
5	2	05	007	Steel road drag.	Steel	3.8	2.0	0.25	1.90	0.38	1000[a]	
6	2	06	008 009 010 011 012	Wooden building, 2 rooms, particle board walls, furnace in inside room, various debris (eg. cable, empty 45 gal drums, plywood).	Wood	4.6	2.1	1.9	18.35	3.6708	1400[a]	
7	2	07	013	977 L bull dozer with forks, and cable winch at rear, fuel tank (tank 65). Not serviceable.	Steel						25000[c]	
8	2	08	014 015 016 017	Sleigh camp unit, with fuel tank (tank 64) at rear. Two propane (100 Lbs) on rear. Inside four bunks, range, tables, wall board. Suspected asbestos containing material next to area where furnace was located. Sample was collected. Outside of unit covered with aluminum siding.	Steel/Wood	4.6	2.1	1.9	18.35	3.6708	9100[d]	X
9	2	09/10/11	018 019 020 021 022 023	Portabuilt units, built in Edmonton, AB. Unit on Nodwell tracks. 3 units in total (2 pale yellow, 1 orange) originally owned by Kenn Borek Construction. 2 sides of units fold out. Various debris and graffiti though out, wall board on inside, aluminum siding on outside. 1st unit is bunk house, 2nd is washroom/shower, and 3rd is kitchen.	Steel/Wood	5.9	2.1	2.5	92.93	18.585	34000[a]	
10	2	13	024 025	Plywood shed on wooden skid, inside 2 bags of drilling sand, used electrical wire, 2 Nodwell tires, 1 lead-acid battery.	Wood	3.7	2.5	2.6	24.05	4.81	1400[a]	X
11	2	12	026 027 028	2 plywood sheds joined together. Various debris including: electrical cables, furnace blowers, fuel hoses, suction hoses, drill sand, empty fuel tanks, fibregalss insulation, and ladders.	Wood/Steel	8.2	2.5	2.6	53.30	10.66	3000[a]	
12	1	01	029	193 - Empty or partial 45 gallon drums, all upright and frozen in place, contents could not be confirmed. Suspected to contain: oil, tranmission fluid, calcozine, varsol, and water.	Steel	10	10	1	100.00	20	900[a]	X

Item Number	Area	5	Photo Number(s)	Description	Materials	Dimensions (m)			Present Volume (m^3)	Demolished Volume (m^3)	Approximate Weight (Kg)	Hazardous Material
						Length	Width	Height				
13	1	03	030	44 - 5 gallon containers, all upright and frozen in place, contents could not be confirmed. Suspected to contain gear oil, engine oil, hydraulic fluid, and chloroforide.	Steel	5	5	0.5	12.50	2.5	330[a]	X
14	1	N/A	031	Lead-acid batteries, less than 10 in total. Batteries contained in open 45 gallon drum.	Lead	2	2	0.2	0.80	0.16	200[a]	X
15	1	02	032	100 Lbs pressurized gas containers, 26 in total, all were frozen in place, contents could not be confirmed. Suspected 10 partial to full tanks contain propane, 2 full tanks contain acetylene, while 14 empty tanks (propane (9), acetylene (2), and oxygen (3)).	Steel/Gas	10	10	0.3	30.00	6	1400[a]	X
16	1	01/04	033	Partial 45 gallon drums, no owner details, 21 in total.	Steel/Fuel	3	3	1	9.00	1.8	1500[a]	
17	1	N/A	034	Jet A-1 Diamonds North 1 partial 45 gallon drum.	Steel/Fuel	0.5	0.5	1	0.25	0.05	100[a]	
18	1	N/A	035 036	Jet A-1 Diamonds North 8 full 45 gallon drums.	Steel/Fuel	1	5	1	5.00	1	1100[a]	
19	1	N/A	037	Jet A-1 RWED (ENR) 7 full 45 gallon drums.	Steel/Fuel	1	5	1	5.00	1	950[a]	
20	1	04	038	Furnace (moved from barrel stock pile to present location since 1992 DIAND site visit).	Steel	0.75	0.75	1	0.56	0.1125	100[a]	
21	2	14	039	Fuel sloop on skis (tanks 59, 60, 61, 62, 63).	Steel/Wood	6.7	2.8	1	18.76	3.752	4500[b]	
22	1	N/A	040	Turbo Jet B DIAND 1999 19 full 45 gallon drums.	Steel/Fuel	3	3	1	9.00	1.8	2600[a]	
23	1	N/A	041	Jet B DIAND 2000 5 full 45 gallon drums.	Steel/Fuel	1	4	1	4.00	0.8	700[a]	
24	1	N/A	042	Av-Gas ENR 7 empty 45 gallon drums.	Steel	1	5	1	5.00	1	30[a]	
25	3		043	Small breached soil berm, timbers on ground.	Wood	5.0	5.0	0.75	18.75	3.75		
26	3	N/A	044	2 valves from pipeline. One is a 5" line reduced to 2", the other is a 4" line reduced to 3".	Steel	0.1	0.1	0.1	0.00	0.0002	2[a]	
27	3	08	045 046 047	Former generator shack, constructed of steel on skid. Fuel tank inside (tank 26), propane tank (100 Lbs), 1 lead-acid battery, gen set is not present. Unit owned by KAPS Transport.	Steel	2.5	3.0	2.2	16.50	3.3	2500[a]	X
28	3	07	048 049	Plywood building, debris inside (cardboard banned into sheets).	Wood	2.5	2.0	2.0	10.00	2	1400[a]	
29	3	09	050	Wooden fuel sloop (tank 27) on skis.	Steel/Wood	6.7	2.7	1	18.09	3.618	2500[b]	
30	1	05	051 052	Navaid on wooden skid. Styrofoam covering inside walls. No instrumentation present. Florescent lights present, but no model numbers likely contains PCB ballast). Structure is supported on 9 wooden piles. Navaid is constructed of bolt together steel panels.	Steel/Wood							X

Item Number	Area	5	Photo Number(s)	Description	Materials	Dimensions (m)			Present Volume (m^3)	Demolished Volume (m^3)	Approximate Weight (Kg)	Hazardous Material
						Length	Width	Height				
31	2	N/A	053	Culvert constructed of 45 gallon drums	Steel	5.0	0.75	0.75	2.81	0.5625	100[a]	
32	2	N/A	054	5" steel pipe from pipeline	Steel	75	0.125	0.125	1.17	0.234375	1000[a]	
33	3	05	055 056 057	Plywood shed on metal skid/skis, furnace inside, benches, electric wires, steel container with kamlok fittings. DIAND feature 03, metal box, can be seen in photo.	Steel/Wood	3.0	6.0	3.0	54.00	10.8	2500[a]	
34	3	04	058 059	Plywood building with steel edges. Kamlok fittings and hoses inside.	Wood/Steel	3.7	2.5	2.5	23.13	4.625	1400[a]	
35	3	10	060	2 - 45 gallon drums welded together and 200 gallon tank, plywood debris.	Steel/Wood	2	0.75	0.75	1.13	0.225	20[a]	
36	3	10	061	Soil berm, contains crushed 45 gallon drum, and 200 gallon tank (item 60) on outside edge.	Steel	5.0	5.0	0.75	18.75	3.75		
37	3	01	062 063 064 065 066 067 068	Maintenance shed, constructed out of plywood, wooden planks are laid on ground, several empty 15 and 45 gallon drums, electrical wires, "Herman Nelson" heater, steel bolts, and two CO_2 fire extinguishers. Some hydrocarbon staining on floor of building. 1 door is missing, 25% of roof is missing.	Wood/Steel	13.4	6.1	3.6	294.26	58.8528	5000[a]	
38	3	03	069 070	4' x 4' x 4' wooden seacan containing burlap sacks full of sawdust	Wood	1.2	1.2	1.2	1.73	0.3456	250[a]	
39	3	02	071	Tank (Tank 25) located directly adjacent to maintenance shed	Steel	See information from Tank Inventory						
40	3	13	072	Tank (Tank 22) with metal skid on side and bottom	Steel							
41	3	14	073	Tank (Tank 23) with metal skid on side and bottom	Steel							
42	3	15	074	Tank (Tank 24) with metal skid on side and bottom	Steel							
43	3	16	075	Tank (Tank 20)	Steel							
44	3	17	076	Tank (Tank 21), paint sample collected for analysis	Steel							
45	3	N/A	077	5 wooden poles, approximately 7 - 9 meters tall, though to be used for communication system, poles are not treated	Wood	8	0.5		7.85	7.85	500[a]	
46	3	11	078 079 080	Fuel sloop on skis (tanks 28, 29, 30 ,31) with wooden shed. 2 bags of oil/water sorbent in shed, as well as steel survey markers	Steel/Wood	6.7	2.7	1	18.09	3.618	4500[b]	
47	3	12	081	Fuel sloop on skis (tanks 32, 33, 34, 35, 36) owned by Kenn Borek Construction	Steel/Wood	6.7	2.7	1	18.09	3.618	4500[b]	

Item Number	Area	5	Photo Number(s)	Description	Materials	Dimensions (m)			Present Volume (m^3)	Demolished Volume (m^3)	Approximate Weight (Kg)	Hazardous Material
						Length	Width	Height				
48	5	01	082	Metal skid with Nodwell tracks (5) stored on it. Skid supported by 6 - 45 gallon drums. Sign on skid reads "United CEO" small tank (tank 45) is located on one end of skid.	Steel	9.1	2.7	1	24.57	4.914	3000[a]	
49	5	02	083	Wooden deck on metal skid, 1 full 45 gallon drum (tank 44). Several pieces of 4 x 4 x 4' seacans marked "Elf Oil Explosives"	Wood/Steel	7.6	3.0	1	22.80	4.56	1000[a]	
50	5	03	084	Metal skid on rack. Pipe debris on ground.	Steel	9.1	2.7	0.5	12.29	2.457	1000[a]	
51	5	04	085	Metal skid on pipe rack, wooden timbers.	Steel/Wood	9.1	2.7	0.5	12.29	2.457	2000[a]	
52	5	05	086	Metal/plywood skid sled with tank (tank 37) inside.	Wood/Steel	4.0	2.4	0.5	4.80	0.96	2000[a]	
53	5	06/07/08/09	087 088 089 090 091	4 - 8' x 8' x 8' plywood sheds, with steel tower on top. First shed has 1 empty 45 gallon drum, and 1 full 45 gallon drum (tank 43). Second shed has hoses, and cables. Third shed has 5 45 gallon drums (tanks 38, 39, 40, 41, 42) of Turbo B). Forth shed has hoses, bed frames, and other debris. DIAND feature 10 can be seen in photo 87.	Wood/Steel/ Fuel	2.4	2.4	2.4	13.82	2.7648	3400[a]	
54	5	N/A	092	Assorted debris on ground surface, mostly wood and steel.	Wood/Steel	1.5	1.5	0.5	1.13	0.225	500[a]	
55	6	01	093	Lay down timbers (10" x 10") untreated, approximately 30 in total.	Wood	3.5	0.25	0.25	6.56	1.3125	6500[a]	
56	7	02	094	Metal skid with timbers, pallets, fence posts, and 3 full 45 gallon drums.	Steel/Wood	9.1	2.7	1	24.57	4.914	2500[a]	
57	7	04	095	Metal frame made from 4" pipe.	Steel	3.0	0.1	2	0.75	0.15	500[a]	
58	7	05	096	3 pieces of 10' x 4" pipe on timbers (10" x 10")	Steel/Wood	3.5	0.25	0.25	0.22	0.04375	500[a]	
59	7	01	097	5 large posts (communication posts) (20 cm x 9.1 m) untreated, supported on 5 crushed 45 gallon	Wood/Steel							
60	7	06/07/08/09	098 099 100 101	Pallet line of various metal debris (mostly pipe and some tower sections) supported on timbers (10" x 10"), 1 skid supported by 6 - 45 gallon drums (empty).	Steel/Wood							
61	7	10	102	Metal skid on 5 - 45 gallon drums. 4 wooden pallets, metal debris, and plywood on skid.	Steel/Wood	9.1	2.7	0.25	6.14	1.2285	1500[a]	
62	7	13	103	Metal skid with wooden deck and tanks (tanks 46, 47, 48, 49).	Steel/Wood	9.1	2.7	1	24.57	4.914	2500[a]	
63	7	N/A	104	Metal skid with metal tractor tracks.	Steel	9.1	2.7	0.5	12.29	2.457	3650[a]	
64	7	15	105 106 107	"Atco" type trailer, with aluminum siding. 3 room bunkhouse, 4 beds per each room. Wall board on interior walls. Metal ski "bunks" are next to unit (DIAND feature 14).	Wood/Steel	11	3.0	2.4	79.20	15.84	18500[d]	

Item Number	Area	5	Photo Number(s)	Description	Materials	Dimensions (m)			Present Volume (m^3)	Demolished Volume (m^3)	Approximate Weight (Kg)	Hazardous Material
						Length	Width	Height				
65	7	16	108 109 110 111	"Atco" type trailer, on metal skis with aluminum siding. 3 rooms, washroom/shower room, office (with 1 bed) and bunk room (with 4 beds). Wall board on interior walls. PVC/stainless steel piping in washroom, washer/dryer unit in washroom.	Wood/Steel	11	3.0	2.4	79.20	15.84	18500[d]	X
66	7	18	112 113 114 115 116 117 118 119 120	"Atco" type trailer on metal skis with aluminum siding. Generator unit, no gen set present. 2 rooms are present, 1 small storage room, and 1 large room where gen set was located. 1 - 45 gallon drum with water in bottom, Hydrocarbon staining on the floor. Breaker and fuse boxes present. Internal walls covered with wall board, no asbestos paneling present.	Wood/Steel	11	3.0	2.4	79.20	15.84	18500[d]	X
67	7	N/A	121 122 123 124 125	"Atco" type trailer on metal skis with aluminum siding. Unit is very similar to item 66. 2 rooms are located within the unit. Appears to be a workshop in large room. 1 - 100Lbs propane tank. Small room is storage room, deep freezer present.	Wood/Steel	11	3.0	2.4	79.20	15.84	18500[d]	X
68	7	19	126 127 128	"Atco" type trailer, not on skis. 2 rooms , 1 large "TV" room, 2 furnaces, the small room has 1 bunk bed, wall board interior walls. Paint sample collected from ceiling. Aluminum siding on outside.	Wood/Steel	11	3.0	2.4	79.20	15.84	18500[d]	X
69	7	20	129 130 131 132	"Atco" type trailer on skis with aluminum siding. 3 room bunkhouse, 4 beds per each room. Wall board on interior walls.	Wood/Steel	11	3.0	2.4	79.20	15.84	18500[d]	X
70	7	21	133	Metal skid on skis, contains tanks (tanks 50, 51) metal debris (skis), wood, and 2 nodwell tracks.	Steel/Wood	11	3.0	0.5	16.50	3.3	4000[a]	
71	7	22	134	Metal debris (pipe).	Steel							
72	7	17	135 136 137	"Atco" type trailer on skis with aluminum siding. Kitchen unit, range and fridge present. Fridge bolted to wall, cannot tell type of refrigerant.	Wood/Steel	11	3.0	2.4	79.20	15.84	18500[d]	X
73	8	17/18	138	Steel and wood rams, separated into two pieces	Steel/Wood	13.3	3.7					
74	8	N/A	139	Debris pile (plywood and steel), 45 gallon drum (tank 58).	Steel/Wood							
75	8	19	140	6 - 12" x 12" timbers bolted together with steel, total length is 9 m. 16" x 16" timber, total length is 4.5 m.	Wood/Steel							

Item Number	Area	5	Photo Number(s)	Description	Materials	Dimensions (m)			Present Volume (m^3)	Demolished Volume (m^3)	Approximate Weight (Kg)	Hazardous Material
						Length	Width	Height				
76	8	20	141	Debris (wood and cable).	Wood							
77	8	16	142 143	Solid waste incinerator on skid, debris (nodwell tire, cable, wood, ladder).	Steel	2.1	1.4	1.4	4.12	0.8232	1500[a]	
78	8	N/A	144	Nodwell track.	Steel/Rubber						200[a]	
79	8	14	145 146	Small plywood shed, contains hoses and fittings.	Wood	2.4	2.4	1.8	10.37	2.0736	1000[a]	
80	8	12/13	147	Metal skid with nodwell tracks, nowell tire, 45 gallon drum (without top), and various metal debris.	Steel	4.9	1.2	0.5	2.94	0.588	1500[a]	
81	8	11	148	2 - 45 gallon drums (Tanks 57 and 58).	Steel							
82	8	10	149 150	Nodwell trailer, contains tires, 2 - 5 gallon pails with frozen material, plywood box containing drilling pieces, and debris (wood and metal).	Steel/Wood	5.9	2.1	1.5	18.59	3.717	6800[a]	
83	8	09	151 152 153	Nodwell. Contains tanks 53, 54a, 54b. Lead-acid "Cat" battery, engine present. Rear storage area contains rope, cable, chain, hoses, and plywood.	Steel	5.9	2.1	1.8	22.30	4.4604	10500[e]	X
84	8	04	154 155 156 157 158 159	Nodwell camp generator unit. Cables, plugs, and aluminum siding on outside. 45 gallon drum (tank 55), fuel tank (tank 56) for gen set present. 2 - lead-acid batteries present. Gen set originally sold by R. Angus Alberta Ltd (Model # D330). Air compressor and other assorted debris (ladder, fuel hoses, bolts, wood shelves) located within unit. Unit owned by United Geophysical of Calgary, Alberta.	Steel/Wood	5.9	2.1	2.4	29.74	5.9472	14000[a]	X
85	8	02	160 161 162	Nodwell portabuilt camp unit. Bunk/sleeper unit. 2 - rooms in foldout portion, 6 - foldup beds per room. 1 - furnace. Centre room has separate door (opposite end of unit). Room was used as storage/tool crib. All internal walls covered with plywood.	Wood/Steel	5.9	2.1	2.4	29.74	5.9472	11500[a]	X
86	8	05	163 164 165 166	Nodwell portabuilt camp unit. Kitchen unit, contains fridge, deep freeze, range/oven, water tank. Kitchen is located in centre of unit, 1 - wing of unit has 6 - fold up beds, opposite wing is dining area. Paint peeling from ceiling collected for analysis.	Wood/Steel	5.9	2.1	2.4	29.74	5.9472	11500[a]	X

Item Number	Area	5	Photo Number(s)	Description	Materials	Dimensions (m)			Present Volume (m^3)	Demolished Volume (m^3)	Approximate Weight (Kg)	Hazardous Material
						Length	Width	Height				
87	8	03	167 168 169 170 171	Nodwell portabuilt camp unit. Bunk/office unit. 6 - beds per room, located in the two wings. Office located in centre of unit. Plywood on internal walls, carpet on floor. Paint peeling from ceiling (similar to item 86). Paint peeling from walls collected for analysis. 1 - furnace located in the unit.	Wood/Steel	5.9	2.1	2.4	29.74	5.9472	11500[a]	X
88	8	08	172	Solid waste incinerator, fuel tank empty.	Steel	2.5	1.2	1.4	4.20	0.84	500[a]	
89	8	07	173	Fuel tank (tank 52) on Nodwell tracked unit. Suction hoses and other debris (metal and wood) located on top of tank.	Steel	5.9	2.1	1.5	18.59	3.717	6800[a]	
90	8	06	174 175 176 177 178	Nodwell portabuilt camp unit. Bunk/office unit. 6 - beds per room, rooms located in 2 wings. Centre of unit is storage/office, contains fuel filters, and maintenance equipment. Dates shown in office - 1980. Interior walls covered with plywood.	Wood/Steel	5.9	2.1	2.4	29.74	5.9472	11500[a]	X
91	8	01	179 180 181 182 183	Nodwell portabuilt camp unit. Washroom/bunk unit. Washroom is located in centre of unit, contains washer, toilet, shower, sink. 2 - bunkbeds located in each of the rooms located in the 2 wings.	Wood/Steel	5.9	2.1	2.4	29.74	5.9472	11500[a]	X

Appendix E.2

Table 2 – Analytical Results – Paint Samples

Sample Location				Feature 44	Feature 68	Feature 86	Feature 87
Sample ID:	D.L.	Units	CCME Guideline Values	#44	#68	#86	#87
Collected By:				IEG	IEG	IEG	IEG
Laboratory:				ETL	ETL	ETL	ETL
Sample Date:				3-Oct-05	4-Oct-05	5-Oct-05	5-Oct-05
Lab Reference No.:				L335238-1	L335238-2	L335238-3	L335238-4
CCME Metals							
Silver (Ag)	1	mg/kg		<1	<1	1	<1
Aluminum (Al)	10	mg/kg		52500	1520	3810	4290
Arsenic (As)	0.1	mg/kg		10.5	0.4	0.8	0.5
Barium (Ba)	0.5	mg/kg		334	6.2	41.2	43.6
Beryllium (Be)	1	mg/kg		<1	<1	<1	<1
Calcium (Ca)	100	mg/kg		4600	163000	67500	63700
Cadmium (Cd)	0.5	mg/kg		25.1	<0.5	0.6	1.3
Cobalt (Co)	1	mg/kg		222	<1	366	332
Chromium (Cr)	0.5	mg/kg		826	1.5	2.3	5.2
Copper (Cu)	1	mg/kg		22	3	5	47
Iron (Fe)	100	mg/kg		63000	1000	400	500
Mercury (Hg)	0.01	mg/kg		0.04	<0.01	1.42	0.26
Potassium (K)	20	mg/kg		230	150	180	430
Magnesium (Mg)	10	mg/kg		1470	820	1220	1850
Manganese (Mn)	20	mg/kg		250	<20	40	20
Molybdenum (Mo)	1	mg/kg		<1	<1	<1	<1
Sodium (Na)	100	mg/kg		300	100	800	800
Nickel (Ni)	2	mg/kg		12	<2	<2	3
Lead (Pb)	5	mg/kg		6620	9	592	932
Antimony (Sb)	0.1	mg/kg		0.2	<0.1	<0.1	<0.1
Selenium (Se)	0.1	mg/kg		<0.1	0.1	<0.1	0.1
Tin (Sn)	5	mg/kg		<5	<5	<5	<5
Strontium (Sr)	1	mg/kg		12	74	115	99
Vanadium (V)	1	mg/kg		6	<1	2	2
Tungsten (W)	5	mg/kg		<5	<5	<5	<5
Zinc (Zn)	0.5	mg/kg		5100	683	4180	920
Zirconium (Zr)	5	mg/kg		<5	<5	216	<5
CCME PCB's							
Aroclor 1016	0.3	mg/kg		<0.3	<0.3	<0.3	<0.3
Aroclor 1221	0.3	mg/kg		<0.3	<0.3	<0.3	<0.3
Aroclor 1232	0.3	mg/kg		<0.3	<0.3	<0.3	<0.3
Aroclor 1242	0.3	mg/kg		<0.3	1.0	52	40
Aroclor 1248	0.3	mg/kg		<0.3	<0.3	<0.3	<0.3
Aroclor 1254	0.3	mg/kg		16	0.7	7.6	<0.3
Aroclor 1260	0.3	mg/kg		<0.3	<0.3	<0.3	<0.3
Aroclor 1262	0.3	mg/kg		<0.3	<0.3	<0.3	<0.3
Aroclor 1268	0.3	mg/kg		<0.3	<0.3	<0.3	<0.3
Total PCBs	0.3	mg/kg		16	1.7	60	40
Decachlorobiphenyl		%		N/A	105	N/A	N/A

Appendix E.3

Table 3 – Analytical Results – Asbestos Samples

Sample Location Sample ID: Collected By: Laboratory: Sample Date: Lab Reference No.:	D.L.	Units	CCME Guideline Values	Feature 8 #8 IEG ETL 2-Oct-05 L335238-5
Asbestos Containing Material				
Asbestos: Chrysotile	1	%		25-50
Other Fibres: Cellulose	1	%		1-5

Appendix E.4

Table 4 – Analytical Results – Duplicate Soil Samples

Sample Location **Sample ID:**	**D.L.**	**Units**	**CCME Residential Parkland***	**CCME Commercial Indistrial***	**30S 0W**	**DUP2 30S0W Duplicate**	**RPD**
Collected By:					**IEG**	**IEG**	**IEG**
Laboratory:					**ETL**	**ETL**	
Sample Date:							
Lab Reference No.:					**L335239-45**	**L335239-49**	
Total Organic Vapour	0-2000	ppm			9.5	-	-
PetroFlag Results	10-2000	ppm			2660	-	-
CCME F1-F4 Hydrocarbons							
Androstane		%			116	172	
F1 (C6-C10)	5	mg/kg	30	310 (230[a])	<5	<5	nc
F2 (C10-C16)	5	mg/kg	150	760 (150[a])	**1300**	**1500**	-14.3
F3 (C16-C34)	5	mg/kg	400	1700	**820**	**1000**	-19.8
F4 (C34-C50)	5	mg/kg	2800	3300	21	19	10.0
Total Hydrocarbons (C6-C50)	5	mg/kg	3380	5000	2100	2500	-17.4
Chromatogram to baseline at nC50					YES	YES	
% Moisture	0.1	%			12	11	

nc: not calculated

-: Not analyzed

CCME: Canadian Council of Ministers of the Environment Canada-wide Standard (CWS) for Petroleum Hydrocarbons in Soil

ppm: parts per million

mg/kg: milligrams per kilogram

5 Concentration above CWS PHC

*: Standard for Coarse-grained soil

[a] Where applicable, for protection against contaminated groundwater discharge to an adjacent surface water body

Sample Location Sample ID:	D.L.	Units	CCME Residential Parkland*	CCME Commercial Indistrial*	40S 0W	DUP3 40S0w Duplicate	RPD
Collected By:					IEG	IEG	IEG
Laboratory:					ETL	ETL	
Sample Date:							
Lab Reference No.:					L335239-46	L335239-50	
Total Organic Vapour	0-2000	ppm			11.8	-	-
PetroFlag Results	10-2000	ppm			678	-	-
CCME F1-F4 Hydrocarbons							
Androstane		%			103	93	
F1 (C6-C10)	5	mg/kg	30	310 (230[a])	11	8	31.6
F2 (C10-C16)	5	mg/kg	150	760 (150[a])	110	77	35.3
F3 (C16-C34)	5	mg/kg	400	1700	90	68	27.8
F4 (C34-C50)	5	mg/kg	2800	3300	<5	6	nc
Total Hydrocarbons (C6-C50)	5	mg/kg	3380	5000	210	160	27.0
Chromatogram to baseline at nC50					YES	YES	
% Moisture	0.1	%			16	17	

nc: not calculated

-: Not analyzed

CCME: Canadian Council of Ministers of the Environment Canada-wide Standard (CWS)
for Petroleum Hydrocarbons in Soil

ppm: parts per million

mg/kg: milligrams per kilogram

5 Concentration above CWS PHC

*: Standard for Coarse-grained soil

[a] Where applicable, for protection against contaminated groundwater discharge to an adjacent surface water body

Sample Location Sample ID: Collected By: Laboratory: Sample Date: Lab Reference No.:	D.L.	Units	CCME Residential Parkland*	CCME Commercial Indistrial*	50S 80W IEG ETL L335239-36	DUP1 50S 80W Duplicate IEG ETL L335239-48	RPD IEG
Total Organic Vapour	0-2000	ppm			3.0	-	-
PetroFlag Results	10-2000	ppm			0	-	-
CCME F1-F4 Hydrocarbons							
Androstane		%			91	101	
F1 (C6-C10)	5	mg/kg	30	310 (230[a])	<5	<5	
F2 (C10-C16)	5	mg/kg	150	760 (150[a])	<5	8	0
F3 (C16-C34)	5	mg/kg	400	1700	12	<5	nc
F4 (C34-C50)	5	mg/kg	2800	3300	<5	<5	nc
Total Hydrocarbons (C6-C50)	5	mg/kg	3380	5000	12	8	nc
Chromatogram to baseline at nC50					YES	YES	
% Moisture	0.1	%			7.2	7.8	

nc: not calculated

-: Not analyzed

CCME: Canadian Council of Ministers of the Environment Canada-wide Standard (CWS)
for Petroleum Hydrocarbons in Soil

ppm: parts per million

mg/kg: milligrams per kilogram

5 Concentration above CWS PHC

*: Standard for Coarse-grained soil

[a] Where applicable, for protection against contaminated groundwater discharge to an adjacent surface water body

Appendix E.5

Table 5 – Analytical Results – Soil Samples

Sample Location Sample ID:	D.L.	Units	CCME Residential Parkland*	CCME Commercial Industrial*	100N	90N 0W	80N 0W	70N 0W	60N 0W
Collected By:					IEG	IEG	IEG	IEG	IEG
Laboratory:					ETL				
Sample Date:									
Lab Reference No.:					L335239-43				
Total Organic Vapour	0-2000	ppm			2.2	1.6	1.1	2.2	3.0
PetroFlag Results	10-2000	ppm			348	26	164	330	186
Particle Size Analysis % > 75um	1	%			65	-	-	-	-
CCME F1-F4 Hydrocarbons									
Androstane		%			89	-	-	-	-
F1 (C6-C10)	5	mg/kg	30	310 (230[a])	<5	-	-	-	-
F2 (C10-C16)	5	mg/kg	150	760 (150[a])	<5	-	-	-	-
F3 (C16-C34)	5	mg/kg	400	1700	22	-	-	-	-
F4 (C34-C50)	5	mg/kg	2800	3300	<5	-	-	-	-
Total Hydrocarbons (C6-C50)	5	mg/kg	3380	5000	22	-	-	-	-
Chromatogram to baseline at nC50					YES				
% Moisture	0.1	%			12	-	-	-	-

nc: not calculated
-: Not analyzed
CCME: Canadian Council of Ministers of the Environment Canada-wide Standard (CWS)
for Petroleum Hydrocarbons in Soil
ppm: parts per million
mg/kg: milligrams per kilogram

5	Concentration above CWS PHC

*: Standard for Coarse-grained soil
[a] Where applicable, for protection against contaminated groundwater discharge to an adjacent surface water body

Sample Location Sample ID:	D.L.	Units	CCME Residential Parkland*	CCME Commercial Industrial*	50N 0W	40N 0W	30N 0W	20N 0W	10N 0W
Collected By:					**IEG**	**IEG**	**IEG**	**IEG**	**IEG**
Laboratory:					**ETL**				
Sample Date:									
Lab Reference No.:					**L335239-44**				
Total Organic Vapour	0-2000	ppm			3.8	4.1	1.1	2.4	2.3
PetroFlag Results	10-2000	ppm			668	430	290	190	128
Particle Size Analysis % > 75um	1	%			47	-	-	-	-
CCME F1-F4 Hydrocarbons									
Androstane		%			112	-	-	-	-
F1 (C6-C10)	5	mg/kg	30	310 (230[a])	<5	-	-	-	-
F2 (C10-C16)	5	mg/kg	150	760 (150[a])	**300**	-	-	-	-
F3 (C16-C34)	5	mg/kg	400	1700	280	-	-	-	-
F4 (C34-C50)	5	mg/kg	2800	3300	13	-	-	-	-
Total Hydrocarbons (C6-C50)	5	mg/kg	3380	5000	590	-	-	-	-
Chromatogram to baseline at nC50					YES				
% Moisture	0.1	%			14	-	-	-	-

nc: not calculated

-: Not analyzed

CCME: Canadian Council of Ministers of the Environment Canada-wide Standard (CWS) for Petroleum Hydrocarbons in Soil

ppm: parts per million

mg/kg: milligrams per kilogram

5 Concentration above CWS PHC

*: Standard for Coarse-grained soil

[a] Where applicable, for protection against contaminated groundwater discharge to an adjacent surface water body

Sample Location Sample ID:	D.L.	Units	CCME Residential Parkland*	CCME Commercial Industrial*	0N 0W	10S 0W	20S 0W	30S 0W	40S 0W
Collected By:					IEG	IEG	IEG	IEG	IEG
Laboratory:							ETL	ETL	ETL
Sample Date:									
Lab Reference No.:							L335239-27	L335239-45	L335239-46
Total Organic Vapour	0-2000	ppm			3.2	4.9	1.2	9.5	11.8
PetroFlag Results	10-2000	ppm			100	188	138	2660	678
Particle Size Analysis % > 75um	1	%			-	-	-	-	-
CCME F1-F4 Hydrocarbons									
Androstane		%			-	-	111	116	103
F1 (C6-C10)	5	mg/kg	30	310 (230[a])	-	-	<5	<5	11
F2 (C10-C16)	5	mg/kg	150	760 (150[a])	-	-	56	**1300**	110
F3 (C16-C34)	5	mg/kg	400	1700	-	-	54	**820**	90
F4 (C34-C50)	5	mg/kg	2800	3300	-	-	<5	21	<5
Total Hydrocarbons (C6-C50)	5	mg/kg	3380	5000	-	-	110	2100	210
Chromatogram to baseline at nC50							YES	YES	YES
% Moisture	0.1	%			-	-	14	12	16

nc: not calculated
-: Not analyzed
CCME: Canadian Council of Ministers of the Environment Canada-wide Standard (CWS) for Petroleum Hydrocarbons in Soil
ppm: parts per million
mg/kg: milligrams per kilogram
5 Concentration above CWS PHC
*: Standard for Coarse-grained soil
[a] Where applicable, for protection against contaminated groundwater discharge to an adjacent surface water body

Sample Location Sample ID:	D.L.	Units	CCME Residential Parkland*	CCME Commercial Industrial*	50S 0W	60S 0W	ON 10W	10S 10W	20S 10W
Collected By:					IEG	IEG	IEG	IEG	IEG
Laboratory:						ETL	ETL	ETL	ETL
Sample Date:									
Lab Reference No.:						L335239-47	L335239-17	L335239-23	L335239-28
Total Organic Vapour	0-2000	ppm			26.9	14.6	3.3	9.2	3
PetroFlag Results	10-2000	ppm			225	42	135	694	142
Particle Size Analysis % > 75um	1	%			-	-	-	-	-
CCME F1-F4 Hydrocarbons									
Androstane		%			-	146	112	135	110
F1 (C6-C10)	5	mg/kg	30	310 (230[a])	-	<5	<5	<5	<5
F2 (C10-C16)	5	mg/kg	150	760 (150[a])	-	41	33	**690**	48
F3 (C16-C34)	5	mg/kg	400	1700	-	35	75	**580**	68
F4 (C34-C50)	5	mg/kg	2800	3300	-	<5	18	<5	13
Total Hydrocarbons (C6-C50)	5	mg/kg	3380	5000	-	76	130	1300	130
Chromatogram to baseline at nC50						YES	NO	YES	YES
% Moisture	0.1	%			-	12	7.3	6.8	10

nc: not calculated
-: Not analyzed
CCME: Canadian Council of Ministers of the Environment Canada-wide Standard (CWS)
for Petroleum Hydrocarbons in Soil
ppm: parts per million
mg/kg: milligrams per kilogram

5 Concentration above CWS PHC

*: Standard for Coarse-grained soil
[a] Where applicable, for protection against contaminated groundwater discharge to an
adjacent surface water body

Sample Location Sample ID:	D.L.	Units	CCME Residential Parkland*	CCME Commercial Industrial*	ON 20W	10S 20W	20S 20W	ON 30W	10S 30W
Collected By:					IEG	IEG	IEG	IEG	IEG
Laboratory:					ETL	ETL	ETL	ETL	ETL
Sample Date:									
Lab Reference No.:					L335239-18	L335239-24	L335239-29	L335239-19	L335235-2
Total Organic Vapour	0-2000	ppm			4.9	50.8	9.4	1.2	83.3
PetroFlag Results	10-2000	ppm			1349	3480	1268	220	4640
Particle Size Analysis % > 75um	1	%			-	75	-	-	67
CCME F1-F4 Hydrocarbons									
Androstane		%			150	171	137	100	141
F1 (C6-C10)	5	mg/kg	30	310 (230[a])	<5	<5	**120**	<5	**73**
F2 (C10-C16)	5	mg/kg	150	760 (150[a])	**830**	**3100**	**850**	94	**4100**
F3 (C16-C34)	5	mg/kg	400	1700	**930**	**1400**	**1000**	200	**1500**
F4 (C34-C50)	5	mg/kg	2800	3300	32	20	17	8	15
Total Hydrocarbons (C6-C50)	5	mg/kg	3380	5000	1800	**4500**	2000	300	**5700**
Chromatogram to baseline at nC50					NO	NO	YES	YES	NO
% Moisture	0.1	%			10	10	18	6.6	11

nc: not calculated

-: Not analyzed

CCME: Canadian Council of Ministers of the Environment Canada-wide Standard (CWS) for Petroleum Hydrocarbons in Soil

ppm: parts per million

mg/kg: milligrams per kilogram

5	Concentration above CWS PHC

*: Standard for Coarse-grained soil

[a] Where applicable, for protection against contaminated groundwater discharge to an adjacent surface water body

Sample Location Sample ID:	D.L.	Units	CCME Residential Parkland*	CCME Commercial Industrial*	20S 30W	ON 40W	10S 40W	20S 40W	ON 50W
Collected By:					IEG	IEG	IEG	IEG	IEG
Laboratory:					ETL	ETL	ETL	ETL	ETL
Sample Date:									
Lab Reference No.:					L335239-30	L335239-20	L335239-25	L335239-31	L335239-21
Total Organic Vapour	0-2000	ppm			18.4	3.5	4.5	6.4	9.1
PetroFlag Results	10-2000	ppm			3072	490	810	102	1690
Particle Size Analysis % > 75um	1	%			-	-	-	-	76
CCME F1-F4 Hydrocarbons									
Androstane		%			135	109	144	98	177
F1 (C6-C10)	5	mg/kg	30	310 (230[a])	18	<5	<5	<5	<5
F2 (C10-C16)	5	mg/kg	150	760 (150[a])	**1800**	**220**	**710**	16	**1100**
F3 (C16-C34)	5	mg/kg	400	1700	**1300**	300	**640**	42	**1100**
F4 (C34-C50)	5	mg/kg	2800	3300	17	6	46	<5	57
Total Hydrocarbons (C6-C50)	5	mg/kg	3380	5000	3100	530	1400	58	2300
Chromatogram to baseline at nC50					YES	YES	NO	YES	NO
% Moisture	0.1	%			13	8.3	7.9	10	9.6

nc: not calculated

-: Not analyzed

CCME: Canadian Council of Ministers of the Environment Canada-wide Standard (CWS) for Petroleum Hydrocarbons in Soil

ppm: parts per million

mg/kg: milligrams per kilogram

5	Concentration above CWS PHC

*: Standard for Coarse-grained soil

[a] Where applicable, for protection against contaminated groundwater discharge to an adjacent surface water body

Sample Location Sample ID:	D.L.	Units	CCME Residential Parkland*	CCME Commercial Industrial*	10S 50W	20S 50W	ON 60W	10S 60W	20S 60W
Collected By:					IEG	IEG	IEG	IEG	IEG
Laboratory:					ETL		ETL		ETL
Sample Date:									
Lab Reference No.:					L335239-26		L335239-22		L335239-32
Total Organic Vapour	0-2000	ppm			3.3	2.9	4.0	2.1	1
PetroFlag Results	10-2000	ppm			150	52	124	38	64
Particle Size Analysis % > 75um	1	%			-	-	-	-	-
CCME F1-F4 Hydrocarbons									
Androstane		%			125	-	98	-	88
F1 (C6-C10)	5	mg/kg	30	310 (230[a])	<5	-	<5	-	<5
F2 (C10-C16)	5	mg/kg	150	760 (150[a])	60	-	66	-	<5
F3 (C16-C34)	5	mg/kg	400	1700	120	-	160	-	9
F4 (C34-C50)	5	mg/kg	2800	3300	45	-	14	-	6
Total Hydrocarbons (C6-C50)	5	mg/kg	3380	5000	230	-	240	-	15
Chromatogram to baseline at nC50					NO		NO		YES
% Moisture	0.1	%			8.2	-	10	-	3.7

nc: not calculated

-: Not analyzed

CCME: Canadian Council of Ministers of the Environment Canada-wide Standard (CWS) for Petroleum Hydrocarbons in Soil

ppm: parts per million

mg/kg: milligrams per kilogram

5 Concentration above CWS PHC

*: Standard for Coarse-grained soil

[a] Where applicable, for protection against contaminated groundwater discharge to an adjacent surface water body

Sample Location Sample ID: Collected By: Laboratory: Sample Date: Lab Reference No.:	D.L.	Units	CCME Residential Parkland*	CCME Commercial Industrial*	0N 70W IEG	10S 70W IEG	20S 70W IEG ETL L335239-33	10S 80W IEG	20S 80W IEG
Total Organic Vapour	0-2000	ppm			2.6	3.4	1.5	1.9	2.0
PetroFlag Results	10-2000	ppm			149	98	236	216	0
Particle Size Analysis % > 75um	1	%			-	-	-	-	-
CCME F1-F4 Hydrocarbons									
Androstane		%			-	-	81	-	-
F1 (C6-C10)	5	mg/kg	30	310 (230[a])	-	-	<5	-	-
F2 (C10-C16)	5	mg/kg	150	760 (150[a])	-	-	<5	-	-
F3 (C16-C34)	5	mg/kg	400	1700	-	-	9	-	-
F4 (C34-C50)	5	mg/kg	2800	3300	-	-	<5	-	-
Total Hydrocarbons (C6-C50)	5	mg/kg	3380	5000	-	-	9	-	-
Chromatogram to baseline at nC50							YES		
% Moisture	0.1	%			-	-	6.0	-	-

nc: not calculated

-: Not analyzed

CCME: Canadian Council of Ministers of the Environment Canada-wide Standard (CWS) for Petroleum Hydrocarbons in Soil

ppm: parts per million

mg/kg: milligrams per kilogram

5 Concentration above CWS PHC

*: Standard for Coarse-grained soil

[a] Where applicable, for protection against contaminated groundwater discharge to an adjacent surface water body

Sample Location Sample ID:	D.L.	Units	CCME Residential Parkland*	CCME Commercial Industrial*	30S 80W	40S 80W	50S 80W	60S 80W	70S 80W
Collected By:					IEG	IEG	IEG	IEG	IEG
Laboratory:					ETL	ETL	ETL		
Sample Date:									
Lab Reference No.:					L335239-34	L335239-35	L335239-36		
Total Organic Vapour	0-2000	ppm			3.2	1.5	3.0	0.1	0.6
PetroFlag Results	10-2000	ppm			94	58	0	28	0
Particle Size Analysis % > 75um	1	%			-	-	-	-	-
CCME F1-F4 Hydrocarbons									
Androstane		%			74	79	91	-	-
F1 (C6-C10)	5	mg/kg	30	310 (230[a])	<5	<5	<5	-	-
F2 (C10-C16)	5	mg/kg	150	760 (150[a])	<5	<5	<5	-	-
F3 (C16-C34)	5	mg/kg	400	1700	23	27	12	-	-
F4 (C34-C50)	5	mg/kg	2800	3300	<5	<5	<5	-	-
Total Hydrocarbons (C6-C50)	5	mg/kg	3380	5000	23	27	12	-	-
Chromatogram to baseline at nC50					YES	YES	YES		
% Moisture	0.1	%			7.7	4.8	7.2	-	-

nc: not calculated
-: Not analyzed
CCME: Canadian Council of Ministers of the Environment Canada-wide Standard (CWS)
for Petroleum Hydrocarbons in Soil
ppm: parts per million
mg/kg: milligrams per kilogram
5 Concentration above CWS PHC
*: Standard for Coarse-grained soil
[a] Where applicable, for protection against contaminated groundwater discharge to an
adjacent surface water body

Sample Location Sample ID: Collected By: Laboratory: Sample Date: Lab Reference No.:	D.L.	Units	CCME Residential Parkland*	CCME Commercial Industrial*	80S 80W IEG	90S 80W IEG	100S 80W IEG	110S 80W IEG	120S 80W IEG
Total Organic Vapour	0-2000	ppm			0.5	0.5	1.8	1.7	0.8
PetroFlag Results	10-2000	ppm			32	348	258	61	10
Particle Size Analysis % > 75um	1	%			-	-	-	-	-
CCME F1-F4 Hydrocarbons									
Androstane		%			-	-	-	-	-
F1 (C6-C10)	5	mg/kg	30	310 (230[a])	-	-	-	-	-
F2 (C10-C16)	5	mg/kg	150	760 (150[a])	-	-	-	-	-
F3 (C16-C34)	5	mg/kg	400	1700	-	-	-	-	-
F4 (C34-C50)	5	mg/kg	2800	3300	-	-	-	-	-
Total Hydrocarbons (C6-C50)	5	mg/kg	3380	5000	-	-	-	-	-
Chromatogram to baseline at nC50									
% Moisture	0.1	%			-	-	-	-	-

nc: not calculated
-: Not analyzed
CCME: Canadian Council of Ministers of the Environment Canada-wide Standard (CWS)
for Petroleum Hydrocarbons in Soil
ppm: parts per million
mg/kg: milligrams per kilogram

5	Concentration above CWS PHC

*: Standard for Coarse-grained soil
[a] Where applicable, for protection against contaminated groundwater discharge to an adjacent surface water body

Sample Location Sample ID: Collected By: Laboratory: Sample Date: Lab Reference No.:	D.L.	Units	CCME Residential Parkland*	CCME Commercial Industrial*	10S 90W IEG	20S 90W IEG	30S 90W IEG	40S 90W IEG	50S 90W IEG
Total Organic Vapour	0-2000	ppm			1.3	0.9	2.2	1.9	2
PetroFlag Results	10-2000	ppm			162	152	63	12	184
Particle Size Analysis % > 75um	1	%			-	-	-	-	-
CCME F1-F4 Hydrocarbons									
Androstane		%			-	-	-	-	-
F1 (C6-C10)	5	mg/kg	30	310 (230[a])	-	-	-	-	-
F2 (C10-C16)	5	mg/kg	150	760 (150[a])	-	-	-	-	-
F3 (C16-C34)	5	mg/kg	400	1700	-	-	-	-	-
F4 (C34-C50)	5	mg/kg	2800	3300	-	-	-	-	-
Total Hydrocarbons (C6-C50)	5	mg/kg	3380	5000	-	-	-	-	-
Chromatogram to baseline at nC50									
% Moisture	0.1	%			-	-	-	-	-

nc: not calculated
-: Not analyzed
CCME: Canadian Council of Ministers of the Environment Canada-wide Standard (CWS)
for Petroleum Hydrocarbons in Soil
ppm: parts per million
mg/kg: milligrams per kilogram

5	Concentration above CWS PHC

*: Standard for Coarse-grained soil
[a] Where applicable, for protection against contaminated groundwater discharge to an
adjacent surface water body

Sample Location Sample ID:	D.L.	Units	CCME Residential Parkland*	CCME Commercial Industrial*	60S 90W	70S 90W	80S 90W	90S 90W	100S 90W
Collected By:					IEG	IEG	IEG	IEG	IEG
Laboratory:								ETL	ETL
Sample Date:									
Lab Reference No.:								L335239-37	L335239-38
Total Organic Vapour	0-2000	ppm			1.9	0.9	1.4	4.2	4.2
PetroFlag Results	10-2000	ppm			256	46	262	32	1136
Particle Size Analysis % > 75um	1	%			-	-	-	-	-
CCME F1-F4 Hydrocarbons									
Androstane		%			-	-	-	92	98
F1 (C6-C10)	5	mg/kg	30	310 (230[a])	-	-	-	<5	<5
F2 (C10-C16)	5	mg/kg	150	760 (150[a])	-	-	-	10	19
F3 (C16-C34)	5	mg/kg	400	1700	-	-	-	130	390
F4 (C34-C50)	5	mg/kg	2800	3300	-	-	-	29	59
Total Hydrocarbons (C6-C50)	5	mg/kg	3380	5000	-	-	-	170	470
Chromatogram to baseline at nC50								NO	NO
% Moisture	0.1	%			-	-	-	5.9	5.7

nc: not calculated

-: Not analyzed

CCME: Canadian Council of Ministers of the Environment Canada-wide Standard (CWS) for Petroleum Hydrocarbons in Soil

ppm: parts per million

mg/kg: milligrams per kilogram

5 Concentration above CWS PHC

*: Standard for Coarse-grained soil

[a] Where applicable, for protection against contaminated groundwater discharge to an adjacent surface water body

Sample Location Sample ID:	D.L.	Units	CCME Residential Parkland*	CCME Commercial Industrial*	110S 90W	20S 100 W	30S 100W	40S 100W	50S 100W
Collected By:					IEG	IEG	IEG	IEG	IEG
Laboratory:					ETL				
Sample Date:									
Lab Reference No.:					L335239-39				
Total Organic Vapour	0-2000	ppm			0.0	13.7	3.5	4.1	6.2
PetroFlag Results	10-2000	ppm			134	80	112	184	180
Particle Size Analysis % > 75um	1	%			-	-	-	-	-
CCME F1-F4 Hydrocarbons									
Androstane		%			85	-	-	-	-
F1 (C6-C10)	5	mg/kg	30	310 (230[a])	<5	-	-	-	-
F2 (C10-C16)	5	mg/kg	150	760 (150[a])	<5	-	-	-	-
F3 (C16-C34)	5	mg/kg	400	1700	26	-	-	-	-
F4 (C34-C50)	5	mg/kg	2800	3300	7	-	-	-	-
Total Hydrocarbons (C6-C50)	5	mg/kg	3380	5000	33	-	-	-	-
Chromatogram to baseline at nC50					YES				
% Moisture	0.1	%			4.3	-	-	-	-

nc: not calculated

-: Not analyzed

CCME: Canadian Council of Ministers of the Environment Canada-wide Standard (CWS) for Petroleum Hydrocarbons in Soil

ppm: parts per million

mg/kg: milligrams per kilogram

5 Concentration above CWS PHC

*: Standard for Coarse-grained soil

[a] Where applicable, for protection against contaminated groundwater discharge to an adjacent surface water body

Sample Location Sample ID:	D.L.	Units	CCME Residential Parkland*	CCME Commercial Industrial*	60S 100W	70S 100W	80S 100W	90S 100W	100S 100W
Collected By:					IEG	IEG	IEG	IEG	IEG
Laboratory:						ETL	ETL	ETL	
Sample Date:									
Lab Reference No.:						L335239-40	L335239-41	L335239-42	
Total Organic Vapour	0-2000	ppm			5.3	6.5	30.1	2.5	4.9
PetroFlag Results	10-2000	ppm			182	122	2924	428	142
Particle Size Analysis % > 75um	1	%			-	-	65	-	-
CCME F1-F4 Hydrocarbons									
Androstane		%			-	81	145	81	-
F1 (C6-C10)	5	mg/kg	30	310 (230[a])	-	<5	**87**	<5	-
F2 (C10-C16)	5	mg/kg	150	760 (150[a])	-	17	**2500**	98	-
F3 (C16-C34)	5	mg/kg	400	1700	-	38	**1700**	110	-
F4 (C34-C50)	5	mg/kg	2800	3300	-	<5	60	24	-
Total Hydrocarbons (C6-C50)	5	mg/kg	3380	5000	-	55	**4300**	230	-
Chromatogram to baseline at nC50						YES	NO	NO	
% Moisture	0.1	%			-	13	25	15	-

nc: not calculated
-: Not analyzed
CCME: Canadian Council of Ministers of the Environment Canada-wide Standard (CWS)
for Petroleum Hydrocarbons in Soil
ppm: parts per million
mg/kg: milligrams per kilogram

5 Concentration above CWS PHC

*: Standard for Coarse-grained soil
[a] Where applicable, for protection against contaminated groundwater discharge to an adjacent surface water body

Sample Location Sample ID:	D.L.	Units	CCME Residential Parkland*	CCME Commercial Industrial*	110S 100W	TFNE	TFSW	BERM1 (N)	BERM2 (S)
Collected By:					**IEG**	**IEG**	**IEG**	**IEG**	**IEG**
Laboratory:						**ETL**	**ETL**	**ETL**	**ETL**
Sample Date:									
Lab Reference No.:						**L335235-1**	**L335239-51**	**L335239-52**	**L335239-53**
Total Organic Vapour	0-2000	ppm			1.2	27.4	1.2	0.0	6.0
PetroFlag Results	10-2000	ppm			164	5148	755	342	
Particle Size Analysis % > 75um	1	%			-	67	-	-	70
CCME F1-F4 Hydrocarbons									
Androstane		%			-	222	100	101	
F1 (C6-C10)	5	mg/kg	30	310 (230[a])	-	**140**	<5	<5	<5
F2 (C10-C16)	5	mg/kg	150	760 (150[a])	-	**5700**	**180**	**290**	77
F3 (C16-C34)	5	mg/kg	400	1700	-	**2000**	310	59	**24000**
F4 (C34-C50)	5	mg/kg	2800	3300	-	13	14	6	**11000**
Total Hydrocarbons (C6-C50)	5	mg/kg	3380	5000	-	**7900**	500	360	**35000**
Chromatogram to baseline at nC50						NO	YES	YES	NO
% Moisture	0.1	%			-	15	15	5.6	7.4

nc: not calculated

-: Not analyzed

CCME: Canadian Council of Ministers of the Environment Canada-wide Standard (CWS) for Petroleum Hydrocarbons in Soil

ppm: parts per million

mg/kg: milligrams per kilogram

5 Concentration above CWS PHC

*: Standard for Coarse-grained soil

[a] Where applicable, for protection against contaminated groundwater discharge to an adjacent surface water body

Appendix E.6

Table 6 – Analytical Results – Soil Samples (Geophysical Anomalies)

Sample Location Sample ID:	D.L.	Units	CCME Residential Parkland*	CCME Commercial Indistrial*	SSA1	SSA2
Collected By:					IEG	IEG
Laboratory:					ETL	ETL
Sample Date:					5-Oct-05	5-Oct-05
Lab Reference No.:					L335239-1	L335239-2
Total Organic Vapour	0-2000	ppm			6.1	6
PetroFlag Results	10-2000	ppm			296	122
CCME F1-F4 Hydrocarbons						
Androstane		%			101	101
F1 (C6-C10)	5	mg/kg	30	310 (230[a])	<5	<5
F2 (C10-C16)	5	mg/kg	150	760 (150[a])	37	9
F3 (C16-C34)	5	mg/kg	400	1700	74	61
F4 (C34-C50)	5	mg/kg	2800	3300	6	40
Total Hydrocarbons (C6-C50)	5	mg/kg	3380	5000	120	110
Chromatogram to baseline at nC50					YES	NO
% Moisture	0.1	%			19	14
CCME Metals						
Silver (Ag)	1	mg/kg	20	40	<1	<1
Arsenic (As)	0.2	mg/kg	12	12	3.5	3.7
Barium (Ba)	5	mg/kg	500	2000	41	46
Beryllium (Be)	1	mg/kg	4	8	<1	<1
Cadmium (Cd)	0.5	mg/kg	10	22	<0.5	<0.5
Cobalt (Co)	1	mg/kg	50	300	4	4
Chromium (Cr)	0.5	mg/kg	64	87	24.1	25.6
Copper (Cu)	2	mg/kg	63	91	16	13
Mercury (Hg)	0.05	mg/kg	6.6	24	0.09	0.08
Molybdenum (Mo)	1	mg/kg	10	40	4	5
Nickel (Ni)	2	mg/kg	50	50	9	9
Lead (Pb)	5	mg/kg	140	260 (600)	20	14
Antimony (Sb)	0.2	mg/kg	20	20	<0.2	<0.2
Selenium (Se)	0.2	mg/kg	1	3.9	<0.2	<0.2
Tin (Sn)	5	mg/kg	50	300	<5	<5
Thallium (Tl)	1	mg/kg	1	1	<1	<1
Uranium (U)	40	mg/kg			<40	<40
Vanadium (V)	1	mg/kg	130	130	23	27
Zinc (Zn)	10	mg/kg	200	360	30	20

nc: not calculated

-: Not analyzed

CCME: Canadian Council of Ministers of the Environment Canada-wide Standard (CWS) for Petroleum Hydrocarbons in Soil

ppm: parts per million

mg/kg: milligrams per kilogram

5	Concentration above CWS PHC

*: Standard for Coarse-grained soil

[a] Where applicable, for protection against contaminated groundwater discharge to an adjacent surface water body

Sample Location Sample ID:	D.L.	Units	CCME Residential Parkland*	CCME Commercial Indistrial*	SSB1	SSB2
Collected By:					IEG	IEG
Laboratory:					ETL	ETL
Sample Date:					5-Oct-05	5-Oct-05
Lab Reference No.:					L335239-3	L335239-4
Total Organic Vapour	0-2000	ppm			5.7	3.9
PetroFlag Results	10-2000	ppm			428	174
CCME F1-F4 Hydrocarbons						
Androstane		%			110	94
F1 (C6-C10)	5	mg/kg	30	310 (230[a])	<5	<5
F2 (C10-C16)	5	mg/kg	150	760 (150[a])	8	<5
F3 (C16-C34)	5	mg/kg	400	1700	100	6
F4 (C34-C50)	5	mg/kg	2800	3300	76	<5
Total Hydrocarbons (C6-C50)	5	mg/kg	3380	5000	180	6
Chromatogram to baseline at nC50					NO	YES
% Moisture	0.1	%			15	22
CCME Metals						
Silver (Ag)	1	mg/kg	20	40	<1	<1
Arsenic (As)	0.2	mg/kg	12	12	3.1	3.6
Barium (Ba)	5	mg/kg	500	2000	90	87
Beryllium (Be)	1	mg/kg	4	8	<1	<1
Cadmium (Cd)	0.5	mg/kg	10	22	<0.5	<0.5
Cobalt (Co)	1	mg/kg	50	300	4	5
Chromium (Cr)	0.5	mg/kg	64	87	21	22.4
Copper (Cu)	2	mg/kg	63	91	10	11
Mercury (Hg)	0.05	mg/kg	6.6	24	0.06	0.06
Molybdenum (Mo)	1	mg/kg	10	40	3	3
Nickel (Ni)	2	mg/kg	50	50	8	10
Lead (Pb)	5	mg/kg	140	260 (600)	<5	6
Antimony (Sb)	0.2	mg/kg	20	20	<0.2	<0.2
Selenium (Se)	0.2	mg/kg	1	3.9	<0.2	<0.2
Tin (Sn)	5	mg/kg	50	300	<5	<5
Thallium (Tl)	1	mg/kg	1	1	<1	<1
Uranium (U)	40	mg/kg			<40	<40
Vanadium (V)	1	mg/kg	130	130	22	25
Zinc (Zn)	10	mg/kg	200	360	20	20

nc: not calculated
-: Not analyzed
CCME: Canadian Council of Ministers of the Environment Canada-wide Standard (CWS)
for Petroleum Hydrocarbons in Soil
ppm: parts per million
mg/kg: milligrams per kilogram

5	Concentration above CWS PHC

*: Standard for Coarse-grained soil
[a] Where applicable, for protection against contaminated groundwater discharge to an adjacent surface water body

Sample Location Sample ID:	D.L.	Units	CCME Residential Parkland*	CCME Commercial Indistrial*	SSB3	SSC1
Collected By:					IEG	IEG
Laboratory:					ETL	ETL
Sample Date:					5-Oct-05	5-Oct-05
Lab Reference No.:					L335239-5	L335239-6
Total Organic Vapour	0-2000	ppm			2.5	5.6
PetroFlag Results	10-2000	ppm			246	94
CCME F1-F4 Hydrocarbons						
Androstane		%			94	93
F1 (C6-C10)	5	mg/kg	30	310 (230[a])	<5	<5
F2 (C10-C16)	5	mg/kg	150	760 (150[a])	<5	<5
F3 (C16-C34)	5	mg/kg	400	1700	11	6
F4 (C34-C50)	5	mg/kg	2800	3300	<5	<5
Total Hydrocarbons (C6-C50)	5	mg/kg	3380	5000	11	6
Chromatogram to baseline at nC50					YES	YES
% Moisture	0.1	%			20	18
CCME Metals						
Silver (Ag)	1	mg/kg	20	40	<1	<1
Arsenic (As)	0.2	mg/kg	12	12	2.9	2.7
Barium (Ba)	5	mg/kg	500	2000	48	273
Beryllium (Be)	1	mg/kg	4	8	<1	<1
Cadmium (Cd)	0.5	mg/kg	10	22	<0.5	<0.5
Cobalt (Co)	1	mg/kg	50	300	5	3
Chromium (Cr)	0.5	mg/kg	64	87	8.8	24.8
Copper (Cu)	2	mg/kg	63	91	8	9
Mercury (Hg)	0.05	mg/kg	6.6	24	<0.05	0.05
Molybdenum (Mo)	1	mg/kg	10	40	<1	5
Nickel (Ni)	2	mg/kg	50	50	8	8
Lead (Pb)	5	mg/kg	140	260 (600)	<5	<5
Antimony (Sb)	0.2	mg/kg	20	20	<0.2	<0.2
Selenium (Se)	0.2	mg/kg	1	3.9	<0.2	<0.2
Tin (Sn)	5	mg/kg	50	300	<5	<5
Thallium (Tl)	1	mg/kg	1	1	<1	<1
Uranium (U)	40	mg/kg			<40	<40
Vanadium (V)	1	mg/kg	130	130	21	19
Zinc (Zn)	10	mg/kg	200	360	20	20

nc: not calculated
-: Not analyzed
CCME: Canadian Council of Ministers of the Environment Canada-wide Standard (CWS)
for Petroleum Hydrocarbons in Soil
ppm: parts per million
mg/kg: milligrams per kilogram

5	Concentration above CWS PHC

*: Standard for Coarse-grained soil
[a] Where applicable, for protection against contaminated groundwater discharge to an adjacent surface water body

Sample Location Sample ID:	D.L.	Units	CCME Residential Parkland*	CCME Commercial Indistrial*	SSC2	SSC3
Collected By:					IEG	IEG
Laboratory:					ETL	ETL
Sample Date:					5-Oct-05	5-Oct-05
Lab Reference No.:					L335239-7	L335239-8
Total Organic Vapour	0-2000	ppm			5.4	2.6
PetroFlag Results	10-2000	ppm			234	18
CCME F1-F4 Hydrocarbons						
Androstane		%			98	98
F1 (C6-C10)	5	mg/kg	30	310 (230[a])	<5	<5
F2 (C10-C16)	5	mg/kg	150	760 (150[a])	<5	41
F3 (C16-C34)	5	mg/kg	400	1700	<5	85
F4 (C34-C50)	5	mg/kg	2800	3300	<5	<5
Total Hydrocarbons (C6-C50)	5	mg/kg	3380	5000	<5	130
Chromatogram to baseline at nC50					YES	YES
% Moisture	0.1	%			19	17
CCME Metals						
Silver (Ag)	1	mg/kg	20	40	<1	<1
Arsenic (As)	0.2	mg/kg	12	12	2.6	2.9
Barium (Ba)	5	mg/kg	500	2000	75	67
Beryllium (Be)	1	mg/kg	4	8	<1	<1
Cadmium (Cd)	0.5	mg/kg	10	22	<0.5	<0.5
Cobalt (Co)	1	mg/kg	50	300	4	4
Chromium (Cr)	0.5	mg/kg	64	87	27.9	7.1
Copper (Cu)	2	mg/kg	63	91	10	7
Mercury (Hg)	0.05	mg/kg	6.6	24	<0.05	0.07
Molybdenum (Mo)	1	mg/kg	10	40	5	<1
Nickel (Ni)	2	mg/kg	50	50	9	7
Lead (Pb)	5	mg/kg	140	260 (600)	<5	<5
Antimony (Sb)	0.2	mg/kg	20	20	<0.2	<0.2
Selenium (Se)	0.2	mg/kg	1	3.9	<0.2	<0.2
Tin (Sn)	5	mg/kg	50	300	<5	<5
Thallium (Tl)	1	mg/kg	1	1	<1	<1
Uranium (U)	40	mg/kg			<40	<40
Vanadium (V)	1	mg/kg	130	130	20	17
Zinc (Zn)	10	mg/kg	200	360	20	20

nc: not calculated
-: Not analyzed
CCME: Canadian Council of Ministers of the Environment Canada-wide Standard (CWS) for Petroleum Hydrocarbons in Soil
ppm: parts per million
mg/kg: milligrams per kilogram

5	Concentration above CWS PHC

*: Standard for Coarse-grained soil
[a] Where applicable, for protection against contaminated groundwater discharge to an adjacent surface water body

Sample Location Sample ID:	D.L.	Units	CCME Residential Parkland*	CCME Commercial Indistrial*	SSD1	SSD2
Collected By:					IEG	IEG
Laboratory:					ETL	ETL
Sample Date:					5-Oct-05	5-Oct-05
Lab Reference No.:					L335239-9	L335239-10
Total Organic Vapour	0-2000	ppm			4.9	4
PetroFlag Results	10-2000	ppm			0	0
CCME F1-F4 Hydrocarbons						
Androstane		%			103	106
F1 (C6-C10)	5	mg/kg	30	310 (230[a])	<5	<5
F2 (C10-C16)	5	mg/kg	150	760 (150[a])	<5	<5
F3 (C16-C34)	5	mg/kg	400	1700	<5	26
F4 (C34-C50)	5	mg/kg	2800	3300	<5	9
Total Hydrocarbons (C6-C50)	5	mg/kg	3380	5000	<5	35
Chromatogram to baseline at nC50					YES	YES
% Moisture	0.1	%			15	12
CCME Metals						
Silver (Ag)	1	mg/kg	20	40	<1	<1
Arsenic (As)	0.2	mg/kg	12	12	2.1	2
Barium (Ba)	5	mg/kg	500	2000	43	47
Beryllium (Be)	1	mg/kg	4	8	<1	<1
Cadmium (Cd)	0.5	mg/kg	10	22	<0.5	<0.5
Cobalt (Co)	1	mg/kg	50	300	2	3
Chromium (Cr)	0.5	mg/kg	64	87	19	8
Copper (Cu)	2	mg/kg	63	91	8	9
Mercury (Hg)	0.05	mg/kg	6.6	24	0.06	<0.05
Molybdenum (Mo)	1	mg/kg	10	40	4	1
Nickel (Ni)	2	mg/kg	50	50	6	5
Lead (Pb)	5	mg/kg	140	260 (600)	<5	<5
Antimony (Sb)	0.2	mg/kg	20	20	<0.2	<0.2
Selenium (Se)	0.2	mg/kg	1	3.9	<0.2	<0.2
Tin (Sn)	5	mg/kg	50	300	<5	<5
Thallium (Tl)	1	mg/kg	1	1	<1	<1
Uranium (U)	40	mg/kg			<40	<40
Vanadium (V)	1	mg/kg	130	130	15	14
Zinc (Zn)	10	mg/kg	200	360	10	10

nc: not calculated
-: Not analyzed
CCME: Canadian Council of Ministers of the Environment Canada-wide Standard (CWS)
for Petroleum Hydrocarbons in Soil
ppm: parts per million
mg/kg: milligrams per kilogram

5 Concentration above CWS PHC

*: Standard for Coarse-grained soil
[a] Where applicable, for protection against contaminated groundwater discharge to an adjacent surface water body

Appendix E.7

Table 7 – Analytical Results – Sediment Samples

Sample Location						
Sample ID:	**D.L.**	**Units**	**Freshwater Sediment ISQG**	**SUMP1**	**SUMP2**	**LAKE**
Collected By:				**IEG**	**IEG**	**IEG**
Laboratory:				**ETL**	**ETL**	**ETL**
Lab Reference No.:				**L335239-12**	**L335239-14**	**L335239-16**
BTEX						
Benzene	0.005	mg/kg		<0.005	<0.005	<0.005
Toluene	0.01	mg/kg		<0.01	<0.01	<0.01
Ethylbenzene	0.01	mg/kg		<0.01	<0.01	<0.01
Xylenes	0.01	mg/kg		<0.01	<0.01	<0.01
CCME F1-F4 Hydrocarbons						
Androstane		%		123	120	103
F1 (C6-C10)	5	mg/kg		<5	<5	<5
F1-BTEX	5	mg/kg		<5	<5	<5
F2 (C10-C16)	5	mg/kg		29	6	<5
F3 (C16-C34)	5	mg/kg		300	260	140
F4 (C34-C50)	5	mg/kg		40	44	110
Total Hydrocarbons (C6-C50)	5	mg/kg		370	310	250
Chromatogram to baseline at nC50				NO	NO	NO
% Moisture	0.1	%		15	16	22
CCME Metals						
Silver (Ag)	1	mg/kg		<1	<1	<1
Arsenic (As)	0.2	mg/kg	5.9	2.4	2.7	6.3
Barium (Ba)	5	mg/kg		50	49	60
Beryllium (Be)	1	mg/kg		<1	<1	<1
Cadmium (Cd)	0.5	mg/kg	0.6	<0.5	<0.5	<0.5
Cobalt (Co)	1	mg/kg		3	4	7
Chromium (Cr)	0.5	mg/kg	37.3	17.5	28.6	14.9
Copper (Cu)	2	mg/kg	35.7	9	11	15
Mercury (Hg)	0.05	mg/kg	0.17	<0.05	0.08	<0.05
Molybdenum (Mo)	1	mg/kg		3	8	1
Nickel (Ni)	2	mg/kg		7	12	15
Lead (Pb)	5	mg/kg	35	<5	<5	8
Antimony (Sb)	0.2	mg/kg		<0.2	<0.2	<0.2
Selenium (Se)	0.2	mg/kg		<0.2	<0.2	0.2
Tin (Sn)	5	mg/kg		<5	<5	<5
Thallium (Tl)	1	mg/kg		<1	<1	<1
Uranium (U)	40	mg/kg		<40	<40	<40
Vanadium (V)	1	mg/kg		21	19	28
Zinc (Zn)	10	mg/kg	123	20	20	40
CCME PCB's						
Aroclor 1016	0.01	mg/kg		<0.01	<0.01	<0.01
Aroclor 1221	0.01	mg/kg		<0.01	<0.01	<0.01
Aroclor 1232	0.01	mg/kg		<0.01	<0.01	<0.01
Aroclor 1242	0.01	mg/kg		<0.01	<0.01	<0.01
Aroclor 1248	0.01	mg/kg		<0.01	<0.01	<0.01
Aroclor 1254	0.01	mg/kg	0.06[a]	<0.01	<0.01	<0.01
Aroclor 1260	0.01	mg/kg		<0.01	<0.01	<0.01
Aroclor 1262	0.01	mg/kg		<0.01	<0.01	<0.01
Aroclor 1268	0.01	mg/kg		<0.01	<0.01	<0.01
Total PCBs	0.05	mg/kg	0.0341	<0.05	<0.05	<0.05
Decachlorobiphenyl		%		78	79	79

nc: not calculated

-: Not analyzed

CCME: Canadian Council of Ministers of the Environment Interim Sediment Quality Guidelines for Freshwater Sediment

ppm: parts per million

mg/kg: milligrams per kilogram

5	Concentration above ISQG
5 (shaded)	Detection Limit above ISQG

[a] Sediment quality guideline for Aroclor 1254: Provisional; 1% TOC; adoption of the severe effect level of 34ug/g TOC from Ontario (Persaud et al. 1993).

Appendix E.8

Table 8 – Analytical Results – Surface Water Samples

Sample Location							
Sample ID:	D.L.	Units	CCME EQG Aquatic Life		SUMP1	SUMP2	LAKE
			Freshwater	Marine			
Collected By:					IEG	IEG	IEG
Laboratory:					ETL	ETL	ETL
Lab Reference No.:					L335239-11	L335239-13	L335239-15
BTEX							
Benzene	0.0005	mg/L	0.370	0.110	<0.0005	<0.0005	<0.0005
Toluene	0.0005	mg/L	0.002	0.215	<0.0005	<0.0005	<0.0005
EthylBenzene	0.0005	mg/L	0.090	0.025	<0.0005	<0.0005	<0.0005
Xylenes	0.0005	mg/L			<0.0005	<0.0005	<0.0005
CCME F1-F4 Hydrocarbons							
F1(C6-C10)	0.1	mg/L			<0.1	<0.1	<0.1
F1-BTEX	0.1	mg/L			<0.1	<0.1	<0.1
F2 (>C10-C16)	0.05	mg/L			<0.05	<0.05	<0.05
F3 (C16-C34)	0.05	mg/L			<0.05	<0.05	<0.05
F4 (C34-C50)	0.05	mg/L			<0.05	<0.05	<0.05
Routine Water Analysis							
Chloride (Cl)	1	mg/L			134	118	949
Calcium (Ca)	0.5	mg/L			41.7	54.2	261
Potassium (K)	0.5	mg/L			3.3	3.7	16.6
Magnesium (Mg)	0.1	mg/L			36.0	48.1	181
Sodium (Na)	1	mg/L			129	133	379
Sulfate (SO4)	0.5	mg/L			49.8	86.2	232
Ion Balance		%			99.4	102	99.3
TDS (Calculated)		mg/L			573	658	2430
Hardness (as CaCO3)		mg/L			252	333	1400
Nitrate+Nitrite-N	0.1	mg/L			<0.1	0.2	0.2
Nitrate-N	0.1	mg/L	13.0[a]	16.0[a]	<0.1	0.2	0.2
Nitrite-N	0.05	mg/L	0.060[b]		<0.05	<0.05	<0.05
pH	0.1	pH	6.5-9.0[c]	7.8-8.7[c]	8.5	8.4	8.0
Conductivity (EC)	0.2	uS/cm			1000	1090	3720
Bicarbonate (HCO3)	5	mg/L			347	419	827
Carbonate (CO3)	5	mg/L			9	8	<5
Hydroxide (OH)	5	mg/L			<5	<5	<5
Alkalinity, Total (as CaCO3)	5	mg/L			299	357	678
Total Major Metals							
Calcium (Ca)	0.5	mg/L			41.1	51.5	247
Potassium (K)	0.1	mg/L			3.4	3.2	15.6
Magnesium (Mg)	0.1	mg/L			32.6	43.6	165
Sodium (Na)	1	mg/L			118	122	364
Iron (Fe)	0.005	mg/L			0.250	0.338	0.104
Manganese (Mn)	0.001	mg/L	0.300[b]		0.006	0.007	0.004
Total Trace Metals							
Silver (Ag)	0.0004	mg/L	0.0001[b]		<0.0004	<0.0004	<0.0004
Aluminum (Al)	0.01	mg/L	0.005-0.100		0.22	0.18	0.06
Arsenic (As)	0.0004	mg/L	0.005	0.0125	0.0017	0.0017	0.0069
Boron (B)	0.05	mg/L			0.16	0.10	0.23
Barium (Ba)	0.003	mg/L			0.111	0.104	0.497
Beryllium (Be)	0.001	mg/L			<0.001	<0.001	<0.001
Cadmium (Cd)	0.0002	mg/L	0.000017	0.00012	<0.0002	<0.0002	<0.0002
Cobalt (Co)	0.002	mg/L			<0.002	<0.002	<0.002
Chromium (Cr)	0.005	mg/L			<0.005	<0.005	0.005
Copper (Cu)	0.001	mg/L	0.002-0.004[b]		0.006	0.007	0.008
Mercury (Hg)	0.0002	mg/L	0.000026[d]	0.000016d	<0.0002	<0.0002	<0.0002

Sample Location Sample ID:	D.L.	Units	CCME EQG Aquatic Life Freshwater	 Marine	SUMP1	SUMP2	LAKE
Collected By:					IEG	IEG	IEG
Laboratory:					ETL	ETL	ETL
Lab Reference No.:					L335239-11	L335239-13	L335239-15
Lithium (Li)	0.01	mg/L			<0.01	<0.01	0.03
Molybdenum (Mo)	0.005	mg/L	0.073		<0.005	<0.005	<0.005
Nickel (Ni)	0.002	mg/L	0.025-0.150[b]		0.002	0.003	0.004
Lead (Pb)	0.0001	mg/L	0.001-0.007[b]		0.0009	0.0009	0.0003
Antimony (Sb)	0.0004	mg/L			<0.0004	0.0006	0.0008
Selenium (Se)	0.0004	mg/L	0.001[b]		0.0004	0.0005	0.0020
Tin (Sn)	0.05	mg/L			<0.05	<0.05	<0.05
Titanium (Ti)	0.001	mg/L			0.004	0.004	0.002
Thallium (Tl)	0.0001	mg/L	0.0008		<0.0001	<0.0001	<0.0001
Uranium (U)	0.0001	mg/L			0.0014	0.0025	0.0020
Vanadium (V)	0.001	mg/L			<0.001	<0.001	<0.001
Zinc (Zn)	0.004	mg/L	0.030		0.010	0.007	0.011
CCME PCB's							
Aroclor 1016	0.00005	mg/L			<0.00005	<0.00005	<0.00005
Aroclor 1221	0.00005	mg/L			<0.00005	<0.00005	<0.00005
Aroclor 1232	0.00005	mg/L			<0.00005	<0.00005	<0.00005
Aroclor 1242	0.00005	mg/L			<0.00005	<0.00005	<0.00005
Aroclor 1248	0.00005	mg/L			<0.00005	<0.00005	<0.00005
Aroclor 1254	0.00005	mg/L			<0.00005	<0.00005	<0.00005
Aroclor 1260	0.00005	mg/L			<0.00005	<0.00005	<0.00005
Aroclor 1262	0.00005	mg/L			<0.00005	<0.00005	<0.00005
Aroclor 1268	0.00005	mg/L			<0.00005	<0.00005	<0.00005
Total PCBs	0.00005	mg/L	No EQG[e]		<0.00005	<0.00005	<0.00005
Decachlorobiphenyl		%			81	84	79

nc: not calculated
-: Not analyzed
uS/cm: microSiemens per centimetre
mg/L: milligrams per litre

5	Concentration above EQG
5	Detection Limit above EQG

[a]For protection from direct toxic effects; the guidelines do not consider indirect effects due to eutrofication
[b]No CCME fact sheet created. For more information on this guideline, please refer to Canadian Water Quality Guidelines (CCREM 1987)
[c]No units for pH
[d]May not protect fully high trophic level fish, and may not prevent accumulation of methylmercury in aquatic life, therefore, may not protect wildlife that consume aquatic life
[e]No EQG: No environmental qualtiy guideline is recommended; see environmental quality guidelines for other media where appropriate

Appendix E.9

Table 9 – Tank Dimensions

Tank ID	Location	Tank Walls	Tank Orientation	Opening Type	Tank Volume (L)	Height (cm)	Length (cm)	Diameter (cm)
Tank 1	Area 3	Bolted; 3mm	Vertical	4"	313634	493	NA	900
Tank 2	Area 3	Bolted; 3mm	Vertical	-	314906	495	NA	900
Tank 3	Area 3	Bolted; 3mm	Vertical	4"	479337	737	NA	910
Tank 4	Area 3	Bolted; 3mm	Vertical	4"	479337	737	NA	910
Tank 5	Area 3	Bolted; 3mm	Vertical	4"	313634	493	NA	900
Tank 6	Area 3	Bolted; 3mm	Vertical	4"	312998	492	NA	900
Tank 7	Area 3	Welded; 4mm	Vertical	3"	91934	955	NA	350.1
Tank 8	Area 3	Welded; 4mm	Vertical	3"	91934	955	NA	350.1
Tank 9	Area 3	Welded; 4mm	Vertical	3"	91934	955	NA	350.1
Tank 10	Area 3	Welded; 4mm	Vertical	3"	91934	955	NA	350.1
Tank 11	Area 3	Welded; 4mm	Vertical	3"	91934	955	NA	350.1
Tank 12	Area 3	Welded; 4mm	Vertical	3"	91934	955	NA	350.1
Tank 13	Area 3	Welded; 4mm	Vertical	3"	91934	955	NA	350.1
Tank 14	Area 3	Bolted; 4mm	Vertical	4"	1653224	737	NA	1690
Tank 15	Area 3	Bolted; 4mm	Vertical	4"	1650981	736	NA	1690
Tank 16	Area 3	Bolted; 4mm	Vertical	-	1662120	734	NA	1698
Tank 17	Area 3	Bolted; 4mm	Vertical	4"	801602	733	NA	1180
Tank 18	Area 3	Bolted; 4mm	Vertical	4"	800509	732	NA	1180
Tank 19	Area 3	Bolted; 4mm	Vertical	4"	801602	733	NA	1180
Tank 20	SE of Tank Farm	Hot Rivet Wall; 4mm	Horizontal	2"	59459	NA	618	350
Tank 21	SE of Tank Farm	Welded; 4mm	Horizontal		57073	NA	607	346
Tank 22	SE of Tank Farm	Welded; 4mm	Horizontal		57073	NA	607	346
Tank 23	SE of Tank Farm	Hot Rivet Wall; 4mm	Horizontal	3"	59266	NA	616	350
Tank 24	SE of Tank Farm	Hot Rivet Wall; 4mm	Horizontal	2", 3"	59074	NA	614	350
Tank 25	W of Garage	Welded; 3mm	Horizontal	1 1/2", 3"	22192	NA	617	214
Tank 26	E of Garage	Welded; 3mm	Horizontal	2", 3"	2325	NA	220	116
Tank 27	E of Garage	Welded; 3mm	Horizontal	3/4"	2254	NA	217	115
Tank 28	S of Garage	Welded; 3mm	Horizontal	60mm ID	2262	NA	214	116
Tank 29	S of Garage	Welded; 3mm	Horizontal	60mm ID	2262	NA	214	116
Tank 30	S of Garage	Welded; 3mm	Horizontal	60mm ID	2262	NA	214	116
Tank 31	S of Garage	Welded; 3mm	Horizontal	60mm ID	2262	NA	214	116
Tank 32	S of Garage	Welded; 3mm	Horizontal	60mm ID	2312	NA	215	117
Tank 33	S of Garage	Welded; 3mm	Horizontal	60mm ID	2312	NA	215	117
Tank 34	S of Garage	Welded; 3mm	Horizontal	60mm ID	2312	NA	215	117
Tank 35	S of Garage	Welded; 3mm	Horizontal	60mm ID	2312	NA	215	117

Tank ID	Location	Tank Walls	Tank Orientation	Opening Type	Tank Volume (L)	Height (cm)	Length (cm)	Diameter (cm)
Tank 36	S of Garage	Welded; 3mm	Horizontal	60mm ID	2312	NA	215	117
Tank 37	Area 5, beside sheds	Welded; 3mm	Horizontal	3"	2264	NA	218	115
Tank 38	Area 5, in shed row	205-L Drum	Vertical	-	205	NA	NA	NA
Tank 39	Area 5, in shed row	205-L Drum	Vertical	-	205	NA	NA	NA
Tank 40	Area 5, in shed row	205-L Drum	Vertical	-	205	NA	NA	NA
Tank 41	Area 5, in shed row	205-L Drum	Vertical	-	205	NA	NA	NA
Tank 42	Area 5, in shed row	205-L Drum	Vertical	-	205	NA	NA	NA
Tank 43	Area 5, in shed row	205-L Drum	Vertical	-	205	NA	NA	NA
Tank 44	Area 5, W of sheds	205-L Drum	Vertical	-	205	NA	NA	NA
Tank 45	Area 5, W of sheds	Welded Equipment Tank	Dimensional	-	205	NA	NA	NA
Tank 46	Area 7, E of Trailers	Welded; 3mm	Horizontal	1 1/4"	3860	NA	185	163
Tank 47	Area 7, E of Trailers	Welded; 3mm	Horizontal	-	3860	NA	185	163
Tank 48	Area 7, E of Trailers	Welded; 3mm	Horizontal	-	3860	NA	185	163
Tank 49	Area 7, E of Trailers	Welded; 3mm	Horizontal	-	3860	NA	185	163
Tank 50	Area 7, W of Trailers	Welded; 3mm	Horizontal	1 1/4"	2304	NA	218	116
Tank 51	Area 7, W of Trailers	Welded; 3mm	Horizontal	-	2304	NA	218	116
Tank 52	Area 8, Nodwell trailer	Welded; 4mm	Dimensional	2"		NA	NA	NA
Tank 53	Area 8, Nodwell deck tank	Welded; 4mm	Dimensional	60mm ID		NA	NA	NA
Tank 54	Area 8, Nodwell fuel tank x 2	Welded; 2mm	Dimensional	3/8"		NA	NA	NA
Tank 55	Area 8, Nodwell Gen Shack	205-L Drum	Vertical	-	205	NA	NA	NA
Tank 56	Area 8, Nodwell Gen Shack	Welded Equipment Tank	Dimensional	-		NA	NA	NA
Tank 57	S of Area 8	205-L Drum	Vertical	-	205	NA	NA	NA
Tank 58	S of Area 8	205-L Drum	Vertical	-	205	NA	NA	NA
Tank 59	Area 2; E of Camp	Welded; 3mm	Horizontal	1"	2262	NA	214	116
Tank 60	Area 2; E of Camp	Welded; 3mm	Horizontal	1"	2262	NA	214	116
Tank 61	Area 2; E of Camp	Welded; 3mm	Horizontal	1"	2262	NA	214	116
Tank 62	Area 2; E of Camp	Welded; 3mm	Horizontal	1"	2262	NA	214	116
Tank 63	Area 2; E of Camp	Welded; 3mm	Horizontal	1"	2262	NA	214	116
Tank 64	Area 2; W of Camp	Welded; 3mm	Horizontal	1"	2304	NA	218	116
Tank 65	Area 2; Loader fuel tank	Welded; 3mm	Dimensional	3/8"		NA	NA	NA
Tank 66	Area 2; N of Camp	Welded; 3mm	Horizontal	60mm ID	2262	NA	214	116
Tank 67	Area 2; N of Camp	Welded; 3mm	Horizontal	60mm ID	2262	NA	214	116
Tank 68	Area 2; N of Camp	Welded; 3mm	Horizontal	60mm ID	2262	NA	214	116
Tank 69	Area 2; N of Camp	Welded; 3mm	Horizontal	60mm ID	2262	NA	214	116

Note:
Tank locations identified by area based on 1992 AES report drawings

Appendix E.10

Table 10 – Tank Contents

Tank ID	Location	Type	Orientation	Volume of Product (L)	Volume of Sludge (L)	Suspected Contents	Comments
Tank 1	Tank Farm	Bolted; 3mm	Vertical	1400	0	Aged Diesel	
Tank 2	Tank Farm	Bolted; 3mm	Vertical	2672	3817	Aged Diesel	
Tank 3	Tank Farm	Bolted; 3mm	Vertical	2016	2602	Aged Diesel	
Tank 4	Tank Farm	Bolted; 3mm	Vertical	1301	3252	Aged Diesel	
Tank 5	Tank Farm	Bolted; 3mm	Vertical	0	0	Aged Diesel	
Tank 6	Tank Farm	Bolted; 3mm	Vertical	2354	10179	Aged Diesel	
Tank 7	Tank Farm	Welded; 4mm	Vertical	1300	0	Aged Diesel	Difficult Access
Tank 8	Tank Farm	Welded; 4mm	Vertical	1396	0	Aged Diesel	Difficult Access
Tank 9	Tank Farm	Welded; 4mm	Vertical	2407	0	Aged Diesel	Difficult Access
Tank 10	Tank Farm	Welded; 4mm	Vertical	2407	0	Aged Diesel	Difficult Access
Tank 11	Tank Farm	Welded; 4mm	Vertical	3658	0	Aged Diesel	Difficult Access
Tank 12	Tank Farm	Welded; 4mm	Vertical	1396	0	Aged Diesel	Difficult Access
Tank 13	Tank Farm	Welded; 4mm	Vertical	2599	0	Aged Diesel	Difficult Access
Tank 14	Tank Farm	Bolted; 4mm	Vertical	0	0	Empty	Liner
Tank 15	Tank Farm	Bolted; 4mm	Vertical	0	0	Empty	Liner
Tank 16	Tank Farm	Bolted; 4mm	Vertical	0	0	Empty	Liner
Tank 17	Tank Farm	Bolted; 4mm	Vertical	0	0	Empty	Liner
Tank 18	Tank Farm	Bolted; 4mm	Vertical	0	21872	Empty	Liner, tank MT, liner debris on bottem?
Tank 19	Tank Farm	Bolted; 4mm	Vertical	0	0	Empty	Liner
Tank 20	SE of Tank Farm	Hot Rivet Wall; 4mm	Horizontal	5039	172	Aged Diesel	
Tank 21	SE of Tank Farm	Welded; 4mm	Horizontal	463	1323	Aged Diesel	Couldn't collect sample
Tank 22	SE of Tank Farm	Welded; 4mm	Horizontal	0	0	Empty	
Tank 23	SE of Tank Farm	Hot Rivet Wall; 4mm	Horizontal	2990	225	Aged Diesel	Leaking S end4-6 drops/min, sample rusty
Tank 24	SE of Tank Farm	Hot Rivet Wall; 4mm	Horizontal	1480	793	Aged Diesel	Sample very rusty
Tank 25	W of Garage	Welded; 3mm	Horizontal	19894	221	Aged Diesel	Incenerator supply if adequate quality
Tank 26	E of Garage	Welded; 3mm	Horizontal	1978	0	Aged Diesel	
Tank 27	E of Garage	Welded; 3mm	Horizontal	916	0	Aged Diesel	
Tank 28	S of Garage	Welded; 3mm	Horizontal	2167	0	Aged Diesel	
Tank 29	S of Garage	Welded; 3mm	Horizontal	2206	0	Aged Diesel	
Tank 30	S of Garage	Welded; 3mm	Horizontal	2206	0	Aged Diesel	
Tank 31	S of Garage	Welded; 3mm	Horizontal	2194	0	Aged Diesel	
Tank 32	S of Garage	Welded; 3mm	Horizontal	45	0	Aged Diesel	
Tank 33	S of Garage	Welded; 3mm	Horizontal	96	0	Aged Diesel	
Tank 34	S of Garage	Welded; 3mm	Horizontal	96	0	Aged Diesel	
Tank 35	S of Garage	Welded; 3mm	Horizontal	56	0	Aged Diesel	
Tank 36	S of Garage	Welded; 3mm	Horizontal	25	0	Aged Diesel	
Tank 37	Area 5, beside sheds	Welded; 3mm	Horizontal	0	0	Empty	
Tank 38	Area 5, in shed row	205-L Drum	Vertical	205	0	Jet B	
Tank 39	Area 5, in shed row	205-L Drum	Vertical	25	0	ATF	
Tank 40	Area 5, in shed row	205-L Drum	Vertical	205	0	Aged Gasoline	
Tank 41	Area 5, in shed row	205-L Drum	Vertical	205	0	Jet B	
Tank 42	Area 5, in shed row	205-L Drum	Vertical	205	0	Jet B	
Tank 43	Area 5, in shed row	205-L Drum	Vertical	205	0	Glycol	

Tank ID	Location	Type	Orientation	Volume of Product (L)	Volume of Sludge (L)	Suspected Contents	Comments
Tank 44	Area 5, W of sheds	205-L Drum	Vertical	205	0	Aviation Gasoline	
Tank 45	Area 5, W of sheds	Welded Equipment Tank	Dimensional	153	0	Aged Diesel	Dimension: W 80, L 239, H 32
Tank 46	Area 7, E of Trailers	Welded; 3mm	Horizontal	0	0	Empty	
Tank 47	Area 7, E of Trailers	Welded; 3mm	Horizontal	168	84	Aged Diesel	
Tank 48	Area 7, E of Trailers	Welded; 3mm	Horizontal	0	0	Empty	
Tank 49	Area 7, E of Trailers	Welded; 3mm	Horizontal	0	0	Empty	
Tank 50	Area 7, W of Trailers	Welded; 3mm	Horizontal	0	45	No Product	
Tank 51	Area 7, W of Trailers	Welded; 3mm	Horizontal	0	25	No Product	
Tank 52	Area 8, Nodwell trailer	Welded; 4mm	Dimensional	4805	0	Aged Diesel	Dimension: W 219, L 477, H 66
Tank 53	Area 8, Nodwell deck tank	Welded; 4mm	Dimensional	257	0	Aged Diesel	Dimension: W 233, L 368, H 50
Tank 54	Area 8, Nodwell fuel tank x 2	Welded; 2mm	Dimensional	128	0	Aged Diesel	Dimension: W 30, L 72, H 81
Tank 55	Area 8, Nodwell Gen Shack	205-L Drum	Vertical	100	0	Heavy Motor Oil	No access for sampling
Tank 56	Area 8, Nodwell Gen Shack	Welded Equipment Tank	Dimensional	153	0	Aged Diesel	Dimension: W 80, L 239, H 32
Tank 57	S of Area 8	205-L Drum	Vertical	410	0	Aged Gasoline	Count 2 drums as 1, only could open 1
Tank 58	S of Area 8	205-L Drum	Vertical	205	0	Glycol	Fluid looked simular to that in Tank 43
Tank 59	Area 2; E of Camp	Welded; 3mm	Horizontal	1617	0	Jet B	Fluid smelled like Av Gas or Jet B
Tank 60	Area 2; E of Camp	Welded; 3mm	Horizontal	2020	0	Jet B	Fluid smelled like Av Gas or Jet B
Tank 61	Area 2; E of Camp	Welded; 3mm	Horizontal	2090	0	Jet B	Fluid smelled like Av Gas or Jet B
Tank 62	Area 2; E of Camp	Welded; 3mm	Horizontal	2090	0	Jet B	Fluid smelled like Av Gas or Jet B
Tank 63	Area 2; E of Camp	Welded; 3mm	Horizontal	2115	0	Jet B	Fluid smelled like Av Gas or Jet B
Tank 64	Area 2; W of Camp	Welded; 3mm	Horizontal	2058	0	Aged Diesel	Located on back of skid camp trailer
Tank 65	Area 2; Loader fuel tank	Welded; 3mm	Dimensional	0	0	Empty	Dimension: W 50, L 138, H 55
Tank 66	Area 2; N of Camp	Welded; 3mm	Horizontal	530	0	Aged Diesel	Sample very rusty
Tank 67	Area 2; N of Camp	Welded; 3mm	Horizontal	1451	0	Aged Diesel	Sample clean
Tank 68	Area 2; N of Camp	Welded; 3mm	Horizontal	1255	0	Aged Diesel	Sample clean
Tank 69	Area 2; N of Camp	Welded; 3mm	Horizontal	56	0	Aged Diesel	Sample very rusty
				89667	44607		

Note:

1. Volumes for horzontal tanks calculated formula in Section 12.1
2. Volumes for horizontal tanks with combination of sludge and product calculated by determining total volume of sludge and product and then subtracting volume of sludge to find volume of product
3. Tank locations identified by area based on 1992 AES report drawings

Appendix E.11

Table 11 – Analytical Results – Fuel Samples

Sample Location Sample ID: Collected By: Laboratory: Sample Date: Lab Reference No.:	D.L.	Units	TANK 1 L338165-1	TANK 2 L338165-2	TANK 3 L338165-3	TANK 4 L338165-4	TANK 6 L338165-5	TANK 20 L338165-6
Flashpoint	-7	°C AET	83	74	80	78	79	62
Chlorine	0.5	ug/g						
C1-C60 GC/FID Scan								
Diethylene Glycol	50	mg/kg						
Ethylene Glycol	50	mg/kg						
Propylene Glycol	50	mg/kg						
Triethylene Glycol	50	mg/kg						
Silver (Ag)	1	mg/kg	<1	<1	<1	<1	<1	<1
Barium (Ba)	5	mg/kg	<5	<5	<5	<5	<5	<5
Beryllium (Be)	1	mg/kg	<1	<1	<1	<1	<1	<1
Cadmium (Cd)	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cobalt (Co)	1	mg/kg	<1	<1	<1	<1	<1	<1
Chromium (Cr)	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Copper (Cu)	2	mg/kg	<2	<2	<2	<2	<2	<2
Molybdenum (Mo)	1	mg/kg	<1	2	<1	<1	<1	<1
Nickel (Ni)	2	mg/kg	<2	<2	<2	<2	<2	<2
Lead (Pb)	5	mg/kg	<5	<5	<5	<5	<5	<5
Tin (Sn)	5	mg/kg	6	<5	<5	9	<5	<5
Strontium (Sr)	1	mg/kg	<1	<1	<1	<1	<1	<1
Thallium (Tl)	1	mg/kg	<1	<1	<1	8	<1	<1
Vanadium (V)	1	mg/kg	<1	<1	<1	<1	<1	<1
Zinc (Zn)	10	mg/kg	<10	<10	<10	<10	<10	<10
Polychlorinated Biphenyls								
Aroclor 1016	0.5	mg/kg						
Aroclor 1221	0.5	mg/kg						
Aroclor 1232	0.5	mg/kg						
Aroclor 1242	0.5	mg/kg						
Aroclor 1248	0.5	mg/kg						
Aroclor 1254	0.5	mg/kg						
Aroclor 1260	0.5	mg/kg						
Aroclor 1262	0.5	mg/kg						
Aroclor 1268	0.5	mg/kg						
Total PCBs	2	mg/kg						
Decachlorobiphenyl		%						

nc: not calculated

-: Not analyzed

uS/cm: microSiemens per centimetre

mg/L: milligrams per litre

5
5

[a]For protection from direct toxic effects; the guidelines do not consider indirect effects due to eutrofication

[b]No CCME fact sheet created. For more information on this guideline, please refer to Canadian Water Quality Guidelines (CCREM 1987)

[c]No units for pH

[d]May not protect fully high trophic level fish, and may not prevent accumulation of methylmercury in aquatic life, therefore, may not protect wildlife that consume aquatic life

[e]No EQG: No environmental qualtiy guideline is recommended; see environmental quality guidelines for other media where appropriate

Sample Location Sample ID: Collected By: Laboratory: Sample Date: Lab Reference No.:	D.L.	Units	TANK 23 L338165-7	TANK 24 L338165-8	TANK 26 L338165-9	TANK 27 L338165-10	TANK 32 L338165-11
Flashpoint	-7	°C AET	55	55	65	53	59
Chlorine	0.5	ug/g			2.1		
C1-C60 GC/FID Scan					See attach		
Diethylene Glycol	50	mg/kg			<50		
Ethylene Glycol	50	mg/kg			<50		
Propylene Glycol	50	mg/kg			<50		
Triethylene Glycol	50	mg/kg			<50		
Silver (Ag)	1	mg/kg	<1	<1	<1	<1	<1
Barium (Ba)	5	mg/kg	<5	<5	<5	<5	<5
Beryllium (Be)	1	mg/kg	<1	<1	<1	<1	<1
Cadmium (Cd)	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Cobalt (Co)	1	mg/kg	<1	<1	<1	<1	<1
Chromium (Cr)	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Copper (Cu)	2	mg/kg	<2	<2	<2	<2	<2
Molybdenum (Mo)	1	mg/kg	<1	6	<1	<1	<1
Nickel (Ni)	2	mg/kg	<2	<2	<2	<2	<2
Lead (Pb)	5	mg/kg	<5	<5	6	<5	<5
Tin (Sn)	5	mg/kg	<5	<5	<5	<5	<5
Strontium (Sr)	1	mg/kg	<1	<1	<1	<1	<1
Thallium (Tl)	1	mg/kg	<1	<1	<1	<1	<1
Vanadium (V)	1	mg/kg	<1	<1	<1	<1	<1
Zinc (Zn)	10	mg/kg	<10	<10	<10	<10	<10
Polychlorinated Biphenyls							
Aroclor 1016	0.5	mg/kg			<0.5		
Aroclor 1221	0.5	mg/kg			<0.5		
Aroclor 1232	0.5	mg/kg			<0.5		
Aroclor 1242	0.5	mg/kg			<0.5		
Aroclor 1248	0.5	mg/kg			<0.5		
Aroclor 1254	0.5	mg/kg			<0.5		
Aroclor 1260	0.5	mg/kg			<0.5		
Aroclor 1262	0.5	mg/kg			<0.5		
Aroclor 1268	0.5	mg/kg			<0.5		
Total PCBs	2	mg/kg			<2.0		
Decachlorobiphenyl		%			98		

nc: not calculated

-: Not analyzed

uS/cm: microSiemens per centimetre

mg/L: milligrams per litre

5
5

[a]For protection from direct toxic effects; the guidelines do not consider indirect effects due to eutrofication

[b]No CCME fact sheet created. For more information on this guideline, please refer to Canadian Water Quality Guidelines (CC

[c]No units for pH

[d]May not protect fully high trophic level fish, and may not prevent accumulation of methylmercury in aquatic life, therefore, may
wildlife that consume aquatic life

[e]No EQG: No environmental qualtiy guideline is recommended; see environmental quality guidelines for other media where a

Sample Location Sample ID: Collected By: Laboratory: Sample Date: Lab Reference No.:	D.L.	Units	TANK 33 L338165-12	TANK 34 L338165-20	TANK 35 L338165-21	TANK 36 L338165-22	TANK 38 L338165-23
Flashpoint	-7	^{o}C AET	57	58	63	52	<-7
Chlorine	0.5	ug/g					<0.5
C1-C60 GC/FID Scan							See attach
Diethylene Glycol	50	mg/kg					<50
Ethylene Glycol	50	mg/kg					<50
Propylene Glycol	50	mg/kg					<50
Triethylene Glycol	50	mg/kg					<50
Silver (Ag)	1	mg/kg	<1	<1	<1	<1	<1
Barium (Ba)	5	mg/kg	<5	<5	<5	<5	<5
Beryllium (Be)	1	mg/kg	<1	<1	<1	<1	<1
Cadmium (Cd)	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Cobalt (Co)	1	mg/kg	<1	<1	<1	<1	<1
Chromium (Cr)	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Copper (Cu)	2	mg/kg	<2	<2	<2	<2	<2
Molybdenum (Mo)	1	mg/kg	<1	<1	<1	<1	<1
Nickel (Ni)	2	mg/kg	<2	<2	<2	<2	<2
Lead (Pb)	5	mg/kg	<5	<5	<5	6	<5
Tin (Sn)	5	mg/kg	<5	8	<5	<5	<5
Strontium (Sr)	1	mg/kg	<1	<1	<1	<1	<1
Thallium (Tl)	1	mg/kg	<1	<1	<1	<1	<1
Vanadium (V)	1	mg/kg	<1	<1	<1	<1	<1
Zinc (Zn)	10	mg/kg	20	<10	<10	<10	<10
Polychlorinated Biphenyls							
Aroclor 1016	0.5	mg/kg					<0.5
Aroclor 1221	0.5	mg/kg					<0.5
Aroclor 1232	0.5	mg/kg					<0.5
Aroclor 1242	0.5	mg/kg					<0.5
Aroclor 1248	0.5	mg/kg					<0.5
Aroclor 1254	0.5	mg/kg					<0.5
Aroclor 1260	0.5	mg/kg					<0.5
Aroclor 1262	0.5	mg/kg					<0.5
Aroclor 1268	0.5	mg/kg					<0.5
Total PCBs	2	mg/kg					<2.0
Decachlorobiphenyl		%					122

nc: not calculated

-: Not analyzed

uS/cm: microSiemens per centimetre

mg/L: milligrams per litre

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[a]For protection from direct toxic effects; the guidelines do not consider indirect effects due to eutrofication

[b]No CCME fact sheet created. For more information on this guideline, please refer to Canadian Water Quality Guidelines (CC

[c]No units for pH

[d]May not protect fully high trophic level fish, and may not prevent accumulation of methylmercury in aquatic life, therefore, may
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[e]No EQG: No environmental qualtiy guideline is recommended; see environmental quality guidelines for other media where ap

Sample Location Sample ID: Collected By: Laboratory: Sample Date: Lab Reference No.:	D.L.	Units	TANK 40 L338165-24	TANK 41 L338165-25	TANK 42 L338165-26	TANK 43 L338165-27	TANK 44 L338165-28
Flashpoint	-7	°C AET	<-7	<-7	<-7	110	53
Chlorine	0.5	ug/g	2.5	1.7	2.4	7	1.2
C1-C60 GC/FID Scan			See attach	See attach	See attach	See attach	See attach
Diethylene Glycol	50	mg/kg	<50	<50	<50	66000	<50
Ethylene Glycol	50	mg/kg	<50	<50	<50	700000	<50
Propylene Glycol	50	mg/kg	<50	<50	<50	<50	<50
Triethylene Glycol	50	mg/kg	<50	<50	<50	<50	<50
Silver (Ag)	1	mg/kg	<1	<1	<1	<1	<1
Barium (Ba)	5	mg/kg	<5	<5	<5	<5	<5
Beryllium (Be)	1	mg/kg	<1	<1	<1	<1	<1
Cadmium (Cd)	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Cobalt (Co)	1	mg/kg	<1	<1	<1	<1	<1
Chromium (Cr)	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Copper (Cu)	2	mg/kg	<2	<2	<2	<2	<2
Molybdenum (Mo)	1	mg/kg	<1	5	<1	<1	<1
Nickel (Ni)	2	mg/kg	<2	<2	<2	<2	<2
Lead (Pb)	5	mg/kg	6	<5	7	<5	<5
Tin (Sn)	5	mg/kg	<5	<5	<5	<5	<5
Strontium (Sr)	1	mg/kg	<1	<1	<1	<1	<1
Thallium (Tl)	1	mg/kg	<1	<1	<1	<1	12
Vanadium (V)	1	mg/kg	<1	<1	<1	<1	<1
Zinc (Zn)	10	mg/kg	<10	<10	<10	<10	<10
Polychlorinated Biphenyls							
Aroclor 1016	0.5	mg/kg	<0.5	<0.5	<0.5	<0.002	<0.5
Aroclor 1221	0.5	mg/kg	<0.5	<0.5	<0.5	<0.002	<0.5
Aroclor 1232	0.5	mg/kg	<0.5	<0.5	<0.5	<0.002	<0.5
Aroclor 1242	0.5	mg/kg	<0.5	<0.5	<0.5	0.020	<0.5
Aroclor 1248	0.5	mg/kg	<0.5	<0.5	<0.5	<0.002	<0.5
Aroclor 1254	0.5	mg/kg	<0.5	<0.5	<0.5	0.0038	<0.5
Aroclor 1260	0.5	mg/kg	<0.5	<0.5	<0.5	<0.002	<0.5
Aroclor 1262	0.5	mg/kg	<0.5	<0.5	<0.5	<0.002	<0.5
Aroclor 1268	0.5	mg/kg	<0.5	<0.5	<0.5	<0.002	<0.5
Total PCBs	2	mg/kg	<2.0	<2.0	<2.0	0.024	<2.0
Decachlorobiphenyl		%	120	121	128	106	95

nc: not calculated

-: Not analyzed

uS/cm: microSiemens per centimetre

mg/L: milligrams per litre

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[b]No CCME fact sheet created. For more information on this guideline, please refer to Canadian Water Quality Guidelines (CC

[c]No units for pH

[d]May not protect fully high trophic level fish, and may not prevent accumulation of methylmercury in aquatic life, therefore, may
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Sample Location Sample ID: Collected By: Laboratory: Sample Date: Lab Reference No.:	D.L.	Units	TANK 45 L338165-29	TANK 52 L338165-30	TANK 54 L338165-31	TANK 56 L338165-13	TANK 57 L338165-14
Flashpoint	-7	°C AET	66	53	59	48	<-7
Chlorine	0.5	ug/g					1.1
C1-C60 GC/FID Scan							See attach
Diethylene Glycol	50	mg/kg					<50
Ethylene Glycol	50	mg/kg					<50
Propylene Glycol	50	mg/kg					<50
Triethylene Glycol	50	mg/kg					<50
Silver (Ag)	1	mg/kg	<1	<1	<1	<1	<1
Barium (Ba)	5	mg/kg	<5	<5	<5	<5	<5
Beryllium (Be)	1	mg/kg	<1	<1	<1	<1	<1
Cadmium (Cd)	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Cobalt (Co)	1	mg/kg	<1	<1	<1	<1	<1
Chromium (Cr)	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Copper (Cu)	2	mg/kg	<2	<2	<2	<2	<2
Molybdenum (Mo)	1	mg/kg	<1	<1	<1	<1	<1
Nickel (Ni)	2	mg/kg	<2	<2	<2	<2	<2
Lead (Pb)	5	mg/kg	<5	<5	<5	5	<5
Tin (Sn)	5	mg/kg	<5	<5	<5	<5	<5
Strontium (Sr)	1	mg/kg	<1	<1	<1	<1	<1
Thallium (Tl)	1	mg/kg	<1	<1	8	<1	<1
Vanadium (V)	1	mg/kg	<1	<1	<1	<1	<1
Zinc (Zn)	10	mg/kg	<10	<10	<10	<10	<10
Polychlorinated Biphenyls							
Aroclor 1016	0.5	mg/kg					<0.5
Aroclor 1221	0.5	mg/kg					<0.5
Aroclor 1232	0.5	mg/kg					<0.5
Aroclor 1242	0.5	mg/kg					<0.5
Aroclor 1248	0.5	mg/kg					<0.5
Aroclor 1254	0.5	mg/kg					<0.5
Aroclor 1260	0.5	mg/kg					<0.5
Aroclor 1262	0.5	mg/kg					<0.5
Aroclor 1268	0.5	mg/kg					<0.5
Total PCBs	2	mg/kg					<2.0
Decachlorobiphenyl		%					113

nc: not calculated

-: Not analyzed

uS/cm: microSiemens per centimetre

mg/L: milligrams per litre

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5

[a]For protection from direct toxic effects; the guidelines do not consider indirect effects due to eutrofication

[b]No CCME fact sheet created. For more information on this guideline, please refer to Canadian Water Quality Guidelines (CC

[c]No units for pH

[d]May not protect fully high trophic level fish, and may not prevent accumulation of methylmercury in aquatic life, therefore, may
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[e]No EQG: No environmental qualtiy guideline is recommended; see environmental quality guidelines for other media where ap

Sample Location Sample ID: Collected By: Laboratory: Sample Date: Lab Reference No.:	D.L.	Units	TANK 64 L338165-15	TANK 66 L338165-16	TANK 67 L338165-17	TANK 68 L338165-18	TANK 69 L338165-19
Flashpoint	-7	^{o}C AET	51	56	54	57	55
Chlorine	0.5	ug/g					
C1-C60 GC/FID Scan							
Diethylene Glycol	50	mg/kg					
Ethylene Glycol	50	mg/kg					
Propylene Glycol	50	mg/kg					
Triethylene Glycol	50	mg/kg					
Silver (Ag)	1	mg/kg	<1	<1	<1	<1	<1
Barium (Ba)	5	mg/kg	<5	<5	<5	<5	<5
Beryllium (Be)	1	mg/kg	<1	<1	<1	<1	<1
Cadmium (Cd)	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Cobalt (Co)	1	mg/kg	<1	<1	<1	<1	<1
Chromium (Cr)	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	1.0
Copper (Cu)	2	mg/kg	<2	<2	<2	<2	<2
Molybdenum (Mo)	1	mg/kg	<1	<1	<1	<1	<1
Nickel (Ni)	2	mg/kg	<2	<2	<2	<2	<2
Lead (Pb)	5	mg/kg	<5	<5	<5	<5	<5
Tin (Sn)	5	mg/kg	<5	<5	<5	7	<5
Strontium (Sr)	1	mg/kg	<1	<1	<1	<1	<1
Thallium (Tl)	1	mg/kg	<1	<1	<1	<1	<1
Vanadium (V)	1	mg/kg	<1	<1	<1	<1	<1
Zinc (Zn)	10	mg/kg	<10	<10	<10	<10	<10
Polychlorinated Biphenyls							
Aroclor 1016	0.5	mg/kg					
Aroclor 1221	0.5	mg/kg					
Aroclor 1232	0.5	mg/kg					
Aroclor 1242	0.5	mg/kg					
Aroclor 1248	0.5	mg/kg					
Aroclor 1254	0.5	mg/kg					
Aroclor 1260	0.5	mg/kg					
Aroclor 1262	0.5	mg/kg					
Aroclor 1268	0.5	mg/kg					
Total PCBs	2	mg/kg					
Decachlorobiphenyl		%					

nc: not calculated

-: Not analyzed

uS/cm: microSiemens per centimetre

mg/L: milligrams per litre

5
5

[a]For protection from direct toxic effects; the guidelines do not consider indirect effects due to eutrofication

[b]No CCME fact sheet created. For more information on this guideline, please refer to Canadian Water Quality Guidelines (CCI

[c]No units for pH

[d]May not protect fully high trophic level fish, and may not prevent accumulation of methylmercury in aquatic life, therefore, may
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Appendix E.12

Table 12 – Analytical Results – Fuel Characterization

Sample ID:	Method	CAN/CGSB-3.517-2000 Type A-LS		Composite 7-13	Composite 25	Composite 28-31	Composite 59-63
		Minimum	Maximum				
Collected By:				IEG	IEG	IEG	IEG
Laboratory:				ARC	ARC	ARC	ARC
Acid Number	ASTM D974		0.10	0.00	0.02	0.00	0.00
Accelerated Stability (16 hrs.), mg/100mL	ASTM D2274			Table	na	0.0	0.0
Appearance	GL-4						
Ash, Mass %	ASTM D482		0.01	0.000		0.000	0.000
Cetane Number	ASTM D613	40		42.5	38.3	41.5	41.1
Cloud Point, oC	ASTM D5773		-47	-52.4	-53.1	-55.6	-52.7
Copper Corrosion, 3hrs @50oC	ASTM D130		No. 1	1a	1a	1a	1a
Carbon Residue, 10% Bottoms, Mass %	ASTM D524 & D86		0.15	0.11	0.10	0.10	0.11
Distillation, % Recovered, oC (corrected)	ASTM D86						
I.B.P				163.1	158.1	159.2	157.4
5%				172.4	167.0	166.8	167.6
10%				176.3	170.8	169.6	170.9
20%				179.6	174.8	173.8	174.9
30%				183.5	179.0	176.6	178.3
40%				186.9	183.5	181.3	181.5
50%				191.9	188.5	185.4	185.9
60%				198.7	195.5	192.0	192.6
70%				209.1	206.0	201.6	201.9
80%				224.2	221.9	217.1	217.6
90%			290	244.9	244.2	241.0	241.1
E.P.				275.4	280.7	276.0	274.9
Residue, %				1.2	1.3	1.2	1.2
Loss, %				0.7	0.5	0.4	0.5
Electrical Conductivity, pS/m	ASTM D2624	25		8 @ 20.4oC	123 @ 20.6oC	44 @ 20.0oC	18 @ 20.0oC
Flash Point, oC	ASTM D93, Procedure A	40		54.0	46.0	47.0	49.0
Density, kg/m3, @15oC	ASTM D4052	775	850	804.3	802.7	801	801.9
Lubricity by High Frequency Reciprocating Rig (HFRR), Wear Scar Diameter at 60oC	ASTM D6079						
Major Axis, mm				0.70	0.73	0.71	0.69
Minor Axis, mm				0.67	0.72	0.69	0.66
Wear Scar Diameter, mm			0.46	0.68	0.72	0.70	0.68

Sample ID:	Method	CAN/CGSB-3.517-2000 Type A-LS		Composite 7-13	Composite 25	Composite 28-31	Composite 59-63
		Minimum	Maximum				
Collected By:				IEG	IEG	IEG	IEG
Laboratory:				ARC	ARC	ARC	ARC
Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES), ug/g	ASTM D5185						
Silver (Ag)				<1	4	<1	<1
Aluminum (Al)				<1	<1	<1	<1
Boron (B)				<1	2	<1	<1
Barium (Ba)				<1	<1	<1	<1
Beryllium (Be)				<1	<1	<1	<1
Calcium (Ca)				11	392	5	2
Chromium (Cr)				<1	<1	<1	<1
Copper (Cu)				<1	5	<1	<1
Iron (Fe)				<1	1	<1	<1
Potassium (K)				<1	1	<1	<1
Lithium (Li)				<1	<1	<1	<1
Magnesium (Mg)				<1	1	<1	<1
Molybdenum (Mo)				<1	<1	<1	<1
Sodium (Na)				<1	1	1	1
Nickel (Ni)				<1	<1	<1	<1
Phosphorous (P)				3	97	2	1
Lead (Pb)				1	2	<1	1
Antimony (Sb)				<1	1	<1	<1
Silicon (Si)				<1	<1	<1	<1
Tin (Sn)				<1	<1	<1	<1
Titanium (Ti)				<1	<1	<1	<1
Vanadium (V)				<1	<1	<1	<1
Zinc (Zn)				4	155	2	<1
Pour Point, oC	ASTM D5949, ASTM D97 Equivalent			-60	-60	-63	-63
High Temperature Stability of Distillate Fuels, 150 oC, 180min.aging	ASTM D6468						
Average Reflection Pad Rating (%), W Search Unit				100			100
Sulphur, Mass%	ASTM D5453		500	34	61	29	38
Kinematic Viscosity, mm2/s(cSt)	ASTM D445	1.3	3.6				
Clear, at 40oC				1.238	1.180	1.149	1.168
Water and Sediment, Volume %	ASTM D1796		0.05	0	0	0	0

Appendix F

Laboratory Documentation

Appendix F.1

Laboratory Certificates of Analysis

Appendix F.2

Laboratory QAQC Report

Appendix F.3

Chain of Custody Records

Appendix G

Tank Inventory Field Forms

Appendix H

Standard Methods for CAN/CGSB-3.517-2000

Acidity:

ASTM D 974

New and used petroleum products can contain basic or acidic constituents that are present as additives or as degradation products formed during service, such as oxidation products. The relative amount of these materials can be determined by titrating with acids or bases. This number, whether expressed as acid number or base number, is a measure of the amount of acidic or basic substances, respectively, in the oil—always under the conditions of the test. This number is used as a guide in the quality control of lubricating oil formulations.

Accelerated Stability

ASTM D 2274 – *Oxidation Stability of Distillate Fuel Oil (Accelerated Method)*

After filtration to remove any particulate contamination, a 350-milliliter sample is transferred to a special glass container and held at 203°F (95°C) for 16 hours while oxygen is bubbled through the sample. At the end of the treatment period, the sample is allowed to cool to room temperature and filtered to collect any insoluble material that formed.

Appearance:

GL-4 – *Visual Method*

The CGSB specification states that the fuel shall be a stable homogenous liquid free from foreign matter likely to clog filters or nozzles or damage equipment. A visual appearance is done to ensure that there is no gross contamination of the fuel with particulate matter and or water. Particulate matter can clog filters or nozzles and water can be detrimental because when water is present bacterial growth can occur which may also cause clogging of filters and nozzles.

Ash

ASTM D 482 – *Ash from Petroleum Products*

The sample is placed in a crucible, ignited, and allowed to burn. The carbonaceous residue is heated further in a muffle furnace to convert all the carbon to carbon dioxide and all the mineral salts to oxides (ash). The ash is then cooled and weighed.

Cetane Number

Cetane number measures the tendency of the fuel to ignite spontaneously. In the cetane number scale, high values represent fuels that ignite readily and, therefore, perform better in a diesel engine.

ASTM D613 – *Cetane Number of Diesel Fuel Oil*

A fuel sample is run through a singe cylinder engine with a continuously variable compression ratio under a fixed set of conditions.

Cetane Index

ASTM D976 – *Calculated Cetane Index of Distillate Fuels*

This method uses the density of the fuel and its mid-distillation temperature estimate the cetane number.

Cloud Point

ASTM D 5773 – *Cloud Point of Petroleum Products (Constant Cooling Method)*

A clean clear sample is cooled at a specified rate and examined periodically. The temperature at which a haze is first observed is the cloud point.

Copper Corrosion

ASTM D 130 – *Detection of Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test*

A polished copper strip is immersed in the sample for three hours at 122°F (50°C) and then removed and washed. The condition of the copper surface is qualitatively rated by comparing it to standards.

Carbon Residue

ASTM D 524 – Ramsbottom Carbon Residue of Petroleum Products

The sample is first distilled (D 86) until 90% of the sample has been recovered. The residue is weighed into a special glass bulb and heated in a furnace to 1022°F (550°C). Most of the sample evaporates or decomposes under these conditions. The bulb is cooled and the residue is weighed.

Distillation

ASTM D 86 – *Distillation of Petroleum Products*

The distillation profile is a fundamental fuel property. In this test, a 100 ml sample is placed in a round bottom flask and heated to obtain a controlled rate of evaporation. The temperature is recorded when the first drop is collected (the initial boiling point), at recovered volume percentages of 5%, 10%, every subsequent 10% to 90%, 95%, and at the end of the test (end point).

Electrical Conductivity:

ASTM D 2624

Conductivity is important because the ability of a fuel to dissipate charge that has been generated during pumping and filtering operations is controlled by its electrical conductivity, which depends upon its content of ion species. If the conductivity is sufficiently high, charges dissipate fast enough to prevent their accumulation and dangerously high potentials in a receiving tank are avoided. The conductivity can be increased with the addition of conductivity-improver additive.

Flash Point

ASTM D 93 – *Flash-Point by Pensky-Martens Closed Cup Tester*

The sample is stirred and heated at a slow, constant rate in a closed cup. At intervals, the cup is opened and an ignition source is moved over the top of the cup. The flash point is the lowest temperature at which the application of the ignition source causes the vapors above the liquid to ignite.

Density:

ASTM D 4052 - *Standard Test Method for Density and Relative Density of Liquids by Digital Density Meter*

Density is a fundamental physical property that can be used in conjunction with other properties to characterize both the light and heavy fractions of petroleum and petroleum products.

Determination of the density or relative density of petroleum and its products is necessary for the conversion of measured volumes to volumes at the standard temperature of 15°C.

Lubricity

ASTM D 6079 – *Evaluating Lubricity of Diesel Fuels by the High-Frequency Reciprocating Rig (HFRR)*

A hardened steel ball oscillates across a hardened steel plate under a fixed load for 75 minutes. The point of contact between the ball and plate is immersed in the sample. The size of the resulting wear scar on the steel ball is a measure of the sample's lubricity.

Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)

ASTM D 5185 - *Standard Test Method for Determination of Additive Elements, Wear Metals, and Contaminants in Used Lubricating Oils and Determination of Selected Elements in Base Oils by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)*

A clean sample is processed in the ICP-AES and the instrument measures the strength of the emission spectrum for each element of interest.

Pour Point

ASTM D 97 – *Pour Point of Petroleum Products*

A clean sample is first warmed and then cooled at a specified rate and observed at intervals of 5°F (3°C). The lowest temperature at which sample movement is observed when the sample container is tilted is the pour point.

Thermal Stability

Octel/Dupont F21 – *150°C Accelerated Fuel Oil Stability Test*

After filtration to remove any particulate contamination, a 50-milliliter sample is placed in a glass container and aged for either 90 minutes or 180 minutes at 302°F (150°C) with air exposure. At the end of the treatment period, the sample is allowed to cool to room temperature and filtered. The amount of insoluble material collected on the filter pad is estimated by measuring the light reflection of the pad.

Sulfur

ASTM D 2622 – *Sulfur in Petroleum Products by X-Ray Spectrometry*

The sample is placed in an x-ray beam and the intensity of the sulfur x-ray fluorescence is measured.

Kinematic Viscosity

ASTM D 445 – *Kinematic Viscosity of Transparent and Opaque Liquids*

The sample is placed in a calibrated capillary glass viscometer tube and held at a closely controlled temperature. The time required for a specific volume of the sample to flow through the capillary under gravity is measured. This time is proportional to the kinematic viscosity of the sample.

Water and Sediment

ASTM D 2709 – *Water and Sediment in Middle Distillate Fuels by Centrifuge*

Water and sediment are contaminants. In this test, a 100 ml sample is centrifuged under specified conditions in a calibrated tube. The amount of sediment and water that settles to the bottom of the tube is read directly using the scale on the tube.

Acidity:

ASTM D 974

New and used petroleum products can contain basic or acidic constituents that are present as additives or as degradation products formed during service, such as oxidation products. The relative amount of these materials can be determined by titrating with acids or bases. This number, whether expressed as acid number or base number, is a measure of the amount of acidic or basic substances, respectively, in the oil—always under the conditions of the test. This number is used as a guide in the quality control of lubricating oil formulations.

Accelerated Stability

ASTM D 2274 – *Oxidation Stability of Distillate Fuel Oil (Accelerated Method)*

After filtration to remove any particulate contamination, a 350-milliliter sample is transferred to a special glass container and held at 203°F (95°C) for 16 hours while oxygen is bubbled through the sample. At the end of the treatment period, the sample is allowed to cool to room temperature and filtered to collect any insoluble material that formed.

Appearance:

GL-4 – *Visual Method*

The CGSB specification states that the fuel shall be a stable homogenous liquid free from foreign matter likely to clog filters or nozzles or damage equipment. A visual appearance is done to ensure that there is no gross contamination of the fuel with particulate matter and or water. Particulate matter can clog filters or nozzles and water can be detrimental because when water is present bacterial growth can occur which may also cause clogging of filters and nozzles.

Ash

ASTM D 482 – *Ash from Petroleum Products*

The sample is placed in a crucible, ignited, and allowed to burn. The carbonaceous residue is heated further in a muffle furnace to convert all the carbon to carbon dioxide and all the mineral salts to oxides (ash). The ash is then cooled and weighed.

Cetane Number

Cetane number measures the tendency of the fuel to ignite spontaneously. In the cetane number scale, high values represent fuels that ignite readily and, therefore, perform better in a diesel engine.

ASTM D613 – *Cetane Number of Diesel Fuel Oil*

A fuel sample is run through a singe cylinder engine with a continuously variable compression ratio under a fixed set of conditions.

Cetane Index

ASTM D976 – *Calculated Cetane Index of Distillate Fuels*

This method uses the density of the fuel and its mid-distillation temperature estimate the cetane number.

Cloud Point

ASTM D 5773 – *Cloud Point of Petroleum Products (Constant Cooling Method)*

A clean clear sample is cooled at a specified rate and examined periodically. The temperature at which a haze is first observed is the cloud point.

Copper Corrosion

ASTM D 130 – *Detection of Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test*

A polished copper strip is immersed in the sample for three hours at 122°F (50°C) and then removed and washed. The condition of the copper surface is qualitatively rated by comparing it to standards.

Carbon Residue

ASTM D 524 – Ramsbottom Carbon Residue of Petroleum Products

The sample is first distilled (D 86) until 90% of the sample has been recovered. The residue is weighed into a special glass bulb and heated in a furnace to 1022°F (550°C). Most of the sample evaporates or decomposes under these conditions. The bulb is cooled and the residue is weighed.

Distillation

ASTM D 86 – *Distillation of Petroleum Products*

The distillation profile is a fundamental fuel property. In this test, a 100 ml sample is placed in a round bottom flask and heated to obtain a controlled rate of evaporation. The temperature is recorded when the first drop is collected (the initial boiling point), at recovered volume percentages of 5%, 10%, every subsequent 10% to 90%, 95%, and at the end of the test (end point).

Electrical Conductivity:

ASTM D 2624

Conductivity is important because the ability of a fuel to dissipate charge that has been generated during pumping and filtering operations is controlled by its electrical conductivity, which depends upon its content of ion species. If the conductivity is sufficiently high, charges dissipate fast enough to prevent their accumulation and dangerously high potentials in a receiving tank are avoided. The conductivity can be increased with the addition of conductivity-improver additive.

Flash Point

ASTM D 93 – *Flash-Point by Pensky-Martens Closed Cup Tester*

The sample is stirred and heated at a slow, constant rate in a closed cup. At intervals, the cup is opened and an ignition source is moved over the top of the cup. The flash point is the lowest temperature at which the application of the ignition source causes the vapors above the liquid to ignite.

Density:

ASTM D 4052 - *Standard Test Method for Density and Relative Density of Liquids by Digital Density Meter*

Density is a fundamental physical property that can be used in conjunction with other properties to characterize both the light and heavy fractions of petroleum and petroleum products.

Determination of the density or relative density of petroleum and its products is necessary for the conversion of measured volumes to volumes at the standard temperature of 15°C.

Lubricity

ASTM D 6079 – *Evaluating Lubricity of Diesel Fuels by the High-Frequency Reciprocating Rig (HFRR)*

A hardened steel ball oscillates across a hardened steel plate under a fixed load for 75 minutes. The point of contact between the ball and plate is immersed in the sample. The size of the resulting wear scar on the steel ball is a measure of the sample's lubricity.

Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)

ASTM D 5185 - *Standard Test Method for Determination of Additive Elements, Wear Metals, and Contaminants in Used Lubricating Oils and Determination of Selected Elements in Base Oils by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)*

A clean sample is processed in the ICP-AES and the instrument measures the strength of the emission spectrum for each element of interest.

Pour Point

ASTM D 97 – *Pour Point of Petroleum Products*

A clean sample is first warmed and then cooled at a specified rate and observed at intervals of 5°F (3°C). The lowest temperature at which sample movement is observed when the sample container is tilted is the pour point.

Thermal Stability

Octel/Dupont F21 – *150°C Accelerated Fuel Oil Stability Test*

After filtration to remove any particulate contamination, a 50-milliliter sample is placed in a glass container and aged for either 90 minutes or 180 minutes at 302°F (150°C) with air exposure. At the end of the treatment period, the sample is allowed to cool to room temperature and filtered. The amount of insoluble material collected on the filter pad is estimated by measuring the light reflection of the pad.

Sulfur

ASTM D 2622 – *Sulfur in Petroleum Products by X-Ray Spectrometry*

The sample is placed in an x-ray beam and the intensity of the sulfur x-ray fluorescence is measured.

Kinematic Viscosity

ASTM D 445 – *Kinematic Viscosity of Transparent and Opaque Liquids*

The sample is placed in a calibrated capillary glass viscometer tube and held at a closely controlled temperature. The time required for a specific volume of the sample to flow through the capillary under gravity is measured. This time is proportional to the kinematic viscosity of the sample.

Water and Sediment

ASTM D 2709 – *Water and Sediment in Middle Distillate Fuels by Centrifuge*

Water and sediment are contaminants. In this test, a 100 ml sample is centrifuged under specified conditions in a calibrated tube. The amount of sediment and water that settles to the bottom of the tube is read directly using the scale on the tube.

Appendix I

GC/FID C1-C60 Chromatograms

Appendix J

Inuvialuit Benefits Reporting

Inuvialuit Regional Corporation

Co-operation and Benefits Agreements

Employment Benefits Report

Reporting Company:	**IEG Environmental**	**Reporting Period:**	**2005**
Reported By:	**IEG Environmental**	**Phone No./E-mail:**	**867-777-8520**
	Name & Title		

Position	Program Component	Employee Home Community (list name of community)	Employee Totals					Person-hours						Total Person Hours
			Northern			Southern		Northern			Total Northern Hours	Southern		
			I	G	N	I	S	I	G	N		I	S	
Site Supervisor		Yellowknife			X					96				
Sample Tech		Inuvik			X					96				
Sample Tech		Inuvik			X					96				
Geophys. Tech		Calgary					X			96				
Cook		Inuvik			X								96	
Wildlife Monitor		Sachs Harbour	X					96						
		Totals:						**96**		**384**			**96**	**576**

Legend:

I = Inuvialuit; **G** = Gwich'in; **N** = Other Northerner; **S** = Southern, F = Foreign

Program Component = Seismic, Drilling, Construction, Operations or Other

Northern = All communities located within the Northwest Territories, Yukon Territories and/or Nunavut Territories

SUMMARY INFORMATION	
TOTAL WAGES PAID TO ALL:	$ 14,400.00
% TOTAL WAGES PAID TO INUVIALUIT:	17%
% TOTAL HRS WORKED BY INUVIALUIT:	17%

revised August 2003

Inuvialuit Regional Corporation
Co-operation and Benefits Agreements

Wages and Person Hours by Community & Component Report

Reporting Company:	**IEG Environmental**	**Reporting Period:**	**2005**
Reported By:	**IEG Environmental**	**Phone No./E-mail:**	**867-777-8520**
	Name & Title		

Employee Home Community	Total Number of Person Hours	Total Direct Wages Paid
Aklavik		
Holman		
Inuvik	288	$ 7,200.00
Paulatuk		
Sachs Harbour	96	$ 2,400.00
Tuktoyaktuk		
Fort McPherson		
Tsiigehtchic		
Other NWT	96	$ 2,400.00
TOTALS FOR NORTH:	**480**	**$ 12,000.00**
Southern Canada	96	$ 2,400.00
TOTALS FOR SOUTH:	**96**	**$ 2,400.00**

TOTALS FOR PROGRAM:	**576**	**$ 14,400.00**

Program Component	Total Number of Northern Person Hours
Seismic	
Drilling	
Construction	
Operations	
Other	480
TOTAL NORTHERN PERSON HOURS FOR PROGRAM:	**480**

Note: above total includes only NORTHERN person hours

revised August 2003

Inuvialuit Regional Corporation

Co-operation and Benefits Agreements

Direct Contracting Report - Operators

Operator:	**IEG Environmental**	**Reporting Period:**	**2005**
Reported By:	**IEG Environmental**	**Phone No./E-mail:**	**867-777-8520**
	Name & Title		

Name of Direct Contractor	Contractor Community	Inuvialuit Business (Y/N)	If non-Inuvialuit Business Select basis of award:					Summary of Good or Service Purchased	Value of Direct Contract ($)
			Safety	Environmental	Technical/Quality	Availability	Cost		
IEG Environmental	Inuvik	Y						Environmental Site Assessment	$ 250,000.00

Total Direct Contract Value:	**$ 250,000.00**
Total Value of Direct Contracts paid to Inuvialuit Businesses:	**$ 250,000.00**
Total Value of Direct Contracts paid to non-Inuvialuit Businesses:	**$ -**
Total Value of Direct Contracts paid to Northern Businesses:	**$ 250,000.00**

Note: In the case of previous and current multi-year contracts include all expenditures payable for this reporting period only.

RANGES:

(a) $0-$3K; (b) $3K -$10K; (c) $10K - $25K; (d) $25K-$50K; (e) $50K-$100K; (f) $100K-$200K; (g) $200K-$300K; (h) $300K - $500K; (i) $500K-$1M; (j) $1M-$5M; (k) $5M-$10M; (l) over $10M

Inuvialuit Regional Corporation

Co-operation and Benefits Agreements ***Sub-Contracting Report***

Reporting Company:	**IEG Environmental**	**Reporting Period:**	**2005**
Reported By:	**IEG Environmental**	**Phone No./E-mail:**	**867-777-8520**

Name of Sub - Contractor	Sub - Contractor Community	Inuvialuit Business (Y/N)	If non-Inuvialuit Business Select basis of award:					Summary of Good or Service Purchased	Value of Sub-Contract ($)
			Safety	Environmental	Technical/Quality	Availability	Cost		
Dowland Contracting	Inuvik	Y						Skilled Labour	$ 10,000.00
Aklak Air	Inuvik	Y						Charter Aircraft (Twin Otter)	$ 30,000.00
Kenn Borek Air	Calgary	N				X		Charter Aircraft (DC-3)	$ 30,000.00
Komex International	Calgary	N			X			Geophysical Survey	$ 20,000.00
Arctic Oil and Gas Service	Inuvik	Y						Camp Catering	$ 8,000.00
Sachs Harbour HTC	Sachs Harbour	Y						Wildlife Monitoring	$ 3,000.00
Lakes and Rivers Consultir	Inuvik	Y						Camp Services	$ 12,000.00
Canadian North	Yellowknife	Y						Cargo, Air Transport	$ 5,000.00
EnviroTest Laboratories	Edmonton	N			X			Analytical	$ 30,000.00
NewNorth Networks	Inuvik	N				X		Telecommunications	$ 1,000.00
Arctic Dove	Inuvik	N				X		Fuel	$ 1,000.00
								Total Sub-Contract Value:	**$ 150,000.00**

NOTE: In the case of previous and current multi-year contracts include all expenditures payable for this reporting period only.

Total Value of Sub-Contracts paid to Inuvialuit Businesses:	**$ 68,000.00**
Total Value of Sub-Contracts paid to non-Inuvialuit Businesses:	**$ 82,000.00**

RANGES:

(a) $0-$3K; (b) $3K -$10K; (c) $10K - $25K; (d) $25K-$50K; (e) $50K-$100K; (f) $100K-$200K; (g) $200K-$300K; (h) $300K - $500K; (i) $500K-$1M; (j) $1M-$5M; (k) $5M-$10M; (l) over $10M

Appendix K

Incineration Plan

INCINERATION PLAN FOR ONSITE WASTE FUEL
JOHNSON POINT, NORTHWEST TERRITORIES

Prepared for:

Emma Pike
Project Officer
Indian & Northern Affairs Canada
4914-50th St.
Yellowknife, NT
X1A 2R3

Prepared by:

IEG Environmental

December, 2005
IEG Project: 20194

Calgary, AB ¤ Yellowknife, NT ¤ Fort McMurray, AB ¤ Inuvik, NT

INCINERATION PLAN FOR ONSITE WASTE FUEL
JOHNSON POINT, NORTHWEST TERRITORIES

Submitted to:

Emma Pike
Project Officer
Indian & Northern Affairs Canada
4914-50th St.
Yellowknife, NT
X1A 2R3

DISTRIBUTION:

1 Copy	Emma Pike Indian & Northern Affairs Canada
1 Copy	IEG Environmental Inuvik, NT
1 Copy	IEG Environmental Calgary, AB

IEG Environmental (IEG) is pleased to present Indian and Northern Affairs Canada (INAC) this Incineration Plan for the disposal of waste fuel at Johnson Point, located on the east side of Banks Island, adjacent to the Prince of Wales Strait, approximately 270 kilometres from the Sachs Harbour, NT.

This is a controlled document. This Incineration Plan is effective until completion of fieldwork at Johnson Point following the September, 2005 Incineration Program, and applies to the Johnson Point Waste Fuel Incineration Program of Indian and Northern Affairs Canada.

This document is organized into the following sections:

- Section 2 – Fuel Consolidation and Transportation Plan
- Section 3 – Operations and Maintenance Plan

Copies of this document have been distributed to the following individuals or companies:

Copy 1 Emma Pike, Indian and Northern Affairs Canada

Copy 2 IEG Environmental, Inuvik

Copy 3 IEG Environmental, Calgary

For additional copies of this controlled document contact:

Joey Herrington, Spec.B.Sc.
Environmental Geoscientist
IEG Environmental
joey.herrington@ieg.ca

TABLE OF CONTENTS

1.0 INTRODUCTION

The purpose of IEG's Incineration Plan is to provide a plan of action for every foreseeable event, including spills, at Johnson Point during Waste Fuel Incineration activities. The plan defines the responsibilities of key personnel and outlines the current best approach to each identified activity. Parts of the plan define procedures for responding to spills in a way that will minimize potential negative impacts to human health and the environment. The plan has been prepared to provide easy access to all the information needed to undertake waste fuel incineration at a remote arctic site.

Onsite operations will require a crew of 4 people, with pilots and visitors raising the total number of people on site to approximately 8 during mobilization, re-supply, and demobilization activities. Hazardous materials used on-site during the incineration program will include diesel, stove oil, gasoline, propane, and aviation fuel. These products will be stored in new, clearly labelled containers.

It is IEG company policy:

- To comply with existing spill regulations;
- To provide such protection of the environment as is technically feasible and economically practical;
- To cooperate with other groups working on protection of the environment;
- To anticipate future pollution control requirements and to make provision for them; and
- To keep employees, government regulators, and the public fully informed.

In February 2002 the spill reporting requirements of the Northwest Territories were revised to include:

- The Operator, i.e. the Company, must ensure that spills are promptly reported, controlled, and cleaned up as per the approved Spill Contingency Plan (SCP). This includes any spills by contractors employed by the Operator.
- Report all spills, regardless of volume, to the 24-hour Report Line. Spill Line administrators will assign the Lead Agency and Notify the National Energy Board (NEB) and other agencies.
- The Operator is not required to provide a separate spill notification to the NEB unless:
  - The spill is not yet contained and could result in further safety, property, or environmental damage; and/or
  - The spill exceeds $0.20m^3$ (200L).

2.0 FUEL CONSOLIDATION AND TRANSPORTATION PLAN

Field activities at Johnson Point for the Waste Fuel Incineration Program depend largely on the consolidation and transfer of waste fuel located at the site. Approximately 90,000 L of waste diesel fuel is known to exist at the site in fuel sloops and within several large POL tanks (commonly referred to as the tank farm). The POL tanks inside the Tank Farm represent nearly 50,000 L of waste fuel. The remaining onsite waste fuel is located in various tanks spread across the site.

In total 69 tanks were inventoried on-site. This number includes 19 large POL tanks ranging in size from 90,000 L to 1,600,000 L located inside the bermed area of the Tank Farm, 10 standard 205 L barrels, and 40 smaller horizontal tanks ranging in size from 2000 L to 60,000 L. With the exception of the 10 barrels, all onsite tanks are constructed of bolted or welded steel walls. Specific details of each tank including location, wall construction type, orientation, size of openings, and dimensions have been summarized in Table 9 of the accompanying Phase I/II ESA Report.

In preparation for fuel consolidation and transportation from the fuel sloops and tank farm to the waste fuel incinerator the following plan has been developed. The plan will outline the general procedures for evacuating fuel sloops and tanks, transferring fuel to the incinerator, and consolidating the fuel where it will be available for disposal in the waste fuel incinerator.

2.1 Pre-departure Considerations

Appropriate measures will be taken to ensure that appropriate mitigative measures are implemented prior to departure to avoid unnecessary delays. This will include, but not be limited to, collection of the following equipment:

- Incinerator:
  - Extra fan motor;
  - Extra pumps
  - Gaskets for ignition burner mounts
- Generator:
  - Fuel (volume required to be based on burn rate of specific generator selected)
  - Oil filters
  - Fuel filters
  - Belts
- Fuel Transfer:
  - Pumps:
    - Gorman Rupp Explosion proof type
    - Robin Explosion proof type
  - Hoses (200ft. in various lengths)
  - Flanges
  - Valves
- Tank Entry:
  - Electric impacts
  - Star sockets

2.2 Fuel Transfer

At the outset of the incineration program one of the large POL tanks should be established as the primary feedstock tank. This tank should be carefully investigated for any signs of compromised integrity.

The contents of every other tank should then be systematically transferred to this tank allowing each tank to be subsequently cleaned and inspected in preparation for decommissioning.

Larger tanks will be inspected for presence and condition of approved fire-proof vents.

The first step in the fuel transfer process will be to measure the thickness of the fuel contained in the tank. Appropriate safety procedures will be employed to mount the tank. Waste fuel thickness will be measured by dipping the tank with an Interface Meter or a 'dip' tape coated with hydrocarbon paste. Any person or persons working on top of tanks will be required to wear fall arrest equipment specific to the situation. Safety lines will be installed at the top and down the sides of the tank.

If tank nozzles are too high to permit direct suction of fuel out of the tank, a floating suction assembly can be introduced through the lower manway to remove the fuel via a hose assembly flanged to a suction line outside the tank. Entry to the tank will be limited to individuals who have up to date training in confined space entry. The lowest spot on the tank bottom will be determined and a bottom plate will be installed. Fuel will be pumped directly into the feedstock tank or into 45-gallon drums located on the fuel transfer trailer (see below). When the fuel transfer is complete the tank will be cleaned and sealed until decommissioning. Pertinent information regarding the state of the tank will be painted on the outside of the tank. Detailed records of pertinent information will be kept for each tank drained.

If the fuel level is above the height of the side nozzle the tank will be inspected for an approved shut off valve (e.g. ball valve) to control flow. If a shut off valve is not present, reasonable effort will be made to fit one to the tank prior to fluid transfer. When a bottom drain and/or shut off valve is not present, and if it safe to do so, tanks will be pumped from an opening near the top of the vessel.

Fuel transfer will only take place from the top hatches of tanks if it is deemed safe to do so and if there is no potential of a spark entering the tank.

Fuel pumps, if required, will be approved, spark proof (explosion proof) pumps, specifically designed for the transfer of liquid fuel.

Only approved fuel hoses will be used to transfer fuel between tanks and barrels. Selected hoses must be of the proper length.

All barrels and equipment will be checked to ensure there are no cracks or obvious signs of leaking. If a leak is apparent, or there are other obvious problems with the equipment, the transfer will be stopped immediately pending appropriate action.

Prior to pumping fuel to the receiving tank, the tank will be carefully inspected and once integrity is confirmed then pumping can commence. During the pumping process there will be regular inspection of the hoses and lines to ensure there are no leaks. The crew members operating the pump and inspecting the hoses/lines will be equipped with two-way radios to ensure immediate communication will be possible in the event of a leak. This procedure should apply whenever fuel is being transferred.

Attention is drawn to the possible hazard due to electrostatic charges which may be present in the fuel. Electrostatic charges occur, in particular, with static accumulator liquids, i.e. liquids which have low conductivity of 50 picoSiemens/metre (pS/m) or less.

It is very important that equipment/instruments be grounded to the tank before being introduced into the tank and remain grounded until after complete withdrawal from the tank.

If is it not possible to pump from tank to tank using a direct hose (due to proximity or other reasons) the following system will be implemented:

1. In instances where moving the incinerator is unwarranted or a significant volume of fuel cannot be pumped directly into the feedstock tank, two 45 gallon drums will be secured inside a small quad wagon. The wagon will be lined with spill containment material. Tanks will be drained into the drums and transported to the incinerator unit for transfer to the feedstock reservoir.
2. A liner will be used underneath the containers while transferring fluids.
3. Before the transfer drums are moved the straps and bungs will be double checked to reduce the possibility of tipping/spilling during transport.
4. Transportation of fuel to the incinerator unit will, to the extent possible, follow existing 'roadways' or pathways on site.
5. Uneven terrain such as gullies will be avoided to reduce the possibility of tipping the transfer drums.
6. The quad pulling the transfer drums will be operated by an experienced driver and the on site speed limit will be set at 10km/h.

In addition, the following general precautions will be taken:

7. Spills may occur while transferring fuel between barrels, and while loading and offloading. Extra precaution must be used at these times.
8. Before transferring, the contractor will check all container levels and pumps to prevent overfilling or accidental release. In the case of liquid fuel being transported to the incinerator, it is expected that any accidental spills occurring during fuel transfer will be contained within the wagon.
9. The contractor will maintain constant line-of-sight contact with critical components throughout fluid transfer procedure.
10. The contractor will be prepared to stop the transfer immediately if any leak is observed. The contractor will not try to fix a leak during transfer.
11. The contractor will never leave fluid transfer operations unattended.
12. Transferred fluids will be placed as far away from bodies of water, tundra, and wildlife habitat as possible (at least 30m from waters edge). When dealing with fluid transfers near water:
    a. Verify that extra booms and sorbents are on hand.
    b. Inspect hoses, connections, valves etc., before starting any fluid transfers. Be sure each connection is tightened properly.
    c. Booms are to be present near the waters edge, slightly downstream of transfer site at all times.
13. A minimum of two sets of fuel transfer pumps will be available for use at the site.
14. One fuel transfer pump will remain at or near the tank being evacuated, while the second set will remain at or near the incinerator to transfer fuel from the transfer tanks to the feedstock vessel, as and when necessary.

2.2.1 Tank Cleaning

Safe work procedures for confined space and H2S must be followed. All personnel must be certified in H2S and confined space entry. Tank Cleaners will be certified and experienced in Confined Space Entry, Lock-out/Tag-out procedures, and working in dangerous atmospheres. Daily tailboard meetings should be held prior to the commencement of work. These meetings should be a forum to discuss the day's proposed activities as well as a chance to review safety procedures so that all members of the crew have a clear understanding of the work planned for the day and how it will be executed. Emergency procedures should be reviewed and roles for all crewmembers should be confirmed. Standard Tank Cleaning Procedure Checklists and Hot/Cold work permits for work inside the tanks should be reviewed at these meetings.

Tank cleaning activities generally require a crew of 6 personnel, including the following:

- Tank Cleaner/Project Foreman
- Tank Cleaning Supervisor
- Tank Cleaner
- Fresh Air Blower Monitor
- Safety Person
- Wildlife Monitor

General tank cleaning procedure is as follows:

- Tank entry – assess LEL levels inside tank – open tank vents
- Pump out any fuel or residues on tank bottom
- Wash tank with steam/hot water – pump out waste water
- Rinse tank – wash & rinse procedure may have to be repeated if tank very dirty
- Pump out rinse water & dry tank bottom and sides with clean white rags
- Confirm LEL level OK for tank inspection – leave tank well vented

Tank Cleaners should be provided with rain gear to minimize contamination of clothing. Only one tank-cleaner will be in any tank at one time unless rescue is required.

Manways will be opened to provide access and ventilation for tank cleaning operations. Manways that will be re-sealed will have new gaskets installed as well as any flanges that are taken apart. Disturbed gaskets should be replaced. Gasket material to be used for manways should be Durlon 8500 material. Any flange gaskets disturbed should be replaced with Garlock Blue-Gard Style 3000 2" ring gaskets. Studs and nuts will also be replaced on all disturbed fittings and connections. A supply of spare parts should be brought to the site to maintain equipment and to effect minor repairs should they be required. Equipment should be maintained in excellent condition to keep the likelihood of breakdown minimal. Fire extinguishers must be available for emergency use at all times.

Water or sludge at the bottom of any tank can be pumped into barrels. The tank will then be cleaned, inspected, and ready for disassembly.

Residues from tank-cleaning operations will be put into UN certified 45-gallon tight-head drums. Hydrophobic oil spill materials, filtration materials and dirty rags from tank cleaning will be placed in 'open-head' drums. Labeling of drums will be as per TDG specifications. Barrels will be left in containment dykes. At the conclusion of the project copies of completed TDG Hazardous Goods Waste Management Forms and standard drum inventory forms will be filed for inclusion in the project documentation.

The contaminated water from tank cleaning operations should have organic material removed by agitation with an oil absorbent material. The water can then be analyzed for Cadmium, Chromium and Lead according to the DEW Line Cleanup Protocol for Barrels. If metals are present at acceptable levels the water may be discarded on land that is a minimum of 30m from natural drainage courses.

2.3 Recommended Reading

The following documentation may prove useful in the development of Technical Specifications for fuel transfer and tank cleaning.

ANSI/API Standard 2015, *Requirements for Safe Entry and Cleaning of Petroleum Storage Tanks*, is intended for use by companies to develop safe practices for planning, managing, and conducting tank cleaning work in atmospheric and low pressure storage tanks.

ANSI/API Recommended Practice 2016, *Guidelines and Procedures for Entering and Cleaning Petroleum Storage Tanks*, provides guidance and additional information specific aspects of tank cleaning preparation, hazard awareness, decommissioning, emptying, isolating, vapour and gas freeing, degassing, ventilating, atmospheric testing, inspecting, cleaning, entry, safe (cold) work, and hot work.

These documents are intended to be consistent with Title 29 of the *U.S. Code of Federal Regulations, Occupational Safety and Health Administration Standards*, Part 1910, 'General Industry,' and Part 1926 'Construction.' These standards are also intended to be consistent with US National Fire Protection Association Codes and Standards applicable to the entry and cleaning of aboveground petroleum storage tanks. The standards are not intended to conflict with statutory or regulatory requirements or to function as a substitute for applicable Canadian or Territorial regulations, codes, standards, or employer practices and procedures, all of which must be reviewed in their entirety to determine their applicability to the site, its location, the tanks involved, and the proposed work.

As the transfer of fluid will be done from large tanks to smaller tanks, or from one 45gallon barrel to another, the following procedures will be implemented: