



Indian and Northern Affairs
Canada

HAINES-FAIRBANKS PIPELINE:

ENVIRONMENTAL SITE ASSESSMENTS OF BEAVER CREEK, DONJEK AND DESTRUCTION BAY, PUMPING STATIONS

Final Report

Lorimer & Associates
in association with
Hemmera Resource Consultants Ltd.

20 December 1995

Lorimer

& Associates

Consulting Engineers

Our File: YT 173 01

20 December 1995

Arctic Environmental Strategy
Indian and Northern Affairs Canada
345-300 Main Street
Whitehorse, Yukon
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Attention: Mr. Brett Hartshorne
Manager, Action on Waste

Re: Haines-Fairbanks Pipeline
Environmental Site Assessments and Field Investigations:
Beaver Creek, Donjek and Destruction Bay Pump Stations
Final Report - Contract # 95-0037

Dear Mr. Hartshorne:

Lorimer & Associates, in association with Hemmera Resource Consultants Ltd., is pleased to submit the attached final report concerning environmental site assessments and field investigations of pump station sites at Beaver Creek, Donjek and Destruction Bay on the former Haines-Fairbanks Pipeline.

The report documents work carried out during the assignment, including field and laboratory programs, findings, interpretations, risk assessments and recommendations.

Thank you for the opportunity to carry out this assignment on your behalf. Should you have any questions regarding the report or its conclusions, please feel free to contact either of the undersigned.

Yours very truly,

LORIMER & ASSOCIATES



Robert J. Lorimer, P.Eng.

RJL/
encl.

HEMMERA RESOURCE
CONSULTANTS LTD.



Bruce Willmer, M.Sc., P.Geo.

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1.0 INTRODUCTION

Lorimer & Associates (Lorimer) in association with Hemmera Resource Consultants Ltd. (Hemmera) were retained by Indian and Northern Affairs Canada (INAC), Arctic Environmental Strategy (AES) under contract no. 95-0037 to carry out Environmental Site Assessments and Field Investigations of the Beaver Creek, Donjek and Destruction Bay Pump Stations on the former Haines-Fairbanks Pipeline (Figure 1).

This report documents the work carried out during the assignment, including a review of existing information, field and laboratory programs, findings, interpretations, risk assessments and recommendations. The report follows the format established by INAC in the Terms of Reference for the work.

1.1 Background

In the 1950's, the United States government constructed the Haines - Fairbanks Pipeline to supply fuels to its military installations in Alaska. The pipeline consisted of an eight inch multi - product line with six pumping stations along the Canadian section. Fuels transported through the lines included: diesel fuel; aircraft turbine and jet engine fuel (JP-4); automotive combat gasoline (grade 95C); and aviation gasoline (Rickard, W.E. Denecke, F. 1972; 172D Infantry Brigade Alaska 1982). A significant portion of the line was installed above ground. The pipeline was decommissioned in 1972, with the majority of the pipe and one pumping station removed in 1990 - 1991.

In 1994, the Arctic Environmental Strategy (AES) - Action on Waste program conducted a preliminary environmental investigation of four of the pumping stations. Later in the same year, DDT canisters were found buried near a pumping station in Northern B. C. by the British Columbia Ministry of Environment, Lands and Parks. As a result of the preliminary investigations and the discovery of the DDT canisters, AES concluded that additional information relating to activities associated with the pumping stations was required to determine the environmental status of the sites. This report documents those additional investigations. The information collected during the assessments and the preliminary investigations will be used to develop remediation strategies.

1.2 Project Objectives and Scope

The overall objective of the program was to carry out **preliminary environmental assessments** based on a cursory inspection and sampling of the three pumping stations and to develop recommendations for future assessments and/or remediation of the three sites as appropriate.

The specific scope of work for the assignment included the following tasks:

- Completion of a Phase I assessment of the sites;
- Preparation and implementation of a Response/Operation/Health & Safety Plan;
- Completion of a visual reconnaissance of the sites;
- Completion of INAC-approved Phase II investigations; and
- Completion of a report on the work.

2.0 METHODOLOGY

2.1 Phase I Assessment

Lorimer completed a review of all relevant information for each site. This included: historical review of site maps and aerial photos; review of records to determine previous owners, uses and tenants; review of maintained lists of known hazardous/toxic substance sites and emergency response/remediation action sites within an applicable distance of the pumping stations; search and review of other local, territorial, federal and international files, lists and documents as appropriate; interview of past and present on-site and neighbouring parties to determine the past history of the site, the status of the permits, waste water disposal practices, the location of on-site wells and the management of other waste; description of existing and intended land use of the site and surrounding areas; and determination of the hydrogeological regime both on-site and in the area.

A list of documents reviewed and sources of information is provided in Appendix A.

2.2 Response/Operation/Health & Safety Plan

A preliminary Health, Safety and Contingency Plan was developed prior to initiating the field work (Appendix B).

2.3 Visual Reconnaissance of the Site

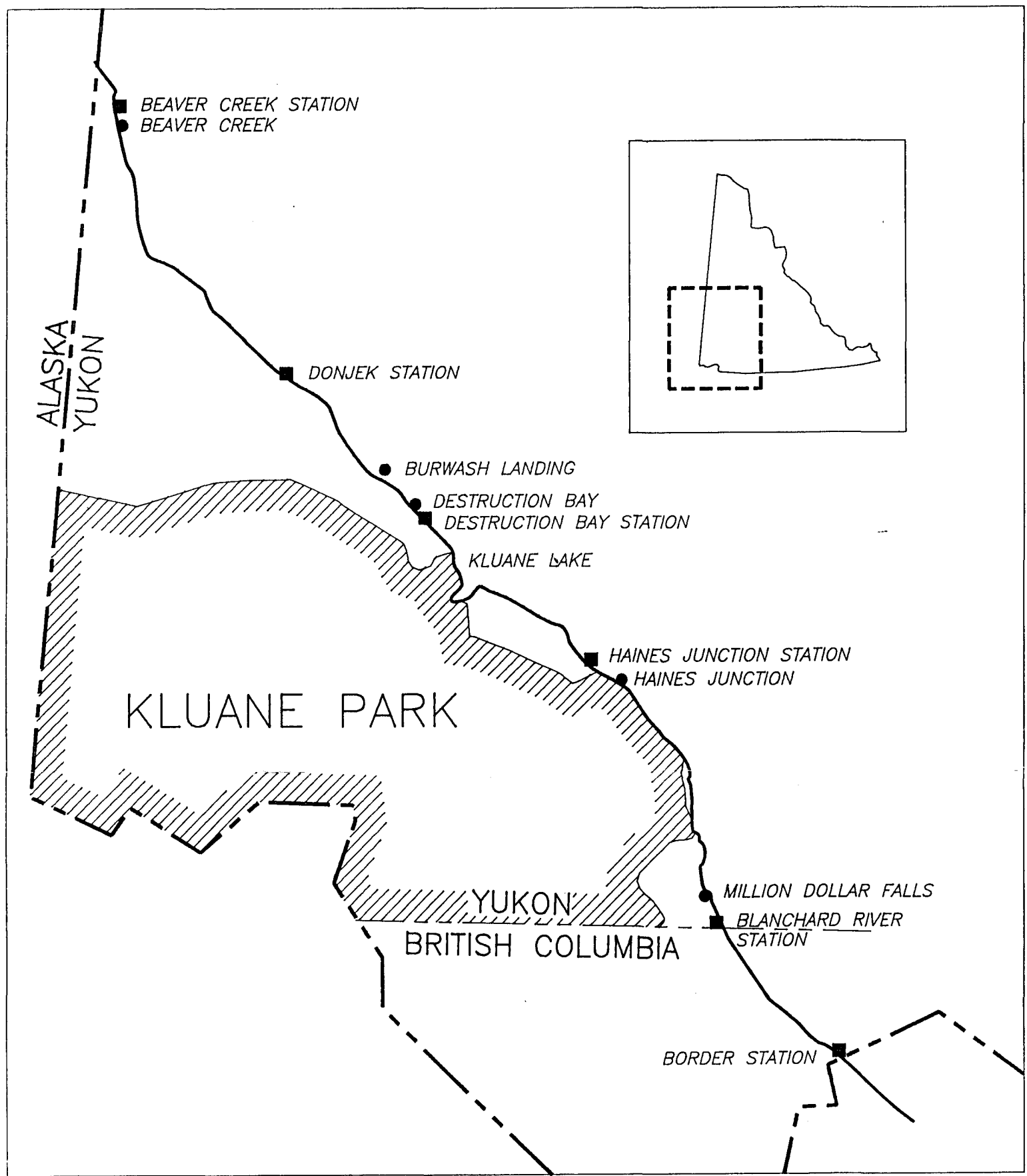
Lorimer conducted a site inspection of each pumping site in order to determine the logistical constraints to be addressed in the Phase II component of the investigation; to undertake a preliminary assessment of the environmental status of the sites; to identify specific areas to be targeted; and to ascertain the appropriateness of the scope of the work in the context of the stated objectives. The visual reconnaissance was completed on June 18, 1995.

2.4 Phase II Investigation Plan

Based on the results of the Phase I tasks detailed above, Lorimer prepared a Phase II investigation plan for each site. These plans outlined the surface soil sampling program; surface water sampling program; building surface swab sampling program; a soil vapour probe survey; and geophysical survey to delineate and identify disposal areas (Appendix C).

Site visits to complete the aforementioned sampling occurred on the following dates:

Beaver Creek - July 23rd and 24th, 1995;
Donjek - July 25th and 26th, 1995; and
Destruction Bay - July 27th and 28th, 1995.



**Lorimer
& Associates**

In association with

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BEAVER CREEK, DONJEK, AND
DESTRUCTION BAY PUMP STATION

DATE:

PROJECT No:

FIGURE 1

APPENDIX D
SAMPLING PROTOCOL

General Considerations

The method of sample collection in the field is the responsibility of the individual involved. The following points should be observed.

- the sample must be truly representative of the whole;
- all possible sources of sample contamination (sampling devices, motor exhausts, disturbing of bottom sediments, use of inappropriate containers, etc.) should be eliminated or reduced to a minimal level;
- for certain parameters sample composition will change with time and temperature therefore rapid transportation to the laboratory is desirable. For some parameters, use of a preservative is recommended. Theoretically, this should fix the concentration of the parameter of interest and reduce the need for rapid transport and analysis. However, in practice this only delays the perishability of the parameter and the sample should still be transported as quickly as possible; and
- for samples which do not have a preservative already in the collection bottle, rinsing both the bottle and cap with sample (two or three times) is strongly recommended. This procedure, while reducing any contamination that may be present, also tends to equilibrate the sample with the container walls and hence "Container effects" (leaching, adsorption, etc.) are minimized. Sampling for organic compounds is an exception since repeated rinsing may concentrate the compounds on the walls of the container.

Sample Containers

In general, surface water samples are collected in 1 litre glass bottles, but some analyses require special plastic containers or glass tubes. The selection of containers is also determined by sample volume required. Special studies may require a certain container type sample pretreatment during sample collection. It is the responsibility of the sampler to obtain the proper sample container for special studies. Sludge samples are collected in wide mouth glass or plastic bottles and extra space is required as an expansion zone for gaseous products that may be formed. Failure to submit samples in this manner may result in container explosion during transit or at the laboratory. Sludge samples for trace organic contaminant analysis must have a foil lined cap.

For trace level metal analysis on surface and domestic waters, special acid washed polyethylene or new (unwashed) polystyrene containers are required. Standard glass containers with non-metal cap liners should be utilized for all routine water samples requiring metal determinations.

Aqueous samples for the analysis of organic contaminants should be submitted in new 1 litre glass bottles with foil or Teflon lined caps. Generally, the sample should have no head space and should be refrigerated. Care should be taken to avoid freezing the sample. If analysis of hydrocarbon gases is required approximately 20% head space should be provided. The sample should not contact anything but Teflon, glass, aluminum foil, or stainless steel. Avoid contact and contamination of sample with rubber or latex gloves.

Polychlorinated biphenyls (PCB) and pesticide samples must be collected in new 1 litre glass bottles that have been previously rinsed with methylene chloride followed by acetone and baked at 300°C. These specialized containers are prepared and marked at the laboratory. Do not fill these containers above the indicated level.

Preservation Techniques

The function of a preservative is to stabilize the parameter of interest so that changes in composition during transit and the time prior to analysis are minimized. Several different preservation methods are recommended and these are outlined by parameter in Table 1.

Preservation techniques usually involve the addition of a chemical which binds the parameter in a form which is unaffected by sample aging or else provides conditions unsuitable for a further reaction to occur. In some cases, refrigeration or freezing to reduce reaction rates provides the best preservation, particularly for those parameters which have a direct biological relationship (i.e., with respect to growth or decline, for example, nutrients). Preservation of some parameters is effective, for others it serves only as a technique to marginally reduce the decay of conversion rate. Therefore it is imperative for such parameters as phenol, chlorophyll, etc., that every effort be made to submit the samples to the appropriate laboratory as quickly as possible to avoid or reduce loss.

The sampler should be aware that the use of the recommended preservative for one parameter may negate the possible analyses of another. For example, heavy metal samples preserved with nitric acid are unsuitable for nutrient analyses. It is the sampler's responsibility to determine whether use of a certain preservative will eliminate the possibility of analysis of another requested parameter, and provide suitable replicates samples to avoid the problem. If in doubt, consultation with laboratory staff is advised. Each replicate should have the preservative used clearly marked on the bottle label.

Sample Volume

The analytical method used to determine parameter concentrations require a certain minimum volume of sample in each case, as outlined in Table 1. The field sampler is expected to calculate the total volume of sample required by summing the specified individual volumes (Table 1) for all the analyses requested and submit the appropriate quantity. In addition, samplers are asked to submit at 10% of sample in excess of their original total estimate, if available, to allow for possible repeat analysis.

In most cases, the volume required for analysis depends on parameter concentration, with "clean" samples (i.e. low concentrations) needing the largest amounts. Domestic water supplies, well waters, and unpolluted surface waters fall in this category. Tests for these sample types require the largest practical volume in order to provide a sufficient quantity of the substance of interest for reliable detection. Samples of high concentration (effluent, sewage, etc.) require a much smaller amount, and even a dilution may be employed. Submission of excessive quantities of noxious, toxic or hazardous wastes create serious safety and disposal problems at the laboratory. If in doubt, contact laboratory personnel.

In certain cases where the sampler is unable to obtain sufficient sample volume or when resampling is impossible, analysis may still be obtained if special care and analytical techniques are used in the laboratory. This can only be achieved after consultation with laboratory personnel has been initiated

by the sampler and before sample submission. This technique may have impact on the detection limits of the analysis.

TABLE D-1
ANALYTICAL METHODS

PARAMETERS	METHODS
most metals	inductively coupled plasma (ICP) spectroscopy /Graphite Furnace
arsenic, selenium	hydride vapour generation atomic absorption spectroscopy
mercury	cold vapour generation/mercury monitor
cadmium, lead	flame atomic absorption analysis spectroscopy
general qualitative scan	gas chromatography with mass spectroscopy detection
polyaromatic hydrocarbons	gas chromatography with mass spectroscopic or EPA method 625
volatile organic compounds	purge and trap or EPA method 624
total petroleum hydrocarbons	gas chromatography with flame ionization detection
Oil and Grease	Infra-red Spectroscopy
PCB	gas chromatography with electron capture detection

TABLE 1
SAMPLING PROTOCOLS

Constituent	Volume Required	Container	Preservative	Holding Time
Bacteriological Coliform	100	P,G	cool, 4C	analyze ASAP
Physical Properties				
Colour	100	P,G	cool, 4C	24hours
Hardness	100	P,G	cool, 4C	6months
Odour	500	G only	cool, 4C	24hours
pH	25	P,G	do on-site	2hours
Taste	500	G only	cool, 4C	24hours
Solids:				
-total	100	P,G	cool, 4C	7days
-dissolved	100	P,G	cool, 4C	7days
-volatile	100	P,G	cool, 4C	7days
-suspended	100	P,G	cool, 4C	7days
Temperature	1000	P,G	do on-site	no holding
Turbidity	100	P,G	cool, 4C, store in dark	24hours
Inorganics:				
Acidity	100	P,G	cool, 4C	14days
Alkalinity	200	P,G	cool, 4C	14days
Carbon Dioxide	100	P,G	analyze immediately	no holding
Chloride	50	P,G	cool, 4C	7days
Chlorine, residual	500	P,G	analyze immediately	2hours
Conductivity	500	P,G	cool, 4C	28days
Cyanide - total	500	P,G	NaOH to pH > 12, cool in dark	14days
Fluoride	300	P	none	28days
Oil and Grease	1000	G	H2SO4 to pH < 2, cool, 4C	28days
Iodine	500	P,G	analyze immediately	no holding
Nitrogen:				
-ammonia	500	P,G	analyze immediately, or H2SO4 to pH < 2	28days
-nitrate	100	P,G	H2SO4 to pH < 2, cool, 4C	28hours
-nitrate	100	P,G	analyze immediately, or H2SO4 to pH < 2	28days
-total Kjeldahl	500	P,G	cool, 4C, H2SO4 to pH < 2	28days
-organic	500	P,G	cool, 4C, H2SO4 to pH < 2	28days
Phosphorus	100	G only	H2SO4 to pH < 2, cool, 4C	48hours
Sulphate	100	P,G	cool, 4C	28days
Sulphide	100	P,G	cool, 4C, add 2 drops 2N Zinc acetate/100ml	28days
Silica	100	G only	none	7days
Organics				
BOD	1000	P,G	cool, 4C	48hours
Carbon:				
-organic	100	G	analyze immediately	28days
-total	100	G	analyze immediately	28days
COD	100	P,G	analyze immediately, H2SO4 to pH < 2	28days
Pesticides	500	G, TFE cap	cool, 4C, add 100 mg H2S2O3 if residual chlorine is present	7days
Phenols	500	P,G	cool, 4C store in dark, CUSO4, H3PO4 to pH < 2	28days
Polynuclear Aromatic Hydrocarbons	1000	G only	cool, 4C	
Polychlorinated Biphenyls	1000	G only	cool, 4C	
Trihalomethanes	250	P,G	analyze immediately	no holding

Metals:

Total

Total mercury

P = plastic

100 ea

500

G = glass

P,G

G only

HNO₃ to pH <2

HNO₃ + K₂Cr₂O₇

6months

28days

APPENDIX E
QA/QC

These field QA/QC procedures include replicates, blanks and background samples.

Replicates

Replicates are a check on laboratory and field procedures. Replicates will be collected from sampling points which are known or suspected to be contaminated. A minimum of 1 sample or 5%/parameter/matrix/site whichever is greater will be collected.

Replicates will be collected for samples which will be submitted for a complete parameter suite. Identify the sampling point, if known, which will have replicate samples. The replicate will be collected, numbered, packaged, and sealed in the same manner as the other samples. The replicate sample sets will be filled in parallel by matched parameter. Samples from surface waters will be filled from a composite vessel, not sequentially from the surface water body (except for volatile parameters).

Blank and Background Samples: 1/day/shipment/lab

Blank samples are a check for cross-contamination during sample collection and shipment and the laboratory. Analytically-certified organic-free water for organic parameters will be used. Deionized water will be used for metal parameters.

Blank samples will be analyzed for the complete parameter suite. The blank is collected, numbered, packaged and sealed in the same manner as the other samples.

Only one type of blank need be collected. Blanks are listed below in order of collection preference.

- Equipment Blank - Collected after the last rinse of the equipment decontamination process. Use the appropriate "blank water" identified above to fill equipment and then pour it into the appropriate containers.
- Field Bottle Blank - Collect when decontamination of equipment is not necessary or possible. The field bottle blank will be poured at a sampling point.
- Volatile Organic (VOA) Travel Blank - Collect when there is no other type of VOA blank. All of the VOA vials should be shipped in the same container as the VOA blank.

Background Samples (Soil and Surface Water)

Background samples will be analyzed for the complete parameter suite. The background sample is collected, numbered, packaged, and sealed in the same manner as the other samples. Approximately 5% or 1 in 20 samples will be collected as a background.

As part of the Quality Assurance Plan, the chain-of-custody protocol must be described. A chain-of-custody provided defensible proof of the sample and data integrity. The less rigorous sample traceability documentation merely provides a record of when operations were performed and by whom. Sample traceability is not acceptable for enforcement activities nor is it acceptable in a court of a law.

Chain-of-custody is required for analysis which may result in legal proceedings and where the data may be subject to legal scrutiny. Chain-of-custody provides conclusive written proof that samples are taken, transferred, prepared and analyzed in an unbroken line as a means to maintain sample integrity. A sample is in custody if:

- it is in the possession of an authorized individual;
- it is in the field of vision of an authorized individual;
- it is in a designated secure area; or
- it has been placed in a locked container by an authorized individual.

A typical chain-of-custody protocol contains the following elements:

- unique sample identification numbers;
- records of sample container preparation and integrity prior to sampling;
- records of the sample collection such as;
 - specific location of sampling,
 - date of collection
 - type of sample taken (e.g. air, water, soil),
 - initialling each entry,
 - entering pertinent information on chain-of-custody record,
 - maintaining the samples in one's possession or under lock and key,
 - filling out the chain-of-custody records, and
 - the chain-of custody records must accompany the samples;
- assigning a sample custodian who will be responsible for maintaining chain-of-custody;
- laboratory will inform field sample (or office) that samples have arrive and are in good condition;
- for unbroken custody during shipping. Completer shipping records must be retained; samples must be shipped in locked or sealed (evidence tape) containers; and
- the field sampler(or delegated personnel) is to inform appropriate laboratory that samples will be arriving and will supply name of transporter, depot location, waybill number, and if they will be delivered or held for pick-up. The field sampler will ask laboratory for verification of received samples.

Laboratory chain-of-custody procedures consist of:

- receiving the samples;

- checking each sample for tampering;
- checking each sample against the chain-of-custody records; and
- checking each sample and noting its condition.

APPENDIX F
FRONTIER GEOSCIENCES REPORT

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4a	Destruction Bay Pumping Station Electromagnetic Conductivity Contour Plan	Appendix A
4b	Destruction Bay Pumping Station Total Magnetic Field Contour Plan	Appendix A

1. INTRODUCTION

In the period July 23 to July 28, 1995, Frontier Geosciences Inc. conducted a terrain conductivity and magnetometer survey for Lorimer and Associates in association with Hemmera Resource Consultants Ltd. at the Donjek Pumping Station, Destruction Bay Pumping Station, and Beaver Creek Pumping Station. The purposes of the investigation were to locate buried metallic objects, and if detectable, delineate conductive leachate in the soils arising from buried metal objects, or from dissolved metals in the groundwater.

The investigation consisted of terrain conductivity and magnetometer surveying on grids with 5 m line spacing and 2 m station intervals established at the site through open areas and thick bush. In all, a total of approximately 8.1 km of combined terrain conductivity and magnetometer surveying was completed on the grids. The survey locations (Destruction Bay Station, Donjek Station and Beaver Creek Station) are illustrated in Fig. 1.

2. THE ELECROMAGNETIC TERRAIN CONDUCTIVITY METHOD

2.1 Equipment

The electromagnetic terrain resistivity investigation was carried out using a Geonics Ltd. Model EM-31 terrain conductivity meter. This unit is an electromagnetic instrument consisting of a transmitter coil and a receiver coil at opposing ends of a 3.66 metre boom. The unit is one man portable and does not require ground contact. The effective penetration of the instrument under usual conditions is six metres.

In operation, the transmitter coil induces circular eddy current loops in the earth. Under certain conditions fulfilled in the design of the EM-31, the magnitude of any of these current loops is directly proportional to the terrain conductivity in the vicinity of that loop. Each of the current loops generates a magnetic field which is proportional to the value of the current flowing within that loop. A part of the magnetic field from each loop is intercepted by the receiver coil and results in an output voltage which is linearly related to the terrain conductivity.

The instrument is calibrated to read the correct conductivity when the earth is uniform. In the event that the earth is layered, with each layer of different conductivity, the instrument will read an intermediate value and a simple layered earth model may be derived.

2.2 Field Procedure

At a survey station, the instrument was held parallel to the ground surface and the reading recorded and stored in a field book. Readings were made at a constant terrain clearance and at 2 m intervals throughout the survey. Effects of metallic objects on the body as well as any coupling effect due to other surveying equipment were tested for and were found to be negligible.

3. THE MAGNETOMETER SURVEY

3.1 Equipment

The magnetometer survey was carried out with a Gem Systems Inc. GSM-19 Overhauser Memory Magnetometer. The GSM-19 is a portable, high sensitivity unit which measures the absolute total intensity of the geomagnetic field to a precision of the order of 0.1 nT, without the need for orienting devices.

The magnetometer measures the precession frequency of protons in a hydrogen-rich medium. Excited by radio frequency energy, the protons emit a signal with a precessional frequency related to the earth's field through a well known constant, the gyromagnetic ratio.

3.2 Field Procedure

This magnetometer was used in mobile mode where the unit cycles every time a reading is taken. A single sensor was used, thus giving the value of the total magnetic field. Readings were made at 2 m intervals and a constant terrain clearance was maintained throughout the survey via the usage of a back-pack attachment on which the sensor was placed. The

precaution of re-occupation of stations obtained earlier to detect the presence of instrument drift or diurnal effects was followed. No significant effects were noted during the surveying intervals.

4. GEOPHYSICAL RESULTS

4.1 General

The survey data, after downloading from the instrument, was gridded, contoured and plotted at a scale of 1:500 (metric). The results of the soil conductivity mapping and magnetometer surveying are included at 1:500 (metric) scale in Figures 2a, 2b, 3a, 3b, 4a and 4b in Appendix A. Figures 2a and 2b are the soil conductivity and magnetometer plans respectively for the Beaver Creek Pumping Station, figures 3a and 3b are the soil conductivity and magnetometer plans for the Donjek Pumping Station and figures 4a and 4b are the soil conductivity and magnetometer plans for the Destruction Bay Pumping Station.

Background values for magnetic data is in the range of 57000 nT and less. Electromagnetic background is in the range of 0 to 2 millimhos/m, with negative values present in anomalous areas. The units of conductivity in Figures 2a, 3a, and 4a are millimhos per metre with a contour interval of 1 millimho per metre (1000 ohm-m resistivity). The units of magnetic intensity in figures 2b, 3b, and 4b are in nanoTeslas or gammas of the earth's total field. The spread of magnetic intensity values have been logarithmically distributed in order to highlight subtle features in areas of low magnetic relief. The lines were continued past the dumpsite and into the forest, as well extra lines were added to either side of the dumpsite in order to differentiate anomalous zones from the background data. Good correlation exists between the magnetic intensity and soil conductivity surveys.

4.2 Beaver Creek Pumping Station

The conductivity map is characterized by strong anomalies within the dumpsite area. Anomaly A located along line -65 at stations 34-36 is likely to be due to a buried metal tank because of its amplitude. Anomaly C, located along line -50 at Station 16-18 is also a likely candidate as the site for a buried metal tank. There are other anomalies at the site which may be indicative of smaller buried metal objects. Anomaly D, line -60, stations 22 which can be seen in both the conductivity as well as magnetometer data, is possibly due to buried metal debris.

Excellent correlation exists between the soil conductivity and magnetometer data at this site. Some examples of this are anomalies A, B, C and D, with magnetic amplitudes of 59427 nT, 58951 nT, 58597 nT respectively which are likely to be due to buried metal objects. Due to the low density of gridlines and the relatively high values separating the anomalies B, D, C it is difficult to ascertain whether they are caused by the same object. Due to the distance separating the anomalies and because the magnetic readings drop-off to effectively low values (57400 nT) anomaly A is likely to be caused by a separate entity.

4.3 Donjek Pumping Station

In contrast to the conductivity map of the Beaver Creek Pumping Station, the Donjek Pumping Station site shows higher conductivity values in regions where no magnetic anomalies exist. Therefore giving evidence for possible presence of conductive leachates. There is excellent correlation between the magnetometer and the soil conductivity data. The anomalies of interest on this site are those labelled A, B and C on figures 3a and 3b. Two anomalies were defined in this area along line-5, labelled A and B. Due to their relative proximity to each other and their large amplitudes it is difficult to ascertain whether these are two different sources or if they are due to the same buried metal object. Both of these may be buried metallic objects. Anomaly C on line 0, stn-4, is also of interest because of its high magnetic amplitude although with the grid density it is difficult to determine the object's size.

4.4 Destruction Bay Pumping Station

Several anomalies were delineated in area 1, labelled A to S on figures 4a and 4b, due to their excellent correlation between the soil conductivity and magnetic data. The background magnetic readings were in the 5700 nT and less range. The linear ridge as seen in figure 4b which essentially parallels the baseline could possibly be due to buried metal objects which have subsequently contaminated the surrounding areas as seen by the large conductivity values to the north and south of the topographic feature. Anomaly A, B, C, E with maximum magnetic amplitudes of 58943 nT, 57340 nT, 57435 nT, 58500 nT respectively are easily correlated between the two data sets, but due to the density of the gridlines, it is difficult to determine their sizes.

5. LIMITATIONS

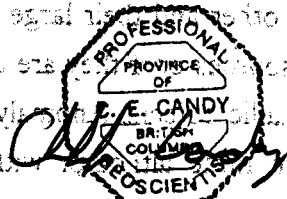
The EM-31 measures terrain electrical conductivity and is successful only if the desired parameter exhibits a significant conductivity contrast with respect to the background. In addition, the nominal penetration depth of the instrument is approximately six metres. The overhauser magnetometer measures total magnetic field, and has an effective depth of several meters. The relatively coarse line spacing of 5 metres may cause the response from a buried object to be under-represented, or to be missed entirely if the object is small. As well, due to this low density the possibility arises of merging multiple sources together.

The results are interpretive in nature and are considered to be a reasonably accurate presentation of subsurface conditions within the limitations of the electromagnetic and magnetic methods.

For Frontier Geosciences Inc.,

Zongyang Liu, Ph.D.

Cliff Candy, P. Geo.



2.4.1 Soil Sampling

Soil samples were collected at each site using stainless steel trowels and a hand-held auger. Soil samples were procured from within the upper 0.75 metres. Latex gloves were worn during sampling to prevent any cross contamination. Gloves were changed between sampling events. Cleaning of the sampling implements was completed on clean plastic sheeting to avoid contamination of implements through contact with the ground surface. Each trowel was cleaned with Alconox soap and water and then rinsed with distilled water between sampling events. The trowels were air dried prior to use.

Sampling protocol for soil samples are contained in Appendix D. A discussion of sampling duplicates and replicates and QA/QC is included in Appendix E.

Soil samples were screened in the field for hydrocarbons using a Photovac MicroTip organic vapour analyser (OVA) with a 0 to 2000 ppm (parts per million) range and equipped with a 10.6 eV UHF excited electrodeless discharge tube. All measurements were noted in the field book. Soil samples were placed in a mason jar with 2.5 centimetres of head space remaining above the sample, sealed with aluminum foil and a lid, shaken, and allowed to stand for 0.5 hours to allow the soil temperature to rise to ambient temperatures then shaken once again. The OVA intake was pushed through the aluminium foil after the 0.5 hour period and measurements of head space vapours taken (noted on borehole logs). Environment Canada, Jar Head space Analytical Screening Procedures were used.

Soil samples were placed in precleaned glass jars with TEFLON coated lids. Care was taken to ensure the jars were filled completely and the lids screwed on to form a seal to prevent volatilization of the potential contaminant. Sample numbers were clearly marked on both the lid and jar label as per the Terms of Reference (TOR). Soil samples were then placed in plastic bags and placed in ice-filled coolers for transport to the project laboratory. Soil samples were analysed for compounds listed in the TOR.

2.4.2 Surface Water

Samples were obtained from surface water if present downstream and upstream of potentially contaminated areas. Water contained in sumps, presumed to be indicative of groundwater conditions, was also sampled. All waters were analysed in the field for pH, conductivity, and temperature. The samples were analysed in the project laboratory for the compounds defined in the TOR. Depending upon analytical requirements, up to approximately three litres of sample was placed in the appropriate containers in order to accommodate laboratory analysis requirements. All samples were accompanied by a Chain of Custody form Appendix E).

2.4.3 Soil Vapour Probe Survey

A survey of volatile hydrocarbons in near surface soil at each site was completed using the OVA. Slotted polyvinyl chloride (PVC), 1.25 cm diameter pipe in approximately 0.45 m lengths was driven into the subsurface to depths ranging from 0.3 metres to 0.4 metres. Each pipe was sealed with plastic wrap and left for at least 4 hours. The OVA intake was then be pushed through the plastic seal on each pipe and a measurement of head space vapours was taken.

2.5 Geophysical Program

Frontier Geosciences Inc. of North Vancouver, B.C. completed a ground conductivity and total magnetic survey at the Donjek, Destruction Bay and Beaver Creek Pump Station sites. Each site survey comprised one 100 metre by 100 metre area with 5 metre line spacings and with readings compiled at 2 metre intervals. Geophysical surveys were oriented to incorporate areas where suspected dump sites may be located. The Frontier final report is contained in Appendix F.

2.5.1 Electromagnetic Conductivity Survey

Rapid acquisition of ground resistivity (conductivity) information is an important part of environmental site assessment studies. The Geonics EM-31 terrain conductivity meter is very effective in the depth range of 1-6 metres. The unit is a one person, portable, electromagnetic survey instrument. The device does not require ground contact and is very cost effective under a variety of field conditions.

In operation, a transmitter coil located at one end of the instrument induces circular eddy current loops in the earth. Under certain conditions accommodated in the design of the EM-31, the magnitude of any of these current loops is directly proportional to the terrain conductivity in the vicinity of that loop. Each of the current loops generates a magnetic field which is proportional to the value of the current flowing within that loop. A part of the magnetic field from each loop is intercepted by the receiver coil and results in an output voltage which is linearly related to the terrain conductivity.

The instrument is calibrated to read the correct conductivity when the earth is uniform. In the event that the earth is layered, with each layer of different conductivity, the instrument will read an intermediate value and a simple layered earth model may be derived.

The unit of conductivity recorded is the millimho per metre. To obtain resistivity in ohm-metres the instrument reading is divided into 1000 - i.e., a reading of four millimhos per metre yields a value of two hundred and fifty ohm-metres.

There are two components of the induced magnetic field measured by the EM-31. The first is the quadrature-phase component which gives the ground conductivity measurement as described. The second is the in-phase component used primarily in the EM-31 for calibration purposes. The in-phase component, however, is significantly more sensitive to large metallic objects and is very effective for buried metal drum surveys. Although this component has been available in the standard EM-31 by operation in the compensation mode, both components are available in the EM-31-D when operating with a data logger. The data logger was used in this survey to facilitate contour plotting of data points using standard surfer plotting routines (Appendix F).

2.5.2 Magnetometer Survey

To differentiate conductors identified in the EM-31 surveying, a fluxgate magnetometer survey was completed to detect ferromagnetic metals. Buried metal, if unweathered, yields excellent, high amplitude magnetic anomalies when measured

against background values.

The advantage of the additional magnetometer surveying is the ability to select conductors that are related to buried, large metallic objects versus smaller conductors, electrical wiring, buried fence wires, pipes, and numerous additional "noise" sources. The fluxgate magnetometer is superior to other magnetometers in such environments due to the high gradients and ambient electrical noise generally encountered in old waste piles.

Data from the surveys were plotted in contour form and anomalies were assessed for the likelihood of buried metallic objects or contaminants (Appendix F).

2.6 Analytical Program

The analytical program followed the required analyses stipulated in the TOR. Lorimer was responsible for sample collection, packaging and shipping and chain-of-custody protocol. Final laboratory reports are contained in Appendix G.

2.6.1 Regulatory Context

Analytical results from this study were compared to the Alberta Tier I Criteria for Contaminated Soil Assessment and Remediation, the Remediation Guidelines for Petroleum Storage Tank Sites (Alberta Environmental Protection, 1994) and the Canadian Council of Ministers of the Environment Interim Canadian Environmental Quality Criteria for Contaminated Sites.

2.6.1.1 Tier I Criteria for Contaminated Soil Assessment and Remediation

Alberta Environmental Protection has developed a two tier system for the assessment of potentially contaminated soil. Tier I criteria are generic and have been developed to represent acceptable concentrations of contaminants for all site land uses and site conditions without defining the actual risk. Tier II criteria are site specific criteria developed for the protection of human health and the environment. Tier II criteria are based on acceptable risk specific to the site such as: soil type; geology; surface and groundwater; climate; and present and future land use.

Tier I criteria were developed by Alberta Environmental Protection through a review of the scientific literature and from existing guidelines and practices in Alberta and across Canada.

2.6.1.2 Remediation Guidelines for Petroleum Storage Tank Sites

The Draft Alberta remediation guidelines have been developed through the use of a risk-based approach to remediation which ensures the protection of human health, safety and the environment. The guidelines, although not adopted yet, will provide a uniform standard for the remediation of petroleum storage tank sites in Alberta. The guidelines refer to both underground and above ground storage tanks containing gasoline, diesel, heating oil, aviation fuel, used oil or related petroleum products (Alberta Environmental Protection, 1994).

The draft guidelines are based on the role of risk assessment and risk management in the remediation of sites containing both underground storage tanks (USTs) and aboveground storage tanks (ASTs). Numerical criteria, above which either remediation or a risk assessment must be completed to address the potential risk to human health and safety or to the environment, are provided in the draft guideline documents (Alberta Environmental Protection, 1994).

The remediation guidelines outline the process to be followed by the owner or operator in remediating or managing a contaminated site. Numerical risk management criteria are provided for soil and groundwater along with a recommended approach for the determination of the applicable remediation levels based on site sensitivity. The owner or operator may use the numerical criteria directly for remediation and risk-management decisions, or may choose to complete a detailed risk assessment to define site-specific remediation or risk management criteria (Alberta Environmental Protection, 1994).

The numerical criteria are based on a site sensitivity assessment. The site sensitivity assessment considers both the sensitivity of the potential human and environmental receptors and the likelihood of human impact of those receptors. The sensitivity system classifies a site according to its sensitivity (high - Level I, medium - Level II or low - Level III). A separate classification system is in place for each of the two major routes of impact, inhalation and ingestion. Soil and groundwater at a particular site would normally be remediated to the lowest risk management criteria indicated by the site sensitivity assessment and the main exposure pathways.

Two soil types have been considered for the Alberta risk management criteria, coarse-grained soil and fine-grained soil. Classification of the soil is based on gradation. Coarse-grained soil is defined as soil with a median grain size greater than 75 microns. Fine-grained soil is classified as soil with a median grain size less than 75 microns.

2.6.1.3 Interim Canadian Environmental Quality Criteria for Contaminated Sites

In response to the growing public concern over the potential environmental and human health effects associated with contaminated sites, the CCME has developed Interim Canadian Environmental Quality Criteria for Contaminated Sites (CCME criteria) (CCME, 1991). These interim criteria have been adopted from existing guidelines and criteria currently in use in various jurisdictions across Canada. They are currently being assessed and will be modified, as required, to reflect the emerging body of scientific information relevant to contaminant effects on the environment and human health.

The CCME criteria include two levels or concentrations for soil and water quality: namely, assessment and remediation criteria. Assessment criteria are the approximate background concentrations or approximate analytical detection limits for contaminants in soil and water. Background concentration refers to a representative ambient concentration for a contaminant in soil or water. Analytical detection limits are the lowest concentrations that can be routinely measured within an acceptable level of accuracy and reproducibility. Remediation criteria are generally considered protective of human and environmental health for specific uses of soil or water at contaminated sites.

If concentrations of a substance in water or soil at a site do not exceed the

assessment criteria, further action is not usually required. When concentrations exceed assessment criteria, further investigation is required to assess the nature and extent of any contamination at the site. If contaminant concentrations exceed the remediation criteria for a current or proposed future land use for the site, then remediation of the site to meet the current or proposed land use criteria is or will be required.

Soil remediation criteria have been developed for three land uses: agricultural; residential/parklands; and commercial/industrial. Water remediation criteria are based on CCME Water Quality Guidelines and Health and Welfare Canada's Drinking Water Quality Guidelines.

Although the CCME criteria are not considered to be applicable to all contaminated site investigations, they are currently applied in a blanket fashion. The CCME is developing guidance documents for the development of site-specific assessment and remediation objectives. Until these are available, the CCME criteria are generally being applied directly to individual site assessments on Federal lands.

2.6.2 Applicable Criteria for Comparison

Lorimer compared the analytical results from the pumping stations with the Alberta Tier I Criteria for Contaminated Soil Assessment and Remediation and the draft Remediation Guidelines for Petroleum Storage Tank Sites as well as the CCME Interim Canadian Environmental Quality Criteria for Contaminated Sites. These guidelines and criteria have been followed during the completion of this field work at all sites.

3.0 RESULTS OF THE STUDY

The following sections summarize the results of the study.

3.1 Description of the Sites

The following sections describe the sites. Photographs of each site are contained in Appendix H.

3.1.1 Beaver Creek Pump Station

The Beaver Creek Pump Station is located at mile 324 on the pipe line at coordinates 62°24.46N (6919400m N) and 140°50.99 W (508000m E). The site is located some 2.5 km north of the community of Beaver Creek and approximately 1 km east of the airport. It is accessed via a gravel road which leaves the east side of the Alaska Highway approximately 1.5 km north of the Canada Customs Station and then follows the old pipeline right-of-way to the south.

The site originally consisted of a combination building and family housing. The housing units have been removed (Petroleum Distribution OFFICE USARAL Support Command 1966). The site is fairly heavily overgrown with aspen and some spruce. There has been some vandalism. Two aboveground storage tanks (ASTs) used for bulk storage of fuel are located at the south end of the pump station complex. These ASTs are surrounded by an earth berm and are standing on a gravel base. A former landfill is located approximately 250 m north of the site. A logging operation is situated immediately on the north side of the pump station compound. A residential trailer unit is located on the same site (Figure 2).

The area is generally flat and low lying with no well-defined drainage courses in the immediate vicinity. Beaver Creek, which is located approximately 1 km to the east, flows to the north. Surface and groundwater flow is believed to be generally to the east or northeast, however, no confirmatory data is available.

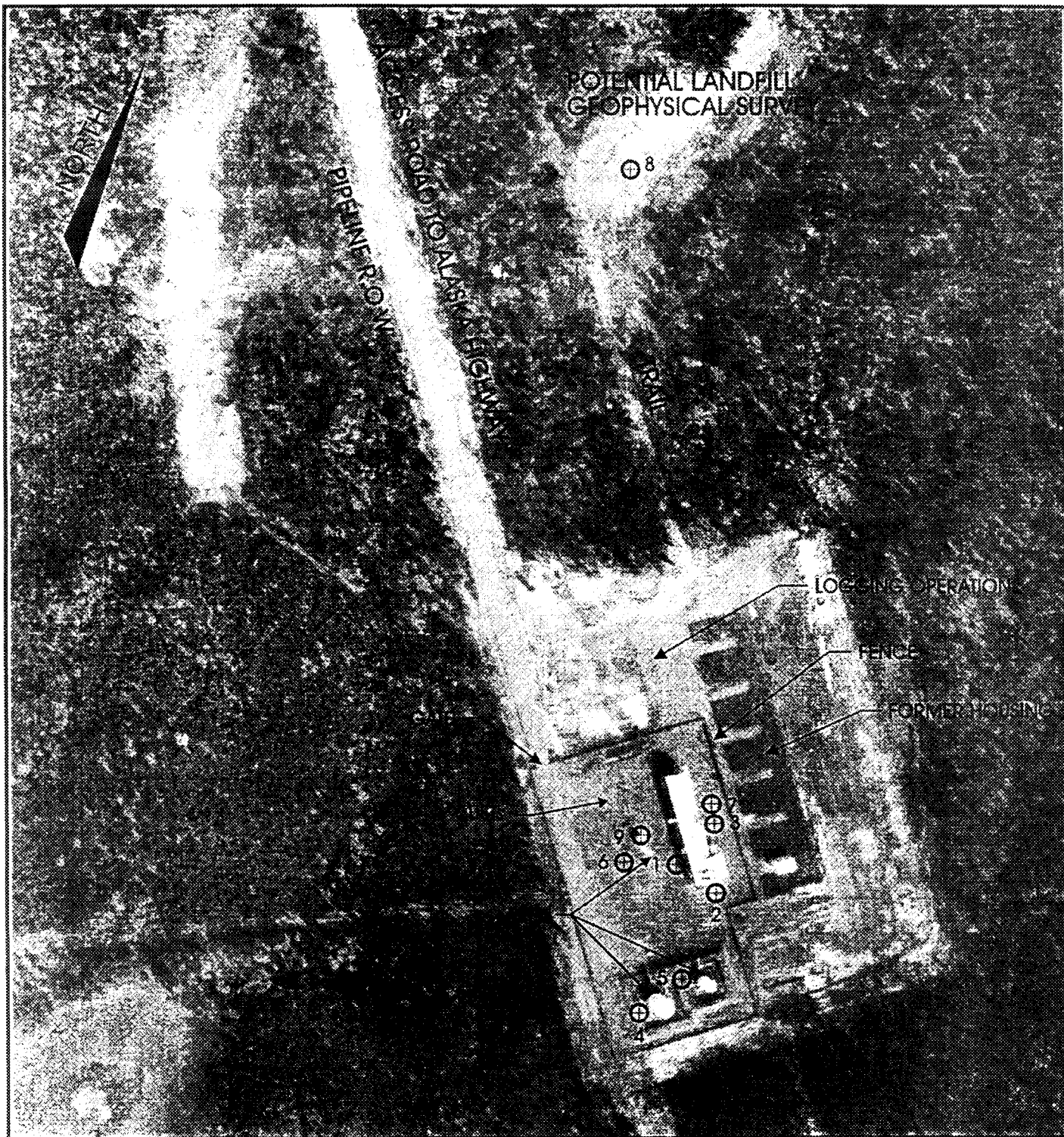
Soils in the area consist of glaciofluvial gravels overlain by surficial silts.

One water well is located on-site adjacent to the main building. The well is located in a small enclosed structure attached to west side of the building (immediately northeast of sample location 9 in Figure 2). No information on the depth or construction of the well or the quality of groundwater is available.

3.1.2 Donjek Pump Station

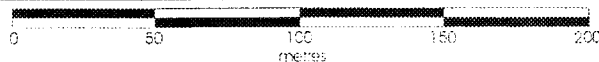
The Donjek Pump Station is located at mile 248 of the pipe line at coordinates 61°37.03N and 139°33.09W (6832300m N and 577000m E) which is some 14.5 km southeast of the Donjek River Bridge along the Alaska Highway. The site is approximately 300 m north of the highway along a gravel road.

The site consists of a mainline pump building, a utility building (generators and garage), a single family residence and a multi-family dwelling (Petroleum Distribution Office USARAL Support Command 1988). The station has been vandalized. Two large ASTs used for storage of fuel are located at the east end of the complex. The pump station is surrounded by a firebreak. The pump station landfill is located



LEGEND

AST	ABOVEGROUND STORAGE TANK			
UST	UNDERGROUND STORAGE TANK			
○	SAMPLE LOCATION			
1	BC1BS001	6	BC1S003	
2	BC1BS002	7	BC1S004	
3	BC1BS003	8	BC1S005	
4	BC1S001	9	BC1GW001	
5	BC1S002			



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LOCATION

BEAVER CREEK PUMP STATION

TITLE

SITE PLAN & SAMPLE LOCATIONS

FIGURE 2

at the end of a trail approximately 500 m to the north (Figure 3).

The pump station compound is moderately overgrown with aspen, willows and small spruce. Vegetation outside of the compound consists of boreal spruce forest. The area is generally wet, indicating a shallow or perched water table. A small, intermittent creek flows from east to west along the southern boundary of the site.

Soils in the area consist of undifferentiated glacial drift.

One water well is located at the Donjek Pump Station site (Figure 3). The water well is located in a self-contained shed approximately 100 metres east of the main building (Figure 3). Anecdotal information provided by Mr. Darrell Duensing (maintenance man on the Haines-Fairbanks pipe line) indicated that this well was never used due to poor water quality and objectionable odours ("swampy") (K. Bisset & Associates 1995). The static water level in the water well was located at approximately 1.8 metres depth below the floor of the shed at the time of our investigations.

3.1.3 Destruction Bay Pump Station

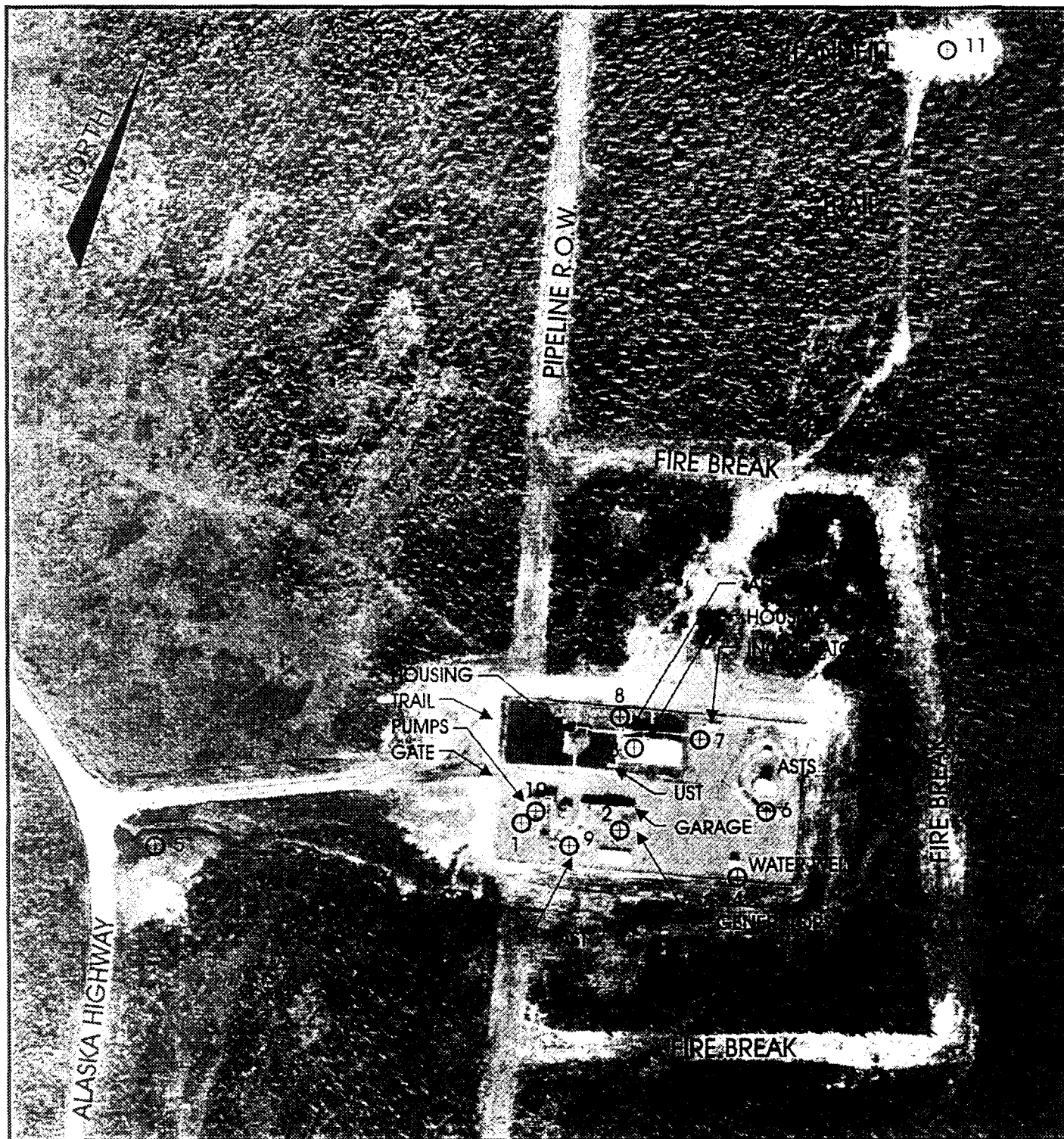
The Destruction Bay Pump Station is located at mile 209 of the pipe line at coordinates 61°13.65N and 138°45.43W (6790000m N and 620500 m E), which is some 4.5 km southeast of the community of Destruction Bay along the Alaska Highway. The pump station compound is located approximately 200 m west of the highway at the end of a gravel driveway.

The 9.9 acre site originally consisted of a main building (identified as a "Combination Building") and family housing which comprised six trailer units (Petroleum Distribution Office USARAL Support Command 1966). The housing units have since been removed. There has been some vandalism. The site is moderately overgrown with a mixture of aspen, spruce and willows (Figure 4). Two ASTs used for fuel storage are located in the southeast corner of the complex. There are several abandoned landfills in the Destruction Bay area. The landfill identified with the pump station is located on the immediately opposite side of the Alaska Highway (Figure 5) from the pump station.

The site is generally well drained, with the direction of surface and groundwater flow inferred to the east towards nearby Kluane Lake. No defined water courses flow through the site. No data on groundwater hydrology in the immediate area is available. The depth to groundwater is believed to be greater than 30 m, based on measurements at one of two on-site wells.

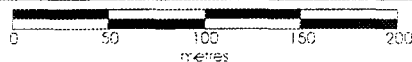
The first well is located in a small enclosed structure on the west side of the main building (west of sample location 5 in Figure 4). The second well is located in the small garage along the Alaska Highway at the north eastern corner of the site. An attempt to ascertain the depth to the static water level was made in the well attached to the main building. The depth exceeded the length of the water level tape (>30 metres depth). The second well had the associated pumps and electrical wiring still attached to the well head preventing the measurement of water levels. No other information of well depth, or construction, or water quality was available.

Available geological mapping identifies soils in the area as glacial drift. However, on-site observations indicate the presence of fluvial sands and gravels, probably either representing beach deposits along a formerly higher lake level or



LEGEND

AST	ABOVEGROUND STORAGE TANK			
UST	UNDERGROUND STORAGE TANK			
○	SAMPLE LOCATION			
1	DO1BS001	6	DO1S001	
2	DO1BS002	7	DO1S002	
3	DO1BS003	8	DO1S003	
4	DO1GW001	9	DO1S004	
5	DO1W001	10	DO1S005	
		11	DO1S006	



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LOCATION

DONJEK PUMP STATION

TITLE

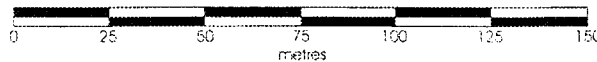
SITE PLAN & SAMPLE LOCATIONS

FIGURE 3



LEGEND

AST	ABOVEGROUND STORAGE TANK			
UST	UNDERGROUND STORAGE TANK			
⊕	SAMPLE LOCATION			
1	DB1S001	6	DB1BS002	
2	DB1S002	7	DB1BS003	
3	DB1S003	8	DB1GW001	
4	DB1S005			
5	DB1BS001			



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LOCATION

DESTRUCTION BAY PUMP STATION

SITE PLAN & SAMPLE LOCATIONS

FIGURE 4

NORTH



0 25 50 75 100 125 150 175 200
metres

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LOCATION

DESTRUCTION BAY PUMP STATION

TITLE

OVERALL SITE LOCATION PLAN

FIGURE 5

glacial outwash.

3.2 Sampling

The following sections summarize the number of samples collected at each site, the type of samples and the requested analyses. Sample locations for each site are indicated in Figures 1 to 3. Sample numbering followed the protocol specified in the TOR (Appendix D).

3.2.1 Soil Samples

A total of 14 soil samples were collected from the three sites. Table 1 summarizes the number of soil samples collected at each site.

TABLE 1
NUMBER OF SOIL SAMPLES COLLECTED PER SITE

SITE	NUMBER OF SAMPLES
Beaver Creek	5
Donjek	5
Destruction Bay	4

3.2.2 Surface Water and Groundwater

Samples were obtained from surface water if found on-site. In addition, samples of groundwater were taken from sumps and/or wells, where possible. All water samples were analysed in the field for pH, conductivity, and temperature. The sample of water collected from the sump at Beaver Creek was assumed to be representative of the local groundwater, based on the swampy setting of the site and an inferred shallow water table. Water in the sump at Beaver Creek enters through holes in the concrete at the sump base. Groundwater collected at Donjek was also assumed to be representative of the local groundwater. However, water collected from a sump at Destruction Bay is assumed to be from rainwater and surface water run-off through an unprotected entrance into the sump at the ground surface.

Table 2 summarizes the number of water samples collected at each site. Figures 2 to 4 indicate the sample locations.

TABLE 2
NUMBER OF WATER SAMPLES COLLECTED PER SITE

SITE	NUMBER OF WATER SAMPLES	NUMBER OF GROUNDWATER SAMPLES	Sample Location
Beaver Creek	0	1	BC1GW001 - collected from small shed east of main building.
Donjek	1	1	DO1W001 - end of entrance road at highway, south side of entrance. DO1GW001 - water well
Destruction Bay	0	1	DB1GW001 - concrete sump around pipes next to AST west of main building.

3.2.3 Soil Vapour Probe Survey

A survey of volatile hydrocarbons in near surface soils (<0.75 metres) in areas of fuel storage and pumping was completed using the OVA. Table 3 summarizes the number of soil vapour readings collected per site.

TABLE 3
SOIL VAPOUR READINGS COLLECTED PER SITE

SITE	NUMBER OF READINGS
Beaver Creek	18
Donjek	17
Destruction Bay	14

A summary of the headspace readings collected at each site follows. Refer to Figures 2 to 4 for sample locations.

TABLE 4
HEADSPACE READINGS MEASURED AT BEAVER CREEK PUMP STATION

LOCATION	READINGS (ppm)
Large AST (sample location 4)	0, 0, 0, 0
Small AST (sample location 5)	0, 0, 0, 0
Underground Storage Tanks (USTs)	0, 0, 0
Small AST (sample location 9)	0, 0, 7.1
Valve on pipe line (sample location 6)	0, 0, 0
Valve north of large tank (sample location 4)	0

TABLE 5
HEADSPACE READINGS MEASURED AT DONJEK PUMP STATION

LOCATION	READINGS (ppm)
Large AST (sample location 6)	28.3, 81.3, 92, 10.4, 6.1, 0, 0
Small AST (sample location 6)	0, 0, 0
Underground Storage Tank	0, 0
AST (sample location 9)	2.6
Pump Room (sample location 10)	0, 0
AST - Apartments (sample location 8)	0, 0

TABLE 6
HEADSPACE READINGS MEASURED AT DESTRUCTION BAY PUMP STATION

LOCATION	READINGS (ppm)
Large AST (sample location 1)	0, 11.2, 12.5, 0, 0, 2.5, 0
Small AST (sample location 1)	145, 30.2, 0, 0
Small AST (sample location 2)	0, 0
Valves in pipeline (south of sample location 2)	0

3.2.4 Building Swabs

Swabs were collected from areas considered to have a high risk of polychlorinated biphenyl (PCB) contamination. Each swab was completed using a sterilized glass fibre filter soaked in acetone. An area measuring 10 centimetres by 10 centimetres was swabbed with the filter until the acetone had predominantly volatilized. Each

glass fibre filter was folded and placed within a glass jar with Teflon coated lid for transport to the project laboratory. Table 7 summarizes the number of building swabs collected per site and Figures 2 to 4 indicate the general location of each sample.

TABLE 7
BUILDING SWABS COLLECTED PER SITE

SITE	NUMBER OF SAMPLES	SAMPLE LOCATION
Beaver Creek	3	BC1BS001 - east side of building, below run-off from former exhaust out of generator room. BC1BS002 - southeast end of building. BC1BS003 - west side of building below exhaust from kitchen.
Donjek	3	DO1BS001 - main pump building - east wall. DO1BS002 - main building, generator room, inside of door on left side looking south. DO1BS003 - generator room in apartment complex, north wall.
Destruction Bay	3	DB1BS001 - main building, boiler room, south wall next to light switch. DB1BS002 - Diesel engine room, south east corner of building, above light switch just inside the room. DB1BS003 - generator room, centre of building next to door leading south.

3.3 Analytical Program

The analytical program followed the analyses stipulated in the TOR. A summary of the analyses is contained in Table 8.

TABLE 8
SUMMARY OF SAMPLE ANALYSES

	Soil	Surface Water	Ground water	Swab	Misc.
BETX/LH (benzene, ethylbenzene, toluene, xylenes / light hydrocarbons)	-	1	3	-	-
TEH (total extractable hydrocarbons)	8	-	-	-	-
PAH (polycyclic aromatic hydrocarbons)	5	1	3	-	-
Total Metals	11	1	3	-	-
Dissolved Metals	-	1	3	-	-
PCBs and Pesticides	3	-	-	-	-
PCBs (polychlorinated biphenyls)	-	-	-	6	-
Phenoxy Herbicides	2	-	-	-	-
Asbestos	-	-	-	-	1

The following sections summarize the results of the laboratory analyses of construction materials, soil samples, surface water and groundwater samples and building swabs collected from Beaver Creek, Donjek and Destruction Bay pump stations. Sample locations are indicated in Figures 2 to 4.

3.3.1 Building Materials

A building material sample, collected from boiler wrap located at the west end of the apartment complex at the Donjek pumping station, was submitted to the project laboratory for the analysis of concentrations of asbestos (Table 9). Analysis of this sample (DO1AS001) indicated concentrations of amosite (10 to 30%) and chrysotile (1 to 10%) in the sample. The remainder of the sample was composed of glass fibre (10 to 30 %) and cellulose (1 to 20%).

3.3.2 Soil

The following sections summarize the results of the analyses of soil samples. Figures 2 to 4 indicate the sample locations.

3.3.2.1 BTEX/LH

One soil sample was submitted to the project laboratory for analysis of concentrations of BTEX/LH (Table 10). Sample DB1S001 collected at the Destruction

Bay pump station contained no detectable concentrations of BTEX/LH.

3.3.2.2 PAH

Six soil samples were submitted to the project laboratory for analyses of concentrations of PAHs (Table 11). Trace concentrations of PAHs were indicated in all samples collected. However, none of the indicated concentrations exceed the CCME residential or commercial criteria.

3.3.2.3 TEH

Eight soil samples were submitted to the project laboratory for analyses of concentrations of TEH (Table 12). The analyses indicated trace concentrations of TEH in samples procured from Beaver Creek, (sample BC1S001 (450 ug/g) and sample BC1S002 (75 ug/g)); and samples procured from Donjek, (DO1S001 (3100 ug/g), sample DO1S003 (140 ug/g) and sample DO1S004 (130 ug/g)). The indicated concentration of 3100 ug/g in sample DO1S001 does not exceed the Alberta Level III soil risk management criteria for TPH (total petroleum hydrocarbons) for both coarse and fine-grained soil in the Remediation Guidelines for Petroleum Storage Tank Sites. No detectable concentrations of TEH were indicated in samples procured from the Destruction Bay site.

3.3.2.4 Pesticides and PCBs

Five soil samples were submitted to the project laboratory for analyses of concentrations of pesticides and PCBs (Table 13). Trace concentrations of pesticides and PCBs were indicated in all samples submitted to the project laboratory. However, none of the indicated concentrations exceed the CCME residential or commercial criteria.

3.3.2.5 Herbicides

Two samples were submitted to the project laboratory for analyses of concentrations of herbicides (Table 14). The analyses of these two soil samples indicated no detectable concentrations of herbicides in soil.

3.3.2.6 Metals

Eleven soil samples were submitted to the project laboratory for analyses of concentrations of metals (Table 15). The analyses of two soil samples collected from the Beaver Creek site indicated concentrations of lead in excess of the Alberta Tier 1 criteria for lead but not the CCME residential or commercial criteria. Sample BC1S001 contained 115 ug/g of lead and sample BC1S002 showed 158 ug/g of lead. The analyses of two samples procured at the Donjek Pump Station contained concentrations of nickel in excess of the Alberta Tier 1 criterion, but not the CCME residential or commercial criteria. The analyses of three samples collected at the Destruction Bay site indicated concentrations of nickel in excess of the Alberta Tier 1 criterion but not the CCME residential or commercial criteria. In addition, sample DB1S002 contained a concentration of zinc (163 ug/g) in excess of the Alberta Tier 1 criteria. No other concentrations of metals in excess of the applicable

criteria were noted.

3.3.3 Surface and Groundwater

The following sections summarize the results of the analyses of surface and groundwater samples. Sample locations are indicated in Figures 2 to 4.

3.3.3.1 BTEX/LH

Four water samples were submitted to the project laboratory for analyses of concentrations of BTEX/LH (Table 16). The analyses of the water samples indicated no detectable concentrations of BTEX/LH in any of the samples or the duplicate samples. The analysis of a trip blank submitted to the project laboratory did not indicate any detectable concentrations of BTEX/LH.

3.3.3.2 PAH

Four water samples were submitted to the project laboratory for analyses of concentrations of PAHs (Table 17). The analyses of groundwater samples indicated trace concentrations of PAHs in sample BC1GW001 (sump), DO1GW001 (water well) and DB1GW001 (sump). The analysis of sample DO1W001 (surface water sample) collected at the Donjek pump station indicated no detectable concentrations of PAHs.

3.3.3.3 Metals

Four water samples were submitted to the project laboratory for analyses of concentrations of metals (Table 18). The analysis of a water sample collected from Beaver Creek indicated concentrations of iron (380 ug/g), lead (13 ug/g) and manganese (85 ug/g), all in excess of the CCME drinking water criteria. The analysis of a groundwater sample collected at the Donjek Pump Station indicated concentrations of manganese (95 ug/g) in excess of the CCME drinking water criteria. The analysis of a groundwater sample collected from the Destruction Bay Pump Station indicated cadmium (8 ug/g) and manganese (110 ug/g) in excess of the CCME drinking water criteria. No other concentrations in excess of the applicable criteria were indicated by the analyses.

3.3.4 Building Swabs

Six building swab samples were submitted to the project laboratory for analyses of concentrations of PCBs (Table 19). The analyses of the six samples indicated trace concentrations of PCBs in five of the buildings. The analysis of sample BC1BS001, collected at the Beaver Creek pump station, did not contain any detectable concentrations of PCBs.

3.4 Geophysical Program

Results of the geophysical survey at all three pumping station sites suggest good to excellent correlation between the soil conductivity and magnetic data. Magnetic and conductive anomalies were found at all three sites, suggesting buried metallic

objects. The survey results indicate that both magnetic and conductive values drop off to low values once outside the target areas, supporting the hypothesis of buried metal. The geophysical survey at Beaver Creek and Donjek indicated a concentration of metallic targets within the areas thought to be waste disposal sites. In contrast, the survey completed at Destruction Bay suggests a more wide-spread sporadic pattern to the anomalies, suggesting random or patchy disposal patterns (Appendix F).

Confirmation of the presence of buried waste at Donjek was completed through the advancement of hand-dug testpits into the subsurface. Waste, consisting of rubber belts and miscellaneous metal pieces, was found at a depth of approximately 0.45 metres. No evidence of buried waste could be found at Beaver Creek or Destruction Bay during the excavations due to the bouldery nature of the soil encountered.

TABLE 9
 PERCENTAGE OF ASBESTOS IN BUILDING MATERIAL
 INDIAN AND NORTHERN AFFAIRS CANADA
 HAINES - FAIRBANKS PIPELINE
 File: 281-02

	Sample
	DO1AS001
amosite	10 - 30
chrysotile	1 - 10
glass fiber	10 - 30
cellulose	1 - 20

TABLE 10
 CONCENTRATIONS OF BTEX AND LIGHT HYDROCARBONS IN SOIL
 INDIAN AND NORTHERN AFFAIRS CANADA
 HAINES - FAIRBANKS PIPELINE
 File: 281-02
 ug/g (ppm)

Sample No.	Date Sampled	Location		Benzene	Ethylbenzene	Toluene	Xylenes
			Tier I	0.05	0.5	1	1
			Alberta PST coarse	0.02	0.1	0.36	3.5
			Alberta PST fine	0.07	0.41	0.22	11.9
			Detection Limit	0.0001	0.0002	0.004	0.0004
DB1S001	7/27/95	AST		<	<	<	<

All sample numbers preceded by 162-95

< = Less than detection limit

Tier I - Alberta Environmental Protection Tier I Criteria for Contaminated Soil Assessment and Remediation, March, 1994.

Alberta PST coarse - Remediation Guidelines for Petroleum Storage Tank Sites, 1994 - Soil Criteria for Groundwater Ingestion Pathway

Alberta PST fine - Remediation Guidelines for Petroleum Storage Tank Sites, 1994 - Soil Criteria for Groundwater Ingestion Pathway -

TABLE 11
CONCENTRATIONS OF POLYCYCLIC AROMATIC HYDROCARBONS IN SOIL
INDIAN AND NORTHERN AFFAIRS CANADA
HAINES - FAIRBANKS PIPELINE
File: 281-02
ug/g (ppm)

Sample No.				BC1S001	BC1S002	DO1S001	DB1S001	DB1S005	DB1S005
Date sampled				7/24/95	7/24/95	26-Jul-95	27-Jul-95	27-Jul-95	27-Jul-95
Location	Alberta Tier I	CCME		Large Tank	Small Tank	Large Tank	Large Tank	Garage	Dupl.
Depth (m)		Res/ Park	Com/Ind	0.3 m	0.3 m	0.4 m	0.3 m	0.3 m	0.3 m
Naphthalene		5	50	0.047	0.033	0.037	0.011	0.0016	0.0016
Acenaphthylene		-	-	0.0056	0.00048	0.038	0.042	0.0001	<
Acenaphthene		-	-	0.00092	0.001	0.0049	0.03	<	<
Fluorene		-	-	0.0031	0.0021	0.0049	0.0024	0.00015	0.00017
Phenanthrene		5	50	0.012	0.017	0.011	0.0033	0.00096	0.00082
Anthracene		-	-	0.0048	0.0021	0.0034	0.0012	<	<
Fluoranthene		-	-	0.00064	0.0082	0.0021	0.00022	0.0007	0.00084
Pyrene		10	100	0.034	0.032	0.018	0.0031	0.00095	0.00086
Benzo(a)anthracene		1	10	0.00082	0.004	0.0014	<	0.0002	0.00024
Chrysene		-	-	0.016	0.014	0.0087	0.00079	0.00062	0.00055
Benzo(b)fluoranthene *		1	10	0.0076	0.015	0.0062	0.00023	0.0002	0.00033
Benzo(k)fluoranthene *									
Benzo(e)pyrene		-	-	0.01	0.026	0.0078	0.00057	<	0.00036
Benzo(a)pyrene		1	10	0.0017	0.0089	0.00094	<	<	<
Perylene		-	-	0.0069	0.015	0.0069	<	<	<
Dibenzo(a,h)anthracene		1	10	0.0012	0.0023	0.0011	<	<	<
Indeno(1,2,3-c,d)pyrene		1	10	0.0045	0.0073	0.0032	<	<	<
Benzo(g,h,i)perylene		-	-	0.0063	0.056	0.0071	<	<	0.00024

< = Less than detection limit

* = Benzo(a)fluoranthene and Benzo(k)fluoranthene reported as total

CCME - Canadian Council of Ministers of the Environment - Interim Canadian Environmental Quality Criteria for Contaminated Sites, Sept. 1991

Res/Park - CCME remediation criteria for Residential Parkland use

Com/Ind. - CCME remediation criteria for Commercial Industrial land use

TABLE 12
 CONCENTRATIONS OF TOTAL EXTRACTABLE HYDROCARBONS (TEH) IN SOIL
 INDIAN AND NORTHERN AFFAIRS CANADA
 HAINES - FAIRBANKS PIPELINE
 File: 281-02
 ug/g (ppm)

Sample No.	Location	Sample Date	Result	Detection Limit
BC1S001	Large Fuel Tank	24-Jul-95	450	20
BC1S002	Small Fuel Tank	24-Jul-95	75	20
BC1S003	AST east of building	24-Jul-95	<	20
DO1S001	Large Fuel Tank	26-Jul-95	3100	20
DO1S003	North of apartment AST	26-Jul-95	140	20
DO1S004	Tower tank - south	26-Jul-95	130	20
DB1S002	AST west of building	27-Jul-95	<	20
DB1S005	Small garage @ highway	27-Jul-95	<	20

< = Less than detection limit

Remediation Guidelines for Petroleum Storage Tank Sites, 1994

Soil Criteria for Ground water Ingestion Pathway - Coarse-Grained and Fine-Grained = 5000 ug/g

TABLE 13
CONCENTRATION OF PESTICIDES AND POLYCHLORINATED BIPHENYLS IN SOIL
INDIAN AND NORTHERN AFFAIRS CANADA
HAINES - FAIRBANKS PIPELINE
File: 281-02
ug/g (ppm)

Sample No. Date Sampled Location	Criteria		BC1S004 24-Jul-95	DO1S002 26-Jul-95	DO1S005 26-Jul-95	DO1S006 26-Jul-95	DB1S003 27-Jul-95
	CCME		West side	Incinerator	Pump	Landfill	Pump
	Residential	Commercial	building		building		building
Hexachlorobenzene			<	0.00002	0.00001	0.000006	0.00006
alpha HCH			<	<	<	<	<
beta HCH			<	<	<	<	<
gamma HCH			<	<	<	<	<
Heptachlor			<	<	<	<	<
Aldrin			0.00015	0.00006	0.00006	0.00006	0.00006
Oxychlordan			<	<	<	0.00004	<
trans-Chlordane			<	<	<	0.00002	0.0009
cis-Chlordane			<	<	<	0.00003	0.00011
o,p'-DDE			<	<	<	<	<
p,p'-DDE			0.01	0.00005	0.00002	0.00005	0.00004
trans-Nonachlor			<	<	<	<	0.00004
cis-Nonachlor			<	<	<	<	<
o,p'-DDD			<	<	<	<	<
p,p'-DDD			<	<	0.00007	0.00003	<
p,p'-DDT			0.03	0.00042	0.0014	0.00042	0.00091
Mirex			<	<	<	<	0.00003
Heptachlor Epoxide			<	<	<	<	<
alpha-Endosulphan			<	<	<	<	<
Dieldrin			0.00012	<	0.00002	<	0.00003
Endrin			<	<	<	<	<
Methoxychlor			<	<	<	<	<
Aroclor 1242*	5	50	<	<	<	<	<
Aroclor 1254*			0.039	0.00057	<	0.00066	0.0063
Aroclor 1260*			0.047	0.00006	0.00057	0.0006	0.035

* Includes Aroclor 1242, 1254 and 1260

CCME - Canadian Council of Ministers of the Environment - Interim Canadian
Environmental Quality Criteria for Contaminated Sites, Sept. 1991

Res/Park - CCME remediation criteria for Residential Parkland use

Com/Ind. - CCME remediation criteria for Commercial Industrial land use

TABLE 14
 CONCENTRATION OF PHENOXY HERBICIDES IN SOIL
 INDIAN AND NORTHERN AFFAIRS CANADA
 HAINES - FAIRBANKS PIPELINE
 File: 281-02
 ug/g (ppm)

Parameter	Detection	Sample No.	
	Limit	DO1S002	DO1S006
Dicamba	0.005	<	<
2,4-D	0.005	<	<
2,4-DB	0.005	<	<
MCPA	0.005	<	<
MCPP	0.005	<	<
Picloram	0.1	<	<
2,4,5-T	0.005	<	<
2,4,5-TP	0.005	<	<

TABLE 15
CONCENTRATION OF METALS IN SOIL
INDIAN AND NORTHERN AFFAIRS CANADA
HAINES - FAIRBANKS PIPELINE
File: 281-02
ug/g (ppm)

Parameter	Tier 1	PST	CCME Detection			Sample Numbers										
			Res/Park	Com/Ind	Limit	BC1S001	BC1S002	BC1S005	DO1S001	DO1S002	DO1S003	DO1S004	DO1S006	DB1S001	DB1S002	DB1S005
Antimony	-		20	40	10	<	<	<	<	<	<	<	<	<	<	<
Arsenic	10		30	50	0.05	2.3	1.2	2.6	1.8	1.8	2.7	1.3	2.1	3	5	3.5
Barium	600		500	2000	0.1	48	24	105	54	39	122	41	62	166	55	63
Beryllium	5		4	8	1	<	<	<	<	<	<	<	<	<	<	<
Boron (total)	-		-	-	0.5	19	17	23	20	21	24	20	16	32	28	25
Cadmium	1		5	20	0.25	<	0.53	<	<	<	0.28	<	<	0.28	0.8	<
Chromium (total)	100		250	800	2	21	48	29	44	40	53	39	25	80	62	49
Cobalt	20		50	300	1	7	6	10	12	12	12	10	9	18	16	13
Copper	80		100	500	1	26	26	43	31	49	34	28	27	61	41	39
Lead	50	50	500	1000	1	115	158	3	15	22	25	6	2	52	82	6
Mercury	0.2		2	10	0.001	0.01	0.008	0.013	0.013	0.019	0.042	0.019	0.013	0.049	0.07	0.04
Molybdenum	4		10	40	4	<	<	<	<	<	<	<	<	<	<	<
Nickel	40		100	500	2	17	16	22	84	32	37	44	24	91	93	50
Selenium	2		3	10	0.5	<	<	<	<	<	<	<	<	<	<	<
Silver	-		20	40	2	<	<	<	<	<	<	<	<	<	<	<
Thallium	1		-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tin	50		50	300	5	5	<	<	<	<	<	<	<	<	<	<
Vanadium	100		200	-	0.5	56	30	65	44	57	70	51	45	63	55	54
Zinc	120		500	1500	1	58	96	47	34	60	61	39	37	113	163	51

< = Less than detection limit

>Tier 1 - Alberta Environmental Protection Tier I Criteria for Contaminated Soil Assessment and Remediation

PST - Remediation Guidelines for Petroleum Storage Tank Sites, 1994 - Soil Criteria for Groundwater Ingestion Pathway - Coarse and fine grained soil

CCME - Canadian Council of Ministers of the Environment - Interim Canadian

Environmental Quality Criteria for Contaminated Sites, Sept. 1991

Res/Park - CCME remediation criteria for Residential Parkland use

Com/Ind. - CCME remedition criteria for Commercial Industrial land use

TABLE 16
CONCENTRATIONS OF BTEX IN SURFACE & GROUNDWATER
INDIAN AND NORTHERN AFFAIRS CANADA
HAINES - FAIRBANKS PIPELINE
File: 281-02
ug/g (ppm)

Parameter	Criteria			Sample Numbers						
	Alberta PST	CCME		BC1GW001	DW1W001	DO1BS003	DO1BS003	DB1GW001	DB1GW001	Trip
		FAL	DW	24-Jul-95	26-Jul-95	26-Jul-95	Dupl.	28-Jul-95	Dupl.	Blank
Benzene	5	300	5	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	2.4	700	<=2.4	ND	ND	ND	ND	ND	ND	ND
Toluene	24	300	<=24	ND	ND	ND	ND	ND	ND	ND
Xylenes	300	-	<=300	ND	ND	ND	ND	ND	ND	ND

< = Less than detection limit

Alberta PST - Remediation Guidelines for Petroleum Storage Tank Sites, 1994 - Groundwater Criteria for Groundwater Ingestion Pathway

CCME - Canadian Council of Ministers of the Environment - Interim Canadian Environmental Quality Criteria for Contaminated Sites, Sept. 1991

A - Assessment Criteria

FAL - Freshwater Aquatic Life Criteria

>DW - Drinking Water Criteria

TABLE 17
 CONCENTRATION OF POLYCYCLIC AROMATIC HYDROCARBONS IN SURFACE AND GROUNDWATER
 INDIAN AND NORTHERN AFFAIRS CANADA
 HAINES - FAIRBANKS PIPELINE
 File: 281-02
 ug/g (ppm)

Sample No.	CCME		BC1GW001	DO1W001	DO1GW001	DB1GW001
	DW	FAL				
Date sampled			7/24/95	7/26/95	7/26/95	28-Jul-95
Location			Concrete sump	Entrance off highway	Water Well	Concrete sump
Naphthalene	-	-	ND	ND	0.006	0.044
Acenaphthylene	-	-	ND	ND	ND	0.023
Acenaphthene	-	-	ND	ND	ND	0.0087
Fluorene	-	-	ND	ND	ND	ND
Phenanthrene	-	-	ND	ND	0.0065	0.016
Anthracene	-	-	ND	ND	ND	0.0036
Fluoranthene	-	-	ND	ND	0.0024	0.001
Pyrene	-	-	0.004	ND	0.0019	0.021
Benzo(a)anthracene	-	-	ND	ND	ND	0.0024
Chrysene	-	-	0.0042	ND	ND	0.0092
Benzo(b)fluoranthene *	-	-	ND	ND	ND	0.0028
Benzo(k)fluoranthene *	-	-	ND	ND	ND	0.0026
Benzo(e)pyrene	-	-	ND	ND	ND	ND
Benzo(a)pyrene	0.01	-	ND	ND	ND	ND
Perylene	-	-	ND	ND	ND	ND
Dibenzo(a,h)anthracene	-	-	ND	ND	ND	ND
Indeno(1,2,3-c,d)pyrene	-	-	ND	ND	ND	ND
Benzo(g,h,i)perylene	-	-	ND	ND	ND	ND
Total PAH's	-	-	0.0082	ND	0.0168	0.1343

ND = Less than detection limit

* = Benzo(a)fluoranthene and Benzo(k)fluoranthene reported as total

CCME - Canadian Council of Ministers of the Environment - Interim Canadian Environmental Quality Criteria for Contaminated Sites, Sept. 1991

DW - Drinking Water Criteria

FAL - Freshwater Aquatic Life Criteria

TABLE 18
CONCENTRATION OF METALS IN GROUNDWATER
INDIAN AND NORTHERN AFFAIRS CANADA
HAINES - FAIRBANKS PIPELINE
File: 281-02
ug/L (ppb)

Parameter	Criteria			Sample Numbers			
	CCME	Alberta	Detection	BC1GW001	DO1GW001	DO1W001	DB1GW001
	DW	PST	Limit	7/24/95 Sump	7/26/95 Well	7/26/95 Stream	28-Jul-95 Sump
Aluminum	-	-	150	ND	ND	ND	ND
Antimony	-	-	150	ND	ND	ND	ND
Arsenic	25	-	1	ND	7	ND	ND
Barium	1000	-	1	16	12	42	6
Beryllium	-	-	3	ND	ND	ND	ND
Boron (total)	5000	-	10	ND	30	120	ND
Cadmium	5	-	0.2	0.7	ND	ND	8
Calcium	-	-	10	36200	45200	139000	20500
Chromium (total)	50	-	1	ND	ND	ND	ND
Cobalt	-	-	1	ND	ND	ND	ND
Copper	<=1000	-	1	5	1	2	ND
Iron*	<=300	-	30	380	30	ND	130
Lead	10	10	1	13	ND	1	7
Manganese*	<=50	-	3	85	95	3	110
Mercury	1	-	0.05	ND	ND	ND	ND
Molybdenum	-	-	1	ND	ND	ND	ND
Nickel	-	-	1	2	ND	3	3
Selenium	10	-	1	ND	ND	ND	ND
Silver	-	-	1	ND	ND	ND	ND
Sodium	<=200mg/L	-	100	13600	25100	21800	4300
Thallium	-	-	-	-	-	-	-
Tin	-	-	1	ND	ND	3	ND
Uranium	100	-	-	-	-	-	-
Vanadium	-	-	10	ND	ND	ND	ND
Zinc (total)	<=5000	-	10	450	ND	ND	ND

ND = Less than detection limit
PST - Remediation Guidelines for Petroleum Storage Tank Sites, 1994 - Groundwater
Criteria for Ground Water Ingestion Pathway
CCME - Canadian Council of Ministers of the Environment - Interim Canadian
Environmental Quality Criteria for Contaminated Sites, Sept. 1991
>DW - Drinking Water Criteria
FAL - Freshwater Aquatic Life Criteria
* - Aesthetic Objectives Not Health-Based

TABLE 19
 CONCENTRATION OF POLYCHLORINATED BIPHENYLS IN BUILDING SWABS
 INDIAN AND NORTHERN AFFAIRS CANADA
 HAINES - FAIRBANKS PIPELINE
 File: 281-02
 ug/filter

Parameter	Sample Numbers					
	BC1BS001	BC1BS003	DO1BS001	DO1BS002	DB1BS002	DB1BS003
Aroclor 1242	ND	ND	0.047	0.029	0.01	0.0098
Aroclor 1254	ND	ND	0.074	0.19	0.058	0.11
Aroclor 1260	ND	0.0029	0.058	0.29	0.012	0.03

4.0 INTERPRETATION

4.1 Soils

Based on a review of the field notes and the analytical data, there is evidence to suggest the existence of hydrocarbon contamination in the upper soil stratigraphy (0.75 m) surrounding the fuel storage tanks at each site. However, the indicated concentrations of hydrocarbons in soil suggest no restrictions on future site uses. Trace concentrations of pesticides and metals were indicated at all three sites; however, the indicated concentrations did not suggest widespread contamination. Indicated concentrations of lead in soil samples collected at the Beaver Creek site suggest some contamination of soil possibly associated with the use of leaded fuels. However, the indicated concentrations do not exceed the residential or commercial CCME criteria for lead concentrations in soil. The analyses of soil samples also indicated concentrations of nickel in excess of the Alberta Tier I criterion but not the CCME residential or commercial criteria. The indicated concentrations of nickel suggest that they may be indicative of the regional geological mineralization in the area. In general, none of the indicated concentrations of potential contaminants contained in near surface soil preclude the use of the three pump station sites for any future site use. However, caution should be exercised when interpreting the results, as these conclusions are only based on a cursory sampling of the surface and near surface soil at all sites. In areas of hydrocarbon storage there is evidence to suggest past spills of hydrocarbons at all three sites. Based on the length of time these sites have been inactive, it is possible that the hydrocarbon concentrations in near surface soils have decreased due to natural biodegradation and aeration of the soil. Therefore, the migration of hydrocarbons in the subsurface could potentially have impacted the groundwater (as indicated at the Donjek pumping station).

4.2 Water

Analytical results collected from surface and groundwater at each site suggest some minor impact to groundwater. However, the sampling of groundwater was limited to sumps at two of the sites and should therefore not be considered representative of ambient groundwater conditions. The trace concentrations of hydrocarbons and metals in the groundwater samples are likely a result of spills and/or leaks from the pipe line and valves contained in the sumps, and corrosion of the pipes and valves. However, analysis of the sample collected from the former water well located at Donjek indicates trace concentrations of polycyclic aromatic hydrocarbons in the water. The water well at Donjek is located downgradient of the fuel storage tanks (ASTs). The analytical results suggest that the groundwater has been impacted at this site.

4.3 PCBs

A review of the analytical data suggests that trace concentrations of PCBs are found on walls within the pumping stations at each of the three inspected sites. This may be due to transformers connected to the powerplants at each pumping station.

4.4 Landfills

Results of the geophysical survey indicated buried metallic anomalies at all three sites. However, only the Beaver Creek and Donjek Pump station sites appeared to have organized landfills. The geophysical survey completed at the Destruction Bay site indicated widespread, scattered, metallic objects with no definite concentration of waste. Beaver Creek and Donjek Pump stations had waste disposal areas defined by clearings in the surrounding forest and evidence of an organized deposition of waste. Hand-advanced testpits at the Donjek site confirmed the presence of waste overlain with at least 0.3 metres of clayey silt. Excavations at Beaver Creek did not confirm the presence of waste; however, the cover at this site was gravel-rich with an abundance of boulders, making the excavation difficult.

The waste area at Beaver Creek is located 200 metres north northeast of the main compound. It measures approximately 50 metres in length (east west) by 25 metres. The waste area at Donjek is located 500 metres north northeast of the main compound and measures approximately 75 metres (east west) by 40 metres.

The analysis of building materials at the Donjek pumping station confirmed the presence of asbestos in tank and pipe wrapping within the apartment complex. Future demolition activities should utilize personal protection during decommissioning activities and when handling potentially asbestos containing material (ACM). All potential ACM should be disposed of and handled in a manner acceptable to the Workers Compensation Board.

5.0 SITE SENSITIVITY ANALYSIS (ANALYSIS OF RISK)

The site sensitivity analysis established by the Province of Alberta classifies a site according to its sensitivity (high, moderate or low) based on a number of factors governing the likelihood of impact and the receptor sensitivity (Alberta Environmental Protection, 1994). This process is defined in the Alberta Remediation Guidelines for Petroleum Storage Sites. Based on the guidelines, a site's sensitivity for ingestion and/or inhalation by humans may be ascertained.

Appendix I contains the flow charts used to ascertain the site sensitivity and the level of risk management to be used at each site. Table 9 summarizes the analysis of each site's sensitivity and the resulting level of risk management.

TABLE 20
SUMMARY OF SITE SENSITIVITY AND RISK ANALYSIS
BEAVER CREEK, DONJEK AND DESTRUCTION BAY PUMP STATIONS

FACTOR	STATION		
	BEAVER CREEK	DONJEK	DESTRUCTION BAY
Ingestion Sensitivity Assessment			
Receptor Sensitivity	low	low	low
Likelihood of Impact	medium/low	medium/low	medium/low
Site Sensitivity Ranking	NR	NR	NR
Inhalation Sensitivity Assessment			
Receptor Sensitivity	low	low	low
Likelihood of Impact	low	low	low
Site Sensitivity Ranking	low	low	low
RISK MANAGEMENT CRITERIA	Coarse-grained soil: Low (Level III)	Fine-grained soil: Low (Level III)	Coarse-grained soils Low (Level III)

NR - No Response Required

5.1 Risk Relating to Ingestion of Water

Following the guidelines defined in the Alberta Remediation Guidelines for Petroleum Storage Sites, the likelihood of human ingestion of water is low at all three sites. The water sources are downgradient and have no present or potential future usage. The likelihood of impact on downgradient water sources, using the definitions contained within the Guidelines, (i.e. > 500 metres downgradient), is "low". Based on the overall site sensitivity ranking, no response may be required for the three sites.

5.2 Risk Relating to Inhalation of Vapours From Soil and Groundwater

Based on the guidelines established by the Alberta Environmental Protection, the site sensitivity for inhalation by humans is low and the likelihood of impact is low.

5.3 Required Level of Risk Management

Based on the aforementioned analyses of site sensitivity and receptors, and based on the sites' physical parameters (coarse-grained soil at Beaver Creek and Destruction Bay, and fine-grained soil at Donjek), the Level III criteria for coarse-grained soil should be used to manage the risk associated with the remaining hydrocarbon contamination at the Beaver Creek and Destruction Bay sites. The Level III criteria for fine-grained soil should be used at the Donjek site (Table 9).

6.0 RECOMMENDATIONS

Based on the preceding results and interpretations, Lorimer and Associates recommend further exploratory work at all three former pumping station sites. Exploratory work should consist of the installation of at least two monitoring wells downgradient of the suspected landfills and one upgradient. Groundwater should be analysed for concentrations of suspected contaminants such as phenoxy herbicides, hydrocarbons, metals and PCBs. In addition, some limited testpit excavations may be considered at Beaver Creek and Destruction Bay in order to confirm the presence of buried waste. This confirmation has already been carried out at Donjek.

Further groundwater monitoring should be considered at all three sites in the areas immediately surrounding the fuel storage sites. At the Donjek pumping station, groundwater collected from the water well contained trace concentrations of hydrocarbons. The potential for impact of hydrocarbons on the groundwater should be considered. The water well at Donjek should be capped to prevent future use as a drinking water supply.

Any future decommissioning activities should include provisions for the protection of workers from friable Asbestos Containing Material (ACM). Disposal of potential ACM should follow the recommendations of the Workers Compensation Board.

7.0 STANDARD LIMITATIONS

This report was prepared by Lorimer and Associates in association with Hemmera Resource Consultants Ltd. for the account of Indian and Northern Affairs Canada. The material in it reflects Lorimer and Associates and Hemmera Resource Consultants Ltd. judgment in light of the information available to them at the time of preparation. Any use which a Third Party makes of this report, including any reliance on decisions based on it, are the responsibility of such Third Parties. Lorimer and Associates and Hemmera Resource Consultants accept no responsibility for damages, if any, suffered by any Third Party as a result of decisions made or actions based on this report.

REFERENCES

- Alberta Environmental Protection. 1994. Draft Remediation Guidelines for Petroleum Storage Tank Sites, 1994.
- Alberta Environmental Protection. 1994. Alberta Tier I Criteria for Contaminated Soil Assessment and Remediation. March, 1994.
- Canadian Council of Ministers of the Environment. 1992. National Classification System for Contaminated Sites. CCME EPC-CS39E, March, 1992.
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- K. Bisset & Associates. 1995. Report to Arctic Environmental Strategy, Indian and Northern Affairs Canada. Research of Former Military Sites and Activities in the Yukon. July 8, 1995.
- Petroleum Distribution Office USARAL Support Command. 1966. General Description of Facilities USARAL Support Command Petroleum Distribution Office. Prepared for Headquarters United States Army, Alaska Support Command Petroleum Distribution Office APO Seattle 98749. January 1, 1966.
- Rickard, W.E. Deneke, F. 1972. Preliminary Investigation of Petroleum Spillage, Haines-Fairbanks Military Pipeline, Alaska. Prepared for Army Research Office, Life Sciences Division DA Project 2N061102B71D by Corps of Engineers, U.S. Army Cold Regions Research and Engineering Laboratory. Hanover, New Hampshire. April 1972.

APPENDIX A
INFORMATION SOURCES

INFORMATION SOURCES

The following sources of information were utilized during the development of the history of each of the pumping station sites.

Airphotos

Flight Line	Frames	Year	Comments
<u>Donjek</u>			
A11000	299-300	1947	Prior to Construction
A15278	90-91	1957	
A18396	155-157	1964	
A22997	60-61	1972	High Level
A24176	178-179	1975	

Beaver Creek

A18476	8	1964	Infrared
A18535	41-42	1964	High Level
A18395	122-123	1967	
A24208	75-76	1975	
A25288	50-51	1979	High Level

Destruction Bay

A11068	92-93	1947	Prior to construction
A14960	1-2	1955	High Level
A15739	37-38	1957	High Level
A18396	61-62	1964	
A23000	74-75	1972	High Level
A24208	182-183	1975	

References

K. Bisset & Associates. 1995. Report to Arctic Environmental Strategy, Indian and Northern Affairs Canada. Research of Former Military Sites and Activities in the Yukon. July 8, 1995.

(Used to obtain information from former employees and local residents)

Garfield, D.E. et. al. 1977. Haines-Fairbanks Pipeline, Design, Construction and Operation. Special Report 77-4. February 1977.

Petroleum Distribution Office USARAL Support Command. 1966. General Description of Facilities USARAL Support Command Petroleum Distribution Office. Prepared for Headquarters United States Army, Alaska Support Command Petroleum Distribution Office APO Seattle 98749. January 1, 1966.

Rickard, W.E. Deneke, F. 1972. Preliminary Investigation of Petroleum Spillage, Haines-Fairbanks Military Pipeline, Alaska. Prepared for Army Research Office, Life Sciences Division DA Project 2N061102B71D by Corps of Engineers, U.S. Army Cold Regions Research and Engineering Laboratory. Hanover, New Hampshire. April 1972.

172D Infantry Brigade (Alaska). 1982. Pamphlet 360-1. Description of Alaskan
Military Petroleum Facilities. January 15, 1982

APPENDIX B
HEALTH, SAFETY AND CONTINGENCY PLAN

3.0 HEALTH AND SAFETY

The purpose of the Safety Execution Plan (SEP) is to establish requirements for protecting the health and safety of field personnel during the activities conducted on the site. The SEP has been prepared to ensure that the consulting and geophysical personnel are suitably protected during drilling and sampling operations until such time as the soils have been confirmed to be at non-hazardous levels. The plan contains safety information, instruction and procedures.

3.1 Scope and Objectives

The objectives of the SEP are to protect the health and ensure the safety of personnel on the site by specifying standard safety procedures; outlining the types of personal protection and safety equipment which will be required on this site; describing clean up procedures; and providing emergency procedures should they be needed. The guidelines issued by the U.S. National Institute for Occupational Safety and Health (NIOSH) were used as a reference to develop this plan. Normal OH&S requirements for field personnel will apply. The enforcement of the plan will include the following:

- Site reconnaissance and the identification of known hazards and evaluation of the risks associated with the site activities.
- List of key personnel responsible for site safety, response operatives and the protection of team members.
- Description of the levels of protection required.
- Delineation of the work areas.
- Description of decontamination procedures for personnel and equipment.
- Establishment of emergency procedures.
- Emergency medical aid for injuries and toxicological problems.
- Establishment of procedures for protection of the field teams from weather.

If it becomes necessary to vary the procedures described in this SEP, INAC will be immediately notified in writing by the Consultant. Any subcontractors involved in the activities will be made aware of the procedures and will be responsible for ensuring their staff conform to the most recent version of the SEP.

3.2 Site Characterization

The NIOSH guidelines for assessing chemical and physical hazards will be used by the Consultant to determine the level of worker protection required when working around excavated soils. The type and level of worker protection will be reviewed after receipt of testing results, and will be further reviewed as the amount of information on the chemical and physical nature of the soils increases. The level of worker protection may be adjusted as the site characterization becomes more refined. Adjustments to the level of protection will be determined by the Consultant and will be supplied immediately to any contractors and subcontractors involved in the activities in the program.

3.3 Standard Safety Procedures

The health and safety officer (HSO) designated for this program will be the team leader, Mr. Bruce Willmer. The HSO will have the responsibility of ensuring that the appropriate safety procedures, as outlined in this document, are followed with regard to the site activities. The fundamental safety guidelines for which the HSO will be responsible in overseeing are described in the following sections.

Under normal circumstances, NIOSH Level D protective gear will be adequate for all personnel on-site.

The first day procedure at each site will be for the HSO to inspect the soil and ascertain whether organic vapours are at concentrations of concern prior to sampling. Based on previous investigations of the sites, and on our initial reconnaissance, we have no reason to believe that this will be the case. The HSO may monitor the air quality during sampling to confirm that the safety precautions are appropriate. The air quality may be monitored on a regular basis by the HSO for comparison to earlier findings. The air quality monitoring program may be increased or reduced depending on results of initial test results.

If any suspicious material is encountered a site safety meeting will be held to review this plan.

3.4 Site Personnel Requirements

Site personnel must:

- be aware of the potential hazards which they may encounter on the site and follow set procedures in the event of emergency;
- avoid unprotected contact with any contaminated soil or moisture from the soil due to walking through the soil, kneeling or sitting in the sampling area, or from equipment which may have come in contact with the soil;
- remove contact lenses if they begin to create irritation due to dust or organic vapours;
- wear required protective equipment at all times while in the sampling area. If vapours are encountered personnel having any facial hair or jewellery which would interfere with the proper functioning of the safety equipment should retreat from the site; and
- all personnel should shower at the end of each day.

Site personnel must NOT:

- consume any food or drink, chew gum or tobacco, or smoke while sampling;
- consume any alcoholic beverages, or prescription drugs which may have a deleterious effect on their abilities to perform their tasks during the day in which they are sampling; and
- act in any way which is less than completely professional and safe.

3.5 NIOSH Level D Protective Equipment

NIOSH Level D protection is expected to provide a proper level of protection for personnel in direct contact with soils at these sites. The characteristics of NIOSH Level D protective equipment include:

Required:

- work coveralls;
- safety glasses and/or goggles;
- safety boots with steel toe and shank; and
- hard hat.

Contingency:

- sunscreen;
- MSHA/NIOSH approved filter-type respirators with OV/AG/Hepa filter cartridges;
- tear resistant tape to repair small rips in tyvek coveralls;
- if handling potentially sharp objects (glass, metallic objects, etc.) then a suitable protective outer glove must be worn;
- disposable outer boots; and
- hearing protection if working around machinery for any length of time.

3.6 Safety and Emergency Equipment

The following equipment should always be within close proximity of workers on the site:

- first aid kit with wool and reflective blankets;
- eyewash.

3.7 Wildlife Concerns

Field team members will attempt to avoid dangerous contact with wildlife. All field team members will carry pepper spray canisters with them in the event of contact with bears. Team members will always be in visual contact with each other. All personnel will be familiar with safe acceptable practices for working in the wilderness.

3.8 Emergency Contact Numbers

Project Manager and Client Contact (Whitehorse), Bob Lorimer	(403) 667-4146
INAC	(403) 667-3268
Yukon Government Renewable Resources	(403) 667-5683
Wildlife Management	(403) 667-5721
Beaver Creek Nursing Station	(403) 862-4444
Beaver Creek Ambulance Service	(403) 862-3333
Burwash Landing Nursing Station	(403) 841-5401
Burwash Landing Ambulance Service	(403) 841-3333
Destruction Bay Nursing Station	(403) 841-4444
Destruction Bay Ambulance Service	(403) 841-3333

APPENDIX C
PHASE II INVESTIGATION PLAN

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1.0 INTRODUCTION

Lorimer and Associates in association with Hemmera Resource Consultants (Hemmera) are pleased to submit the following work program for the Phase II Environmental Site Assessments and Field Investigations of: the Donjek, Destruction Bay and Beaver Creek Pump Station sites on the Haines Fairbanks Pipeline.

This work program is based on the details outlined in the RFP and information obtained through a review of background documents provided to Lorimer and Associates by INAC (Indian and Northern Affairs Canada), a preliminary site reconnaissance and an airphoto review.

1.1 Background

In the 1950's, the United States government constructed the Haines - Fairbanks Pipeline in order to supply fuels to their military installations in Alaska. This pipeline consisted of an eight inch multi - product line with six pumping stations located along the Canadian section. A significant portion of the line was installed above ground. The pipeline was decommissioned in 1972, with the majority of the pipe and one pumping station removed in 1990 - 1991.

In 1994, the Arctic Environmental Strategy (AES) - Action on Waste program conducted a preliminary environmental investigation of four of the pumping stations. Later in the same year, DDT canisters were found buried near a pumping station in Northern B. C. by the British Columbia Ministry of Environment, Lands and Parks. As a result of these preliminary investigations and the discovery of the DDT canisters, the AES - Action on Waste program requires further information related to activities associated on and near these pumping stations in order to determine the environmental status of the sites. The information collected during these assessments and the preliminary investigations will be used to develop remediation strategies.

The Donjek Pump Station is located at mile 248 of the pipe line at coordinates 61°37.03N and 139°33.09 W. The site consisted of a mainline pump building, a utility building and family housing. The station has been vandalized. There is at least one suspected disposal area at this site.

The Destruction Bay Pump Station is located at mile 209 of the pipe line at coordinates 61°13.65N and 138°45.43W. The site consisted of a combination building and family housing. The housing units have been removed. There has been some vandalism at the site. There is at least one suspected disposal site in the area.

The Beaver Creek Pump Station is located at mile 324 on the pipe line at coordinates 62°24.46N and 140°50.99 W. The site consisted of a combination building and family housing. The housing units have been removed. There has been some vandalism at the site. There is at least one suspected disposal area at the site.

1.2 Scope and Objectives

Based on the aforementioned background information, the following tasks will be completed to ascertain the environmental status of these sites:

- Prepare and implement a Response/Operation/Health & Safety Plan (included in this work plan);
- Conduct a visual reconnaissance of the site;
- Complete Phase II Sampling:
 - surface soil sampling program;
 - surface water sampling program;
 - building surface swab sampling program;
 - a soil vapour probe survey;
 - a geophysical survey to delineate and identify disposal areas, with test pitting to verify;

The following sections summarize the details and methodologies for the work program.

2.0 WORK PROGRAM

The following sections summarize our proposed approach to field work at the three sites. A description of the proposed work, field personnel, field equipment and schedule follows.

2.1 Personnel

Bob Lorimer, P.Eng. - Project Manager Client Contact - Bob Lorimer will provide support services out of Whitehorse and will also be responsible for backup field support.

Bruce Willmer, M.Sc., P.Geo.: Team Leader and field coordinator will be responsible for all data collection and ensuring that each site work plan is complete.

Mr. Steve Wittchen - Geophysical Crew Chief will coordinate and conduct the collection of geophysical data.

Mr. Paul McGee - Geophysical Assistant will assist in the collection of geophysical data.

2.2 Field Reporting

All field notes will be compiled in water resistant field books. All pages will be labelled with the date, and applicable site. Field notes will be transcribed at the project completion for insertion in the final report as an appendix.

Field notes will detail all sample locations with sketch maps and coordinates of the sample location, suggested analyses for any samples collected based on suspected contaminant types, records of photographs including the roll and picture number and details of any incidents such as accidents that may occur on-site.

2.3 Field Equipment

A list of equipment proposed for the field program follows:

General Materials

Field books
Lap top
Camera
Maps, scales, check lists
Video camera

Sampling Equipment

Power auger
Hand auger
Shovel and pick
Plastic slotted PVC 0.25"
Sample bottles
Latex gloves
DI water andalconox
Photoionization detector
Sample bags

Survey Equipment

Level and rod
30 metre tape
Flagging tape
Hip chain
Clinometer
Compass

Safety Equipment

Insect repellent
Pepper spray
First aid kit
Eye wash
Organic vapour respirators

Geophysical Equipment

Geonics EM-31 terrain conductivity meter

3.0 HEALTH AND SAFETY

The purpose of the Safety Execution Plan (SEP) is to establish requirements for protecting the health and safety of field personnel during the activities conducted on the site. The SEP has been prepared to ensure that the consulting and geophysical personnel are suitably protected during drilling and sampling operations until such time as the soils have been confirmed to be at non-hazardous levels. The plan contains safety information, instruction and procedures.

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- Delineation of the work areas.
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If it becomes necessary to vary the procedures described in this SEP, INAC will be immediately notified in writing by the Consultant. Any subcontractors involved in the activities will be made aware of the procedures and will be responsible for ensuring their staff conform to the most recent version of the SEP.

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If any suspicious material is encountered a site safety meeting will be held to review this plan.

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Site personnel must:

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- remove contact lenses if they begin to create irritation due to dust or organic vapours;
- wear required protective equipment at all times while in the sampling area. If vapours are encountered personnel having any facial hair or jewellery which would interfere with the proper functioning of the safety equipment should retreat from the site; and
- all personnel should shower at the end of each day.

Site personnel must NOT:

- consume any food or drink, chew gum or tobacco, or smoke while sampling;
- consume any alcoholic beverages, or prescription drugs which may have a deleterious effect on their abilities to perform their tasks during the day in which they are sampling; and
- act in any way which is less than completely professional and safe.

3.5 NIOSH Level D Protective Equipment

NIOSH Level D protection is expected to provide a proper level of protection for personnel in direct contact with soils at these sites. The characteristics of NIOSH Level D protective equipment include:

Required:

- work coveralls;
- safety glasses and/or goggles;
- safety boots with steel toe and shank; and
- hard hat.

Contingency:

- sunscreen;
- MSHA/NIOSH approved filter-type respirators with OV/AG/Hepa filter cartridges;
- tear resistant tape to repair small rips in tyvek coveralls;
- if handling potentially sharp objects (glass, metallic objects, etc.) then a suitable protective outer glove must be worn;
- disposable outer boots; and
- hearing protection if working around machinery for any length of time.

3.6 Safety and Emergency Equipment

The following equipment should always be within close proximity of workers on the site:

- first aid kit with wool and reflective blankets;
- eyewash.

3.7 Wildlife Concerns

Field team members will attempt to avoid dangerous contact with wildlife. All field team members will carry pepper spray canisters with them in the event of contact with bears. Team members will always be in visual contact with each other. All personnel will be familiar with safe acceptable practices for working in the wilderness.

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Burwash Landing Ambulance Service	(403) 841-3333
Destruction Bay Nursing Station	(403) 841-4444
Destruction Bay Ambulance Service	(403) 841-3333

4.0 WORK PROGRAM AND SITE CHECK LISTS

The following sections will summarize in table format the proposed field program for each of the three sites. Sampling protocol for both soil and surface water will follow the QA/QC protocol described in our proposal dated May 26, 1995. Soil samples will be screened in the field using a PID in order to detect volatile contaminant concentrations. Surface water will be screened in the field for the parameters of pH, conductivity and temperature.

Samples will be submitted to Axys Analytical Services Ltd. of Sidney, B.C. The requested analyses will be as per the Terms of Reference provided to Lorimer and Associates. Copies of the sample Chain of Custody forms will be forwarded to INAC for its use in tracking the laboratory testing program.

Sample locations for each site will expand upon the preliminary sampling completed for INAC in June 1994.

4.1 Beaver Creek

Date of Investigation: July 23 and 24th, 1995
Comments: One suspected landfill site (possible additional landfill)
Objective: Delineate potential hydrocarbon contamination and lateral/vertical extent of landfill

4.1.1 Investigation Program

July 23, 1995

- Install vapour monitoring points.
- Install geophysical grid.

July 24, 1995

- Complete the geophysical survey.
- Completion of soil vapour survey.
- Sample soil and surface water.
- Excavate test holes in areas of high risk and downslope of landfills.
- Obtain soil samples for laboratory analyses.
- Obtain surface swab samples.

4.1.2 Laboratory Program

Soil and Swab Samples

* Sample collected for potential future analyses

# of Samples	Analyses	Cost	Total Cost
4	TEH	\$125	\$500
4	BTEX	\$150	\$600
4	PAH	\$345	\$1,380
4	Metals	\$105	\$420
4	Phenoxy Herbicides	\$350	\$1,400
4	Fenuron	\$250	\$1,000
4	PCBs and pesticides	\$485	\$1,940
4	Dioxins/Furans*		
4	PCBs (swabs)	\$285	\$1,140
TOTAL			\$8,380

Water Samples

# of Samples	Analyses	Cost	Total Cost
4	Phenoxy Herbicides	\$350	\$1,400
4	Fenuron	\$250	\$1000
4	BTEX	\$150	\$600
4	Metals (Total and dissolved)	\$240	\$960
4	PCBs and Pesticides	\$485	\$1,940
4	PAH	\$345	\$1,380
Total			\$7,280

Two to three shallow, hand augered boreholes will be advanced in areas of fuel storage and former work / garage areas. Profiles of headspace will be collected for each borehole to an approximate depth of 1 metre. Worst case samples, as indicated by headspace, will be submitted to the project laboratory for testing.

Two hand augered borehole / excavations will be advanced downslope of the landfill area and one upslope of the landfill area. Soil samples will be collected for submission to the project laboratory.

In addition, at least one or two hand augered borehole / excavations will be advanced over the waste piles where the geophysical survey indicates anomalies. These will be advanced with extreme caution in order to confirm the presence of waste and to avoid puncturing any potentially buried drums. Suspect soil will be procured for submission to the project laboratory.

A soil vapour survey will be completed at a minimum of ten sample points. The vapour survey will focus on the former fuel storage areas and garage / work areas of the pump stations. If the borehole / excavations within the landfill areas indicate potential fuel disposal, then the soil vapour survey will be extended to include the landfills.

4.1.3 Check List

Item	Personnel	Completed
Survey grid with references to landmarks for geophysical data collection. Mark on site plan and airphotos.		
Completion of geophysical survey and identification of anomalies.		
Completion of vapour survey		
Location of soil sampling sites. Mark on site plan and airphotos.		
Soil descriptions		
Photographic documentation		
Analytical results		

4.2 Donjek

Date of Investigation: July 25 and 26th, 1995
Comments: One suspected landfill site
Objective: Delineate potential hydrocarbon contamination and lateral/vertical extent of landfill

4.2.1 Investigation Program

July 25, 1995

- Install vapour monitoring points.
- Install geophysical grid.

July 26, 1995

- Completion of geophysical survey.
- Completion of vapour survey.
- Sample soil, surface water and asbestos wrapping on old boiler.
- Excavate test holes in areas of high risk and downslope of landfill.
- Obtain soil samples for laboratory analyses.
- Obtain surface swab samples.

4.2.2 Laboratory Program

Soil and Swab Samples

* Sample collected for potential future analyses

# of Samples	Analyses	Cost	Total Cost
4	TEH	\$125	\$500
4	BTEX	\$150	\$600
4	PAH	\$345	\$1,380
4	Metals	\$105	\$420
4	Phenoxy Herbicides	\$350	\$1,400
4	Fenuron	\$250	\$1,000
4	PCBs and pesticides	\$485	\$1,940
4	Dioxins/Furans*		
4	PCBs (swabs)	\$285	\$1,140
TOTAL			\$8,380

Water Samples

# of Samples	Analyses	Cost	Total Cost
4	Phenoxy Herbicides	\$350	\$1,400
4	Fenuron	\$250	\$1000
4	BTEX	\$150	\$600
4	Metals (Total and dissolved)	\$240	\$960
4	PCBs and Pesticides	\$485	\$1,940
4	PAH	\$345	\$1,380
Total			\$7,280

Asbestos Samples

# of Samples	Analyses	Cost	Total Cost
2	Asbestos		
Total			

Two to three shallow, hand augered boreholes will be advanced in areas of fuel storage and former work / garage areas. Profiles of headspace will be collected for each borehole to an approximate depth of 1 metre. Worst case samples, as indicated by headspace, will be submitted to the project laboratory for testing.

Two hand augered borehole / excavations will be advanced downslope of the landfill area and one upslope of the landfill area. Soil samples will be collected for submission to the project laboratory.

In addition, at least one or two hand augered borehole / excavations will be advanced over the waste piles where the geophysical survey indicates anomalies. These will be advanced with extreme caution in order to confirm the presence of waste and to avoid puncturing any potentially buried drums. Suspect soil will be procured for submission to the project laboratory.

A soil vapour survey will be completed at a minimum of ten sample points. The vapour survey will focus on the former fuel storage areas and garage / work areas of the pump stations. If the borehole / excavations within the landfill areas indicate potential fuel disposal, then the soil vapour survey will be extended to include the landfills.

4.2.3 Check List

Item	Personnel	Completed
Survey grid with references to landmarks for geophysical data collection. Mark on site plan and airphotos.		
Completion of geophysical survey and identification of anomalies.		
Completion of soil vapour survey		
Location of soil sampling sites. Mark on site plan and airphotos.		
Soil descriptions		
Photographic documentation		
Analytical results		

4.3 Destruction Bay

Date of Investigation: July 27 and 28th, 1995
 Comments: One suspected landfill site (potentially 2 to 3 additional landfills which may or may not be related to the pipeline)
 Objective: Delineate potential hydrocarbon contamination and lateral/vertical extent of landfill

4.3.1 Investigation Program

July 27, 1995

- Install vapour monitoring points.
- Install geophysical grid.

July 28, 1995

- Completion of the geophysical survey.
- Completion of soil vapour survey.
- Sample soil and surface water.
- Excavate test holes in areas of high risk and downslope of landfill.
- Obtain soil samples for laboratory analyses.
- Obtain surface swab samples.

4.3.2 Laboratory Program

Soil and Swab Samples

* Sample collected for potential future analyses

# of Samples	Analyses	Cost	Total Cost
4	TEH	\$125	\$500
4	BTEX	\$150	\$600
4	PAH	\$345	\$1,380
4	Metals	\$105	\$420
4	Phenoxy Herbicides	\$350	\$1,400
4	Fenuron	\$250	\$1,000
4	PCBs and pesticides	\$485	\$1,940
4	Dioxins/Furans*		
4	PCBs (swabs)	\$285	\$1,140
TOTAL			\$8,380

Water Samples

# of Samples	Analyses	Cost	Total Cost
4	Phenoxy Herbicides	\$350	\$1,400
4	Fenuron	\$250	\$1000
4	BTEX	\$150	\$600
4	Metals (Total and dissolved)	\$240	\$960
4	PCBs and Pesticides	\$485	\$1,940
4	PAH	\$345	\$1,380
Total			\$7,280

Two to three shallow, hand augered boreholes will be advanced in areas of fuel storage and former work / garage areas. Profiles of headspace will be collected for each borehole to an approximate depth of 1 metre. Worst case samples, as indicated by headspace, will be submitted to the project laboratory for testing.

Two hand augered borehole / excavations will be advanced downslope of the landfill area and one upslope of the landfill area. Soil samples will be collected for submission to the project laboratory.

In addition, at least one or two hand augered borehole / excavations will be advanced over the waste piles where the geophysical survey indicates anomalies. These will be advanced with extreme caution in order to confirm the presence of waste and to avoid puncturing any potentially buried drums. Suspect soil will be procured for submission to the project laboratory.

A soil vapour survey will be completed at a minimum of ten sample points. The vapour survey will focus on the former fuel storage areas and garage / work areas of the pump stations. If the borehole / excavations within the landfill areas indicate potential fuel disposal, then the soil vapour survey will be extended to include the landfills.

4.3.3 Check List

Item	Personnel	Completed
Survey grid with references to landmarks for geophysical data collection. Mark on site plan and airphotos.		
Completion of geophysical survey and identification of anomalies.		
Completion of soil vapour survey		
Location of soil sampling sites. Mark on site plan and airphotos.		
Soil descriptions		
Photographic documentation		
Analytical results		

5.0 WORK PROGRAM COSTS AND SCHEDULING

Lorimer & Associates anticipate completing the aforementioned field work within the budget contained in our May 26, 1995 proposal to Indian and Northern Affairs Canada. This budgeting assumes that only one landfill at each site will be assessed using the geophysical survey. Our preliminary site visit and airphoto review indicated the potential for additional landfills, particularly at the Destruction Bay site. However, based on our discussions with INAC, Lorimer and Associates intend to assess the landfill most likely associated with the operation of the pump stations. Therefore, the landfill closest to each pump station will be included in this Phase II assessment.

5.1 Scheduling

Based on a completion date for the field work of July 28, 1995, Lorimer and Associates anticipate completing the Draft report on schedule or prior to the August 18th, 1995 deadline.

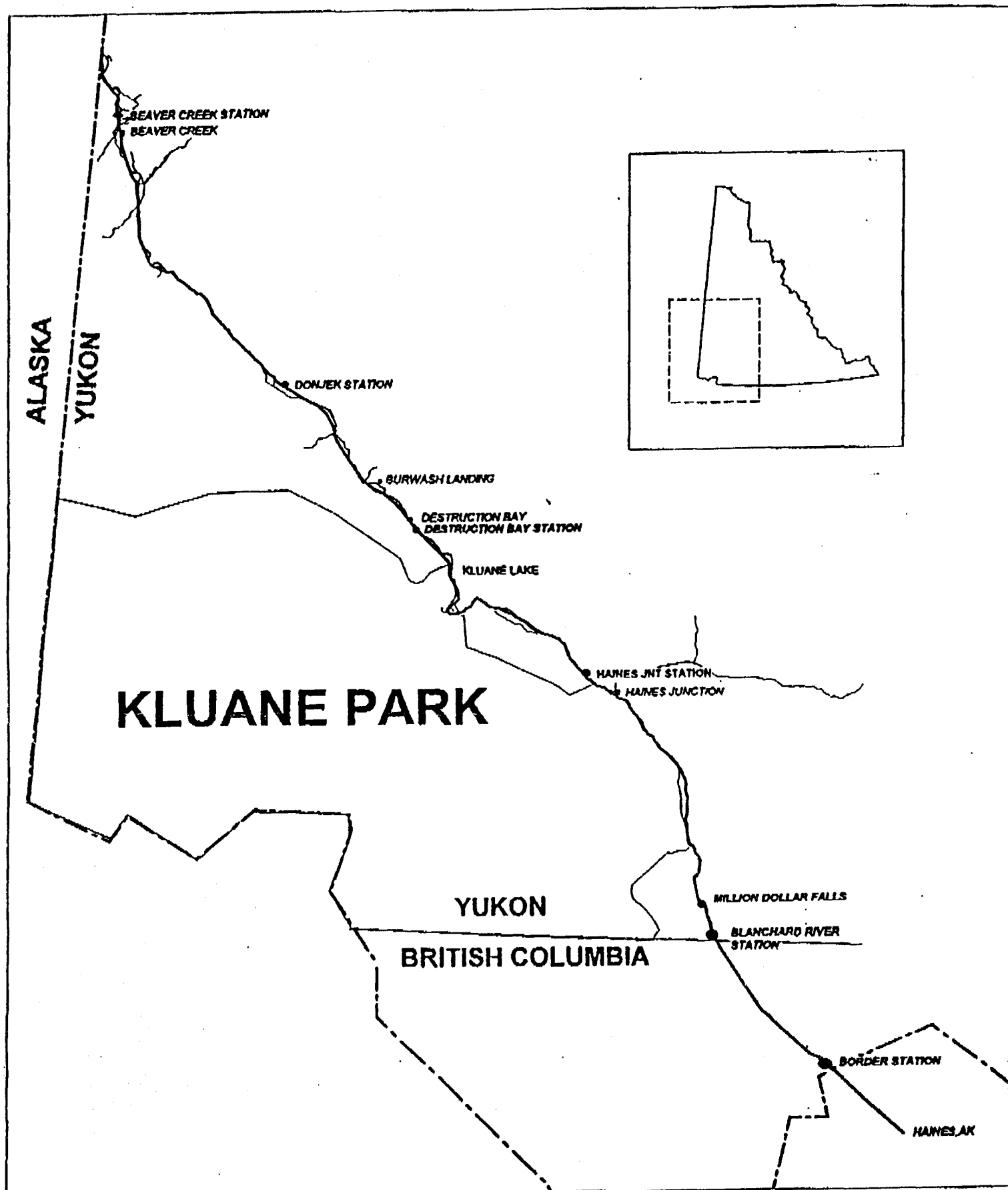
6.0 CONCLUSIONS

We look forward to completing the following Work Program in an expeditious manner. If you should have any comments, questions or concerns please contact the undersigned at (403) 667-4146.

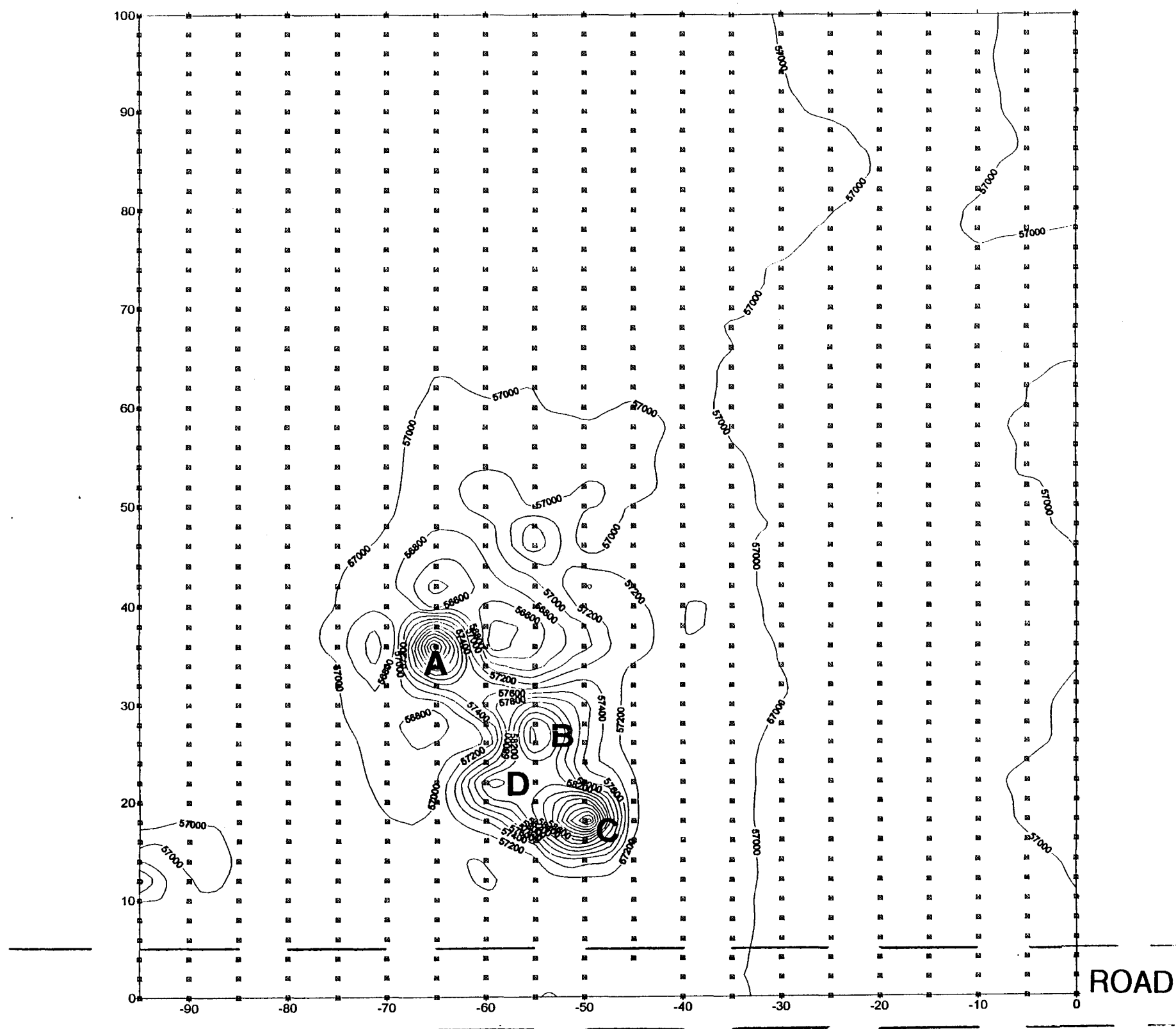
Yours truly,

LORIMER & ASSOCIATES

Bob Lorimer, P.Eng.



LORIMER AND ASSOCIATES BEAVER CREEK, DONJEK, AND DESTRUCTION BAY PUMP STATION		
OVERHAUSER MAGNETOMETER & EM SURVEY		
LOCATION OF THE SURVEYING AREA		
FRONTIER GEOSCIENCES INC.		
Date: July 1995		Fig. 1



167.8 m to
PUMP STATION →

SCALE = 1:500 (METRIC)

LORIMER AND ASSOCIATES
BEAVER CREEK PUMPING STATION

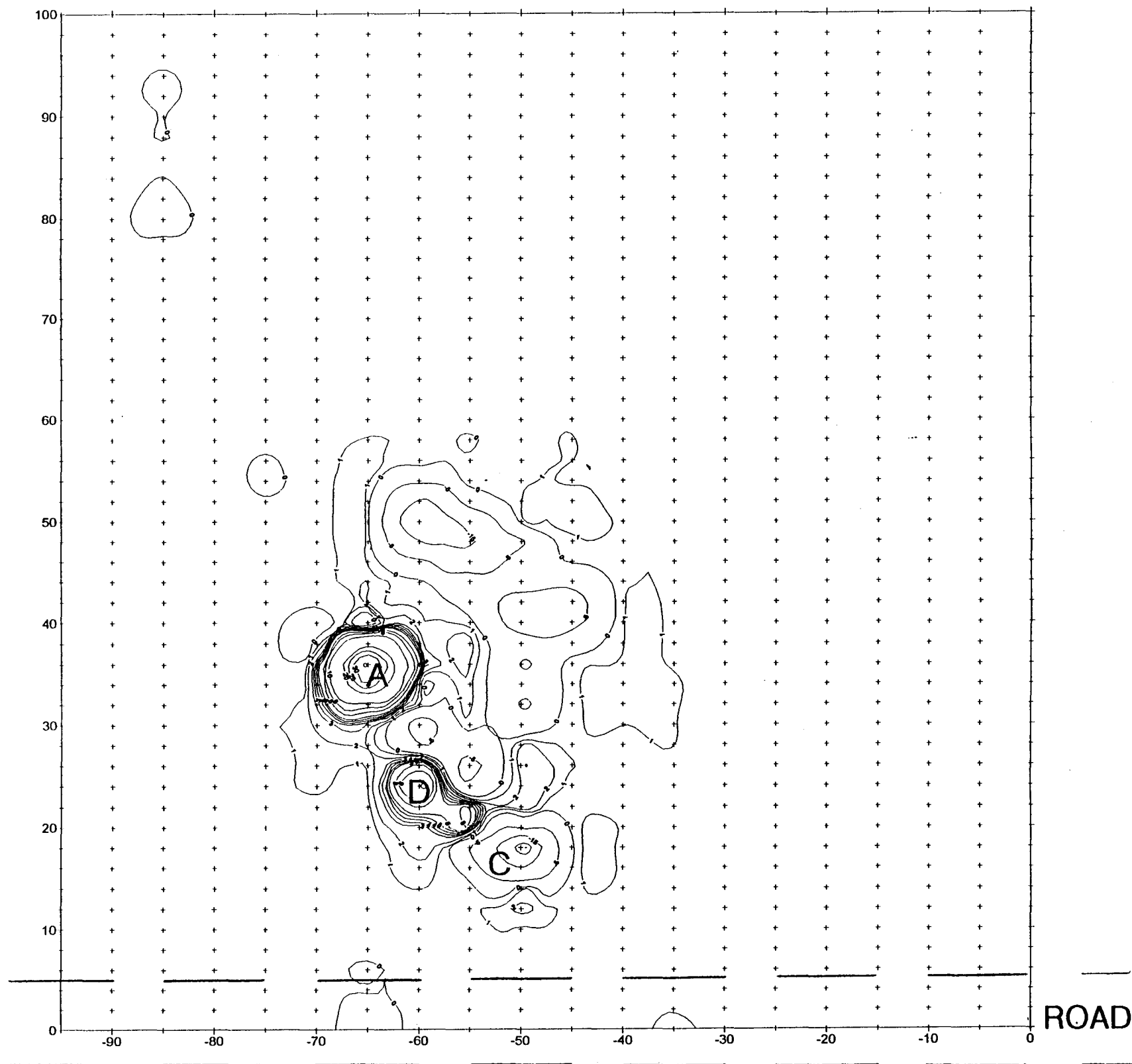
TOTAL MAGNETIC FIELD CONTOUR PLAN

AMPLITUDE IN NANOTESLAS
INSTRUMENT: GEM OVERHAUSER MAGNETOMETER

FRONTIER GEOSCIENCES INC.

DATE: JULY, 1995

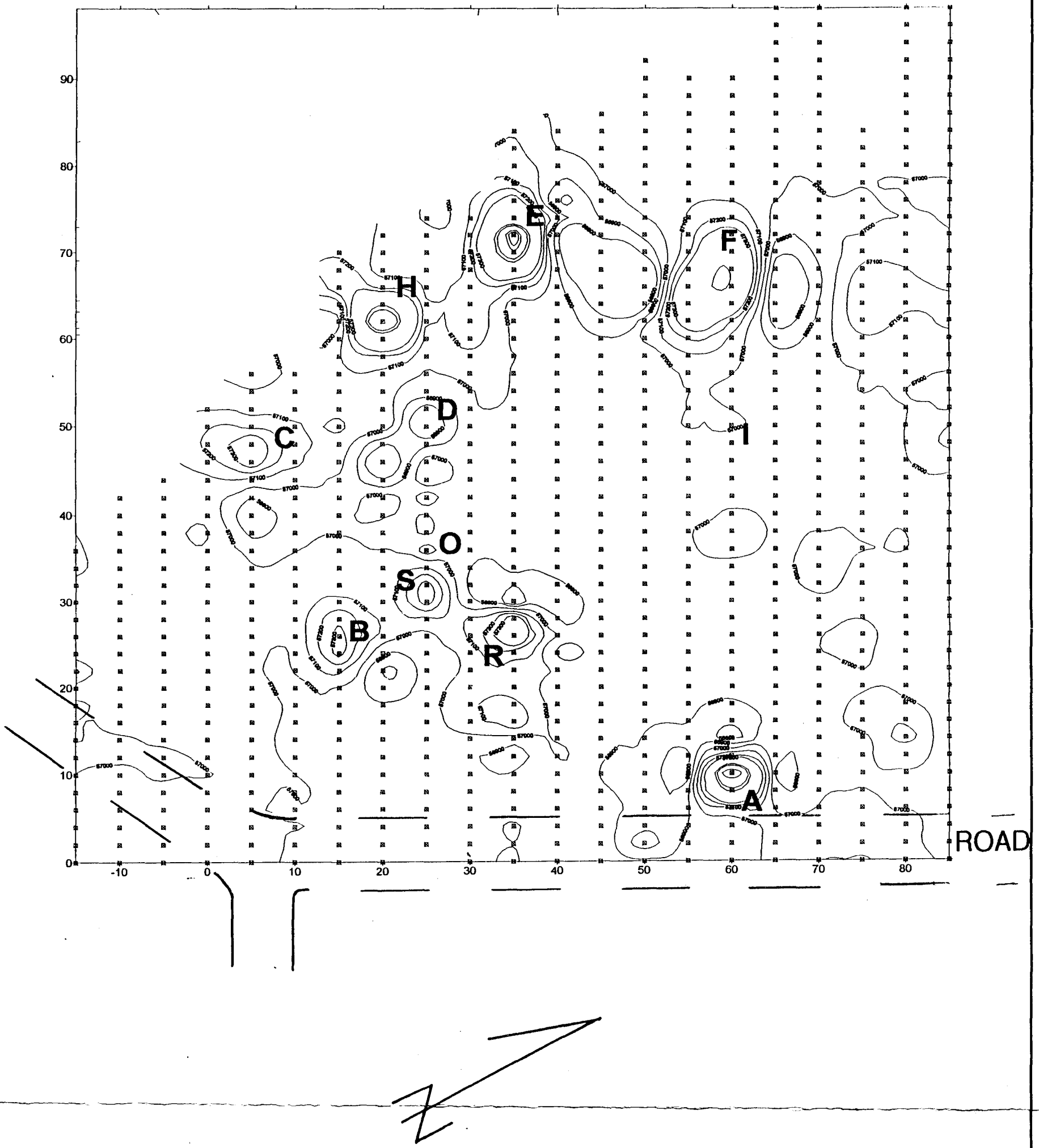
Fig. 2b



167.8 m to
PUMP STATION →

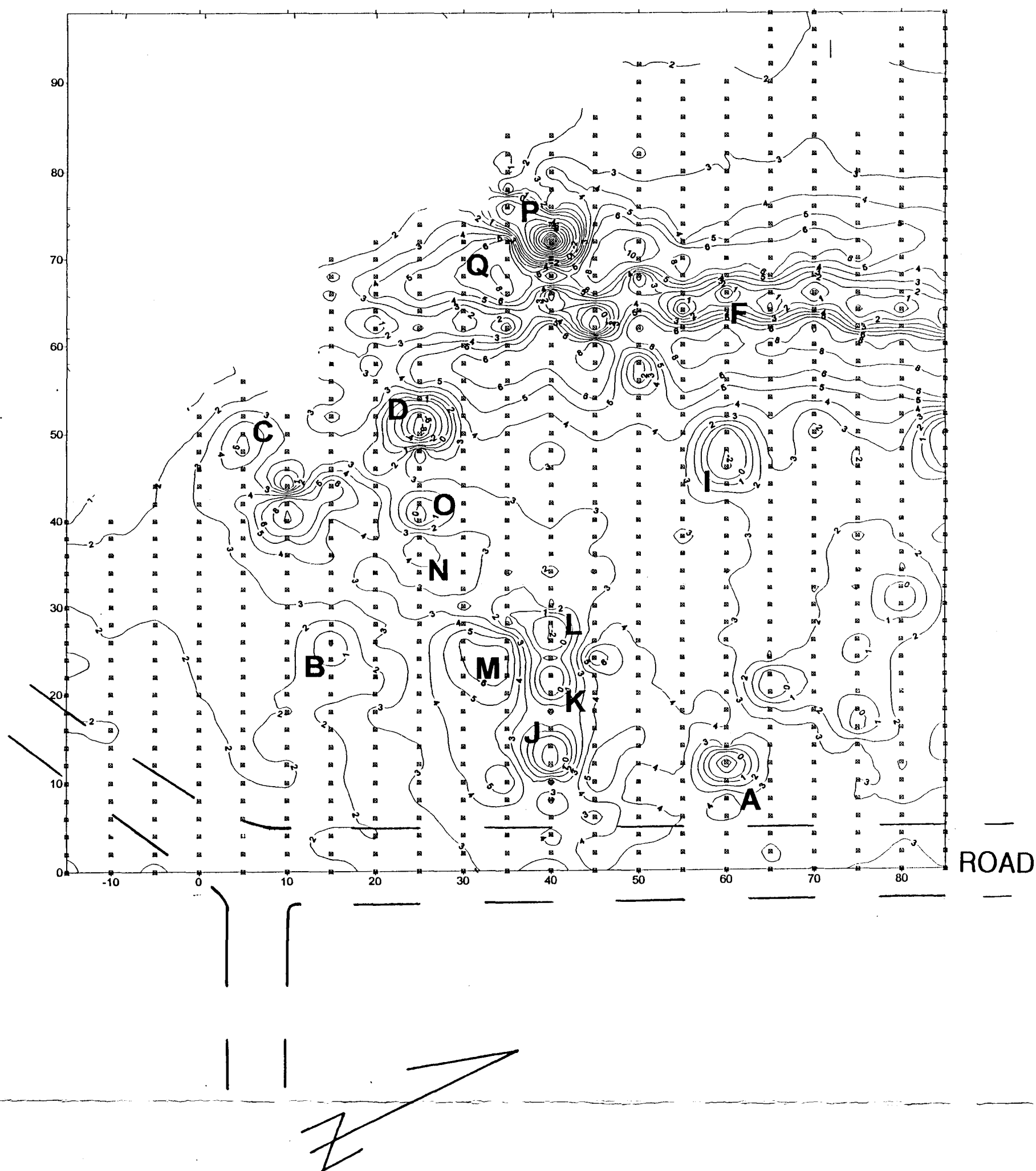
SCALE = 1:500 (METRIC)

LORIMER AND ASSOCIATES		
BEAVER CREEK PUMP STATION		
ELECTROMAGNETIC CONDUCTIVITY CONTOUR PLAN		
AMPLITUDE IN MILLIMHOS PER METRE		
INSTRUMENT: GEONICS EM-31		
FRONTIER GEOSCIENCES INC.		
Date: July 1995		Fig. 2a



SCALE=1:500 (METRIC)

LORIMER AND ASSOCIATES		
DESTRUCTION BAY PUMP STATION		
TOTAL MAGNETIC FIELD CONTOUR PLAN		
AMPLITUDE IN NANOTESLAS		
INSTRUMENT: GEM OVERHAUSER MAGNETOMETER		
FRONTIER GEOSCIENCES INC.		
Date: July 1995		Fig.4b



SCALE=1:500 (METRIC)

LORIMER AND ASSOCIATES

DESTRUCTION BAY PUMP STATION

ELECTROMAGNETIC CONDUCTIVITY CONTOUR PLAN

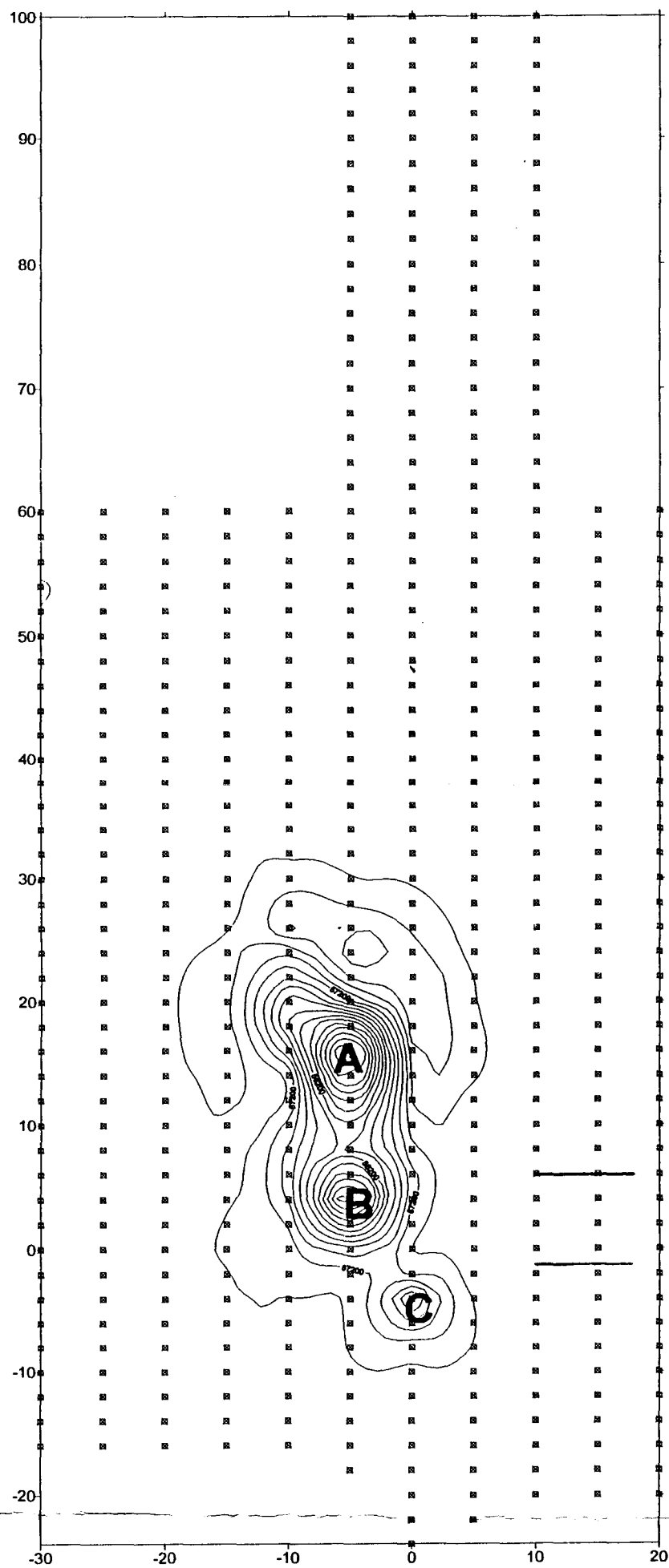
AMPLITUDE IN MILLIMHOS PER METRE

INSTRUMENT: GEONICS EM-31

FRONTIER GEOSCIENCES INC.

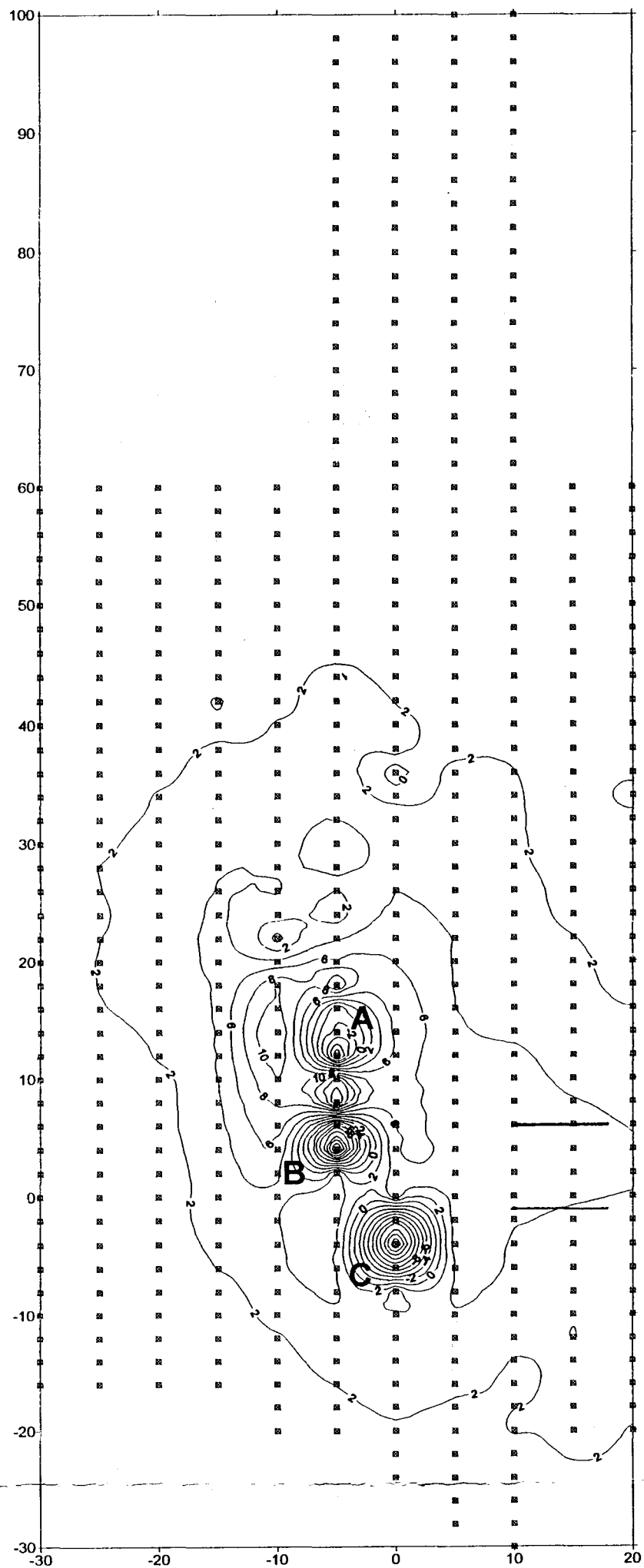
Date: July 1995

Fig. 4a



SCALE=1:500 (METRIC)

LORIMER AND ASSOCIATES		
DONJEK PUMP STATION		
TOTAL MAGNETIC FIELD CONTOUR PLAN		
AMPLITUDE IN NANOMETRES		
INSTRUMENT: GEM OVERHAUSER MAGNETOMETER		
FRONTIER GEOSCIENCES INC.		
Date: July 1995		Fig. 3b



SCALE=1:500 (METRIC)

LORIMER AND ASSOCIATES		
DONJEK PUMP STATION		
ELECTROMAGNETIC CONDUCTIVITY CONTOUR PLAN		
AMPLITUDE IN MILLIMHOS PER METRE		
INSTRUMENT: GEONICS EM-31		
FRONTIER GEOSCIENCES INC.		
Date: July 1995		Fig. 3a

APPENDIX G
LABORATORY REPORTS

PCB/PESTICIDE ANALYSIS REPORT

CLIENT SAMPLE I.D: Procedural Blank

AXYS ID: CL-PF-BLK 612 12

CLIENT: Hemmerz Resource Consultants

DATE: 25/Aug/95

SAMPLE TYPE: Blank

METHOD NO.: CL-PF-01/Ver.2

SAMPLE SIZE: 1.0 Swab

INSTRUMENT: GC-ECD

CONCENTRATION IN: ng/swab

Compounds	Concentration	(SDL)
Aroclor 1242	ND	4.6
Aroclor 1254	ND	2.9
Aroclor 1260	ND	2.0

Surrogate Standards	% Recovery
Tetrachloro-M-xylene	83
PCB 209	120

1. SDL = Sample Detection Limit
2. ND = Not Detected
3. NDR = Peak detected but did not meet quantification criteria
4. Concentrations are recovery corrected


Approved

PCB/PESTICIDE ANALYSIS REPORT

CLIENT SAMPLE I.D.: Spiked Matrix

AXYS ID: CL-PF-SPM 450

CLIENT: Hemmera Resource Consultants

DATE: 25/Aug/95

SAMPLE TYPE: Filter

METHOD NO.: CL-PF-01/Ver.2

SAMPLE SIZE: 3.0 filter

INSTRUMENT: GC-ECD

CAUTION: NO FARMER'S CODE

CONCENTRATION IN: ng/filter

Compounds	(PCB)	Determined	Expected	% Recovery
Aroclor 1242	80	500	450	111
Aroclor 1254	11	370	460	80
Aroclor 1260	2.5	440	460	96

Surrogate Standards

% Recovery

Tetrachloro-M-xylene
PCB 20880
82

Q11

Q11
Q11

Q11

Q11
Q11

Final Concentration = 100

Recovery = 100

Analysis Note: Response = 100

Analysis Note: Response = 100

Analysis Note: Response = 100



Approved

PCB/PESTICIDE ANALYSIS REPORT

CLIENT SAMPLE I.D: BC1BS001

AXYS ID: 9514-307 12

CLIENT: Hemmera Resource Consultants

DATE: 25/Aug/95

SAMPLE TYPE: Swab

METHOD NO.: CL-PF-01/Ver.2

SAMPLE SIZE: 1.0 swab

INSTRUMENT: GC-ECD

CONCENTRATION IN: ng/swab

Compounds	Concentration	(SDL)
Aroclor 1242	ND	6.6
Aroclor 1254	ND	3.7
Aroclor 1260	ND	2.6

Surrogate Standards

% Recovery

Tetrachloro-M-xylene
PCB 209

75

110

1. SDL = Sample Detection Limit
2. ND = Not Detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected
5. Concentrations are recovery corrected

Approved

PCB/PESTICIDE ANALYSIS REPORT

CLIENT SAMPLE I.D.: BC18S003

AXYS ID: 9514-30912

CLIENT: Hemmera Resource Consultants

DATE: 25/Aug/95

SAMPLE TYPE: Swab

METHOD NO.: CL-PF-01/Ver.2

SAMPLE SIZE: 1.0 swab

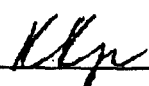
INSTRUMENT: GC-ECD

CONCENTRATION IN: ng/swab

Compounds	Concentration	(SDL)
Aroclor 1242	ND	12
Aroclor 1254	ND	7.0
Aroclor 1260	NDR 2.9	2.4

Surrogate Standards	% Recovery
Tetrachloro-M-xylene	70
PCB 209	100

1. SDL = Sample Detection Limit
2. ND = Not Detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected
5. Concentrations are recovery corrected


Approved

PCB/PESTICIDE ANALYSIS REPORT

CLIENT SAMPLE I.D: D01BS001

AXYS ID: 9514-2821

CLIENT: Hemmera Resource Consultants

DATE: 25/Aug/95

SAMPLE TYPE: Swab

METHOD NO.: CL-PF-01/Ver.2

SAMPLE SIZE: 1.0 swab

INSTRUMENT: GC-ECD

CONCENTRATION IN: ng/swab

Compounds	Concentration	(SDL)
Aroclor 1242	47	4.0
Aroclor 1254	74	2.5
Aroclor 1260	58	1.0

Surrogate Standards	% Recovery
Tetrachloro-M-xylene	73
PCB 208	120

1. SDL = Sample Detection Limit
2. ND = Not Detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected
5. Concentrations are recovery corrected


Approved

PCB/PESTICIDE ANALYSIS REPORT

CLIENT SAMPLE I.D: D01BS002

AXYS ID: 9514-283 I

CLIENT: Hemmera Resource Consultants

DATE: 25/Aug/95

SAMPLE TYPE: Swab

METHOD NO.: CL-PF-01/Ver.2

SAMPLE SIZE: 1.0 swab

INSTRUMENT: GC-ECD

CONCENTRATION IN: ng/swab

Compounds	Concentration	(SDL)
Aroclor 1242	29	4.3
Aroclor 1254	100	4.7
Aroclor 1260	290	1.9

Surrogate Standards	% Recovery
Tetrachloro-M-xylene	71
PCB 209	93

1. SDL = Sample Detection Limit
2. ND = Not Detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected
5. Concentrations are recovery corrected


Approved

PCB/PESTICIDE ANALYSIS REPORT

CLIENT SAMPLE I.D: DB1BS002

AXYS ID: 9514-2341

CLIENT: Hemmera Resource Consultants

DATE: 25/Aug/95

SAMPLE TYPE: Swab

METHOD NO.: CL-PF-01/Ver.2

SAMPLE SIZE: 1.0 swab

INSTRUMENT: GC-ECD

CONCENTRATION IN: ng/swab

Compounds	Concentration	(SDL)
Aroclor 1242	NDR 10	3.8
Aroclor 1254	58	1.7
Aroclor 1260	12	0.93

Surrogate Standards	% Recovery
Tetrachloro-M-xylene	87
PCB 208	110

1. SDL = Sample Detection Limit
2. ND = Not Detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected
5. Concentrations are recovery corrected


Approved

PCB/PESTICIDE ANALYSIS REPORT

CLIENT SAMPLE I.D: DB18S003

AXYS ID: 9514-296 i

CLIENT: Hemmera Resource Consultants

DATE: 25/Aug/95

SAMPLE TYPE: Swab

METHOD NO.: CL-PF-01/Ver.2

SAMPLE SIZE: 1.0 swab

INSTRUMENT: GC-ECD

CONCENTRATION IN: ng/swab

Compounds	Concentration	(SDL)
Aroclor 1242	NDR 9.8	4.5
Aroclor 1254	110	2.2
Aroclor 1260	30	1.5

Surrogate Standards	% Recovery
Tetrachloro-M-xylene	71
PCB 209	110

1. SDL = Sample Detection Limit
2. ND = Not Detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected
5. Concentrations are recovery corrected


Approved

VOC/PTX ANALYSIS REPORT

CLIENT SAMPLE I.D: Procedural Blank

AXYS FILE: VO-W-BLK 11

CLIENT: AMBIO Research Associates Inc.

DATE: 21/Aug/95

SAMPLE TYPE: Blank

METHOD NO.: VO-W-01/VO-QMS-1.0

SAMPLE SIZE: 5.0 mL

INSTRUMENT: GC-MS

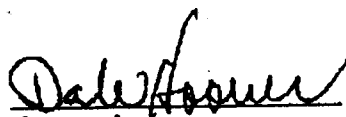
CONCENTRATION IN: ng/mL

Compounds	Concentration	(SDL)
1,1-Dichloroethane	ND	0.31
1,3-Dichloropropane	ND	0.22
1,1-Dichloroethane	ND	0.21
o-1,2-Dichloroethane	ND	0.18
Chloroform	ND	0.37
1,1,1-Trichloroethane	ND	0.16
1,2-Dichloroethane	ND	0.61
1,2-Dichloropropane	ND	0.21
Bromodichloromethane	ND	0.25
Trichloroethylene	ND	0.22
1,1,2-Trichloroethane	ND	0.24
1,1,2,2-Tetrachloroethane	ND	0.37
Bromoform	ND	0.08
Benzene	0.35	0.08
Toluene	1.4	0.02
Ethylbenzene	ND	0.02
p/m-Xylene	ND	0.03
o-Xylene	ND	0.03

Surrogate Standards % Recovery

Bromofluorobenzene 100

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected.
5. Concentrations are not recovery corrected.


 Approved

VOC/BTEX ANALYSIS REPORT

CLIENT SAMPLE I.D: Trip Blank

AXYS FILE: 9514-302A

CLIENT: Hemmera Resource Consultants Ltd.

DATE: 21/Aug/95

SAMPLE TYPE: Water

METHOD NO.: VO-W-01/VO-QMS-1.0

SAMPLE SIZE: 5.0 mL

INSTRUMENT: GC-MS

CONCENTRATION IN: ng/mL

Compounds	Concentration	(SDL)
1,1-Dichloroethane	ND	0.47
1,3-Dichloropropene	ND	0.38
1,1-Dichloroethane	ND	0.18
c-1,2-Dichloroethane	ND	0.28
Chloroform	ND	0.18
1,1,1-Trichloroethane	ND	0.3
1,2-Dichloroethane	ND	0.42
1,2-Dichloropropane	ND	0.22
Bromodichloromethane	ND	0.2
Trichloroethylene	ND	0.1
1,1,2-Trichloroethane	ND	0.24
1,1,2,2-Tetrachloroethane	ND	0.26
Bromoform	ND	0.1
Benzene	ND	0.02
Toluene	ND	0.5
Ethylbenzene	ND	0.02
p/m-Xylene	ND	0.06
o-Xylene	ND	0.02

Surrogate Standards	% Recovery
Bromofluorobenzene	110

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected.
5. Concentrations are not recovery corrected.

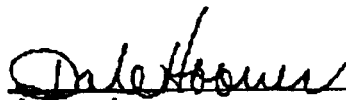

Approved

BTEX ANALYSIS REPORT**CLIENT SAMPLE I.D.:** Travelling Blank A**AXYS FILE:** 9514-304A1**CLIENT:** Hemmera Resource Consultants Ltd.**DATE:** 23/Aug/95**SAMPLE TYPE:** Water**METHOD NO.:** VO-W-01/VO-QMS-1.0**SAMPLE SIZE:** 5.0 mL**INSTRUMENT:** GC-MS**CONCENTRATION IN:** ng/mL

Compounds	Concentration	(SDL)
Benzene	ND	0.01
Toluene	ND	0.2
Ethylbenzene	ND	0.01
p/m-Xylene	ND	0.02
o-Xylene	ND	0.01

Surrogate Standards	% Recovery
Bromofluorobenzene	97

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected.
5. Concentrations are not recovery corrected.


Approved

BTEX ANALYSIS REPORT

CLIENT SAMPLE I.D.: BC1GW001

AXYS FILE: 9514-308A1

CLIENT: Hammera Resource Consultants Ltd.

DATE: 23/Aug/95

SAMPLE TYPE: Water

METHOD NO.: VO-W-01/VO-QMS-1.0

SAMPLE SIZE: 5.0 mL

INSTRUMENT: GC-MS

CONCENTRATION IN: ng/mL

Compounds	Concentration	(SDL)
Benzene	ND	0.01
Toluene	ND	0.2
Ethylbenzene	ND	0.01
p/m-Xylene	ND	0.05
o-Xylene	ND	0.02

Surrogate Standards	% Recovery
Bromofluorobenzene	95

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected.
5. Concentrations are not recovery corrected.


Approved

BTEX ANALYSIS REPORT

CLIENT SAMPLE I.D.: ^{DO} DW1W001

AXYS FILE: 9514-28681

CLIENT: Hemmera Resource Consultants Ltd.

DATE: 28/Aug/95

SAMPLE TYPE: Water

METHOD NO.: VO-W-01/VO-QMS-1.0

SAMPLE SIZE: 5.0 mL

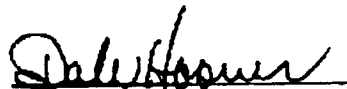
INSTRUMENT: GC-MS

CONCENTRATION IN: ng/mL

Compounds	Concentration	(SDL)
Benzene	ND	0.1
Toluene	ND	0.3
Ethylbenzene	ND	0.05
p/m -Xylene	ND	0.2
o-Xylene	ND	0.01

Surrogate Standards	% Recovery
Bromofluorobenzene	99

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected.
5. Concentrations are not recovery corrected.


Approved

BTEX ANALYSIS REPORT

CLIENT SAMPLE I.D.: ~~D01B9003~~ D01GW001

AXYS FILE: 9514-285A

CLIENT: Hemmera Resource Consultants Ltd.

DATE: 18/Aug/95

SAMPLE TYPE: Water

METHOD NO.: VO-W-01/VO-QMS-1.0

SAMPLE SIZE: 5.0 mL

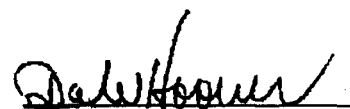
INSTRUMENT: GC-MS

CONCENTRATION IN: ng/mL

Compounds	Concentration	(SDL)
Benzene	ND	0.02
Toluene	ND	0.15
Ethylbenzene	ND	0.02
p/m -Xylene	ND	0.03
o-Xylene	ND	0.03

Surrogate Standards	% Recovery
Bromofluorobenzene	93

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected.
5. Concentrations are not recovery corrected.


Approved

BTEX ANALYSIS REPORT

CLIENT SAMPLE I.D.: ~~D0129003~~

D01GW001

AXYS FILE: 9514-295B

DUPLICATE

CLIENT: Hemmera Resource Consultants Ltd.

DATE: 18/Aug/95

SAMPLE TYPE: Water

METHOD NO.: VO-W-01/VO-QM8-1.0

SAMPLE SIZE: 5.0 mL

INSTRUMENT: GC-MS

CONCENTRATION IN: ng/mL

Compounds	Concentration	(SDL)
Benzene	ND	0.01
Toluene	ND	0.1
Ethylbenzene	ND	0.01
p/m -Xylene	ND	0.01
o-Xylene	ND	0.01

Surrogate Standards	% Recovery
Bromofluorobenzene	94

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected.
5. Concentrations are not recovery corrected.


Approved

BTEX ANALYSIS REPORT

CLIENT SAMPLE I.D.: DB1GW001

AXYS FILE: 9514-301A

CLIENT: Hemmera Resource Consultants Ltd.

DATE: 18/Aug/95

SAMPLE TYPE: Water

METHOD NO.: VO-W-01/VO-QMS-1.0

SAMPLE SIZE: 5.0 mL

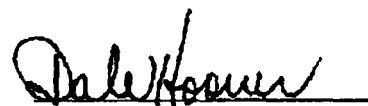
INSTRUMENT: GC-MS

CONCENTRATION IN: ng/mL

Compounds	Concentration	(SDL)
Benzene	ND	0.01
Toluene	ND	0.1
Ethylbenzene	ND	0.03
p/m -Xylene	ND	0.05
o-Xylene	ND	0.03

Surrogate Standards	% Recovery
Bromofluorobenzene	97

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected.
5. Concentrations are not recovery corrected.


Approved

BTEX ANALYSIS REPORT

CLIENT SAMPLE I.D.: DB1GW001

CLIENT: Hemmera Resource Consultants Ltd.

SAMPLE TYPE: Water

SAMPLE SIZE: 5.0 mL

AXYS FILE: 9514-301B

DUPLICATE

DATE: 18/Aug/95

METHOD NO.: VO-W-01/VO-QMS-1.0

INSTRUMENT: GC-MS

CONCENTRATION IN: ng/mL

Compounds	Concentration	(SDL)
Benzene	ND	0.02
Toluene	ND	0.15
Ethylbenzene	ND	0.03
p/m -Xylene	ND	0.06
o-Xylene	ND	0.02

Surrogate Standards	% Recovery
Bromofluorobenzene	100

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected.
5. Concentrations are not recovery corrected.


Approved

PAH ANALYSIS REPORT

CLIENT SAMPLE ID.: Procedural Blank

AXYS FILE: PH-W-BLK 782

CLIENT: HEMMERA Resource Consultants Ltd.

DATE: 18/Aug/95

SAMPLE TYPE: Blank

METHOD NO.: PH-W-04/Ver.2

SAMPLE SIZE: 1.0 L

INSTRUMENT: GC-MS

CONCENTRATION IN: ng/L

Compounds	Concentration	(SDL)
Naphthalene	NDR 4.0	1.0
Acenaphthylene	ND	1.1
Acenaphthene	ND	1.9
Fluorene	ND	1.6
Phenanthrene	ND	2.3
Anthracene	ND	2.4
Fluoranthene	ND	0.91
Pyrene	ND	0.66
Benzo(a)anthracene	ND	1.4
Chrysene	ND	1.3
Benzo(b)fluoranthene	ND	1.9
Benzo(e)pyrene	ND	1.9
Benzo(a)pyrene	ND	2.3
Perylene	ND	2.4
Dibenz(ah)anthracene	ND	3.6
Indeno(1,2,3-cd)pyrene	ND	3.5
Benzo(ghi)perylene	ND	2.9

Surrogate Standards	% Recovery
Naphthalene-d8	76
Acenaphthene-d10	77
Phenanthrene d-10	74
Pyrene d-10	80
Chrysene d-12	80
Benzo(a)pyrene d-12	87
Perylene d-12	91
Dibenz(ah)anthracene d-14	86
Benzo(ghi)perylene d-12	84

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria

[Signature]
Approved

PAH ANALYSIS REPORT

CLIENT SAMPLE I.D.: DBIGW001

AXYS FILE: 9514-301

CLIENT: HEMMERA Resource Consultants Ltd.

DATE: 18/Aug/95

SAMPLE TYPE: Water

METHOD NO.: PH-W-04/Ver.2

SAMPLE SIZE: 1.0 L

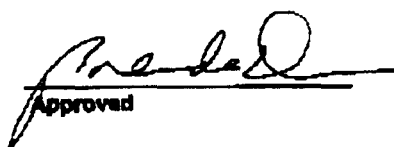
INSTRUMENT: GC-MS

CONCENTRATION IN: ng/L

Compounds	Concentration	(SDL)
Naphthalene	NDR 44	0.71
Acenaphthylene	NDR 23	0.35
Acenaphthene	NDR 6.7	0.61
Fluorene	ND	0.54
Phenanthrene	18	0.9
Anthracene	NDR 3.6	0.95
Fluoranthene	NDR 1.0	0.38
Pyrene	21	0.38
Benz(a)anthracene	NDR 2.4	0.91
Chrysene	9.2	0.86
Benzofluoranthene	NDR 2.8	1.3
Benzo(a)pyrene	NDR 2.6	1.4
Benzo(a)pyrene	ND	1.3
Perylene	ND	1.9
Dibenz(ah)anthracene	ND	4.7
Indeno(1,2,3-cd)pyrene	ND	2.4
Benzo(ghi)perylene	ND	2.0

Surrogate Standards	% Recovery
Naphthalene-d8	59
Acenaphthene-d10	130
Phenanthrene d-10	100
Pyrene d-10	75
Chrysene d-12	66
Benzo(a)pyrene d-12	72
Perylene d-12	70
Dibenz(ah)anthracene d-14	46
Benzo(ghi)perylene d-12	63

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected.


Approved

PAH ANALYSIS REPORT

CLIENT SAMPLE I.D.: D01GW001

AXYS FILE: 9514-285

CLIENT: HEMMERA Resource Consultants Ltd.

DATE: 18/Aug/95

SAMPLE TYPE: Water

METHOD NO.: PH-W-04/Var.2

SAMPLE SIZE: 1.0 L

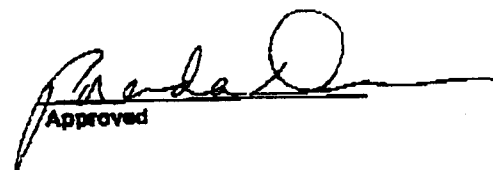
INSTRUMENT: GC-MS

CONCENTRATION IN: ng/L

Compounds	Concentration	(SDL)
Naphthalene	NDR 8.0	0.94
Acenaphthylene	ND	1.8
Acenaphthene	ND	1.6
Fluorene	ND	1.5
Phenanthrene	6.5	1.8
Anthracene	ND	1.9
Fluoranthene	2.4	0.7
Pyrene	1.9	0.68
Benz(a)anthracene	ND	0.95
Chrysene	ND	0.89
Benzofluoranthene	ND	1.1
Benzo(e)pyrene	ND	1.1
Benzo(a)pyrene	ND	1.3
Perylene	ND	1.4
Dibenz(ah)anthracene	ND	2.2
Indeno(1,2,3-cd)pyrene	ND	2.5
Benzo(ghi)perylene	ND	2.1

Surrogate Standards	% Recovery
Naphthalene-d8	59
Acenaphthene-d10	84
Phenanthrene d-10	68
Pyrene d-10	80
Chrysene d-12	84
Benzo(a)pyrene d-12	94
Perylene d-12	98
Dibenz(ah)anthracene d-14	79
Benzo(ghi)perylene d-12	90

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected.


Approved

PAH ANALYSIS REPORT

CLIENT SAMPLE I.D.: BCIGW001

AXYS FILE: 8514-306

CLIENT: HEMMERA Resource Consultants Ltd.

DATE: 18/Aug/95

SAMPLE TYPE: Water

METHOD NO.: PH-W-04/Ver.2

SAMPLE SIZE: 1.0 L

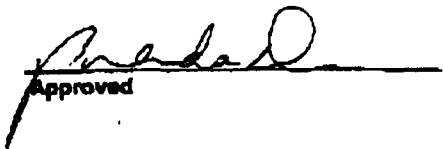
INSTRUMENT: GC-MS

CONCENTRATION IN: ng/L

Compounds	Concentration	(SDL)
Naphthalene	ND	3.7
Acenaphthylene	ND	1.8
Acenaphthene	ND	0.94
Fluorene	ND	1.5
Phenanthrene	ND	1.8
Anthracene	ND	1.9
Fluoranthene	ND	1.2
Pyrene	4.0	1.2
Benz(a)anthracene	ND	1.4
Chrysene	NDR 4.2	1.3
Benzo(a)fluoranthene	ND	1.7
Benzo(e)pyrene	ND	2.0
Benzo(a)pyrene	ND	1.3
Perylene	ND	1.4
Dibenz(ah)anthracene	ND	2.2
Indeno(1,2,3-cd)pyrene	ND	2.2
Benzo(ghi)perylene	ND	1.8

Surrogate Standards	% Recovery
Naphthalene-d8	78
Acenaphthene-d10	83
Phenanthrene d-10	78
Pyrene d-10	80
Chrysene d-12	75
Benzo(a)pyrene d-12	90
Perylene d-12	93
Dibenz(ah)anthracene d-14	64
Benzo(ghi)perylene d-12	88

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected.


 Approved

PAH ANALYSIS REPORT

CLIENT SAMPLE I.D.: D01W001

AXYS FILE: 9514-288

CLIENT: HEMMERA Resource Consultants Ltd.

DATE: 18/Aug/95

SAMPLE TYPE: Water

METHOD NO.: PH-W-04/Ver.2

SAMPLE SIZE: 1.0 L

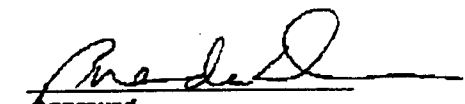
INSTRUMENT: GC-MS

CONCENTRATION IN: ng/L

Compounds	Concentration	(SDL)
Naphthalene	ND	3.3
Acenaphthylene	ND	2.2
Acenaphthene	ND	1.7
Fluorene	ND	1.9
Phenanthrene	ND	2.3
Anthracene	ND	1.7
Fluoranthene	ND	0.83
Pyrene	ND	2.0
Benzo(a)anthracene	ND	1.3
Chrysene	ND	1.2
Benzo(b)fluoranthene	ND	1.6
Benzo(e)pyrene	ND	1.6
Benzo(a)pyrene	ND	2.0
Perylene	ND	2.4
Dibenz(ah)anthracene	ND	3.3
Indeno(1,2,3-cd)pyrene	ND	3.9
Benzo(ghi)perylene	ND	3.3

Surrogate Standards	% Recovery
Naphthalene-d8	57
Acenaphthene-d10	61
Phenanthrene d-10	64
Pyrene d-10	71
Chrysene d-12	58
Benzo(a)pyrene d-12	63
Perylene d-12	57
Dibenz(ah)anthracene d-14	53
Benzo(ghi)perylene d-12	57

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected.


Approved

Analysis Report**CANTEST**

CanTest Ltd

Professional
Analytical
Services1829 West 3rd Ave
Vancouver, BC
V6J 1J8

Fax: 604 731 2386

Tel: 604 734 7276

1 800 665 8566

REPORT ON: Results of Testing

REPORTED TO: Acys Analytical Services Ltd.
P.O. Box 2219
2045 Mills Road
Sidney, B.C.
V8L 3S8

Attn: Ms. Brenda Dunn**PROJECT NUMBER:** 9514**NUMBER OF SAMPLES:** 16**REPORT DATE:** August 18, 1995**DATE SUBMITTED:** August 4, 1995**GROUP NUMBER:** 5080404**SAMPLE TYPE:** Paper, Soil and Water**TEST METHODS:**

Asbestos Fiber Identification - Analysis by Polarized Light Microscopy/Dispersion Staining in accordance with Workers' Compensation Board (WCB) Method No. 0205.

Mercury in Water - Acid permanganate digestion, analysis by Cold Vapour Atomic Absorption.

Metals in Water - Analysis by Inductively Coupled Plasma Spectroscopy (ICP), or Graphite Furnace Atomic Absorption.

Zinc in Water - Analysis by Atomic Absorption Spectrophotometry (AA).

Arsenic in Soil - Analysis by Zeeman background-corrected Graphite Furnace Atomic Absorption Spectrophotometry.

Cadmium in Soil - Analysis by background-corrected Flame Atomic Absorption Spectrophotometry.

Mercury in Soil - Analysis by Cold Vapour Atomic Absorption Spectrophotometry.

Lead in Soil - Analysis by background-corrected Flame Atomic Absorption Spectrophotometry.

Metals in Soil - Undried representative samples were digested with a mixture of nitric acid and hydrochloric acid ("Aqua Regia"). Analysis was performed using Inductively Coupled Argon Plasma Spectroscopy (ICAP) or by specific techniques as described. Moisture was determined gravimetrically at 106 C on a separate sample portion.

Selenium in Soil - Analysis by Zeeman background-corrected Graphite Furnace Atomic Absorption Spectrophotometry.

TEST RESULTS:

(See following pages)

CAN TEST LTD.

Richard S. Jomitz
Supervisor, Inorganic Testing

Page 1 of 8



REPORTED TO: Axyx Analytical Services Ltd.

CANTEST

REPORT DATE: August 18, 1995

GROUP NUMBER: 5080404

Metals Analysis in Water

CLIENT SAMPLE IDENTIFICATION:		9514-301 0316wood	9514-286 001wood	9514-285 0016wood	9514-306 0316wood		
SAMPLE PREPARATION:		DISSOLVED	DISSOLVED	DISSOLVED	DISSOLVED	DETECTION LIMIT	UNITS
CAN TEST ID:		508040020	508040021	508040022	508040023		
Aluminum	Al	<	<	<	<	0.15	mg/L
Antimony	Sb	<	<	<	<	0.15	mg/L
Arsenic	As	<	0.007	<	<	0.001	mg/L
Barium	Ba	0.016	0.12	0.042	0.006	0.001	mg/L
Beryllium	Be	<	<	<	<	0.003	mg/L
Boron	B	<	0.03	0.12	<	0.01	mg/L
Cadmium	Cd	0.0007	<	<	0.008	0.0002	mg/L
Calcium	Ca	36.2	45.2	139	20.5	0.01	mg/L
Chromium	Cr	<	<	<	<	0.001	mg/L
Cobalt	Co	<	<	<	<	0.001	mg/L
Copper	Cu	0.005	0.001	0.002	<	0.001	mg/L
Iron	Fe	0.38	0.03	<	0.13	0.03	mg/L
Lead	Pb	0.013	<	0.001	0.007	0.001	mg/L
Magnesium	Mg	1.46	103	93.6	0.51	0.01	mg/L
Manganese	Mn	0.085	0.095	0.003	0.11	0.003	mg/L
Mercury	Hg	<	<	<	<	0.05	µg/L
Molybdenum	Mo	<	<	<	<	0.001	mg/L
Nickel	Ni	0.002	<	0.003	0.003	0.001	mg/L
Phosphorus	PO4	<	<	<	<	0.4	mg/L
Potassium	K	3.54	12.9	8.71	1.56	0.01	mg/L
Selenium	Se	<	<	<	<	0.001	mg/L
Silicon	SiO2	9.2	2.0	17.7	3.4	0.08	mg/L
Silver	Ag	<	<	<	<	0.001	mg/L
Sodium	Na	13.6	25.1	21.8	4.3	0.1	mg/L
Strontium	Sr	0.080	0.73	0.55	0.0401	0.001	mg/L
Tin	Sn	<	<	0.003	<	0.001	mg/L
Titanium	Ti	<	<	<	<	0.006	mg/L
Vanadium	V	<	<	<	<	0.01	mg/L
Zinc	Zn	0.45	<	<	<	0.01	mg/L
Zirconium	Zr	<	<	<	<	0.015	mg/L

mg/L = milligrams per liter
 < = Less than detection limit

µg/L = micrograms per liter

REPORTED TO: Axyx Analytical Services Ltd.

CANTEST

REPORT DATE: August 18, 1995

GROUP NUMBER: 5080404

Metals Analysis in Soil

CLIENT SAMPLE IDENTIFICATION:		9514-310 BC15001	9514-311 BC15002	9514-281 BC15005	9514-287 0015001		
CAN TEST ID:		508040009	508040010	508040011	508040012	DETECTION LIMIT	UNITS
Moisture		6.41	6.28	9.80	6.59	0.01	%
Metals Analysis							
Arsenic	As	2.3	1.2	2.6	1.8	0.05	µg/g
Barium	Ba	48	24	105	54	0.1	µg/g
Cadmium	Cd	<	0.53	<	<	0.25	µg/g
Chromium	Cr	21	48	29	44	2	µg/g
Cobalt	Co	7	6	10	12	1	µg/g
Copper	Cu	26	26	43	31	1	µg/g
Lead	Pb	115	158	3	15	1	µg/g
Mercury	Hg	0.010	0.008	0.013	0.013	0.001	µg/g
Molybdenum	Mo	<	<	<	<	4	µg/g
Nickel	Ni	17	16	22	84	2	µg/g
Selenium	Se	<	<	<	<	0.5	µg/g
Silver	Ag	<	<	<	<	2	µg/g
Tin	Sn	5	<	<	<	5	µg/g
Zinc	Zn	58	98	47	34	1	µg/g
Aluminum	Al	14800	12500	18900	12800	10	µg/g
Antimony	Sb	<	<	<	<	10	µg/g
Beryllium	Be	<	<	<	<	1	µg/g
Boron	B	19	17	23	20	0.5	µg/g
Calcium	Ca	5540	4960	8650	14800	1	µg/g
Iron	Fe	27000	23700	32100	26000	2	µg/g
Magnesium	Mg	8610	8270	10000	17000	0.1	µg/g
Manganese	Mn	386	346	524	412	0.2	µg/g
Phosphorus	PO4	1220	1390	2420	1150	20	µg/g
Sodium	Na	378	271	537	178	5	µg/g
Strontium	Sr	41	27	44	29	0.1	µg/g
Titanium	Ti	518	198	473	353	0.3	µg/g
Vanadium	V	56	30	65	44	0.5	µg/g

% = percent

< = Less than detection limit

µg/g = micrograms per gram, on a dry weight basis.

REPORTED TO: Axys Analytical Services Ltd.

CANTEST

REPORT DATE: August 18, 1995

GROUP NUMBER: 5080404

Metals Analysis in Soil

CLIENT SAMPLE IDENTIFICATION:		9514-288 0015002	9514-289 0015003	9514-290 0015004	9514-292 0015006	DETECTION LIMIT	UNITS
CAN TEST ID:		508040013	508040014	508040015	508040016		
Moisture		13.5	24.4	10.7	10.2	0.01	%
Metals Analysis							
Arsenic	As	1.8	2.7	1.3	2.1	0.05	µg/g
Barium	Ba	39	122	41	62	0.1	µg/g
Cadmium	Cd	<	0.28	<	<	0.25	µg/g
Chromium	Cr	40	53	39	25	2	µg/g
Cobalt	Co	12	12	10	9	1	µg/g
Copper	Cu	49	34	28	27	1	µg/g
Lead	Pb	22	25	6	2	1	µg/g
Mercury	Hg	0.019	0.042	0.019	0.013	0.001	µg/g
Molybdenum	Mo	<	<	<	<	4	µg/g
Nickel	Ni	32	37	44	24	2	µg/g
Selenium	Se	<	<	<	<	0.5	µg/g
Silver	Ag	<	<	<	<	2	µg/g
Tin	Sn	<	<	<	<	5	µg/g
Zinc	Zn	60	61	39	37	1	µg/g
Aluminum	Al	15700	17800	12700	11300	10	µg/g
Antimony	Sb	<	<	<	<	10	µg/g
Beryllium	Be	<	<	<	<	1	µg/g
Boron	B	21	24	20	16	0.5	µg/g
Calcium	Ca	50800	33600	17700	26200	1	µg/g
Iron	Fe	30400	30500	25300	22100	2	µg/g
Magnesium	Mg	14600	13800	13800	8880	0.1	µg/g
Manganese	Mn	559	548	365	405	0.2	µg/g
Phosphorus	PO4	1290	1600	1140	900	20	µg/g
Sodium	Na	179	567	179	289	5	µg/g
Strontium	Sr	133	75	36	62	0.1	µg/g
Titanium	Ti	348	504	215	273	0.3	µg/g
Vanadium	V	57	70	51	45	0.5	µg/g

% = percent

< = Less than detection limit

µg/g = micrograms per gram, on a dry weight basis.

REPORTED TO: Axyx Analytical Services Ltd.

CANTEST

REPORT DATE: August 18, 1995

GROUP NUMBER: 5080404

Metals Analysis in Soil

CLIENT SAMPLE IDENTIFICATION:		9514-297 0315001	9514-298 0315002	9514-300 0315005	DETECTION LIMIT	UNITS
CAN TEST ID:		508040017	508040018	508040019		
Moisture		17.0	8.47	13.5	0.01	%
Metals Analysis						
Arsenic	As	3.0	5.0	3.5	0.05	µg/g
Barium	Ba	166	55	63	0.1	µg/g
Cadmium	Cd	0.28	0.80	<	0.25	µg/g
Chromium	Cr	80	62	49	2	µg/g
Cobalt	Co	18	16	13	1	µg/g
Copper	Cu	61	41	39	1	µg/g
Lead	Pb	52	82	6	1	µg/g
Mercury	Hg	0.049	0.070	0.040	0.001	µg/g
Molybdenum	Mo	<	<	<	4	µg/g
Nickel	Ni	91	93	50	2	µg/g
Selenium	Se	<	<	<	0.5	µg/g
Silver	Ag	<	<	<	2	µg/g
Tin	Sn	<	<	<	5	µg/g
Zinc	Zn	113	183	51	1	µg/g
Aluminum	Al	21200	15000	17600	10	µg/g
Antimony	Sb	<	<	<	10	µg/g
Beryllium	Be	<	<	<	1	µg/g
Boron	B	32	28	25	0.5	µg/g
Calcium	Ca	53900	24000	31300	1	µg/g
Iron	Fe	40900	32000	34100	2	µg/g
Magnesium	Mg	22800	21200	19700	0.1	µg/g
Manganese	Mn	707	557	595	0.2	µg/g
Phosphorus	PO4	2000	1020	2520	20	µg/g
Sodium	Na	271	81	103	5	µg/g
Strontium	Sr	116	39	75	0.1	µg/g
Titanium	Ti	233	266	297	0.3	µg/g
Vanadium	V	63	55	54	0.5	µg/g

% = percent

< = Less than detection limit

µg/g = micrograms per gram, on a dry weight basis.

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TO 16046564511-

PAGE.007/013

CANTEST

QUALITY ASSURANCE / QUALITY CONTROL DATA



CANTEST

Client: Axyx Analytical Services Ltd.
 File: 5080404
 Date: August 8, 1995

Sample I.D.		9514-300 508040019 0315005	508040019 Duplicate	508040019 Average	RPD	Detection Limit
% Moisture	H2O	19.5%	—	19.5%		
Arsenic	As	4.4	2.8	3.5	61%	0.06
Barium	Ba	66	80	63	10%	0.1
Cadmium	Cd	<	<	<		0.25
Chromium	Cr	54	43	48	24%	2
Cobalt	Co	13	13	13	7.1%	1
Copper	Cu	42	36	39	14%	1
Lead	Pb	7	5	6	31%	1
Mercury	Hg	0.042	0.037	0.039	12%	0.001
Molybdenum	Mo	<	<	<		4
Nickel	Ni	50	49	50	0.8%	2
Selenium	Se	<	<	<		0.5
Silver	Ag	<	<	<		2
Tin	Sn	<	<	<		5
Zinc	Zn	55	47	51	16%	1
Aluminum	Al	18200	17000	17600	8.8%	10
Antimony	Sb	<	<	<		10
Beryllium	Be	<	<	<		1
Boron	B	27	23	25	15%	0.5
Calcium	Ca	31200	31300	31300	0.4%	1
Iron	Fe	36700	32500	34100	9.3%	2
Magnesium	Mg	19800	19600	19700	1.3%	0.1
Manganese	Mn	611	579	595	5.3%	0.2
Phosphorus	PO4	1880	3380	2520	68%	20
Potassium	K	—	—	—	—	1
Sodium	Na	107	99	103	8.4%	5.0
Strontium	Sr	74	76	75	3.4%	0.1
Titanium	Ti	450	145	297	103%	0.3
Vanadium	V	60	49	54	20%	0.5

All results expressed as micrograms per gram (µg/g) on a dry weight basis.

< = Less than

% = percent

Q009 DUPLICATE 5080404.WK1

CANTEST

Client: Axys Analytical Services Ltd.
 File: 5080404
 Date: August 8, 1995

CanTest I.D. Client I.D.		Digestion Blank #1	Digestion Blank #2	Digestion Blank #3	Detection Limit
Aluminum	Al	<	<	<	0.15
Antimony	Sb	<	<	<	0.15
Arsenic	As	<	<	<	0.01
Barium	Ba	0.001	0.008	<	0.001
Beryllium	Be	<	<	<	0.006
Boron	B	0.04	0.01	0.04	0.010
Cadmium	Cd	<	<	<	0.005
Calcium	Ca	0.1	0.1	0.07	0.01
Chromium	Cr	<	<	<	0.08
Cobalt	Co	<	<	<	0.02
Copper	Cu	<	<	<	0.015
Iron	Fe	0.08	0.04	<	0.030
Lead	Pb	<	<	<	0.08
Magnesium	Mg	0.02	0.02	0.01	0.001
Manganese	Mn	<	<	<	0.008
Mercury	Hg	<	<	<	0.0002
Molybdenum	Mo	<	<	<	0.04
Nickel	Ni	<	<	<	0.025
Phosphorus	PO4	<	<	<	0.4
Potassium	K	<	<	<	1
Selenium	Se	<	<	<	0.05
Silver	Ag	<	<	<	0.03
Sodium	Na	<	<	<	0.1
Strontium	Sr	<	<	<	0.001
Tin	Sn	<	<	<	0.09
Titanium	Ti	0.057	<	<	0.006
Vanadium	V	<	<	<	0.010
Zinc	Zn	0.015	0.02	<	0.015

Results expressed as milligrams per litre (mg/L).

< = Less than

D:\CA-0008-081W0

CANTEST

Client: Axy's Analytical Services Ltd.
 File: 5090404
 Date: August 8, 1995

National Research Council Canada (NRC)
 Certified Reference Material

PACS-1

COMPONENT		RESULT	PERCENT RECOVERY	CERTIFIED VALUE
Major Components (%)				
Silica	SiO ₂	—		55.7 ±0.5
Alumina	Al ₂ O ₃	5.09	41%	12.23 ±0.22
Iron	Fe ₂ O ₃	6.39	92%	6.98 ±0.12
Calcium	CaO	1.57	54%	2.82 ±0.09
Magnesium	MgO	1.78	74%	2.41 ±0.09
Sodium	Na ₂ O	2.39	54%	4.40 ±0.11
Potassium	K ₂ O	0.28	18%	1.50 ±0.09
LOI		—		
Trace Components (µg/g)				
Antimony	Sb	135	79%	171. ±14.
Arsenic	As	165	73%	211. ±11.
Barium	Ba	385		—
Beryllium	Be	<3.0		—
Boron	B	145		—
Cadmium	Cd	2.50	105%	2.38 ±0.20
Chromium	Cr	65.0	58%	113. ±8.
Cobalt	Co	14.0	80%	17.5 ±1.1
Copper	Cu	445	98%	452. ±16.
Lead	Pb	410	101%	404. ±20.
Manganese	Mn	315	67%	470. ±12.
Mercury	Hg	4.50	98%	4.57 ±0.16
Molybdenum	Mo	7.0	54%	12.9 ±0.9
Nickel	Ni	57.0	84%	44.1 ±2.0
Phosphorous	PO ₄	2800	90%	3110. ±240.
Selenium	Se	0.25	23%	1.09 ±0.11
Silver	Ag	<15		—
Strontium	Sr	95.0	34%	277. ±11.
Tin	Sn	50.0	122%	41.1 ±3.1
Titanium	Ti	1700	40%	4210. ±66.
Vanadium	V	90	71%	127. ±5.
Zinc	Zn	805	98%	824. ±22.

< = Not detected

% = Percent

µg/g = micrograms per gram

CANTEST

Client: Alys Analytical Services Ltd.
File: 5080404
Date: August 8, 1995

QUALITY CONTROL REPORT FOR WATER ANALYSIS

Results of Duplicate Analysis

CLIENT SAMPLE IDENTIFICATION:		9514-301 0316W001	9514-301 Duplicate	Relative Percent Difference	UNITS
CAN TEST ID:		508040020	508040020	508040020	
Aluminum	Al	<0.15	<0.15	NC	mg/L
Antimony	Sb	<0.15	<0.15	NC	mg/L
Arsenic	As	<0.01	<0.01	NC	mg/L
Barium	Ba	0.017	0.016	6.2%	mg/L
Beryllium	Be	<0.01	<0.01	NC	mg/L
Boron	B	<0.01	<0.01	NC	mg/L
Bromine	Br	<0.001	<0.001	NC	mg/L
Calcium	Ca	36.1	36.3	0.4%	mg/L
Chloride	Cl	<0.01	<0.01	NC	mg/L
Cobalt	Co	<0.001	<0.001	NC	mg/L
Copper	Cu	0.005	0.005	0.0%	mg/L
Iron	Fe	0.38	0.39	1.3%	mg/L
Lead	Pb	0.013	0.013	0.0%	mg/L
Magnesium	Mg	1.46	1.46	0.1%	mg/L
Manganese	Mn	0.005	0.005	0.0%	mg/L
Mercury	Hg	<0.05	<0.05	NC	mg/L
Molybdenum	Mo	<0.01	<0.01	NC	mg/L
Nickel	Ni	0.002	0.003	PASS	mg/L
Phosphorus	P	<0.1	<0.1	NC	mg/L
Potassium	K	3.55	3.53	0.6%	mg/L
Selenium	Se	<0.1	<0.1	NC	mg/L
Silver	Ag	<0.001	<0.001	NC	mg/L
Sodium	Na	1.3	1.3	0.0%	mg/L
Strontium	Sr	0.060	0.060	0.5%	mg/L
Tin	Sn	<0.001	<0.001	PASS	mg/L
Titanium	Ti	<0.006	<0.006	NC	mg/L
Vanadium	V	<0.01	<0.01	NC	mg/L
Zinc	Zn	0.48	0.47	0.6%	mg/L
Zirconium	Zr	<0.01	<0.01	NC	mg/L

< = Less than the detection limit

mg/L = milligrams per litre.

µg/L = micrograms per litre.

NC = Not Calculable. Duplicate sample results were less than the detection limit. RPD calculation is not defined for analyte levels of less than detection limit.

PASS = Duplicate sample results were in the range of one to five times the detection limit. RPD calculation is not applicable in this range. Acceptance criteria is a maximum difference between the duplicates equivalent to the value of the detection limit.

CANTEST

Client: Acys Analytical Services Ltd.
File: 5080404
Date: August 8, 1995

QUALITY CONTROL REPORT FOR WATER ANALYSIS

Results of Digestion Blank Analysis

PREPARATION DATE		BLANK #1 August 9/95	BLANK #2 August 9/95	UNITS
Aluminum	Al	<0.15	<0.15	mg/L
Antimony	Sb	<0.15	<0.15	mg/L
Arsenic	As	<0.001	<0.001	mg/L
Barium	Ba	<0.001	<0.001	mg/L
Beryllium	Be	<0.001	<0.001	mg/L
Boron	B	<0.01	<0.01	mg/L
Cadmium	Cd	<0.001	<0.001	mg/L
Calcium	Ca	<0.01	<0.01	mg/L
Chromium	Cr	<0.001	<0.001	mg/L
Cobalt	Co	<0.001	<0.001	mg/L
Copper	Cu	<0.001	<0.001	mg/L
Iron	Fe	<0.08	<0.08	mg/L
Lead	Pb	<0.001	<0.001	mg/L
Magnesium	Mg	<0.01	<0.01	mg/L
Manganese	Mn	<0.001	<0.001	mg/L
Mercury	Hg	<0.05	<0.05	µg/L
Molybdenum	Mo	<0.001	<0.001	mg/L
Nickel	Ni	<0.001	<0.001	mg/L
Phosphorus	P	<0.1	<0.1	mg/L
Potassium	K	<0.01	<0.01	mg/L
Selenium	Se	<0.001	<0.001	mg/L
Silver	Ag	<0.001	<0.001	mg/L
Sodium	Na	<0.1	<0.1	mg/L
Strontium	Sr	<0.001	<0.001	mg/L
Tin	Sn	<0.001	<0.001	mg/L
Titanium	Ti	<0.008	<0.008	mg/L
Vanadium	V	<0.001	<0.001	mg/L
Zinc	Zn	<0.01	<0.01	mg/L
Zirconium	Zr	<0.015	<0.015	mg/L

< = Less than the detection limit
mg/L = milligrams per litre.
µg/L = micrograms per litre.



CANTEST

Client: Ays Analytical Services Ltd.
File: 5080404
Date: August 8, 1995

QUALITY CONTROL REPORT FOR WATER ANALYSIS

Results of Digestion Blank Analysis

		BLANK #1	BLANK #2	UNITS
PREPARATION DATE		August 9/95	August 9/95	
Aluminum	Al	<0.15	<0.15	mg/L
Antimony	Sb	<0.15	<0.15	mg/L
Arsenic	As	<0.001	<0.001	mg/L
Barium	Ba	<0.001	<0.001	mg/L
Beryllium	Be	<0.001	<0.001	mg/L
Boron	B	<0.01	<0.01	mg/L
Calcium	Ca	<0.01	<0.01	mg/L
Chromium	Cr	<0.001	<0.001	mg/L
Cobalt	Co	<0.001	<0.001	mg/L
Copper	Cu	<0.001	<0.001	mg/L
Iron	Fe	<0.08	<0.08	mg/L
Lead	Pb	<0.01	<0.01	mg/L
Magnesium	Mg	<0.01	<0.01	mg/L
Manganese	Mn	<0.001	<0.001	mg/L
Mercury	Hg	<0.05	<0.05	µg/L
Molybdenum	Mo	<0.001	<0.001	mg/L
Nickel	Ni	<0.001	<0.001	mg/L
Phosphorus	P	<0.01	<0.01	mg/L
Potassium	K	<0.01	<0.01	mg/L
Selenium	Se	<0.001	<0.001	mg/L
Silver	Ag	<0.001	<0.001	mg/L
Sodium	Na	<0.01	<0.01	mg/L
Strontium	Sr	<0.001	<0.001	mg/L
Tin	Sn	<0.001	<0.001	mg/L
Titanium	Ti	<0.008	<0.008	mg/L
Vanadium	V	<0.001	<0.001	mg/L
Zinc	Zn	<0.01	<0.01	mg/L
Zirconium	Zr	<0.01	<0.01	mg/L

< = Less than the detection limit
mg/L = milligrams per litre.
µg/L = micrograms per litre.

CCRS/MSCL/00004048.1/001



REPORTED TO: Arcys Analytical Services Ltd.

REPORT DATE: August 21, 1995

GROUP NUMBER: 5080813

CANTEST**Total Extractable Hydrocarbons in Soil**

CLIENT SAMPLE IDENTIFICATION:	9514-310 BC15001	9514-311 BC15002	9514-279 BC15003	9514-287 D015001	DETECTION LIMIT
CAN TEST ID:	508080043	508080044	508080045	508080046	
DETECTION LIMIT:	<	<	<	<	<

Results expressed as micrograms per gram, on a dry weight basis. ($\mu\text{g/g}$)

< = Less than detection limit

Sample # 508080044 - The presence of hydrocarbon components with boiling points greater than that of C30 were detected.

REPORTED TO: Axys Analytical Services Ltd.

REPORT DATE: August 21, 1995

GROUP NUMBER: 5080813

CANTEST**Total Extractable Hydrocarbons in Soil**

CLIENT SAMPLE IDENTIFICATION:	0514 200 0015003	0514 200 0015004	0514 200 0015002	0514 300 0015005	DETECTION LIMIT
CAN TEST ID:	508080047	508080048	508080049	508080050	
TEST					

Results expressed as micrograms per gram, on a dry weight basis. ($\mu\text{g/g}$)

< = Less than detection limit

Sample# 508080047 - The presence of hydrocarbon components with boiling points greater than that of C30 were detected.

REPORTED TO: Alys Analytical Services Ltd.

CANTEST

REPORT DATE: August 18, 1995

GROUP NUMBER: 5080404

Asbestos Fiber Identification in Bulk Material

CLIENT SAMPLE ID	CAN TEST ID	ASBESTOS TYPE	ASBESTOS CONTENT	OTHER FIBER ID	OTHER FIBER CONTENT	FILLER
9514-293 001A5001	508040007	amosite chrysotile	10-30 1-10	glass fiber cellulose	10-30 1-20	35-55

Results expressed as % volume fibre found/submitted (% vol/vol)

< = Less than 1 percent (% vol/vol)

PAH ANALYSIS REPORT

CLIENT SAMPLE I.D.: Procedural Blank

AXYS FILE: PH-S-BLK 783

CLIENT: HEMMERA Resource Consultants Ltd.

DATE: 28/AUG/95

SAMPLE TYPE: Blank

METHOD NO.: PH-S-01/Ver.2

SAMPLE SIZE: 10.0

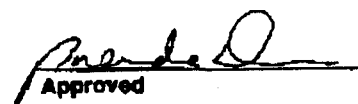
INSTRUMENT: GC-MS

CONCENTRATION IN: ng/g

Compounds	Concentration	(SDL)
Naphthalene	NDR 0.8	0.03
Acenaphthylene	ND	0.07
Acenaphthene	ND	0.08
Fluorene	0.1	0.04
Phenanthrene	0.21	0.02
Anthracene	ND	0.05
Fluoranthene	ND	0.10
Pyrene	ND	0.10
Benz(a)anthracene	ND	0.04
Chrysene	ND	0.10
Benzo(a)fluoranthene	ND	0.08
Benzo(a)pyrene	ND	0.09
Benzo(b)pyrene	ND	0.11
Perylene	ND	0.11
Dibenz(ah)anthracene	ND	0.19
Indeno(1,2,3-cd)pyrene	ND	0.12
Benzo(ghi)perylene	ND	0.09

Surrogate Standards	% Recovery
Naphthalene-d8	83
Acenaphthene-d10	84
Phenanthrene d-10	80
Pyrene d-10	84
Chrysene d-12	88
Benzo(a)pyrene d-12	88
Perylene d-12	91
Dibenz(ah)anthracene d-14	70
Benzo(ghi)perylene d-12	86

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Concentrations are recovery corrected


Approved

PAH ANALYSIS REPORT

CLIENT SAMPLE I.D.: DO1S001

AXYS FILE: 9514-287

CLIENT: HEMMERA Resource Consultants Ltd.

DATE: 28/AUG/95

SAMPLE TYPE: SOIL

METHOD NO.: PH-S-01/Ver.2

SAMPLE SIZE: 9.79 g dry

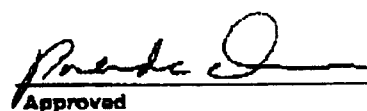
INSTRUMENT: GC-MS

CONCENTRATION IN: ng/g

Compounds	Concentration	(SDL)
Naphthalene	NDR 37	0.41
Acenaphthylene	NDR 38	1.5
Acenaphthene	NDR (4.9)	0.47
Fluorene	NDR 4.9	0.36
Phenanthrene	NDR 11	12
Anthracene	NDR 3.4	12
Fluoranthene	NDR 2.1	0.01
Pyrene	18	0.01
Benz(a)anthracene	NDR 1.4	0.04
Chrysene	8.7	0.03
Benzofluoranthene	6.2	0.07
Benzo(e)pyrene	7.8	0.07
Benzo(a)pyrene	0.94	0.09
Perylene	6.9	0.09
Dibenz(ah)anthracene	1.1	0.54
Indeno(1,2,3-cd)pyrene	3.2	0.06
Benzo(ghi)perylene	7.1	0.06

Surrogate Standards	% Recovery
Naphthalene-d8	94
Acenaphthene-d10	*
Phenanthrene d-10	110
Pyrene d-10	89
Chrysene d-12	81
Benzo(a)pyrene d-12	100
Perylene d-12	100
Dibenz(ah)anthracene d-14	92
Benzo(ghi)perylene d-12	98

1. SDL = Sample Detection Limit
 2. ND = Not detected
 3. NDR = Peak detected but did not meet quantification criteria
 4. Data have not been blank corrected.
 5. Concentrations are recovery corrected
- * Unknown due to interferences; acenaphthylene, acenaphthene, and fluorene results were calculated with respect to phenanthrene d-10.


Approved

PAH ANALYSIS REPORT

CLIENT SAMPLE I.D.: DB1S001

AXYS FILE: 9514-297

CLIENT: HEMMERA Resource Consultants Ltd.

DATE: 29/AUG/95

SAMPLE TYPE: SOIL

METHOD NO.: PH-S-01/Ver.2

SAMPLE SIZE: 8.82 dry

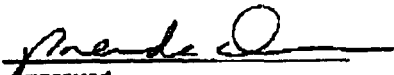
INSTRUMENT: GC-MS

CONCENTRATION IN: ng/g

Compounds	Concentration	(SDL)
Naphthalene	NDR 11	0.5
Acenaphthylene	NDR 42	2.6
Acenaphthene	NDR 30	0.78
Fluorene	NDR 2.4	0.6
Phenanthrene	3.3	0.01
Anthracene	NDR 1.2	0.01
Fluoranthene	NDR 0.22	0.03
Pyrene	3.1	0.03
Benz(a)anthracene	ND	0.2
Chrysene	0.79	0.2
Benzo(a)fluoranthene	NDR 0.23	0.22
Benzo(e)pyrene	NDR 0.57	0.24
Benzo(a)pyrene	ND	0.3
Perylene	ND	0.29
Dibenz(ah)anthracene	ND	0.43
Indeno(1,2,3-cd)pyrene	ND	0.46
Benzo(ghi)perylene	ND	0.6

Surrogate Standards	% Recovery
Naphthalene-d8	94
Acenaphthene-d10	*
Phenanthrene d-10	86
Pyrene d-10	84
Chrysene d-12	74
Benzo(a)pyrene d-12	76
Perylene d-12	84
Dibenz(ah)anthracene d-14	60
Benzo(ghi)perylene d-12	76

1. SDL = Sample Detection Limit
 2. ND = Not detected
 3. NDR = Peak detected but did not meet quantification criteria
 4. Data have not been blank corrected.
 5. Concentrations are recovery corrected
- * Unknown due to interferences; acenaphthylene, acenaphthene, and fluorene results were calculated with respect to phenanthrene d-10.


Approved

PAH ANALYSIS REPORT

CLIENT SAMPLE ID.: DB15005

AXYS FILE: 9514-300A

CLIENT: HEMMERA Resource Consultants Ltd.

DATE: 29/AUG/95

SAMPLE TYPE: SOIL

METHOD NO.: PH-S-01/Ver.2

SAMPLE SIZE: 10.36 g dry

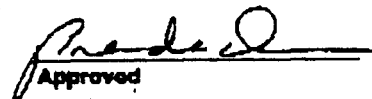
INSTRUMENT: GC-MS

CONCENTRATION IN: ng/g

Compounds	Concentration	(SDL)
Naphthalene	1.8	0.04
Acenaphthylene	NDR 0.1	0.07
Acenaphthene	ND	0.08
Fluorene	0.15	0.05
Phenanthrene	0.96	0.02
Anthracene	ND	0.02
Fluoranthene	0.7	0.03
Pyrene	0.95	0.04
Benz(a)anthracene	0.2	0.05
Chrysene	0.62	0.05
Benzo(a)fluoranthene	NDR 0.2	0.2
Benzo(e)pyrene	ND	0.21
Benzo(a)pyrene	ND	0.26
Perylene	ND	0.24
Dibenz(ah)anthracene	ND	0.51
Indeno(1,2,3-cd)pyrene	ND	0.35
Benzo(ghi)perylene	ND	0.32

Surrogate Standards	% Recovery
Naphthalene-d8	75
Acenaphthene-d10	80
Phenanthrene d-10	76
Pyrene d-10	75
Chrysene d-12	73
Benzo(a)pyrene d-12	60
Perylene d-12	71
Dibenz(ah)anthracene d-14	42
Benzo(ghi)perylene d-12	55

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected.
5. Concentrations are recovery corrected


Approved

PAH ANALYSIS REPORT

CLIENT SAMPLE I.D.: DB19005

CLIENT: HEMMERA Resource Consultants Ltd.

SAMPLE TYPE: SOIL

SAMPLE SIZE: 10.17 g dry

AXYS FILE: 9514-3008

DUPLICATE

DATE: 29/AUG/95

METHOD NO.: PH-S-01/Ver.2

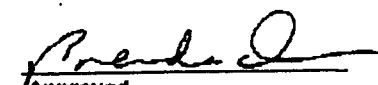
INSTRUMENT: GC-MS

CONCENTRATION IN: ng/g

Compound	Concentration	(SDL)
Naphthalene	1.6	0.04
Acenaphthylene	ND	0.06
Acenaphthene	ND	0.07
Fluorene	0.17	0.05
Phenanthrene	0.82	0.02
Anthracene	ND	0.02
Fluoranthene	0.84	0.03
Pyrene	0.86	0.03
Benzo(a)anthracene	0.24	0.04
Chrysene	0.55	0.04
Benzo(b)fluoranthene	NDR 0.33	0.16
Benzo(e)pyrene	NDR 0.36	0.17
Benzo(a)pyrene	ND	0.2
Perylene	ND	0.19
Dibenz(ah)anthracene	ND	0.35
Indeno(1,2,3-cd)pyrene	ND	0.23
Benzo(ghi)perylene	NDR 0.24	0.21

Surrogate Standards	% Recovery
Naphthalene-d8	77
Acenaphthene-d10	86
Phenanthrene d-10	84
Pyrene d-10	85
Chrysene d-12	86
Benzo(a)pyrene d-12	69
Perylene d-12	81
Dibenz(ah)anthracene d-14	48
Benzo(ghi)perylene d-12	60

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected.
5. Concentrations are recovery corrected


Approved

PAH ANALYSIS REPORT

CLIENT SAMPLE I.D.: BC19001

AXYS FILE: 9514-310

CLIENT: HEMMERA Resource Consultants Ltd.

DATE: 29/AUG/95

SAMPLE TYPE: SOIL

METHOD NO.: PH-S-01/Ver.2

SAMPLE SIZE: 10.85 g dry

INSTRUMENT: GC-MS

CONCENTRATION IN: ng/g

Compounds	Concentration	(SDL)
Naphthalene	47	0.04
Acenaphthylene	NDR 5.8	0.02
Acenaphthene	NDR 0.92	0.81
Fluorene	NDR 3.1	0.80
Phenanthrene	12	0.01
Anthracene	4.8	0.01
Fluoranthene	NDR 0.64	0.02
Pyrene	34	0.02
Benzo(a)anthracene	NDR 0.62	0.06
Chrysene	16	0.08
Benzo(b)fluoranthene	7.6	0.15
Benzo(e)pyrene	10	0.16
Benzo(a)pyrene	1.7	0.19
Perylene	6.9	0.19
Dibenz(ah)anthracene	NDR 1.2	0.62
Indeno(1,2,3-cd)pyrene	NDR 4.5	0.14
Benzo(ghi)perylene	6.3	0.13

Surrogate Standards	% Recovery
Naphthalene-d8	43
Acenaphthene-d10	140
Phenanthrene d-10	140
Pyrene d-10	76
Chrysene d-12	35
Benzo(a)pyrene d-12	85
Perylene d-12	93
Dibenz(ah)anthracene d-14	100
Benzo(ghi)perylene d-12	110

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected.
5. Concentrations are recovery corrected


Approved

PAH ANALYSIS REPORT

CLIENT SAMPLE I.D.: BC1S002

AXYS FILE: 9514-311

CLIENT: HEMMERA Resource Consultants Ltd.

DATE: 28/AUG/95

SAMPLE TYPE: SOIL

METHOD NO.: PH-S-01/Ver.2

SAMPLE SIZE: 9.70 g dry

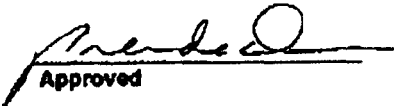
INSTRUMENT: GC-MS

CONCENTRATION IN: ng/g

Compounds	Concentration	(SDL)
Naphthalene	33	0.04
Acenaphthylene	0.48	0.07
Acenaphthene	NDR 1.0	0.32
Fluorene	2.1	0.29
Phenanthrene	17	0.02
Anthracene	2.1	0.02
Fluoranthene	8.2	0.03
Pyrene	32	0.03
Benz(a)anthracene	4.0	0.04
Chrysene	14	0.04
Benzofluoranthene	15	0.08
Benzo(e)pyrene	26	0.08
Benzo(a)pyrene	8.9	0.1
Perylene	15	0.1
Dibenz(ah)anthracene	NDR 2.3	0.54
Indeno(1,2,3-cd)pyrene	7.3	0.08
Benzo(ghi)perylene	56	0.07

Surrogate Standards	% Recovery
Naphthalene-d8	68
Acenaphthene-d10	79
Phenanthrene d-10	83
Pyrene d-10	85
Chrysene d-12	78
Benzo(a)pyrene d-12	92
Perylene d-12	96
Dibenz(ah)anthracene d-14	110
Benzo(ghi)perylene d-12	110

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected.
5. Concentrations are recovery corrected


Approved

PCB/PESTICIDE ANALYSIS REPORT

CLIENT SAMPLE I.D.: DBIS003

AXYS ID: 9514-239

CLIENT: Hemmera Resource Consultants

DATE: 06/Sept/95

SAMPLE TYPE: Soil

METHOD NO.: CL-S-01/Ver.2

SAMPLE SIZE: 10.5 g dry

INSTRUMENT: GC-ECD

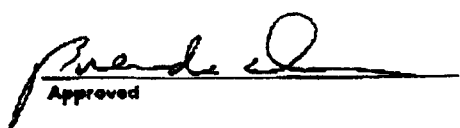
% MOISTURE: 7.0

CONCENTRATION IN: ng/g

Compounds	Concentration	(SDL)
Hexachlorobenzene	0.08	0.01
alpha HCH	ND	0.01
beta HCH	ND	0.04
gamma HCH	ND	0.02
Heptachlor	ND	0.02
Aldrin	NDR 0.08	0.01
Oxychlordane	ND	0.05
trans-Chlordane	0.08	0.02
cis-Chlordane	0.11	0.03
o,p'-DDE	ND	0.04
p,p'-DDE	NDR 0.04	0.01
trans-Nonsachlor	0.04	0.03
cis-Nonsachlor	ND	0.02
o,p'-DDD	ND	0.04
p,p'-DDD	ND	0.04
p,p'-DDT	0.21	0.09
Mirex	0.03	0.005
Heptachlor Epoxide	ND	0.02
alpha-Endosulphan (I)	ND	0.02
Dieldrin	0.03	0.01
Endrin	ND	0.03
Methoxychlor	ND	0.06
Aroclor 1242	ND	0.54
Aroclor 1254	6.3	0.43
Aroclor 1260	35	0.09

Surrogate Standards	% Recovery
Tetrachloro-M-xylene	78
PCB 209	99
d4-alpha-Endosulphan	88

1. SDL = Sample Detection Limit
2. ND = Not Detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected
5. Concentrations are recovery corrected



Approved

PCB/PESTICIDE ANALYSIS REPORT

CLIENT SAMPLE ID: Procedural Blank

AXYS ID: CL-S-BLK 613

CLIENT: Hammer Resource Consultants

DATE: 31/Aug/95

SAMPLE TYPE: Blank

METHOD NO.: CL-S-01/Ver.2

SAMPLE SIZE: 10.0 g

INSTRUMENT: GC-ECD

CONCENTRATION IN: ng/g

Compounds	Concentration	(SDL)
Hexachlorobenzene	ND	0.002
alpha HCH	ND	0.006
beta HCH	ND	0.03
gamma HCH	ND	0.01
Heptachlor	ND	0.003
Aldrin	NDR 0.04	0.002
Oxychlordane	ND	0.04
trans-Chlordane	ND	0.01
cis-Chlordane	ND	0.01
o,p'-DDE	ND	0.02
p,p'-DDE	ND	0.003
trans-Nonachlor	ND	0.01
cis-Nonachlor	ND	0.02
o,p'-DDD	ND	0.02
p,p'-DDD	ND	0.02
p,p'-DDT	ND	0.05
Mirex	ND	0.003
Heptachlor Epoxide	ND	0.01
alpha-Endosulphan (I)	ND	0.01
Dieldrin	ND	0.01
Endrin	ND	0.02
Methoxychlor	ND	0.06
Aroclor 1242	ND	0.14
Aroclor 1254	ND	0.12
Aroclor 1260	ND	0.06

Surrogate Standards	% Recovery
Tetrachloro-M-xylene	92
PCB 209	110
d4-alpha-Endosulphan	100

1. SDL = Sample Detection Limit
2. ND = Not Detected
3. NDR = Peak detected but did not meet quantification criteria
4. Concentrations are recovery corrected


Approved

PCB/PESTICIDE ANALYSIS REPORT

CLIENT SAMPLE ID: Spiked Matrix

AXYS ID: CL-S-SPM 431

CLIENT: Hammer Resource Consultants

DATE: 31/AUG/86

SAMPLE TYPE: Soil

METHOD NO.: CL-S-01/Ver.2

SAMPLE SIZE: 10.0 g

INSTRUMENT: GC-ECD

CONCENTRATION IN: ng/g

Compounds	Determined	Expected	% Recovery
Hexachlorobenzene	4.4	5.8	79
alpha HCH	5.0	5.8	89
beta HCH	5.2	6.2	63
gamma HCH	3.9	5.4	72
Heptachlor	3.8	5.8	66
Aldrin	2.2	3.6	61
Oxyheptachlor	4.0	5.0	80
trans-Chlordane	3.2	3.2	100
cis-Chlordane	4.6	4.8	96
o,p'-DDE	3.4	5.7	60
p,p'-DDE	3.0	5.4	56
trans-Nonachlor	3	4.1	73
cis-Nonachlor	4.3	4.2	100
o,p'-DDD	3.7	5.6	66
p,p'-DDD	3.8	6.2	58
p,p'-DDT	5.6	6.2	90
Mirex	3.3	5.4	61
Heptachlor Epoxide	3.8	4.0	95
alpha-Endosulphan (I)	3.7	4.0	93
Dieldrin	4.6	5.2	88
Endrin	12	11	110
Methoxychlor	26	25	100
Aroclor 1242	39	45	87
Aroclor 1254	28	46	61
Aroclor 1260	35	46	76

Surrogate Standards	% Recovery
Tetrachloro-M-xylene	79
PCB 209	110
d4-alpha endosulphan	84

1. Concentrations are recovery corrected


Approved

PCB/PESTICIDE ANALYSIS REPORT

CLIENT SAMPLE I.D: BC18004

AXYS ID: 0614-285

CLIENT: Hemmera Resource Consultants

DATE: 31/Aug/95

SAMPLE TYPE: Soil

METHOD NO.: CL-S-01/Var.2

SAMPLE SIZE: 10.7 g dry

INSTRUMENT: GC-ECD

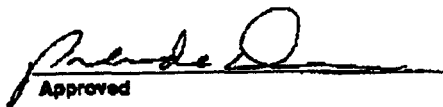
% MOISTURE: 5.0

CONCENTRATION IN: ng/g

Compound	Concentration	(SDL)
Hexachlorobenzene	ND	0.04
alpha HCH	ND	0.03
beta HCH	ND	0.06
gamma HCH	ND	0.04
Heptachlor	ND	0.05
Aldrin	NDR 0.15	0.03
Octachlorodane	ND	0.03
trans-Chlordane	ND	0.06
cis-Chlordane	ND	0.07
o,p'-DDE	ND	0.15
p,p'-DDE	10	0.04
trans-Nonachlor	ND	0.09
cis-Nonachlor	ND	1.1
o,p'-DDD	ND	0.1
p,p'-DDD	ND	1.9
p,p'-DDT	30	0.22
Mirex	ND	0.04
Heptachlor Epoxide	ND	0.02
alpha-Endosulphan (I)	ND	0.02
Dieldrin	0.12	0.02
Endrin	ND	0.04
Methoxychlor	ND	0.11
Aroclor 1242	ND	0.81
Aroclor 1254	39	1.5
Aroclor 1260	47	0.95

Surrogate Standards	% Recovery
Tetrachloro-M-xylene	80
PCB 209	49
d4-alpha-Endosulphan	71

1. SDL = Sample Detection Limit
2. ND = Not Detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected
5. Concentrations are recovery corrected


Approved

PCB/PESTICIDE ANALYSIS REPORT

CLIENT SAMPLE I.D.: D01S002

AXYS ID: 9514-2061

CLIENT: Hemmera Resource Consultants

DATE: 31/Aug/95

SAMPLE TYPE: Soil

METHOD NO.: CL-S-01/Ver.2

SAMPLE SIZE: 10.5 g dry

INSTRUMENT: GC-ECD

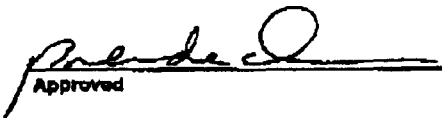
% MOISTURE: 9.0

CONCENTRATION IN: ng/g

Compounds	Concentration	(SDL)
Hexachlorobenzene	0.02	0.005
alpha HCH	ND	0.01
beta HCH	ND	0.04
gamma HCH	ND	0.02
Heptachlor	ND	0.005
Aldrin	0.06	0.005
Oxychlorane	ND	0.02
trans-Chlordane	ND	0.02
cis-Chlordane	ND	0.02
o,p'-DDE	ND	0.03
p,p'-DDE	0.05	0.005
trans-Nonachlor	ND	0.03
cis-Nonachlor	ND	0.02
o,p'-DDD	ND	0.03
p,p'-DDD	ND	0.02
p,p'-DDT	0.42	0.02
Mirex	ND	0.007
Heptachlor Epoxide	ND	0.02
alpha-Endosulphan (I)	ND	0.02
Dieldrin	ND	0.02
Endrin	ND	0.03
Methoxychlor	ND	0.05
Aroclor 1242	ND	0.34
Aroclor 1254	0.57	0.27
Aroclor 1260	0.8	0.14

Surrogate Standards	% Recovery
Tetrachloro-M-xylene	79
PCB 209	97
d4-alpha-Endosulphan	50

1. SDL = Sample Detection Limit
2. ND = Not Detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected
5. Concentrations are recovery corrected



Approved

PCB/PESTICIDE ANALYSIS REPORT

CLIENT SAMPLE ID: DO15005

AXYS ID: 9614-291

CLIENT: Hammera Resource Consultants

DATE: 31/Aug/95

SAMPLE TYPE: Soil

METHOD NO.: CL-8-01/Ver.2

SAMPLE SIZE: 11.39 g dry

INSTRUMENT: GC-ECD

CONCENTRATION IN: ng/g

Compounds	Concentration	(SDL)
Hexachlorobenzene	0.01	0.004
alpha HCH	ND	0.008
beta HCH	ND	0.02
gamma HCH	ND	0.01
Heptachlor	ND	0.01
Aldrin	NDR 0.06	0.007
Oxychlordane	ND	0.03
trans-Chlordane	ND	0.01
cis-Chlordane	ND	0.01
o,p'-DDE	ND	0.02
p,p'-DDE	0.02	0.008
trans-Nonachlor	ND	0.01
cis-Nonachlor	ND	0.02
o,p'-DDD	ND	0.02
p,p'-DDD	0.07	0.01
p,p'-DDT	1.4	0.05
Mirex	ND	0.004
Heptachlor Epoxide	ND	0.01
alpha-Endosulphan (I)	ND	0.01
Dieldrin	0.02	0.01
Endrin	ND	0.02
Methoxychlor	ND	0.06
Aroclor 1242	ND	0.24
Aroclor 1254	ND	0.19
Aroclor 1260	0.57	0.1

Surrogate Standards	% Recovery
Tetrachloro-M-xylene	74
PCB 209	85
d4-alpha-Endosulphan	81

1. SDL = Sample Detection Limit
2. ND = Not Detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected
5. Concentrations are recovery corrected

Brenda O
 Approved

PCB/PESTICIDE ANALYSIS REPORT

CLIENT SAMPLE I.D: DO15006

AXYS ID: 9514-2921

CLIENT: Hemmers Resource Consultants

DATE: 31/Aug/95

SAMPLE TYPE: Soil

METHOD NO.: CL-S-01/Ver.2

SAMPLE SIZE: 9.00 g dry

INSTRUMENT: GC-ECD

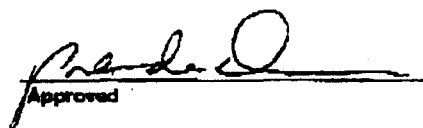
% MOISTURE: 13

CONCENTRATION IN: ng/g

Compounds	Concentration	(SDL)
Hexachlorobenzene	0.006	0.007
alpha HCH	ND	0.006
beta HCH	ND	0.03
gamma HCH	ND	0.02
Heptachlor	ND	0.01
Aldrin	NDR 0.06	0.006
Oxychlorodane	0.04	0.02
trans-Chlordane	0.02	0.02
cis-Chlordane	0.03	0.02
o,p'-DDE	ND	0.03
p,p'-DDE	0.05	0.007
trans-Nonachlor	ND	0.02
cis-Nonachlor	ND	0.02
o,p'-DDD	ND	0.02
p,p'-DDD	0.03	0.02
p,p'-DDT	0.42	0.08
Mirex	ND	0.006
Heptachlor Epoxide	ND	0.02
alpha-Endosulphan (I)	ND	0.02
Dieldrin	ND	0.02
Endrin	ND	0.03
Methoxychlor	ND	0.06
Aroclor 1242	ND	0.46
Aroclor 1254	0.66	0.34
Aroclor 1260	0.6	0.22

Surrogate Standards	% Recovery
Tetrachloro-M-xylene	62
PCB 209	69
d4-alpha-Endosulphan	78

1. SDL = Sample Detection Limit
2. ND = Not Detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected
5. Concentrations are recovery corrected



Approved

BTEX ANALYSIS REPORT

CLIENT SAMPLE I.D.: DB19001

AXYS FILE: 9514-297A1

CLIENT: Hammera Resource Consultants Ltd.

DATE: 23/Aug/95

SAMPLE TYPE: Soil

METHOD NO.: VO-S-01/VO-QMS-1.0

SAMPLE SIZE: 1.76 g dry

INSTRUMENT: GC-MS

CONCENTRATION IN: ng/g

Compounds	Concentration	(SDL)
Benzene	ND	0.1
Toluene	ND	4.0
Ethylbenzene	ND	0.2
p/m -Xylene	ND	0.4
o-Xylene	ND	0.3

Surrogate Standards	% Recovery
Bromofluorobenzene	90

1. SDL = Sample Detection Limit
2. ND = Not detected
3. NDR = Peak detected but did not meet quantification criteria
4. Data have not been blank corrected.
5. Concentrations are not recovery corrected.


Approved

PHENOXYACID HERBICIDE ANALYSIS REPORT

CLIENT SAMPLE I.D.: D019002

AXYS FILE: 9514-288

CLIENT: Hemmera Resource Consultants

DATE: 24/Aug/95

SAMPLE TYPE: Soil

CONCENTRATION IN: ug/g

Compounds	Concentration	(SDL)
Dicamba	ND	0.005
2,4-D	ND	0.005
2,4-DB	ND	0.005
MCPA	ND	0.005
MCPP	ND	0.005
Pictoram	ND	0.1
2,4,5-T	ND	0.005
2,4,5-TP	ND	0.005

1. SDL = Sample Detection Limit
2. ND = Not detected
3. ug/g = micrograms per gram, on a dry weight basis

PHENOXYACID HERBICIDE ANALYSIS REPORT

CLIENT SAMPLE I.D.: D01S006

AXYS FILE: 9514-292

CLIENT: Hemmera Resource Consultants

DATE: 24/Aug/95

SAMPLE TYPE: Soil

CONCENTRATION IN: ug/g

Compounds	Concentration	(SDL)
Dicamba	ND	0.005
2,4-D	ND	0.005
2,4-DB	ND	0.005
MCPA	ND	0.005
MCPP	ND	0.005
Pictoram	ND	0.1
2,4,5-T	ND	0.005
2,4,5-TP	ND	0.005

1. SDL = Sample Detection Limit
2. ND = Not detected
3. ug/g = micrograms per gram, on a dry weight basis

PHENOXYACID HERBICIDE ANALYSIS REPORT

CLIENT SAMPLE I.D.: Spike Recovery

AXYS FILE: Spike #1

CLIENT: Hemmera Resource Consultants

DATE: 10/Aug/95

SAMPLE TYPE: Soil

CONCENTRATION IN: ug/g

SAMPLE SIZE: 1.0 g

Compounds	Determined	Expected	% Recovery
Dicamba	0.027	0.04	68
2,4-D	0.016	0.15	11
2,4-DB	0.37	0.4	93
MCPA	5.3	9.5	56
MCPP	45	42	107
Picloram	0.024	0.074	32
2,4,5-T	0.043	0.044	98
2,4,5-TP	0.03	0.034	88

1. SDL = Sample Detection Limit
2. ND = Not detected

PHENOXYACID HERBICIDE ANALYSIS REPORT

CLIENT SAMPLE I.D.: Method Blank

AXYS FILE: Blank #2

CLIENT: Hemmera Resource Consultants

DATE: 25/Aug/95

SAMPLE TYPE: Soil

CONCENTRATION IN: ug/g

Compounds	Concentration	(SDL)
Dicamba	ND	0.005
2,4-D	ND	0.005
2,4-DB	ND	0.01
MCPA	ND	0.005
MCPP	ND	0.005
Picloram	ND	0.1
2,4,5-T	ND	0.005
2,4,5-TP	ND	0.005

1. SDL = Sample Detection Limit
2. ND = Not detected

APPENDIX H
SITE PHOTOGRAPHS



Photo 1: Entrance to Beaver Creek pumping station. Logging operation occurs outside the pumping station compound.



Photo 2: Logging operation outside Beaver Creek compound.



Photo 3: Main building at Beaver Creek looking north.



Photo 4: Main building, east side, looking south. Maintenance garage in the foreground.



Photo 5: Above ground storage tanks at the south end of Beaver Creek compound.



Photo 6: Berm around large above ground storage tank, south end of Beaver Creek compound.

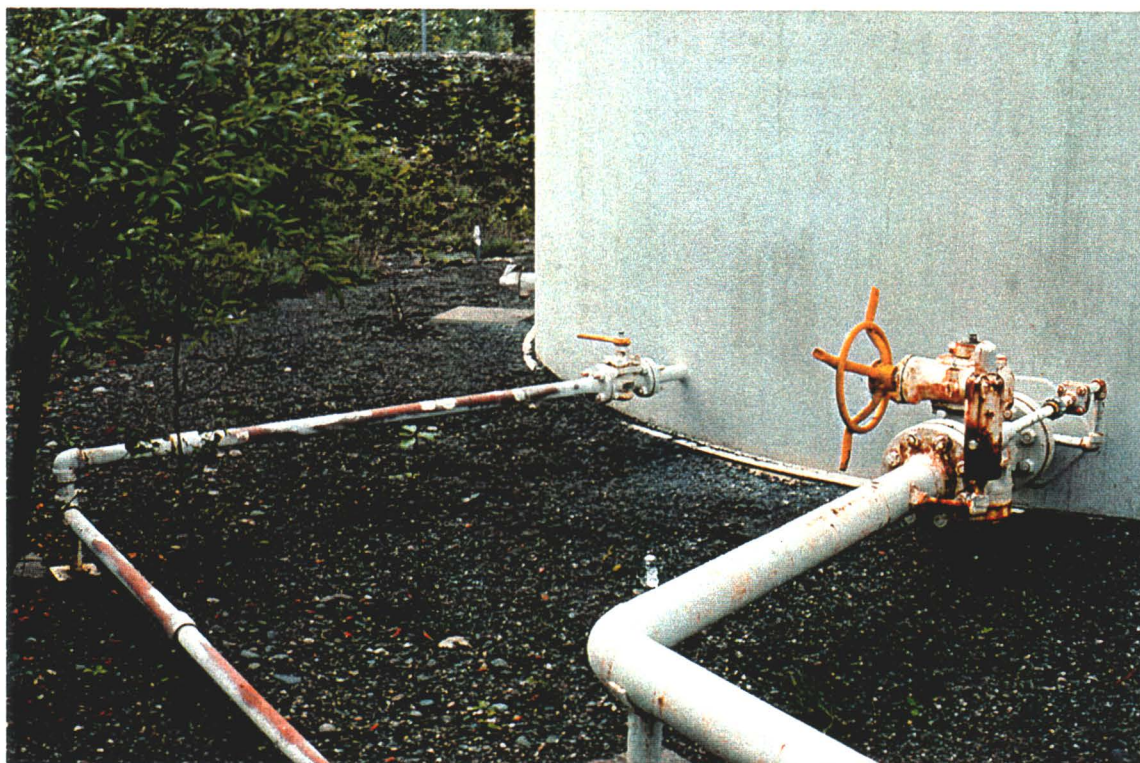


Photo 7: Base of bermed area around AST's. Gravelly base with no liner.



Photo 8: Smaller of the two AST's at Beaver Creek.



Photo 9: Old underground storage tanks - well overgrown by trees at Beaver Creek.

Photo 10: Above ground storage tank with sump (shed) for accessing underground pipes on west side of the main building at Beaver Creek.



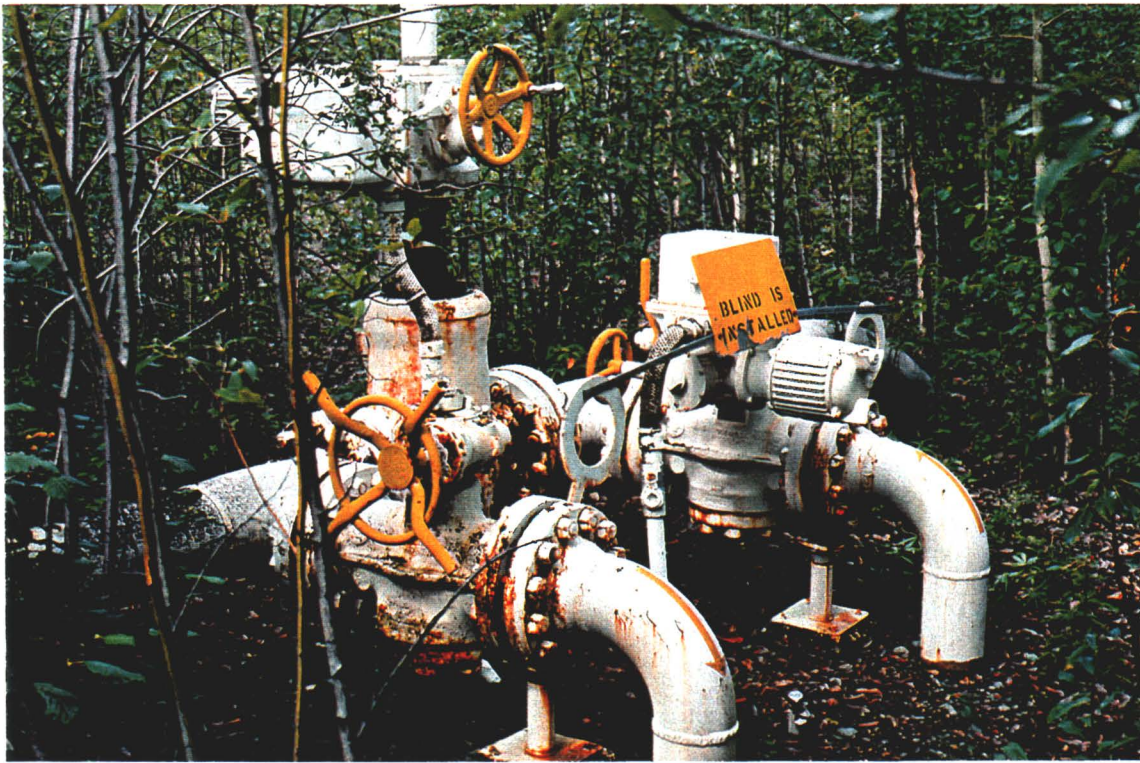


Photo 11: Valves along pipeline at Beaver Creek pumping station.

Photo 12: Road into the inferred former landfill to the north of the pump station. Red marks denote the geophysical survey grid.





Photo 13: Inferred former landfill site north of the Beaver Creek pump station.



Photo 15: Entrance to Donjek pumping station looking east.

South



North

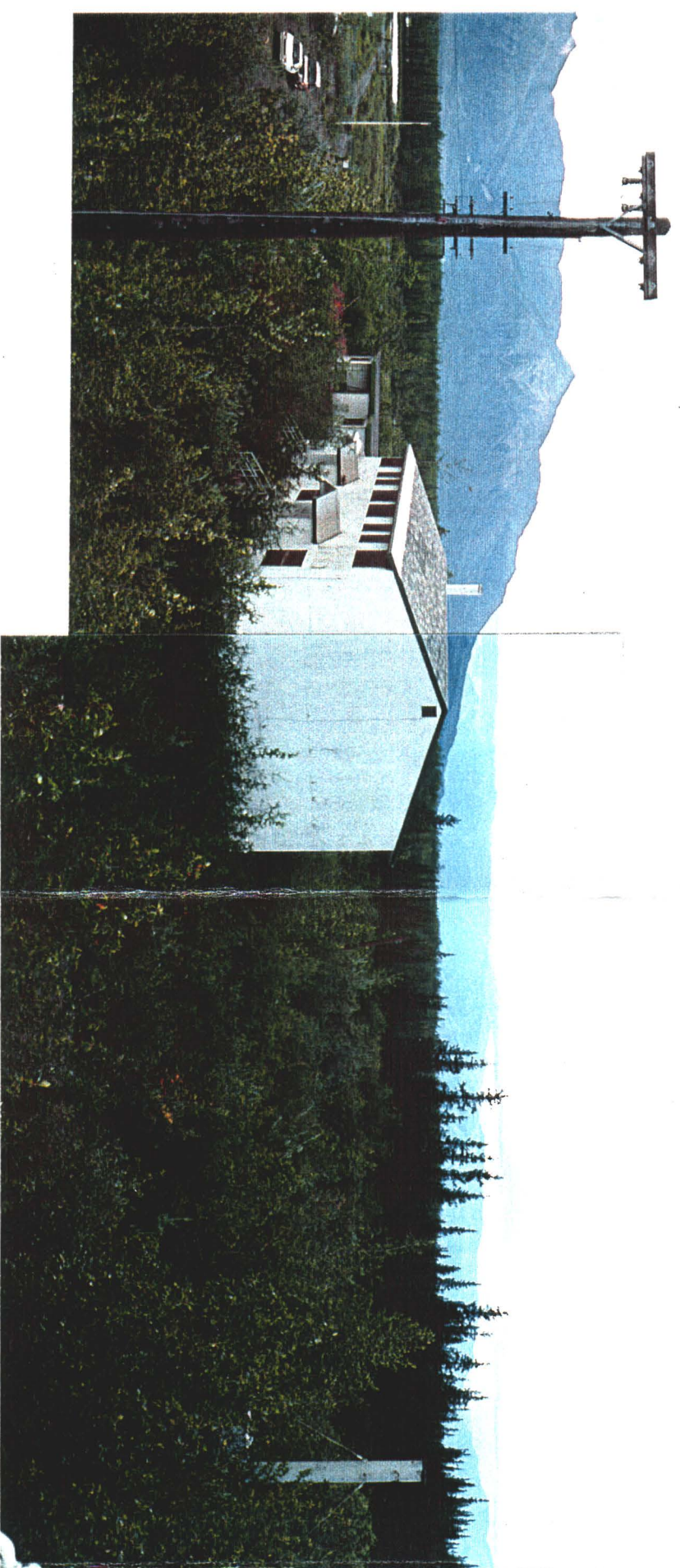


Photo 14: Panorama of the Donjek pumping station looking west.

Photo 16: Old gasoline pump. The underground storage tank is located behind and above the gasoline pump.



Photo 17: Pump building at Donjek. Various associated valves along the pipeline are in the foreground.

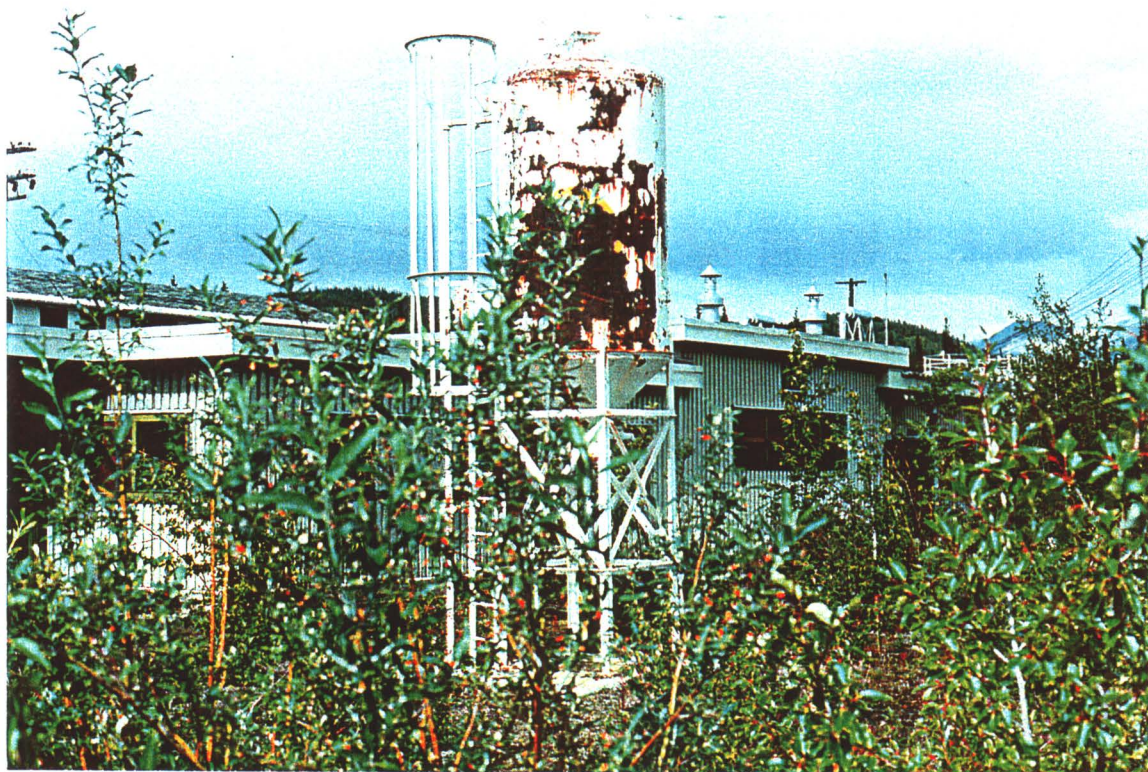


Photo 18: Above ground storage tank to the south of the main building at Donjek.



Photo 19: Housing complex at Donjek looking east. Single family dwelling in the foreground and an apartment complex in the background. Note the former incinerator stack to the left of the apartment complex.



Photo 20: Trail leading into the inferred landfill north of the Donjek site.



Photo 21: Inferred former landfill at Donjek.



Photo 22: Hand dug excavation into the former landfill exposing waste.



Photo 24: Main building at Destruction Bay. The maintenance garage is at the far end of the building.

South



Northeast



Photo 23: Panorama of the Destruction Bay site. Picture is taken from the large AST looking west and north.



Photo 25: Former water well located on the west side of the main building. The well is in excess of 100 feet deep.



Photo 26: Above ground storage tank to the west of the main building.



Photo 27: Two AST's on the east side of the main building near the compound entrance.



Photo 28: Small AST.



Photo 29: Granular material on the base of the bermed area surrounding the AST's.



Photo 30: Old foundations located northwest of the former garage along the highway at Destruction Bay.

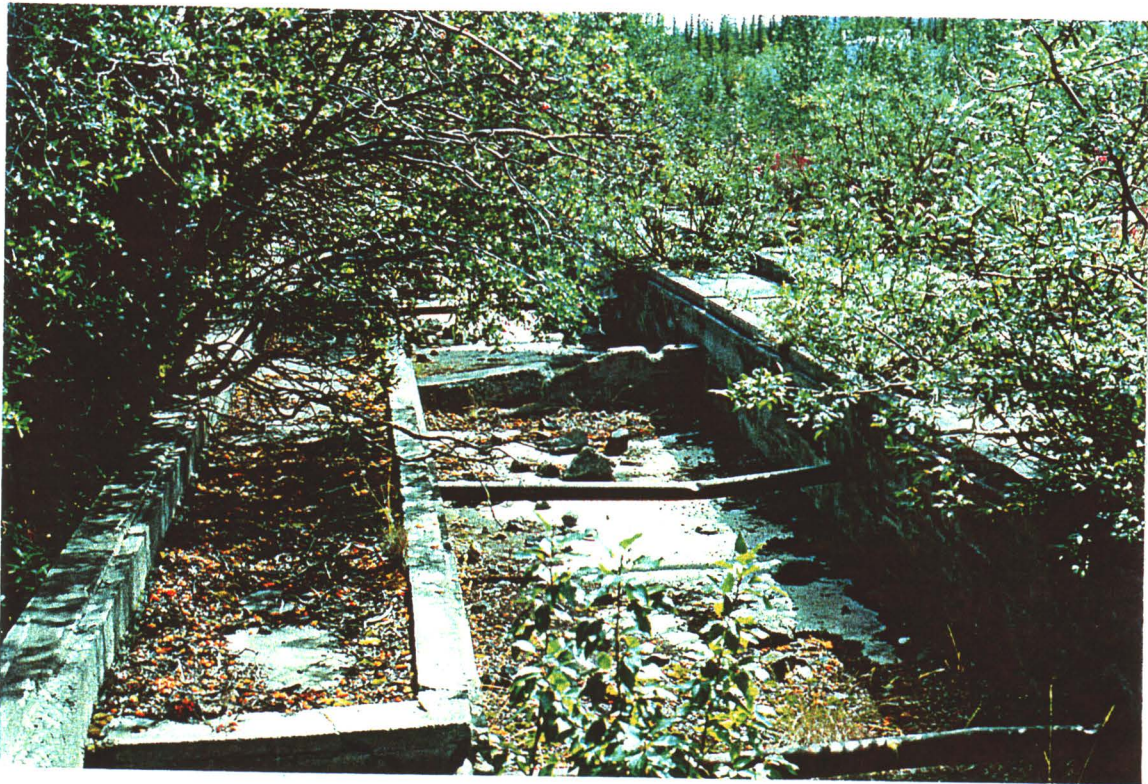


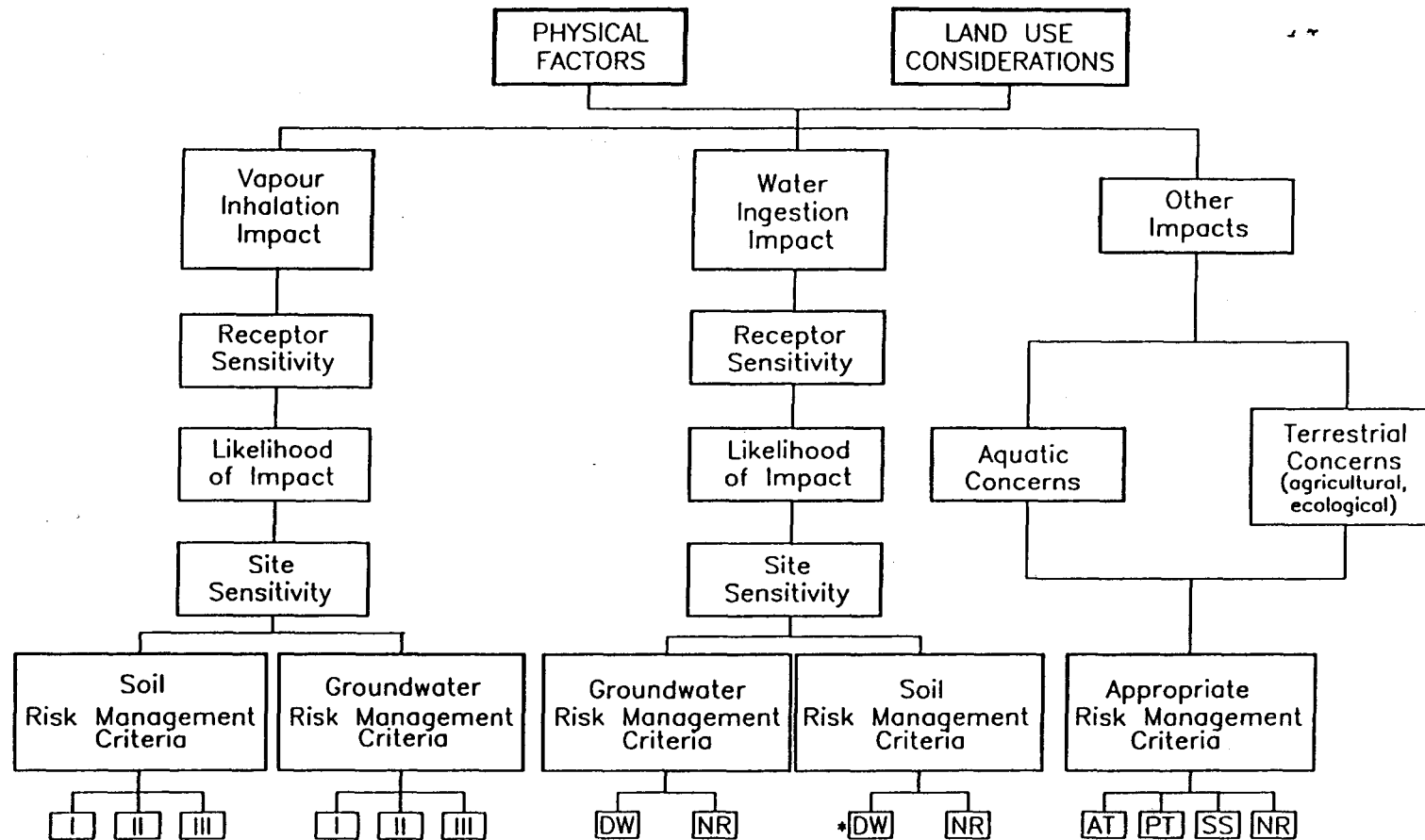
Photo 31: Old foundations to the west of the former garage along the highway at Destruction Bay.



Photo 32: Former garage along the highway at Destruction Bay.

APPENDIX I
SITE SENSITIVITY ANALYSIS AND RISK MANAGEMENT

SITE SENSITIVITY ASSESSMENT PROCESS



- I -risk management criteria for sites of high sensitivity
- II -risk management criteria for sites of moderate sensitivity
- III -risk management criteria for sites of low sensitivity
- * -soil risk management criteria for soil to groundwater ingestion pathway

- DW -risk management criteria based on relevant drinking water quality guidelines
- AT -aquatic toxicity criteria (where available)
- PT -phytotoxicity criteria (where available)
- SS -site-specific risk management criteria may be necessary
- NR -no response may be necessary

Site Sensitivity Assessment Process

DRAWN BY: MG

DATE: 94/05/16

DWG. NO.: B-2

RECEPTOR SENSITIVITY

Ingestion of Water

RECEPTOR	SENSITIVITY
Use, or potential use, of groundwater or surface water for domestic supply	high
Groundwater or surface water with no current or potential usage	low

200 meters

Receptor Sensitivity

Ingestion of Water

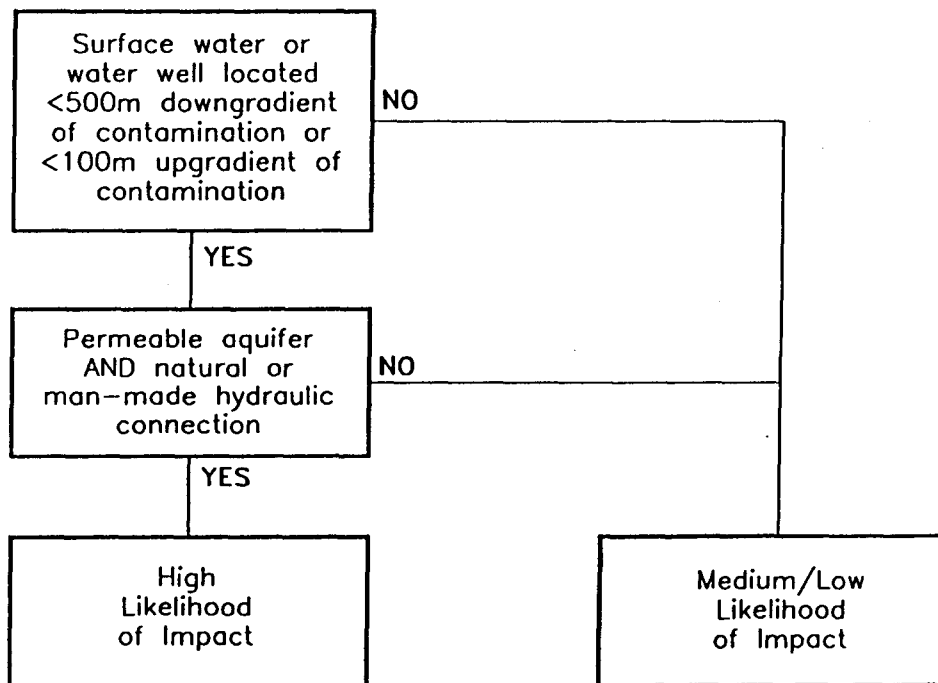
DRAWN BY: MG

DATE: 94/05/13

DWG. NO.: B-3

LIKELIHOOD OF IMPACT

Ingestion of Water
(complete for each receptor)



Likelihood of Impact

Ingestion of Water

DRAWN BY: MG

DATE: 94/05/13

DWG. NO.: B-4

SITE SENSITIVITY RANKING

Ingestion of Water

Likelihood of Impact \ Receptor Sensitivity	HIGH	LOW
HIGH	H	NR
MEDIUM/LOW	SS	NR

H - high sensitivity ranking (remediate to ingestion-based criteria)
 SS - site-specific remediation criteria may be necessary
 NR - no response may be necessary

Site Sensitivity Ranking Ingestion of Water		
		DATE: 94/05/13
	DRAWN BY: MG	DWG. NO.: B-5

RECEPTOR SENSITIVITY

Inhalation of Vapours from Soil and Groundwater

RECEPTOR	SENSITIVITY
RESIDENTIAL / INSTITUTIONAL (indoor)	high
COMMERCIAL / INDUSTRIAL / PUBLIC (indoor)	medium
OUTDOOR	low

Receptor Sensitivity
Inhalation of Vapours from
Soil and Groundwater

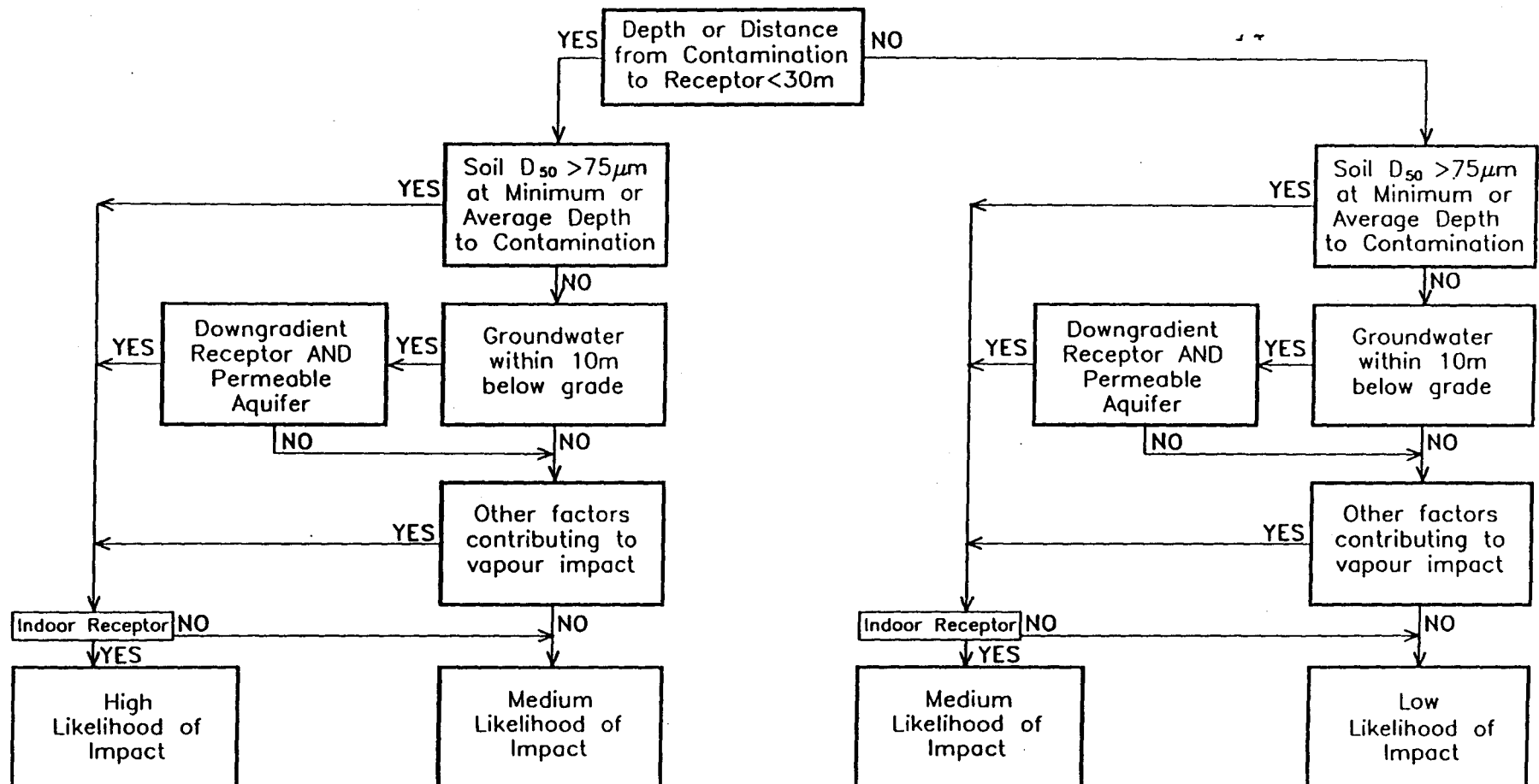
DRAWN BY: MG

DATE: 94/05/13

DWG. NO.: B-6

LIKELIHOOD OF IMPACT

Inhalation of Vapours from Soil and Groundwater (complete for each receptor)



Likelihood of Impact			
Inhalation of Vapours from Soil and Groundwater			
		DATE: 94/05/13	
DRAWN BY: MG		DWG. NO.: B-7	

SITE SENSITIVITY RANKING

Inhalation of Vapours from Soil and Groundwater

Likelihood of Impact	Receptor Sensitivity	HIGH	MEDIUM	LOW
HIGH		H	M	M
MEDIUM		M	M	L
LOW		M	L	L

H – high sensitivity site
M – moderate sensitivity site
L – low sensitivity site

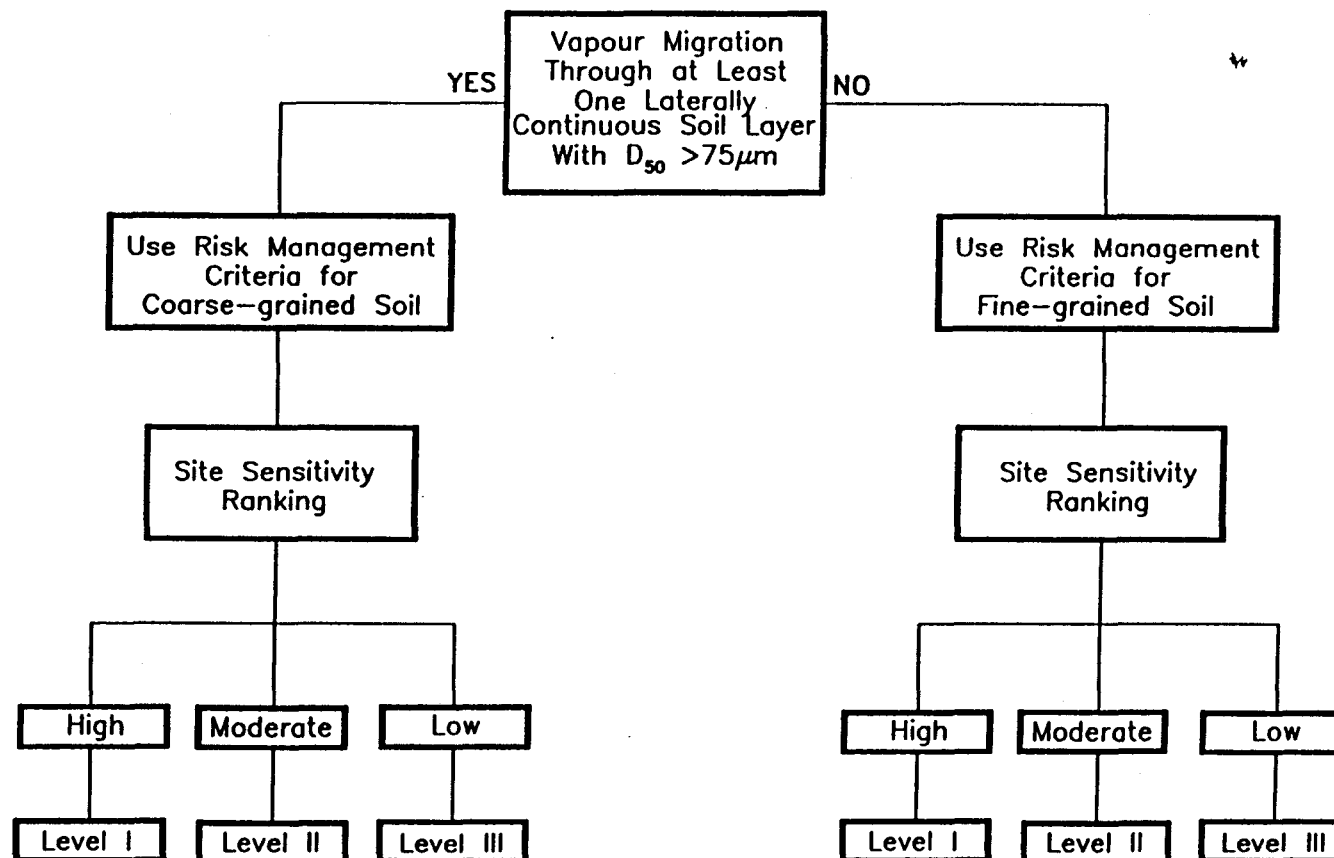
Site Sensitivity Ranking
Inhalation of Vapours from
Soil and Groundwater

DRAWN BY: MG

DATE: 94/05/13

DWG. NO.: B-8

RELATIONSHIP OF SITE SENSITIVITY TO REQUIRED LEVEL OF RISK MANAGEMENT CRITERIA Inhalation of Vapours from Soil and Groundwater



Relationship of Site Sensitivity
to Required Level of Risk Management Criteria

Inhalation of Vapours from
Soil and Groundwater

DRAWN BY: MG

DATE: 94/05/13

DWG. NO.: B-9