



# ROYAL ROADS UNIVERSITY

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Attention: Mr. Brett Hartshorne

Dear Brett:

**Date:** June 10, 2002

**Re: Completion Report for Ex-Situ Soil Remediation of the Peel-Caribou Staging Area.**

Please find enclosed one copy of the revised Completion Report for the Peel-Caribou Project. We have incorporated comments received following review of the draft report submitted to DIAND Waste Management and PWGSC Environmental Services.

We are still awaiting copies of the site drawings and other documents from the Prime Contractor who conducted all the site surveys during the project. These materials when received would be incorporated into the report as an Attachment under Drawings and in Appendix B.

Thank you for the opportunity to working on this project.

Yours sincerely,

Matt Dodd, Ph.D.  
Applied Research Division

## Report Distribution

1. PWGSC, Environmental Services Vancouver – 1 copy
2. PWGSC, Environmental Services, Edmonton – 1 copy
3. DIAND Waste Management and Contaminants Program, Whitehorse – 1 copy

**EX-SITU SOIL REMEDIATION OF THE  
PEEL-CARIBOU STAGING AREA, YUKON TERRITORY:  
COMPLETION REPORT**

*June 7, 2002*

Prepared for:

Peel River Working Group  
&  
Public Works and Government Services Canada  
Environmental Services

By:

Royal Roads University - Applied Research Division

## EXECUTIVE SUMMARY

The Peel-Caribou Staging Area is located on the north side of the Peel River, 4 km upstream of its confluence with the Caribou River. It was used for exploratory drilling activities during the mid-1960's. Following abandonment of the project in 1975, waste materials were buried in a pit on site. The Peel River changed its course over the years and in 1994, the northeast bank of the river encroached on the waste pit, exposing some of the waste materials. The site is currently only accessible by small boats on Peel River or by helicopter as river conditions in some areas do not allow tug/barge access.

Preliminary site investigations in 1998 and 1999 identified DDT contamination in soil samples collected from locations near the Peel River shoreline. An additional investigation to delineate the extent of the pit and contamination was conducted in April 2000 on behalf of the Peel River Working Group. This included the drilling of 33 boreholes using a helicopter portable rig and sampling soil, water and sediments. The results of contaminant analysis along with data from previous geophysical investigation indicated contaminated soils and debris were located in a 2 metre thick layer along the riverbank, with an overburden of soil varying in depths from 3 to 4 metres. Debris layer was exposed in the riverbank face. The volume of debris and contaminated materials was estimated to be 2000 cubic metres. The validation of various field test kits including, immunoassay test kits, PetroFLAG™, and photoionization detector, as possible analytical tools for on site testing was conducted during the site investigations in April 2000.

Various options for remediation including risk management, in-situ remediation and excavation and off site disposal were considered. An analysis suggested that the erosion forces of Peel River flood waters and the movement of ice during spring break-up would render a long-term, effective stabilization solution or in-situ remediation both challenging and cost-prohibitive to implement. Removal of major source areas of the contaminants was considered as the most cost-efficient mechanism for curtailing future entry into the Peel River ecosystem.

Site remediation commenced in January 2002 and was effectively completed in March 2002 by a team that included representatives from:

- GDC Civil Construction – Prime contractor providing all construction, excavation and shipping services
- DIAND, Waste Management, Yukon Region – Project Authority
- PWGSC Environmental Services – Engineering services and contract management
- Royal Roads University – On site testing services, environmental and quality control

The program was initiated with the construction of an overland winter road to the site along existing seismic cut lines. After site preparation, 1016 cubic metres of overburden were removed to expose debris and contaminated soils in the waste pit.

A total of 350 cubic metres of contaminated soils and debris was excavated from the waste pit, loaded into 588 Seacan™ boxes and transported off site to a temporary holding area near Fort McPherson. The boxes were consequently shipped to Beaver County Landfill, Alberta for disposal. Debris excavated from the contaminated area included barrels (which were probably the source of the DDT contamination), wood, concrete, brown fibrous materials, bags of drilling fluid, and other miscellaneous metal including parts of cat track and a vehicle. Due to logistical constraints, and on the basis of the validation exercise, immunoassay test kit and a PID were employed for the on site delineation and confirmatory testing during site remediation.

An additional 1550 cubic metres of debris including bags of bentonite, cement, wooden pallets, plastic, metal and other miscellaneous materials were removed from the waste pit. These materials were buried in a new secure landfill constructed outside on Federal land approximately 20 km from the Peel-Caribou Staging Area.

After the completion of the excavation and transportation of all materials off site, the stockpile area was re-graded in a manner which was consistent with the topography of the site and which prevented erosion and surface runoff from carrying sediments into the river. Vegetation removed from the site during site preparation was then spread over the area. The waste pit excavation was left as is, without the replacement of overburden. It was anticipated that the erosion forces of the Peel River would remove any overburden placed in the pit and deposit it into the river thereby increasing sediment loading into the river.

Data for sediment samples indicated the presence of low concentrations of DDT in the riverbed adjacent to the site (0.025 to 2.5 ppm). The in-place sediments are expected to undergo erosion and further mixing with clean sediments and/or burial over time. In addition, limited degradation of the various DDT compounds in sediments is expected, albeit at a relatively slow rate. There is no compelling evidence that the sediments constitute a hazard and the impact is therefore expected to be minimal. A monitoring program is recommended to ascertain the expected decrease in DDT concentrations in the sediment following the removal of all the major source of DDT and other contaminants such as dichloromethane, and petroleum hydrocarbon products along with all visible debris including barrels, wood, bentonite, cement, metal and miscellaneous materials.

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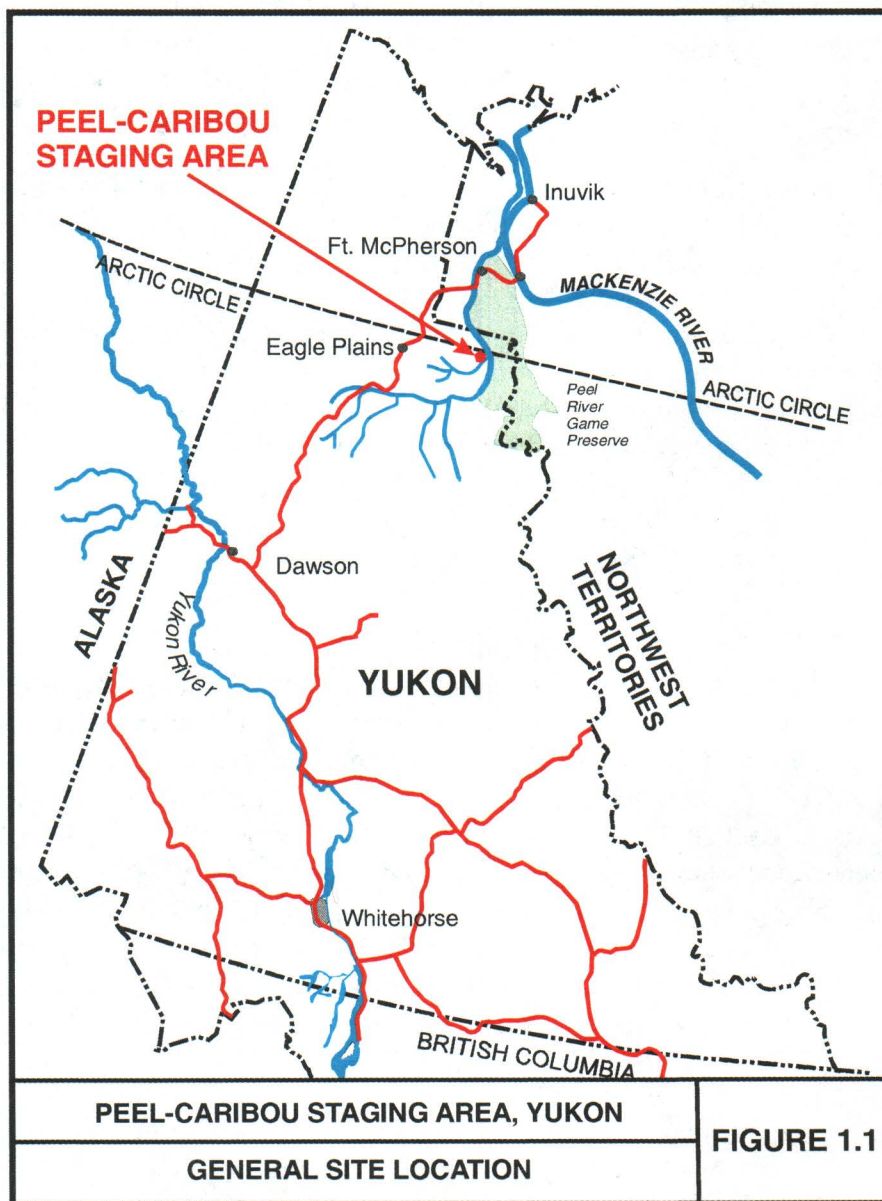
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# 1. INTRODUCTION

## 1.1 Site Location

The Peel River Waste Site is located in the Yukon on the north side of the Peel River, four kilometers upstream of its confluence with the Caribou River at 66° 30.98' N, 134° 04.26' W (Figure 1.1). The river flows through Fort McPherson, N.W.T., which is the closest community situated 105 km to the north. Eagle Plains, a highway lodge and service station, is located 120 km to the west (Figure 1.1). The site is within the Tetlit Gwich'in Comprehensive Land Claim Agreement, and is part of the Peel River Preserve.



## 1.2 Background

During the mid-1960's, Shell Resources Canada (Shell) carried out exploratory drilling in the area where approximately 4 ha was cleared and an airstrip was constructed on a gravel bar nearby. Project personnel and drilling equipment were stationed on site until 1967 when the project was abandoned. Equipment and reusable materials were removed off site. A final cleanup of the site was conducted by Shell in 1975. Two wooden trailers that were on site were demolished. Demolition debris and other materials including bagged drilling mud, bagged cement and miscellaneous debris were buried in a pit on site. The Peel River changed its course over the years and in 1994, the northeast bank of the river encroached on the disposal pit, exposing the debris.

An investigation was conducted during a site inspection in August 1994. Results of this investigation indicated there were no potential contaminants of concern at the site. A short-term stabilization program was performed in September 1994. This was followed by an electromagnetic survey in March 1995 to delineate the extent of debris in the pit (Power, 1994).

Debris buried in the pit continued to be exposed by the river as such Indian and Northern Affairs Canada (DIAND), Shell, and the Gwich'in Tribal Council initiated a joint project in 1994 to pick up the exposed debris for aesthetic reasons.

In October 1998, representatives of the Northwest Territories Municipal and Community Affairs collected 10 soil samples from the site. The samples were composited and analyzed by Enviro-Test Laboratories in Edmonton for organochlorine insecticides. It was found that the composite contained 79 ppm (mg/kg) of DDT, 11 ppm of DDD and 3.2 ppm of DDE.

## 1.3 What are DDT, DDE and DDD?

The name DDT is derived from Dichloro-Diphenyl-Trichloroethane and is commonly applied to 1,1,1-trichloro-2,2-bis-(p-chlorophenyl) ethane (p,p'-DDT) and its other isomeric forms o,p'-DDT and m,p'-DDT. Commercial pesticides that contain these compounds are generally called DDTs. The commercial pesticide formulations contain several similar compounds such as DDD and DDE isomers (Table 1.1). Commercial pesticides usually contain 70 – 80% of the p,p'-DDT isomer and up to 30% of the o,p'-DDT isomer. Once introduced into the environment, these active ingredients are transformed, either metabolically or photochemically, into a number of chemically similar compounds. The most common of these metabolites or degradation products are the isomeric forms of DDE (dichloro-diphenyl-ethylene) and DDD (dichloro-diphenyl-dichloroethane). Small amounts of DDE and DDD are also found as impurities in technical grade DDT.

In this report the term total DDT refers to the sum of the six isomers presented in Table 1.1.

**Table 1.1: Chemical Names of DDT, DDD and DDE isomers**

Common Name	Isomeric Forms	Chemical Name
DDT	p, p'-DDT or 4,4'-DDT	1,1,1-trichloro-2,2-bis-(p-chlorophenyl) ethane
	o, p'-DDT or 2,4'-DDT	1,1,1-trichloro-2-(o-chlorophenyl)-2-(p-chlorophenyl) ethane
DDE	p, p'-DDE or 4,4'-DDE	1,1-dichloro-2,2-bis (p-chlorophenyl) ethylene
	o, p'-DDE or 2,4'-DDE	1,1-dichloro-2- (o-chlorophenyl)-2-(p-chlorophenyl) ethylene
DDD	p, p'-DDD or 4,4'-DDD	1,1-dichloro-2,2-bis (p-chlorophenyl) ethane
	o, p'-DDD or 2,4'-DDD	1,1-dichloro-2-(o-chlorophenyl)-2-(p-chlorophenyl) ethane

Technical grade DDT is a white, crystalline or waxy, tasteless, odourless solid at room temperature. It is not very volatile and not very soluble in water but is highly soluble in organic solvents (CCME, 1999). DDT was discovered to have insecticidal properties during the Second World War and its use significantly reduced the incidence of insect borne diseases such as malaria and typhus. The low cost of DDT, its high activity against insects, ease of application and persistence encouraged its use by civilians after the war. It was used extensively to control a wide range of insect pests on agricultural lands. Swamps, forests as well as residential areas were sprayed with DDT to control insect pests. It was sold for household use in granules, aerosols, smoke candles, lotions, and charges for vaporizers (CCME, 1999).

Early investigations indicated that excessive use of DDT could kill fish, birds and other wildlife. Residues of DDT were found in plant and animal tissue and cows milk, but these were accepted as unavoidable hazards and of little concern. During the 1950's and 1960's, residues of DDT and other organochlorine insecticides were detected in soils and small amounts in water and sediments. Thinning of bird eggshells and birth deformities in birds were also linked to DDT and other organochlorine compounds. Humans were exposed to DDT through ingesting food containing DDT residues and there were indications that DDT and other organochlorine insecticides were accumulated in humans and other animals (bioaccumulation). Other pathways for human exposure to DDT included ingestion of contaminated soil particles, inhalation of contaminated air and adsorption through the skin.

Short-term exposure to DDT affects primarily the nervous system; highly exposed soldiers in the Second World War suffered aching joints, tremors and depression. Long-term exposure to low doses results in some reversible changes in the level of liver enzymes. Because of these observed effects, its high persistence, bioaccumulation and long-range transport, the use of DDT was banned in many developed countries including Canada and the USA in the early 1970's. However, it is still used in many countries around the world.

## **1.4 Preliminary Environmental Site Investigations**

The discovery of DDT in samples collected by Northwest Territories Municipal and Community Affairs led to additional investigations by AGRA Earth and Environmental Ltd. (AGRA, 1999) on behalf of the Gwich'in Tribal Council, Shell Canada, DIAND, and the Peel River Working Group. The investigation was initiated with a site visit in June 1999 during which 11 soil samples were collected and analyzed on site using immunoassay based field test kits. The samples were subsequently analyzed at Enviro-Test Laboratories and found to contain DDT, DDE and DDD at concentrations ranging from <0.002 to 3.3 ppm. Additional sampling and analysis was therefore recommended.

AGRA conducted a follow up to the June 18 investigation on September 18 and 19, 1999. Forty soil samples were collected. These samples were analyzed in two sets to reduce the analysis cost and determine if areas of relatively high DDT contamination could be differentiated from other less contaminated areas. Twenty-five samples were analyzed in the first batch. The concentrations of total DDT in most of the samples were less than the Canadian Council of Ministers of the Environment (CCME) criterion for DDT in parkland soils of 0.7 ppm (mg/kg) apart from three samples. These three samples contained 7.02, 27 and 53 ppm (mg/kg) of total DDT. On the basis of the above results, the remaining 14 samples were subsequently analyzed. High concentrations of total DDT (up to 266 ppm) were found in seven of the samples. These samples were collected from locations at or below the June 1999 water level.

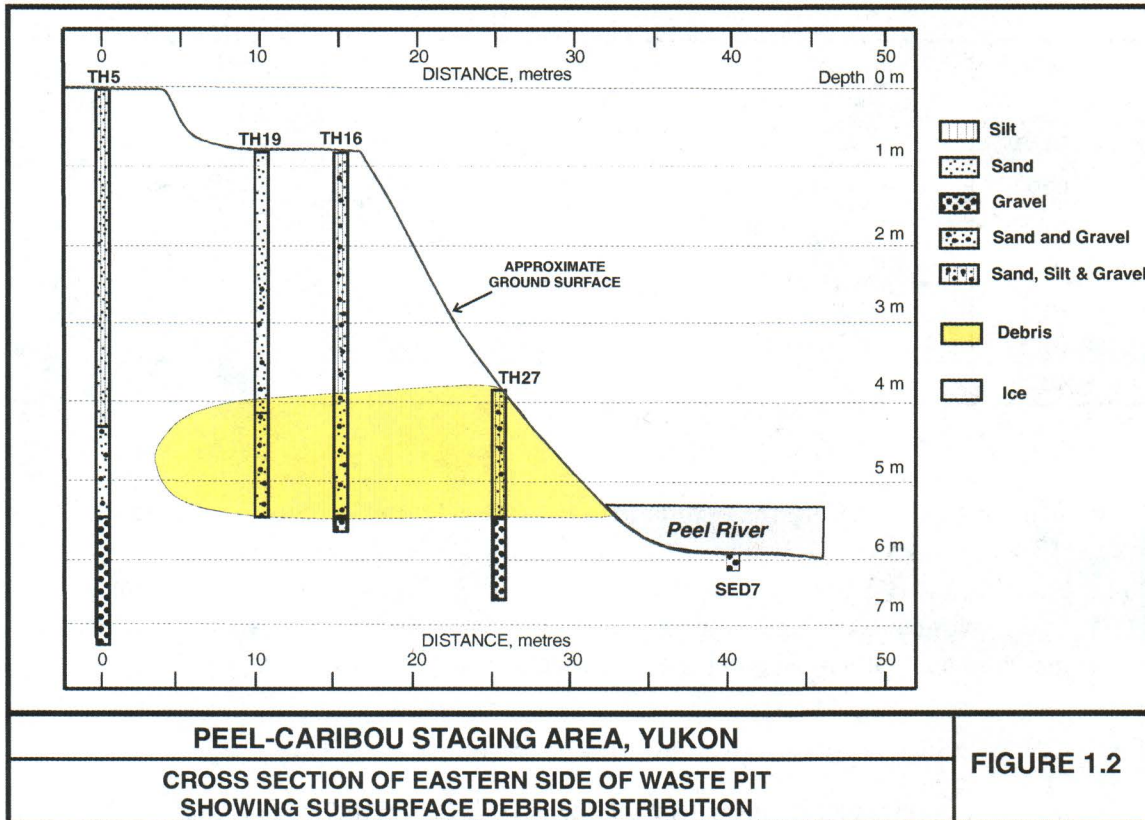
## **1.5 Detailed Site Investigations**

Additional information was needed to determine the amount and distribution of DDT and other possible contaminants at the Peel River Waste Site as such, representatives from DIAND Waste Management, Yukon Region and Royal Roads University – Applied Research Division (Royal Roads) undertook a more thorough investigation in 2000. Field investigations were conducted between April 11 and 25, 2000 during which 110 soil samples were collected from 33 boreholes advanced in and around the waste pit to depths of up to 8 m below the present ground surface. Sediments (8) and water samples (5) were also obtained from locations below the waste pit along Peel River. The samples were analyzed using a combination of field and laboratory techniques for organochlorine pesticides including DDT, metals, hydrocarbons, volatile organic compounds and polychlorinated biphenyls (PCBs). The results were evaluated by using the Canadian Environmental Quality Guidelines (CCME, 1999). A report containing the results, conclusions and recommended of the investigation was submitted to the Peel River Working Group in December 2000 (Royal Roads, 2000). A summary of the findings is presented below.

### **1.5.1 Debris**

Debris including wood, bentonite, metals, cement and an unidentifiable brown fibrous material (coconut husk) was generally located at a depth of 3 to 4 m below ground surface

on the upper bench and extended to a maximum depth of 2 m. This debris was exposed along the cut bench of the river (Figure 1.2). Snow cover during the site investigations precluded observation of the extent of exposed debris along the riverbank. The volume of this debris was estimated to be 2000 cubic metres. Allowing for a contingency factor of 50%, the total volume of debris was approximately 3000 cubic metres.



### 1.5.2 DDT

DDT and its related metabolites were identified as contaminants of potential concern in a large subset of soil and sediment samples analyzed. A summary statistics of the data is given in Table 1.2. The concentrations encountered, and the distribution of DDT, DDD and DDE isomers suggested the presence of a buried source of DDT on the eastern side of the waste pit and contaminant migration into the river. However, the transient nature of river water and sediment near the site would be expected to limit the extent to which elevated concentrations of DDT would occur in the river. The maximum DDT concentration detected in the sediments was 2.4 ppm exceeding the CCME Interim Sediment Quality Guideline (ISQG) but lower than the probable effect level (PEL). The concentrations of DDT in water samples collected directly below the waste site were generally below detection or very low. Based on a DDT soil remediation guideline of 0.7 ppm, which is the CCME environmental quality guideline for residential or park land use,

the volume of contaminated soil was estimated to be 1000 cubic metres; this included a contingency factor of 50%.

**Table 1.2: Summary Statistics for DDT in Soil/Sediment Samples Collected from Peel River Waste Site in April 2000.**

Parameter	Number of Samples		Concentration (ppm or mg/kg)			
	Analyzed	Detected	Minimum	Maximum	Arithmetic Mean	Standard Deviation
Field Test Kit	106	54	<0.2	>10	-	-
<i>Laboratory</i>						
2,4'-DDD	50	41	<0.001	3.17	0.131	0.506
4,4'-DDD	50	41	<0.001	6.67	0.280	1.08
2,4'-DDE	50	14	<0.002	0.321	0.036	0.083
4,4'-DDE	50	34	<0.001	1.99	0.088	0.339
2,4'-DDT	50	43	<0.001	8.68	0.43	1.50
4,4'-DDT	50	45	<0.002	32.9	1.7	5.91
Total DDT	50	46	nd	51.63	2.49	8.83

Five soil samples from the contaminated areas were subjected to the Special Waste/Leachate Extraction Procedure (SWEP/LEP) outlined in the BC Waste Management Act, BC Special Waste Regulation (BC, Reg. 63/88). The concentrations of DDT in the extracts were all below detection. The contaminated materials were therefore not considered special waste under the BC Special Waste Regulations.

### 1.5.3 PCBs and Other Chlorinated Hydrocarbons

The concentrations of this group of analytes, which included PCBs and chlorinated pesticides other than DDT, were below detection (Table 1.3).

**Table 1.3: Summary Statistics for Polychlorinated Biphenyls (PCBs) and Organochlorine Pesticides in Soil/Sediment Samples Collected from Peel River Waste Site in April 2000**

Parameter	Number of Samples		Concentration (ppm or mg/kg)			
	Analyzed	Detected	Minimum	Maximum	Arithmetic Mean	Standard Deviation
<i>Polychlorinated Biphenyls</i>						
Total PCBs (laboratory)	10	0	<0.05	<0.05	-	-
Total PCBs (field test kits)	34	0	<1	<1		
<i>Organochlorine Pesticides</i>						
Aldrin	50	0	<0.001	<0.001	-	-
alpha-BHC	50	0	<0.001	<0.001	-	-
beta-BHC	50	0	<0.002	<0.002	-	-
delta-BHC	50	0	<0.001	<0.001	-	-
cis-Chlordane (alpha)	50	0	<0.001	<0.002	-	-
trans-Chlordane (gamma)	50	0	<0.001	<0.001	-	-
Dieldrin	50	0	<0.001	<0.001	-	-
Endosulfan I	50	0	<0.001	<0.001	-	-
Endosulfan II	50	0	<0.001	<0.005	-	-
Endosulfan Sulfate	50	0	<0.001	<0.001	-	-
Endrin	50	0	<0.005	<0.005	-	-
Endrin Aldehyde	50	0	<0.01	<0.01	-	-
Heptachlor	50	0	<0.002	<0.002	-	-
Heptachlor Epoxide	50	0	<0.001	<0.001	-	-
Lindane (gamma - BHC)	50	0	<0.001	<0.001	-	-
Methoxychlor	50	0	<0.005	<0.005	-	-
Mirex	50	0	<0.001	<0.001	-	-
cis-Nonachlor	50	0	<0.001	<0.001	-	-
trans-Nonachlor	50	0	<0.001	<0.001	-	-

#### 1.5.4 Metals

Of the metals analyzed, only arsenic and barium were found to occur at concentrations exceeding the CCME environmental quality guideline for residential/parkland in soil. The data is summarized in Table 1.4. The concentrations of metals in the SWEP/LEP extracts were below the BC Leachate quality standard. Elevated metal concentrations were detected in water samples. This was attributed to particulate matter, as metal concentrations in dissolved water samples were considerably lower.

**Table 1.4 Summary Statistics for Metals in Soil/Sediment Samples Collected from Peel River Waste Site in April 2000.**

Parameter	Number of Samples		Concentration (ppm or mg/kg)			
	Analyzed	Detected	Minimum	Maximum	Arithmetic Mean	Standard Deviation
Physical Tests						
Moisture %	23	23	10.6	71.2	26.1	18
pH	23	23	7.52	10	8.3	0.7
Total Metals						
Antimony T-Sb	23	0	<20	<20	-	-
Arsenic T-As	23	19	<0.5	16	12	2.6
Barium T-Ba	23	23	100	3510	653	728
Beryllium T-Be	23	20	<0.5	1.6	0.8	0.2
Cadmium T-Cd	23	11	<0.5	1.3	0.7	0.3
Chromium T-Cr	23	23	6	43	30	10
Cobalt T-Co	23	22	<2	11	7.1	2.5
Copper T-Cu	23	23	3	56	25	13
Lead T-Pb	23	2	<50	140	106	47
Mercury T-Hg	23	23	0.015	0.168	0.052	0.031
Molybdenum T-Mo	23	0	<4	<4	-	-
Nickel T-Ni	23	22	<5	36	24	8.6
Selenium T-Se	23	0	<2	<2	-	-
Silver T-Ag	23	0	<2	<2	-	-
Thallium T-Tl	23	0	<2	<2	-	-
Tin T-Sn	23	0	<10	<10	-	-
Vanadium T-V	23	23	11	130	84	35
Zinc T-Zn	23	23	32	145	88	33

### 1.5.5 Hydrocarbons

Detectable concentrations of BETX, PAHs, LEPH and HEPH were found in some of the soil samples (Table 1.5) No guidelines exist for extractable hydrocarbons in the 1999 CCME EQGs as such the Yukon CSR standard for hydrocarbons was used to evaluate LEPH and HEPH data. Only one of the samples contained LEPH at a concentration that exceeded the Yukon CSR standard for residential/parkland use. A black stain with hydrocarbon odour was associated with this sample, which also contained DDT in excess of the CCME R/P guideline. Data for PAHs in soil was similar to the LEPH results in that only one sample contained a PAH (naphthalene) at a concentration which was greater than the guideline. For volatile hydrocarbons, the levels of BTEX in one of the soil samples were greater than the CCME guidelines. Hydrocarbons concentrations in water samples were either below detection or well below the CCME benchmark.

**Table 1.5: Summary Statistics for Hydrocarbons in Soil/Sediment Samples Collected from Peel River Waste Site in April 2000.**

Parameter	Number of Samples		Concentration (ppm or mg/kg)			
	Analyzed	Detected	Minimum	Maximum	Arithmetic Mean	Standard Deviation
<b>Volatiles</b>						
Benzene	8	1	<0.01	5	5	0
Ethylbenzene	8	1	<0.01	3	3	0
Styrene	8	0	<0.01	<1	-	-
Toluene	8	1	<0.01	9	9	0
meta- & para-Xylene	8	1	<0.01	9	9	0
ortho-Xylene	8	1	<0.01	4	4	0
<b>PAHs</b>						
Acenaphthene	16	0	<0.01	<0.4	-	-
Acenaphthylene	16	0	<0.01	<0.08	-	-
Anthracene	16	0	<0.01	<0.06	-	-
Benz(a)anthracene	16	8	<0.01	0.06	0.016	0.018
Benzo(a)pyrene	16	9	<0.01	0.05	0.020	0.012
Benzo(b)fluoranthene	16	15	<0.01	0.09	0.036	0.022
Benzo(g,h,i)perylene	16	15	<0.01	0.11	0.065	0.033
Benzo(k)fluoranthene	16	1	<0.01	0.01	0.010	0
Chrysene	16	13	<0.01	0.09	0.035	0.021
Dibenz(a,h)anthracene	16	8	<0.01	0.01	0.010	0
Fluoranthene	16	11	<0.01	0.03	0.023	0.006
Fluorene	16	11	<0.01	0.59	0.135	0.202
Indeno(1,2,3-c,d)pyrene	16	9	<0.01	0.03	0.014	0.007
Naphthalene	16	16	<0.01	1.9	0.276	0.464
Phenanthrene	16	15	<0.01	0.62	0.176	0.176
Pyrene	16	15	<0.01	0.16	0.043	0.038
<b>Extractable Hydrocarbons</b>						
EPH10-19	16	7	<200	2420	771	782
EPH19-32	16	1	<200	659	659	0
LEPH	16	7	<200	2410	769	779
HEPH	16	1	<200	659	659	0
<i>PetroFLAG Test Kits</i>	65	65	11	>2000	566	616

### 1.5.6 Halogenated Volatile Organic Compounds

The concentrations of these compounds, which are generally found in solvents, paint thinners and degreasers, were generally below detection except for dichloromethane (CH<sub>2</sub>Cl<sub>2</sub>) and chloroform (CHCl<sub>3</sub>) in one sample. This sample also contained elevated levels of BETX compounds.

**Table 1.6: Summary Statistics for Halogenated Volatile Organic Compounds in Soil/Sediment Samples Collected from Peel River Waste Site in April 2000.**

Parameter	Number of Samples		Concentration (ppm or mg/kg)			
	Analyzed	Detected	Minimum	Maximum	Arithmetic Mean	Standard Deviation
Field headspace analysis (PID)	117	117	0.9	744	22	74
<b>Laboratory Analysis</b>						
Bromodichloromethane	8	0	<0.01	<0.01	-	-
Bromoform	8	0	<0.01	<0.01	-	-
Carbon Tetrachloride	8	0	<0.01	<0.01	-	-
Chlorobenzene	8	0	<0.01	<0.01	-	-
Chloroethane	8	0	<0.01	<0.01	-	-
Chloroform	8	1	<0.01	3	3	0
Chloromethane	8	0	<0.01	<0.01	-	-
Dibromochloromethane	8	0	<0.01	<0.01	-	-
1,2-Dichlorobenzene	8	0	<0.01	<0.01	-	-
1,3-Dichlorobenzene	8	0	<0.01	<0.01	-	-
1,4-Dichlorobenzene	8	0	<0.01	<0.01	-	-
1,1-Dichloroethane	8	0	<0.01	<0.01	-	-
1,2-Dichloroethane	8	4	<0.01	0.01	0.01	0
cis-1,2-Dichloroethylene	8	0	<0.01	<0.01	-	-
trans-1,2-Dichloroethylene	8	0	<0.01	<0.01	-	-
1,1-Dichloroethylene	8	0	<0.01	<0.01	-	-
Dichloromethane	8	1	<0.4	26	26	0
1,2-Dichloropropane	8	0	<0.01	<0.01	-	-
cis-1,3-Dichloropropylene	8	0	<0.01	<0.01	-	-
trans-1,3-Dichloropropylene	8	0	<0.01	<0.01	-	-
1,1,1,2-Tetrachloroethane	8	0	<0.01	<0.01	-	-
1,1,2,2-Tetrachloroethane	8	0	<0.01	<0.01	-	-
Tetrachloroethylene	8	0	<0.01	<0.01	-	-
1,1,1-Trichloroethane	8	0	<0.01	<0.01	-	-
1,1,2-Trichloroethane	8	0	<0.01	<0.01	-	-
Trichloroethylene	8	0	<0.01	<0.01	-	-
Trichlorofluoromethane	8	0	<0.01	<0.01	-	-
Vinyl Chloride	8	0	<0.01	<0.01	-	-

### 1.5.7 Recommendations and Remedial Options

The results summarized in the preceding sections provided further evidence of contamination of subsurface soil within the waste pit with DDT, as well as the release to and limited contamination of sediments in the adjacent aquatic environment of the Peel River. Based on the spatial and vertical distribution of contamination and debris, it was suspected that the landfill contained barrels with technical DDT mixtures and possibly other organic solvents such as dichloromethane and monoaromatic hydrocarbons. The co-

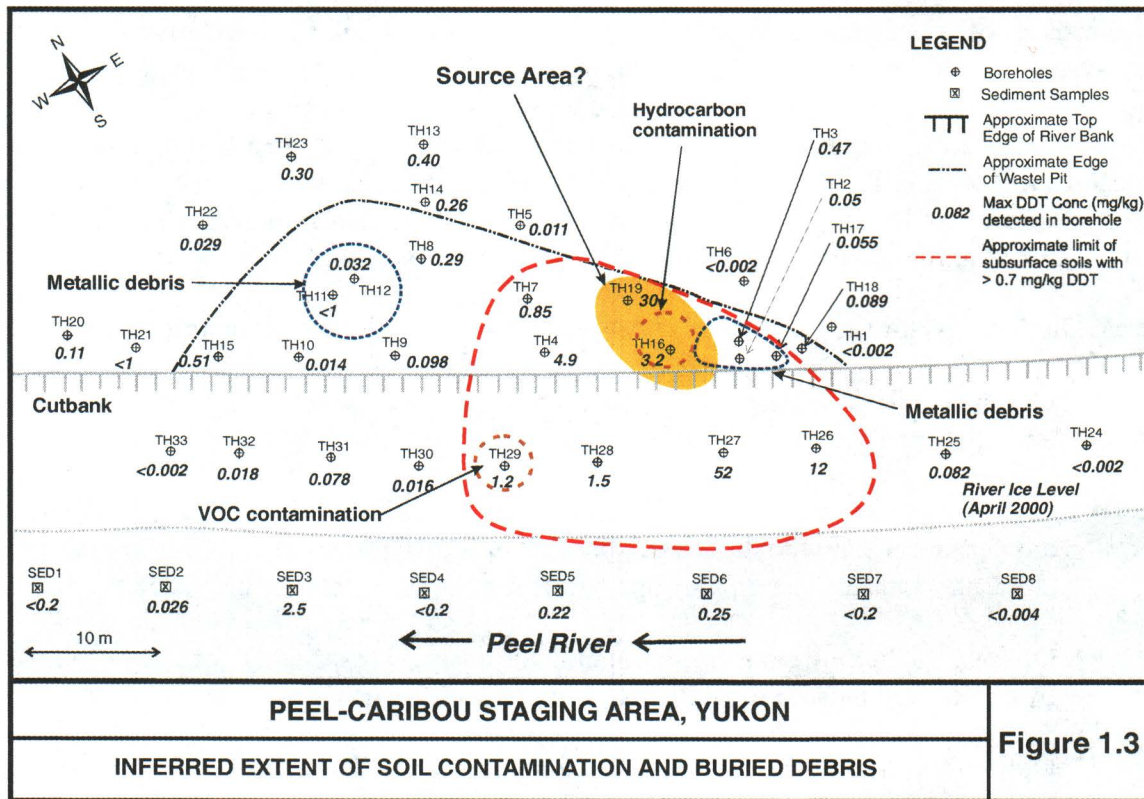
occurrence of a substantial contaminant source (i.e. for DDT), a relatively sensitive ecosystem containing valued and ecologically important aquatic ‘ecological receptors’, and an operating transport pathway between the two suggests the possibility of unacceptable ecological risks under the present conditions. It was clear that the unfortunate location of the landfill in the Peel River flood plain, coupled with the recent changes in river channel, would result in continued, direct erosion of DDT-contaminated soils into the river. Remediation to curtail further release into the river was therefore necessary.

Remedial options for the Peel River Waste Site was divided into four major categories:

- Option 1 – Risk Management, consisting of leaving the existing materials in place and properly securing the waste site to reduce any erosion;
- Option 2 – Complete removal of the waste site, including non-hazardous debris, any hazardous materials found (should they exist) and soils with contaminant concentrations exceeding the appropriate standards, criteria or provisional criteria;
- Option 3 – Partial removal of contaminant hotspots (especially for DDT) followed by engineered closure including slope stabilization; or,
- Option 4 – In situ remediation - including biodegradation, solidification, solvent extraction, and electrochemical focusing.

Options 1 to 3 were presented to the Peel River Working Group for further review. Option 4 – In situ remediation was excluded from the analysis owing to either a lack of technical credibility in achieving the remedial objectives, practicality of implementation, cost effectiveness, or any combination thereof. While risk management through river bank stabilization and partial encapsulation may be considered, a cursory analysis suggested that the erosion forces of Peel River flood waters and the movement of ice during spring break-up would render a long-term, effective stabilization solution both challenging and cost-prohibitive to implement. Removal of major source areas of DDT and other contaminants such as various solvents and petroleum hydrocarbon products was considered as the most cost-efficient mechanism for curtailing future entry into the Peel River ecosystem. Following further review and community consultations at Ft. McPherson and Inuvik, complete removal of the waste pit was selected as the preferred option.

Figure 1.3 provides a summary of the areas of concern and also includes maximum DDT concentrations detected in each borehole.



## 1.6 Scope and Objectives of this Report

A request for proposal for the Ex-Situ Soil Remediation of Peel-Caribou Staging Area, Yukon Territory was issued by Public Works and Government Services Canada (PWGSC) in November 2001. Following review of the bids received, a contract was awarded to GDC (Gwich'in Development Corporation) Civil Construction Ltd. Site remediation by the Contractor involved the complete removal of the waste site including non-hazardous debris, any hazardous material found (should they exist), and soils with contaminant concentrations exceeding appropriate standards, criteria or provisional criteria (including DDT and its metabolites). Royal Roads provided on site testing services, environmental and quality control functions on behalf PWGSC for the remediation project.

Royal Roads personnel's tasks included the following environmental and quality control activities:

- Assisting in defining the excavation boundaries.
- Conducting confirmatory sampling within the excavation and analyzing samples on site using field test kits.
- Reviewing the results of confirmatory sampling and directing the Contractor to conduct additional excavation, until closure results are obtained.

- Monitoring surface runoff and obtain water samples, if necessary.
- Producing a completion report.

The remediation program was conducted from January to March 2002. This report presents a summary of the methods and the results of the project.

## **2. REMEDIAL ACTIVITIES AND METHODOLOGY**

### **2.1 Project Team**

Site remediation services were provided by a team comprising:

- GDC Civil Construction – Prime contractor providing all construction, excavation and shipping services.
- Arctic Environmental Services – Project management.
- DIAND, Waste Management, Yukon Region – Project Authority.
- PWGSC Environmental Services – Engineering services and contract management.
- Royal Roads – On site testing services, environmental and quality control.

### **2.2 Permits and Authorization**

Prior to the construction of the winter access road and site excavation all the necessary permits were obtained. This included

- Water License – Type B obtained from the Yukon Territory Water Board and amendment not to fill excavation
- Land Use Permit – Issued by DIAND Land Use Section
- Gwich'in Access Authorization – Quarry permit issued by the Gwich'in Tribal Council
- Gwich'in Access Authorization – Road permit issued by the Gwich'in Tribal Council

Copies of the permits are attached to Appendix A.

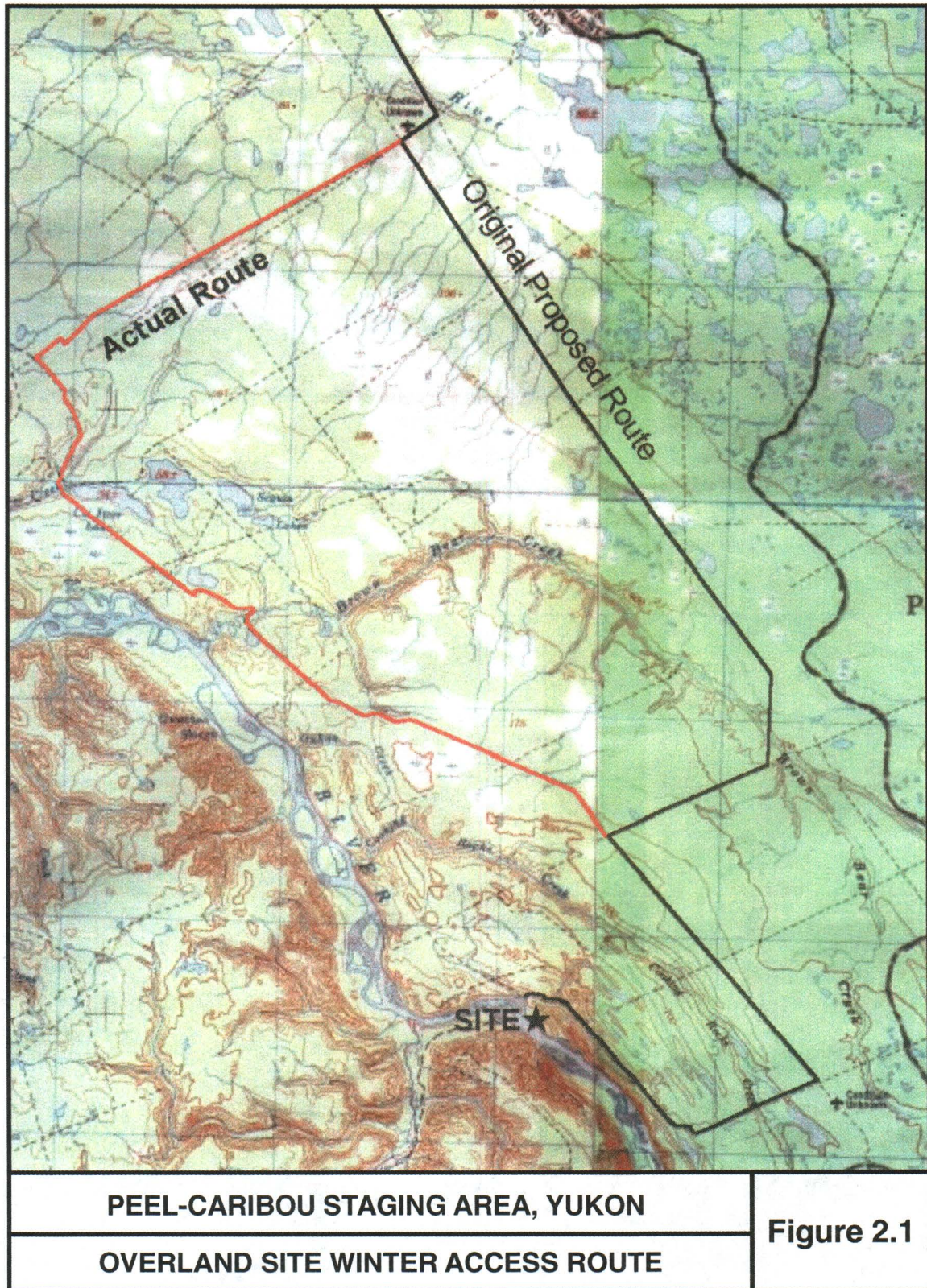
### **2.3 Health and Safety Program**

A health and safety program, an emergency response and spill contingency plan was prepared by the prime contractor. A copy of the plan is provided in Appendix B.

### **2.4 Winter Access Road and Construction Camp**

Approximately 170 km of an overland winter road (Figure 2.1) was constructed from Dempster Highway, near Ft McPherson, to the site along existing seismic lines (Photograph 2.1). A camp (Photograph 2.2) was established about 20 km to the site, just

outside the Peel River Game Preserve to provide accommodation and meals for project personnel.





**Photograph 2.1: Water truck and Challenger working on the access road near the waste site**



**Photograph 2.2: View of the construction camp and part of the winter access road**

## 2.5 Site Preparation

A site meeting was conducted on February 13, 2002 to initiate site excavation activities. The site was covered with up to 0.5 m of snow (Photographs 2.3 and 2.4).



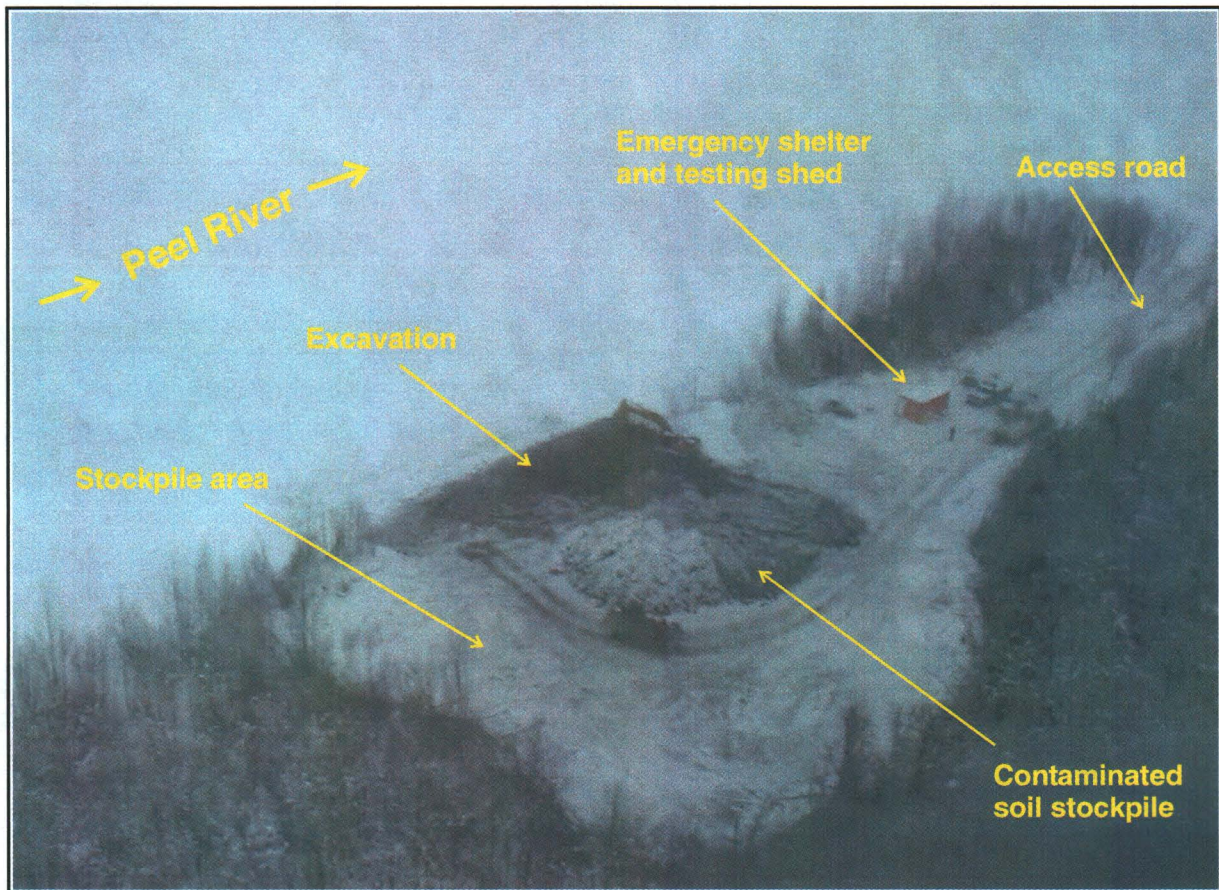
**Photograph 2.3: View of the upper bench of the waste site showing snow cover**



**Photograph 2.4: Removing snow cover from the waste site as viewed from the frozen river**

This snow cover was removed using the front blade of a D6 caterpillar. The approximate limits of the waste pit were demarcated based on the results from the detailed site investigation (see Figure 1.3). A survey was then conducted to establish the base line prior to excavation. A plot of the baseline is given in Drawing 1, which is reproduced as an attachment to this report.

An area of approximately 100 m x 100 m on the upper bench was then prepared to serve as a stockpile and loading area. All surface vegetation was removed and piled at the edges of the clearing for re-use after completion of the project. A small trailer equipped with a portable generator and heater was also set up at the northwestern end of the stockpile area to serve as an emergency shelter and on site testing facility. A general layout of the site showing the excavation, stockpile area, emergency shelter and access road is shown in Photograph 2.5 below. The photograph was taken halfway during the project.



**Photograph 2.5: Aerial view of the Peel-Caribou showing site layout halfway during the project**

## 2.6 Removal of Overburden

As summarized in Section 1.5, debris and contaminated soils were generally located at a depth of 3 to 4 m below ground surface on the upper bench and were exposed along the cut bench of the river (Figure 1.2). This necessitated removal of the non-contaminated overburden, which consisted mostly of sand, silt and gravel. The surface frost layer was broken using a pick attached to the front end of a Cat 322 excavator (Photograph 2.6).



**Photograph 2.6: Ripping the surface frost layer using a pick which was attached to the Cat 322 excavator**

After breaking the frost layer, the pick was replaced with a bucket. The loose overburden was scooped and placed at the stockpile area. It was then re-graded into the surrounding terrain in a manner consistent with the topography of the site to minimize erosion and surface runoff from carrying sediments into the river. Re-grading was accomplished with a D6 caterpillar.

To facilitate the segregation of contaminated soils and debris from non-contaminated materials, the removal of the overburden was conducted in two phases. The initial phase involved excavation from areas identified as contaminated (see Figure 1.3) while the second phase encompassed the remainder of the waste pit.

Following the initial excavation of all the non-contaminated overburden (Photograph 2.7), the area was surveyed to establish the base line for the contaminated area. This was to allow for an estimation of the in-situ volume of contaminated materials to be removed (Drawing 2).



**Photograph 2.7: Waste pit after removal of overburden from the contaminated zone**

The contaminated soils and debris were excavated. After excavation of all contaminated materials, the remaining overburden was removed and a second survey was conducted (Drawing 3). The combined volume of overburden removed from the waste pit was then calculated to be 1016 m<sup>3</sup>.

## **2.7 Excavation and Disposal of Contaminated Soils and Debris**

After removal of the overburden, a 5 m x 5 m grid was set up in the contaminated zone; a tighter grid as opposed to the 10 m x 10 m grid used for the detailed site investigation was utilized in order to refine the contaminate zone. Soil samples were collected and analyzed for DDT on site using the immunoassay field test kits. The combined field test kits and detailed site investigation results were used to delineate the area requiring excavation. Sampling and analytical methods are presented in detail in Section 2.11. Results are discussed in Chapter 3.

### **2.7.1 Excavation of Contaminated Soils and Debris**

Removal of materials from the contaminated zone was initiated on February 20, 2002 and completed on February 25, 2002. Excavation was achieved with a CAT 322 excavator operated by the prime contractor. Contaminated soil and all debris were removed from the contaminated zone until native gravel was encountered (Photograph 2.8). The excavated materials were either placed directly on a synthetic liner at the stockpile area or in the case of materials at the lower bench, loaded onto a truck and transported to the stockpile area.



**Photograph 2.8: Waste pit after excavation of contaminated soils**

Confirmatory samples were collected from the contaminated zone after the initial excavation and analyzed on site using the field test kits. On the basis of the results obtained further excavation and confirmatory sampling was conducted. The process was repeated until confirmatory samples indicated DDT concentrations as determined by the field test kits was less than 0.7 ppm. Confirmatory sampling results are discussed in Chapter 3.

A survey was conducted and a drawing showing the excavated zone was generated (Drawing 3). The data from Drawing 3 along with that from the baseline, Drawing 2 was used to determine the in-situ volume of contaminated materials excavated from the pit. The volume excavated was calculated to be 350 m<sup>3</sup>.

### **2.7.2 Contaminated Soil and Debris Stockpiling**

Debris uncovered during the excavation of the contaminated soils included crushed empty barrels (Photograph 2.9), metal drill casings (Photograph 2.10), wood, concrete, bags of drilling fluid, brown fibrous material and other miscellaneous metal debris including parts of cat track and a motor vehicle. The brown fibrous material was identified as coconut husk, which was previously used for drilling.

The contaminated soils and debris were placed on a geomembrane liner at the stockpile area. The drill casings and other debris in excess of 0.5 m in any dimension (excluding barrels) were segregated from the contaminated pile. These were treated as per the non-contaminated debris (see section 2.8).



**Photograph 2.9: Barrel and other debris excavated from the contaminated zone**



**Photograph 2.10: Drill casings excavated from the waste pit and the excavator**

### **2.7.3 Off site Transport and Disposal**

The excavated soils and debris from the stockpile area were loaded into polyethylene-lined Seacan™ boxes (Photograph 2.11) and transported by truck via the winter access road to a temporary holding area near Fort McPherson (Photograph 2.12).

All the 588 boxes filled were subsequently shipped to Beaver County Landfill, a licensed hazardous waste facility in Alberta, for disposal.



**Photograph 2.11: Loading contaminated soils and debris into Seacan containers**



**Photograph 2.12: Seacans in storage at a temporary holding area near Fort McPherson awaiting shipping to Alberta for disposal**

## 2.8 Excavation and Disposal of Un-Contaminated Debris

### 2.8.1 Excavation

All soils and debris from areas containing less than 0.7 ppm total DDT and other parameters such as hydrocarbons and volatile organic hydrocarbons at concentrations below the CCME residential/parkland use standard were considered as not contaminated. Materials from these areas were excavated after removal of the contaminated materials. Excavated materials included bags of bentonite, cement, wood, plastic bags, cables, and other miscellaneous metallic debris (Photographs 2.13 to 2.15). The excavation was continued until all visible debris had been removed and the native gravel layer was reached.

Prior to the excavation, all the overburden was removed until debris was encountered. A survey was then conducted to establish the surface topography. The drawing generated (Drawing 4) along with initial baseline (Drawing 1) was used to generate the overall volume of overburden removed.



**Photograph 2.13: Wood and other debris exposed along the cut bank prior to excavation**



**Photograph 2.14: Brown fibrous material, bentonite and other debris excavated from the waste pit**



**Photograph 2.15: Metal cable excavated from the waste pit**

### **2.8.2 Off site Transport and Disposal**

The excavated soils and debris from the un-contaminated areas were loaded directly into dump trucks and transported to a landfill which was created outside the Peel River Game Preserve, approximately 20 km from the waste pit. The materials were placed into the landfill and covered with excavated overburden. The entire landfill area was then graded (Photograph 2.16).



**Photograph 2.16: Aerial view of the new landfill after burial of non-contaminated debris and site re-contouring.**

### **2.9 Surface Water and Sediment Runoff Control**

The excavation of the waste pit was conducted in winter while the river was frozen in order to provide appropriate sediment and surface water control during the performance of the work. To minimize disturbance to the river, the excavation was initiated at the upper bench and the ice along the riverbank was left intact to act as a surface water runoff control system. The ice barrier, which was left in place until the completion of excavation, provided appropriate control for sediments runoff into the river.

Generally no surface water runoff was generated until a series of excavations had been conducted within the contaminated zone. Confirmatory samples collected after a second set of excavation in the gravel layer underlying the debris zone indicated the presence of DDT in excess of 1 ppm. As such additional excavations were conducted. A groundwater seep was uncovered at the northeastern end of the pit since the excavation was below the river level at this point. This resulted in a small pool of water. A berm was created and this

along with the ice barrier prevented the release of this water into the river (Photograph 2.17). A sample of the water was collected for laboratory analysis for DDT. The results are discussed in Chapter 3. The water froze overnight. Since the results of the field-testing indicated substrate in the area contained DDT in excess of 1 ppm, additional excavation was conducted. Sediments, along with water in the area were removed to the stockpile area and subsequently shipped off site for disposal.



**Photograph 2.17: Small pool generated after excavation at the contaminated zone**

## **2.10 Site Grading and Restoration**

### **2.10.1 Waste Pit Excavation**

The original intention was to replace the excavated overburden back into the pit and re-contour the slope after completion of the excavation. However it was felt that the erosion forces of the Peel River would remove this overburden and deposit it into the river. Following consultation with stakeholders and regulators an application was submitted to the Yukon Water Board to allow for a deviation to the original plan for re-contouring and leaving the excavation as is. The excavation was therefore left as is following the removal of all contaminated soils and debris (Photograph 2.18): no overburden was re-placed into the pit. A copy of the approved amendment is attached to Appendix A.



**Photograph 2.18: Waste Pit after removal of all debris and contaminated soil**

### **2.10.2 Stockpile Area**

The removal and off site transport of contaminated soils and debris from the stockpile area was completed in March 2002. The emergency shelter was removed and transported off site. The ground was then re-graded in a manner which was consistent with the topography of the site and which prevented erosion and surface runoff from carrying sediments into the river. Vegetation removed from the site during site preparation was then spread over the site. Photograph 2.19 shows the status of the stockpile area after completion of the project.



**Photograph 2.19: Stockpile area after project completion**

## 2.11 Delineation and Confirmatory Sampling

### 2.11.1 Sampling Locations

Confirmation sampling was performed in compliance with the protocols outlined in the BC Ministry of the Environment Lands and Parks Technical Guidance on Contaminated Sites, Document 1 Site Characterization and Confirmation Testing, (BC MELP, 1997). The protocols calls for one sample per 10m<sup>3</sup> of material contaminated at levels exceeding the industrial or commercial standard. This translates to a grid size of 10 m x 10 m to a depth of 0.1 m. To allow for a better coverage of the site, a 5 m x 5 m grid was used. This implied one sample per 2.5 m<sup>3</sup> (i.e., 5 m x 5 m x 0.1 m = 2.5 m<sup>3</sup>). To ensure that the sampling grid was maintained during excavation activities, the baseline for the sampling grid was tied into the survey marker used to generate all the drawings. The sampling locations are indicated in Figure 2.2.

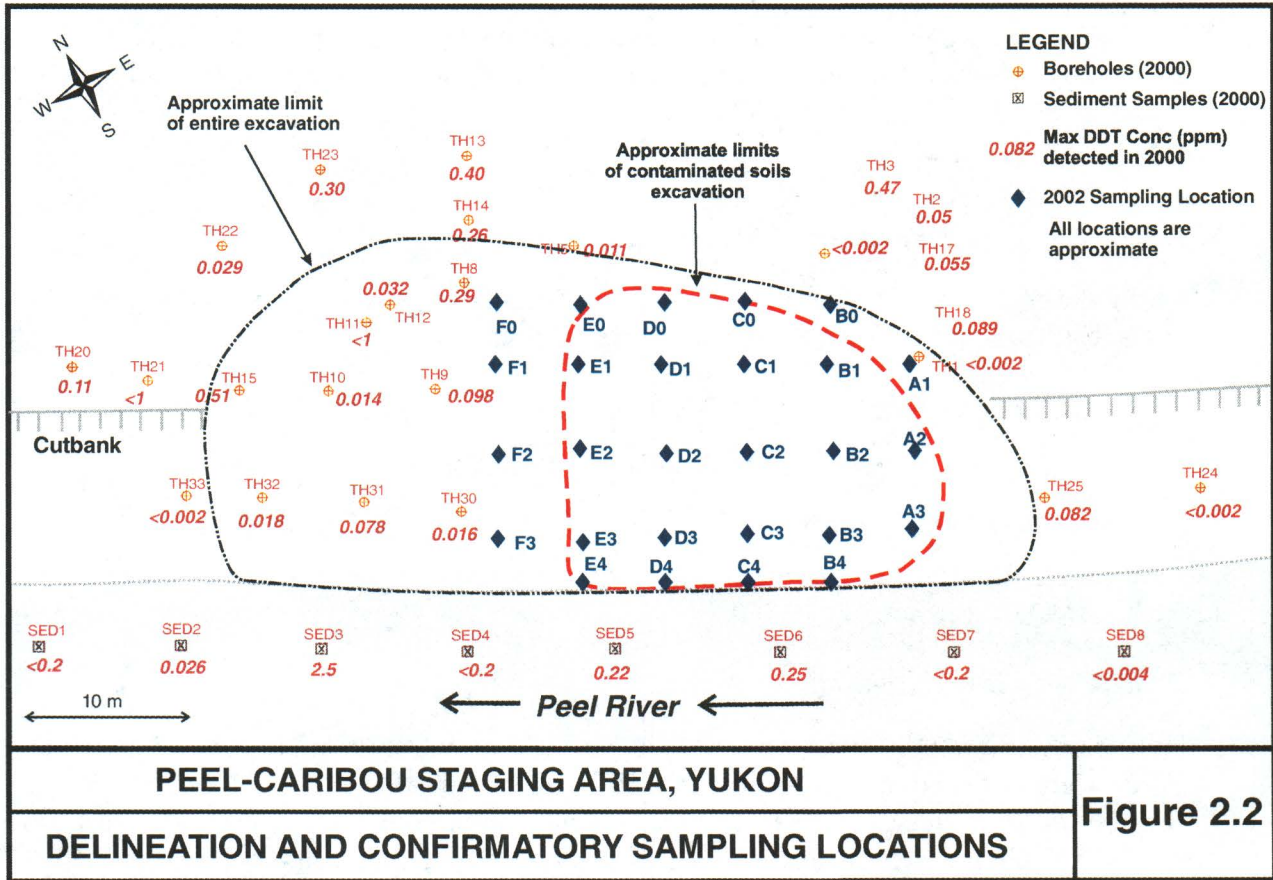


Figure 2.2

### **2.11.2 Sampling Protocols**

Soil samples were obtained using stainless steel scoops. The scoops were cleaned by washing with laboratory detergent (Sparkleen™), rinsing with distilled water and wiping dry with laboratory grade paper towels (Kimwipes™). Samples designated for field analyses were placed into 250 mL glass jars with aluminum foil lined-lid while those earmarked for laboratory analyses (metals, hydrocarbons, pesticides and VOC) were placed into 125 mL glass jars with Teflon lined lids. Disposable gloves were worn during sampling to reduce the chance of cross-contamination.

Surface water grab samples for DDT analyses were collected directly into 1 L amber glass jars. The container was held at the base and the neck plunged below the surface and tilted such that the neck pointed to the water flow during filling.

### **2.11.3 Sample Handling**

All the labeled sample containers were placed into coolers and shipped to the Analytical Laboratory via courier. Chain of custody forms accompanied the shipment.

### **2.11.4 Analytical Program**

#### **2.11.4.1 *Potential Contaminants of Concern***

On the basis of the remediation plan the contaminants of concern from the Detailed Site Investigation the following contaminants were targeted:

- DDT and its metabolites DDD and DDE.
- Hydrocarbons - Extractable petroleum hydrocarbons.
- Metals and metalloids.
- Volatile Organic Compounds (VOC) - including benzene, toluene, xylenes and dichloromethane.

#### **2.11.4.2 *Field Analysis***

Field analysis for DDT was performed by using EnviroGard™ immunoassay test kits. These were obtained from Osprey Scientific, Edmonton Alberta. The kits utilize the enzyme-linked immunoabsorbent assay technique, which is based on antibodies that are designed to bind to specific analytes. These antibodies are bonded onto polystyrene coated test tubes and operate on the principles of competitive immunoassay where the absorbance signal is inversely proportional to the concentration of the analyte (i.e., the greater the concentration of analyte, the lighter the colour). When solutions containing an analyte of interest (e.g., DDT) are incubated in the tube along with an enzyme conjugate, the analyte bind to the antibodies while the conjugate binds to the unoccupied antibody binding sites. After incubation the unbound conjugate is decanted and the tube washed thoroughly. A

solution containing a chromogene peroxidase substrate is then added to the tubes. This interacts with the bound enzyme conjugate to form a coloured product. Quantitation is achieved by comparing the colourimetric signal generated by an unknown sample with a set of standards using a portable spectrophotometer. Soil screening for DDT by immunoassay has been evaluated and incorporated into the US EPA SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Method 4042 (EPA, 1996).

The validation of the immunoassay test kits as a possible analytical method for confirmatory testing was carried out during the Site Investigations (Royal Roads, 2000). The results are summarized in Chapter 3 of this report.

The immunoassay was carried out on site according to the manufacturer's instructions. A 10 g portion of soil was weighed and extracted with 10 mL methanol. The soil-methanol mixture was filtered and an aliquot of the extract used for subsequent analysis. At least 20% of the samples were subjected to laboratory analysis as per US EPA protocols for field test kits.

A PE Photovac Photoionization Detector (Model PE 2020) was made available for screening for volatile organic compounds by the jar headspace method. The Jar Headspace Procedure is a quick and simple field screening procedure used to determine the presence of volatile organic compounds in soil. The procedure involved collecting a soil or water sample, placing it in an airtight container and then analyzing the headspace vapor using a portable analytical instrument such as a photoionization detector (PID). The "headspace" is the area between the sample and the top of the container. This procedure has been incorporated into US EPA and Environment Canada protocols. (Driscoll, 1993; Environment Canada, 1997). Since areas contaminated with VOCs were collocated with DDT, no headspace analysis was conducted instead DDT concentrations were used on site to confirm closure. Samples were subsequently submitted to the laboratory to confirm cleanup of VOCs.

#### **2.11.4.3      *Laboratory Analysis***

At least 20% of the soil samples collected during the remediation program programs were submitted to ALS Environmental Services, Vancouver, for DDT, metal, hydrocarbon and VOC analyses. Water samples were submitted for DDT analysis only. ALS is an accredited member of the Canadian Association for Environmental Laboratories. Laboratory methods are included in reports attached to Appendix C. ALS provided pre-cleaned sampling containers.

#### **2.11.4.4      *Summary of Analytical Program***

A summary of the sampling and analytical program is given in Table 2.1.

**Table 2.1: Summary of Sampling and Analytical Program**

Parameter	Total No of Samples	Field Analysis	Lab Analysis
<i>Soil Samples</i>			
DDT, DDE and DDD	52	42	10
VOC <sup>1</sup> , BTEX, VPH	5	-	5
Hydrocarbons (EPH) <sup>2</sup>	5	-	5
Metals	5	-	5
<i>Water Samples</i>			
DDT, DDE and DDD	1	-	1

Notes:

1. VOC = Volatile Organic Compounds including halogenated compounds Benzene, Toluene, Ethylbenzene and Xylene. VPH = Volatile Petroleum Hydrocarbons.
2. EPH = Extractable Petroleum Hydrocarbons.

### 2.11.5 Quality Assurance and Quality Control

A field QA/QC program, which incorporated measures to ensure the integrity of the soil and water samples, collected was utilized. All field instruments were calibrated daily using the manufacturer's specification. As a minimum, the QA/QC program included –

- Documentation of sampling;
- Collection and analysis of field duplicates;
- Copies of the chain-of-custody forms.

### **3. RESULTS AND DISCUSSIONS**

#### **3.1 Data Presentation**

To facilitate the presentation and ease of readability, all soil/sediment results are presented in ppm (parts per million, equivalent to mg/kg or  $\mu\text{g/g}$ ). Data for water are given in ppb (parts per billion, equivalent to ng/mL or  $\mu\text{g/L}$ ).

#### **3.2 Remediation Criteria**

The environmental criteria used to assess if remedial objective has been achieved was based on the:

- CCME (Canadian Council of Ministers of the Environment) Canadian Environmental Quality Guidelines (EQG) (CCME, 1999)

The EQG provide a broad range of environmental assessment and management functions, which are relevant to this investigation including the following:

- a national benchmark to determine impairment of socially-relevant resource uses;
- scientific benchmarks or targets in the assessment and remediation of contaminated sites; and
- the scientific basis for the development of site specific objectives

Thus, a comparison of contaminant concentrations in samples collected from the site with the EQG provides a simple assessment of the remediation. The EQG provide a screening-level evaluation of the likelihood of risk to humans, fish, other animals, plants, and other living receptors that use the site or are part of the larger ecosystem. Contaminant concentrations that exceed the benchmarks do not necessarily result in harmful impacts; rather, environmental concentrations below the benchmarks are very unlikely to cause harm. Contaminant concentrations in excess of the relevant criterion or standard may or may not lead to elevated risk depending on a large suite of site-specific conditions, including the organisms present.

The CCME EQG for soil samples are divided into four land use categories:

- Agricultural;
- Residential;
- Commercial; and,
- Industrial.

Peel River is currently used for camping and other recreational purposes and is apart of the land preserve. The residential/parkland criteria were therefore deemed to be the most

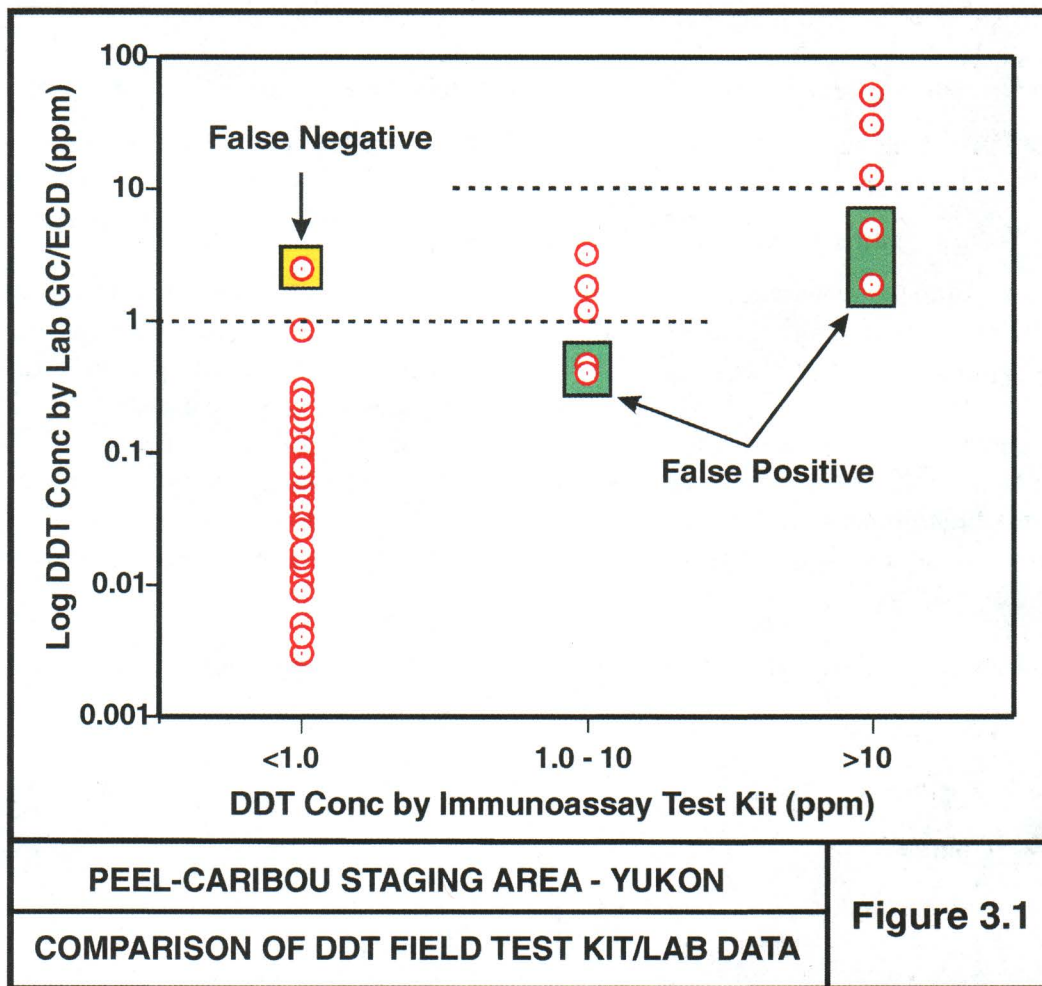
appropriate for soil samples. The agricultural criteria were deemed inappropriate since they were developed for land use involving intensive and repeated sowing and harvesting of plants and intense livestock husbandry, and are based on scientific information such as the bioaccumulation of contaminants by livestock feeding exclusively on plants grown in contaminated soils. The relevant guidelines are included in data tables in the next sections.

### 3.3 Validation of Field test Kits

The validation of the immunoassay, PID and PetroFLAG test kits as possible tools for confirmatory testing was carried out during the Site Investigations (Royal Roads, 2000).

#### 3.3.1 DDT Immunoassay Test Kit

A total of 50 soil samples were analyzed for DDT using field test kits and laboratory gas chromatography with electron capture detection (GC/ECD). The field test kits accurately estimated the ‘true’ concentration as determined by GC/ECD for a majority of the samples. However, there was one false negative and 4 false positives (Figure 3.1).



The false negative result (i.e., the field test kit indicated the concentration was less than what was found in the laboratory) was for a sediment sample. High moisture content in this sample may have accounted for the discrepancy. Sediment samples were not target for remediation. While four soil samples indicated false positives (i.e., over-estimate the total DDT concentration based on laboratory analysis), in no case did a soil sample determined to contain less than 1 ppm DDT using the field test kits have a real total DDT concentration greater than 1 ppm. It was concluded that the DDT field test kit data would provide a good indication of soil samples at the sites with DDT concentrations above or below 1 ppm. To determine the exact concentration a subset of the samples would be analyzed in the laboratory using gas chromatography with electron capture detection.

### **3.3.2 Headspace Analysis for Volatile Organic Compounds (VOC)**

A portable Photoionization detector was used to screen a number of samples by headspace analysis for volatile organic compounds. As noted in Section 1.5.6 VOC generally were found to occur at concentrations lower than the relevant CCME soil quality guidelines in the soil samples analyzed. The noted exception was the presence of dichloromethane at a concentration of 26 ppm and chloroform at concentration of 3 ppm in one sample. This same sample also had elevated levels of volatile hydrocarbons. A corresponding elevated concentration (744 ppm) was obtained with the PID. The remaining samples had mostly low PID readings that corresponded with the laboratory data for VOC and volatile hydrocarbons. It was concluded that the PID would give an indication of VOC contamination during site cleanup.

### **3.3.3 Hydrocarbon analysis with PetroFLAG Analyzer**

A PetroFLAG™ hydrocarbon analysis system was used to screen a number of soil samples in the field. The test kit responds to all types of hydrocarbons regardless of the source or state of degradation. The response factor however, is dependent on the type of hydrocarbon. A table containing the response factor for a number of hydrocarbon contaminants is supplied with the kit (e.g., diesel fuel has a response factor of 5 while weathered gasoline has a response factor of 2). Since information on hydrocarbon contamination at the site was unknown at the time of the site investigation, a response factor of 5 was arbitrarily chosen for all analysis.

Though elevated levels of EPH (> 1000 ppm) were found in some of the samples using PetroFLAG test kits, the corresponding laboratory results were less than the 1000 ppm. This discrepancy may be attributed to the response factor of 5 used in the field analysis. Hydrocarbon distribution reports attached to the laboratory reports indicated different types of hydrocarbon products were present at the site. For example, TH16-2 contained mostly diesel, TH17-1 was comprised of heavy oils while TH18-3 had a mixture of diesel and heavy oils. It was concluded that the PetroFLAG analyzer would not be a useful tool for the remediation program. Hydrocarbon contamination was however, associated with DDT as such removing the DDT contaminated soil would result in the remediation of the hydrocarbon substrate. In order to provide assurances that hydrocarbon contaminated soils had been remedied, five confirmatory soil samples were analyzed in the laboratory.

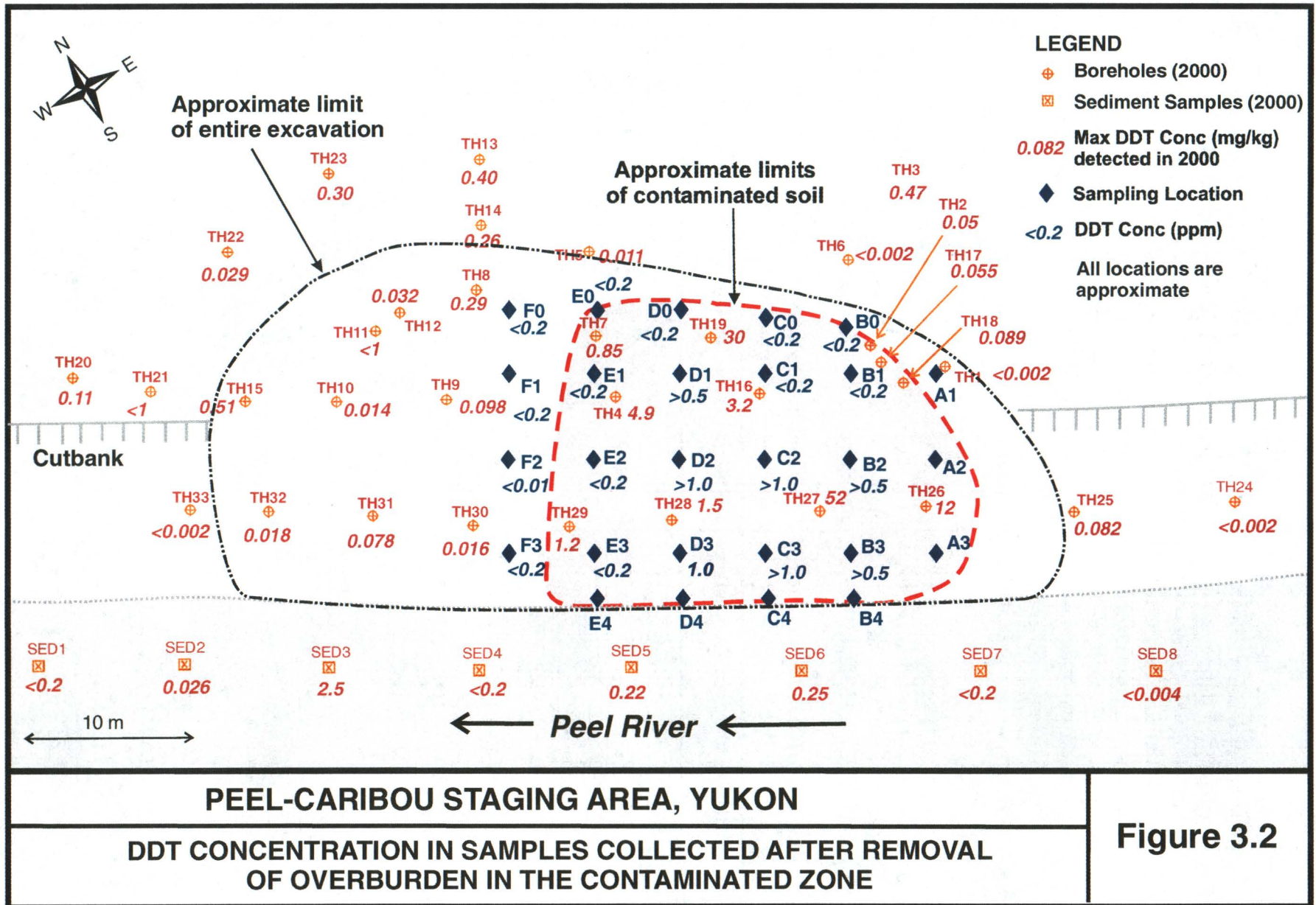
### 3.4 Results for DDT

#### 3.4.1 Delineation

Soil sampling and analyses employed during remediation was consistent with methodologies presented in Section 2.11 of this report. In all cases, soil samples were collected systematically on 5-m grid spacing for the base and sidewalls of the excavation so that each sample point was approximately equidistant to all nearest neighbour points. After removal of the overburden and exposing the contaminated soils and debris, 20 soil samples were collected and analyzed on site. The concentrations of DDT in these samples are given in Table 3.1 and illustrated in Figure 3.2.

**Table 3.1: DDT Concentration in Soil Samples Collected from the Waste Pit on February 20, 2002**

Sample ID	Optical Density at 450 nm	DDT Concentration by Field Test Kit (ppm)	DDT Concentration by Lab GC/ECD (ppm)
0 ppm (mg/kg)	1.14	Control	-
0.2 ppm	0.77	Calibration Standard	-
0.5 ppm	0.75	Calibration Standard	-
1.0 ppm	0.61	Calibration Standard	-
B0-1	1.01	<0.2	-
B1-1	0.98	<0.2	<0.01
B2-1	0.65	0.5 – 1.0	-
B3-1	0.69	0.5 – 1.0	-
C0-1	1.11	<0.2	<0.01
C1-1	0.85	<0.2	-
C2-1	0.24	>1.0	-
C3-1	0.13	>1.0	-
D0-1	0.93	<0.2	-
D1-1	0.67	0.5 – 1.0	-
D2-1	0.55	>1.0	-
D3-1	0.62	1.0	-
E0-1	0.96	<0.2	-
E1-1	0.82	<0.2	0.57
E2-1	0.88	<0.2	-
E3-1	0.84	<0.2	-
F0-1	1.03	<0.2	-
F1-1	0.93	<0.2	<0.01
F2-1	0.88	<0.2	-
F3-1	0.85	<0.2	-



The field test kit data indicated soils with concentrations exceeding 0.5 ppm were present in a number of locations including C1-C3, D1-D3, B2 and B3. This coincided with the hotspot identified during the detailed site investigation such as TH4, TH7, TH9, TH16, TH19, and TH26 – TH29. Concentrations in the other locations were below detection, which was confirmed by the laboratory data for three samples (B1, C0- and F1) that were analyzed. The contaminated area was flagged and soils and debris were excavated. Debris excavated from the area included crushed barrels, drill casings, wood, brown fibrous materials, metal and other miscellaneous refuse (see Section 2.7).

### 3.4.2 Confirmatory Sampling and Analysis

Following the excavation of all debris and contaminated soils to the native sand and gravel substrate, confirmatory samples were collected and analyzed using the 5-m grid. The analysis was conducted in two batches and the results are given in Table 3.2 and Table 3.3. The data indicated that DDT at concentrations exceeding 0.7 ppm was still present in the vicinities of C1 to C4 and D1 to D4. Laboratory data confirmed this observation.

**Table 3.2: DDT Concentration in Soil Samples Collected from the Waste Pit after Initial Excavation of Contaminated Soils and Debris (Batch 1)**

Sample ID	Optical Density at 450 nm	DDT Concentration by Field Test Kit (ppm)	DDT Concentration by Lab GC/ECD (ppm)
0 ppm (mg/kg)	1.00	Control	-
0.2 ppm	0.76	Calibration Standard	-
0.7 ppm	0.73	Calibration Standard	-
1.0 ppm	0.68	Calibration Standard	-
A1-2	1.04	<0.2	-
A3-2	0.83	<0.2	-
B0-2	0.80	<0.2	-
B1-2	0.84	<0.2	-
B2-2	0.77	<0.2	-
B3-2	0.74	<0.7	<0.01
B4-2	0.74	<0.7	-
C1-2	0.46	>1.0	-
C2-2	0.54	>1.0	-
C2-2 Duplicate	0.56	>1.0	-
C3-2	0.43	>1.0	-
C4-2	0.68	>1.0	5.47
D0-2	0.95	<0.2	4.75
D1-2	0.43	>1.0	-
D2-2	0.70	>0.7	3.28

**Table 3.2: DDT Concentration in Soil Samples Collected from the Waste Pit after Initial Excavation of Contaminated Soils and Debris (Batch 2)**

Sample ID	Optical Density at 450 nm	DDT Concentration by Field Test Kit (ppm)	DDT Concentration by Lab GC/ECD (ppm)
0 ppm (mg/kg)	1.12	Control	-
0.7 ppm	0.75	Calibration Standard	-
1.0 ppm	0.69	Calibration Standard	-
C3-2 duplicate	0.43	>1.0	-
D3-2	0.56	>1.0	-
D4-2	0.52	>1.0	-
E1-2	0.82	<0.7	-
E2-2	0.77	<0.7	-
E3-2	1.05	<0.7	<0.01
E3-2 Duplicate	0.93	<0.7	<0.01
E4-2	0.77	<0.7	-

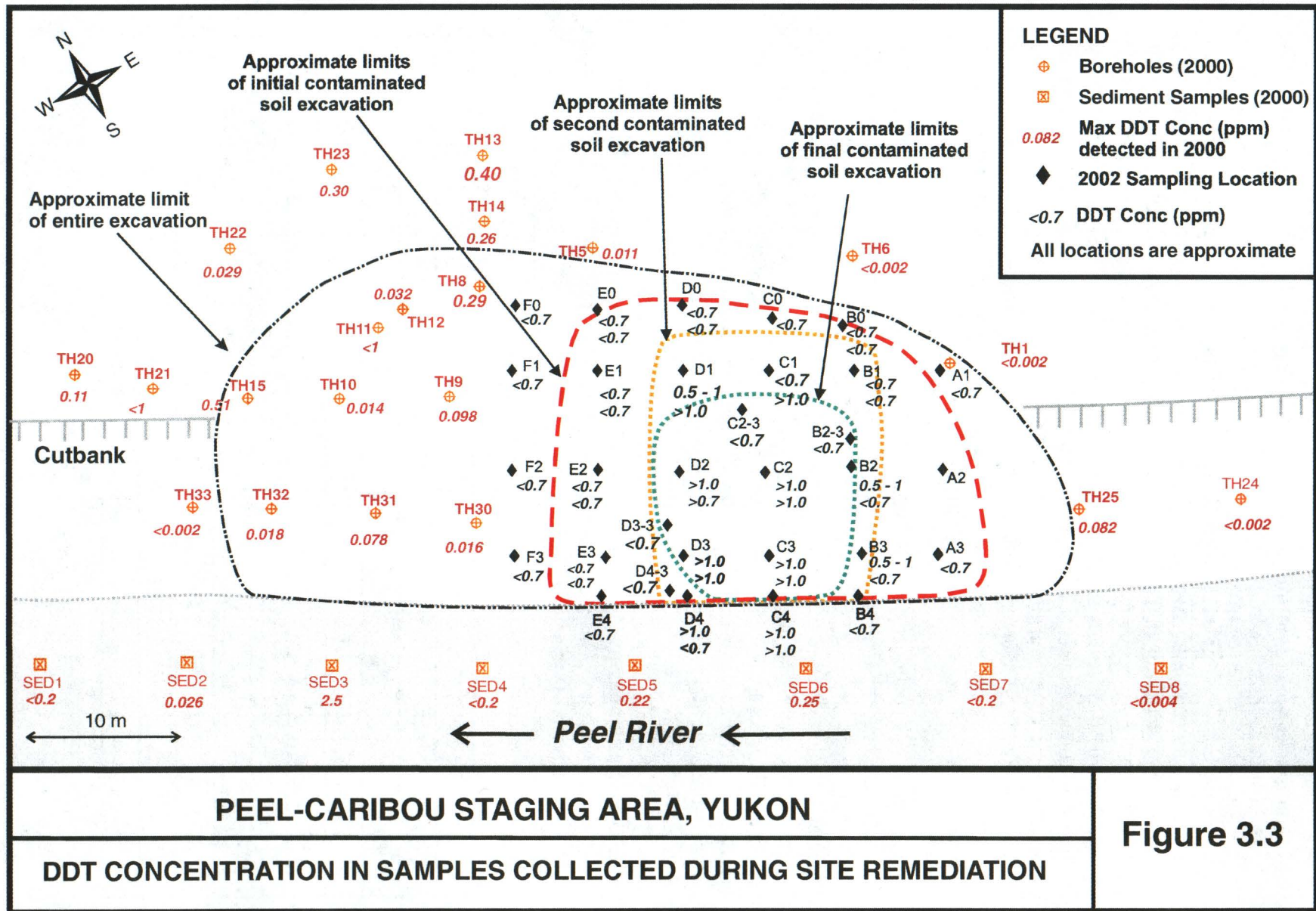
Further excavation was conducted in the vicinity of D0 to D4 and C0-C4. A groundwater seep was encountered on the northeastern side of the pit since the bottom of the excavation was below the river level at this point. This subsequently resulted in a small pool of water (see Photograph 2.17). The substrate comprised mostly of coarse sand and gravels (greater than 1 mm in size). This made the collection of representative samples for DDT analysis unachievable from a number of the grid points. Five samples were eventually collected from the excavation. In addition two samples (S1 and S2) were obtained from a stockpile created by the removal of substrate from the bottom of the flooded area. Field analyses indicated materials in the stockpile and areas near C4 contained DDT in excess of 0.7 ppm. As such, the stockpile along with all materials in the vicinity C4 was removed and shipped off site. No further confirmatory sampling was conducted since the remaining substrate was comprised mostly of coarse gravel. Figure 3.3 indicates sampling locations and concentrations of DDT in all confirmatory samples. For ease of readability a detection limit of <0.7 was used to generate this figure; i.e., all field test kits results with values of <0.2, 0.2 – 0.5, and 0.5 - 0.7 ppm are expressed as <0.7 ppm.

**Table 3.2: DDT Concentration in Soil Samples Collected from the Waste Pit after Further Excavation of Contaminated Soils on February 23, 2002**

Sample ID	Optical Density at 450 nm	DDT Concentration by Field Test Kit (ppm)
0 ppm	0.94	Control
0.2 ppm	0.93	Calibration Standard
0.7 ppm	0.63	Calibration Standard
1.0	0.62	Calibration Standard
B2-3	0.65	<0.7
C2-3	0.64	<0.7
C4-3	0.52	>1.0
D3-3	0.64	<0.7
D4-3	0.64	<0.7
S1	0.49	>0.1
S2	0.41	>0.1

One water sample was obtained from the pool of water and was found to contain 0.09 ppb of DDT. The low DDT concentration detected in this water sample is associated with particulate matter present in the sample. As presented in the preceding paragraph, two samples obtained from the sediments in this pool (S1 and S2) contained detectable levels of DDT. The guideline for DDT in water, originally published by the CCME is no longer recommended and has been withdrawn. This is because DDT is not very water-soluble and environmental exposure is predominantly via sediment, soil and/or tissue. With the removal of the major source of DDT contamination in the waste pit, the major exposure pathway has been curtailed.

A survey of the layout of the pit was conducted after the removal of all the contaminated soils. The data obtained is summarized in Drawing 4. Using the data for the survey carried out after removal of the overburden (Drawing 2), the in-situ volume of excavated contaminated materials was estimated to 350 m<sup>3</sup>.



### 3.4.3 Comparison of Immunoassay Field Test Kit to Laboratory Gas Chromatography Results

As part of the confirmatory sampling activities, 10 of the samples analyzed on site using the field test kits were later re-analyzed at ALS laboratory by gas chromatography with electron capture detection (GC-ECD). A comparison of the data when interpreting the results at the 0.7 ppm cutoff is given in Table 3.3. The immunoassay yielded 1/10 false negatives and 0/10 false positives. The single sample (B0-1) that generated the false negative was collected near the edge of the pool created from the groundwater seep and comprised coarse sand and gravel. The low concentration detected by the field test kit could be attributed to the high moisture content or sample heterogeneity. A similar result was obtained during the validation exercise in that there was one false negative that was attributed to a coarse sand and gravel sediment sample (Sed-2).

A total of 60 soil/sediment samples collected from the Peel-Caribou Waste Site were analyzed using both the field test kit and laboratory GC between April 2000 and February 2002.. There were 2/60 false negatives (3.3%) and 4/60 false positives (6.7%). These are comparable to that given in the US EPA SW846-4000 Method for Immunoassay of 3.1% false negatives and 6.3% false positives. The results obtained in this investigation are therefore, within acceptable limits indicating that the EnviroGard™ DDT in Soil Test Kit served as a useful tool for the field analysis. With the removal of the source of DDT contamination, the risk associated with any residue remaining as a result of the false negative is minimal.

**Table 3.3: Immunoassay Field Test Kit Interpretation at 1 ppm Compared to Laboratory Gas Chromatography Results for DDT in Soil Samples Collected During Site Remediation**

Sample Number	Laboratory GC	Immunoassay Test Interpretation at 0.7 ppm	Results Agree?
B0-1	<0.01	Negative	Yes
C0-1	<0.1	Negative	Yes
E0-1	0.57	Negative	Yes
F0-1	<0.1	Negative	Yes
B3-2	<0.01	Negative	Yes
C4-2	5.5	Positive	Yes
D0-2	4.7	Negative	False Negative
D2-2	3.28	Positive	Yes
E3-2	<0.01	Negative	Yes
E3-2 Duplicate	<0.01	Negative	Yes

### 3.5 Volatile Organic Compounds (VOC)

The concentrations of VOCs including dichloromethane in five soil samples collected after removal of the contaminated soils were either below detection or well below the CCME parkland use standard (Table 3.4). This indicated the successful removal of dichloromethane-contaminated soils found during the detailed site investigation. Bags of drilling fluids were noted in the vicinity of the dichloromethane contamination during the excavation and these may have accounted for the contamination.

**Table 3.4: Concentrations (ppm) of Halogenated Volatile Organic Compounds (VOC) in Soils Samples Collected During Site Remediation**

Sample ID	E3-2	C1-2	C2-2	D1-1	E2-1	CCME R/P
Bromodichloromethane	<0.01	<0.01	<0.01	<0.01	<0.01	-
Bromoform	<0.01	<0.01	<0.01	<0.01	<0.01	-
Carbon Tetrachloride	<0.01	<0.01	<0.01	<0.01	<0.01	5
Chlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	2
Chloroethane	<0.01	<0.01	<0.01	<0.01	<0.01	5
Chloroform	<0.01	<0.01	<0.01	<0.01	<0.01	5
Chloromethane	<0.01	<0.01	<0.01	<0.01	<0.01	5
Dibromochloromethane	<0.01	<0.01	<0.01	<0.01	<0.01	1
1,2-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	1
1,3-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	1
1,4-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	1
1,1-Dichloroethane	<0.01	<0.01	<0.01	<0.01	<0.01	5
1,2-Dichloroethane	<0.01	<0.01	<0.01	<0.01	<0.01	5
cis-1,2-Dichloroethylene	<0.01	<0.01	<0.01	<0.01	<0.01	5
trans-1,2-Dichloroethylene	<0.01	<0.01	<0.01	<0.01	<0.01	5
1,1-Dichloroethylene	<0.01	<0.01	<0.01	<0.01	<0.01	5
Dichloromethane	<0.05	<0.05	<0.05	0.05	<0.05	5
1,2-Dichloropropane	<0.01	<0.01	<0.01	<0.01	<0.01	5
cis-1,3-Dichloropropylene	<0.01	<0.01	<0.01	<0.01	<0.01	5
trans-1,3-Dichloropropylene	<0.01	<0.01	<0.01	<0.01	<0.01	5
1,1,1,2-Tetrachloroethane	<0.01	<0.01	<0.01	<0.01	<0.01	5
1,1,2,2-Tetrachloroethane	<0.01	<0.01	<0.01	<0.01	<0.01	5
Tetrachloroethylene	<0.01	<0.01	<0.01	<0.01	<0.01	0.2
1,1,1-Trichloroethane	<0.01	<0.01	<0.01	<0.01	<0.01	5
1,1,2-Trichloroethane	<0.01	<0.01	<0.01	<0.01	<0.01	5
Trichloroethylene	<0.01	<0.01	<0.01	<0.01	<0.01	3
Trichlorofluoromethane	<0.01	<0.01	<0.01	<0.01	<0.01	-
Vinyl Chloride	<0.01	<0.01	<0.01	<0.01	<0.01	5

### 3.6 Hydrocarbons

Hydrocarbons such as BTEX (Benzene, ethylbenzene, toluene and xylene) and light extractable petroleum hydrocarbons (LEPH) were detected in the vicinity of the DDT contaminated area during the detailed site investigation. This hydrocarbon contamination was attributed to either the use of hydrocarbons as a carrier solvent for technical DDT mixture or the disposal of petroleum products in the dump. Seven samples obtained from the DDT contaminated zone during the site excavation were analyzed for BTEX and extractable petroleum hydrocarbons (EPH). The concentrations of these parameters in the samples were either below detection or well below the remediation target (Table 3.5) indicating successful removal of hydrocarbon contamination.

**Table 3.5: Concentrations of Hydrocarbons (ppm) in Soil Samples Collected from the Waste Pit During Site Remediation**

Sample ID	B1-2	C1-1	C1-2	C2-2	D1-1	E3-2	E2-1	CCME R/P
<i>Non-Halogenated Volatiles</i>								
Benzene	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	0.5
Ethylbenzene	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	1.2
Styrene	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	5
Toluene	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	0.8
Meta- & para-Xylene	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	1
Ortho-Xylene	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	1
<i>Extractable Hydrocarbons</i>								
EPH10-19	<200	382	<200	<200	-	-	-	1000*
EPH19-32	<200	338	<200	<200	-	-	-	1000*

Notes:

\* Values adapted from the Yukon Contaminated Sites Regulation (1996).

### 3.7 Metals

Five soil samples were analyzed for metals. As with the data for the detailed sites investigation, arsenic and barium were found to occur at concentrations exceeding the CCME residential/parkland soil quality guidelines/criteria (Tables 3.6). These two metals/metalloids are often observed at naturally elevated concentrations based on site geology. The concentrations of arsenic in glacial till samples from a number of Canadian sites range from 1 to 6590 ppm while uncontaminated soils were found to contain up to 888 ppm of barium (CCME, 1999). The exceedance of the CCME soil quality guidelines for these two elements for much of the soils mass is likely associated with naturally elevated concentrations at the site. However, the elevated barium concentration, in particular, may be due to the use of barite in the drilling mud disposed in the waste pit. It should be noted that leachable metals concentrations in extracts obtained using BC Special

Waste Extraction Procedure/Leachate Extraction Protocols for contaminated soils were below the Leachate Quality Standards as presented in the detailed site investigation report.

**Table 3.6: Concentrations of Metals (ppm) in Soil Samples Collected from the Waste Pit During Site Remediation**

Sample ID	A3-2	BO-1	C3-2	D1-2	F1-1	CCME R/P
pH	9.55	8.12	8.36	9.3	7.94	
<i>Total Metals</i>						
Antimony T-Sb	<10	<10	<10	<10	<10	20
Arsenic T-As	19	21	18	18	14	12
Barium T-Ba	550	463	541	861	473	500
Beryllium T-Be	<0.5	<0.5	0.5	0.6	<0.5	4
Cadmium T-Cd	0.6	0.8	0.6	0.6	0.7	10
Chromium T-Cr	13	14	16	16	16	64
Cobalt T-Co	9	10	11	10	9	50
Copper T-Cu	26	26	30	35	29	63
Lead T-Pb	<50	<50	<50	<50	<50	140
Mercury T-Hg	<0.05	0.06	0.07	0.06	0.08	6.6
Molybdenum T-Mo	<4	<4	<4	<4	<4	-
Nickel T-Ni	26	31	34	31	30	50
Selenium T-Se	<4	<4	<3	<3	<2	3
Silver T-Ag	<2	<2	<2	<2	<2	20
Tin T-Sn	<5	<5	<5	<5	<5	-
Vanadium T-V	42	46	47	47	44	130
Zinc T-Zn	97	111	113	114	115	200

**Notes:**

Shaded areas indicate parameters that equal or exceed the CCME residential/park guidelines

### 3.8 Contaminated Soils and Waste Distribution

#### 3.8.1 Excavation

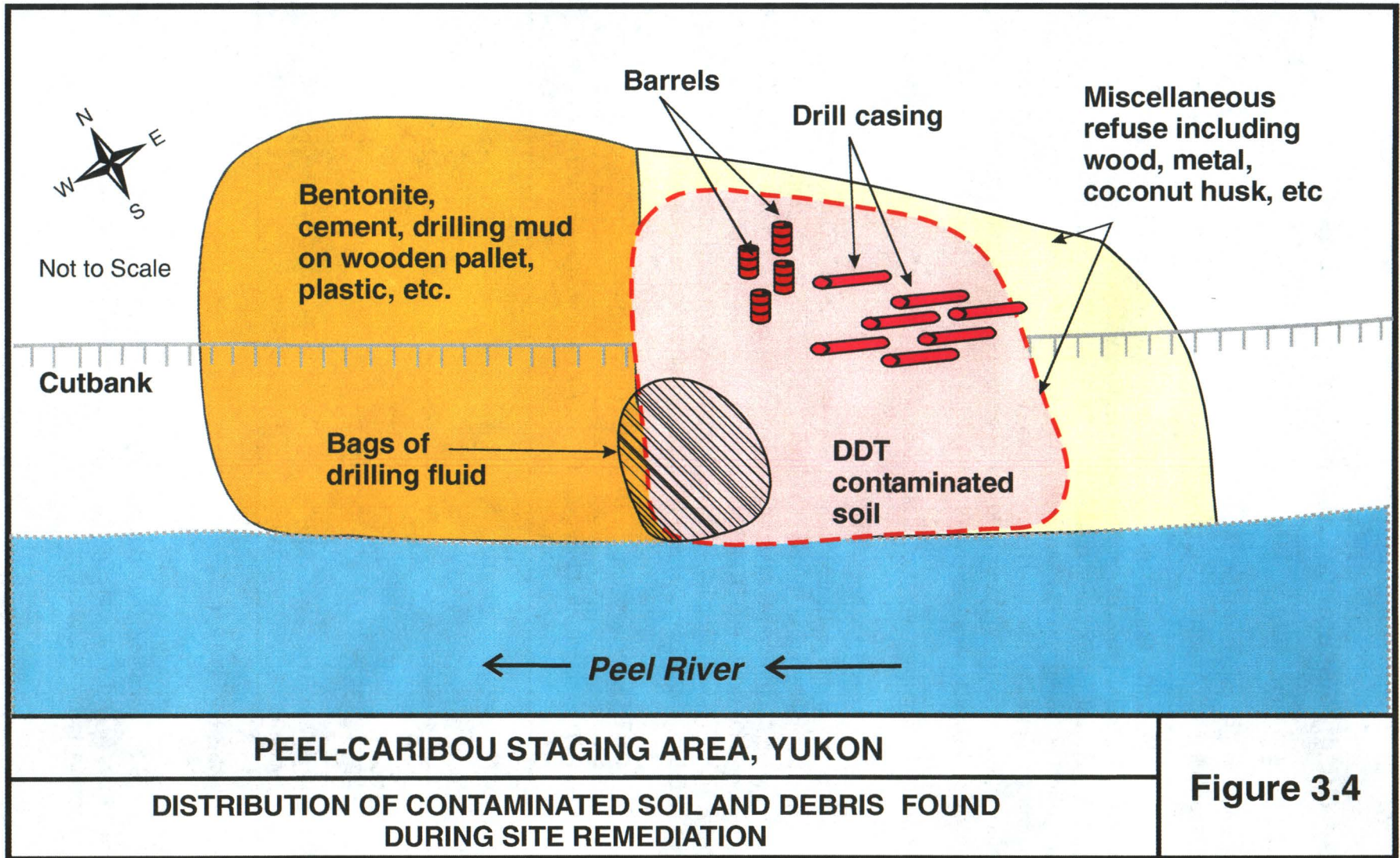
The excavation of contaminated soils from the waste pit was completed at the end of February 2002. Debris uncovered during the removal contaminated soils included crushed empty barrels, metal drill casings, wood, concrete, brown fibrous materials, bags of drilling fluid and other miscellaneous metal debris including part of cat track and a motor vehicle. All the materials excluding metallic debris in excess of 0.5 m in diameter were shipped off site for disposal.

Soils and debris remaining in the waste pit were then excavated. Excavated materials included bags of bentonite, cement, wood, plastic bags, cables, and other miscellaneous

metallic debris. The excavated soils and debris from the un-contaminated areas were loaded directly into dump trucks and transported to a landfill which was created on Federal land, approximately 20 km from the waste pit. The materials were placed into the landfill and covered with overburden removed during the construction of the landfill.

The distribution of contaminated soils and debris is shown in Figure 3.4. A summary of the observations is given below:

- 350 cubic metres in of contaminated soils and debris were excavated and placed into 588 Seacan boxes that were shipped off site.
- 1550 cubic metres of un-contaminated debris was excavated, transported to the landfill and buried.
- Crushed barrels were found in the contaminated zone and these were probably the source(s) of DDT and hydrocarbon contamination.
- Bags of frozen drilling fluids were encountered in the vicinity of the dichloromethane contamination and that may have accounted for the contamination.
- Metal drill casings were excavated in areas identified as containing metallic debris through the geophysical survey and drilling during the previous site investigations.
- Areas with low DDT concentrations (<0.7 ppm) contained primarily bags of bentonite and cement on wooden pallets.



### 3.9 Quality Assurance Quality Control Results

#### 3.9.1 Field QA/QC

The field QA/QC program incorporated measures, which ensured the integrity of the soil, and water samples. Aspects of the program are described in the following sections.

In order to guarantee that all the samples collected maintained their integrity prior to analysis, the general protocols presented in Guidance Manual on Sampling, Analysis, and Data Management for Contaminated Sites (CCME, 1993) were used. Briefly, each sample was collected using pre-cleaned equipment and placed in appropriate pre-cleaned containers supplied by the analytical laboratories. The containers were labeled, placed in coolers and transported via courier to the laboratory for analysis. Sample information was recorded on the chain-of-custody forms, copies of which accompanied the shipment.

All field instruments were calibrated prior to use following the manufacturer's instructions.

In addition to samples collected to meet the objective of the overall program, three field duplicate samples were taken to meet the QA/QC objective of monitoring precision/reproducibility of sampling activities. These three pairs of duplicates were analyzed on site using the DDT test kits; one pair was submitted to the laboratory for analysis as individual samples. The results obtained for the field duplicate samples are given in Table 3.7. A comparison of the data indicated good reproducibility.

**Table 3.7: DDT Concentrations in Duplicate soil Samples**

Sample ID	Optical Density at 450 nm	DDT Concentration by Field Test Kit (ppm)	DDT Concentration by Lab GC/ECD (ppm)
C2-2	0.54	>1.0	-
C2-2 duplicate	0.56	>1.0	-
C3-2	0.43	>1.0	-
C3-2 duplicate	0.43	>1.0	-
E3-2	1.05	<0.7	<0.01
E3-2 Duplicate	0.93	<0.7	<0.01

#### 3.9.2 Laboratory QA/QC

Water and soil/sediment samples were analyzed at ALS Environmental, Vancouver, BC. ALS has been evaluated and accredited by the Canadian Association for Environmental Laboratories (CAEL). Laboratory QA results are included in the chemical analysis report attached to Appendix C.

## **4. CONCLUSIONS AND RECOMMENDATIONS**

### **4.1 Remedial Closure**

Excavation and off site disposal of soils and debris at the Peel-Caribou Waste Site commenced in January 2002 and was effectively completed in March 2002. The program was initiated with the construction of an overland winter road to the site along existing seismic cut lines. After site preparation, 1016 cubic metres of overburden were removed to expose debris and contaminated soils in the waste pit.

A total of 350 cubic metres of contaminated soils and debris was excavated from the waste pit, loaded into 588 Seacan boxes and transported off site to a temporary holding area near Fort McPherson. The boxes were consequently shipped to Beaver County Landfill, Alberta, for disposal. Debris excavated from the contaminated zone included barrels (which were probably the source of the DDT contamination), wood, concrete, brown fibrous materials, bags of drilling fluid and other miscellaneous metal debris including part of cat track and a motor vehicle. The brown fibrous material was identified as coconut husk, which was previously used for drilling.

An additional 1550 cubic metres of debris including bags of bentonite, cement, wooden pallets, plastic, metal and other miscellaneous materials were removed from the waste pit. These materials along with the surrounding soil were buried in a new landfill constructed on Federal land, approximately 20 km from the Peel-Caribou Staging Area.

After the completion of the excavation and transportation of all materials off site, the stockpile area was re-graded in a manner which was consistent with the topography of the site and which prevented erosion and surface runoff from carrying sediments into the river. Vegetation removed from the site during site preparation was then re-used to construct a brush layer over the entire site.

The waste pit excavation was left as is, without the replacement of overburden. It was anticipated that erosion forces of the Peel River would remove any overburden placed in the pit and deposit it into the river thereby increasing the sediments loading. A view of the site upon completion of the project is shown in Photograph 4.1.



**Photograph 4.1: Area view of the Peel-Caribou Staging Area looking north, after project completion in March 2002**

## 4.2 Follow-up Monitoring

The major source of DDT and other contaminants such as dichloromethane, and petroleum hydrocarbon products have been removed from the waste pit along with all visible debris including barrels, wood, bentonite, cement, metal and miscellaneous materials. Given the limited scope of previous site investigations, the CCME (1999) DDT soil quality guidelines were used as a benchmark for defining DDT-contaminated soils. In particular, a value of 0.7 ppm total DDT was used. This soil quality standard, however, was derived based on the back-calculation of ecologically protective soil concentrations using a model scenario involving trophic transfer (biomagnification of DDT) and ecosystem uptake over the entire foraging range of the species involved (i.e., soils → earthworms → American robin → kestrel). Where the potential for biomagnification is limited by a more limited spatial extent of contamination, wherein uptake in diet is limited by dilution from feeding in uncontaminated areas, a value of 0.7 ppm is a highly conservative estimate of soil concentrations of DDT beyond which biological effects might be expected.

Data for sediment samples indicated the presence of low concentrations of DDT (0.025 to 2.5 ppm) in the riverbed adjacent to the site. DDT in the sediment could feasibly be available to benthic invertebrates such as dragonfly nymphs or chironomid larvae. These bottom-dwelling organisms, in turn, might conceivably serve as a source of DDT to higher

trophic level organisms such as fish and piscivorous birds. The potential however, for food web mediated transfer of DDT from the sediments to invertebrates at toxicologically significant levels, is strongly limited by the relatively small area of sediment contamination (approximately 1000 m<sup>2</sup>) relative to the riverbed. As for the terrestrial food web, the area of riverbed affected by localized DDT contamination is very small relative to the effective foraging range of bottom-feeding fish species such as whitefish.

Studies completed to the present time have not directly or indirectly assessed the risks to aquatic life or their consumers based on the residual sediment DDT contamination at the Peel-Caribou Staging Area. The in-place sediments are expected to undergo erosion and further mixing with clean sediments and/or burial over time. In addition, limited degradation of the various DDT compounds in sediments is expected, albeit at a relatively slow rate (over the next decade or longer). There is no compelling evidence that the sediments constitute a hazard and the impact is therefore expected to be minimal. If remediation of the sediment is to be considered, it would be useful to better evaluate (i) the extent of re-distribution of DDT from the site across and down the Peel River, and (ii) levels of DDT in the aquatic food web, in comparison with areas farther up river.

With the removal of the major source of DDT contamination, the transient nature of river water and sediment near the site would be expected to limit the extent to which elevated concentrations of residual DDT would occur in the river. It is recommended that sediment samples should be monitored for DDT to ascertain the expected decrease in concentration over time.

A total of ten samples may be collected as follows:

- Two locations upstream of the site to document background conditions
- Six locations adjacent to the excavation; and
- Two locations downstream of the site to assess the potential of off site migration.

In addition, limited sampling of whitefish tissue might be considered, but the transient nature of the species, with a strong seasonal component, along with the known contributions to tissue concentrations from long-range transport from non-Arctic sources it would be necessary to design the sampling and analysis to allow for a differentiation of local from global sources. One way to do this would be to examine atypical high ratios of DDT to other atmospherically transferred organochlorines such as PCBs, chlordane, of toxaphenes.

The field program would be developed in collaboration with the Gwich'in Tribal Council and the Peel River Working Group. An appropriate quality control/quality assurance (QA/QC) program including field duplicates, blanks, proper sampling protocols and documentation would be incorporated into the program. This would ensure the validity and reliability of the data obtained.

Should the data indicate the expected decrease in DDT concentration over time, the monitoring program would be curtailed, in consultation with the Working Group and other stakeholders.

## 5. REFERENCES

- AGRA. *Draft Report: Analytical Results of Samples Taken from the Peel River*. AGRA Earth & Environmental Limited, Calgary, AB. September 1999.
- BC MELP, 1997. British Columbia Ministry of the Environment Lands and Parks, Technical Guidance on Contaminated Sites, Document 1 Site Characterization and Confirmation Testing, April 1997. [http://wlapwww.gov.bc.ca/epd/epdpa/contam\\_sites/guidance/technical/1.html](http://wlapwww.gov.bc.ca/epd/epdpa/contam_sites/guidance/technical/1.html) accessed April 30, 2002.
- BC, Reg. 63/88. Government of British Columbia, Waste Management Act, B.C. Reg. 63/88, includes amendments up to B.C. Reg. 52/95. [http://www.qp.gov.bc.ca/statreg/reg/W/WasteMgmt/WasteMgmt63\\_88Special/63\\_88.htm](http://www.qp.gov.bc.ca/statreg/reg/W/WasteMgmt/WasteMgmt63_88Special/63_88.htm): Accessed April 30, 2002
- CCME (Canadian Council of Ministers of the Environment). 1993. *Guidance Manual on Sampling, Analysis, and Data Management for Contaminated Sites*. Report CCME EPC-NCS62E, Winnipeg, Manitoba, December 1993.
- CCME. (Canadian Council of Ministers of the Environment). 1999. *Canadian Environmental Quality Guidelines*. Canadian Council of Ministers of the Environment, Winnipeg.
- Driscoll, J. N., 1993. Portable instrumentation for on site monitoring of toxic gases. *American Laboratory*, May 1993, 37 - 46.
- Environment Canada. 1997. Procedures for Contaminated Sites. Technical Assistance Bulletins (TAB) #1: Jar Headspace Analytical Screening Procedure. [http://www.cciw.ca/green-lane/epb/fpd/con\\_st.html](http://www.cciw.ca/green-lane/epb/fpd/con_st.html) Accessed January 18, 2000.
- Power M.A. 1995. *Ground Conductivity and Total Magnetic Field Surveys of the Peel River Waste Site*. 11 pp.
- Yukon Renewable Resources, 1996. Environment Act Contaminated Sites Regulations. 56 pp.
- US EPA. 1996. SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Method 4042: Soil screening for DDT by Immunoassay. <http://www.epa.gov/epaoswer/hazwaste/test/4042.pdf> Accessed April 30, 2002.

**DRAWINGS**

***Pending Receipt from the Prime Contractor***

**APPENDIX A:  
PERMITS AND AUTHORIZATIONS**

- Land Use Permit –DIAND Land Use Section
- Yukon Territory Water Board – Water License
- Amendment to Water Licence
- Gwich'in Tribal Council – Gwich'in Access Authorization: Quarry permit
- Gwich'in Tribal Council –Gwich'in Access Authorization: Road permit



LAND USE SECTION  
345-300 Main Street  
Whitehorse, Yukon  
Y1A 2B5

15 November, 2001

YA0X786

DIAND, Waste Management Program  
345-300 Main Street  
Whitehorse, Yukon  
Y1A 2B5

Attention: Brett Hartshorne

Dear Mr. Hartshorne:

**LAND USE PERMIT YA0X786  
ACCESS TO & REMEDIATION OF CONTAMINATED SITE AT CONFLUENCE OF CARIBOU AND  
PEEL RIVERS**

---

Attached is Land Use Permit YA0X786 with annexed terms and conditions.

You are required to contact Todd Pilgrim, the Inspector in Dawson City at 867-993-5468 prior to commencing your operation to discuss the operating conditions.

Thank you for providing us a copy of the Gwich'in Tribal Council Access Authorization G01A01.

Please contact me at 867- 667-3236 if you have any questions.

Yours truly,

Heli Aatelma  
A/Head, Land Use

- c. RMO, Klondike
- YTG Renewable Resources
- Yukon Territory Water Board
- Gwitchin Tribal Council
- Nacho Nyak Dun First Nation
- Shell Canada (letter only)
- Peel River Working Group (letter only)

*faxed 15/11/01 BT*



**LAND USE PERMIT**  
NORTHERN AFFAIRS PROGRAM

**PERMIS D'UTILISATION DES TERRES**  
PROGRAMME DES AFFAIRES DU NORD

Permit Class - Permis catégorique <b>A</b>	Permit No. - No de permis <b>YAOX786</b>
---	---

Subject to the Territorial Land Use Regulations and the terms and conditions of this Permit, authority is hereby granted to:

Sous réserve du Règlement sur l'utilisation des terres territoriales et des conditions de ce permis:

**DIAND - WASTE MANAGEMENT PROGRAM**

Permittee - Détenteur de permis

To proceed with the Land Use operation described in the application of:

Est autorisé à entreprendre les travaux d'exploitation des terres décrits dans la demande de permis de:

Signature <b>BRETT HARTSHORNE</b>	Date <b>29 NOVEMBER 2000</b>
Type of Land Use Operation - Genre de travaux d'exploitation des terres <b>ACCESS &amp; REMEDIATION OF CONTAMINATED SITE</b>	
Location - Emplacement <b>ACCESS - ENTERING YUKON AT 67°00' N 134°20' W ALONG EXISTING SEISMIC LINES, CONTAMINATED SITE - CONFLUENCE OF PEEL &amp; CARIBOU RIVER</b>	

This permit may be assigned, extended, discontinued, suspended or cancelled pursuant to the Territorial Land Use Regulations.

Ce permis peut faire l'objet d'une cession, d'une prolongation, d'une cessation, d'une suspension ou d'une annulation, en vertu du Règlement sur l'utilisation des terres territoriales.

Dated at WHITEHORSE, YUKON  
Daté à \_\_\_\_\_

Engineer *Del: Ardel*  
Ingénieur \_\_\_\_\_

This 15TH Day of NOVEMBER  
Ce \_\_\_\_\_ jour de \_\_\_\_\_, 2001.

Commencement Date 01 DECEMBER 2001  
Date du début des travaux \_\_\_\_\_

Expiry Date 30 NOVEMBER 2003  
Date d'achèvement \_\_\_\_\_

**NOTE**

IT IS A CONDITION OF THIS PERMIT THAT THE PERMITTEE COMPLY WITH ANY OTHER APPLICABLE ACT, REGULATION, ORDINANCE, BY-LAW OR ORDER. DEFAULT HEREOF MAY RESULT IN SUSPENSION OR CANCELLATION OF THIS PERMIT.

**REMARQUE**

LE DÉTENTEUR DU PRÉSENT PERMIS DOIT SE CONFORMER À TOUT AUTRE RÉGLEMENT, LOI, DÉCRET, RÉGLEMENT MUNICIPAL OU ARRÊTÉ APPLICABLE. LE MANQUEMENT À CETTE OBLIGATION POURRAIT DONNER LIEU À LA SUSPENSION OU À L'ANNULATION DU PERMIS.

LAND USE PERMIT TERMS AND CONDITIONS

**NAME OF PERMITTEE: DIAND - WASTE MANAGEMENT PROGRAM**

The following terms and conditions are made pursuant to Section 31 (1) of the Territorial Land Use Regulations and are hereby annexed to and form part of Permit YA0X786.

**3.0 PLANS**

- |    |  |  |
|----|--|--|
| 1. | The Permittee's field supervisor shall contact or meet with the Land Use Inspector at the Dawson office of Indian and Northern Affairs Canada. Phone 867-993-5468 at least 48 hours prior to the commencement of this Land Use Operation.  | <b>CONTACT<br/>INSPECTOR</b>                                 |
| 2. | The Permittee shall not conduct this Land Use Operation on any lands not designated in the accepted application, unless otherwise authorized in writing by the Engineer.   | <b>PLANS</b>   |
| 3. | The Permittee shall not conduct any part of the Land Use Operation within 30 metres of any privately owned land or structure unless otherwise authorized in writing by the Engineer.   | <b>PRIVATE<br/>PROPERTY</b>                                  |
| 4. | The Permittee shall, prior to commencing this Land Use Operation, submit a plan of all campsites to the Engineer for approval.   | <b>CAMPSITE<br/>PLAN</b>                                     |
| 5. | The Permittee shall, in accordance with Section 33 of the Territorial Land Use Regulations submit a Final Plan.  | <b>FINAL<br/>PLAN</b>  |
| 6. | The Permittee shall at all times conform to all applicable Federal, Territorial or local regulations, ordinances or by-laws.   | <b>CONFORM TO<br/>APPLICABLE<br/>LAWS</b>                    |
| 7. | The Permittee shall register all stationary petroleum and allied petroleum storage tank systems that are greater than 230 litres with the Land Use Engineer or designate. This requirement is pursuant to the Canadian Environmental Protection Act, Regulation of Storage Tank Systems for Petroleum Products and Allied Petroleum Products on Federal Lands Regulations. | <b>REGISTRATION<br/>OF FUEL TANK<br/>STORAGE<br/>SYSTEMS</b> |

**4.0 NOTICES / REPORTS**

- |   |   |
|---|---|
| <p>1. The Permittee shall provide in writing to the Land Use Inspector the following information at least 10 days prior to completion of the Land Use Operation:</p> <ul style="list-style-type: none"><li>(a) the plan for removal or storage of equipment and materials; and</li><li>(b) when final clean-up and restoration of the lands used will be completed.</li></ul>   | <p><b>REPORTS<br/>BEFORE<br/>REMOVAL</b></p>    |
| <p>2. The Permittee shall notify a Land Use Inspector at least 10 days prior to backfilling any sump.</p>   | <p><b>BACKFILLING<br/>NOTIFICATION</b></p>      |
| <p>3. The Permittee shall provide in writing to the Engineer, at least 48 hours prior to commencement of this Land Use Operation, the following information:</p> <ul style="list-style-type: none"><li>(a) person, or persons, in charge of the field operation to whom notices, orders, and reports may be served; and</li><li>(b) alternates; and</li><li>(c) all the methods for contacting the above person(s).</li></ul> | <p><b>IDENTIFY<br/>AGENT</b></p>                |
| <p>4. The Permittee shall contact the Land Use Inspector not less than 5 days prior to start-up during each season during which work will be undertaken; including changes to equipment, contractors or method of operation.</p>  | <p><b>SEASONAL<br/>START-UP</b></p>             |
| <p>5. The Permittee shall supply a Campsite Development Plan at least 5 days prior to camp establishment. The plan will include a map of the camp, proximity to water, location of sewage/grey water facilities, and a copy of the Health Canada Septic Disposal Permit if applicable.</p>  | <p><b>CAMPSITE<br/>DEVELOPMENT<br/>PLAN</b></p> |

**5.0 DISPLAY PERMIT / INSTRUCT EMPLOYEES AND CONTRACTORS**

- |    |  |  |
|----|--|--|
| 1. | The Permittee shall display a copy of this permit on the permit site.  | <b>DISPLAY<br/>PERMIT</b>                                    |
| 2. | The Permittee shall ensure that a copy of this Permit, operating conditions and definitions is provided to and understood by all contractors and sub-contractors prior to the start-up of this Land Use Operation. | <b>PERMIT<br/>CONTRACTORS<br/>&amp; SUB-<br/>CONTRACTORS</b> |

**6.0 EQUIPMENT**

- |    |  |  |
|----|--|--|
| 1. | The Permittee shall not use any equipment except of the type, size and number that is listed in the accepted application unless otherwise authorized in writing by the Land Use Inspector or the Engineer. | <b>ONLY<br/>APPROVED<br/>EQUIPMENT</b> |
|----|--|--|

**7.0 PETROLEUM**

- |    |   |  |
|----|---|--|
| 1. | The Permittee shall clearly mark with stakes or flags the location of any spill of any petroleum and forthwith report the time, manner, location, amount and type of spill to the Engineer and Environmental Protection Service. (Environmental Protection Service can be contacted by Phone (867)-667-7244, or Fax (867) 667-7962 in Whitehorse, Yukon). | <b>REPORT<br/>PETROLEUM<br/>SPILLS</b> |
| 2. | The Permittee shall not place any petroleum fuel storage containers within 30 metres of the normal high water mark of any stream.   | <b>FUEL<br/>BY STREAM</b>              |
| 3. | The Permittee shall not allow petroleum products to spread to surrounding lands or into water bodies.   | <b>FUEL<br/>CONTAINMENT</b>            |
| 4. | The Permittee shall have one extra fuel storage container on site equal to or greater than the size of the largest fuel container at the site.  | <b>FUEL<br/>EXTRA<br/>CONTAINER</b>    |

- |     |   |  |
|-----|---|--|
| 5.  | The Permittee shall take every precaution to ensure petroleum fuel or associated products do not escape from storage, distribution or dispensing facilities in such a manner as:  | <b>FUEL<br/>CONTAINMENT<br/>AT FUEL DEPOTS</b> |
|     | a) to create a hazard to public health or safety.   |  |
|     | b) to contaminate any fresh water source or stream.   |  |
|     | c) to interfere with the rights of any person; or   |  |
|     | d) to allow entry of a product into a sewer system or underground stream or drainage system.  |  |
| 6.  | The Permittee shall mark all stationary petroleum products storage facilities with flags, posts or similar devices so that they are at all times plainly visible to local vehicle travel.                                       | <b>MARK FUEL<br/>LOCATION</b>                  |
| 7.  | The Permittee shall seal all container outlets except the outlet currently in use.  | <b>SEAL OUTLET</b>                             |
| 8.  | The Permittee shall mark all fuel containers with the Permittee's name.   | <b>MARK<br/>CONTAINERS</b>                     |
| 9.  | The Permittee shall locate mobile fuel facilities on land when stationary for any period of time exceeding 12 hours.  | <b>FUEL ON<br/>LAND</b>                        |
| 10. | The Permittee shall dispose of all combustible waste petroleum products as per the Special Waste Regulations of the Yukon Environment Act.  | <b>WASTE<br/>PETROLEUM<br/>DISPOSAL</b>        |
| 11. | The Permittee shall at all times have on site sufficient oil spill clean-up equipment and material in readiness to clean-up all petroleum which may be spilled.   | <b>OIL SPILL<br/>CLEAN-UP<br/>EQUIPMENT</b>    |
| 12. | The Permittee shall have a Spill Contingency Plan in place or ensure that the haul contractor has a Spill Contingency Plan in place to provide for response to and clean-up of any spills of fuel or other hazardous materials. | <b>SPILL<br/>CONTINGENCY<br/>PLAN</b>          |

**9.0 WILDLIFE HABITAT**

- |    |   |                                     |
|----|---|-------------------------------------|
| 1. | The Permittee shall take every precaution to ensure that wildlife habitat is not damaged.   | <b>HABITAT<br/>DAMAGE</b>           |
| 2. | The Permittee shall, while preparing the access road, make every effort to avoid covering or destroying traps or snares that may be found along these routes.   | <b>TRAPS<br/>PROTECTION</b>         |
| 3. | The Permittee shall restore any trails used by trappers or hunters along access routes by slashing any and all trees that may fall across these paths or trails and by removing any other obstructions such as snow piles or debris that may be pushed across the trails. | <b>TRAILS<br/>RESTORATION</b>       |
| 4. | Encounters with wildlife are to be reported to the Dawson Conservation Officer at 867-993-5492.   | <b>ENCOUNTERS<br/>WITH WILDLIFE</b> |

**10.0 TRAVEL RESTRICTIONS**

- |    |  |  |
|----|--|--|
| 1. | The Permittee shall suspend overland travel of equipment or vehicles if rutting occurs.  | <b>SUSPEND<br/>OVERLAND<br/>TRAVEL</b>     |
| 2. | The Permittee shall not move any equipment or vehicles unless the ground surface is in a state capable of fully supporting the equipment or vehicles without rutting or gouging. | <b>VEHICLES<br/>MOVEMENT<br/>FREEZE-UP</b> |

**11.0 LINES, TRAILS AND RIGHT OF WAYS**

- |    |   |                                  |
|----|---|----------------------------------|
| 1. | The Permittee shall construct and maintain winter roads with a minimum of 10 centimetres packed snow at all times during this Land Use Operation.   | <b>SNOW ROADS</b>                |
| 2. | The Permittee shall scout proposed lines and routes to select the best location for crossing streams and avoiding terrain obstacles prior to the movement of any vehicle that exerts pressure on the ground in excess of 35 K pa. | <b>DETOURS AND<br/>CROSSINGS</b> |

- |    |  |  |
|----|--|--|
| 3. | The Permittee shall use existing accesses where possible.  | USE EXISTING<br>ACCESSES                         |
| 4. | The Permittee shall immediately suspend the Land Use operation on the site and notify the Land Use Inspector of the location of the site and nature of any unearthed materials, structures or artifacts. | ARCHAEOLOGICAL<br>SITES AND/OR<br>BURIAL GROUNDS |

**13.0 DISPOSAL - BRUSH AND TREES**

- |    |   |                          |
|----|---|--------------------------|
| 1. | The Permittee shall dispose of all brush and debris by running heavy machinery over the trees and brush until they are crushed to lie flat on the ground. | BRUSH DISPOSAL           |
| 2. | The Permittee shall, at the contaminated site, totally disperse of all debris by burning.   | BURN BRUSH               |
| 3. | The Permittee shall complete total disposal of all debris and brush cleared prior to permit expiry.   | BRUSH DISPOSAL<br>TIMING |
| 4. | The Permittee shall not use any self-propelled machinery for clearing the brush.  | HAND CREWS<br>ONLY       |

**14.0 DISPOSAL - GARBAGE AND SOLID WASTE**

- |    |  |                               |
|----|--|-------------------------------|
| 1. | The Permittee shall burn all combustible garbage and debris in a container acceptable to the Land Use Inspector.   | INCINERATION                  |
| 2. | The Permittee shall burn all garbage and debris at least daily.  | GARBAGE<br>DISPOSAL           |
| 3. | The Permittee shall keep all garbage and debris in a covered metal container until disposed of.  | GARBAGE<br>CONTAINERS         |
| 4. | The Permittee shall remove all non-combustible garbage and debris from the Land Use area to a disposal site approved in writing by the Land Use Inspector. | REMOVE<br>NON-<br>COMBUSTIBLE |

5. The Permittee shall ensure that the Land Use area is kept clean and tidy at all times.

CLEAN  
WORK AREA

**15.0 DISPOSAL - SEWAGE AND LIQUID WASTE**

1. The Permittee shall obtain appropriate sewage disposal authorization required by law from the appropriate authority and provide a copy at least 48 hours prior to operation commencement to the Land Use Inspector.

SEWAGE  
DISPOSAL

**16.0 DISPOSAL - CHEMICAL AND TOXIC WASTE**

1. The Permittee shall clearly mark with stakes or flags the location of any spill of liquid or dry chemicals or other toxic substance and forthwith report the time, manner, location, amount and type of spill to the Engineer and Environmental Protection Service. (Environmental Protection Service can be contacted at Phone (867) 667-7244, Whitehorse, Yukon).
2. The Permittee shall ensure that all special wastes are disposed of in accordance with the Yukon Special Waste Regulations

REPORT  
CHEMICAL  
SPILLS

SPECIAL WASTES

**17.0 WATER COURSES AND FISH HABITAT**

1. The Permittee shall not clear or otherwise remove any vegetation within 10 metres of the natural boundary of any watercourse except by hand.
2. The Permittee shall not in any circumstances allow the deposit of any unauthorized soils or debris in any watercourse, or in any location where these materials could be deposited into any watercourse.
3. The Permittee shall not in any circumstances deposit or allow the deposit of any deleterious substances (including but not limited to fuels, lubricants, hydraulics, and coolants) of any type into any waters, or in any place under any conditions where the deleterious substances may enter any waters.

HAND CLEARING

DEPOSITING  
SOIL IN STREAMS  
PROHIBITED

DEPOSITING  
DELETERIOUS  
SUBSTANCES

- |     |  |  |
|-----|--|--|
| 4.  | The Permittee shall not excavate the banks of any stream unless authorized in writing by the Land Use Inspector.   | STREAM BANKS                             |
| 5.  | The Permittee shall not use any material but snow or water in the construction of ice bridges and approaches.  | ICE BRIDGE<br>MATERIAL                   |
| 6.  | The Permittee shall not allow any ice bridge to hinder the flow of water in any stream.  | ICE BRIDGE                               |
| 7.  | The Permittee shall not erect camps or store materials on the surface ice of watercourses or bodies unless authorized in writing by the Land Use Inspector.  | STORAGE<br>ON ICE                        |
| 8.  | The Permittee shall remove all ice bridges and snow fills from stream crossings prior to spring break-up or completion of the Land Use Operation unless instructed in writing by the Land Use Inspector.   | REMOVE<br>ICE BRIDGES<br>AND SNOW FILLS  |
| 9.  | The Permittee shall ensure that all natural or constructed ice crossings are and remain capable of supporting the vehicles taken across them, by monitoring and repeated testing of ice thickness and condition during the period of use.                          | ICE<br>CROSSINGS                         |
| 10. | The Permittee shall not place dirt or debris into streams to serve as ramps for loading or unloading ships or barges unless first authorized in writing by the Land Use Inspector.   | DIRT RAMPS                               |
| 11. | The Permittee shall conduct all activities associated with the water crossings in accordance Fisheries and Oceans direction.   | FISHERIES AND<br>OCEANS<br>AUTHORIZATION |
| 12. | The Permittee shall, in the event that any piece(s) of equipment fall(s) through the ice, immediately advise Fisheries and Oceans in Whitehorse. Telephone number is (867) 393-6721, or Fax (867) 393-6738.  | CONTACT<br>FISHERIES AND<br>OCEANS       |
| 13. | The Permittee shall design, construct, maintain and decommission all temporary and permanent structures placed in streams which may be frequented by fish in such a manner that the up or downstream passage of fish is not obstructed either entirely or in part. | FISH<br>PASSAGE                          |

**18.0 EROSION CONTROL / PREVENTION**


- |    |   |                                  |
|----|---|----------------------------------|
| 1. | The Permittee shall locate all camps on gravel, sand or other durable land.                       | CAMP<br>LOCATION                 |
| 2. | The Permittee, when access only is required, shall keep the bulldozer blade in a raised position. | RAISE<br>BULLDOZER<br>BLADE      |
| 3. | The Permittee shall equip the bulldozer with tracks that limit any environmental damage.          | LIMIT<br>ENVIRONMENTAL<br>DAMAGE |

**19.0 RESTORATION**

- |    |  |                     |
|----|--|---------------------|
| 1. | The Permittee shall complete all clean-up and restoration of the lands used prior to the expiry date of this Permit. | CLEAN-UP            |
| 2. | The Permittee shall remove any obstruction to natural drainage caused by any part of this Land Use Operation.        | NATURAL<br>DRAINAGE |

**21.0 OTHER MATTERS**

- |    |   |                       |
|----|---|-----------------------|
| 1. | The Engineer reserves the right to close any area to the Permittee during periods when dangers to natural resources are severe. | CLOSURE               |
| 2. | The Permittee shall be liable for any costs of clean-up resulting from this Land Use operation.                                 | CLEAN-UP<br>LIABILITY |

  
Heli Aatelma  
Acting Head, Land Use

**YUKON TERRITORY WATER BOARD**

Pursuant to the Yukon Waters Act and Regulations, the Yukon Territory Water Board hereby grants a Type B water licence for a miscellaneous undertaking to:

Indian and Northern Affairs Canada  
345-300 Main Street  
Whitehorse, YT Y1A 2B5

**LICENCE NUMBER:** MS00-159

**LICENCE TYPE:** B **UNDERTAKING:** MISCELLANEOUS

**LOCATION:** Peel River

**MAP CO-ORDINATES:** Latitude: 66° 30.98' N Longitude: 134° 34.26' W

**PURPOSE:** Waste Site Remediation Project

**EFFECTIVE DATE:** The effective date of this Licence shall be the date on which the signature of the Chairperson of the Yukon Territory Water Board is affixed.

**EXPIRY DATE:** December 1, 2003

This licence shall be subject to the restrictions and conditions contained herein and to the restrictions and conditions contained in the Yukon Waters Act and the Regulations made thereunder. Where there is a discrepancy between the application and the terms of this licence, the terms of this licence shall prevail.

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## PART A - GENERAL CONDITIONS

### 1. Definitions

- a) "Act" means Yukon Waters Act and any amendments thereto.
- b) "Application" and "Water Use Application" mean Water Use Application MS00-159, including any additional submissions and/or revisions, submitted to the Board by the Licensee, up to the date of the Board's decision.
- c) "Board" means the Yukon Territory Water Board.
- d) "DDD" means dichlorodiphenyldichloroethane, which is a metabolite of DDT.
- e) "Deleterious Substance" means a deleterious substance as defined in Section 34(1) of the Fisheries Act.
- f) "DDE" means diphenyldichloroethylene, which is a metabolite of DDT.
- g) "DDT" means dichlorodiphenyltrichloroethane, which will metabolize into the body and persist in body fat.
- h) "Inspector" means any person designated as an inspector under the Act.
- i) "Minister" means the Minister of Indian Affairs and Northern Development.
- j) "Regulations" means the Regulations made under the Act.
- k) "Waste" means any substance as defined in Section 2 of the Yukon Waters Act.
- l) "Watercourse" means any stream, lake, pond, river, creek, spring, ravine, or swamp whether ordinarily containing water or not.
- m) "Wetted Perimeter" means the horizontal extent of the present water level while the work is taking place.

### 2. Representations, Warranties and Undertakings

The Board has relied on the representations, warranties and undertakings provided by the applicant in the material filed as Application MS00-159. Such representations, warranties and undertakings are considered by the Board to be a part of the licence, but shall be subject to, and may be modified by the terms and conditions of the licence.

### 3. Other Laws

No term of this licence limits the application of any other Federal, Territorial, or First Nation law.

4. All contaminated material recovered from this undertaking and/or a fuel or hazardous material spill shall be removed to a special waste disposal facility approved under the Special Waste Regulations of the Environment Act of the Yukon.
5. The Licensee shall comply with the requirements of the Yukon Regulations Respecting Public Health, pursuant to the Public Health and Safety Act, including, but not limited to, any orders issued by the Medical Officer of Health for sewage disposal.

## 6. Correspondence

Where any direction, notice, order, or report under this licence is required to be in writing, it shall be given:

- (a) to the Licensee, if left at or mailed by registered mail to the following address:
- Indian and Northern Affairs Canada  
Contaminants/Waste Program  
345-300 Main Street  
Whitehorse, YT Y1A 2B5

and shall be deemed to have been given to the Licensee on the day it was left or seven (7) days after the day it was mailed, as the case may be.

- (b) to the Board, if left at, or sent by fax to (867) 668-3628, or sent by registered mail to the following address:
- Yukon Territory Water Board  
Suite 106, 419 Range Road  
Whitehorse, Yukon Y1A 3V1

and shall be deemed to have been given to the Board on the day it was left, sent by fax, or seven (7) days after it was mailed, as the case may be.

## 7. Non-Compliance

In the event that the Licensee fails to comply with any provision or condition of this licence, the Board may, with the approval of the Minister and subject to the Act, cancel the licence.

## 8. Deleterious Substances

No deleterious substances shall be deposited or allowed to be deposited into any watercourse. This includes, but is not limited to, fuels, coolants, hydraulic fluids and lubricants.

## 9. Other Uses

If, subsequent to the issuing of this licence, the Licensee uses water and/or deposits waste which

- a) has no potential for significant adverse environmental effects; and
- b) does not interfere with existing rights of other water users or waste depositors; and
- c) satisfies the criteria set out in column II of Schedule X of the Regulations,

no amendment to this licence will be required for this use of water and/or deposit of waste.

**10. Spills and Unauthorized Discharges**

The Licensee shall immediately contact the 24-hour Yukon Spill Report number (867) 667-7244 and implement the Spill Contingency Plan, should a spill or an unauthorized discharge occur. A detailed written report on any such event, including but not limited to, dates, quantities, parameters, causes and other relevant details and explanations, shall be submitted to the Board not later than fifteen (15) days after the occurrence.

11. All personnel shall be trained in the use of the spill containment equipment in the event of a spill.

**12. Annual Reports**

On or before the anniversary of the date of issuance of this licence, and for each year during which this licence is in effect, the Licensee shall submit an annual report to the Board. The report shall include the information required by the Regulations including, but not necessarily limited to:

- a) a description of all watercourse training; and
- b) a description of the engineered landfill activities.

13. Unless otherwise specified in this licence, all reports shall be submitted to the Board in an unbound form that is reproducible by standard photocopier and shall be accompanied by five (5) copies.

14. All reports shall be submitted in digital form on diskette using an IBM compatible format that is readable using commonly available software, or by email.

**15. Term of Licence**

The term of this licence is for the period from the effective date to December 1, 2002.

**PART B - OPERATING CONDITIONS****Description of Water Use**

16. The Licensee is hereby authorized to:

- a) conduct watercourse training, and
- b) deposit non-hazardous solid waste into an engineered landfill approximately 8 Km East of the Peel River waste site, and
- c) construction of associated earthworks,

all as proposed in Water Use Application MS00-159, and subject to this licence. Where there is a discrepancy between the application and the terms of this licence, the terms of this licence shall prevail.

17. Notification, including the name and phone number of the field supervisor, shall be provided to the Board, in writing, ten days prior to the start of construction.

18. Design

All works shall be carried out in accordance with the design drawings submitted to the Board.

Excavation & Construction

19. All construction, excavation or installation of associated works authorized by this licence shall occur on property that the Licensee has the right to enter upon and use for that purpose.

20. All stream crossings shall be constructed of snow and ice only and shall be removed and reclaimed prior to breakup.

21. The channel of the Peel River shall not be disturbed beyond the immediate area required for the purposes of the undertaking.

22. Fuel, lubricants, hydraulic fluids, coolants, equipment and materials shall be stored or transferred a minimum of 30 metres from the natural boundary of any watercourse.

23. All works associated with the undertaking shall be maintained in good repair.

24. Construction and/or maintenance equipment shall be mechanically sound and free of leaks.

25. No heavy equipment shall be operated within the wetted perimeter of the Peel River.

26. Work shall be carried out during low flow periods while the Peel River is under frozen conditions.

27. Waste substances shall be used, transported, stored or disposed of in such a manner that they are not deposited in or allowed to be deposited into any watercourse or on any surrounding land.

28. All work shall be carried out in a manner which minimizes the release of sediment, or the potential for release of sediment, from the site into the watercourse.

29. Excavated material from the stream shall be deposited a minimum of 10 metres beyond the ordinary high water mark of the unnamed creek.

30. Hazardous Materials

Soils contaminated with DDT, DDD and DDE shall be handled as hazardous materials and transported off-site to a licensed disposal facility.

31. All disturbed ground surfaces shall be re-graded in a manner which is consistent with the topography of the site and which prevents erosion and surface runoff from carrying sediment into any watercourse.
  32. Vegetation removed from the site shall be reused to construct a brush layer along the 2 metre contour (as referenced in the datum provided in the water use application) of the fill slope. A row of live shrubs shall be transplanted several metres back from the top of the re-contoured slope. Each row shall extend the entire length of the disturbed area, and the shrubs within each row shall be placed at 5 metre intervals. Refer to the diagram attached as Appendix A.
  33. The re-contoured slope shall not restrict navigation of the Peel River.
  34. All construction materials, equipment, temporary structures and debris shall be removed from the site upon completion of the work.
- 

Dated this 7 day of

May, 2001.

Kelly Boutilier  
Witness

Approved:

  
Chairperson  
YUKON TERRITORY WATER BOARD

Appendix A

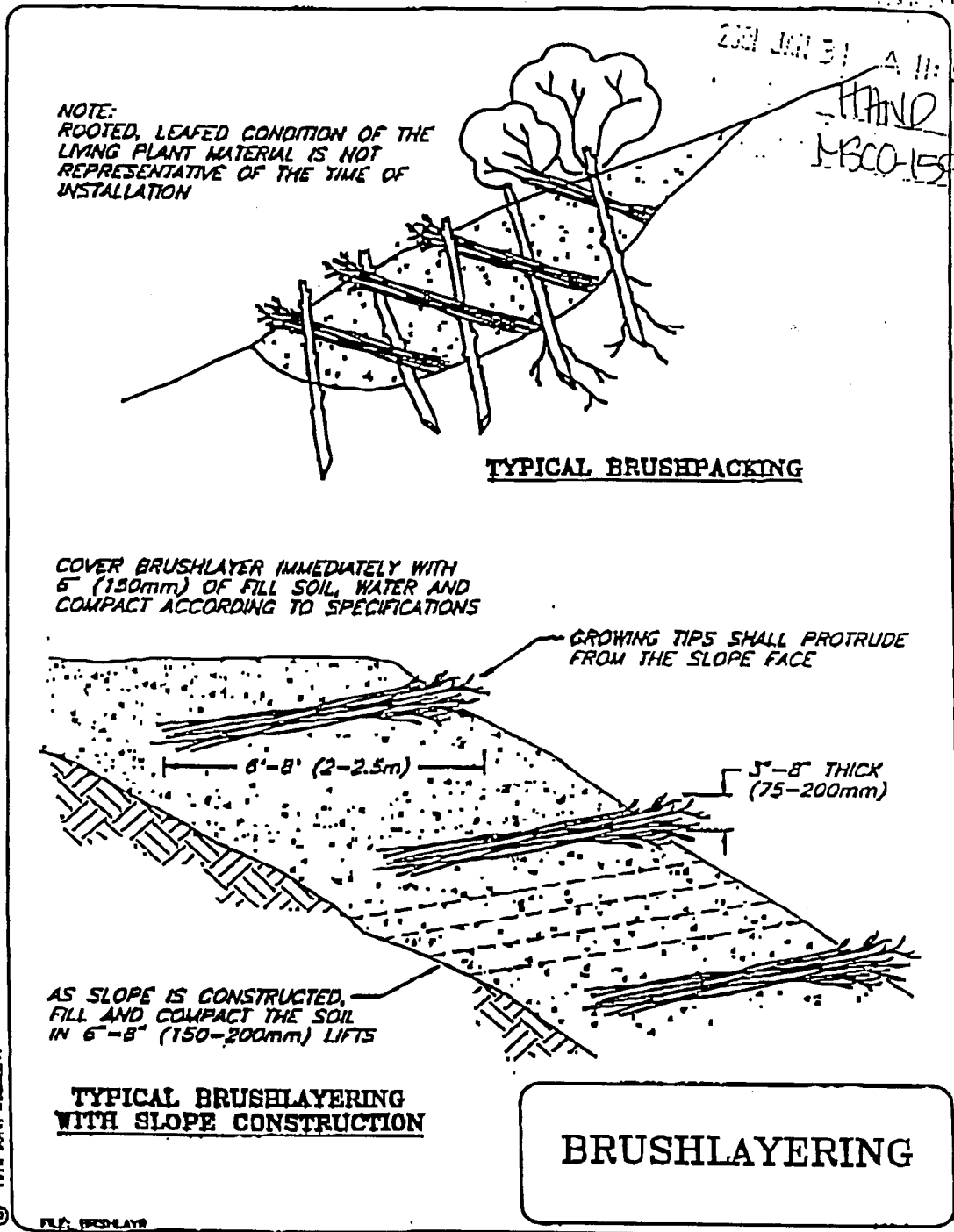


Fig. 5.13 Typical drawing Brushlayering. (Erosion draw 2.0, 1996)

## REASONS FOR DECISION

### WATER USE APPLICATION MS00-159 INDIAN AND NORTHERN AFFAIRS CANADA WASTE SITE REMEDIATION PROJECT PEEL RIVER

The Yukon Territory Water Board ("the Board") has concluded deliberations pertaining to application MS00-159 for a Type B Licence for a miscellaneous undertaking. Indian and Northern Affairs ("DIAND") proposes to remediate a waste site which contains soil contaminated with DDD, DDE and DDT. The waste site is actively being eroded by the Peel River.

The site is located within the Traditional Territory of the Nacho Nyak Dun First Nation and is within the Gwich'in Primary Use Area.

Prior to making licensing decisions, the Board undertook an environmental assessment of this project, pursuant to the Canadian Environmental Assessment Act (CEAA). The Board is satisfied that the project is not likely to cause significant adverse environmental effects.

Public notice of this application was provided in accordance with the requirements of the Yukon Waters Act. In response, the Board received interventions from Indian and Northern Affairs, Canada, Fisheries and Oceans Canada ("DFO") and Canadian Coast Guard.

The Board did not receive a request for a public hearing.

This application was Tabled at the March 13, 2001 Board meeting. The Board requested that DIAND clarify the levels of DDT that varied on the drawings that were submitted as part of the application. DIAND responded, stating that the test holes which indicated <0.2 total DDT concentration in ppm were obtained using field test kits. These kits could not obtain accurate readings below 0.2 ppm. These results could also be interpreted to mean that the sample possibly did not contain DDT. Test holes that indicated <0.002 ppm total DDT concentration were obtained through laboratory analysis.

The proposed operation will not substantially alter the quantity, quality or rate of flow of water flowing on or adjacent to settlement land. Soils contaminated with DDT, DDD and DDE will be removed from the river bank, preventing the organochlorines from entering the river system and potentially entering the food chain.

Reasons for Decision - Water Use License Application MS00-158

Page 2 of 2

The Board determined that the information provided was adequate to proceed with the issuance of a water use licence for this project.

No term of the Licence limits the application of any Federal, Territorial, or First Nation law.

Without limiting the generality of this statement, but in order to provide further clarification, the Board notes that the Licence does not constitute approval or authorization pursuant to the Fisheries Act.

  
\_\_\_\_\_  
Chairperson  
Yukon Territory Water Board

Date: May 7 2001

**YUKON TERRITORY WATER BOARD  
AMENDMENT OF LICENCE**

LICENSEE: Indian and Northern Affairs Canada

Licence: MS00-159

AMENDMENT NUMBER: ONE (1)

Application Number: MS01-192

Pursuant to the Yukon Waters Act, Water Use Licence, is hereby amended as follows:

**1. Clause 3 of this licence is hereby withdrawn and replaced by:**

No term of this licence limits the application of any other Federal, Territorial, First Nation or Municipal legislation.

**2. Clause 9 of this licence is hereby withdrawn and replaced by:**

If, subsequent to the issuing of this licence, the Licensee uses water and/or deposits waste in one or more ways not authorized in this licence, and the combined effect of those uses

- (a) has no potential for significant adverse environmental effects;
- (b) does not interfere with existing rights of other water users or waste depositors;  
and
- (c) satisfies the criteria set out in column II of schedule X of the Regulations, no amendment to this licence will be required for that use of water and/or deposit of waste.

**3. Clause 10 of this licence is hereby withdrawn and replaced by:**

The Licensee shall immediately contact the 24-hour Yukon Spill Report number (867) 667-7244 and implement the Spill Contingency Plan, should a spill or an unauthorized discharge occur. A detailed written report on any such event, including but not limited to, dates, quantities, parameters, causes and other relevant details and explanations, shall be submitted to the Board not later than ten (10) days after the occurrence.

**4. Clause 32 of this licence is hereby withdrawn.**

**5. Appendix A of this licence is hereby withdrawn.**

Dated this 8<sup>th</sup> day of

May, 2002

YUKON TERRITORY WATER BOARD

Kelly Boutilier  
Witness

Gregg Jilson, Chairperson

## REASONS FOR DECISION

### WATER USE APPLICATION MS01-192 (amend. to MS00-159) INDIAN AND NORTHERN AFFAIRS CANADA PEEL RIVER, YT

The Yukon Territory Water Board ("the Board") has concluded deliberations pertaining to Water Use Application MS01-192 for an amendment to a Type B Water Use Licence MS00-159 for a miscellaneous undertaking. Indian and Northern Affairs Canada ("DIAND") intends to remediate the contaminated site without backfilling and revegetating the excavated area as originally proposed in water use application MS00-159.

Public notice of this application was provided in accordance with the requirements of the Yukon Waters Act. In response, the Board received an intervention from the First Nation of the Nacho Nyak Dun. The Board did not receive a request for a public hearing. Prior to making licensing decisions, the Board undertook an environmental assessment of this project, pursuant to the Canadian Environmental Assessment Act ("CEAA") jointly with DIAND. The Board is satisfied that the project is not likely to cause significant adverse environmental effects.

#### Project

The requirement to backfill the excavated area was not specifically required as a condition of water use licence MS00-159. The Licensee did comply with the licence by recontouring the excavated bank in order to stabilize the bank. The issue before the Board was whether to remove the requirement for "brush layering".

Upon consideration of this information, the Board agreed that the required brush layer would be eroded by the river and determined that clause 32 and Appendix A are to be withdrawn from the licence through amendment one of water use licence MS00-159.

#### Submission of Comments

The Board has determined that any letters of intervention from interested parties, that are received after the deadline date for comments will not be considered for the purposes of determining mitigative measures through the CEAA screening and/or water use licence. If additional time is required to review an application for a water use licence with the intent to intervene, potential interveners should contact the Water Board Secretariat, prior to the deadline date for comments.

The Board was informed that DFO submitted a letter of intervention 8 days after the advertised deadline date for comments. The Board determined that this letter of intervention will not be included for consideration for the CEAA screening or water use licence.

#### Chapter 14 of the Umbrella Final Agreement

The Board is satisfied that the project, as proposed, will not substantially alter the quantity, quality or rate of flow, including seasonal rate of flow which is on or flowing through or adjacent to First Nation Settlement Land.

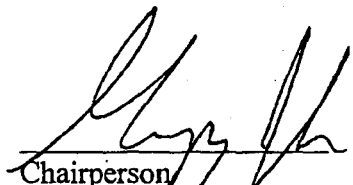
Reasons for Decision MS01-192 (amend. to MS00-159)  
Indian and Northern Affairs Canada

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Page 2 of 2

Other Laws

No term of this licence limits the application of any other Federal, Territorial, First Nation or Municipal legislation. Without limiting the generality of this statement, but in order to provide further clarification, the Board notes that the Licence does not constitute approval or authorization pursuant to the Fisheries Act.

  
Chairperson  
Yukon Territory Water Board

8 May 2002  
Date

**CEAA ENVIRONMENTAL ASSESSMENT ACT  
INTEGRATED SCREENING REPORT AND PROJECT SUMMARY  
YUKON TERRITORY WATER BOARD  
AND DEPARTMENT OF INDIAN AND NORTHERN AFFAIRS CANADA**

**TYPE B WATER USE LICENCE MS01-192 (AMEND. TO MS00-159)  
INDIAN AND NORTHERN AFFAIRS CANADA  
WASTE SITE REMEDIATION PROJECT  
PEEL RIVER**

**PART ONE: PROJECT IDENTIFICATION AND OVERVIEW**

**Proponent:** Indian and Northern Affairs Canada  
345-300 Main Street  
Whitehorse, YT Y1A 2B5

**Project Name:** Waste Site Remediation Project

**Application Number:** MS01-192 (amend. to MS00-159)

**Name of Watercourse:** Peel River

**Tributary Of:** MacKenzie Bay

**NTS Map Sheet Number:** 106L

**Coordinates:** Latitude: 66° 30' 98"N      Longitude: 134° 34' 26"W

**Closest Community:** Fort McPherson, NWT (103 km north)  
Eagle Plains, YT (120 km west)

**Highway:** Dempster Highway

**Traditional Territory:** Tetlit Gwich'in Tribal Council-Comprehensive Land Claim Agreement  
Gwich'in Tribal Council-Primary Use Area  
First Nation of Nacho Nyak Dun-Traditional Territory

## PART TWO: RESPONSIBLE AUTHORITY IDENTIFICATION

**Lead Responsible Authority:** Yukon Territory Water Board  
**Screening Division:** YTWB  
**Lead Responsible Authority Contact:** Kelly Boutilier Licensing Officer, YTWB,  
Suite 106, 419 Range Road, Whitehorse, Yukon  
Y1A 3V1  
Phone: (867) 667-3980, Fax: (867) 668-3628

**Lead Responsible Authority Trigger:** Law List Approval  
**Lead Type of Approval:** Water Use Licence  
**Status of Approval:** Amendment  
**Other Responsible Authorities:** Indian and Northern Affairs Canada  
**Integrated Screening:** Yes  
**Other Agencies:** None  
**Other Triggers:** CEEA, Section 5(1)(a)  
**Other Types of Approval:** None  
**Project File Location:** YTWB-Whitehorse

## PART THREE: PROJECT DESCRIPTION

### **Background Information:**

Shell Resources Canada ("Shell") previously used this site in the mid-1960's for exploratory drilling in the area. Shell constructed a disposal pit in 1975 for demolished debris and other materials, including bagged drilling mud, bagged cement and miscellaneous debris. In 1994 the Gwich'in Tribal Council notified Indian and Northern Affairs Canada ("DIAND") that the Peel River was changing course and the river had exposed the debris contained in the disposal site.

Subsequent site inspections and soil, sediment and water sampling and installation of erosion control devices have been initiated since 1994. Approximately 1,100m<sup>3</sup> of soil was found to be contaminated with dichlorodiphenyltrichloroethane ("DDT") and its derivatives DDD and DDE, at levels above the Canadian Council of Ministers of the Environment criterion.

DIAND, in collaboration with Shell and the Peel River Working Group, have been issued Water Use Licence MS00-159, which will allow DIAND to excavate the entire disposal pit during winter conditions because the contaminated material is located in the river bank and also below the high water mark of the river. The application had originally proposed that approximately 1000m<sup>3</sup> of overburden that was to be stripped, to expose the disposal site, would be replaced and the site will be recontoured to minimize erosion. A project engineer and a scientific consultant

supervised the handling operations for the contaminated materials. The licence required that all hazardous materials be transported to a licensed disposal facility. All non-contaminated materials (approximately 500m<sup>3</sup>) have been authorized to be removed from the site and deposited in an engineered landfill approximately 8 kilometres from the project location. This option would only be used in the event that the landfill is the only viable alternative to disposal of the non-contaminated material.

Access to the site was constructed between December 15, 2001 and February 5, 2002 along existing seismic lines from Fort McPherson, NWT crossing into the Yukon Territory. The site is located in the Peel River Watershed. The site is also located within the traditional territory of the First Nation of Nacho Nyak Dun and is within the Gwich'in Primary Use Area.

#### **Application to Amend Water Use Licence MS00-159**

DIAND has applied amend Water Use Licence MS00-159. DIAND has inspected the site and the active erosion that is occurring, will erode the river bank well beyond the footprint of the excavation area within a short period of time. If the work is completed as originally proposed, approximately 1,100 m<sup>3</sup> of soil and vegetation will erode into the Peel River and DIAND will be in non-compliance with Clause 28 of the water use licence which requires DIAND to minimize the release of sediment into the watercourse.

DIAND has requested that the licence requirements to regrade all disturbed ground surfaces and to revegetate the site be withdrawn from the water use licence to ensure compliance with clause 28 of the licence.

#### **DESCRIPTION OF THE ENVIRONMENT:**

**Ecozone:** Taiga Plain  
**Ecoregion:** Peel River Plateau (#51)  
**Source:** A National Ecological Framework for Canada  
**Written by:** Ecological Stratification Working Group 1995  
**ISBN:** 0-662-24107-X

**PART FOUR: CONSULTATION/REFERRAL**

**Public Consultation:** Yes  
**Date Advertised:** March 8, 2002  
**Deadline for Comments:** March 18, 2002

In addition to the newspaper advertisement, the application was referred to:

AGENCY/ORGANIZATION		WATER BOARD RESPONSE RECEIVED
DIAND	WATER RESOURCES	NO RESPONSE
	LAND RESOURCES	NO RESPONSE
	FOREST RESOURCES	NO RESPONSE
	RMO, DAWSON CITY	NO RESPONSE
	NWT-CONTAMINANTS DIVISION	NO RESPONSE
	NWT-WATER RESOURCES	NO RESPONSE
	OTHER FEDERAL DEPARTMENTS	DFO
	CANADIAN COAST GUARD	NO RESPONSE
	ENVIRONMENT CANADA	NO RESPONSE
	YTG	TOURISM-HERITAGE BRANCH
	RENEWABLE RESOURCES	NO RESPONSE
	LANDS BRANCH	NO RESPONSE
	GOVERNMENT OF NORTHWEST TERRITORY	HAZARDOUS WASTES DIVISION
	MACA	NO RESPONSE
	HEALTH	NO RESPONSE
	RENEWABLE RESOURCES	NO RESPONSE
	RESOURCES, WILDLIFE & ECONOMIC DEVELOPMENT	NO RESPONSE
OTHER GROUPS	TETLIT GWICH'IN RENEWABLE RESOURCES COUNCIL	NO RESPONSE
	SHELL CANADA LIMITED	NO RESPONSE
	FT. MCPHERSON GROUP-TRAPLINE CONCESSION HOLDER	NO RESPONSE
	YUKON SALMON COMMITTEE	NO RESPONSE
	YUKON CONSERVATION SOCIETY	NO RESPONSE
	CANADIAN PARKS AND WILDERNESS SOCIETY	NO RESPONSE

FIRST NATION	NACHO NYAK FIRST NATION	MARCH 8, 2002
	GWICH'IN TRIBAL COUNCIL- IMPLEMENTATION COORDINATOR	NO RESPONSE
	GWICH'IN TRIBAL COUNCIL-PRESIDENT	NO RESPONSE
	TETLIT GWICH'IN COUNCIL-PRESIDENT	NO RESPONSE
	GWICH'IN LAND ADMINISTRATION	NO RESPONSE

### PART FIVE: RESPONSES FROM INTERESTED PARTIES

First Nation of Nacho Nyak Dun

1. No concerns with the application.

**SUMMARY OF RECOMMENDATIONS:**

First Nation of Nacho Nyak Dun

1. Ensure that all environmental regulations are adhered to.

### PART SIX: CEAA MITIGATION RECOMMENDATIONS

In regards to the recommendation from the First Nation of Nacho Nyak Dun, the Water Use Licence contains a standard clause that clearly states that no term of the licence limits the application of any other Federal, Territorial, or First Nation law.

The applicants request to withdraw clause 32 and Appendix A from the water use licence should be reflected in the amendment to water use licence MS00-159.

**CUMULATIVE EFFECTS:**

The proposed undertaking will not substantially alter the quantity, quality or rate of flow of water flowing on or adjacent to settlement land.

The Project Engineer for this project inspected the excavated areas and reports that placing material back into the excavation area and re-grading the site will increase the rate of sedimentation in the Peel River. It is expected that the river will erode well beyond the footprint of the excavation within in short period of time. Therefore, by withdrawing the licence clause 32 and Appendix A of the water use licence will effectively mitigate the potential for cumulative

effects, through sedimentation of the watercourse.

**PART SEVEN: DETERMINATION**

**CEAA Determination**

- ✓ Section 20(1)(a) - Project may proceed as it is not likely to cause significant adverse environmental effects.

**Environmental Assessment and Project Summary prepared by:**

Kelly Boutilier  
Licensing Officer  
Yukon Territory Water Board

March 26, 2002  
Date

Rick Seaman  
A/Manager Waste Contaminants Program  
Indian and Northern Affairs Canada

April 17, 2002  
Date

**Approved by:**

Gregg Jilson  
Chairperson  
Yukon Territory Water Board

April 16, 2002  
Date

Rick Seaman  
A/Manager Waste Contaminants Program  
Indian and Northern Affairs Canada

April 17, 2002  
Date



## GWICH'IN TRIBAL COUNCIL

CHIEF JIM KOE ZHEH, BOX 1507, INUVIK, NT, CANADA - X0E 0T0  
TEL: (867) 777-4869 • FAX: (867) 777-4538

### **Gwich'in Access Authorization**

**Authorization # G01A02**

**GLA File #5479.15.13**

All rights and privileges created by this Authorization are subject to all relevant conditions in the Gwich'in Comprehensive Land Claim Agreement, as well as the conditions expressed in herein. This Authorization assigns specific rights and obligations to Rat River Development Corporation referred to herein as the Licensee. All obligations of the Licensee also apply to its staff, servants, agents, licensees, contractors, successors or assignees. The Licensee is hereby given the non-exclusive right to cross to a specified area. The access is located on Gwich'in Lands, namely the Primary Use Area, Parcel R34FS and R4FS as referenced in Appendix F of the Gwich'in Comprehensive Land Claims Agreement. The area specified for the access is hereinafter referred to as the "crossing". Access to the crossing for the proposed activity described herein is hereby granted. The actions of the licensee are monitored on behalf of the Land Manager and it's agents or any person duly authorized by the Land Manager (hereinafter referred to collectively as the Land Manager).

#### **TERMS AND CONDITIONS**

The following terms and conditions apply to this Authorization:

1. This Authorization is valid from September 2001 to April 30<sup>th</sup> 2002; ground conditions permitting.
2. In consideration of this Authorization being granted, the Licensee agrees to meet all terms and conditions contained in the Permit issued by the Gwich'in Land and Water Board.
3. The Licensee shall pay to the Land Manager the amount of \$220.00 for the consultation process.
4. The Licensee agrees to pay the applicable fees referred to in Schedule 1, attached to this Authorization for the use of the crossing and the materials or resources to be taken from the lands.
5. The Land Manager and/or staff may enter upon the site at all reasonable times for the purpose of inspecting access, working area dimensions, or any other matters.
6. The Licensee agrees that it will indemnify and save harmless the Gwich'in Tribal Council for any and all damages caused by the Licensee, it's staff or it's agents, whether on or off the crossing as a result of any construction, operation, or other act or failure to act. Including but not limited to damages to land, gates, fences, roads, machinery, culverts, bridges and or buildings on or near the site or any other Gwich'in Lands.
7. The Licensee has the right to unload and store material, (except fuel,) vehicles, supplies and equipment on or near the access route, at such times only for the activity authorized by this Authorization, and only in accordance with its terms. Washing of

vehicles, supplies, equipment or surface materials is prohibited on the access lands or any Gwich'in Lands.

8. The Licensee shall immediately notify the Land Manager of any artifact, burial pit, grave or any other item of archaeological interest discovered by the Licensee in the course of its operations. The Licensee shall continue its operations in a manner so as to avoid any damage to the artifact and to ensure its protection. If so requested by the Land Manager, the Licensee shall, at its own expense, deliver the item to the Land Manager.
9. The Licensee may, upon ten days written notice to the Land Manager, to cease the use and occupation of the crossing. This Authorization shall expire ten days after the receipt, of such a notice, subject to any other conditions contained herein.
10. Where in the opinion of the Land Manager, the Licensee has breached a condition of this Authorization:
  - (a) The Land Manager shall, provide written notice of such a breach and outline the particulars of the breach and the requirement that the Licensee remedy the breach.
  - (b) If the Licensee fails to remedy the breach to the satisfaction of the Land Manager within seven days of receipt of such a notice, the Land Manager may;
  - (c) Take necessary steps to remedy the breach and recover the costs of any such action from the Licensee; and or
  - (d) Terminate this Authorization by written notice to the Licensee. Such termination shall be effective immediately upon receipt by the Licensee.
  - (e) Once the Licensee has received notice that it has breached a condition of this Authorization it shall not continue development of the crossing without the written consent of the Land Manager until such time as the breach has been corrected to the satisfaction of the Land Manager.
  - (f) The Licensee shall be responsible, under this section for any and all costs incurred in remedying the breach plus interest at the Bank of Canada rate plus two per cent from the date that the costs were incurred by the Land Manager to the date of the reimbursement by the Licensee. The Licensee shall also be responsible for the costs of the Land Manager on a solicitor client basis for any legal action undertaken by the Land Manager to recover amounts payable under this section.
11. As a condition of this Authorization, the Licensee shall employ a Gwich'in Environmental Monitor for the entire period of the operation, at a daily rate of \$300.00 per day which will be invoiced by the GLA. The Gwich'in Environmental Monitor will provide any necessary access through gates; observe operations and report incidents, breaches and work-completed daily to the Land Manager.
12. The Land Manager may cancel this Authorization in the event that the Licensee or any of its agents, contractors, or creditors institutes bankruptcy proceedings, are adjudicated as bankrupt or insolvent, or make an assignment for the benefit of creditors. Notice of such cancellation shall be made by the Land Manager in writing and shall be effective immediately upon receipt by the Licensee.

13. Upon expiry or sooner termination of this Authorization, the Licensee shall:
  - (a) Cease all operations involved in the development of the access route;
  - (b) Cease occupation of the access route. All vehicles, machinery, equipment and constructions shall be removed within 24 hours, except as noted below;
  - (c) Submit a report of the events leading up to the termination, within 48 hours;
  - (d) Submit a complete report of all activities of the Licensee on the site for the entire period of this Authorization;
  - (e) "Within ten days from the expiry or termination of this Authorization, the Licensee shall clean up the crossing to the satisfaction of the Land Manager.
14. This Authorization is granted solely to authorize the development of land crossings. Any activity the Licensee conducts outside the authorized boundary of the crossing may be considered an act of trespass and may result in penalties.
15. This Authorization does not create any rights of tenancy, possessor rights, or exclusive rights of use or occupation, by implication or otherwise; this Authorization shall not prevent the operations of any existing or future rights granted by the Land Manager.
16. This Authorization shall not be assigned or otherwise transferred without written request to and the consent of the Land Manager. The Licensee must specify in writing to the Land Manager what is to be done with the security deposit provided by the Licensee. If the security deposit is to be returned to the licensee, then the assignee shall be required to provide an equivalent security deposit before the assignment of this Authorization consented to by the Land Manager.
17. The Licensee shall pay all charges, taxes, penalties and assessments whatsoever which, during or after the Authorizations term, become due and payable in respect of the Licensee's development of the crossing.
18. The Licensee shall indemnify and save harmless the Gwich'in Tribal Council and the Gwich'in Land Administration (including interest, penalties lawyer's fees and amounts paid in investigation, defending or settling any of the forgoing) arising out of or in connection with the actions or failure to act of the licensee (including but not limited to its staff, servants, agents, contractors, successors or assigns) regardless of whether:
  - (a) the Licensee is operating on, or off the access route;
  - (b) the operations were negligently performed;
  - (c) the claim arises from an act or omission of the Licensee;
  - (d) the Licensee is exercising or purporting to exercise rights granted by this Authorization; or,
  - (e) any other circumstances.

- 19. The Licensee shall assume full liability for the safety of all persons working on or near the crossing. The Licensee shall operate according to all health and safety legislation, regulations and guidelines applicable to this operation. The Licensee shall consider adequate traffic safety; hazards related to access, noise, water, equipment safety; and any other matter that conditions dictate.
- 20. The Licensee and all operational personnel shall have comprehensive general liability insurance of not less than \$2,000,000 per accident or occurrence, or to such limits as may be stipulated, in writing, by the Land Manager. Proof of such policies shall be delivered to the Land Manager not less than 48 hours before entering the crossing to commence operations.
- 21. Any notice given pursuant to this Authorization shall be delivered in person, or sent by registered mail to:  
  

Gwich'in Tribal Council P.O. Box 1509, Inuvik, NT, X0E 0T0 Attention: Land Manager	Rat River Development Corporation P.O. Box 86 Fort McPherson, NT X0E 0J0 Attention: President Abe Wilson
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A party changing its address shall provide this information by written notice to the other party.
- 22. The Gwich'in Tribal Council and Gwich'in Land Administration reserve the right to add, amend or remove any terms and conditions or terminate any present or future Access Authorization.
- 23. The Licensee's obligations as set out herein survive beyond the expiry or termination of this Authorization.

Issued this 3<sup>rd</sup> day of August 2001; in the Town of Inuvik, in the Northwest Territories.

Howard R. Townsend

Date August 13, 2001

Howard R. Townsend, Land Manager  
Gwich'in Tribal Council

Abe Wilson

Date Aug 13, 2001

Abe Wilson,  
Rat River Development Corporation

J.P.B.

Witness

Date Aug 13, 2001

Sharon Anoushke

Witness

Date Aug. 13, 2001

**SCHEDULE 1.****SCHEDULE OF COSTS FOR THE CARIBOU / PEEL RIVER  
ENVIRONMENTAL PROJECT**

The following costs are required from the Rat River Development Corporation (RRDC) unless otherwise waived:

- Temporary Sites (camps, staging areas, etc.) - \$6,000 per hectare initial payment and \$1,500 per hectare annual rent
- Winter Access Roads - \$300 per kilometer one time payment, and \$200 per kilometer annually thereafter until the Access is no longer used.
- Borrow Pit - \$1,200 initial payment with \$2.20 per cubic meter of material to be removed.

Using the above rates, the RRDC is expected to pay for (#G01A02):

1. 19.5 kilometers X \$300 = \$5,850; plus
2. Excavation site on the YT application: The reclamation site itself [treated as a borrow pit] requires \$1,200 for an initial payment; with
3. \$2.20 per cubic meter of material to be removed. This is expected to amount to 1,500 cubic meters of non-hazardous material plus 500 cubic meters of hazardous material for a total cost of material removed of \$4,400.

The initial payment of the borrow site, materials extracted and the distance rate equals \$11,450.



## Gwich'in Access Authorization

Authorization # G01A01

GLA File #5475.15.12

All rights and privileges created by this Authorization are subject to all relevant conditions in the Gwich'in Comprehensive Land Claim Agreement, as well as the conditions expressed in herein. This Authorization assigns specific rights and obligations to Rat River Development Corporation referred to herein as the Licensee. All obligations of the Licensee also apply to its staff, servants, agents, licensees, contractors, successors or assignees. The Licensee is hereby given the non-exclusive right to cross to a specified area. The access is located on Gwich'in Lands, namely, Parcels P, 25 and 27 as referenced in Appendix F of the Gwich'in Comprehensive Land Claim Agreement. The area specified for the access is hereinafter referred to as the "crossing". Access to the crossing for the proposed activity described herein is hereby granted. The actions of the licensee are monitored on behalf of the Land Manager and its agents or any person duly authorized by the Land Manager (hereinafter referred to collectively as the Land Manager).

### TERMS AND CONDITIONS

The following terms and conditions apply to this Authorization:

1. This Authorization is valid from September 2001 to April 30<sup>th</sup> 2002, ground conditions permitting.
2. In consideration of this Authorization being granted, the Licensee agrees to meet all terms and conditions contained in the Permit issued by the Gwich'in Land and Water Board.
3. The Licensee shall pay to the Land Manager the amount of \$220.00 for the consultation process.
4. The Licensee agrees to pay the applicable fees referred to in Schedule 1, attached to this Authorization for the use of the crossing and the materials or resources to be taken from the lands.
5. The Land Manager and/or staff may enter upon the site at all reasonable times for the purpose of inspecting access, working area dimensions, or any other matters.
6. The Licensee agrees that it will indemnify and save harmless the Gwich'in Tribal Council for any and all damages caused by the Licensee, its staff or its agents, whether on or off the crossing as a result of any construction, operation, or other act or failure to act. Including but not limited to damages to land, gates, fences, roads, machinery, culverts, bridges and or buildings on or near the site or any other Gwich'in Lands.

7. The Licensee has the right to unload and store material, (except fuel), vehicles, supplies and equipment on or near the access route, at such times only for the activity authorized by this Authorization, and only in accordance with its terms. Washing of vehicles, supplies, equipment or surface materials is prohibited on the access lands or any Gwich'in Lands.
8. The Licensee shall immediately notify the Land Manager of any artifact, burial pit, grave or any other item of archaeological interest discovered by the Licensee in the course of its operations. The Licensee shall continue its operations in a manner so as to avoid any damage to the artifact and to ensure its protection. If so requested by the Land Manager, the Licensee shall, at its own expense, deliver the item to the Land Manager.
9. The Licensee may, upon ten days written notice to the Land Manager, to cease the use and occupation of the crossing. This Authorization shall expire ten days after the receipt, of such a notice, subject to any other conditions contained herein.
10. Where in the opinion of the Land Manager, the Licensee has breached a condition of this Authorization:
  - (a) The Land Manager shall, provide written notice of such a breach and outline the particulars of the breach and the requirements that the Licensee remedy the breach.
  - (b) If the Licensee fails to remedy the breach to the satisfaction of the Land Manager within seven days of receipt of such a notice, the Land Manager may;
  - (c) Take necessary steps to remedy the breach and recover the costs of any such action from the Licensee; and or
  - (d) Terminate this Authorization by written notice to the Licensee. Such termination shall be effective immediately upon receipt by the Licensee.
  - (e) Once the Licensee has received notice that it has breached a condition of this Authorization it shall not continue development of the crossing without the written consent of the Land Manager until such time as the breach has been corrected to the satisfaction of the Land Manager.
  - (f) The Licensee shall be responsible, under this section for any and all costs incurred in remedying the breach plus interest at the bank of Canada rate plus two per cent from the date that the costs were incurred by the Land Manager to the date of the reimbursement by the Licensee. The Licensee shall also be responsible for the costs of the Land Manager on a solicitor client basis for any legal action undertaken by the Land Manager to recover amounts payable under this section.
11. As a condition of this Authorization, the Licensee shall employ a Gwich'in Environmental Monitor for the entire period of the operation at the rate of \$300.00 per day to be invoiced by the GLA. The Gwich'in Environmental Monitor will provide any necessary access through gates; observe operations and report incidents, breaches and work-completed daily to the Land Manager.
12. The Land Manager may cancel this Authorization in the event that the Licensee or any of its agents, contractors, or creditors institutes bankruptcy proceedings, are adjudicated as bankrupt or insolvent, or make an assignment for the benefit of creditors. Notice of such cancellation shall be made by the Land Manager in writing and shall be effective immediately upon receipt by the Licensee.

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- (a) Cease all operations involved in the development of the access route;
  - (b) Cease occupation of the access route. All vehicles, machinery, equipment and constructions shall be removed within 24 hours, except as noted below;
  - (c) Submit a report of the events leading up to the termination, within 48 hours;
  - (d) Submit a complete report of all activities of the Licensee on the site for the entire period of this Authorization;
  - (e) \*Within ten days from the expiry or termination of this Authorization, the Licensee shall clean up the crossing to the satisfaction of the Land Manager.
14. This Authorization is granted solely to authorize the development of land crossings. Any activity the Licensee conducts outside the authorized boundary of the crossing may be considered an act of trespass and may result in penalties.
15. This Authorization does not create any rights of tenancy, possessor rights, or exclusive rights of use or occupation, by implication or otherwise; this Authorization shall not prevent the operations of any existing or future rights granted by the Land Manager.
16. This Authorization shall not be assigned or otherwise transferred without written request to and the consent of the Land Manager. The Licensee must specify in writing to the Land Manager what is to be done with the security deposit provided by the Licensee. If the security deposit is to be returned to the licensee, then the assignee shall be required to provide an equivalent security deposit before the assignment of this Authorization consented to by the Land Manager.
17. The Licensee shall pay all charges, taxes, penalties and assessments whatsoever which, during or after the Authorizations term, become due and payable in respect of the Licensee's development of the crossing.
18. The Licensee shall indemnify and save harmless the Gwich'in Tribal Council and the Gwich'in Land Administration (including interest, penalties lawyer's fees and amounts paid in investigation, defending or settling any of the forgoing) arising out of or in connection with the actions or failure to act of the Licensee (including but not limited to its staff, servants, agents, contractors, successors or assigns) regardless of whether:
- (a) the Licensee is operating on, or off the access route;
  - (b) the operations were negligently performed;
  - (c) the claim arises from an act or omission of the Licensee;
  - (d) the Licensee is exercising or purporting to exercise rights granted by this Authorization; or,
  - (e) any other circumstances.

- 19. The Licensee shall assume full liability for the safety of all persons working on or near the crossing. The Licensee shall operate according to all health and safety legislation, regulations and guidelines applicable to this operation. The Licensee shall consider adequate traffic safety; hazards related to access, noise, water; equipment safety; and any other matter that conditions dictate.
- 20. The Licensee and all operational personnel shall have comprehensive general liability insurance of not less than \$2,000,000 per accident or occurrence, or to such limits as may be stipulated, in writing, by the Land Manager. Proof of such policies shall be delivered to the Land Manager not less than 48 hours before entering the crossing to commence operations.
- 21. Any notice given pursuant to this Authorization shall be delivered in person, or sent by registered mail to:
 

<p>Gwich'in Tribal Council          P.O. Box 1509, Inuvik, NT, X0E 0T0          Attention: Land Manager</p>	<p>Rat River Development Corporation          P.O. Box 86 Fort McPherson, NT X0E 0J0          Attention: President Abe Wilson</p>
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A party changing its address shall provide this information by written notice to the other party.
- 22. The Gwich'in Tribal Council and Gwich'in Land Administration reserve the right to add, amend or remove any terms and conditions or terminate any present or future Access Authorization.
- 23. The Licensee's obligations as set out herein survive beyond the expiry or termination of this Authorization.

Issued this 3<sup>rd</sup> day of August 2001; in the Town of Inuvik, in the Northwest Territories.

Howard R. Townsend

Date August 13, 2001

Howard R. Townsend, Land Manager  
Gwich'in Tribal Council

Abe Wilson

Date Aug. 07, 2001

Abe Wilson,  
Rat River Development Corporation

JP B...

Witness

Date Aug 13, 2001

Kayel Keupoo

Witness

Date Aug 07, 2001

SCHEDULE 1.SCHEDULE OF COSTS FOR THE CARIBOU / PEEL RIVER  
ENVIRONMENTAL PROJECT

The following costs are required from the Rat River Development Corporation (RRDC) unless otherwise waived:

- Temporary Sites (camps, staging areas, etc.) - \$6,000 per hectare initial payment and \$1,500 per hectare annual rent
- Winter Access Roads - \$300 per kilometer one time payment, and \$200 per kilometer annually thereafter until the Access is no longer used.
- Borrow Pit - \$1,200 initial payment with \$2.20 per cubic meter of material to be removed.

Using the above rates, the RRDC is expected to pay for (#G01A01):

1. 40.8 kilometers X \$300 = \$12,240

The costs to be charged to the applicant for access through this Authorization is \$12,460.

**APPENDIX B:  
HEALTH AND SAFETY PLAN, EMERGENCY AND SPILL  
RESPONSE PLAN**

***Pending Receipt from the Prime Contractor***

**APPENDIX C:  
ALS ENVIRONMENTAL LABORATORY REPORT FOR DDT,  
METALS, HYDROCARBONS AND VOC IN SAMPLES**



# CHEMICAL ANALYSIS REPORT

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**Date:** March 27, 2002

**ALS File No.** P2224

**Report On:** North Soil Analysis

**Report To:** **Royal Roads University**  
Applied Research Division  
2005 Sooke Road  
Victoria, BC  
V9B 5Y2

**Attention:** **Dr. Matthew Dodd**

**Received:** February 28, 2002

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**ALS ENVIRONMENTAL**

per:

Frederick Chen, B.Sc. - Manager, Special Projects  
Scott P. Hoekstra, B.Sc. - Project Chemist

File No. P2224

**RESULTS OF ANALYSIS - Sediment/Soil<sup>1</sup>**



Sample ID	B1-1	CO-1	F2-1	E3-2	DO-2
Sample Date	02 02 20	02 02 20	02 02 20	02 02 23	02 02 23
ALS ID	1	2	3	4	5

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**Physical Tests**

Moisture %	6.4	6.3	17.9	15.9	11.7
pH	-	-	-	-	-

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< = Less than the detection limit indicated.  
EPH = Extractable Petroleum Hydrocarbons.  
<sup>1</sup>Results are expressed as milligrams per dry kilogram except where noted.

**RESULTS OF ANALYSIS - Sediment/Soil<sup>1</sup>**

Sample ID E3-2  
 Sample Date 02 02 23  
 ALS ID 4

**Halogenated Volatiles**

Bromodichloromethane	<0.01
Bromoform	<0.01
Carbon Tetrachloride	<0.01
Chlorobenzene	<0.01
Chloroethane	<0.01
Chloroform	<0.01
Chloromethane	<0.01
Dibromochloromethane	<0.01
1,2-Dichlorobenzene	<0.01
1,3-Dichlorobenzene	<0.01
1,4-Dichlorobenzene	<0.01
1,1-Dichloroethane	<0.01
1,2-Dichloroethane	<0.01
cis-1,2-Dichloroethylene	<0.01
trans-1,2-Dichloroethylene	<0.01
1,1-Dichloroethylene	<0.01
Dichloromethane	<0.05
1,2-Dichloropropane	<0.01
cis-1,3-Dichloropropylene	<0.01
trans-1,3-Dichloropropylene	<0.01
1,1,1,2-Tetrachloroethane	<0.01
1,1,2,2-Tetrachloroethane	<0.01
Tetrachloroethylene	<0.01
1,1,1-Trichloroethane	<0.01
1,1,2-Trichloroethane	<0.01
Trichloroethylene	<0.01
Trichlorofluoromethane	<0.01
Vinyl Chloride	<0.01

**Non-Halogenated Volatiles**

Benzene	<0.01
Ethylbenzene	<0.01
Styrene	<0.01
Toluene	<0.01
meta- & para-Xylene	<0.01
ortho-Xylene	<0.01

< = Less than the detection limit indicated.

EPH = Extractable Petroleum Hydrocarbons.

<sup>1</sup>Results are expressed as milligrams per dry kilogram except where noted.

**RESULTS OF ANALYSIS - Sediment/Soil<sup>1</sup>**



Sample ID	B1-1	CO-1	F2-1	E3-2	DO-2
Sample Date	02 02 20	02 02 20	02 02 20	02 02 23	02 02 23
ALS ID	1	2	3	4	5

**Organochlorine Pesticides**

2,4'-DDD	<0.01	<0.01	<0.01	<0.01	0.04
4,4'-DDD	<0.01	<0.01	<0.01	<0.01	0.39
2,4'-DDE	<0.01	<0.01	<0.01	<0.01	<0.01
4,4'-DDE	<0.01	<0.01	<0.01	<0.01	0.02
2,4'-DDT	<0.01	<0.01	<0.01	<0.01	0.48
4,4'-DDT	<0.01	<0.01	<0.01	<0.01	3.82

< = Less than the detection limit indicated.

EPH = Extractable Petroleum Hydrocarbons.

<sup>1</sup>Results are expressed as milligrams per dry kilogram except where noted.

File No. P2224

**RESULTS OF ANALYSIS - Sediment/Soil <sup>1</sup>**



Sample ID	D2-2	C4-2	E1-1	B3-2	DUP-1
Sample Date	02 02 23	02 02 23	02 02 20	02 02 23	02 02 23
ALS ID	6	7	8	9	10

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**Physical Tests**

Moisture	%	23.1	18.0	33.6	22.2	14.7
pH		-	-	-	-	-

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< = Less than the detection limit indicated.

EPH = Extractable Petroleum Hydrocarbons.

<sup>1</sup>Results are expressed as milligrams per dry kilogram except where noted.

**RESULTS OF ANALYSIS - Sediment/Soil<sup>1</sup>**



Sample ID	D2-2	C4-2	E1-1	B3-2	DUP-1
Sample Date	02 02 23	02 02 23	02 02 20	02 02 23	02 02 23
ALS ID	6	7	8	9	10

**Organochlorine Pesticides**

2,4'-DDD	0.07	0.58	0.02	<0.01	<0.01
4,4'-DDD	0.31	1.04	0.06	<0.01	<0.01
2,4'-DDE	<0.01	0.01	<0.01	<0.01	<0.01
4,4'-DDE	0.02	0.06	0.01	<0.01	<0.01
2,4'-DDT	0.45	0.51	0.02	<0.01	<0.01
4,4'-DDT	2.43	3.27	0.46	<0.01	<0.01

< = Less than the detection limit indicated.  
 EPH = Extractable Petroleum Hydrocarbons.  
<sup>1</sup>Results are expressed as milligrams per dry kilogram except where noted.

RESULTS OF ANALYSIS - Sediment/Soil<sup>1</sup>

Sample ID		A3-2	D1-2	BO-1	F1-1	C3-2
Sample Date		02 02 23	02 02 23	02 02 20	02 02 20	02 02 23
ALS ID		11	12	13	14	15
<b>Physical Tests</b>						
Moisture	%	-	-	-	-	-
pH		9.55	9.30	8.12	7.94	8.36
<b>Total Metals</b>						
Antimony	T-Sb	<10	<10	<10	<10	<10
Arsenic	T-As	19	18	21	14	18
Barium	T-Ba	550	861	463	473	541
Beryllium	T-Be	<0.5	0.6	<0.5	<0.5	0.5
Cadmium	T-Cd	0.6	0.6	0.8	0.7	0.6
Chromium	T-Cr	13	16	14	16	16
Cobalt	T-Co	9	10	10	9	11
Copper	T-Cu	26	35	26	29	30
Lead	T-Pb	<50	<50	<50	<50	<50
Mercury	T-Hg	<0.05	0.06	0.06	0.08	0.07
Molybdenum	T-Mo	<4	<4	<4	<4	<4
Nickel	T-Ni	26	31	31	30	34
Selenium	T-Se	<4	<3	<4	<2	<3
Silver	T-Ag	<2	<2	<2	<2	<2
Tin	T-Sn	<5	<5	<5	<5	<5
Vanadium	T-V	42	47	46	44	47
Zinc	T-Zn	97	114	111	115	113

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File No. P2224

**RESULTS OF ANALYSIS - Sediment/Soil<sup>1</sup>**



Sample ID	C1-2	C2-2	D1-1	E2-1	B1-2
Sample Date	02 02 23	02 02 23	02 02 20	02 02 20	02 02 23
ALS ID	16	17	18	19	20
<hr/>					
<b>Physical Tests</b>					
Moisture %	13.1	10.5	34.6	16.2	6.5
pH	-	-	-	-	-

< = Less than the detection limit indicated.  
EPH = Extractable Petroleum Hydrocarbons.  
<sup>1</sup>Results are expressed as milligrams per dry kilogram except where noted.

**RESULTS OF ANALYSIS - Sediment/Soil<sup>1</sup>**

Sample ID	C1-2	C2-2	D1-1	E2-1
Sample Date	02 02 23	02 02 23	02 02 20	02 02 20
ALS ID	16	17	18	19
<b><u>Halogenated Volatiles</u></b>				
Bromodichloromethane	<0.01	<0.01	<0.01	<0.01
Bromoform	<0.01	<0.01	<0.01	<0.01
Carbon Tetrachloride	<0.01	<0.01	<0.01	<0.01
Chlorobenzene	<0.01	<0.01	<0.01	<0.01
Chloroethane	<0.01	<0.01	<0.01	<0.01
Chloroform	<0.01	<0.01	<0.01	<0.01
Chloromethane	<0.01	<0.01	<0.01	<0.01
Dibromochloromethane	<0.01	<0.01	<0.01	<0.01
1,2-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01
1,3-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01
1,4-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01
1,1-Dichloroethane	<0.01	<0.01	<0.01	<0.01
1,2-Dichloroethane	<0.01	<0.01	<0.01	<0.01
cis-1,2-Dichloroethylene	<0.01	<0.01	<0.01	<0.01
trans-1,2-Dichloroethylene	<0.01	<0.01	<0.01	<0.01
1,1-Dichloroethylene	<0.01	<0.01	<0.01	<0.01
Dichloromethane	<0.05	<0.05	0.05	<0.05
1,2-Dichloropropane	<0.01	<0.01	<0.01	<0.01
cis-1,3-Dichloropropylene	<0.01	<0.01	<0.01	<0.01
trans-1,3-Dichloropropylene	<0.01	<0.01	<0.01	<0.01
1,1,1,2-Tetrachloroethane	<0.01	<0.01	<0.01	<0.01
1,1,2,2-Tetrachloroethane	<0.01	<0.01	<0.01	<0.01
Tetrachloroethylene	<0.01	<0.01	<0.01	<0.01
1,1,1-Trichloroethane	<0.01	<0.01	<0.01	<0.01
1,1,2-Trichloroethane	<0.01	<0.01	<0.01	<0.01
Trichloroethylene	<0.01	<0.01	<0.01	<0.01
Trichlorofluoromethane	<0.01	<0.01	<0.01	<0.01
Vinyl Chloride	<0.01	<0.01	<0.01	<0.01
<b><u>Non-Halogenated Volatiles</u></b>				
Benzene	<0.01	<0.01	<0.01	<0.01
Ethylbenzene	<0.01	<0.01	<0.01	<0.01
Styrene	<0.01	<0.01	<0.01	<0.01
Toluene	<0.01	<0.01	<0.01	<0.01
meta- & para-Xylene	<0.01	<0.01	<0.01	<0.01
ortho-Xylene	<0.01	<0.01	<0.01	<0.01

< = Less than the detection limit indicated.

EPH = Extractable Petroleum Hydrocarbons.

<sup>1</sup>Results are expressed as milligrams per dry kilogram except where noted.

File No. P2224

**RESULTS OF ANALYSIS - Sediment/Soil<sup>1</sup>**



Sample ID	C1-2	C2-2	B1-2
Sample Date	02 02 23	02 02 23	02 02 23
ALS ID	16	17	20
<hr/>			
<b><u>Extractable Hydrocarbons</u></b>			
EPH10-19	<200	<200	<200
EPH19-32	<200	<200	<200

---

< = Less than the detection limit indicated.  
EPH = Extractable Petroleum Hydrocarbons.  
<sup>1</sup>Results are expressed as milligrams per dry kilogram except where noted.

File No. P2224

**RESULTS OF ANALYSIS - Sediment/Soil <sup>1</sup>**



Sample ID	C1-1
Sample Date	02 02 21
ALS ID	21

---

**Physical Tests**

Moisture	%	24.6
pH		-

---

< = Less than the detection limit indicated.

EPH = Extractable Petroleum Hydrocarbons.

<sup>1</sup>Results are expressed as milligrams per dry kilogram except where noted.

File No. P2224

**RESULTS OF ANALYSIS - Sediment/Soil<sup>1</sup>**



Sample ID	C1-1
Sample Date	02 02 21
ALS ID	21

---

**Extractable Hydrocarbons**

EPH10-19	382
EPH19-32	338

---

< = Less than the detection limit indicated.  
EPH = Extractable Petroleum Hydrocarbons.  
<sup>1</sup>Results are expressed as milligrams per dry kilogram except where noted.

File No. P2224

**RESULTS OF ANALYSIS - Water<sup>1</sup>**



Sample ID PEEL W1  
Sample Date 02 02 24  
ALS ID 23

---

**Organochlorine Pesticides**

2,4'-DDD	0.00001
4,4'-DDD	0.00002
2,4'-DDE	<0.00001
4,4'-DDE	<0.00001
2,4'-DDT	0.00002
4,4'-DDT	0.00004

---

< = Less than the detection limit indicated.

EPH = Extractable Petroleum Hydrocarbons.

<sup>1</sup>Results are expressed as milligrams per litre except where noted.

## Appendix 1 - QUALITY CONTROL - Replicates



Sediment/Soil <sup>1</sup>	F1-1	F1-1
	02 02 20	QC # 277198
<hr/>		
<b>Physical Tests</b>		
pH	7.94	7.88
<b>Total Metals</b>		
Antimony T-Sb	<10	<10
Arsenic T-As	14	14
Barium T-Ba	473	484
Beryllium T-Be	<0.5	<0.5
Cadmium T-Cd	0.7	0.6
Chromium T-Cr	16	17
Cobalt T-Co	9	10
Copper T-Cu	29	28
Lead T-Pb	<50	<50
Mercury T-Hg	0.08	0.07
Molybdenum T-Mo	<4	<4
Nickel T-Ni	30	30
Selenium T-Se	<2	<2
Silver T-Ag	<2	<2
Tin T-Sn	<5	<5
Vanadium T-V	44	44
Zinc T-Zn	115	115

< = Less than the detection limit indicated.  
 EPH = Extractable Petroleum Hydrocarbons.  
 Results are expressed as milligrams per dry kilogram except where noted.

## Appendix 2 - METHODOLOGY



Outlines of the methodologies utilized for the analysis of the samples submitted are as follows

### Moisture in Sediment/Soil

This analysis is carried out gravimetrically by drying the sample at 103 C for a minimum of six hours.

Recommended Holding Time:

Sample: 14 days

Reference: Puget

For more detail see ALS Environmental "Collection & Sampling Guide"

### Organochlorine Pesticides in Sediment/Soil (GC/ECD)

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Methods 3540, 3545, 3610, 3630, 3660 & 8081, published by the United States Environmental Protection Agency (EPA). The procedure uses an automated system (Accelerated Solvent Extractor - ASE) at high temperature and pressure or a Soxhlet system to extract a subsample of the sediment/soil with dichloromethane. The extract is then solvent exchanged to hexane followed by one or more of the following clean-up procedures (if required): alumina clean-up, silica gel clean-up and/or sulphur clean-up. The final extract is analysed by dual capillary column gas chromatography with electron capture detection (GC/ECD).

Recommended Holding Time:

Sample: 14 days                      Extract: 40 days

Reference: EPA

For more detail see ALS Environmental "Collection & Sampling Guide"

### Volatile Organic Compounds in Sediment/Soil

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Methods 5030 & 8260, published by the United States Environmental Protection Agency (EPA). The procedure involves a purge and trap extraction of the volatile compounds with subsequent analysis by capillary column gas chromatography with mass selective detection (GC/MS).

Recommended Holding Time:

Sample: 14 days                      Extract: NA

Reference: EPA

For more detail see ALS Environmental "Collection & Sampling Guide"

### pH in Soil

This analysis is carried out in accordance with procedures described in "Soil Sampling and Methods of Analysis" (CSSS). The procedure involves mixing the air-dried sample with deionized/distilled water. The pH of the solution is then measured using a standard pH probe. A one to two ratio of sediment to water is used for mineral soils and a one to ten ratio is used for highly organic soils.

## Appendix 2 - METHODOLOGY - Continued



### Metals in Sediment/Soil

Method Revised and Replaced: 2002 03 20

### Extractable Hydrocarbons in Sediment/Soil

This analysis is carried out in accordance with the British Columbia Ministry of Environment, Lands and Parks (BCMELP) Analytical Method for Contaminated Sites "Extractable Petroleum Hydrocarbons in Solids by GC/FID, Version 2.1 July 1999". The procedure uses an automated system (Accelerated Solvent Extractor - ASE) to extract a subsample of the sediment/soil with a 1:1 mixture of hexane and acetone at high temperature and pressure. The extract is then solvent exchanged to toluene and analysed by capillary column gas chromatography with flame ionization detection (GC/FID). EPH results include Polycyclic Aromatic Hydrocarbons (PAH) and are therefore not equivalent to Light and Heavy Extractable Petroleum Hydrocarbons (LEPH/HEPH).

Recommended Holding Time:

Sample: 14 days

Extract: 40 days

Reference: BCMELP

For more detail see ALS Environmental "Collection & Sampling Guide"

### Organochlorine Pesticides in Water

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Methods 3510, 3610, 3630, 3660 & 8081, published by the United States Environmental Protection Agency (EPA). The procedure involves extraction of the entire water sample with dichloromethane. The extract is then solvent exchanged to hexane followed by one or more of the following clean-up procedures (if required): alumina clean-up, silica gel clean-up and/or sulphur clean-up. The final extract is analysed by dual capillary column gas chromatography with electron capture detection (GC/ECD) and/or mass spectrometric detection (GC/MS).

Recommended Holding Time:

Sample: 7 days

Extract: 40 days

Reference: EPA

For more detail see ALS Environmental "Collection & Sampling Guide"

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**End of Report**



