An Environmental Assessment of Radio Island, NWT

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March 1997
RMC-CCE-ES-97-16

ACKNOWLEDGMENTS

This project was supported by DIAND under the Action on Waste component of the Arctic Environmental Strategy. The authors would like to particularly acknowledge the support of two individuals in Indian and Northern Affairs Canada: Mr. Scott Mitchell, Regional Manager (Action on Waste), Yellowknife and Dan Elliott, District Manager, Iqaluit.

The analytical work was primarily conducted by the Analytical Services Unit at Queen's University and by Axys Analytical Services. These labs, as they have in the past, demonstrated high professional standards which facilitated the production of this report. Particular thanks are due to the laboratory technicians at Axys, and to Paula Whitley and the laboratory technicians at Analytical Services Unit. Thanks are also given to the Environmental Sciences Group Analytical Laboratory and the University of Western Ontario Occupational Health and Safety Resource Centre for assistance with specific samples.

We would also like to thank Lewis Andrews and Kevin Budgell from Canadian Helicopters for their professionalism and assistance. Thanks are also due to Joe Adams of Iqaluit, who was our bear monitor.

This research was conducted by the Environmental Sciences Group at Royal Military College, headed by Dr. Ken Reimer who assumed overall editorial control. The field study was conducted by Natalie Plato, Sandra Englander, Kim Baker, Adamie Ipeelie and Robert Eno. The site assessment was written by Natalie Plato, Marjorie Pine wrote the methods section, Pat Fortin provided the QA/QC section, Dawn Pier identified the plants, and Dave Pier produced the maps. In addition, Sandra Englander, John Poland and Doug Noonan provided logistical support for the field work; Pat Fortin managed the data and Deborah Reimer administered the project. Thanks are also due to Marjorie Pine for her editorial assistance.

EXECUTIVE SUMMARY

An environmental assessment of Radio Island was conducted by the Environmental Sciences Group from the Royal Military College (RMC), Kingston Ontario in August 1996. The site assessment was at the request of Indian and Northern Affairs Canada (DIAND) under the Action on Waste (AOW) component of the Arctic Environmental Strategy (AES). The purpose of the assessment was three-fold: to determine whether there was any chemical contamination on the island, to determine whether any contamination found was having an impact on the environment, and to identify cleanup requirements for the site.

Radio Island, located off the southern extremity of Resolution Island at the southeastern tip of Baffin Island (see Map I-1), was operated as a navigational aid and weather station from 1929 to 1961. The island is about 1 km long, north by south, and 0.5 km wide. It is situated on Canadian shield bedrock and consists of parallel rock ridges with soil restricted to isolated pockets in the gullies. There are no roads or airstrip. There is a beaching area on the north side of the island (Acadia Cove) in a natural bay. At the time of the ESG visit, there were two buildings left from the original site, and the remains of four others, as well as a light beacon tower located to the southwest of the main site. There was a fair amount of debris, which had been scattered over the island, presumably by winds over the past thirty-five years, and had accumulated in the gullies.

A total of 82 soil, 12 plant, 8 water, 2 paint, and 2 miscellaneous samples were collected from various locations around the island. All samples were analyzed for inorganic elements, and half of the samples were analyzed for PCBs. The results were compared to the DEW Line Cleanup Criteria (DCC), as well as to results for the background samples and the Canadian Council of Ministers of the Environment (CCME) Assessment Criteria. No samples contained PCBs in excess of the DCC. However, 46 samples contained inorganic elements in excess of the DCC. In addition, a few samples were analyzed for PAHs, pesticides, chlorinated hydrocarbons, TPH, asbestos and leachable inorganics. One sample contained PAHs at concentrations in excess of the Criteria for Managing Contaminated Sites in British Columbia. Three samples exceeded both the Ontario Leachate Criteria and the British Columbia Leachate Criteria for lead.

In conclusion, there is extensive inorganic contamination at Radio Island, which should be remediated according to the DEW Line Cleanup Protocol (the general approach used for the cleanup of contaminated northern sites). Non-hazardous debris should be

placed in a properly engineered landfill, and soil containing contaminants in excess of DCC Tier II (estimated volume 310 m^3) should be removed from contact with the ecosystem. Hazardous debris and leachate toxic soil (estimated volume 20 m^3) should be disposed of according to appropriate regulations.

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I. INTRODUCTION

A. Location and History of Radio Island

Radio Island is located on the southern tip of Resolution Island (see Map I-1), off the south eastern tip of Baffin Island. Its location is 61°18'N and 64°52'W, as determined by a Trimble Ensign GPS (Global Positioning System). The island is approximately 1.0 km long and 0.5 km wide. Approaches are by sea at Acadia Cove and air only by helicopter. The site is relatively small and consists of two intact structures, the remains of four other structures and a light beacon tower. Map I-2 shows the general site layout. Photograph I-1 shows the Main Site and Photograph I-2 shows the light beacon tower situated on the southwest end of the island.

The station, originally known as Resolution Island even though it was on Radio Island, was set up in 1929 by the Canadian Department of Transport. It operated year round as a navigational aid and weather station until October 1961 when the personnel were evacuated to Frobisher Bay. The station was moved to Cape Warwick on the northeast corner of Resolution Island in March 1962 and finally closed in 1975 (K. O'Rielly, pers. comm.).

B. General Site Characteristics

The site is situated on Canadian Shield bedrock. The surrounding terrain consists of tilted bedrock with parallel rock ridges, knolls and shallow gullies forming a series of ledges. Soil is restricted to isolated pockets in these gullies and valleys and is virtually nonexistent in other areas. A few minor till deposits occur on the site.

The climate is classified as sub-Arctic and there is considerable moisture in the form of rain, fog, ice and snow. Vegetation at Radio Island is limited to the valleys and other low-lying areas where there is sufficient soil for growth. However, moss covers most of the low-lying areas.

Resolution Island (and hence Radio Island) has been reported in previous studies to be a denning area for polar bears, and these animals have been known to frequent the site (1 CEU 1990). During the site visit, at least 19 polar bears were spotted in the vicinity, and two were seen on Radio Island. The island is also along the migration routes of whales; other marine mammals including whales, seals and walruses are attracted to this area by the numerous species of fish living in nearby waters (ESG 1994).

C. Assessment Objectives

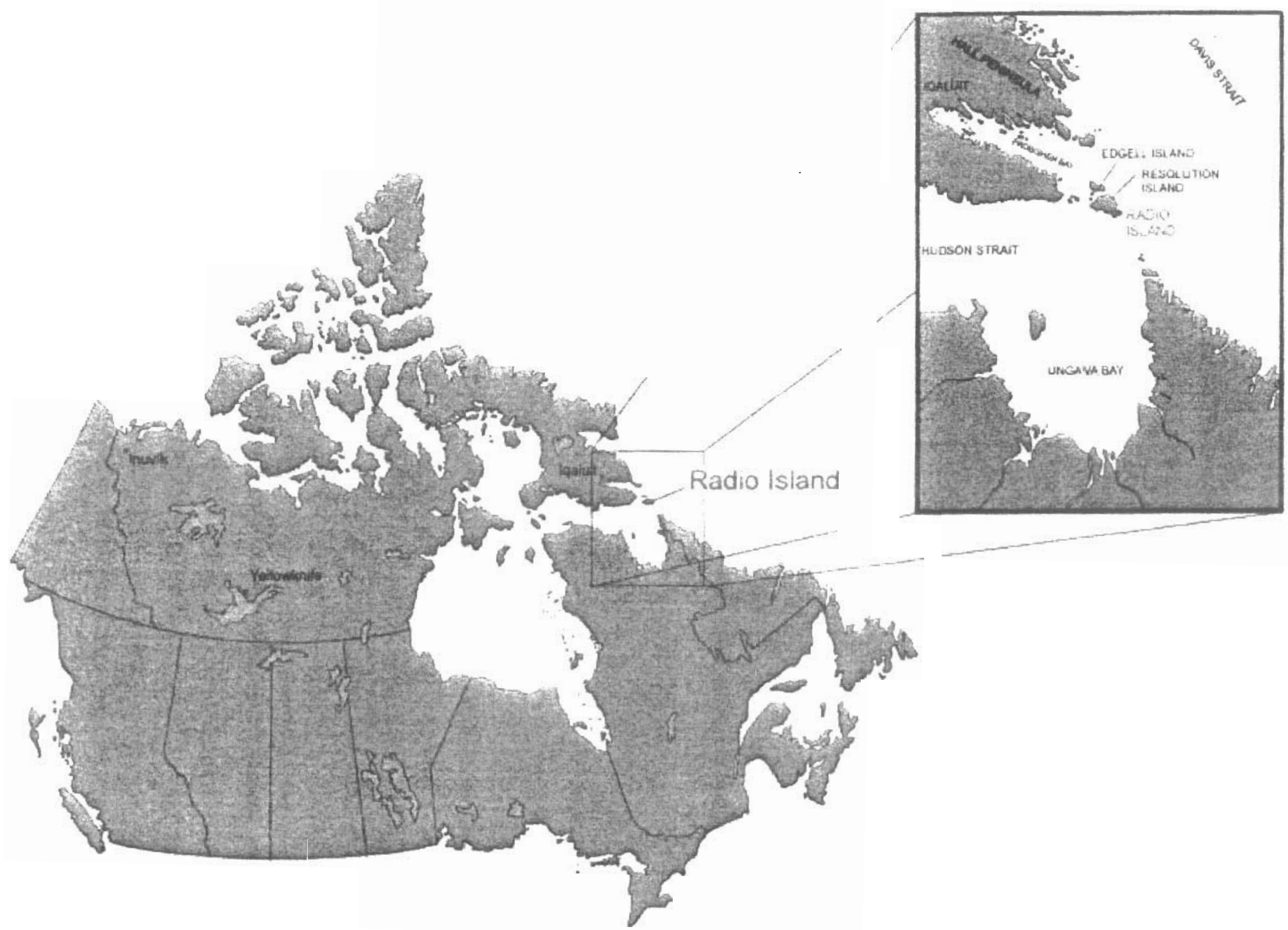
The Environmental Sciences Group (ESG) at Royal Military College in Kingston was asked by Indian and Northern Affairs Canada (DIAND) to conduct an environmental assessment of the site. The objectives of the assessment were to determine whether there was any chemical contamination on the island resulting from past human activities, to determine whether any contamination was having an impact on the ecosystem and to identify any cleanup requirements.

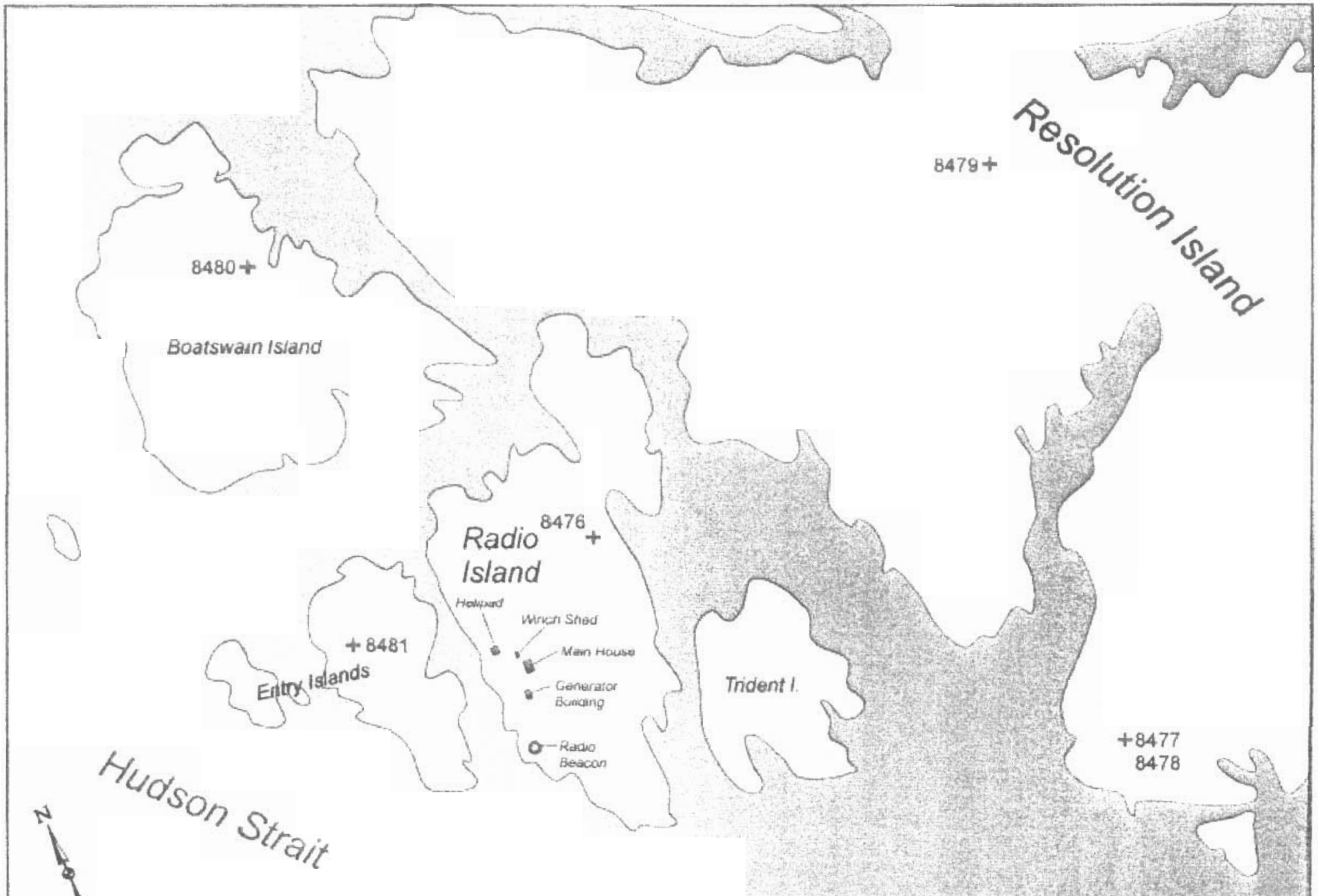
The first objective was accomplished by collecting soil and water samples from various locations around the island. The choice of sampling locations was dictated by the past use of the site. Samples were collected around buildings or building remains, dump areas, drainage pathways. As well, locations were chosen based on previous experience with patterns of chemical contamination found at former military sites. The objective was to identify all areas of concern. The samples were analyzed subsequent to the field program for inorganic and organic contaminants.

The second objective of the assessment was to determine the impact of any contamination on the ecosystem. It can be difficult to determine at what level a given substance will have a deleterious impact on the ecosystem. In this study, two methods were employed to help make this decision. First, the analytical results for soil and water samples were compared to the established criteria, as discussed in Chapter II. The second approach to determining the impact on the ecosystem is to examine the plants. Since plants are at the base of the foodchain they can be very good indicators of uptake of contaminants into the foodchain. Plant samples were collected at the same locations as some of the soil samples and analyzed for the same contaminants.

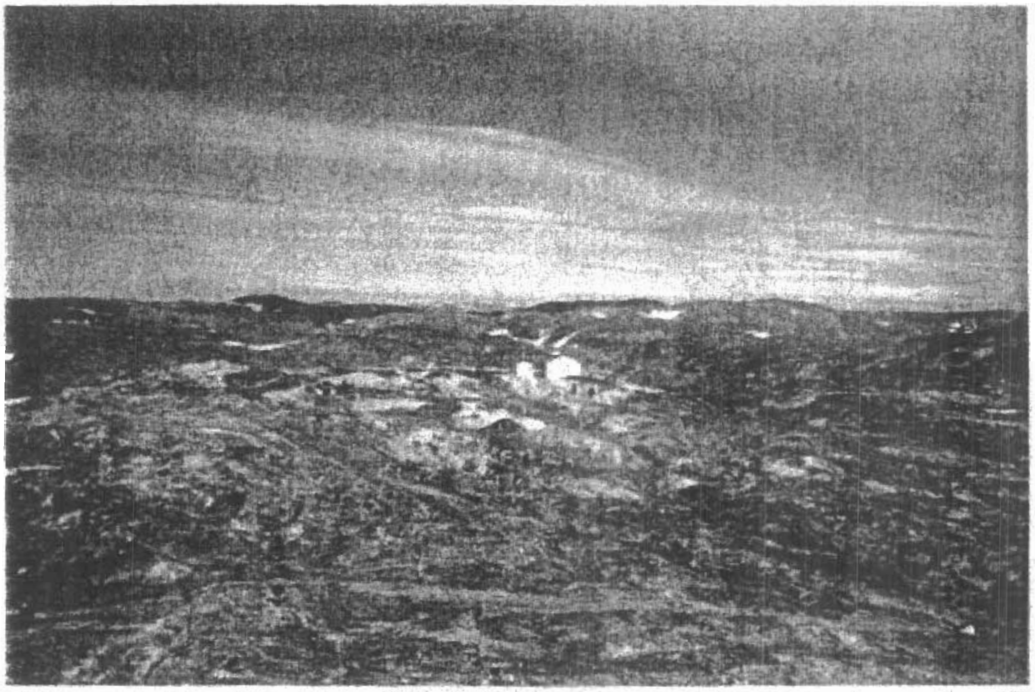
The third objective of the assessment was to identify any cleanup requirements. This was accomplished by the information obtained in the first two objectives. The analysis of soil, water and plant samples and the assessment of the impact of these contaminants have been interpreted based on a protocol developed for the Arctic, and a realistic cleanup strategy that will result in the protection of the environment has been developed for the Radio Island site.

Map I-1: Location of Radio Island

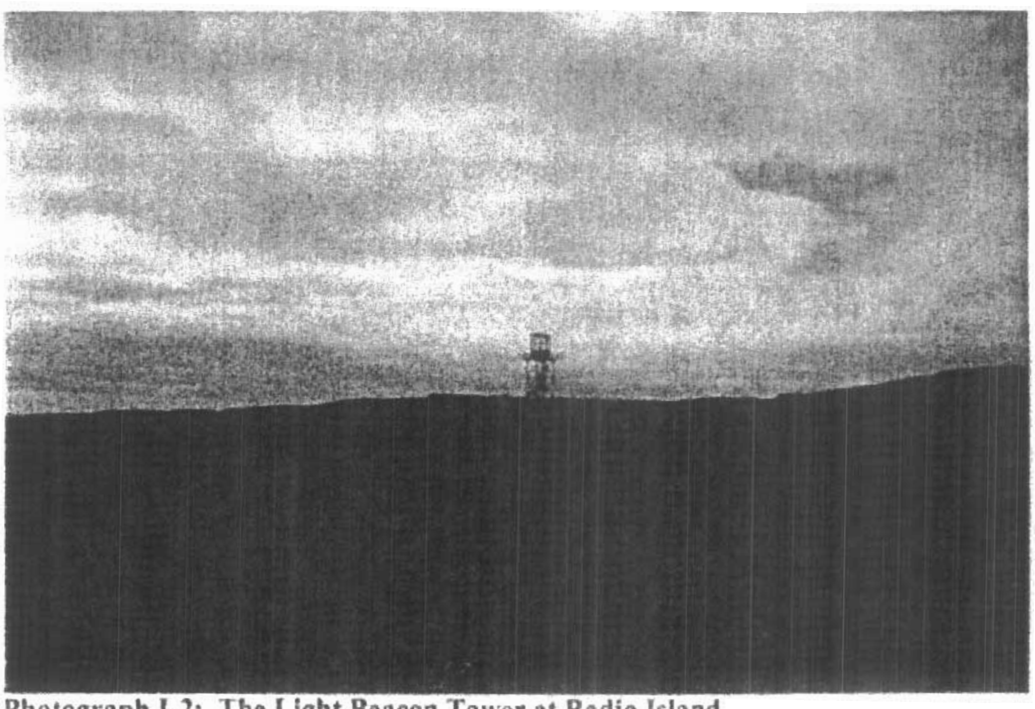




Map I-2: General Site Layout



Photograph I-1: The Main Site at Radio Island as seen from the south. The Generator Building Foundation is seen in the foreground.



Photograph I-2: The Light Beacon Tower at Radio Island.

II. BACKGROUND INFORMATION AND CLEANUP CRITERIA

A. Related Environmental Studies Conducted by the ESG

The Distant Early Warning (DEW) Line was a series of United States military installations built across the Arctic, mostly in Canada, at the height of the Cold War to provide surveillance. With the end of the Cold War and advances in technology, the sites have been closed over a period of years, and control transferred to the Canadian government.

In 1989, the Department of National Defence sponsored a series of scientific studies to assess the environmental impact of the military installations in northern Canada. This work, conducted at representative DEW Line sites over a two year period by the Environmental Sciences Group (ESG) of Royal Military College[1] provided the foundation for new environmental standards designed to protect the uniquely fragile Arctic ecosystem. A protocol for assessing and remediating Arctic sites to meet these standards was proposed. The results were reviewed by representatives from Indian and Northern Affairs, Environment Canada, Government of the Northwest Territories, and the Department of Fisheries and Oceans, and in October 1991 the DEW Line Cleanup Protocol was adopted (See Annex II-A and C for further details). Sites at Horton River, Pearce Point, and Iqaluit have been cleaned up using plans developed from the DEW line Cleanup Protocol (ESG/ASU 1994, ESG 1996, ASU 1996b, ASU 1997). Elements of the protocol, which addresses visible debris, landfills and contaminated soil, have been used for the Radio Island site assessment.

B. Cleanup Criteria and Methods

While it is generally acknowledged that the potential threats posed by contaminants at a given site must be reduced to an acceptable level, defining "acceptable" is not a simple task. Two approaches are used to evaluate environmental quality - absolute and relative.

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[1] ESG relocated from Royal Roads Military College, Victoria, B.C. to Royal Military College, Kingston, Ontario in 1995.

1. 'Absolute' Cleanup Criteria

An "absolute", or criteria-based, method defines numerical values or limits that can be compared with measured environmental levels. It establishes baseline concentrations for various substances below which the impact on the environment is assumed to be minimal. Environmental samples containing concentrations above this limit may indicate the need for further investigation and/or remediation of the sampling area, depending on the extent to which the level is exceeded. This approach has certain advantages such as the relative ease with which it can be used and administered, a common base for communication between interested parties, and reduction in confusion. It suffers, however, from the assumption that the concentration limits apply equally in all circumstances.

a) <u>CCME Criteria</u>

The Canadian Council of Ministers of the Environment (CCME) Interim Canadian Environmental Quality Criteria include Assessment Criteria and Remediation Criteria. Assessment criteria are either approximate background concentrations or approximate analytical detection limits which provide a starting point for examining data. In the current study, efforts were made to obtain samples from locations that were removed from any direct influence of the previous station activities and were representative of the site geomorphology. Data from these background samples were compared to the CCME Assessment Criteria (Table II-1). Results obtained from other soil samples at the sites were, in turn, interpreted in the context of the background levels.

CCME Remediation Criteria are applied as guidelines for cleaning up contaminated sites, depending on whether the land use is agricultural, residential/parkland, or commercial/industrial. Soil samples from potentially contaminated areas of Island could be compared to these criteria, but in this case a more conservative set of criteria were used, as discussed below.

Water samples were collected in order to determine whether there has been any migration of contaminants. Data from these samples were compared to the CCME Assessment Criteria for water (Table II-1).

Some soil samples were analyzed for polycyclic aromatic hydrocarbons (PAHs) and pesticides. Results for these samples were compared to various sets of criteria, including CCME and Canadian provincial as well as international criteria. These criteria are assembled in Tables II-2 and II-3 at the end of this section.

b) DEW Line Cleanup Criteria

The Arctic and the sub-Arctic have many characteristics which distinguish them from more forgiving southern environments. The presence of permafrost and the restrictions of light and temperature contribute to limited biodiversity and a generally fragile ecology. Consequently, the approach to solving environmental problems in the South is not necessarily applicable in the North. In order to take appropriate remediation measures at any northern site, a set of environmental objectives is required that is cognizant of the unique nature of the environment of the North. The ESG has developed such a set of criteria, the DEW Line Cleanup Criteria, presented in Table II-4; the development of these criteria is outlined in Annex A of this chapter. For these reasons, the DEW Line Cleanup Criteria have been used instead of the CCME Remediation Criteria in order to provide lower concentration triggers for cleanup.

2. 'Relative' Cleanup Criteria

In developing relative cleanup criteria, the focus is on the potential for the movement of contaminants from the substrate in which they contained, to humans or other parts of the environment. It is therefore necessary to examine the pathways for this movement in a *site-specific* context, and to assess the impact that this will produce. This was accomplished at Radio Island through the use of plant samples collected from areas where soil samples were taken. The contaminant concentrations in these plants were compared to contaminant concentrations in plants from background areas. This provided a means of measuring the risk that these contaminants pose to the ecosystem, which is a critical part of the environmental assessment. For more discussion of the use of plants as environmental indicators, refer to Annex B.

3. Cleanup Measures

The most comprehensive model for the cleanup of a northern environment is that provided by the Distant Early Warning (DEW) Line Cleanup Project. The cleanup recommendations proposed for Radio Island are therefore based on the objectives outlined in the DEW Line Cleanup Protocol, which addresses three main categories of waste: contaminated soil, visible debris, and landfills. It should be stressed that the general protocol is designed to prevent the migration of contaminants from sources (either in landfills, sewage outfalls and lagoons, and stained areas) to other parts of the ecosystem (vegetation, watercourses and the ocean). In each case where contaminant migration is detected, at any concentration, specific measures are designed to deal with it. Details of the Protocol can be found in Annex C.

Table II-1: Some CCME Interim Criteria for Soil and Water[a]

	Assessment Criteria		Remediation Criteria	
	Soil	Water	Soil	
	µg/g or ppm dry weight	µg/L or ppb	µg/g or ppm dry weight	
			Residential/ Parkland	Commercial/ Industrial
Inorganic Elements				
Arsenic (As)	5	5	30	50
Cadmium (Cd)	0.5	1	5	20
Chromium (Cr)	20	15	250	800
Cobalt (Co)	10	10	50	300
Copper (Cu)	30	25	100	500
Lead (Pb)	25	10	500	1000
Mercury (Hg)	0.1	0.1	2.0	10
Nickel (Ni)	20	10	100	500
Zinc (Zn)	60	50	500	1500
Polychlorinated Biphenyls	0.1	0.1	5	50
Chlorinated Hydrocarbons				
Chlorinated aliphatics[b] (each)	0.1	0.1	5	50

a. This is only a partial list; a complete list may be found in Canadian Council of Ministers of the Environment (CCME) "Interim Canadian Environmental Quality Criteria for Contaminated Sites" Report CCME EPC-CS34, September 1991.

b. Aliphatic chlorinated hydrocarbons include:
chloroform
dichloroethane (1,1- 1,2-), dichloroethene (1,1- 1,2-),
dichloromethane
1,2-dichloropropane, 1,2-dichloropropene (cis and trans)
1,1,2,2-tetrachloroethane, tetrachloroethene
carbon tetrachloride
trichloroethane (1,1,1- 1,1,2-), trichloroethene

Table II-2: Criteria for Polycyclic Aromatic Hydrocarbons (PAHs) in Soils

Substance	Assessment Criteria	Remediation Criteria		
		Agricultural	Residential/ Parkland	Commercial/ Industrial
	ng/g or ppb dry weight			
Naphthalene	100[a]	100	5000	50000
Acenaphthylene	*100*[b]	*10000*	*10000*	*100000*
Acenaphthene	*100*	*10000*	*10000*	*100000*
Fluorene	*100*	*10000*	*10000*	*100000*
Phenanthrene	100	100	5000	50000
Anthracene	*100*	*10000*	*10000*	*100000*
Fluoranthene	*100*	*10000*	*10000*	*100000*
Pyrene	100	100	10000	100000
Benz(a)anthracene	100	*1000*	*1000*	*10000*
Chrysene	*100*	*1000*	*1000*	*10000*
Benzofluoranthenes	*100*	*1000*	*1000*	*10000*
Benzo(a)pyrene	100	100	1000	10000
Dibenz(a,h)anthracene	100	100	1000	10000
Indeno(1,2,3-c,d)pyrene	100	100	1000	10000
Benzo(ghi)perylene	--	--	--	--

a. Non-italicized figures are the CCME Interim Remediation Criteria for Soil.

b. Figures in italics are equivalent values from "Criteria for Managing Contaminated Sites in British Columbia" (BC Ministry of Environment, Land and Parks).

Table II-3: List of Criteria for Pesticides in Soils

Criteria	Total Pesticides[a] (ng/g or ppb)		
	Level A	Level B	Level C
Clean-Up Criteria for British Columbia[b]	100	2000	20000
Soil Guidelines Recommended by MENVIQ[c]	100	2000	30000
Soil Guidelines Recommended by the Netherlands[d]	-	3000	30000

Notes

a. Pesticides analyzed include:

Hexachlorobenzene	o,p'-DDE	Mirex
alpha BHC	p,p'-DDE	Heptachlor Epoxide
beta BHC	trans-Nonachlor	alpha-Endosulphan
gamma BHC	cis-Nonachlor	Aldrin
Heptachlor	o,p'-DDD	Dieldrin
Oxychlordane	p,p'-DDD	Endrin
trans-Chlordane	p,p'-DDT	Methoxychlor
cis-Chlordane		

b. From "Criteria for Managing Contaminated Sites in British Columbia, Ministry of Environment, waste Management Program, November 1989". Level A represents background levels or achievable detection limits; Level B is the remediation criteria for residential, recreational and agricultural land use; and Level C represents significant soil contamination and is the remediation criterion for commercial or industrial land use.

c. Ministère de l'Environnement du Québec (MENVIQ), 1988. " Contaminated Sites Rehabilitation Policy" . Prepared by the Direction des Substances Dangereuses. Level A indicates background concentrations or analytical detection limits; concentrations between A and B are slightly contaminated; Site investigation is needed if concentrations exceed Level B; Concentrations between B and C are considered to be "contaminated; Concentration above C indicate serious contamination.

d. From "Review and Recommendations for Canadian Interim Environmental Quality Criteria for Contaminated sites". The National Contaminated Sites Remediation Program. Scientific Series No.197. The A level marks the boundary between contaminated and uncontaminated soil; B level indicates the relative extent of contamination and potential seriousness of the risk that the contamination might pose; and C level represents concentration above which a soil was considered to be polluted to such an extent that all potential exposure routes present an intolerable risk to man or the environment.

Table II-4: DEW Line Cleanup Criteria

Substance	Units	DCC Tier I	DCC Tier II
Inorganic Elements			
Arsenic	ppm		30
Cadmium	ppm		5.0
Chromium	ppm		250
Cobalt	ppm		50
Copper	ppm		100
Lead	ppm	200	500
Mercury	ppm		2.0
Nickel	ppm		100
Zinc	ppm		500
Polychlorinated Biphenyls	ppm	1.0	5.0

Table II-5: List of Criteria for Leachable Compounds

Substance	Ontario Leachate Criteria[a]	British Columbia Leachate Criteria[a]
	mg/L or ppm	
Arsenic	5.0	5.0
Barium	100	100
Cadmium	0.5	0.5
Chromium	5.0	5.0
Lead	5.0	5.0
Mercury	0.1	0.1
Selenium	1.0	1.0
Silver	5.0	5.0
Boron	500	500
Cyanide	20	20
Fluoride	240	150
PCBs	0.3	-

a: Substrate with leachate values exceeding these criteria would be considered as hazardous or special waste in Ontario and British Columbia, respectively.

Annex A: The Development of the DEW Line Cleanup Criteria

When the Environmental Sciences Group began the environmental study of the North Warning System (NWS, the modernized form of the DEW Line) in 1989, there were no environmental criteria specific to the Canadian Arctic. One of the most comprehensive sets of environmental quality indicators were those produced by the Québec government (MENVIQ 1988). These were therefore employed during the initial interpretation of data obtained from the study of the first ten NWS Long Range Radar and DEW Line sites.

During the course of the NWS Study, the Canadian Council of Ministers of the Environment Interim Environmental Quality Criteria for Contaminated Sites were prepared (CCME 1991). In anticipation that there would be considerable interest in applying *national* criteria to the NWS sites, cleanup recommendations for the NWS sites were reviewed in the context of the new CCME criteria and included in the *North Warning System Environmental Study* (Volumes One - Three, ESG 1991).

Vegetation samples were analyzed in order to determine potential uptake of contaminants into the food chain, and the results of these analyses were correlated with soil results and used to determine the concentrations of contaminants in soil which caused an impact on the food chain. The consideration of results obtained from these analyses of Arctic vegetation and the tendency of certain contaminants (lead and PCBs) to undergo aerial transport indicated a need to combine features of the Québec and the CCME criteria. This combination was designated the DEW Line Cleanup Criteria, DCC.

The DCC Level II Criteria (or DCC-II) and CCME Residential/Parkland Criteria (or CCME R/P) are identical to each other for inorganic element and PCB concentrations in soils. The DCC-II and CCME R/P Criteria are also identical to Québec "B" Criteria (MENVIQ, 1988) for those substances included in the DCC. The DEW Line Cleanup Criteria, however, dictate a more rigorous trigger for the removal of two substances from the Arctic environment: lead and PCBs. Previous research by the ESG, as well as other scientific studies, led to the inclusion of another tier of soil criteria for these two contaminants, the DCC Level I (or DCC-I). Both lead and PCBs, unlike many other contaminants, tend to migrate from a source to surrounding areas (including the surfaces of plant leaves) through the air. Both substances are also known to exert chronic (long term) - as opposed to acute (short term) - toxicological effects on animals in association with long-term bioaccumulation (in the case of lead) or food-chain related biomagnification (in the case of PCBs).

Annex B: The Use of Plants as Environmental Indicators

The same concentration of a contaminant in soil can display very different effects under different circumstances, depending on the soil type and depth, ecosystem features etc. It is therefore necessary to determine the impact of contaminants on a site-specific basis, which means that site-specific criteria must be established. Mathematical models can be used to estimate exposures/dose and the results are then combined with toxicological information to obtain site-specific risk. This methodology has some inherent difficulties such as applying the procedures correctly, having all the toxicological information, and defining acceptable risk levels.

An alternative to the modeling method of generating site-specific criteria is to modify criteria-based assessments by taking into account relative, or site-specific, factors. This can be achieved by directly measuring the entry of contaminants into the food chain, resulting in a measured rather than modeled estimate of risk. Samples of vegetation were therefore collected at the same locations as some of the soil samples. The species collected were those which have importance in the food chain: willows (*Salix* sp.) and oleasters (*Shepherdia* sp.). Willow, for example, demonstrates the ability to accumulate and, in some cases, concentrate one or more of the parameters analyzed from the soil or sediment (North Warning System Environmental Study, Volume One, Chapter VI; see also ESG, 1993 and 1994). The results of the analysis of plant samples are not intended to preclude the interpretation of soil and water data, since the DCC for some substances in soils appear to be reasonable indicators of ecosystem impact at northern sites based on previous vegetation studies (Reimer et al., 1993). Instead, plants provide a different perspective on the environmental status of the site, help to identify substances with particular biological activity and assist in the selection of remedial options.

Plants vary greatly in their ability to accumulate contaminants; some naturally accumulate substances that, in excessive amounts, can be toxic. The specific concentrations of these substances (such as inorganic elements and PCBs) in plants that pose a threat to the ecosystem are unknown. The impact of contaminants on the ecosystem is therefore measured by a comparison of the analytical results for samples collected from impacted areas with the results for samples collected from non-impacted areas (background samples). Thus, background plant and soil samples were collected from areas that were representative of the terrain on the island but removed from the immediate influence of previous station activities. Where possible, plant species common to the various geographical areas of the site were collected from the background locations. Since the geographical areas of the site do not all contain the same types of plants, the results have been pooled together.

Annex C: Dew Line Clean Up Protocol

The DEW Line Clean Up (DLCU) Protocol was originally endorsed by various government agencies including Environment Canada, Indian and Northern Affairs, Government of the Northwest Territories and Fisheries and Oceans at a meeting in Victoria, BC in October 1991. This revised version (April 1994) has been slightly modified as a result of:

- Presentations (1992, 1993, 1994) to the Legislative Assembly of the Northwest Territories;
- Community consultations at ten northern communities in 1992 and twelve in 1993;
- Further scientific studies including analytical field testing, leachate testing and barrel sampling;
- Engineering designs for a landfill leachate control system and a contaminated soil containment facility in permafrost;
- Continuing discussions with regulatory agencies, including a second major workshop held in March 1993; and,
- Changes in staffing requirements at the North Warning System sites.

The DLCU Protocol, which is divided into three main areas, provides a strategy for dealing with chemical contamination and physical debris at the DEW Line sites.

1. Contaminated Soils

Remediation is to be applied to soils and sediments where inorganic elements and/or PCBs have been found to be present at concentrations in excess of the DEW Line Cleanup Criteria (DCC); this includes soils contaminated by sewage in outfall areas and lagoons. The DCC (Table 1) are a combination of the CCME R/P[2] and Quebec B[3] criteria and were determined, on the basis of site specific investigations, to be protective of the Arctic ecosystem.

Table 1: DEW Line Cleanup Criteria

Substance	Units	DCC Tier I	DCC Tier II
Arsenic	ppm	-	30
Cadmium	ppm	-	5.0
Chromium	ppm	-	250
Cobalt	ppm	-	50
Copper	ppm	-	100
Lead	ppm	200	500
Mercury	ppm	-	2.0
Nickel	ppm	-	100
Zinc	ppm	-	500
PCBs	ppm	1.0	5.0

- Soils containing contaminants above the DCC Tier II level should be excavated and removed to a Northern Disposal Facility.
- Soils containing PCBs and lead at concentrations between the DCC Tier I and Tier II levels may be placed in an on-site engineered landfill.
- Special attention should be given to soils that act as sources of contaminants to nearby aquatic environments - even if the concentrations of contaminants are below the DCC criteria.

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[2] Interim Canadian Environmental Quality Criteria for Contaminated Sites as of 1991 produced for the Canadian Council of Ministers for the Environment (CCME).

[3] Quebec Soil Contamination Guidelines as of 1991.

- Soils containing PCBs above the 50 ppm level in contravention of the Canadian Environmental Protection Act (CEPA) must be treated as per the regulation.

- Confirmatory testing will be limited to known, but unstained, contaminated areas and will be to DCC Tier II criteria; visibly stained soils will be excavated to a distance extending a minimum of 0.5m beyond the boundary of the stain.

2. Landfills

These fall into one of three categories:

- Those located in an unstable, high erosion area must be relocated. Contents should be treated as per the procedures for contaminated soils and physical debris.

- Those located in a suitable location with no evidence of contaminated leachate may remain as is; additional granular fill may be required to ensure erosion protection and proper drainage.

- Those located in a suitable location but which are acting as a source of contaminated leachate must be stabilized by the installation of a suitably engineered containment system.

3. Physical Debris

Visible debris should be sorted into hazardous and non-hazardous components. This includes all unburied material and debris resulting from building demolition.

- Hazardous debris should be dealt with according to appropriate regulations.

- Non-hazardous materials should be buried in an engineered landfill on-site provided that there is a suitable location and sufficient gravel is available.

Hazardous debris may include but not necessarily be limited to: radioactive materials, batteries, wastes containing toxic chemicals at potentially harmful levels, and ash produced by the combustion of waste material - such materials should be shipped south for disposal. Asbestos can be suitably wrapped and buried in an on-site engineered landfill.

POL tank sludge, waste oil, petroleum products, antifreezing agents, solvents and barrels are treated as per the DLCU Barrel Protocol.

III. Site Assessment

A. Sampling and Analytical Programs

1 Sampling Program

The main sampling program at Radio Island was carried out from 7-10 August 1996. During the program 82 soil samples, 12 plant samples, 8 water samples, 2 paint samples and 2 samples for asbestos analyses were collected from various locations on the island. These locations included areas around buildings, their drainage pathways, the beach area, and dumps. For comparison purposes, samples were also collected from areas well removed from the site (background samples). The sampling locations were selected on the basis of evidence of former activities as well as previous ESG experience with patterns of contamination and disposal. The number of samples collected was intended to provide enough information that all potential areas of concern would be identified.

Each sample was identified by a number code in the form of 84XX. The exact location of samples are indicated on Map III-1, III-2, and III-3.

2. Analytical Program

There is a lack of reliable information concerning the total range of materials used at the site over its period of operation. Therefore, a screen for a wide range of Environment Canada priority pollutants was conducted on a select number of samples. These included PCBs, inorganic elements, PAHs, and pesticides.

PCBs and inorganic elements have been found to be the main contaminants of concern at former government installations in Northern Canada. Therefore, all soil samples were analyzed for inorganic elements, and half were analyzed for PCBs. Three soil samples were analyzed for polyaromatic hydrocarbons (PAHs) - these samples were deemed most likely to contain PAHs if they were indeed present at the site. Similarly, four soil samples were analyzed for pesticides. These samples were chosen from locations around the site where it was likely that pesticides would have been used. All plant and water samples were analyzed for inorganic elements, while one water and two plant samples were analyzed for PCBs. Table III-1 summarizes the sampling and analytical program.

Table III-1: Sampling and Analytical Program at Radio Island

Type	Total Samples Collected[a]	Number of Samples Analyzed							
		PCBs	Inorganic Elements	Pesticide	PAH	TPH	Asbestos	Chlorinated Hydrocarbon	Leachate Test
Background	6 (1)	5	5	1	-	-	-	-	-
Main Site	48 (3)	24	48	3	2	5	-	-	3
Generator Building	17 (2)	8	17	-	1	11	-	1	5
Beach	11 (1)	4	11	-	-	-	-	-	-
Total soil	**82 (7)**	**41**	**81**	**4**	**3**	**16**	**-**	**1**	**8**
Water	8 (4)	1	4	-		.		-	-
Plant	12[b]	2	12	-	.	-	-	-	-
Paint	2	2	-	-	.	-	-	-	-
Other	2	-	-	-	-	-	2	-	-

a: Number in brackets indicates the number of field duplicates.
b: Two samples were separated into roots and shoots for a total of twelve samples.

B. Results

1. Background Samples

Background samples were collected from areas well removed from the influence of site activities. These background or baseline values were used to compare results from samples collected at the site. Five locations were selected; one to the north east of the site on Radio Island (8476), one to the north of the site on Boatswain Island (8480), one to the east of the site on Resolution Island (8477 and 8478), one to the north east of the site on Resolution Island (8479) and one to the west of the site on Entry Islands (8481). A water sample was collected from a small lake near sample 8476. Plant samples were collected at three of the background location (8477, 8479 and 8480). The background locations are indicated on Map I-2 in Chapter I.

Five of the six background soil samples were analyzed for PCBs by high resolution gas chromatography. All values were below the analytical detection limits. The highest detection limit was 11 ppb, which is well below the CCME Assessment Criteria for PCBs (100 ppb). The one water sample collected at the background location on Radio Island (FW8406) was found to contain PCBs in excess of the CCME Assessment Criteria for water, although PCBs were not detected in the soil sample collected from the same location (8476). There are no CCME Remediation Criteria for PCBs in water but the measured value of 0.4 ppb is well below the Canadian drinking water standard (3 ppb). This elevated result is most likely due to the proximity of the site to the BAF-5 radar site on Resolution Island, where there is known PCB contamination. Aerial transport of PCBs is known (Bright *et. al.* 1995). None of the background plant samples were analyzed for PCBs.

Five of the six background soil samples were analyzed for inorganic elements. Nickel, cobalt, and chromium concentrations were above the CCME Assessment Criteria. However, it is believed that these are naturally occurring since all background samples contained elevated levels of these elements. The water sample collected at the background location (FW8406) was found to contain copper in excess of the CCME Assessment Criteria for water. Three plant samples were analyzed for inorganic elements, and of the eight elements analyzed, five were detected: copper, nickel, cadmium, zinc, and chromium.

The average results for background samples are shown in Table III-2.

Table III-2: Average Results for Background Soil, Water and Plant samples

Sample Type	Analytical parameter (ppm)								
	PCBs	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Soil Average (5 samples)	<0.025	24	42	12.7	<1.0	<10.0	42	46	0.98
CCME Assessment Criteria	**0.10**	**30**	**20**	**10**	**0.5**	**25**	**60**	**20**	**5**
Water (1 sample)	0.0004	0.028	<0.010	<0.010	<0.010	<0.010	0.020	<0.010	<0.001
CCME Assessment Criteria	**0.0001**	**0.025**	**0.010**	**0.010**	**0.001**	**0.010**	**0.050**	**0.015**	**0.005**
Plant Average (3 samples)	-	10.3	26	<5.0	1.2	<15	188	23	<0.2

2. *Area A: Main Site*

The main site is located on the western side of Radio Island. It comprises two intact buildings, a winch shed and main house (Photographs III-1 and III-2), and the foundations of two other structures. One foundation consists of eight concrete supports (Photograph III-3) and the other now houses a recent helipad (Photograph III-4 and III-5). All four structures are in close proximity and have common drainage pathways. These structures are shown on Map III-1.

A large pond (400 m^2) is located in the center of the structures and probably served as a fresh water source. The pond is dammed on the west side. A metal debris dump is located to the west of the helipad. and debris is scattered around the site in numerous ravines (Photograph III-6). Approximately 75 rusty empty barrels were found in 3 caches. All of the barrels were empty. Four piles of coal were found at the site.

In total, 48 assessment soil samples, including five field duplicates, were collected from the vicinity of the main site and its drainage.

All forty-eight samples were analyzed for inorganic elements. Copper, lead and zinc were the prevalent contaminants found at concentrations exceeding the DEW Line Cleanup Criteria (DCC) Tier II (100, 500 and 500 ppm respectively), and were detected above these levels in 26 separate locations. The mean copper concentration (106 ppm) was 1.1 times the criterion, and the maximum concentration detected (580 ppm) was 5.8 times the criterion. The mean lead concentration (2100 ppm) was 4.2 times the criterion, and the maximum concentration detected (41400 ppm) was 83 times the criterion. The mean zinc concentration (1980 ppm) was 4 times the criterion, and the maximum concentration detected (26640 ppm) was 53 times the criterion.

Nickel, cadmium, cobalt, and arsenic were the only other inorganic elements detected at concentrations exceeding the DCC. Nickel contamination was found in three of the assessment samples collected at the main site. The maximum nickel concentration (142 ppm) was 1.4 times the criterion. Cadmium contamination was found in six of the assessment samples collected at the main site. The maximum cadmium concentration (21 ppm) was four times the criterion. Cobalt contamination was found in one of the assessment samples collected at the main site. The maximum cobalt concentration (90 ppm) was 1.8 times the criterion. Arsenic contamination was found in two of the assessment samples collected at the main site. The maximum arsenic concentration (53 ppm) was 1.8 times the criterion.

Leachate tests were conducted on three of the samples: a sample (8402) containing copper, cadmium, lead and zinc (251, 10.5, 13840, and 5480 ppm respectively), a sample (8418) containing copper, lead and zinc (580, 6060, 6640 ppm respectively), and a sample (8441) containing cadmium, lead and zinc (6.5, 41400, 26640 ppm respectively). Leachate from one sample (8441) contained a lead concentration of 41 ppm, exceeding both the Ontario leachate criteria and the British Columbia leachate criteria for lead. Leachate values for the remaining two samples were below the criteria.

Five vegetation samples were analyzed for inorganic elements. All samples showed elevated levels of zinc (mean=1120 ppm). Two samples showed elevated levels of copper (mean=22 ppm); four samples showed elevated levels of cadmium (mean=4.9 ppm); and three samples showed elevated levels of lead (mean=37 ppm).

Twenty-four soil samples were analyzed for PCBs. All values were well below DCC Tier I. The highest level of PCBs detected was 490 ppb. Two plant samples (one root and one shoot) were analyzed for PCBs. Aroclor 1260 was detected in both samples (mean=1.8 ppb).

Two soil samples (8405 and 8436) were analyzed for PAHs. Both samples were well below the CCME Remediation criteria for soil.

Three soil samples were analyzed for pesticides (8410, 8450 and 8470). All levels were well below the applicable criteria.

Five soil samples were analyzed for total petroleum hydrocarbon (TPH). Three samples showed TPH values greater than 1100 ppm with the highest value at 18800 ppm. The average TPH value was 4940 ppm.

Three water samples were analyzed for inorganic elements. One sample (WF8402) contained a concentration of zinc (0.3 ppm) that was 6 times the CCME Assessment criterion for water (0.05 ppm).

Two paint samples were analyzed for PCBs and lead. No PCBs were detected, but very high levels of lead were detected in both samples (mean=78450 ppm). Two samples were collected that were suspected to contain asbestos. Asbestos was found in one of the samples - a tile sample collected from inside the main house. Asbestos was not detected in the other sample collected from the chimney south of the main house.

3. *Area B: Generator Building Foundation*

The generator building foundation is located approximately 35m to the south west of the main site. The foundation is 12 m by 6 m and contains the remains of 3 generators and one boiler. Twenty-six empty barrels are located within the foundation. Other visible debris includes: metal cable, charred wood, insulator caps, filing cabinets, coal, and crushed batteries. The entire generator building area is stained (Photograph III-7) and at the time of the site visit, a hydrocarbon odour was detectable. The drainage from the foundation is to the west and south east of the foundation (Photograph III-8 and III-9). The drainage to the west reaches the sea at approximately 30 m while the drainage to the southeast drains to the interior of the island. These features are shown on Map III-2.

In total, seventeen samples, including two field duplicates, were collected around the generator building foundation and in its drainage.

All seventeen samples were analyzed for inorganic elements. Copper, lead and zinc were the prevalent contaminants found at concentrations exceeding DCC II (100, 500 and 500 ppm respectively), and were detected above these levels in 13 separate locations. The mean copper concentration (487 ppm) was 4.9 times the criterion, and the maximum concentration detected (2160 ppm) was 21.6 times the criterion. The mean lead concentration (5280 ppm) was 10.6 times the criterion, and the maximum concentration detected (18860 ppm) was 38 times the criterion. The mean zinc concentration (4160 ppm) was 8.3 times the criterion, and the maximum concentration detected (20820 ppm) was 42 times the criterion.

Nickel and cadmium were the only other inorganic elements detected at concentrations exceeding the DCC. Nickel contamination was found in two of the assessment samples. The maximum nickel concentration (840 ppm) was 8.4 times the criterion. Cadmium contamination was found in six of the assessment samples collected at the generator building. The maximum cobalt concentration (116 ppm) was 2.3 times the criterion.

Five samples from the vicinity of the generator building contained very high concentrations of various inorganic elements, and therefore were subjected to leachate tests: Two samples (8458 and 8463) exceeded both the Ontario leachate criteria and the British Columbia leachate criteria for lead (5.1 and 7.4 ppm respectively). Leachate values for the remaining three samples were all below the criteria.

Four vegetation samples were analyzed for inorganic elements. Three samples showed elevated levels of zinc (mean=780 ppm); three showed elevated levels of copper (mean=117 ppm); one showed elevated levels of cadmium (mean=11.5 ppm); and three showed elevated levels of lead (mean=124 ppm).

Eight samples were analyzed for PCBs. All concentrations were below the DCC, with the highest level at 85 ppb. No plant samples were analyzed for PCBs.

One soil sample (8466) was analyzed for PAHs. It contained detectable levels of phenanthrene, fluroanthene, pyrene, benzo(a)anthracene and chrysene. The level of chrysene (1100 ppb) was above the criteria for Managing Contaminated Sites in British Columbia.

One soil sample (8466) was analyzed for chlorinated hydrocarbons. None were detected.

Eleven samples were analyzed for total petroleum hydrocarbon (TPH). Seven samples showed TPH values greater than 1100 ppm with the highest value at 36150 ppm. The average TPH value was 4925 ppm.

4. *Area C: Beach*

The beach area at Radio Island drains into Acadia Cove to the north. The beach is a fairly small area (1800 m^2) receiving drainage from the main site. Located on the east side of the beach are the remains of a burnt out house (Photograph III-10). A large pile of coal (anthracite), a suspected dump, two barrel piles consisting of empty rusted barrels are also present at the beach area. These features are shown on Map III-3.

In total, eleven assessment soil samples, including one field duplicate, were collected from the beach area. No vegetation samples were collected as only moss was growing in the area.

All eleven samples were anlayzed for inorganic elements. Lead was the main contaminant found at concentrations exceeding DCC II (500 ppm), and was detected in two separate locations. The maximum lead concentration detected (2900 ppm) was 5.8 times the criterion.

Zinc and cadmium were also found at concentrations exceeding the DCC. Zinc contamination was found in one of the samples collected at the beach area. The zinc concentration (3300 ppm) was 6.6 times the criterion. Cadmium contamination was found at one sample location at the beach area. The cadmium concentration (50 ppm) was 10 times the criterion.

Four soil samples were analyzed for PCBs. All samples were below DCC I. The highest level of PCBs detected was 360 ppb.

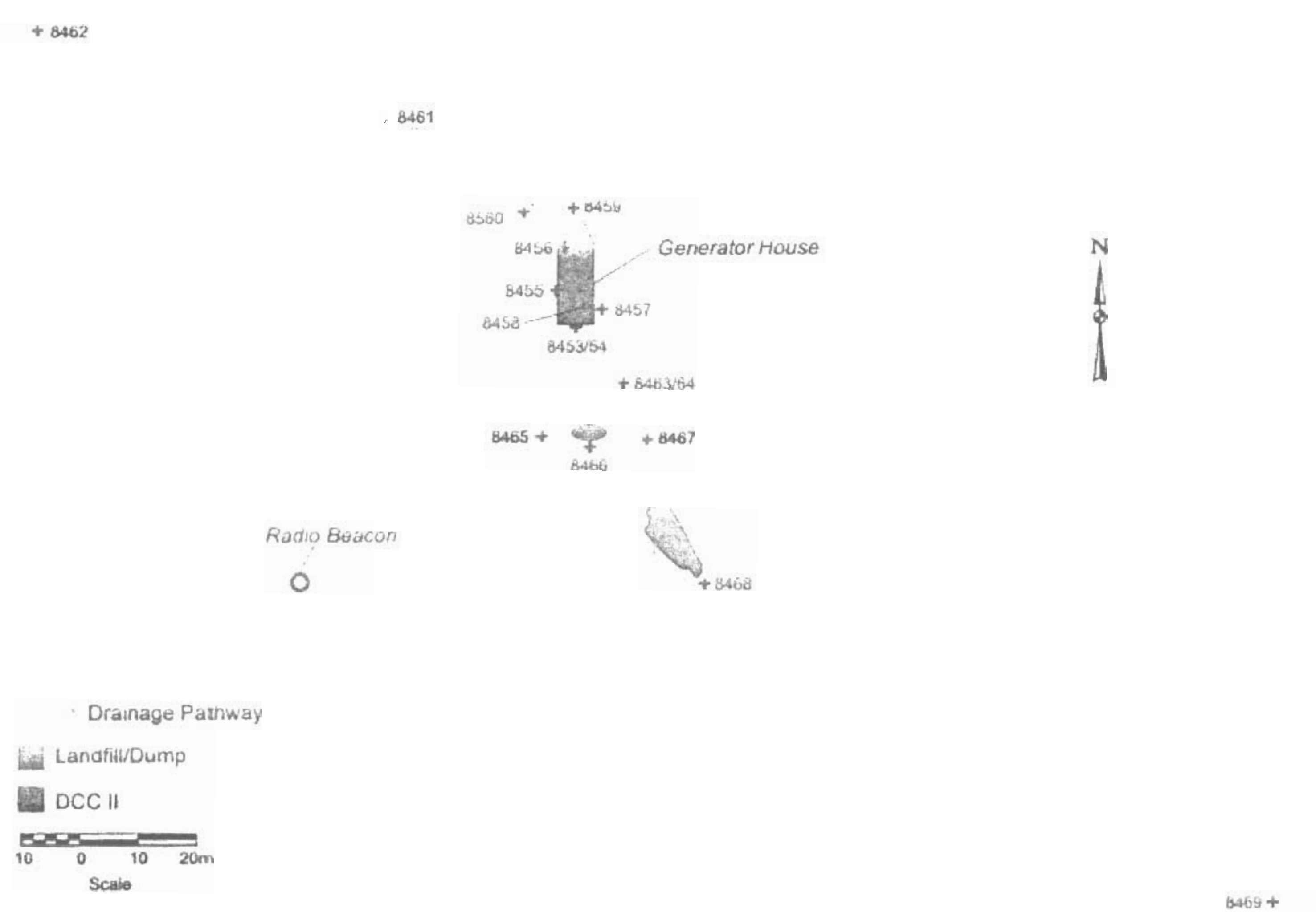
C. Conclusions

Overall, four areas at Radio Island were found to contain at least one contaminant at a concentration exceeding the DEW Line Cleanup or other applicable criteria. Contaminated areas include the main house and winch shed, the helipad, the generator building foundation and a small area at the beach. Copper, lead and zinc were the most prevalent contaminants found at concentrations exceeding the DCC in soil and plant samples. Nickel, cobalt, cadmium and arsenic were also detected at elevated concentrations in many soil and plant samples from the site.

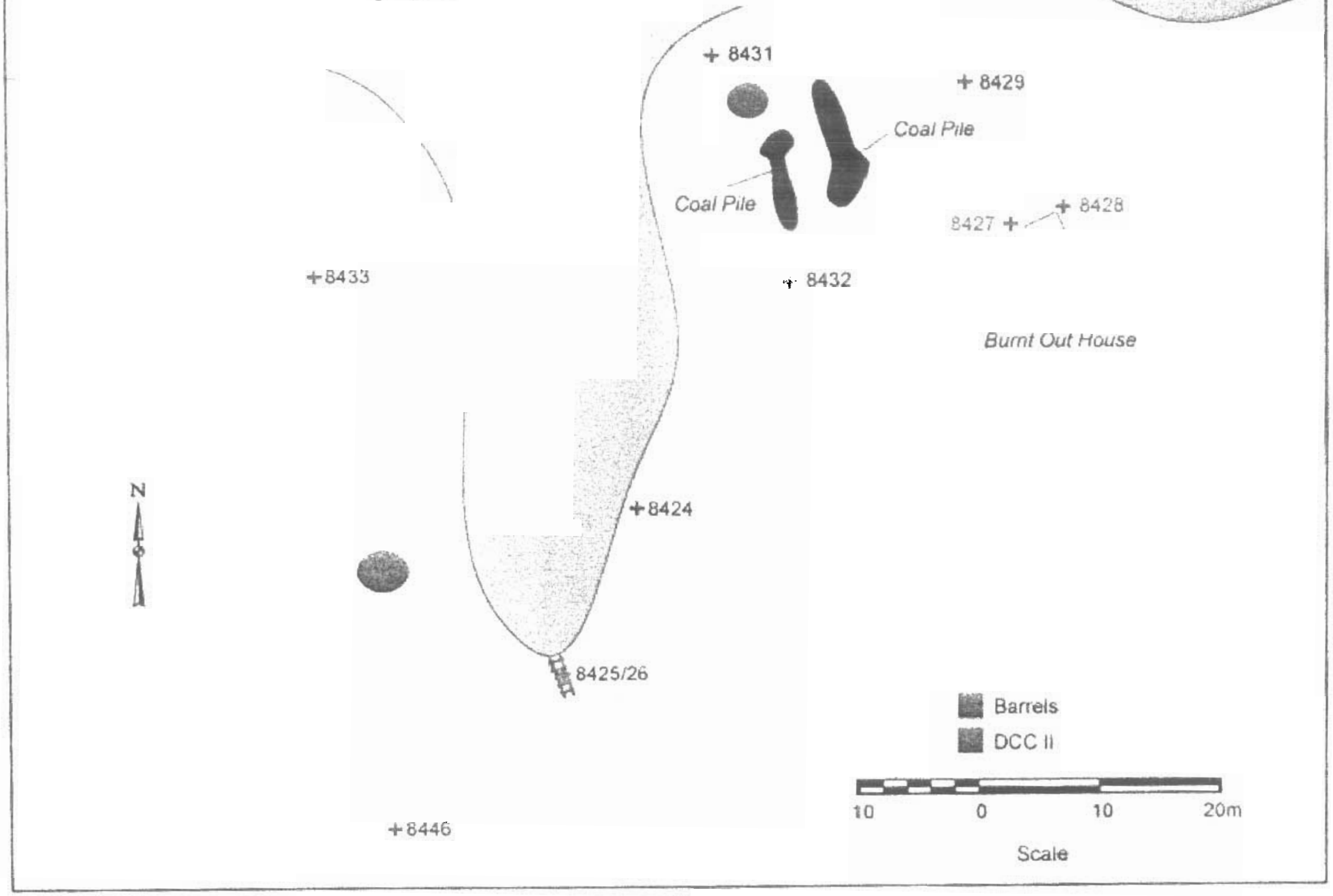
These results of plant samples indicate that contamination in soil at Radio Island is entering the food chain and therefore having an impact on the local terrestrial ecosystem. Fortunately, the relatively low abundance of vegetation minimizes the overall potential for impact. Results from soil samples collected in drainage courses show that contaminants are not reaching the marine environment, and therefore there is no impact on the marine ecosystem.

Map III-1: Area A, Main Site Sampling Locations

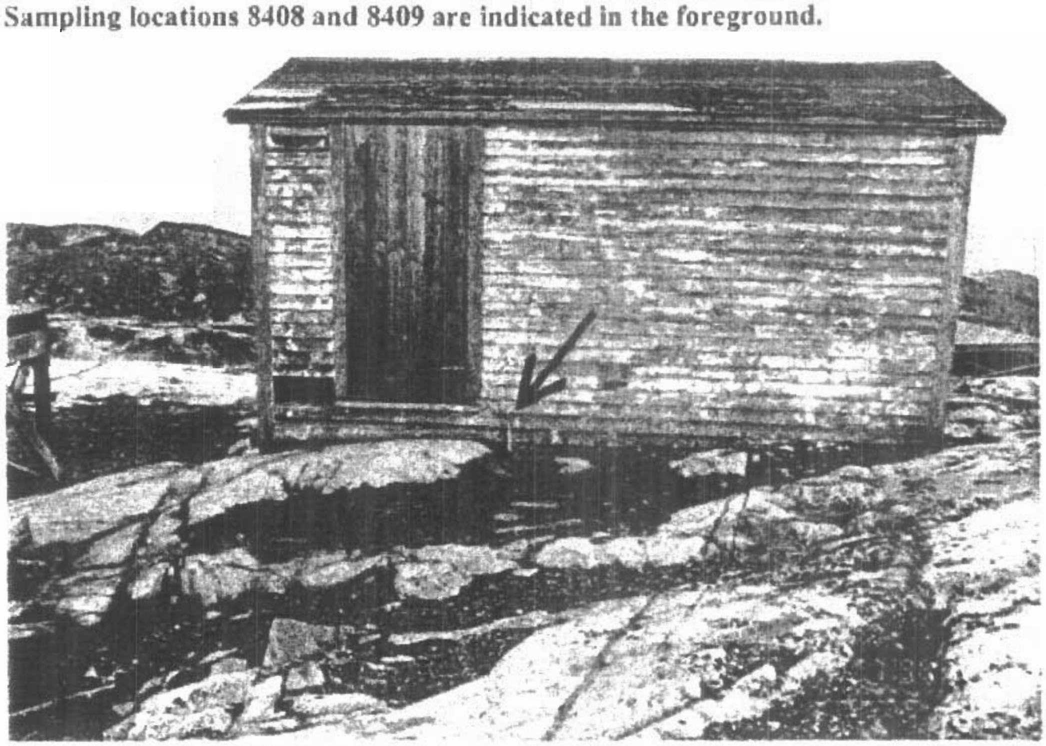
Map III-2: Area B, Generator Building Sampling Locations



Map III-3: Area C, Beach Area Sampling Locations

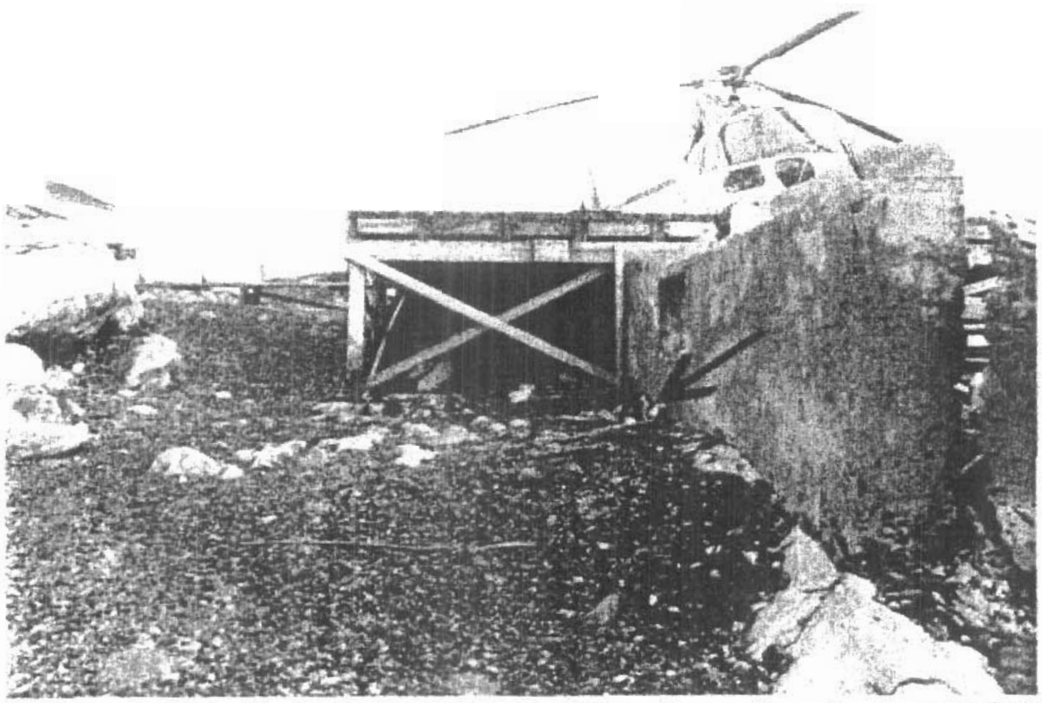


Photograph III-1: The Main House at Radio Island as seen from the southeast. Sampling locations 8408 and 8409 are indicated in the foreground.



Photograph III-2: The Winch Shed at Radio Island as seen from the east. Sampling location 8405 is indicated by the arrow.

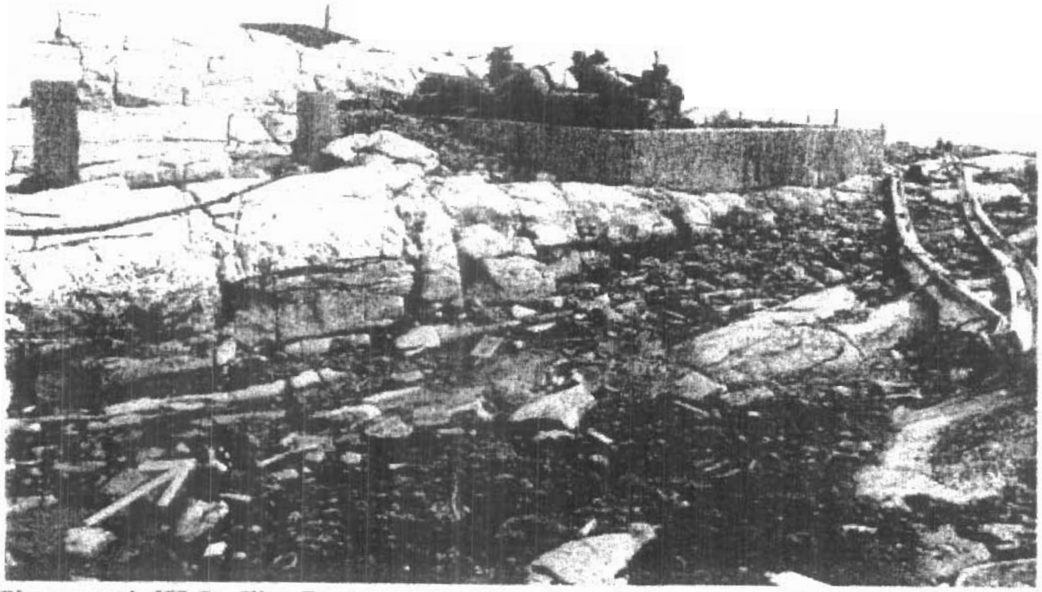
Photograph III-3: The Main House and Concrete Supports as seen from the north. Sampling locations 8411 and 8412 are indicated in the foreground.



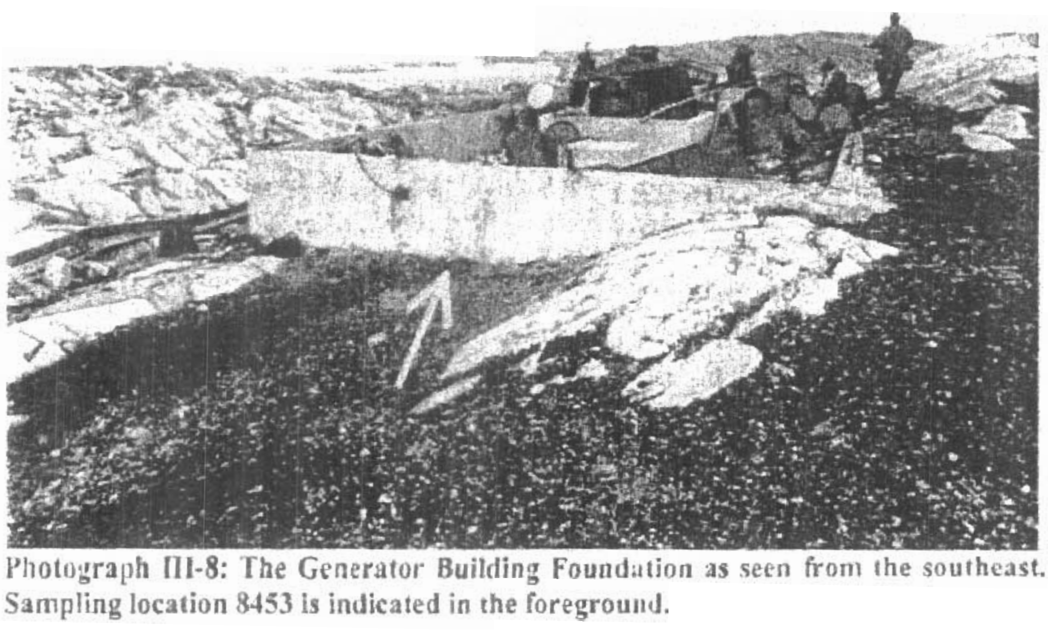
Photograph III-4: The Helipad as seen from the northeast. Sampling location 8441 is indicated by the arrow. The Main House can be seen to the east.

Photograph III-5: The Helipad as seen from the north. Sampling location 8442 is indicated by the arrow. The Winch Shed can be seen to the east.

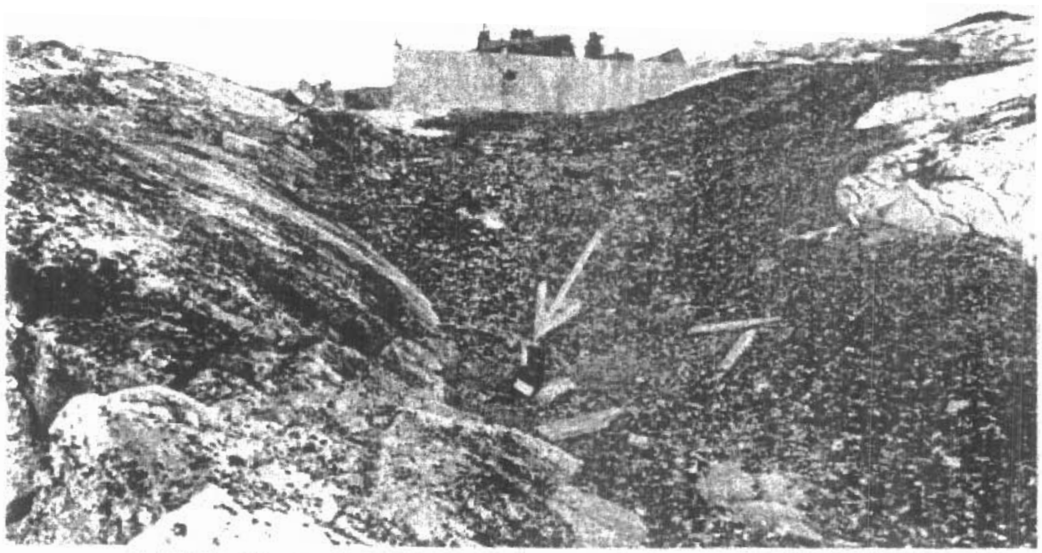
Photograph III-6: A Small Dump Area located to the northeast of the Main House. Sampling location 8417 is indicated by the arrow.



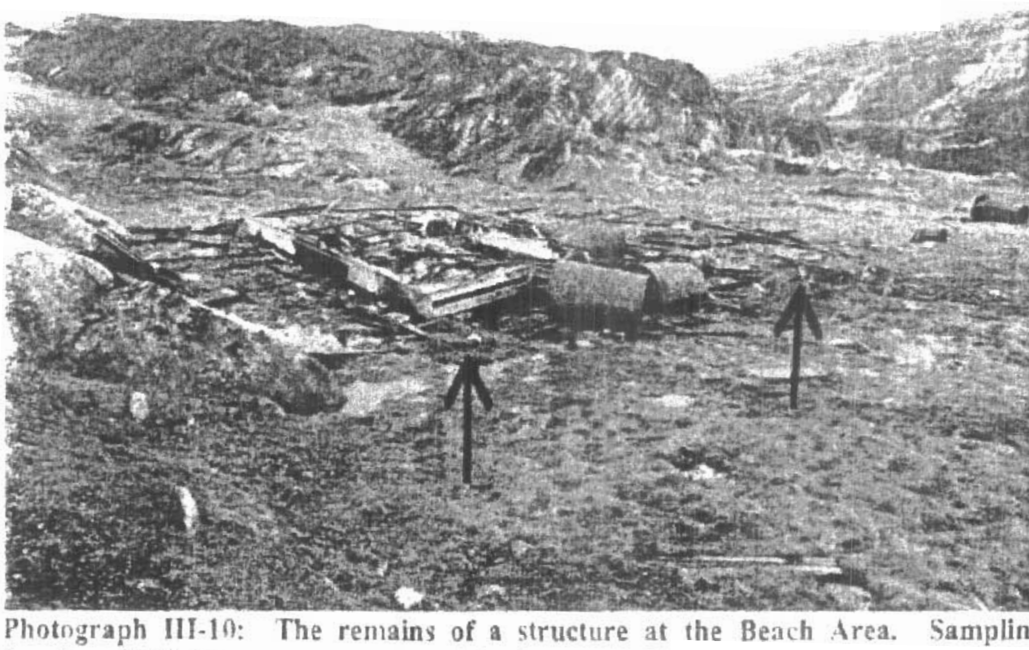
Photograph III-7: The Generator Building Foundation as seen from the northwest. Sampling location 8460 is indicated in the foreground.



Photograph III-8: The Generator Building Foundation as seen from the southeast. Sampling location 8453 is indicated in the foreground.



Photograph III-9: The Generator Building Foundation as seen from the southeast. Sampling location 8463 is indicated in the foreground.



Photograph III-10: The remains of a structure at the Beach Area. Sampling locations 8427 and 8428 are indicated by the arrows.

IV. RECOMMENDATIONS

A. General

Chemical contamination at Radio Island is extensive and is limited mainly to the inorganic elements copper, lead and zinc. Copper contamination is most likely due to the use of copper pipes, and zinc contamination the result of oxidation from the large amount of metal debris found at the site. The lead contamination can be attributed to the combination of three factors: fuel spills and the use of leaded gasoline; high lead concentrations in paint; and the numerous old and decaying batteries found at the site.

The DEW Line Cleanup Protocol has been used to develop the recommendations presented below. Details of the protocol are presented in Chapter II, Annex C. The main points of the protocol are:

- non-hazardous debris should be placed in an engineered landfill along with any soil that contains inorganic elements in excess of DCC Tier I.

- soil containing contaminants in excess of DCC Tier II should be removed from contact with the ecosystem.

In total it is estimated that there are 310 m^3 of soil to be treated as Tier II. It is also estimated that there is an additional 20 m^3 of soil to be treated as hazardous or special waste.

The terrain at Radio Island is mostly bedrock with a very small amount of soil. Moss covers most of the drainage pathways. There are no gravel sources on the island. It is therefore recommended that all nonhazardous debris be shipped to Resolution Island (BAF-5), or elsewhere, for placement in an engineered landfill.

B. Main Site

The contaminants of concern in this area were inorganic elements, specifically copper, nickel, cobalt, cadmium, lead, zinc and arsenic. Thirty soil sampling locations contained some or all of these elements at concentrations in excess of the DCC. The samples collected in the drainage courses from the main site did contain high concentrations of these elements, indicating that the contamination is migrating. However, sampling locations near the ocean did not contain high levels of these elements, indicating that the contamination is not yet reaching the ocean. One soil sampling point at the main site contained leachable lead in excess of both the Ontario and the British Columbia Leachate Criteria for lead.

Cleanup requirements for the main site therefore involve the excavation of soil around the buildings, foundation and drainage courses, and the cleanup of debris, hazardous and nonhazardous. The estimated volume of DCC II soil is 230 m^3. The estimated volume of leachate toxic soil is 10 m^3.

C. Generator Building Foundation

The contaminants of concern in this area were inorganic elements, specifically copper, nickel, cadmium, lead, and zinc. Ten soil sampling locations contained these elements at concentrations in excess of the DCC. The samples collected in the drainage to the north of the foundation did not contain high concentrations of these elements, indicating that the contamination is not migrating to the north of the foundation and ultimately the ocean. However, samples collected in the drainage to the south of the foundation did contain high concentrations of these elements, indicating that the contamination is migrating to the south and interior of the island. Two soil sampling locations contained leachable lead in excess of both the Ontario and the British Columbia Leachate Criteria for lead.

Cleanup requirements for the generator building foundation therefore involve the excavation of soil from around the foundation, and the cleanup of debris, hazardous and nonhazardous. The estimated volume of DCC II soil is 70 m^3. The estimated volume of leachate toxic soil is 10 m^3.

D. Beach Area

The contaminants of concern in this area were inorganic elements, specifically cadmium, lead and zinc. Two soil sampling locations contained these elements at concentrations exceeding the DCC. In both cases nearby samples from drainage courses were compared, and did not contain high concentrations of these elements, indicating that the contamination is relatively localized and is not migrating. Therefore, cleanup requirements for the beach area involve the excavation of soil from the two locations, and the cleanup of debris, hazardous and nonhazardous. The estimated volume of DCC II soil is 10 m^3.

Table IV-1: Summary of Cleanup Actions for Radio Island

Area	Non-Hazardous Materials	Hazardous or Potentially Hazardous Materials	DCC Tier II Contaminated Soil
Main Site	-remains of buildings -empty barrels (70) -metal debris -coal	-Leachate Toxic Soil (10m^3) -batteries -panel containing asbestos	-Main House and Winch Shed (80 m^3) -Helipad (150 m^3)
Generator Building Foundation	-empty barrels (30) -metal debris -coal	-Leachate Toxic Soil (10m^3) -batteries	-Foundation (70 m^3)
Beach Area	-empty barrels (35) -metal debris -coal	-batteries	-8427 and 8428 (10 m^3)

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VI. APPENDICES

Appendix A: Methods

Appendix B: Quality Assurance/ Quality Control

Appendix C: Site Descriptions

Appendix D: Data Tables

APPENDIX A: METHODS

A. Sampling

1. Approach

When there are localized areas of contamination at a large site such as Radio Island, the geostatistical, or random field approach to collecting samples, which involves sampling at the randomly chosen coordinates of a gridded area, may not be the most effective technique since it generates a very large number of samples. An alternative technique, the deterministic random approach, concentrates on areas likely to be contaminated: samples are collected near the contamination sources and in drainage pathways leading away from them. At Radio Island this latter approach was used to obtain samples from the site as a whole.

This approach was designed to obtain samples that would:

- be representative of the status of the site - samples were obtained from all areas of the site;
- determine the nature and distribution of the main chemical contaminants - samples were collected from both stained and unstained soils; and
- indicate any contaminant migration within the ecosystem - soil samples from drainage courses and plant samples (to indicate uptake into the food chain) were collected.

The number of samples collected from each area was dependent on the topography and the extent of dump and spill activity. Background samples were obtained from locations remote from the sites and free of any local inputs.

The sampling approach was also guided by results obtained in previous investigations at military sites (ESG, 1991, 1992, 1993a and 1993b, 1994); the analytical data indicated a common waste disposal pattern at these sites.

2. General Soil and Water

On arrival at the site, the team members familiarized themselves with the area and selected sampling locations. Two types of soil samples were collected at most locations. The one designated for inorganic analyses was obtained using a plastic scoop and stored in a Whirl Pak™ bag. The other, for organic analyses, was collected using a stainless steel scoop (which had been pre-washed, baked and stored in baked aluminum foil to preclude organic contamination) and placed in a 1 litre amber jar fitted with a Teflon-lined lid. These jars were obtained commercially (I-CHEM Ltd.) and were certified free of organic materials. Soil samples were generally restricted to the upper 10 cm of the substrate and care was taken to obtain representative material.

Soil samples were kept at ambient temperatures. The samples were shipped by guaranteed air freight to labs in Victoria, British Columbia where the samples were frozen pending analysis for organic compounds, and in Kingston, Ontario at Queen's University, where the samples were kept cold while awaiting analysis for inorganic elements.

Water samples were collected in 1 litre Teflon bottles for PCB analysis, and in polyethylene bottles for inorganic element analysis. Upon receipt in the laboratory, they were stored at 4°C until analysis.

Each sample collection was witnessed by at least two team members and in all cases a photographic record was made. The sample location and description were independently recorded by at least two team members.

3. Plant Samples

i. Collection of Vegetation

Plants were collected from the same locations as soil samples wherever sufficient material could be obtained. These plants, which included shrubs, grasses and sedges, provided a representative cross-section of the vegetation potentially grazed by herbivores. The plants were collected within a one metre square area surrounding the soil sample location and included leaves, stems and root tissue (where possible). A sufficient quantity was collected both for chemical analysis and for later identification and/or verification. All plant samples were placed in air-tight Ziploc bags and stored until they could be processed.

ii. Processing and Identification of Plants

Samples were rinsed in tap water from Iqaluit NWT and patted dry with analytical grade paper towels before packaging. One representative sample of each plant species collected at a site was subdivided into root and shoot sub-samples (where possible). All processed samples were divided into two homogeneous sub-samples for inorganic and organic analysis. Samples designated for inorganic element analysis were placed in plastic Ziploc bags which were sealed with tape. Samples for organic analysis were wrapped in aluminum foil and placed in Ziploc bags. After processing, all samples were frozen for later chemical analysis.

Samples for identification/verification were pressed (preserved) on-site for future reference. Following preliminary field identification, rigorous identification of species was conducted in Kingston and follows the taxonomy of Scoggan (1978).

4. Potentially Asbestos-Containing Materials

One sample of insulation material was collected from a chimney located at the main site and one sample of floor tile was collected from the main building (building #1). The samples were stored in polyethylene bags which were sealed, labeled and shipped to the laboratory for asbestos analysis.

5. Paint Samples

Paint samples were collected from any remaining buildings and surfaces. Samples were collected using a stainless steel scoop (which had been pre-washed, baked and stored in baked aluminum foil to preclude organic contamination) which acted as a paint scraper and was used to remove the paint from the structure. The samples were stored in polyethylene bags which were sealed, labeled and shipped to the laboratory for analysis.

6. Chain of Custody

A rigorous chain-of-custody was maintained for sample control. Chain of custody forms were filled out and checked for each sample before shipment from the North, and the contents of shipments were verified upon receipt in the laboratory. The relevant documentation is available on request.

7. Quality Assurance/Quality Control (QA/QC)

Field duplicate soil samples were collected with approximately every tenth sample. The soil sample was homogenized in the field and split into two containers which were labeled with consecutive numbers.

The analytical work was conducted by carefully selected analytical laboratories. QA/QC procedures were carried out by means of the standard techniques of blind replicates and spiked samples. A detailed discussion is given in Appendix B.

B. Analysis of Inorganic Elements

1. Method for Soil Samples

Samples were analyzed by the Analytical Services Unit of Queen's University. The concentrations of arsenic (As), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), lead (Pb), nickel (Ni), and zinc (Zn) were measured.

The analyses were carried out using the following procedure. Samples were air-dried and ground to a fine powder with a mortar and pestle; large stones were removed as they would not be expected to contain any anthropogenic environmental contaminants. Approximately 0.5 g of this dried material was heated with 2 mL HNO_3 and 6 mL HCl overnight so that the volume was reduced to 1-2 mL. This solution was then made up to 25 mL with distilled, deionized water and analyzed by atomic absorption spectrophotometry (AAS). While it is recognized that the digestion procedure used may not bring all metals into solution (some metals may be locked into silicate minerals), it was felt that the metals released into solution are of greater environmental significance than absolute total metals. Analyses were done in batches of ≤ 36, which comprised ≤ 28 samples, 2 blanks, 4 duplicates and 2 samples of reference material (NRC MESS-1).

2. Method for Plant and Tissue Samples

Plant or tissue samples were dried in an oven overnight at 70°C and ground in a mill to pass through a 1 mm sieve. Approximately 1.0 g of dried sample was then weighed into a 100 mL beaker; 20 mL of nitric acid was added, and the mixture was heated for 1 hour. Perchloric acid (10 mL) was added and heating continued until the volume was reduced to about 1-2 mL. The digest was then made up to 25 mL and analyzed by AAS as for soils.

3. *Method for Water Samples*

A water sample (400 mL) was placed in a beaker on a hot plate together with 3 mL of nitric acid and slowly boiled to dryness. Twenty millilitres of 2% nitric acid was then added, the samples heated to boiling, cooled, and made up to 25 mL. The resulting solutions were then analyzed for the selected eight elements by AAS.

C. Analysis of Polychlorinated Biphenyls (PCBs) and Pesticides in Sediment/Soil and Plants

1. *Summary*

Analysis for PCBs and pesticides were conducted by Axys Analytical Services Ltd. of Sidney, BC Each sample was clearly labeled and locked in a secure frozen storage area until retrieved by the analyst.

All samples for PCB and/or pesticide analysis were spiked with an aliquot of surrogate standard (2,4,5,6-tetrachloro-m-xylene, PCB 209 and d_4-alpha endosulphan) prior to analysis by gas chromatography with electron capture detection (GC/ECD); for gas chromatography with mass spectrometry (GC/MS), the samples were spiked with aliquots of ^{13}C labeled surrogate standard (PCB 101, PCB 180, PCB 209, gamma-BHC, Mirex, p,p'-DDE, p,p'-DDT and d_4-alpha endosulphan). Sediments were extracted with a solvent on a shaker table. Tissues were ground with sodium sulphate, packed in a glass chromatographic column and eluted with solvent. Water was liquid/liquid extracted with dichloromethane. Sample extracts were separated into three fractions on a Florisil column. The first fraction was also analyzed for PCBs as Aroclors, PCB congeners and chlorinated pesticides by GC/ECD or GC/MS. The second and third fractions were analyzed for chlorinated pesticides by GC/ECD.

2. *Extraction Methods*

i. Soils/Sediments

The sediment sample was thoroughly homogenized and a subsample taken for the determination of wet weight/dry weight ratio.

Wet sediment (10 - 15 g), to which an aliquot of surrogate standard had been added, was extracted once with 80 mL of 1:1 dichloromethane/methanol by shaking on a shaker table for 30 minutes. The extraction procedure was repeated using 80 mL of dichloromethane. The extracts were combined, washed with solvent-extracted water, dried over anhydrous sodium sulphate and concentrated by Kuderna-Danish techniques. After the addition of activated copper to remove sulphur, the extract was separated on a Florisil column.

ii. Tissues

The wet tissue was homogenized and a subsample was dried for moisture determination.

Homogenized wet tissue (5 - 10 g), anhydrous sodium sulphate and an aliquot of surrogate standard were ground with a glass mortar and pestle to a free-flowing powder. This powder was transferred to a glass chromatographic column containing 1:1 dichloromethane/hexane and eluted with additional solvent at 3 - 5 mL/min. The eluent was concentrated and subsampled for gravimetric lipid analysis.

The remaining extract was placed on a calibrated Biobead SX-3 gel permeation column and eluted with 1:1 dichloromethane/hexane. The 150 - 300 mL fraction was collected, evaporated to a small volume, and fractionated on a Florisil column.

iii. Water

A 1 litre sample was placed in a separatory funnel and spiked with aliquots of surrogate standard solution and methanol. The sample was extracted with three 100 mL portions of dichloromethane. The combined portions were dried over anhydrous sodium sulphate, spiked with hexane, reduced by rotary evaporation, and fractionated on a Florisil column.

3. Sample Cleanup and Separation

i. Cleanup for GC/ECD

The extract was quantitatively transferred to a Florisil column and eluted with three solvent systems consisting of hexane (Fraction-1), 85:15 dichloromethane/hexane (Fraction-2) and 50:50 dichloromethane/hexane (Fraction-3).

An aliquot of surrogate standard was added to each Fraction-2 to allow quantification, since the surrogate standard added at the beginning of the procedure eluted into Fraction-1 and Fraction-3. Each fraction was concentrated, transferred to a microvial, and an aliquot of recovery standard (4,4'-dibromooctafluorobiphenyl and PCB 204 to Fraction-1 and Fraction-2 and ^{13}C-PCB 153 to Fraction-3) was added prior to analysis by GC/ECD.

Fraction-1 was analyzed by GC/ECD for PCBs as Aroclors, PCB congeners, and mildly polar chlorinated pesticides.

Fraction-2 was analyzed by GC/ECD for moderately polar chlorinated pesticides.

Fraction-3 was analyzed by GC/ECD for the most polar chlorinated pesticides.

ii. Cleanup for GC/MS

The extract was quantitatively transferred to a Florisil column. The column was eluted with hexane followed by 85:15 dichloromethane/hexane. The eluates were combined (Fraction-1). The column was eluted with 50:50 dichloromethane/hexane (Fraction-2).

Each fraction was concentrated, transferred to a microvial and spiked with an aliquot of recovery standard (^{13}C-PCB 153) prior to instrumental analysis.

Fraction-1 was analyzed by GC/MS for PCBs as Aroclors, PCB congeners, and non-polar and moderately polar chlorinated pesticides.

Fraction-2 was analyzed by GC/ECD for the most polar chlorinated pesticides.

4. *Instrumental Analysis*

i. GC/ECD Analysis

Each fraction was analyzed for pesticides by using an HP 5830A gas chromatograph equipped with a ^{63}Ni electron capture detector (GC/ECD), a 60 m DB-5 column (0.25 mm i.d. x 0.1 µm film thickness) and HP 3392 integrator. Fraction-1 was simultaneously analyzed for PCBs as Aroclors and PCB congeners. Chromatographic conditions were as follows - Initial temp: 100 °C; Injection: splitless, 1 min; Initial time: 2 min; Ramp: 10°C/min to 150°C, 3 °C/min to 300 °C; Final time: 5 min. Column conditions were: Carrier gas, helium; Pressure, 21 psi; Flow rate, 60 mL/min; and Split ratio, 15:1.

The instrument was calibrated daily using a solvent blank and standards of Aroclor 1242, Aroclor 1254 and Aroclor 1260. For each Aroclor, the sum of the areas of three characteristic peaks was used to calculate its response factor against the internal standard. The area of the same three peaks was used to determine the concentration of each Aroclor in the sample.

All values reported in the data tables in Appendix D are in ppb (ng/g) on a dry weight basis for soil samples and on a wet weight basis for plant samples. Procedural blank information is given in the QA/QC discussion, Appendix B.

PCBs were also quantified as individual congeners by calibrating the GC/ECD response with four well-characterized mixtures of 51 congeners (total) obtained from the National Research Council (NRC), Halifax, NS. Aroclor mixtures of known composition were used for some congeners not present in the NRC mixtures.

ii. Low Resolution GC/MS

Fraction-1 was analyzed for PCB congeners, Aroclors and non-polar and moderately polar chlorinated pesticides using a Finnigan INCOS 50 mass spectrometer equipped with a Varian 3400 GC, a CTC autosampler and a DG 10 data system running INCOS 50 (Rev 9) software. Chromatographic separation of pesticides was achieved with a 60 m DB-5 column (0.25 mm i.d. and 0.10 µm film thickness). The mass spectrometer was operated in the electron impact (EI) mode at unit mass resolution in the multiple ion detection (MID) mode acquiring two characteristic ions for each target analyte and surrogate standard.

iii. High Resolution GC/MS

For high resolution GC/MS analysis, a VG 70 SE mass spectrometer, equipped with a Hewlett Packard 5890 GC, a 60 m DB-5 chromatographic column (0.25 mm i.d. and 0.10 µm film thickness) and a CTC autosampler were used. Data was acquired in the MID mode to enhance sensitivity. Two characteristic ions for each target analyte and surrogate standard were monitored.

D. Analysis of Polycyclic Aromatic Hydrocarbons (PAHs)

1. Summary

Analyses were conducted by the Environmental Sciences Group Analytical Laboratory at Royal Military College in Kingston, Ontario. Each sample was in an appropriate container, clearly labeled and stored at low temperatures in a secured area before and after analysis.

Samples were spiked with a Surrogate standard (a mixture of the deuterated PAHs: naphthalene, phenanthrene, anthracene, and benzo(a)anthracene) prior to extraction and analysis by gas chromatography (GC) with mass selective detection (MS). Soil and sediment samples were extracted with dichloromethane using an ultra-sonic bath. Extracts were concentrated using the EPA recommended Kuderna-Danish method and the solvent was exchanged prior to cleanup through a laboratory prepared silica-gel column.

2. Extraction Method

Samples were thoroughly homogenized before analysis. Soil and sediment samples were subsampled for determination of the wet/dry weight ratio.

Accurately weighed wet soil (12 g), to which the surrogate standard (1 mL), sodium sulphate (40 g) and Ottawa sand (20 g) were added, were extracted by ultrasound using three separate portions of 75 mL of dichloromethane for 10 minutes each. The extract, including the solvent used for rinsing (totaling 250 mL) was collected in the Kuderna-Danish apparatus. The volume was then reduced to near 1 mL and exchanged with 2 mL of cyclohexane. This was then applied to a laboratory-prepared activated silica-gel (Grade 923, 100-200 mesh) column for cleanup. The column was rinsed with hexanes (7 mL) and this portion of the eluant was discarded before collecting the dichloromethane fraction (25 mL). In some cases extracts were applied to an LC-Si - Supelco column containing silica gel for cleanup and diluted to 10 mL. In either case a GC vial (2 mL) was filled by measuring 960 µL of the sample solution and 40 µL of an internal standard and submitted for analysis by GC/MS.

3. Instrumental Analysis

Each sample was analyzed using an HP 5890 Series II Plus - GC equipped with an HP 5972 Mass selective detector, a PTE™ - 5 fused silica capillary column (30 m, 0.25 mm ID x 0.25 µm film thickness) and the HPChem station software. The chromatographic conditions were as follows: Sample volume 1 µL, splitless injection, initial temperature - 70°C for 5 min; ramp 12°C/min to 130 °C, 5°C/min to 260°C, final time 27 min. The carrier gas used was high purity helium with a column flow rate of 1 mL/min. The mass selective detector was used in the selective ion monitor mode for the following ions: Mass/Charge ratio (m/z) 128, 136, 152, 166, 172, 178, 188, 202, 228, 240, 252, 276, 278, representing each of the 16 PAHs, 4 surrogates and the internal standard used in the analysis.

For each set of samples analyzed, a six point calibration curve (0, 20, 50, 100, 250, and 500 ppb) was prepared for EACH of the 16 PAHs analyzed. Concentrations of PAHs in samples were determined by comparing sample responses with calibration curves. The surrogate and internal standards were used to account for the efficiency of extraction and analysis.

E. Analysis of Total Petroleum Hydrocarbons (TPH) in Soils

1. Summary

The above analyses were conducted by the Analytical Services Unit, Queen's University, Kingston, Ontario. Each sample was contained in an appropriate container, clearly labelled and stored at low temperatures in a secured area prior to and following the analysis.

2. Extraction

Soil samples were homogenised and subsamples dried for moisture determination. A wet sample (10 g dry equivalent weight) was ground with anhydrous sodium sulphate and Ottawa sand to a free-flowing powder, and loaded into a round-bottomed flask. Pesticide grade hexane (20 mL) was added, and the flask ultrasonically agitated. A 1 mL aliquot of the hexane extract was pipetted from the flask in a manner ensuring no transfer of solid material, and sealed in a gas chromatography (GC) vial.

3. Standard Preparation

A Varsol standard calibration sample (710 μg/mL) was prepared by adding Varsol (9 μL) to pesticide grade hexane (10 mL).

4. GC Analysis

Samples were run by gas chromatography on a DB5 capillary column (30 m, 0.25 mm i.d. x 0.25 μm film thickness). TPH was quantified by comparing the chromatogram peak area of the sample with that of the Varsol standard. Compound identity was determined by comparing the sample chromatogram with those of known hydrocarbons.

F. Analysis of Asbestos in Floor Tiles and Insulation Materials

Asbestos content of the bulk material was determined by polarized light microscopy dispersion staining. The analysis was carried out at the Occupational Health and Safety Resource Centre, University of Western Ontario, London, Ontario.

G. Analysis of Polychlorinated Biphenyls (PCBs) in Paint Samples

1. Summary

The above analyses were conducted by the Environmental Sciences Group Analytical Laboratory, located at the Royal Military College in Kingston, Ontario. Each sample was contained in an appropriate container, clearly labeled and stored at low temperatures in a secured area prior to and following the analysis.

All samples were spiked with an aliquot of decachlorobiphenyl (DCBP), a surrogate standard, prior to analysis by gas chromatography (GC) with electron capture detection (ECD). Soil, concrete, paint and swabs were extracted with methylene chloride using soxhlet apparatus. Extracts were concentrated using a rotovap and the solvent was exchanged to hexane before 'clean-up' of the sample. This was accomplished by passing the hexane containing the PCBs through a Florisil column.

2. Extraction Method

All samples were thoroughly homogenized before sampling for the analysis. Soil samples were subsampled for the determination of wet/dry weight ratio.

Accurately weighed wet soil (15 g), concrete (10 g), paint (1 g) and swabs to which DCBP, sodium sulfate (40 g) and Ottawa sand (20 g) were added, were extracted by soxhlet for 4 hours at 4-6 cycles per hour using 250 mL of methylene chloride. The extract was then concentrated by roto-evaporation to approximately 1 mL, 5 mL of hexane was added and again evaporated to 1 mL. This was repeated twice more resulting in 1 mL of hexane solvent, which was then applied to a Florisil column for clean-up. The column was thoroughly rinsed with hexane and the eluant containing the PCBs was diluted to 10.0 mL. In the case of swab samples the final volume was 2.0 mL. A GC vial (2 mL) was then filled and submitted for analysis by GC/ECD.

3. Instrumental Analysis

Each sample was analyzed using an HP 5890 series II Plus gas chromatograph equipped with a ^{63}Ni electron capture detector (GC/ECD), a SPB^{TM}-1 fused silica capillary column (30 m, 0.25 mm ID x 0.25 μm film thickness) and the HPChem station software. The Chromatographic conditions were as follows: Sample volume - 2 μL , Splitless injection, Initial temperature - 100°C for 2 min; Ramp - 10°C/min to 150°C, 5°C/min to 300°C; Final time 5 min. Carrier gas used was helium at a flow rate of 20 mL/min. Nitrogen was used as a make-up gas for the ECD.

All values were reported as ppm (μg/g) on a dry weight basis, with the exception of the swabs which were reported as $\mu g/100\ cm^2$ PCB.

H. Method for the Determination of Leachable Inorganics

1. Summary

The above analyses were conducted by the Analytical Services Unit, located at Queen's University in Kingston, Ontario. Each sample was contained in an appropriate container, clearly labeled and stored at low temperatures in a secured area prior to and following the analysis.

2. Extraction Method

All samples were thoroughly homogenized before sampling for the analysis. Soil samples were subsampled for the determination of wet/dry weight ratio. Wet soil (50 g dry weight equivalent) was placed in a labeled leachate container with distilled deionized water (800 mL). The bottles were placed in a leachate extraction box and rotated at 10 rpm. The pH of the sample was checked at 15 minutes, 1 hour, 3 hours, 6 hours, 22 hours, and 24 hours. 0.5 N acetic acid was used to lower the pH to 5.0 +/- 0.2 if applicable, at these times. No more than 200 mL of acid was used.

The liquid was vacuum filtered using a 0.45 μm filter. The resulting liquid was analyzed according to the methods for water as described in the above sections.

APPENDIX B: QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

An internal quality assurance/quality control program was implemented to allow the monitoring of data quality on an ongoing basis. All samples were given sequential, numerical codings before submission to the analytical firms; these codings masked any information concerning site location, sample type (for instance, whether a sample came from an outfall, a landfill, etc.) or possible concentration of the sample. Aspects of the QA/QC program and the results are discussed below.

A. QA/QC for Inorganic Analysis - Queen's University Analytical Services Unit (ASU)

1. Accuracy

Accuracy was monitored internally by ASU using 28 replicates of NRC Canada Marine Reference Sediment MESS-2 (Table B-1). These were run concurrently with sample batches throughout the analytical program. Good agreement with the certified values was obtained for all elements, with the exception of nickel, chromium and lead. Results for these elements were consistently low relative to the certified values, but this discrepancy is attributed to differences in the digestion methods.

A similar internal monitoring program was employed by ASU for the analysis of plants using certified reference materials NBS 1547 Peach Leaves and NBS 1515 Apple Leaves. These reference materials have been certified for copper, nickel, lead, zinc and arsenic, and were analyzed along with the plant samples (Table B-2). Only copper and zinc, however, were present at detectable concentrations; good agreement with the certified values was obtained. The concentrations of nickel, lead and arsenic in the standards are lower than ASU's detection limits. Measured values for these elements were below the certified detection limits, which was the best possible agreement obtainable.

2. Precision/Repeatability

Precision was monitored externally by ESG using 29 pairs of soil sample duplicates; these were homogenized in the field and submitted blind as separate samples to ASU for analysis. The results are presented in Table B-3. Average relative standard deviations or coefficients of variation (standard deviation divided by the mean) for sample pairs were expressed as percentages and used to evaluate laboratory precision.

Acceptable limits are generally considered to be less than 30% relative standard deviation, with 20% or less considered good agreement. The average relative standard deviations for all detectable inorganic elements in soil field duplicates were 20% or less with the exception of lead which was showed acceptable agreement at 29%.

Internal monitoring of precision was also carried out by ASU through the use of analytical replicates. Forty soil and sediment samples and six plant samples were analyzed in duplicate and some in triplicate or quadruplicate (Table B-4, Table B-5). The precision of analytical duplicate results is generally better than that of field duplicate results, which may differ because of unavoidable sample heterogeneity. Average relative standard deviations for copper (9.9%), nickel (4.8%), cobalt (4.2%), cadmium (3.1%), lead (19.6%), zinc (7.9%), chromium (5.5%) and arsenic (16.6%) in the soil replicates were less than 20% indicating good to excellent analytical precision for soil analysis (Table B-4). Average relative standard deviations for the plant analytical duplicates were low, with Cu (3.8%), Ni (8.7), Co (7.1%), Cd (4.8%), Pb (14%), Zn (3.3%), Cr (8.4%) and As (16.2%) indicating very good precision for the plant analytical replicates (Table B-5). Two paint chip samples were analyzed for lead at Radio Island and one of the samples was run in duplicate. The results of the duplicate analyses are noted at the bottom of Table B-5 and the relative standard deviation for the duplicate was very good at 15.5%.

B. QA/QC for PCB Analysis - Axys Analytical Services Ltd (Axys)

The QA/QC protocol used by Axys for PCBs consisted of the batch method, in which samples were worked up in batches with associated quality control samples. Each batch consisted of nine or fewer samples, along with one QA/QC sample (certified or internal spiked reference material), one analytical duplicate and a procedural blank. Spiked material was also used in cases where analytical results were anticipated to be outside of the concentration ranges of the available certified reference materials. Each batch was carried through sample workup, instrumentation and interpretation as a unit, and the sample results were interpreted in relation to the associated QA/QC results. All QA/QC data from each batch were considered together in order to evaluate the overall quality of the analytical program. The results of the organic QA/QC program are discussed below, and the QA/QC data from Axys is summarized in Table B-6 through Table B-14.

1. Accuracy

Axys monitored the accuracy of PCB analysis of soils internally using spiked soil reference materials (for Aroclors 1242, 1254 and 1260) which were analyzed 28 times during the analytical program (Table B-6). Good agreement was found between determined and expected values for all three Aroclors (within 17% of the expected value), indicating that analytical accuracy throughout the soil Aroclor analysis program was good.

Accuracy for water PCB Aroclor analyses was also monitored internally by Axys using spiked reference materials. Three water spike samples were analyzed during the analytical program. (Table B-6). The determined values for the Aroclors were also very close to the expected value indicating very good accuracy for the water PCB analyses. Accuracy for plant tissue sample Aroclor analysis was monitored by Axys using N.I.S.T. Certified Reference Material 1588 (Cod Liver Oil). Three reference samples were analyzed in total with good agreement found between determined and certified values for all three Aroclors (Table B-7).

Interferences for PCB analysis as Aroclors were monitored internally throughout the program using 28 soil blanks, three water blanks and three plant tissue blanks (Table B-8). One of the soil analytical blanks and two of the water blanks showed some quantifiable Aroclors but the levels are extremely low and close to the detection limits. The plant analytical blanks showed no detectable Aroclors.

2. Precision/Repeatability

Precision was monitored externally by ESG using 29 pairs of soil sample duplicates which were homogenized in the field during collection and submitted blind to Axys for analysis. Results for these sample replicates are presented in Table B-9. The average relative standard deviations, expressed as a percentage, for soil samples ranged from a low of 0% to a high of 100% for one sample with average relative standard deviation of 35%. The differences in some of the samples must be attributed to insufficient homogenization of the sample in the field since the analytical duplicates described below show good accuracy in the lab.

Precision was also monitored internally by Axys, through the use of 23 soil and sediment analytical replicates and one plant analytical replicate (Table B-10). Results for the plant samples were below detection limits but the average relative standard deviation, or coefficient of variation (standard deviation divided by the mean), for soil and sediment samples was 16%. This indicates good correlation between duplicates and represents good accuracy in the analysis of PCB Aroclors at Axys.

C. QA/QC for Chlorinated Pesticides - Axys

1. Accuracy

The accuracy of pesticide analysis was monitored internally by Axys using two spiked soil reference materials which were analyzed twice each during the analytical program. One spiked water reference solution was analyzed once (Table B-11). Recoveries for most of the chlorinated pesticides were within 20% of the spiked value, indicating good analytical accuracy.

Accuracy of the pesticide analysis for biota samples was monitored by the analysis of certified reference material N.I.S.T. 1588 Cod Liver Oil which was analyzed for pesticides along with the plant samples. Determined values for most compounds were well within the range of certified values for the reference material, indicating very good accuracy for the plant pesticides (Table B-12).

Interferences were also checked internally through the use of analytical blanks. (Table B-13). Four soil blanks, one water blank, and one plant blank were analyzed and values for all chlorinated pesticide concentrations were below or very close to the detection limits.

2. Precision/Repeatability

Precision for pesticide analysis was monitored internally by Axys through the analysis of two soil samples in duplicate (Table B-14). The majority of compounds analyzed in the soil samples were below detection limits. The few compounds that were quantifiable in one sample were within the acceptable range of 20% relative standard deviation. The second sample also showed few compounds above detectable levels and two of these had relative standard deviations >50%. The concentrations are quite low and differences are magnified by the statistic at low levels.

D. QA/QC for Polycyclic Aromatic Hydrocarbons (PAHs) - ESG lab, RMC

1. Accuracy

The accuracy of PAH analysis of soils was monitored internally using certified NRC reference sediment material HS-3 (Table B-15). This table reflects the reference material analyzed throughout the analytical program in the fall of 1996. Results for naphthalene, and benzo(k)fluoranthene may tend to be slightly higher than the certified values because of a methodology bias.

Interferences for PAHs in soils were monitored internally throughout the analytical program using four analytical blanks (Table B-16). All compounds were below detection limits.

2. Precision

The precision of the PAH analyses was monitored internally using three pairs of soil analytical duplicates (Table B-17). Only one compound, pyrene, showed detectable levels and there was good agreement between the duplicates.

E. QA/QC for Total Petroleum Hydrocarbon (TPH) - ASU

1. Precision

Internal monitoring for precision was conducted using eight sets of analytical duplicates. The average relative standard deviations for these duplicates was 19% indicating good agreement (Table B-18).

Table B-1: Summary of Inorganic Analysis Results for Soil Internal Standards

	MESS-2	
Element	**Certified Value ppm (µg/g)**	**Mean (n=28)**
Cu	**39.3 ±2.0**	36 ± 2.5
Ni	**49.3 ± 1.8**	41 ± 2.2
Co	**13.8 ± 1.4**	12.4 ± 0.71
Cd	**0.24 ± 0.01**	<1.0
Pb	**21.9 ± 1.2**	15.3 ± 1.7
Zn	**172 ± 16**	154 ± 7.5
Cr	**106 ± 8**	52 ± 9.4
As	**20.7 ± 0.8**	18 ± 1.5

Table B-2: Inorganic Analysis Results for Plant Tissue Standard

	1. NBS 1547 Peach Leaves		*2. NBS 1515 Apple Leaves*	
Element	**Certified Value** ppm (µg/g)	**Mean** (n=2)	**Certified Value** ppm (µg/g)	**Mean** (n=4)
Cu	**3.7 ± 0.4**	4.1	**5.64 ± 0.24**	6.4 ± 0.13
Ni	**0.69 ± 0.09**	<5	**0.91 ± 0.12**	<5
Co	-	<5	-	<5
Cd	-	<0.5	-	<0.5
Pb	**0.87 ± 0.03**	<15	**0.47 ± 0.024**	<15
Zn	**17.9 ± 0.4**	18.7	**12.5 ± 0.3**	13.2 ± 0.44
Cr	-	<10	-	<10
As	**0.06 ± 0.018**	<0.2	**0.038 ± 0.007**	<0.2

Table B-3: Inorganic Element Results for Soil and Sediment Field Duplicates

Sample	Cu	Ni	Co	Cd	Pb	Zn	Cr	As	Location
				ppm					
ESG7719	8.8	<5.0	<5.0	<1.0	16.2	27	<20	0.44	24m ENE of ESG7704
ESG7720	7.0	<5.0	<5.0	<1.0	21	26	<20	0.25	
Std Dev	1.3	-	-		3.4	0.71	-	0.13	
Rel Std Dev	16.1	-	-		18.2	2.7	-	39	
ESG7714	4.4	<5.0	<5.0	<1.0	17.8	27	<20	0.44	1.5m S of POL tank 3 below valve
ESG7715	<3.0	<5.0	<5.0	<1.0	<10.0	16.3	<20	0.44	
Std Dev			-			7.6	-	0	
Rel Std Dev		-	-			35	-	0	
ESG7741	110	9.3	<5.0	<1.0	25	58	<20	0.84	In narrow drainage, 63m W of ESG7740
ESG7742	230	11.5	5.6	<1.0	47	90	21	1.1	
Std Dev	85	1.6	-	-	15.6	23	-	0.18	
Rel Std Dev	50	15	-	-	43	31	-	19	
ESG7750	6.2	<5.0	<5.0	<1.0	35	110	<20	0.3	In stain, 3m SE of ESG7749
ESG7751	11.1	<5.0	<5.0	<1.0	21	94	<20	0.22	
Std Dev	3.5	-	-		9.9	11.3	-	0.06	
Rel Std Dev	40	-	-		35	11.1	-	22	
ESG7789	9.0	<5.0	<5.0	<1.0	50	42	<20	0.69	10.5m W of W side of Garage
ESG7790	9.8	<5.0	<5.0	<1.0	66	40	<20	0.3	foundation, 9m E of ESG7750
Std Dev	0.57	-	-	-	11.3	1.4	-	0.28	
Rel Std Dev	6.0	-	-		19.5	3.4	-	56	
ESG7731	34	<5.0	<5.0	<1.0	110	73	<20	0.74	55m W of ESG7729
ESG7732	32	<5.0	<5.0	<1.0	64	83	<20	0.74	
Std Dev	1.4	-	-		33	7.1	-	0	
Rel Std Dev	4.3	-	-	-	37	9.1	-	0	

Table B-3: Inorganic Element Results for Soil and Sediment Field Duplicates (cont'd)

Sample	Cu	Ni	Co	Cd	Pb	Zn	Cr	As	Location
				ppm					
ESG7761	11.8	6.2	<5.0	<1.0	11.6	74	<20	0.59	In stain within DOT Mess Hall
ESG7762	11.2	7.3	5.6	<1.0	<10.0	65	<20	0.6	foundation
Std Dev	0.42	0.78	-	-	-	6.4	-	0.01	
Rel Std Dev	3.7	11.5	-	-	-	9.2	-	1.2	
ESG7774	7	<5.0	<5.0	<1.0	17.4	22	<20	0.84	In stain on beach 9m W of ESG7773
ESG7775	6.2	<5.0	<5.0	<1.0	20	23	<20	0.59	
Std Dev	0.57	-	-	-	1.8	0.71	-	0.18	
Rel Std Dev	8.6	-	-	-	9.8	3.1	-	25	
ESG7655	14.6	10.2	5.6	<1.0	<10.0	34	<20	<0.2	~ 1.5 nautical miles NE of the site.
ESG7656	14.2	10.7	<5.0	<1.0	<10.0	34	<20	<0.2	
Std Dev	0.28	0.35	-	-	-	0	-	-	
Rel Std Dev	2.0	3.4	-	-	-	0	-	-	
ESG7513	42	13.8	<5.0	<1.0	40	342	<20	0.3	~ 4.5 m S of NE corner of the
ESG7514	29	13.6	<5.0	<1.0	43	184	21	0.3	maintenance shed
Std Dev	9.2	0.14	-	-	2.1	112	-	0	
Rel Std Dev	26	1.0	-	-	5.1	42	-	0	
ESG7521	19.4	15.5	<5.0	<1.0	349	187	27	0.4	S edge of maintenance garage close to
ESG7522	13.4	12.2	5.9	<1.0	140	114	26	0.2	SW corner (5m).
Std Dev	4.2	2.3	-	-	148	52	0.71	0.14	
Rel Std Dev	26	16.8	-	-	60	34	2.7	47	
ESG7530	15.0	16.7	7.9	<1.0	<10	45	<20	0.2	In the middle of N wall of generator
ESG7531	17.3	16.7	5.9	<1.0	<10	4[illegible]	30	0.2	building
Std Dev	1.6	0	1.4	-	-	2.8	-	0	
Rel Std Dev	10.1	0	20	-	-	6.6	-	0	

Table B-3: Inorganic Element Results for Soil and Sediment Field Duplicates (cont'd)

Sample	Cu	Ni	Co	Cd	Pb	Zn	Cr	As	Location
				ppm					
ESG7541	17.2	39	7.9	<1.0	<10	77	41	0.2	At the N end, midway along the
ESG7542	15.1	41	7.0	<1.0	<10	59	54	<0.2	foundation
Std Dev	1.5	1.7	0.64	-	-	12.7	9.2	-	
Rel Std Dev	9.2	4.2	8.5	-		18.7	19.4	-	
ESG7550	27	44	8.4	<1.0	<10	66	67	0.3	At SW corner of supply depot, 12 m SSE
ESG7551	28	50	9.8	<1.0	<10	68	71	0.2	of tag 46.
Std Dev	0.99	3.8	0.99	-	-	1.4	2.8	0.07	
Rel Std Dev	3.6	8.1	10.9	-	-	2.1	4.1	28	
ESG7562	6.7	<5.0	<5.0	<1.0	2180	173	<20	0.2	At SE corner of kitchen / mess hall
ESG7563	6.4	6.1	<5.0	<1.0	3620	192	<20	<0.2	
Std Dev	0.21	-	-	-	1020	13.4	-	-	
Rel Std Dev	3.2	-	-		35	7.4	-	-	
ESG7590	14.6	16.1	6.1	<1.0	10	33	30	<0.2	~ 9.5 m SW of tag 83, 5.5 m WSW of
ESG7591	12.9	15.2	5.6	<1.0	<10	33	27	<0.2	tag 85
Std Dev	1.2	0.64	0.35	-	-	0	2.1	-	
Rel Std Dev	8.7	4.1	6.0	-	-	0	7.4	-	
ESG7580	10.3	13.5	<5.0	<1.0	42	42	22	<0.2	At E edge of garbage dump, 14 m due E
ESG7581	8.6	11.8	<5.0	<1.0	42	40	21	<0.2	of tag 73.
Std Dev	1.2	1.2	-	-	0	1.4	0.71	-	
Rel Std Dev	12.7	9.5	-	-	0	3.4	3.3	-	
ESG7572	25	12.6	<5.0	<1.0	26	189	<20	<0.2	In a drainage ~ 90 m SSW of SW corner
ESG7573	17.3	9.3	<5.0	<1.0	22	118	<20	<0.2	of messhall
Std Dev	5.6	2.3	-	-	2.8	50	-	-	
Rel Std Dev	26	21	-		11.8	33	-	-	

Table B-3: Inorganic Element Results for Soil and Sediment Field Duplicates (cont'd)

Sample	Cu	Ni	Co	Cd	Pb	Zn	Cr	As	Location
				ppm					
ESG7601	45	16.4	<5.0	<1.0	11.1	81	28	<0.2	In the center of the dump
ESG7602	61	16.8	5.5	<1.0	14.2	122	29	<0.2	due E of tag 92
Std Dev	11.4	0.26	-	-	2.2	29	0.83	-	
Rel Std Dev	22	1.5	-	-	17.5	28	2.9	-	
ESG7614	18.9	28	8.0	<1.0	14.0	41	48	0.6	At toe of crushed barrel pile
ESG7615	20	28	8.7	<1.0	39	52	53	0.6	~ 11 m N of the shoreline.
Std Dev	0.92	0.07	0.49	-	17.7	7.8	3.5	0	
Rel Std Dev	4.7	0.25	5.9	-	67	16.7	7.0	0	
ESG7646	15.2	20	6.4	<1.0	<10	31	34	<0.2	~ 24 m WSW of tag 135 and
ESG7647	21	27	7.4	<1.0	<10	38	41	0.4	37 m S of tag 133
Std Dev	4.0	4.4	0.71	-	-	4.9	4.9	-	
Rel Std Dev	22	18.7	10.2	-	-	14.3	13.2	-	
ESG7631	20	10.8	<5.0	<1.0	16	224	25	0.3	~ 1.5 m W of W side of the original
ESG7632	11.8	9.1	<5.0	<1.0	<10	116	21	<0.2	warehouse foundation
Std Dev	5.8	1.2	-	-	-	76	2.8	-	
Rel Std Dev	36	12.1	-	-	-	45	12.3	-	
ESG8477	23	45	11.8	<1.0	<10.0	28	71	0.5	61°18'583''N, 64°50,549''W
ESG8478	19.9	39	10	<1.0	<10.0	23	65	0.2	
Std Dev	2.2	4.2	1.3	-	-	3.5	4.2	0.21	
Rel Std Dev	10.2	10.1	11.7	-	-	13.9	6.2	61	
ESG8405	31	<5.0	<5.0	<1.0	1800	560	<20.0	1.5	Inside winch shed, 1.5m N of S wall
ESG8406	43	<5.0	<5.0	3.5	980	800	<20.0	0.9	
Std Dev	8.5	-	-	-	580	170	-	0.42	
Rel Std Dev	23	-	-	-	42	25	-	35	

Table B-3: Inorganic Element Results for Soil and Sediment Field Duplicates (cont'd)

Sample	Cu	Ni	Co	Cd	Pb	Zn	Cr	As	Location
				ppm					
ESG8414	39	26	10.7	<1.0	96	182	25	1.2	30m from 8413, radio room drainage
ESG8415	243	24	9.2	<1.0	154	234	21	1.2	
Std Dev	144	1.4	1.1	-	41	37	2.8	0	
Rel Std Dev	102	5.7	10.7	-	33	17.7	12.3	0	
ESG8437	23	35	10.3	<1.0	<10.0	42	29	1.6	Adjacent to small pool of water
ESG8438	32	48	13.3	<1.0	<10.0	55	34	1.9	in winch shed drainage
Std Dev	6.4	9.2	2.1	-	-	9.2	3.5	0.21	
Rel Std Dev	23	22	18	-	-	19	11.2	12.1	
ESG8453	419	27	12.0	10.3	11220	20820	28	3.3	S side of foundation of generator
ESG8454	920	27	11.4	10.2	11760	14560	26	7.3	building, 3m from E wall
Std Dev	354	0	0.42	0.07	382	4420	1.4	2.8	
Rel Std Dev	53	0	3.6	0.69	3.3	25	5.2	53	
ESG8463	354	36	14.7	3.1	18860	2720	29	10.8	Drainage leading from S of generator
ESG8464	347	44	17.0	4.0	13400	3260	43	9.9	foundation, 13m from 8453
Std Dev	4.9	5.7	1.6	0.64	3860	382	9.9	0.64	
Rel Std Dev	1.4	14.1	10.3	17.9	24	12.8	27	6.1	
ESG8425	16.8	24	7.8	<1.0	10.6	25	25	1.7	Narrow drainage, 6m from ocean
ESG8426	17.3	22	6.7	<1.0	27	27	21	2.1	
Std Dev	0.35	1.4	0.78	-	11.6	1.4	2.8	0.28	
Rel Std Dev	2.1	6.1	10.7	-	62	5.4	12.3	14.9	
Average Rel Std Dev	**19.8**	**8.8**	**10.5**	**9.3**	**29**	**16.4**	**9.8**	**21**	
Std Dev	**± 22**	**± 7.1**	**± 4.7**	**± 12.2**	**± 20**	**± 13.1**	**± 6.8**	**± 21**	

Table B-4: Inorganic Element Results for Soil and Sediment Analytical Replicates

Sample	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
				(ppm)				
Soil								
ESG8463	291	37	15.1	3.1	22340	2780	30	11.5
ESG8463	416	36	14.2	3.1	15380	2680	28	10
Std Dev	88	0.71	0.64	0	4920	71	1.4	1.1
Rel Std Dev	25	1.9	4.3	0	26	2.6	4.9	9.9
ESG8479	41	58	17.8	<1.0	<10	55	42	2.3
ESG8479	41	53	17.8	<1.0	<10	52	40	2.3
Std Dev	0	3.5	0		-	2.1	1.4	0
Rel Std Dev	0	6.4	0		-	4	[illegible].4	0
ESG8405	36	<5.0	<5.0	<1.0	1820	442	<20	1.9
ESG8405	26	<5.0	<5.0	<1.0	1780	660	<20	1
Std Dev	7.1	-	-		28	154	-	0.64
Rel Std Dev	23	-	-	-	1.6	28	-	44
ESG8426	17.4	22	7.1	<1.0	31	24	21	1.6
ESG8426	17.2	22	6.3	<1.0	23	29	21	2.6
Std Dev	0.14	0	0.57	-	5.7	3.5	0	0.71
Rel Std Dev	0.82	0	8.4	-	21	13.3	0	34
ESG8449	88	27	11.2	1.3	7160	3580	28	3.6
ESG8449	68	26	11.3	1.3	4640	2480	29	2.6
Std Dev	14.1	0.71	0.07	0	1780	780	0.71	0.71
Rel Std Dev	18.1	2.7	0.63	0	30	26	2.5	23
ESG8456	880	27	11	9	8340	7740	46	5.3
ESG8456	239	29	11.4	7.8	8260	4960	45	4.6
Std Dev	453	1.4	0.28	0.85	57	1960	0.71	0.49
Rel Std Dev	81	5.1	2.5	10.1	0.68	31	1.6	10

Table B-4: Inorganic Element Results for Soil and Sediment Analytical Replicates (cont'd)

Sample	Cu	Ni	Co	Cd (ppm)	Pb	Zn	Cr	As
ESG8404	56	19	7	1	366	900	<20	1.2
ESG8404	60	16.9	[illegible]	1	1020	940	<20	2.1
Std Dev	2.8	1.5	0	0	462	28	-	0.64
Rel Std Dev	4.9	8.3	0	0	67	3.1	-	39
ESG8413	58	34	7.5	2.6	250	800	28	1.5
ESG8413	57	33	6.5	2.8	157	780	25	1.5
Std Dev	0.71	0.71	0.71	0.14	66	14.1	2.1	0
Rel Std Dev	1.2	2.1	10.1	5.2	32	1.8	8	0
ESG8424	22	29	7.5	<1.0	11.7	27	21	1.3
ESG8424	21	28	7.4	<1.0	<10	25	18.9	1.6
Std Dev	0.71	0.71	0.07	-	-	1.4	1.5	0.21
Rel Std Dev	3.3	2.5	0.95	-	-	5.4	7.4	14.6
ESG8442	62	32	14.8	<1.0	242	780	28	5.3
ESG8442	66	38	17.7	<1.0	266	840	36	7.7
Std Dev	2.8	4.2	2.1	-	17	42	5.7	1.7
Rel Std Dev	4.4	12.1	12.6	-	6.7	5.2	17.7	26
ESG8452	61	47	15.8	<1.0	27	198	32	1.5
ESG8452	68	50	16	<1.0	32	238	31	3.7
Std Dev	4.9	2.1	0.14	-	3.5	28	0.71	1.6
Rel Std Dev	7.7	4.4	0.89	-	12	13	2.2	60
ESG8465	72	98	19.6	<1.0	12.2	98	32	2.5
ESG8465	73	99	21	<1.0	12.2	93	30	2.5
Std Dev	0.71	0.71	0.99	-	0	3.5	1.4	0
Rel Std Dev	0.98	0.72	4.9	-	0	3.7	4.6	0

Table B-4: Inorganic Element Results for Soil and Sediment Analytical Replicates (cont'd)

Sample	Cu	Ni	Co	Cd (ppm)	Pb	Zn	Cr	As
ESG8472	38	50	12.5	<1.0	12.2	87	30	1.1
ESG8472	41	51	11.6	<1.0	12.2	98	24	0.99
Std Dev	2.1	0.71	0.64		0	7.8	4.2	0.08
Rel Std Dev	5.4	1.4	5.3		0	8.4	15.7	7.4
ESG8475	42	77	17	<1.0	10.5	121	19.9	1.2
ESG8475	40	76	16.1	<1.0	<10	124	22	1.2
Std Dev	1.4	0.71	0.64		-	2.1	1.5	0
Rel Std Dev	3.4	0.92	3.8		-	1.7	7.1	0
ESG7502	<3.0	<5.0	<5.0	<1.0	19.5	108	<20	0.19
ESG7502	<3.0	<5.0	<5.0	<1.0	27	105	<20	<0.2
Std Dev	-	-	-		5.3	2.1	-	-
Rel Std Dev	-	-	-		23		-	-
ESG7514	27	14.4	<5.0	<1.0	46	187	21	0.31
ESG7514	30	12.8	<5.0	<1.0	40	182	21	0.32
Std Dev	2.1	1.1	-		4.2	3.5	0	0.01
Rel Std Dev	7.4	8.3	-	-	9.9	9	0	2.2
ESG7521	19.3	16.5	<5.0	<1.0	339	179	30	0.39
ESG7521	19.4	14.4	<5.0	<1.0	360	195	24	0.49
Std Dev	0.07	1.5	-		14.8	11.3	4.2	0.07
Rel Std Dev	0.37	9.6	-		4.2	6.1	15.7	16.1
ESG7536	32	33	11.9	<1.0	20	309	58	0.4
ESG7536	33	31	13.8	<1.0	20	195	58	0.64
Std Dev	0.71	1.4	1.3	-	0	81	0	0.17
Rel Std Dev	2.2	4.4	10.5		0	32	0	33

Table B-4: Inorganic Element Results for Soil and Sediment Analytical Replicates (cont'd)

Sample	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
				(ppm)				
ESG7550	30	42	8.9	<1.0	<10	71	67	0.4
ESG7550	24	47	7.9	<1.0	<10	62	67	0.25
Std Dev	4.2	3.5	0.71	-	-	6.4	0	0.11
Rel Std Dev	15.7	7.9	8.4	-	-	9.6	0	33
ESG7563	6	<5.0	<5.0	<1.0	3820	190	<20	<0.2
ESG7563	6.7	7.8	<5.0	<1.0	3420	193	<20	<0.2
Std Dev	0.49	-		-	283	2.1	-	-
Rel Std Dev	7.8	-	-	-	7.8	1.1	-	-
ESG7581	8.9	12.3	<5.0	<1.0	40	41	23	<0.2
ESG7581	8.3	11.4	<5.0	<1.0	44	39	<20	<0.2
Std Dev	0.42	0.64	-	-	2.8	1.4	-	-
Rel Std Dev	4.9	5.4	-	-	6.7	3.5	-	-
ESG7591	12.8	15.2	5.6	<1.0	<10	33	27	<0.2
ESG7591	12.9	15.2	5.6	<1.0	<10	33	27	<0.2
Std Dev	0.07	0	-	-	-	0	0	-
Rel Std Dev	0.55	0	-	-	-	0	0	-
ESG7605	13.5	17.1	6.5	<1.0	19.9	39	30	<0.2
ESG7605	13.8	18.6	6.3	<1.0	23	41	31	<0.2
Std Dev	0.21	1.1	0.14	-	2.2	1.4	0.71	-
Rel Std Dev	1.6	5.9	2.2	-	10.2	3.5	2.3	-
ESG7614	17.8	29	8.5	<1.0	12.9	41	49	0.49
ESG7614	19.9	28	7.6	<1.0	14.7	41	46	0.78
Std Dev	1.5	0.71	0.64	-	1.3	0	2.1	0.21
Rel Std Dev	7.9	2.5	7.9	-	9.2	0	4.5	32

Table B-4: Inorganic Element Results for Soil and Sediment Analytical Replicates (cont'd)

Sample	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
				(ppm)				
ESG7631	21	11.3	<5.0	<1.0	21	237	28	0.4
ESG7631	18.9	10.3	<5.0	<1.0	10.5	211	22	0.25
Std Dev	1.5	0.71	-		7.4	18.4	4.2	0.11
Rel Std Dev	7.4	6.5	-		47	8.2	17	33
ESG7643	56	57	14.8	<1.0	112	126	90	0.79
ESG7643	51	54	14.7	<1.0	10.3	113	88	0.49
Std Dev	3.5	2.1	0.07		72	9.2	1.4	0.21
Rel Std Dev	6.6	3.8	0.48	.	118	7.7	1.6	33
ESG7656	15.9	11.2	<5.0	<1.0	<10	[illegible]	<20	<0.2
ESG7656	12.5	10.2	<5.0	<1.0	<10	33	<20	<0.2
Std Dev	2.4	0.71	-		-	1.4	.	-
Rel Std Dev	16.9	6.6	-		-	4.2	.	-
ESG7660	<3.0	6.1	<5.0	<1.0	<10	9.6	<20	0.94
ESG7660	<3.0	6.1	<5.0	<1.0	<10	9.5	<20	0.94
Std Dev	-	0	-		-	0.07	.	0
Rel Std Dev	-	0	-		-	0.74	.	0
ESG7639	26	22	<5.0	<1.0	28	47	29	0.39
ESG7639	29	17	<5.0	<1.0	16.6	49	[illegible]	0.4
Std Dev	2.1	3.5	-	-	8.1	1.4	1.4	0.01
Rel Std Dev	7.7	18.1	-		36	2.9	4.7	1.8
ESG7714	4.4	<5.0	<5.0	<1.0	16.2	[illegible]	<20	0.44
ESG7714	4.4	<5.0	<5.0	<1.0	19.5	29	<20	0.44
Std Dev	0	-	-		2.3	2.8	-	0
Rel Std Dev	0	-	-		13.1	10.5	-	0

Table B-4: Inorganic Element Results for Soil and Sediment Analytical Replicates (cont'd)

Sample	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
				(ppm)				
ESG7722	12.5	8.5	5.6	<1.0	<10	42	<20	0.49
ESG7722	12.6	8.5	5.6	<1.0	10.7	43	<20	0.64
Std Dev	0.07	0	0	-	-	0.71	-	0.11
Rel Std Dev	0.56	0	0	-	-	1.7	-	18.8
ESG7743	56	6.2	<5.0	<1.0	29	64	<20	0.59
ESG7743	57	6.2	<5.0	<1.0	27	68	<20	0.44
Std Dev	0.71	0		-	1.4	2.8	-	0.11
Rel Std Dev	1.3	0	.	-	5.1	4.3	-	21
ESG7751	13.9	<5.0	<5.0	<1.0	21	93	<20	<0.2
ESG7751	8.3	<5.0	<5.0	<1.0	21	95	<20	0.29
Std Dev	4	-	.	-	0	1.4	-	-
Rel Std Dev	36	-	-	-	0	1.5	-	-
ESG7775	6.2	<5.0	<5.0	<1.0	25	24	<20	0.59
ESG7775	6.2	<5.0	<5.0	<1.0	15.3	22	<20	0.59
Std Dev	0	-		-	6.9	1.4	-	0
Rel Std Dev	0	-	.	-	34	6.1	-	0
ESG7788	46	5.2	<5.0	<1.0	132	138	<20	5
ESG7788	39	5.2	<5.0	<1.0	85	102	<20	4.2
Std Dev	4.9	0		-	33	25	-	0.57
Rel Std Dev	11.6	0		-	31	21	-	12.3
ESG7702	5.7	7	<5.0	<1.0	<10	31	<20	0.74
ESG7702	6.4	8	<5.0	<1.0	<10	30	<20	0.49
Std Dev	0.49	0.71	.	-	-	0.71	-	0.18
Rel Std Dev	8.2	9.4		-	-	2.3	-	29

Table B-4: Inorganic Element Results for Soil and Sediment Analytical Replicates (cont'd)

Sample	Cu	Ni	Co	Cd (ppm)	Pb	Zn	Cr	As
ESG7792	<3.0	<5.0	<5.0	<1.0	<10	19.9	<20	0.25
ESG7792	<3.0	<5.0	<5.0	<1.0	<10	19.2	<20	0.25
ESG7792	<3.0	<5.0	<5.0	<1.0	<10	19.1	<20	0.25
Std Dev	-	-	-		-	0.44	.	0
Rel Std Dev	-	-	-		-	2.2	-	0
ESG7757	22	5.5	<5.0	<1.0	43	69	<20	0.45
ESG7757	22	6.6	<5.0	<1.0	40	66	<20	0.55
Std Dev	0	0.78	-	-	2.1	2.1	-	0.07
Rel Std Dev	0	12.9	-	-	5.1	3.1	-	14.1
ESG7796	6.7	<5.0	<5.0	<1.0	120	76	<20	0.39
ESG7796	8.2	<5.0	<5.0	<1.0	104	109	<20	0.4
Std Dev	1.1	-	-	.	11.3	23	.	0.01
Rel Std Dev	14.2	-	-		10.1	25	.	1.8
ESG7795	4.6	<5.0	<5.0	<1.0	<10	22	<20	0.3
ESG7795	7.6	<5.0	<5.0	<1.0	<10	25	<20	0.3
Std Dev	2.1	-	-		-	2.1	.	0
Rel Std Dev	35	-	-	.	-	.		0
Average Rel Std Dev (n=40)	**9.9**	**4.8**	**4.2**	**3.1**	**19.6**	**7.9**	**5.5**	**16.6**
Std Dev	**± 15.3**	**± 4.5**	**± 4.1**	**± 4.5**	**± 25**	**± 8.9**	**± 5.9**	**± 16.2**

Table B-5: Inorganic Element Results for Plant and Paint Chip Analytical Replicates

Sample	Cu	Ni	Co	Cd (ppm)	Pb	Zn	Cr	As
PLANTS								
ESG8467P	418	82	5.2	41	408	1500	124	0.57
ESG8467P	388	66	4.7	37	355	1440	97	0.5
Std Dev	21	11.3	0.35	2.8	37	42	19.1	0.05
Rel Std Dev	5.3	15.3	7.1	7.3	9.8	2.9	17.3	9.3
ESG7652P	7.6	9.4	<5	0.94	<15	195	10.9	<0.2
ESG7652P	6.9	8.3	<5	0.94	<15	198	10.9	<0.2
Std Dev	0.49	0.78	-	0	-	2.1	0	-
Rel Std Dev	6.8	8.8	-	0	-	1.1	0	-
ESG7603P	6.7	9.1	<	3.1	<15	333	<10	<0.2
ESG7603P	6.7	8.1	<	3	<15	332	<10	<0.2
Std Dev	0	0.71		0.07	-	0.71	-	-
Rel Std Dev	0	8.2	-	2.3	-	0.21	-	-
ESG7606P	10.3	<5	<	9.2	<15	1140	<10	<0.2
ESG7606P	9.7	<5	<5	9.4	<15	1160	<10	<0.2
ESG7606P	9.7	<5	<5	9.4	<15	1100	<10	<0.2
Std Dev	0.35	-	-	0.12	-	31	-	-
Rel Std Dev	3.5	-		1.2	-	2.7	-	-
ESG7516P	27	39	<5	0.97	1560	217	98	1.1
ESG7516P	25	44	<5	1.2	1100	215	112	1.8
ESG7516P	25	44	<5	1	1100	193	104	1.2
ESG7516P	26	51	<5	1	1440	215	121	1.3
Std Dev	0.96	4.9		0.11	236	11.4	10	0.31
Rel Std Dev	3.7	11.1		10.2	18.2	5.4	9.2	23

Table B-5: Inorganic Element Results for Plant and Paint Chip Analytical Replicates (cont'd)

Sample	Cu	Ni	Co	Cd (ppm)	Pb	Zn	Cr	As
ESG7793P	7.8	6.6	<5	0.97	<15	223	11.6	<0.2
ESG7793P	7.4	6.6	<5	0.87	<15	247	10.5	<0.2
Std Dev	0.28	0	-	0.07	-	17	0.78	-
Rel Std Dev	3.7	0	-	7.7	-	7.2	-	-
Average Rel Std Dev	**3.8**	**8.7**	**7.1**	**4.8**	**14**	**3.3**	**8.4**	**16.2**
Std Dev	**± 2.3**	**± 5.6**	-	**± 4.1**	**± 5.9**	**± 2.6**	**± 7.1**	**± 9.7**
PAINT CHIPS								
Radio PC-1					73644			
Radio PC-1					91827			
Std Dev					**12860**			
Rel Std Dev					**15.5%**			

Table B-6: Determination of PCB (Aroclors) in Internal Spiked Reference Material for Soils and Water

Sample	Aroclor 1242			Aroclor 1254			Aroclor 1260		
	Determined	Expected	Recovery (%)	Determined	Expected	Recovery (%)	Determined	Expected	Recovery (%)
SOIL				ppb or ng/g					
CL-S-SPM 710	45	52	87	48	48	100	47	49	96
CL-S-SPM 680	42	52	81	32	48	67	37	49	76
CL-S-SPM 687	40	52	77	34	48	71	41	49	84
CL-S-SPM 697	45	52	87	41	48	85	44	49	90
CL-S-SPM 688	38	52	73	37	48	77	38	49	78
CL-S-SPM 686	42	52	81	40	48	83	43	49	88
CL-S-SPM 684	41	52	79	39	48	81	42	49	86
CL-S-SPM 646	46	52	88	42	48	88	46	49	94
CL-S-SPM 645	71	52	140	38	59	64	40	46	87
CL-S-SPM 661	45	52	87	42	48	88	43	49	88
CL-S-SPM 647	50	52	96	41	59	69	41	46	89
CL-S-SPM 656	55	44	130	37	45	82	40	40	100
CL-S-SPM 631	41	44	93	37	45	82	41	40	100
CL-S-SPM 623	54	52	100	43	59	73	45	46	98
CL-S-SPM 624	60	44	140	34	45	76	37	40	93
CL-S-SPM 672	48	52	92	46	48	96	48	49	98
CL-S-SPM 669	62	52	120	35	45	78	44	46	96
CL-S-SPM 675	110	110	100	84	98	86	91	99	92
CL-S-SPM 648	37	52	71	42	48	88	41	49	84
CL-S-SPM 676	50	52	96	41	48	85	44	49	90
CL-S-SPM 685	45	52	87	38	48	79	41	49	84
CL-S-SPM 698	45	52	87	45	48	94	43	49	88
CL-S-SPM 673	46	52	88	38	59	64	42	46	91
CL-S-SPM 658	56	55	100	58	59	98	49	46	110
CL-S-SPM 674	51	52	98	44	59	75	42	46	91
CL-S-SPM 720*	43	52	83	46	48	96	44	49	90

Table B-6: Determination of PCB (Aroclors) in Internal Spiked Reference Material for Soils and Water (cont'd)

Sample	Aroclor 1242			Aroclor 1254			Aroclor 1260		
	Determined	Expected	Recovery (%)	Determined	Expected	Recovery (%)	Determied	Expected	Recovery (%)
CL-S-SPM 713	45	52	87	44	48	92	41	49	84
CL-S-SPM 722	50	52	96	50	48	100	46	49	94
Average (n=28)			**94**			**83**			**90**
Std Dev			**± 17.0**			**± 11.0**			**± 7.0**
WATER									
CL-W-SPM 712	270	260	100	260	240	110	240	240	100
CL-W-SPM 650*	120	110	110	120	110	110	110	100	110
CL-W-SPM 597*	120	110	110	120	120	100	110	120	92
Average (n=3)			**110**			**110**			**100**
Std Dev			**± 3**			**± 5**			**± 9.2**

* Analyzed HiRes GCMS

Table B-7: Determination of PCBs (Aroclors) in Plant Tissue Internal Standard
(N.I.S.T. Certified Reference Material 1588 - Cod Liver Oil)

Mixture	Certified Value	Mean (n=3)
	ppb (ng/g)	
Aroclor 1242	150 +/- 60	150 ± 15
Aroclor 1254	1500 +/- 500	1800 ± 170
Aroclor 1260	840 +/- 210	940 ± 56

Table B-8: Analytical Blanks for PCB Aroclors

Sample I.D.	Aroclor 1242	Aroclor 1254	Aroclor 1260	Total Aroclor
SOILS		ng/g (ppb)		
CL-S-BLK 1005	<0.24	<0.25	<0.23	
CL-S-BLK 968	<1.6	<1.1	<0.62	
CL-S-BLK 973	<0.58	<0.48	<0.29	
CL-S-BLK 984	<0.43	<0.38	<0.25	
CL-S-BLK 974	<1.1	<1.1	<0.59	
CL-S-BLK 972	<1.1	<1.2	<0.7	
CL-S-BLK 970	<0.67	<0.68	<4.7	
CL-S-BLK 918	<1.7	<1.3	<0.7	
CL-S-BLK 917	<2.3	<0.99	<0.41	
CL-S-BLK 937	<1.4	<0.87	<0.46	
CL-S-BLK 919	<2.3	<1.9	<0.72	
CL-S-BLK 932	<2.0	<1.8	<1.0	
CL-S-BLK 902	<0.83	<0.76	<0.4	
CL-S-BLK 894	<2.3	<1.9	<0.37	
CL-S-BLK 895	<1.2	<1.2	<0.63	
CL-S-BLK 954	<0.82	<0.74	<0.41	
CL-S-BLK 949	<1.8	<1.1	<0.44	
CL-S-BLK 961	<2.0	<3.0	<3.6	
CL-S-BLK 920	<0.74	<0.75	<0.4	
CL-S-BLK 962	<0.65	<0.49	<0.30	
CL-S-BLK 971	<8.0	2.2	<0.92	2.2
CL-S-BLK 985	<0.6	<0.53	<0.32	
CL-S-BLK 957	<1.0	<1.6	<1.4	
CL-S-BLK 933	<3.0	<7.5	<8.4	
CL-S-BLK 958	<5.0	<2.4	<3.0	
CL-S-BLK 1026*	<0.15	<0.18	<0.12	
CL-S-BLK 1009	<0.18	<0.23	<0.3	
CL-S-BLK 1031	<0.12	<0.21	<0.26	

Table B-8: Analytical Blanks for PCB Aroclors (cont'd)

Sample I.D.	Aroclor 1242	Aroclor 1254	Aroclor 1260	Total Aroclor
Water				
CL-W-BLK 1007*	<0.17	NDR(0.3)	0.32	0.32
CL-W-BLK 924*	0.13	0.25	0.12	0.5
CL-W-BLK 866	<0.08	<0.07	<0.02	
Plants				
CL-T-BLK 950	<0.78	<1.2	<1.4	
CL-T-BLK 1008	<0.14	<0.44	<0.79	
CL-T-BLK 1028	<0.33	<0.67	<1.3	

* HR-GCMS

Table B-9: PCB Aroclor Results for Soil and Sediment Field Duplicates

Sample	Aroclor 1242	Aroclor 1254	Aroclor 1260	Total Aroclor	Replicate Std Dev	Replicate Rel Std Dev	Location
		ppb (ng/g)					
ESG7702A	<3.0	<2.0	<1.1				~3.5 km N of site in lush vegetation
ESG7702B	<2.7	<1.7	<1.0				
ESG7719	<3.6	<3.2	<1.7				24m ENE of ESG7704
ESG7720	<2.2	<1.9	1.7	1.7			
ESG7714	<6.6	<3.3	<1.8				1.5m S of POL tank 3 below valve
ESG7715	<8.9	<2.1	<1.1				
ESG7741	<2.2	4.9	5.4	10	37	100	In narrow drainage, 63m W of ESG7740
ESG7742	<2.2	32	30	62			
ESG7750	<12	11	6.4	[illegible]	3.5	24	In stain, 3m SE of ESG7749
ESG7751	<10	12	<4.3	[illegible]			
ESG7789	<2.0	21	5.7	27	1.4	5.4	10.5m W of W side of Garage foundation,9m E of ESG7750
ESG7790	<2.2	17	7.8	25			
ESG7731	<0.64	10	6.6	17	16	56	55m W of ESG7729
ESG7732	<0.47	[illegible]	12	[illegible]			
ESG7761	<19	<10	<3.2				In stain within DOT Mess Hall foundation
ESG7762	<4.6	<2.3	<1.2				
ESG7774	<9.0	<3.9	<2.0				In stain on beach 9m W of ESG7773
ESG7775	<8.9	<4.3	<2.2				
ESG7655	<2.6	<1.4	<0.87				~ 1.5 nautical miles NE of the site.
ESG7656	<0.52	<0.68	<0.3				

Table B-9: PCB Aroclor Results for Soil and Sediment Field Duplicates (cont'd)

Sample	Aroclor 1242	Aroclor 1254	Aroclor 1260	Total Aroclor	Replicate Std Dev	Replicate Rel Std Dev	Location
ESG7513	<14	590	86	680	130	22	~ 4.5 m S of NE corner of the
ESG7514	8.5	430	61	500			maintenance shed
ESG7521	<5.7	<2.9	6.6	6.6	0.1	2.2	S edge of maintenance garage close
ESG7522	<3.6	<2.8	6.4	6.4			to SW corner (5m).
ESG7530	<2.6	<3.5	3.9	3.9	0.2	5.2	In the middle of N wall of generator
ESG7531	<6.8	<8.1	4.2	4.2			building
ESG7541	<1.5	<1.4	<0.76				At the N end, midway along the
ESG7542	<2.7	<3.8	<3.6				foundation
ESG7550	<2.6	4	<4.2	4	2.1	39	At SW corner of supply depot,
ESG7551	<3.4	3	4	7			12 m SSE of tag 46.
ESG7562	45	98	15	160	54	44	At SE corner of kitchen / mess hall
ESG7563	<2.6	73	11	84			
ESG7590	<4.6	<2.2	<1.8				~ 9.5 m SW of tag 83,
ESG7591	<4.9	<2.3	<1.9				5.5 m WSW of tag 85
ESG7580	3.1	14	12	29	9.2	41	At E edge of garbage dump,
ESG7581	<7.1	8.2	8.1	16			14 m due E of tag 73.
ESG7572	<3.4	<3.2	<1.6				In a drainage ~ 90 m SSW of SW
ESG7573	<2.9	<2.6	<1.3				corner of messhall
ESG7601	<1.4	19	6	25	53	85	In the center of the dump due E of
ESG7602	<1.8	86	14	100			tag 92
ESG7614	<4.0	5.9	<4.8	5.9			At toe of crushed barrel pile
ESG7615	<12.0	<5.3	<5.8				~ 11 m N of the shoreline.

Table B-9: PCB Aroclor Results for Soil and Sediment Field Duplicates (cont'd)

Sample	Aroclor 1242	Aroclor 1254	Aroclor 1260	Total Aroclor	Replicate Std Dev	Replicate Rel Std Dev	Location
ESG7646	<1.5	<1.1	<0.72				~ 24 m WSW of tag 135 and
ESG7647	<2.8	<1.0	<0.65				37 m S of tag 133
ESG7631	1.6	520	62	580	240	32	~ 1.5 m W of W side of the
ESG7632	<13	840	83	920			original warehouse foundation
ESG8477	<1.5	<1.4	<0.82				61°18'583''N, 64°50,549''W
ESG8478	<1.8	<1.7	<1.0				
ESG8403	<3.0	6.2	<2.0	6.2	14	87	1m N of N wall of storage house
ESG8406	<11	15	11	26			
ESG8437	<5.6	<1.2	<0.69				Adjacent to small pool of water
ESG8438	<1.2	<0.90	<0.59				in winch shed drainage
ESG8453	1.3	25	14	40	4.2	11	S side of foundation of generator
ESG8454	<2.2	[illegible]	13	[illegible]			building, 3m from E wall
ESG8463	<4.3	26	9.6	36	0	0	Drainage leading from S of
ESG8464	<4.0	26	9.6	36			generator foun., 13m from 8453
ESG8425	1.9	<1.2	<0.75	[illegible]	0	0	Narrow drainage, 6m from ocean
ESG8426	1.9	<1.3	<0.75	1.9			
Average Rel Std Dev (n=29)						35	
Std Dev						± 33	

Table B-10: PCB Aroclor Results for Soil Analytical Duplicates

Sample I.D.	Aroclor 1242	Aroclor 1254	Aroclor 1260	Aroclor Total	Std Dev	Rel Std Dev
ESG7708	<2.4	14	34	48	5.7	13
ESG7708	<2.1	12	28	40		
ESG8454	<2.2	22	14	36	2.8	8.3
ESG8454	<3.0	20	12	32		
ESG7770	<1.3	<1.1	<0.71		-	-
ESG7770	<1.3	<1.0	<0.67			
ESG8463	<4.3	25	9.1	34	1.3	3.8
ESG8463	<4.3	26	10	36		
ESG8434	NDR (12)	16	11	27	4.2	14
ESG8434	NDR (11)	20	13	33		
ESG8400	<2.3	9.4	4.2	14	8.8	44
ESG8400	<2.3	21	5	26		
ESG7746	<6.1	590	380	970	160	18
ESG7746	6.3	400	340	750		
ESG7533	<15	10	32	42	5.7	12
ESG7533	<18	14	36	50		
ESG7773	<5.9	<2.6	<1.4		-	-
ESG7773	<9.3	<4.1	<2.1			
ESG7787	<4.9	290	69	360	61	15
ESG7787	<5.7	370	75	450		

Table B-10: PCB Aroclor Results for Soil Analytical Duplicates (cont'd)

Sample I.D.	Aroclor 1242	Aroclor 1254	Aroclor 1260	Aroclor Total	Std Dev	Rel Std Dev
ESG7530	<2.6	<3.5	3.8	3.8	0.1	3.6
ESG7530	<2.6	<3.4	4	4		
ESG7516	<8.7	<14	<5.1	-	-	-
ESG7516	<7.8	<14	<5.3	-		
ESG7508	<1.6	36	6.6	43	5.2	11
ESG7508	<15	43	7	50		
ESG7611	<1.6	<1.4	<0.8	-	-	-
ESG7611	<1.7	<1.4	<0.8	-		
ESG7783	<5.9	7.8	<1.8	7.8	3.1	56
ESG7783	<5.5	3.4	<1.7	3.4		
ESG7562	45	85	13	140	20	13
ESG7562	45	110	16	170		
ESG7792	<1.8	<1.6	<0.86	-	-	-
ESG7792	<1.3	<1.3	<0.67	-		
ESG7638	<1.8	<1.6	2.1	2.1	0.2	11
ESG7638	<1.9	<2.0	1.8	1.8		
ESG7658	<7.8	<6.0	<3.8	-	-	-
ESG7658	<4.9	<3.3	<2.1	-		
ESG7629	<2.1	11	1.7	13	2.1	19
ESG7629	<1.7	8.1	1.6	9.7		
ESG7615	<12	<5.3	<3.5	-	-	-
ESG7615	<7.0	<4.9	<5.8	-		

Table B-10: PCB Aroclor Results for Soil Analytical Duplicates (cont'd)

Sample I.D.	Aroclor 1242	Aroclor 1254	Aroclor 1260	Aroclor Total	Std Dev	Rel Std Dev
ESG7749	<2.4	32	12	44	2.1	4.7
ESG7749	<2.1	36	11	47		
ESG7705*	0.24	4.1	5.8	10	0.2	2.3
ESG7705*	0.22	3.4	6.2	9.8		
Average Rel Std Dev (n=23)						**16**
Std Dev						**± 15**
Plants						
ESG 7653 P	<0.45	<0.93	<1.1		-	-
ESG 7653 P	<0.38	<0.78	<1.2	-		

* Sample run at high resolution

Table B-11: Determination of Pesticides in Internal Spiked Reference Material for Soils and Water

	Soil Solution #1			Soil Solution #2		
Compounds	Mean (n=2)	Expected	Recovery %	Mean (n=2)	Expected	Recovery %
Concentration in ng/g						
Hexachlorobenzene	6.1	5.4	110	5.3	5.8	91
alpha BHC	4.6	5.8	79	5.3	6	88
beta BHC	8.7	8.5	100	7.5	8.3	90
gamma BHC	5.3	5.9	90	5.1	5.9	86
Heptachlor	5.8	6.4	91	5.9	6	98
Aldrin	3.8	4.3	88	4.3	4.2	100
Oxychlordane	6.1	7	87	7	5.6	130
trans-Chlordane	3.3	3.4	97	3.5	3.2	110
cis-Chlordane	4.5	4.8	94	5.3	5.2	100
o,p'-DDE	5.7	6.1	93	5.9	6	98
p,p'-DDE	5.3	5.5	96	5.5	5.8	95
trans-Nonachlor	3.8	4.2	90	4.5	4.4	100
cis-Nonachlor	2.8	3.1	90	2.7	2.6	100
o,p'-DDD	4.7	5.8	81	6.1	5.4	110
p,p'-DDD	5	6.6	76	7.7	7.1	110
p,p'-DDT	6.5	6.1	110	6.1	6.4	95
Mirex	5.5	5.4	100	5.3	5.9	90
Heptachlor Epoxide	2.9	3.8	76	4.3	5.4	80
alpha-Endosulphan	3.7	3.8	97	3.9	4.2	93
Dieldrin	4.2	4.9	86	4.7	6.3	75
Endrin	9.6	8.9	110	11	12	92
Methoxychlor	30	22	140	27	24	110

Table B-11: Determination of Pesticides in Internal Spiked Reference Material for Soils and Water (cont'd)

Compound	Water Determined	Expected	Recovery %
HR-GCMS ng/L			
Hexachlorobenzene	29	29	100
alpha BHC	29	30	97
beta BHC	41	42	98
gamma BHC	30	30	100
Heptachlor	36	30	120
Aldrin	20	21	95
Oxychlordane	36	28	130
trans-Chlordane	19	16	120
cis-Chlordane	31	26	120
o,p'-DDE	30	30	100
p,p'-DDE	28	29	97
trans-Nonachlor	26	22	120
cis-Nonachlor	17	13	130
o,p'-DDD	33	27	120
p,p'-DDD	43	36	120
p,p'-DDT	33	32	100
Mirex	28	30	93
Heptachlor Epoxide	28	27	100
alpha-Endosulphan	22	21	100
Dieldrin	28	32	88
Endrin	53	60	88
Methoxychlor	170	120	140

Table B-12: Determination of Pesticides in N.I.S.T. Certified Reference Material 1588 Cod Liver Oil

	Plants	
	CL-T-CRM 401	
Compounds	Determined	Certified
Hexachlorobenzene	150	148 +/- 21
alpha HCH	100	86 +/- 19
gamma HCH	23	24 +/- 6
trans-Chlordane	37	50 +/- 13
cis-Chlordane	180	158 +/- 8
p,p'-DDE	640	641 +/- 62
trans-Nonachlor	230	209 +/- 11
o,p'-DDD	37	37 +/- 8
p,p'-DDD	270	277 +/- 15
p,p'-DDT	530	529 +/- 45
Dieldrin	140	150 +/- 12

Table B-13: Analytical Blanks for Pesticides in Soils, Plants and Water

	Soil				Plants	Water
Sample	CL-S-BLK 957	CL-S-BLK 933	CL-S-BLK 1009	CL-S-BLK 1010	CL-T-BLK 1028	CL-W-BLK 1 HR-GCMS
Compounds	ng/g					ng/L
HCB	<0.1	<0.12	0.02	<0.02	0.02	0.04
alpha BHC	<0.18	<0.49	<0.04	<0.12	<0.12	0.007
beta BHC	<0.47	<0.78	<0.07	<0.24	<0.23	<0.01
gamma BHC	<0.38	<0.69	<0.06	<0.16	<0.16	<0.008
Heptachlor	<0.52	<2.6	<0.14	<0.34	<0.26	NDR(0.008)
Aldrin	<0.14	<0.89	<0.03	<0.07	<0.06	<0.003
Oxychlordane	<0.55	<4.0	<0.3	<0.4	<0.34	<0.01
trans-Chlordane	<0.1	<0.71	<0.02	<0.04	<0.04	NDR(0.004)
cis-Chlordane	<0.13	<0.68	<0.02	<0.05	<0.05	NDR(0.004)
o,p'-DDE	<0.04	<0.2	NDR(0.009)	<0.02	<0.02	<0.01
p,p'-DDE	<0.07	<0.22	NDR(0.02)	<0.03	<0.03	<0.01
trans-Nonachlor	<0.11	<0.62	<0.02	<0.05	<0.04	<0.003
cis-Nonachlor	<0.13	<0.47	<0.02	<0.04	<0.03	<0.003
o,p'-DDD	<0.04	<0.21	<0.02	<0.03	<0.03	<0.01
p,p'-DDD	<0.04	<0.22	<0.02	<0.04	<0.04	<0.02
p,p'-DDT	<0.14	<0.28	<0.03	<0.04	<0.07	<0.02
Mirex	<0.12	<0.24	NDR(0.04)	<0.03	<0.06	<0.001
Heptachlor Epoxide	<0.02	<0.03	<0.03	<0.02	<0.02	<0.57
alpha-Endosulphan	<0.03	<0.04	<0.02	<0.02	<0.02	<0.46
Dieldrin	<0.02	<0.04	<0.03	<0.02	<0.02	<0.59
Endrin	<0.08	<0.13	<0.05	<0.04	<0.05	<0.95
Methoxychlor	<0.2	<0.2	<0.1	<0.11	<0.07	<1.9

NDR = Peak detected but did not meet quantification criteria

Table B-14: Pesticide Results for Soil : Analytical Duplicates

Sample	ESG 8410	duplicate	Rel Std Dev	ESG 7525	duplicate	Rel Std Dev
Compound						
Hexachlorobenzene	<0.16	<0.14	-	0.05	0.12	58
alpha BHC	<0.72	<0.58	-	<0.72	<1.4	-
beta BHC	<1.2	<0.94	-	<1.3	<2.6	-
gamma BHC	<1.0	<0.83	-	<0.96	<1.8	-
Heptachlor	<3.4	<2.4	-	<1.4	<0.47	-
Aldrin	<1.2	<0.82	-	<0.35	<0.56	-
Oxychlordane	<5.2	<3.7	-	<3.8	<3.4	-
trans-Chlordane	<0.94	<0.66	-	<0.13	<0.03	-
cis-Chlordane	<0.9	<0.63	-	<0.15	<0.03	-
o,p'-DDE	<0.49	<0.22	-	<0.14	<0.21	-
p,p'-DDE	<0.54	<0.25	-	0.29	<0.3	-
trans-Nonachlor	<0.79	<0.57	-	<0.15	<0.14	-
cis-Nonachlor	<0.6	<0.43	-	<0.07	<0.07	-
o,p'-DDD	<0.31	<0.19	-	0.81	0.83	1.7
p,p'-DDD	0.76	0.6	17.0	2.2	2.1	3.3
p,p'-DDT	<0.58	<0.34	-	13	5.6	56
Mirex	<0.36	<0.25	-	<0.43	<0.38	-
Heptachlor Epoxide	<0.05	<0.05	-	<0.05	<0.08	-
alpha-Endosulphan	<0.08	<0.08	-	<0.04	<0.06	-
Dieldrin	<0.07	<0.07	-	<0.05	<0.08	-
Endrin	<0.25	<0.24	-	<0.08	<0.13	-
Methoxychlor	<0.37	<0.35	-	<0.16	<0.27	-

Table B-15: Results of PAH Analysis for NRC Canada Certified Reference Material, Harbour Sediment at ESG lab

Sample	96-lab-1	96-lab-2	96-lab-3	96-lab-4	96-lab-5	96-lab-6	96-lab-7	96-lab-8
Compound ng/g (ppb)								
Naphthalene	26600	24900	17000	13200	19200	16500	17500	18500
Phenanthrene	76200	84600	71200	67600	70700	84900	76600	76700
Pyrene	33900	40300	31100	31500	31100	34900	30400	32300
Benzo(a)anthracene	15000	16700	9800	10600	10000	11000	8000	10000
Benzo(b)fluoranthene	11700	11500	6400	7000	6200	7600	4700	5000
Benzo(k)fluoranthene	14100	10200	5300	6400	6100	5100	4900	4900
Benzo(a)pyrene	11500	8900	4400	4900	4400	4200	3700	3500
Indeno(1,2,3-cd)pyrene	1800	-	6100	7600	5500	1700	1500	2700
Dibenz(a,h)anthracene	1800	4400	2500	2900	980	-	940	1700
Total	192600	201500	153800	151700	154180	165900	148240	155300

	Average	**Rel Std Dev**	**Average**	**Certified Value**	**% Recovery**
	ppb		ppm		
Naphthalene	19200	23	19.2	9	**213**
Phenanthrene	76100	8.3	76.1	85	**90**
Pyrene	33200	9.8	33.2	39	**85**
Benzo(a)anthracene	11400	26	11.4	14.6	**78**
Benzo(b)fluoranthene	7500	36	7.5	7.7	**97**
Benzo(k)fluoranthene	7100	47	7.1	2.8	**254**
Benzo(a)pyrene	5700	51	5.7	7.4	**77**
Indeno(1,2,3-cd)pyrene	3400	80	3.4	5.4	**63**
Dibenz(a,h)anthracene	1900	72	1.9	1.3	**146**
Total	165000	12	170	170	

Note - the results are reported based on the weight of dry sediment.

Table B-16: Analytical Blanks for PAHs in Soil - ESG lab

PAH	Blank	Blank	Blank	Blank
		ng/g (ppb)		
Naphthalene	< 20	< 20	< 20	< 20
Phenanthrene	< 20	< 20	< 20	< 20
Pyrene	< 20	< 20	< 20	< 20
Benzo(a)anthracene	< 20	< 20	< 20	< 20
Benzo(b)fluoranthene	< 20	< 20	< 20	< 20
Benzo(k)fluoranthene	< 20	< 20	< 20	< 20
Benzo(a)pyrene	< 20	< 20	< 20	< 20
Indeno(1,2,3-cd)pyrene	< 20	< 20	< 20	< 20
Dibenz(a,h)anthracene	< 20	< 20	< 20	< 20
Total	< 20	< 20	< 20	< 20

Table B-17: PAH Results for Analytical Duplicates - ESG Lab

PAH	ESG 7791H	ESG 7791HD	Rel Std Dev	ESG 7773H	ESG 7773HD	Rel Std Dev	ESG 7585	ESG 7585D
Compounds	ng/g (ppb)							
Naphthalene	< 20	< 20		< 20	< 20		< 20	< 20
Phenanthrene	< 20	< 20		< 20	< 20		< 20	< 20
Pyrene	120	140	9.7	920	730	17	25	< 20
Benzo(a)anthracene	< 20	< 20		< 20	< 20		< 20	< 20
Benzo(b)fluoranthene	< 20	< 20		< 20	< 20		< 20	< 20
Benzo(k)fluoranthene	< 20	< 20		< 20	< 20		< 20	< 20
Benzo(a)pyrene	< 20	< 20		< 20	< 20		< 20	< 20
Indeno(1,2,3-cd)pyrene	< 20	< 20		< 20	< 20		< 20	< 20
Dibenz(a,h)anthracene	< 20	< 20		< 20	< 20		< 20	< 20

Table B-18: TPH Results for Analytical Duplicates

Sample	TPH	duplicate	triplicate	Rel std Dev
		ug/g		
ESG8465	45	<40		
ESG7642	3780	3730		0.94
ESG7714/7715*	<40	<40		
ESG7761/7762*	11250	6470	7400	[illegible]
ESG7764	6780	7550	7900	8
ESG7773	24300	19300		16.2
ESG7791	8600	5748	3600	35
ESG7745H	16200	23200		25
Average Rel Std Dev				**19**
Std Dev				**± 13**

* One Sample

Appendix C: SITE DESCRIPTIONS

A. Sampling Locations and Descriptions for Radio Island

1 *Background Samples*

Six background samples, including one field duplicate, were collected at locations outside the influence of the station activities. Plant samples were collected at three of the background sample locations and a water sample was collected at one location.

8476 - 61°18'890'' N, 64°52'072'' W
- Freshwater sample FW8406 was collected for analysis
- At the top of a ridge on east side of island

8477 - 61°18'583'' N, 64°50'549'' W
- *Salix arctica* was collected for analysis

8478 - Field duplicate of 8477

8479 - 61°19'307'' N, 64°51'042'' W
- *Salix arctica* was collected for analysis

8480 - 61°19'428'' N, 64°53'217'' W
- *Salix arctica* was collected for analysis

8481 - 61°18'832'' N, 64°52'727'' W

2. *Area A: Main Site*

The main station was located in the central part of the island. Two buildings remained in tact and the foundations of two other buildings remained. Vegetation in the area was generally sparse due to the geographical nature of the site. Exposed bedrock covered much of the site. Soil samples were collected from areas surrounding the buildings and foundations and in the drainage pathways leading from the main site.

8400 - On the west side of the main house, 0.5 m from the stairs and door .
- A layer of ash covering gravel and coarse sand.
- Debris: coal, rusty nails, wood fragments, rust fragments.
- Vegetation present: species of moss
- ESG tag # 1.

8401 - Located on the south side of the winch shed, 5 m northwest of 8400.
- A 3 cm layer of medium to coarse sand matted with paint chips and packing material. The soil was heavily stained with hydrocarbons and had a strong hydrocarbon odour.
- Debris: coal, rusty nails, wood fragments, rusty metal parts, paint chips, hinge, oil coated packing material.
- Vegetation present: none.
- ESG tag # 2.

8402 - Located on the north side of the winch shed, 0.05 m north of the north wall and 0.3 m west of the door frame.
- A 1 cm mossy surface layer covered a dark brown soil mixed with wood fragments and rust fragments. The soil had a hydrocarbon odour.
- Debris: coal, rusty nails and wire, wood fragments, shotgun shell,.
- Vegetation present: species of moss and lichen.
- ESG tag # 3.

8403 - 1 m north of the north wall of the main house and 4 m south east of sample 8405 (ESG tag # 5).
- Coarse sand covered by 5 cm of debris.
- Debris: coal, rust fragments, wood fragments, packing material, clutch parts, roofing tile, I beam, 3 m wood beam.
- Vegetation present: none.
- ESG tag # 6.

8404 - 1 m south of the north wall of the winch shed, located inside of structure. The floor of the winch shed is soil and the winch and motor occupy 2/3 of the shed area.
- A coarse sand matted with paint chips and rust fragments. The soil was heavily stained with hydrocarbons and had a strong hydrocarbon odour.
- Debris: rust fragments, wood fragments, nails and wire, mesh sack, paint chips.
- Vegetation present: none.
- ESG tag # 4.

8405 - 1.5 m north of the south wall of the winch shed and 5 cm north of the side door frame
- A Coarse sand matted with wood fragments and paint chips. The soil was heavily stained with hydrocarbons and had a strong hydrocarbon odour.
- Debris: wood fragments, paint chips.
- Vegetation present: none.
- ESG tag # 5.

8406 - Field duplicate of 8405.

8407 - Located under the foundation of main house in south east corner, 5 cm from foundation wall.
- A thin layer of moss covering a dark brown coarse sand.
- Debris: coal, wood fragments, paint chips, roof tile fragments, glass fragments, floor tile.
- Vegetation present: species of grass and moss.
- ESG tag # 7.

8408 - In drainage pathway 16 m south east of the main house.

- A 5 cm mossy layer covered a coarse brown sand mixed with unidentified organic material.
- Debris: rusty nails and mechanical parts, wood fragments, glass fragments, roof tiles.
- Vegetation present: *Cerastium alpinum, Oxyria digyna,* species of moss, lichen and grass.
- ESG tag # 8.

8409
- 4 m south east of sample 8408 (ESG tag # 8) in drainage from main house.
- A 5 cm mossy layer covered a thin rust layer which covered a brown clay.
- Debris: wire mesh screen, roofing tiles, rusty wire.
- Vegetation present: *Salix arctica* (collected for analysis), species of moss, lichen and grass.
- ESG tag # 9

8410
- 14 m south of sample 8409 (ESG tag # 9), on the edge of pooled standing water. Two small burn piles were observed between samples 8409 and 8410. A snow goose was observed in the area.
- A 5 cm mossy layer covered a thin rust layer which covered a brown clay.
- Debris: rusty barrel, metal mechanical parts, metal grill, battery parts.
- Vegetation present: *salix* sp., species of moss and grass.
- ESG tag # 10

8411
- 0.3 m north of the north east corner of the concrete support located north east of the main house.
- Coarse to medium dark brown sand.
- Debris: rusty nails, glass pieces, coal, insulator wire support, rusted radio parts, roof tiles, metal pipes, crushed battery parts, small gas cylinders, fuse boxes, metal cable, I beams, porcelain insulator caps.
- Vegetation present: *Cerastium alpinum,* species of moss and grass.

- ESG tag # 11.

8412 - Inside of the of the concrete supports located north east of the main house, along the east wall, 7 m from sample 8411 (ESG tag # 11).
- Coarse to medium dark brown sand.
- Debris: coal stove pipes, coal, rusty metal sheets, switch box, rusty copper wire, concrete.
- Vegetation present: *Cerastium alpinum,* species of moss and grass.
- ESG tag # 12.

8413 - 20 m from sample 8412 (ESG tag # 12) bearing 134°T along the drainage pathway from the concrete supports located north east of the main house. Goose and fox droppings were observed in the area.
- Coarse to medium dark brown sand.
- Debris: coal sack, wood planks, porcelain insulator cap
- Vegetation present: *Trisetum spicatum,* species of moss and lichen.
- ESG tag # 13

8414 - 30 m from sample 8413 (ESG tag # 13) bearing 18°T further along the drainage pathway. This sample was also located 2 m above a pile of 12 barrels
- A 3 cm layer of moss over light brownish gray sand.
- Debris: glass fragments, wood fragments, coal, old running shoe.
- Vegetation present: *Salix arctica* (collected for analysis), *Cerastium alpinum,* species of moss and lichen.
- ESG tag # 14

8415 - Field duplicate of 8414.

8416 - 14 m from sample 8414 (ESG tag # 14) bearing 330°T along a narrow drainage pathway and 6 m below a pile of 12 barrels.

- A 5 cm layer of moss covering rust particles and coarse gravel.
- Debris: wood, rusty paint can, rusty domestic cans, barrel lid.
- Vegetation present: species of moss.
- ESG tag # 15

8417
- 13 m from sample 8416 (ESG tag # 15) bearing 342°T along the drainage pathway. Two snowbuntings were observed in the area.
- A 5 cm layer of moss covering rust particles and dark brown sand.
- Debris: rusty barrel, rusty pails, coal, rusty engine parts, broken glass, wood fragments, gas tank, gas cylinder, rusty domestic cans.
- Vegetation present: species of moss, lichen and grasses.
- ESG tag # 16

8418
- 10 m from sample 8416 (ESG tag # 15) bearing 102°T. Located on a small ridge and adjacent to a small burnt out building foundation. This sample was collected under the floor board of the foundation. Goose droppings were observed in the area.
- Dark brown, damp sand.
- Debris: brick stone fireplace, red bricks, rusty nails, coal, charred wood, switch box parts, burnt rusty metal sheet.
- Vegetation present: *Cerastium alpinum*, species of moss and grasses.
- ESG tag # 17.

8419
- 10 m from sample 8418 (ESG tag # 17) bearing 29°T. This sample was collected in a depression below an outcrop.
- A 5 cm layer of moss covering dark brown sand.
- Debris: wood fragments, crushed battery, rusty engine parts, shoes, cookware, coal.
- Vegetation present: species of moss and grass.
- ESG tag # 18.

8420 - 30 m from sample 8419 (ESG tag # 18) bearing 40°T. Located at the toe of a pile of wooden debris and rusty barrels in a narrow ravine between two bedrock outcrops.
- A 5 cm layer of moss covering dark brown, damp sand.
- Debris: two crushed batteries, charred wood fragments, broken glass, rust particles, rusty domestic cans, wood crates, engine parts, paint can.
- Vegetation present: species of moss and lichen.
- ESG tag # 19.

8421 - 17 m from sample 8420 (ESG tag # 19) bearing 274°T. 25 m from sample 8419 (ESG tag # 18) bearing 11°T. Located at the toe of a dump in a narrow ravine.
- A 4 cm layer of moss covering light brown clay.
- Debris: rusty spring, corroded barrel, rusty nails, domestic cans, wood crates, coal, broken glass, cookware.
- Vegetation present: species of moss and grass.
- ESG tag # 20.

8422 - 77 m from sample 8419 (ESG tag # 18) bearing 343°T. Located in wide flat area. Fresh goose droppings and old polar bear droppings were observed in the area.
- A 3 cm layer of moss covering light brown clay.
- Debris: none present.
- Vegetation present: *Salix reticulata, Lychnis apetala, Salix arctica, Saxifraga oppositifolia*, species of moss, lichen and grass.
- ESG tag # 21.

8423 - 44 m from sample 8422 (ESG tag # 21) bearing 304°T. Located in a 3 m wide drainage pathway above a steep drop off to the beach area.
- A 4 cm layer of moss covering a dark brown organic layer covering a dark brown sand mixed with organics.

- Debris: none present.
- Vegetation present: *Cerastium alpinum*, species of moss and lichen.
- ESG tag # 22.

8434
- 10 m from the north west corner of the winch shed bearing 301°T.
- A layer of coal and ash covering light brown clay.
- Debris: wood pieces, coal, ash, brick, rusty metal fragments, rusty nails.
- Vegetation present: *Cerastium alpinum*, species of moss and grass.
- ESG tag # 32.

8435
- 18 m from sample 8434 (ESG tag # 32) bearing 000°T. Located in the drainage path of the winch shed at the toe of a coal pile which starts just north of sample 8434. Also located at the merging point of two drainage routes; one from the main house and one from the winch shed. Goose droppings were observed in the area.
- A layer of coal covering dark brown clay.
- Debris: wood pieces, coal, crushed battery, roof tiles, metal fragments, cloth, coal sack, metal cable, string, glass fragments, rusty shovel head.
- Vegetation present: *Cerastium alpinum*, species of moss, lichen and grass.
- ESG tag # 33.

8436
- 27 m from sample 8435 (ESG tag # 33) bearing 336°T. Located in the drainage path of the winch shed below a pile of 30 barrels that appear to have been burnt. A walrus bone was observed in the area.
- Dark brown sand with organic material. A strong hydrocarbon odour was detected and an oily film on a small puddle was observed
- Debris: metal fragments, barrel bung.
- Vegetation present: *Colpodium vahlianum* (collected for analysis), species of moss and lichen.
- ESG tag # 34.

8437 - 20 m from sample 8436 (ESG tag # 34) bearing 344°T. Located adjacent to a small standing pool of water in the drainage path of the winch shed.
- A black organic thin top layer covering a light brown clay with some pebbles and gravel.
- Debris: metal and wood support.
- Vegetation present: *Salix arctica*, *Saxifraga oppositifolia*, species of grass, moss and lichen.
- ESG tag # 35.

8438 - Field duplicate of 8437.

8439 - Located on the west side of a concrete foundation that houses the heli-pad. The sampling location was 5 m from the north edge of the foundation.
- A 3 cm moss layer covering a dark brownish black sand mixed with coal.
- Debris: charred wood, nails, paint chips, coal.
- Vegetation present: *Salix arctica*, *Cerastium alpinum,* species of moss.
- ESG tag # 36.

8440 - Located within the foundation of the structure supporting the heli-pad in the north west corner of foundation, 2m from the edge of wall.
- Light brown clay mixed with ash.
- Debris: charred wood, metal cable, stove grill, coal ash, new lumber, broken glass, bottles, bricks, switch box, rusted tub, pipes, springs.
- Vegetation present: species of moss.
- ESG tag # 37.

8441 - Located on the east side of a concrete foundation that houses the heli-pad. The sampling location was 2 m from the north edge of the foundation below a window in the foundation.

- Light to medium brown coarse sand mixed with coal. A strong hydrocarbon odour was detected.
- Debris: charred wood, rusty nails, ash, winch cable, broken glass, roof tiles.
- Vegetation present: species of moss.
- ESG tag # 38.

8442
- Located on the north side of a concrete foundation that houses the heli-pad. The sampling location was 2 m from the east edge of the foundation in the drainage from the structure.
- A 3 cm moss layer covering a light brownish gray clay mixed with coal, ash and brick fragments.
- Debris: bricks, concrete, metal wire.
- Vegetation present: *Saxifraga caespitosa*, species of moss.
- ESG tag # 39.

8443
- 33 m from sample 8442 (ESG tag # 39) bearing 353°T. Located in the drainage pathway from the concrete structure supporting the heli-pad.
- A 8 cm moss layer covering debris mixed with organic black sand.
- Debris: broken glass, rusty nails, rusty metal fragments, wood chips, rusty wire, coal, wood fragments, roof tiles, wooden cable spool, rusty mechanical equipment.
- Vegetation present: *Oxyria digyna*, species of grass and moss.
- ESG tag # 40.

8444
- 28 m from sample 8442 (ESG tag # 39) bearing 308°T. Located below a small dump area in the drainage from the concrete structure supporting the heli-pad.
- Dark brown sand mixed with organic material.
- Debris: broken glass, crushed batteries, rusty cans, two rusty barrels, wood crates, burnt timbers.

- Vegetation present: species of grass and moss.
- ESG tag # 41.

8445 - 65 m from sample 8444 (ESG tag # 41) bearing 357°T. Located in the drainage pathway where the two drainage pathways from the concrete foundation supporting the heli-pad meet.
- A 5 cm moss layer covering a 15 cm dark brown organic layer covering underlying clay. A very anoxic smell was detected.
- Debris: none present.
- Vegetation present: species of grass and moss.
- ESG tag # 42.

8447 - 21 m from sample 8445 (ESG tag # 42) bearing 189°T. Located in flat area that appears to be worked in drainage from sample 8444 (ESG tag # 41).
- Light brown clay mixed with some sand, pebbles and gravel.
- Debris: charred wood, clothes pin.
- Vegetation present: *Salix arctica*, species of moss.
- ESG tag # 44.

8448 - 15 m east of the winch shed, adjacent to a pond which might have been the fresh water supply.
- Light to medium brown sand and clay.
- Debris: coal, charred wood, wood, I beam, winch cable and supports, wood planks, pipes, antenna.
- Vegetation present: species of moss.
- ESG tag # 45.

8449 - Located at south side of concrete foundation that supports the heli-pad underneath a drain hole. Also located 3 m from the pond which might have been the fresh water supply.

- Medium brown sand.
- Debris: charred wood, glass fragments, roof tiles, rusty wire, rusty nails.
- Vegetation present: *Cerastium alpinum*, species of moss.
- ESG tag # 46.

8450
- Located 5 m from the end of the dam located west to the main house in the narrow drainage path from the fresh water pond. Goose droppings were observed in the area.
- A 5 cm moss layer covering a matted mixture of organic material , debris and clay.
- Debris: large battery.
- Vegetation present: *Salix arctica* (collected for analysis), species of moss.
- ESG tag # 47.

8451
- 44 m from sample 8450 (ESG tag # 47) bearing 281°T. Located in drainage pathway which drops off to the ocean. Goose droppings were observed in the area.
- A 5 cm moss and organic layer covering a mixture of debris and sand..
- Debris: rusty metal plate, glass fragments, aluminum foil, plastic fragments, roof tiles.
- Vegetation present: *Salix arctica*, *Oxyria digyna*, species of moss, lichen and grass.
- ESG tag # 48.

8452
- 25 m from sample 8450 (ESG tag # 47) bearing 318°T. Located at the top of a bedrock outcrop at the toe of a domestic waste dump.
- A 5 cm layer of rust fragments covering a mixture of dark brown fine sand and rust particles.
- Debris: rusty domestic cans, broken glass, crushed batteries, wire, pipes, rusty strapping, springs, bottles, aerosol cans.

- Vegetation present: species of moss and lichen.
- ESG tag # 49.

8470
- 10 m from the south side of the main house. Located in the drainage pathway that leads to the southeast.
- Medium brown coarse sand mixed with come rocks.
- Debris: wire, wood, coal, rust fragments, chimney, cable, wood beams, brick, insulator caps, roof tiles, glass fragments, rusty nails.
- Vegetation present: species of grass.
- ESG tag # 65.

8471
- 37 m from sample 8409 (ESG tag # 9) bearing 151°T. Located at the north edge of a pool of standing water containing 48 rusty barrels. The water had an oily sheen.
- A 5cm layer of moss over anoxic, wet, black soil mixed with roots. A hydrocarbon odour was detected.
- Debris: wood fragments.
- Vegetation present: species of moss.
- ESG tag # 66.

8472
- 70 m from sample 8471 (ESG tag # 66) bearing 156°T. Located at the south edge of a pool of standing water containing 48 rusty barrels.
- A 3cm layer of moss over fine medium brown soil.
- Debris: none present.
- Vegetation present: *Salix sp.*, species of moss.
- ESG tag # 67.

8473
- 28 m from sample 8471 (ESG tag # 66) bearing 127°T. Located in the drainage leading to the south east of a standing pool of water that contains 48 barrels.

- Medium brown sand mixed with roots. A rust discolouration was observed on the surface.
- Debris: none present.
- Vegetation present: *Polygonum viviparum, Sedum roseum, Salix sp.*, species of moss, lichen and grass.
- ESG tag # 68.

8474 - 61 m from sample 8473 (ESG tag # 68) bearing 103°T. Located in a well defined drainage pathway leading to the south east of main site.
- A 3 cm moss layer covering medium brown fine sand mixed with some pebbles and rocks.
- Debris: none present.
- Vegetation present: *Polygonum viviparum*, species of moss.
- ESG tag # 69.

8475 - 63 m from sample 8474 (ESG tag # 69) bearing 141°T. Located in the drainage leading to the south east of main site. The sample was collected in a large flat area which drains to a large pond. Goose droppings were observed in the area.
- Medium brown clay mixed with some rocks.
- Debris: none present.
- Vegetation present: *Polygonum viviparum, Saxifraga caespitosa, Salix sp.*, species of lichen and grass.
- ESG tag # 70.

3. Area B: Generator Building Foundation

The generator building foundation lies approximately 60 m to the south south west of the main site.

8453 - Located on the south side of foundation of generator building, 3 m from the east wall.

- Medium to dark brown sand with some pebbles. A strong hydrocarbon odour was detected.
- Debris: charred wood, burnt plastic, glass fragments, concrete fragments, rusty nails.
- Vegetation present: none.
- ESG tag # 50.

8454 - Field duplicate of 8453.

8455 - Located on the west side of foundation of generator building, 6 m from the south wall.
- Medium to dark brown sand with some pebbles and saturated with weathered hydrocarbon. A strong hydrocarbon odour was detected.
- Debris: antenna, charred wood, rope, cable, whole and crushed batteries, concrete blocks, insulator caps, red bricks, rusty nails, wire, coal.
- Vegetation present: species of moss.
- ESG tag # 51.

8456 - Located on the north side of foundation of generator building, 0.50 m from the north west corner.
- Stained black sand with some pebbles and ash. A strong hydrocarbon odour was detected.
- Debris: rusty nails, bricks, concrete, motor parts, burnt plastic, charred wood.
- Vegetation present: none.
- ESG tag # 52.

8457 - Located on the east side of foundation of generator building, 2 m from the south east corner.
- Black sand with some pebbles and ash. A faint hydrocarbon odour was detected.

- Debris: coal, broken glass, insulated copper cable, wire, battery parts, nails.
- Vegetation present: none.
- ESG tag # 53.

8458
- Located inside the foundation of generator building, 2m from the east side and 3 m from the south side of foundation.
- Stained black sand and clay. A faint hydrocarbon odour was detected.
- Debris: 3 generators on platforms, boiler on foundation, metal cable, insulator cable, alternators and various engine parts, crushed batteries, 2 filing cabinets, pipes, wrenches charred wood, sheet metal, insulation material, electrical components, cinder blocks, rusty nails, insulator caps, 2 crushed barrels, broken glass.
- Vegetation present: none.
- ESG tag # 54.

8459
- 7 m north of the north side of the generator building. Located in the drainage adjacent to a 1.5 m high concrete support.
- Dark brown to black sand mixed with some gravel. The soil was saturated with weathered hydrocarbon. A strong hydrocarbon odour was detected.
- Debris: battery parts, insulation material, rusty strapping, cloth, conduit, rusty cans, glass, wood.
- Vegetation present: none.
- ESG tag # 55.

8460
- 9 m from the north west corner of the generator building, bearing 293°T. from the foundation Located in the drainage leading from the west side of structure.
- A 2 cm layer of moss covering dark brown to black sand and clay. A faint hydrocarbon odour was detected.
- Debris: charred wood, broken glass, rusty wires.

- Vegetation present: species of moss.
- ESG tag # 56.

8461
- 34 m from sample 8459 (ESG tag # 55) bearing 311°T. Located in the drainage leading to the north west of the generator foundation.
- A 3 cm layer of moss covering medium brown coarse and fine sand
- Debris: pieces of wood.
- Vegetation present: *Salix arctica* (collected for analysis), *Saxifraga caespitosa*, species of moss and lichen.
- ESG tag # 57.

8462
- 57 m from sample 8461 (ESG tag # 57) bearing 288°T. Located in the drainage leading to the ocean from the north west of the generator foundation.
- A 5 cm layer of moss covering light brown sand
- Debris: glass fragments.
- Vegetation present: *Salix arctica, Cerastium alpinum, Salix herbacea, Polygonum viviparum. Saxifraga caespitosa*, species of lichen.
- ESG tag # 58.

8463
- 13 m from sample 8453 (ESG tag # 50) bearing 139°T. Located in the drainage leading from the south of the generator foundation.
- Light brown sand mixed with ash and some pebbles. A faint hydrocarbon odour was detected.
- Debris: coal, ash, wood fragments, broken glass, a crushed battery was located 2 m from the sample location.
- Vegetation present: none.
- ESG tag # 59.

8464
- Field duplicate of sample 8463.

8465 - 20 m from sample 8453 (ESG tag # 50) bearing 181°T. Located in the drainage leading from the south of the generator foundation.

- Medium brown sand and clay with some pebbles.
- Debris: coal sack, wood fragments, cable wire.
- Vegetation present: *Salix arctica, Salix herbacea, Polygonum viviparum,* species of grass, moss and lichen.
- ESG tag # 60.

8466 - 8 m from sample 8465 (ESG tag # 61) bearing 102°T. Located in the drainage leading from the south of the generator foundation between two boulders in a dump area.

- Medium brown sand mixed with debris. The sample was saturated with oil and grease and a strong hydrocarbon odour was detected.
- Debris: four crushed batteries, charred wood, electrical cabinets and components, support cables, two rusty barrels, rusty cans, radio parts, rope, coal.
- Vegetation present: *none.*
- ESG tag # 61.

8467 - 10 m from sample 8466 (ESG tag # 61) bearing 082°T. Located in the drainage leading from the south of the generator foundation.

- A 3 cm moss layer covering a light brown sand mixed with some pebbles.
- Debris: several crushed batteries, cable wire, glass, wood.
- Vegetation present: *Salix arctica* (collected for analysis), species of grass, moss and lichen.
- ESG tag # 62.

8468 - 27 m from sample 8467 (ESG tag # 62) bearing 158°T. Located in the drainage leading from the south of the generator foundation and adjacent to a pool of standing water The water had an oily sheen.

- Dark brown sand mixed with organics. A strong hydrocarbon odour was detected
- Debris: wood fragments.
- Vegetation present: *Eriophorum scheuchzeri* (collected for analysis), species of moss and lichen.
- ESG tag # 63.

8469 - 75 m from sample 8468 (ESG tag # 63) bearing 120°T. Located farther along the drainage leading from the south of the generator foundation in a low spot at the bottom of a drop off. This area collects water and is saturated.
- Dark to medium brown sand and clay with a coarse overburden.
- Debris: none present.
- Vegetation present: none.
- ESG tag # 64.

4 *Area C: Beach*

The beach area was located on the north west end of the island. The lower beach area was lush with vegetation (moss) and evidence of wildlife. Two polar bears were observed at the beach area.

8424 - 50 from sample 8423 (ESG tag #22) bearing 336°T and 2 m from the ocean in a narrow drainage pathway.
- A light brown clay mixed with some gravel.
- Debris: glass bottle.
- Vegetation present: species of moss and grass.
- ESG tag # 23.

8425 - 16 m from sample 8424 (ESG tag # 23) bearing 204°T and 6 m from the ocean in a narrow drainage pathway. Gull feathers were observed in the area.
- A light brown clay mixed with some gravel.

- Debris: wooden shipping skid, rusty nails, red paint chips.
- Vegetation present: *Cerastium alpinum,* species of moss.
- ESG tag # 24.

8426 - Field duplicate of 8425.

8427 - 40 m from sample 8424 (ESG tag # 23) bearing 053°T. Located at the north west corner of a burnt out house. Goose droppings were observed in the area.
- A 3 cm moss layer covering a layer of ash and light brown clay.
- Debris: rusty cots, three rusty barrels, burnt plastic, insulation, stove parts, cloth fragments, crushed batteries, bricks, broken glass, mattress material, coal.
- Vegetation present: *Cerastium alpinum, Salix reticulata,, Salix arctica,* species of moss and lichen.
- ESG tag # 25.

8428 - 5 m from sample 8427 (ESG tag # 25) bearing 069°T. Located at the north east corner of a burnt out house.
- A 3 cm moss layer covering a layer of medium brown sand mixed with organics.
- Debris: rusty cots, three rusty barrels, burnt plastic, insulation, stove parts, cloth fragments, crushed batteries, bricks, broken glass, mattress material, coal, charred wood, springs, rusty nails, mesh coal bag.
- Vegetation present: *Oxyria digyna,* species of moss.
- ESG tag # 26.

8429 - 13 m from sample 8427 (ESG tag # 25) bearing 343°T. Located in drainage below burnt out house.
- A layer of dark brown sand mixed with clay ,organics and debris.
- Debris: wood, rusty domestic cans.

- Vegetation present: *Oxyria digyna*. species of moss and grass.
- ESG tag # 27.

8430 - 20 m from sample 8429 (ESG tag # 27) bearing 338°T. Located at the shoreline within the intertidal zone. A snow bunting was observed in the area.
- Light brown clay mixed with sand and pebbles.
- Debris: small rusty gas cylinder, sink, metal cable.
- Vegetation present: species of seaweed.
- ESG tag # 28.

8431 - 22 m from sample 8429 (ESG tag # 27) bearing 276°T. Located 2.5 m north of a pile of 30 rusty barrels and 3 m from the intertidal zone.
- Medium to dark brown sand mixed with pebbles and gravel. A slight hydrocarbon odour was observed.
- Debris: rusty barrel lids, rusty metal cable, metal fragments, green garbage bag.
- Vegetation present: species of moss, grass and seaweed.
- ESG tag # 29.

8432 - 20 m from sample 8431 (ESG tag # 29) bearing 160°T. 20 m from sample 8427 (ESG tag # 25) bearing 262°T. Located in a depression at the base of a burn area.
- Medium brown, coarse sand mixed with pebbles.
- Debris: coal, broken glass.
- Vegetation present: species of moss, lichen and seaweed.
- ESG tag # 30.

8433 - Located in the intertidal zone 40 m west of sample 8432 (ESG tag # 30) and bearing 157°T to the main site. This sample location receives drainage from the main site and is located 20 m below a pile of 10 rusty barrels.

- Light brown, coarse sand mixed with pebbles.
- Debris: none in immediate area. Coal, wood planks and crates, green net mesh, plastic jug, metal cable in surrounding area.
- Vegetation present: none.
- ESG tag # 31.

8446 - 42 m from sample 8445 (ESG tag # 42) bearing 002°T. Located in drainage pathway leading to sample 8433 (ESG tag # 31). Goose droppings were observed in the area.

- Dark brown sand mixed with organic material covering clay.
- Debris: none present.
- Vegetation present: *Salix arctica, Salix reticulata*, species of grass and moss.
- ESG tag # 43.

5. *Fresh Water Samples*

WF8400 - Freshwater sample collected from pond 10 m southeast of sample 8475 (ESG # 70)

WF8401 - Duplicate of sample WF8400

WF8402 - Freshwater sample collected from pond west of Building 1 and 2 m from sample 8448 (ESG # 45)

WF8403 - Duplicate of sample WF8402

WF8404 - Freshwater sample collected from pond adjacent to sample 8410 (ESG # 10)

WF8405 - Duplicate of sample WF8404

WF8406 - A background water sample collected from a small lake adjacent to sampling location 8476

WF8407 - Duplicate of sample WF8406

B. Vascular Plant Checklist for Radio Island

Species	Common Name
Poaceae (Grass Family)	
Colpodium vahlianum (Liebm.) Nevski	
Trisetum spicatum (L.) Richt.	
Cyperaceae (Sedge Family)	
Eriophorum scheuchzeri Hoppe	cottongrass
Salicaceae (Willow Family)	
Salix arctica Pall. *s.lat*	Arctic willow
Salix herbacea L.	least willow
Salix reticulata L.	net-veined willow
Polygonaceae (Buckwheat Family)	
Oxyria digyna (L.) Hill	mountain sorrel
Polygonum viviparum L.	bistort
Caryophyllaceae (Pink Family)	
Cerastium alpinum L. *s.lat*	mouse-ear chickweed
Lychnis apetala L.	bladder-campion

Crassulaceae (Stonecrop Family)

Sedum roseum (L.) Scop.	roseroot

Saxifragaceae (Saxifrage Family)

Saxifraga caespitosa L. *s. lat.*	tufted saxifrage
Saxifraga oppositifolia L.	purple saxifrage

C. Record of Bird and Wildlife Observations

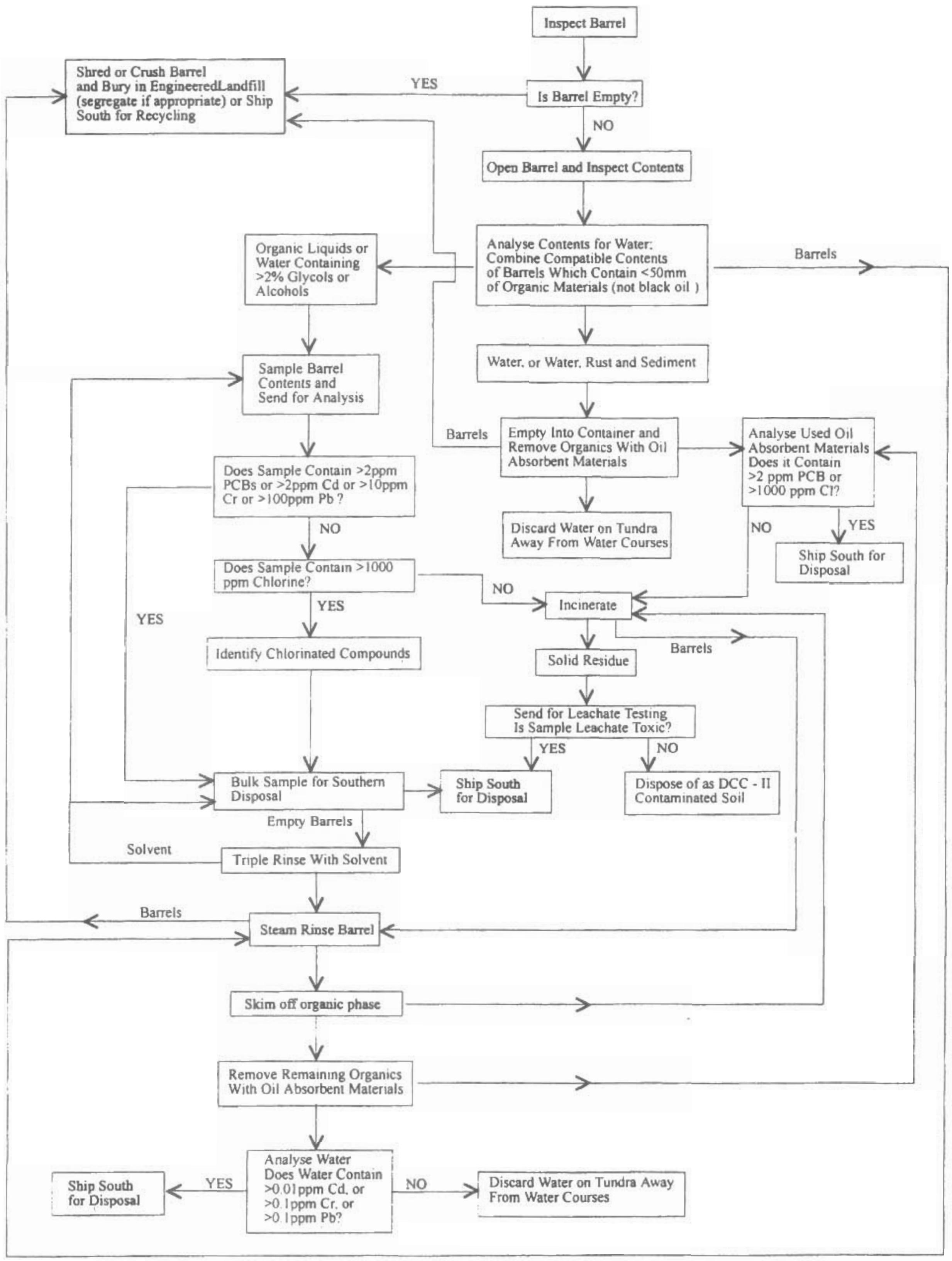
1 Birds

Species	Common Name	Numbers
Chen caerulescens	Snow Goose	1
Plectrophenax nivalis	Snowbunting	3
	Unidentified Goose	droppings, feathers

2. Mammals

Species	Common Name	Numbers
Alopex lagopus	Fox	droppings
Thalarctos maritimus	Polar bear	2
Odobenus rosmarus	Walrus	bones

FLOW CHART FOR THE DEW LINE CLEAN UP BARREL PROTOCOL



Appendix D : Data Tables

A. Inorganic Element Results for Soil and Water Samples

Sample	Tag #	Cu	Ni	Co	Cd	Pb	Zn	Cr	As	Location
					ppm					
1. Background										
8476	no tag	19.3	36	9.0	<1.0	<10.0	60	25	1.1	61º18'890"N, 64º52'072"W
8477	no tag	23	45	11.8	<1.0	<10.0	28	71	0.5	61º18'583"N, 64º50,549"W
8478	no tag	19.9	39	10.0	<1.0	<10.0	23	65	0.2	Field duplicate of 8477
8479	no tag	41	55	17.8	<1.0	<10.0	54	41	2.3	61º19'307"N, 64º51'042"W
8480	no tag	17.1	35	14.8	<1.0	<10.0	45	27	0.8	61º18'832"N, 64º52'727"W
Mean (n=5)		24	42	12.7	<1.0	<10.0	42	46	1.0	
Std Dev		9.7	8.2	3.6	0.0	0.0	16.1	21	0.8	
Minimum		17.1	35	9.0	<1.0	<10.0	23	25	0.2	
Maximum		41	55	17.8	<1.0	<10.0	60	71	2.3	
2. Area A: Main Site and Helipad										
8400	1	540	22	10.1	<1.0	540	4140	<20	3.8	W side of the storage house
8401	2	103	14.2	7.9	2.4	6340	1640	41	3.0	S side of the winch shed
8402	3	251	23	10.1	10.5	13840	5480	31	11.4	N side of the winch shed
8403	6	33	19.0	6.1	<1.0	540	600	44	2.2	1m N of N wall of storage house
8404	4	58	17.9	7.0	1.0	680	920	<20	1.7	Inside winch shed, 1m S of N wall
8405	5	31	<5.0	<5.0	<1.0	1800	560	<20	1.5	Inside winch shed, 1.5m N of S wall
8406	5	43	<5.0	<5.0	3.5	980	800	<20	0.9	Field duplicate of 8405
8407	7	22	46	11.4	<1.0	45	940	34	1.7	Under foundation of storage house, SE corner
8408	8	53	109	27	<1.0	51	272	43	1.2	Drainage, 16m SE of storage house
8409	9	45	64	13.9	<1.0	11.6	57	42	1.8	Drainage from storage house, 4m SE of 8408
8410	10	20	13.6	<5.0	<1.0	35	100	<20	0.4	14m S of 8409, edge of pooled water
8411	11	30	29	6.2	<1.0	254	365	32	0.9	NE corner of foundation, radio room
8412	12	67	19.3	<5.0	2.5	309	780	25	1.2	Inside radio room, along E wall
8413	13	58	33	7.0	2.7	204	800	27	1.5	20m from 8412, radio room drainage
8414	14	39	26	10.7	<1.0	96	182	25	1.2	30m from 8413, radio room drainage
8415	14	243	24	9.2	<1.0	154	234	21	1.2	Field duplicate of 8414
8416	15	224	71	34	10.6	620	3080	62	29	14m from 8414 along narrow drainage, 6m below barrel pile
8417	16	207	71	17.6	4.5	880	1440	55	8.4	13m from 8416, radio room drainage
8418	17	580	67	13.4	3.5	6060	6640	77	6.2	10m from 8416, under floor board of burnt out building foundation
8419	18	217	23	7.5	4.0	700	660	29	3.4	10m from 8418, in depression below an outcrop
8420	19	30	39	7.4	2.6	38	1120	<20	1.6	Toe of a pile of wood debris and rusty barrels, 30m from 8419
8421	20	28	36	7.4	<1.0	<10.0	57	<20	2.3	Toe of a dump in narrow ravine, 17m from 8420
8422	21	13.3	16.4	5.6	<1.0	<10.0	26	<20	1.6	Wide, flat area, 77m from 8422
8423	22	38	50	18.7	<1.0	27	292	<20	2.8	Drainage, above steep drop off to beach, 44m from 8422

Sample	Tag #	Cu	Ni	Co	Cd	Pb	Zn	Cr	As	Location
					ppm					
8434	32	38	24	8.9	<1.0	1340	2260	22	2.6	10m from NW corner of winch shed
8435	33	50	142	38	<1.0	<10.0	192	34	2.5	Winch shed drainage, at toe of coal pile
8436	34	43	45	10.1	<1.0	68	333	36	3.4	Winch shed drainage, below barrel pile
8437	35	23	35	10.3	<1.0	<10.0	42	29	1.6	Adjacent to small pool of water in winch shed drainage
8438	35	32	48	13.3	<1.0	<10.0	55	34	1.9	Field duplicate of 8437
8439	36	344	53	17.8	2.3	6880	3480	54	16.9	W side of concrete foundation housing the helipad
8440	37	159	67	14.4	2.7	6340	8300	47	5.1	Inside the foundation of structure supporting the helipad, NE corner
8441	38	92	51	11.2	6.5	41400	26640	85	11.5	E side of concrete foundation housing the helipad
8442	39	64	35	16.2	<1.0	254	800	32	6.5	N side of concrete foundation housing the helipad
8443	40	243	76	15.3	3.8	1700	1440	55	16.1	Drainage from concrete structure housing the helipad
8444	41	222	117	27	21	351	5000	59	53	Below small dump in drainage from the structure housing the helipad
8445	42	17.6	50	11.1	<1.0	<10.0	76	<20	1.1	At the junction of the two drainage pathways that come from the foundation supporting the helipad
8447	44	21	32	9.3	<1.0	<10.0	62	23	1.6	Flat area, 21m from 8445
8448	45	27	26	7.4	<1.0	52	373	30	1.0	15m E of winch shed, adjacent to pond
8449	46	78	27	11.2	1.3	5900	3020	29	3.1	S side of concrete foundation supporting helipad, under drain hole
8450	47	191	49	14.8	8.7	660	9200	<20.0	8.4	Drainage from fresh water pond, W of storage house
8451	48	74	90	43	<1.0	199	392	45	4.2	Drainage pathway that drops to ocean, 44m from 8450
8452	49	64	49	15.9	<1.0	29	218	31	2.6	Top of bedrock outcrop at toe of a domestic waste dump, 25m from 8450
8470	65	45	23	14.1	<1.0	268	274	41	6.4	10m from S side of storage house, SE drainage
8471	66	48	34	5.3	<1.0	33	185	32	3.0	N edge of pool of standing water containing rusty barrels, 37m from 8409
8472	67	40	51	12.1	<1.0	12.2	93	27	1.0	S edge of pool of standing water containing rusty barrels, 70m from 8471
8473	68	137	84	90	5.4	620	1500	<20	6.1	Drainage leading to SE of pool of standing water containing rusty barrels, 28m from 8471
8474	69	43	105	18.8	<1.0	14.0	189	<20	1.5	Drainage leading to SE of main site 61m from 8473
8475	70	41	77	16.6	<1.0	9.6	123	21	1.2	Drainage leading to SE of main site 63m from 8474
Mean (n=48)		106	46	14.6	2.4	2100	1980	31	5.3	
Std Dev		125	31	14.1	3.8	6380	4240	18.3	8.8	
Minimum		13.3	<5.0	<5.0	<1.0	<10.0	26	<20	0.4	
Maximum		580	142	90	21	41400	26640	85	53	

2. Area B: Generator Building Foundation

8453	50	419	27	12.0	10.3	11220	20820	28	3.3	S side of foundation of generator building, 3m from E wall
8454	50	920	27	11.4	10.2	11760	14560	26	7.3	Field duplicate of 8453
8455	51	880	30	8.9	3.9	5380	3100	63	3.6	W side of foundation of generator building, 6m from S wall
8456	52	560	28	11.2	8.4	8300	6340	45	4.9	N side of foundation of generator building, 0.5m from NW corner
8457	53	580	25	12.0	12.7	1960	2440	26	5.1	E side of foundation of generator building, 2m from SE corner
8458	54	2160	69	17.7	14.6	10060	9900	50	14.8	Inside the foundation of generator building
8459	55	680	26	11.1	3.3	4160	1920	40	2.5	7m N of N side of generator building

A. Inorganic Element Results for Soil and Water (cont'd)

Sample	Tag #	Cu	Ni	Co	Cd	Pb	Zn	Cr	As	Location
					ppm					
8460	56	67	24	9.3	1.0	247	640	28	1.1	Drainage, 9m from NW corner of the generator building
8461	57	47	75	16.1	<1.0	17.5	257	44	1.2	Drainage leading to NW of generator foundation
8462	58	35	56	11.6	<1.0	70	394	36	1.7	Drainage leading to ocean, from NW of generator foundation
8463	59	354	36	14.7	3.1	18860	2720	29	10.8	Drainage leading from S of generator foundation, 13m from 8453
8464	59	347	44	17.0	4.0	13400	3260	43	9.9	Field duplicate of sample 8463
8465	60	72	99	20	<1.0	12.2	95	31	2.5	Drainage leading from S of generator foundation, 20m from 8453
8466	61	348	19.9	7.2	28	4100	3160	<20	7.4	Drainage leading from S of generator foundation, in a dump area
8467	62	31	39	8.0	4.5	19.1	352	26	1.5	Drainage leading from S of generator foundation, 10m from 8466
8468	63	124	168	20	1.2	234	497	47	1.1	Drainage leading from S of generator foundation, next to pool of standing water
8469	64	660	840	116	<1.0	84	237	34	1.4	Drainage leading from S of generator foundation, in a low spot at bottom of a drop off
Mean (n=17)		487	96	19.1	6.3	5280	4160	36	4.7	
Std Dev		520	195	25	7.2	5920	5800	12.3	4.0	
Minimum		31	19.9	7.2	<1.0	12.2	95	<20	1.1	
Maximum		2160	840	116	28	18860	20820	63	14.8	

3. Area C: Beach

Sample	Tag #	Cu	Ni	Co	Cd	Pb	Zn	Cr	As	Location
8424	23	22	29	7.5	<1.0	<10.0	26	19.9	1.5	Narrow drainage, 2m from ocean
8425	24	16.8	24	7.8	<1.0	10.6	25	25	1.7	Narrow drainage, 6m from ocean
8426	24	17.3	22	6.7	<1.0	27	27	21	2.1	Field duplicate of 8425
8427	25	79	21	10.5	50	2900	3300	37	8.9	NW corner of burnt out house, 40m from 8424
8428	26	33	54	12.1	<1.0	680	175	28	2.1	NE corner of burnt out house, 5m from 8427
8429	27	62	85	15.0	<1.0	54	179	40	7.1	Drainage below burnt out house, 13m from 8427
8430	28	23	27	7.4	<1.0	<10.0	39	25	2.3	Shoreline, within the intertidal zone, 20m from 8429
8431	29	20	22	6.5	<1.0	<10.0	145	21	3.1	3m from intertidal zone, 2.5m N of a pile of rusty barrels, 22m from 8429
8432	30	25	26	9.0	<1.0	25	151	25	3.6	In a depression at base of a burn area, 20m from 8431
8433	31	70	29	10.3	<1.0	125	89	27	2.5	Intertidal zone, 40m W of 8432
8446	43	13.3	38	8.4	<1.0	10.0	57	<20	0.8	Drainage pathway leading to 8433
Mean (n=11)		35	34	9.2	5.0	350	383	25	3.2	
Std Dev		24	19.3	2.6	14.9	860	960	8.1	2.5	
Minimum		13.3	21	6.5	<1.0	<10.0	25	<20	0.8	
Maximum		79	85	15.0	50	2900	3300	40	8.9	

A. Inorganic Element Results for Soil and Water (cont'd)

Sample Tag #	Cu	Ni	Co	Cd	Pb	Zn	Cr	As	Location
				ppm					
4. Water Samples									
WF8400	0.01	<0.01	<0.01	<0.001	<0.01	<0.02	<0.01	<0.001	Pond, 10m SE of 8475
WF8402	<0.005	<0.01	<0.01	<0.001	<0.01	0.3	<0.01	<0.001	Duplicate of FW8400
WF8404	<0.005	<0.01	<0.01	<0.001	<0.01	0.02	<0.01	<0.001	Pond, W of Building 1
WF8406	0.03	<0.01	<0.01	<0.001	<0.01	<0.02	<0.01	<0.001	Small lake adjacent to 8476

B. Inorganic Element Results for Vegetation Samples

Sample #	Species	Cu	Ni	Co	Cd	Pb	Zn	Cr	As	Location
					ppm					
1. Background										
8477P	*Salix arctica*	8.6	11.2	<5.0	0.9	<15	148	9.7	<0.2	61°18'583"N, 64°50,549"W
8479P	*Salix arctica*	10.4	30	<5.0	1.2	<15	236	30	<0.2	61°19'307"N, 64°51'042"W
8480P	*Salix arctica*	12.0	37	<5.0	1.5	<15	179	29	<0.2	61°18'832"N, 64°52'727"W
Mean (n=3)		10.3	26	<5.0	1.2	<15	188	23	<0.2	
Std Dev		1.7	13.3	0.0	0.3	0.0	45	11.4	0.0	
Minimum		8.6	11.2	<5.0	0.9	<15	148	9.7	<0.2	
Maximum		12.0	37	<5.0	1.5	<15	236	30	<0.2	
2. Area A: Main Site and Helipad										
8409P	*Salix arctica*	42	5.3	<5.0	5.6	69	1380	<10.0	<0.2	Drainage from storage house, 4m SE of 8408
8414PR	*Salix arctica, roots*	18.1	10.1	<5.0	3.6	60	1020	18.3	0.3	30m from 8413, radio room drainage
8414PS	*Salix arctica, shoots*	12.5	<5.0	<5.0	3.8	21	900	9.7	<0.2	30m from 8413, radio room drainage
8436P	*Colpodium vahlianum*	29	28	5.2	0.9	<15.0	466	13.4	0.3	Winch shed drainage, below barrel pile
8450P	*Salix arctica*	9.3	5.9	<5.0	10.8	25	1840	13.3	<0.2	Drainage from fresh water pond, W of storage house
Mean (n=5)		22	10.4	3.0	4.9	37	1120	11.9	0.2	
Std Dev		13.4	10.2	1.2	3.7	27	520	4.9	0.1	
Minimum		9.3	2.5	<5.0	0.9	7.5	466	5.0	0.1	
Maximum		42	28	5.2	10.8	69	1840	18.3	0.3	
3. Area B: Generator Building Foundation										
8461PR	*Salix arctica, roots*	30	34	<5.0	3.0	36	560	52	0.3	Drainage leading to NW of generator foundation
8461PS	*Salix arctica, shoots*	26	19.0	<5.0	3.2	52	880	33	0.2	Drainage leading to NW of generator foundation
8467P	*Salix arctica*	403	74	5.0	39	382	1460	110	0.5	Drainage leading from S of generator foundation, 10m from 8466
8468P	*Eriophorum scheuchzeri*	10.0	10.7	<5.0	0.8	27	203	21	<0.2	Drainage leading from S of generator foundation, next to pool of standing water
Mean (n=4)		117	34	3.1	11.5	124	780	54	0.3	
Std Dev		191	28	[illegible]	18.4	172	540	39	0.2	
Minimum		10.0	10.7	<5.0	0.8	27	203	21	<0.2	
Maximum		403	74	5.0	39	382	1460	110	0.5	

C. Aroclor PCB Results for Soil and Water Samples

Sample #	Tag #	Aroclor 1242	Aroclor 1254	Aroclor 1260	Total	Location
			ppb			
1. Background						
8476	no tag	<4.2	<10	<11	<25	61º18'890''N, 64º52'072''W
8477	no tag	<1.5	<1.4	<0.82	<3.7	61º18'583''N, 64º50,549''W
8478	no tag	<1.8	<1.7	<1.0	<4.5	Field duplicate of 8477
8479	no tag	<1.4	<1.2	<0.74	<3.3	61º19'307''N, 64º51'042''W
8480	no tag	<1.4	<1.1	<0.69	<3.2	61º18'832''N, 64º52'727''W
Mean (n=5)					4.0	
Std Dev					4.8	
Minimum					<3.2	
Maximum					<25	
2. Area A: Main Site and Helipad						
8400	1	<2.3	15	4.6	20	W side of the storage house
8402	3	<2.5	12	13	25	N side of the winch shed
8403	6	<3.0	6.2	<2.0	6.2	1m N of N wall of storage house
8405	5	8.5	82	18	110	Inside winch shed, 1.5m N of S wall
8406	5	<11	15	11	26	Field duplicate of 8405
8407	7	<1.2	<1.2	<0.71	<3.1	Under foundation of storage house, SE corner
8410	10	<2.7	<6.9	<6.1	<16	14m S of 8409, edge of pooled water
8411	11	<1.4	<1.3	<0.72	<3.4	NE corner of foundation, radio room
8412	12	<1.5	<1.3	1.5	1.5	Inside radio room, along E wall
8414	14	0.51	9.5	16	26	30m from 8413, radio room drainage
8415	14	0.33	9.6	27	37	Field duplicate of 8414
8416	15	<5.3	120	34	150	14m from 8414 along narrow drainage, 6m below barrel pile
8418	17	<1.7	<1.3	0.87	0.87	10m from 8416, under floor board of burnt out building foundation
8434	32	NDR (11)	18	12	30	10m from NW corner of winch shed
8436	34	<0.81	<2.3	<1.3	<4.4	Winch shed drainage, below barrel pile
8437	35	<5.6	<1.2	<0.69	<7.5	Adjacent to small pool of water in winch shed drainage
8438	35	<1.2	<0.90	<0.59	<2.7	Field duplicate of 8437
8440	37	<1.8	15	6.2	21	Inside the foundation of structure supporting the helipad, NE corner
8441	38	7.1	75	14	96	E side of concrete foundation housing the helipad
8443	40	30	340	120	490	Drainage from concrete structure housing the helipad
8448	45	<1.4	1.9	2.4	4.3	15m E of winch shed, adjacent to pond
8449	46	<1.1	1.4	0.92	2.3	S side of concrete foundation supporting helipad, under drain hole
8450	47	6.4	13	<7.7	19	Drainage from fresh water pond, W of storage house
8470	65	<2.1	<3.7	<4.8	<11	10m from S side of storage house, SE drainage
Mean (n=24)					45	
Std Dev					100	
Minimum					0.87	
Maximum					490	

NDR= Peak detected but did not meet qualification criteria

C. Aroclor PCB Results for Soil and Water Samples (cont'd)

Sample #	Tag #	Aroclor 1242	Aroclor 1254	Aroclor 1260	Total	Location
		ppb				
3. Area B: Generator Building Foundation						
8453	50	1.3	25	14	40	S side of foundation of generator building, 3m from E wall
8454	50	<2.2	21	13	34	Field duplicate of 8453
8455	51	<1.9	16	4.4	20	W side of foundation of generator building, 6m from S wall
8456	52	<3.7	12	9.3	21	N side of foundation of generator building, 0.5m from NW corner
8458	54	7.3	46	4.2	58	Inside the foundation of generator building
8463	59	<4.3	26	9.6	36	Drainage leading from S of generator foundation, 13m from 8453
8464	59	<4.0	26	9.6	36	Field duplicate of sample 8463
8466	61	39	31	15	85	Drainage leading from S of generator foundation, in a dump area
Mean (n=8)					42	
Std Dev					22	
Minimum					21	
Maximum					85	
4. Area C: Beach						
8425	24	1.9	<1.2	<0.75	1.9	Narrow drainage, 6m from ocean
8426	24	1.9	<1.3	<0.75	1.9	Field duplicate of 8425
8427	25	<10	360	<10	360	NW corner of burnt out house, 40m from 8424
8432	30	<3.9	<0.95	<0.54	<5.4	In a depression at base of a burn area, 20m from 8431
Mean (n=4)					95	
Std Dev					180	
Minimum					1.9	
Maximum					360	
4. Water Samples						
WF8406		0.22	0.22	NDR(0.31)	0.44	Small lake adjacent to 8476

NDR= Peak detected but did not meet qualification criteria

D. Aroclor PCB Results for Vegetation Samples

Sample #	Species	Aroclor 1242	Aroclor 1254	Aroclor 1260	Aroclor Total	Location
			ppb			
Area A: Main Site						
8414 PR	*Salix arctica*, roots	<0.10	0.84	1.3	2.1	30m from 8413, radio room drainage
8414 PS	*Salix arctica*, shoots	<0.12	<0.26	1.5	1.5	30m from 8413, radio room drainage
Mean (n=2)					1.8	
Std Dev					0.42	
Minimum					1.5	
Maximum					2.1	

E. Pesticide Results for Soil Samples

Sample	8410	8476	8450	8470
			ppb	
Hexachlorobenzene	<0.14	<0.29	0.41	<0.21
alpha HCH	<0.58	<0.74	<0.95	<0.38
beta HCH	<0.94	<1.2	<2.4	<0.95
gamma HCH	<0.83	<1.0	<2.0	<0.78
Heptachlor	<2.4	<3.5	<3.3	<1.7
Aldrin	<0.62	<0.91	<0.71	<0.42
Oxychlordane	<3.7	<5.3	<2.0	<1.3
trans-Chlordane	<0.66	<0.95	<0.55	<0.30
cis-Chlordane	<0.63	<0.91	<0.68	<0.37
o,p'-DDE	<0.22	<0.27	<0.20	<0.11
p,p'-DDE	<0.25	<0.30	0.90	<0.18
trans-Nonachlor	<0.57	<0.87	<0.45	<0.28
cis-Nonachlor	<0.43	<0.66	<0.54	<0.34
o,p'-DDD	<0.19	<0.28	1.4	<0.11
p,p'-DDD	0.60	<0.30	2.4	<0.12
p,p'-DDT	<0.34	<0.53	<0.64	0.98
Mirex	<0.25	<0.38	<0.76	<0.40
Heptachlor Epoxide	<0.050	<0.060	<0.12	<0.050
alpha-Endosulphan (I)	<0.080	<0.10	<0.17	<0.070
Dieldrin	<0.070	<0.070	0.22	<0.050
Endrin	<0.24	<0.26	<0.31	<0.14
Methoxychlor	<0.35	<0.33	<0.79	<0.36

F. PAH Results for Soil Samples

Sample #	8405	8466	8436
		ppb	
Naphthalene	< 20	< 20	< 20
Acenaphylene	< 20	< 20	< 20
Acenapthene	< 20	< 20	< 20
Fluorene	< 20	< 20	< 20
Phenanthrene	260	1400	< 20
Anthracene	< 20	< 20	< 20
Fluroanthene	< 20	540	< 20
Pyrene	< 20	940	51
Benzo(a)anthracene	< 20	180	< 20
Chrysene	< 20	1100	26
Benzo(b)fluoranthene	< 20	< 20	< 20
Benzo(k)fluoranthene	< 20	< 20	< 20
Benzo(a)pyrene	< 20	< 20	< 20
Indeno(1,2,3-cd)pyrene	< 20	< 20	< 20
Dibenz(a,h)anthracene	< 20	< 20	< 20
Benzo(ghi)perylene	< 20	< 20	< 20

G. TPH Results for Soil Samples

Sample	Tag #	TPH ppm
1. Area A: Main Site		
8402	3	630
8405	5	19000
8436	34	2900
8437	35	<40
8441	38	2400
Mean (n=5)		4900
St. Dev		7800
Minimum		<40
Maximum		19000
2. Area B: Generator Building		
8453	50	3900
8454	50	4500
8456	52	5600
8461	57	<40
8462	58	43
8463	59	1700
8464	59	1100
8465	60	45 ; <40
8466	61	36000
8467	62	47
8468	63	1100
Mean (n=11)		4900
Std Dev		11000
Minimum		<40
Maximum		36000

H. Analytical Results for Paint Samples

Sample	Total PCB ppm	Lead Concnetration ppm	Location
Radio PC-1	<1.0	82740	Outside surface of main house
Radio PC-2	<1.0	74160	Outside surface of winch shed

I. Asbestos Results for Potential Asbestos Containing Material

Sample	Asbestos Content	Location
Radio ASB-1	5-25% chrysotile	Panel collected inside of main house
Radio ASB-2	asbestos not detected	Insulation from chimney 10 m S main house

J. Chlorinated Hydrocarbon Results for Soil Samples

Sample	Total Chlorinated Hydrocarbon ppm
8466	<5.0

K. Leachate Test Results for Soil Samples

Sample	8402	8418	8441	8454	8456	8458	8459	8463
	ppm (mg/L)							
Arsenic	<0.050	<0.050	na	na	na	<0.050	na	na
Barium	<1.0	<1.0	na	na	na	1.2	na	na
Cadmium	0.019	0.010	0.030	0.030	0.010	0.15	<0.010	na
Chromium	<0.050	<0.050	na	na	na	<0.050	na	na
Lead	0.49	0.81	41	1.9	0.42	5.1	0.26	7.4
Mercury	<0.0010	<0.0010	na	na	na	<0.0010	na	na
Selenium	<0.010	<0.010	na	na	na	<0.010	na	na
Silver	<0.050	<0.050	na	na	na	<0.050	na	na
Copper	<0.050	0.14	0.050	0.050	<0.050	0.65	<0.050	0.05
Nickel	<0.010	<0.010	na	na	na	<0.010	na	na
Cobalt	<0.10	<0.10	na	na	na	<0.10	na	na
Zinc	15	18	120	32	5.5	75	5.5	16

na = sample not analyzed for that element.