1.0 INTRODUCTION

1.1 BACKGROUND AND OBJECTIVES

UMA Engineering Limited (UMA) in association with Hardy BBT Ltd. (HBT) and Jacques Whitford and Associates Limited (JWA) was commissioned in the spring of 1990 by the Canadian Commercial Corporation (CCC) on behalf of the United States Air Force (USAF) to carry out an environmental clean-up study of 21 Distant Early Warning (DEW) Stations in Canada.

The overall purpose of this study is to identify and investigate areas of the 21 DEW Stations as they have been affected by past waste disposal and spills. In addition, the objective of the study is to determine and evaluate decommissioning alternatives for waste disposal and spill areas, and facility demolition debris (including associated hazardous or toxic materials). Details of the overall study objectives are provided in Volume 2 (Section 1.3)

The study consisted of four phases generally following the National Guidelines for Decommissioning Industrial Sites (Monenco, 1989). These include:

(1) Phase I - a literature review of baseline environmental conditions and existing data on waste materials, spills and facilities at each site.
(2) Phase II/III - a combined field reconnaissance, field sample collection, and sample analysis for each site.
(3) Phase IV - an evaluation of the environmental impacts including a baseline risk assessment for each station and the identification of decommissioning options. A detailed decommissioning plan was not developed.

Details of these phases are provided in Volume 2 (Section 1.3). The final report for this study is provided in 24 volumes as follows:

(1) Volume 1 - Executive Summary.
(2) Volume 2 - General Information.
(3) Volumes 3-23 - Specific DEW Station Reports.
(4) Volume 24 - Quality Assurance and Quality Control.

This Volume (Volume 17) is a specific DEW Station report that presents all four phases pertaining to CAM-5), MacKar Inlet. An overview of the site based on a review of existing literature is presented in Section 2.0. Section 3.0 provides a description of the biophysical environment, including heritage resources and land use. Section 4.0 describes the site infrastructure. Sections 5.0 and 6.0 present the observations and results of the onsite investigation. In Section 5.0, the asbestos, paint and PCB findings are detailed. Section 6.0 summarizes the soil and water sampling program for each of the facilities and features investigated. Facility decommissioning and clean-up alternatives are provided in Section 7.0. In Section 8.0, the costs of decommissioning are summarized. References cited are listed in Volume 2.

1.2 FIELDWORK, SAMPLING AND ANALYSES

Field work at CAM-5 took place between July 23 and July 26, 1990. A brief reconnaissance was completed initially. This was followed by sampling in selected areas.

Data showing the number of soil, water, paint, asbestos, and PCB oil samples taken at CAM-5 are provided in Table 1.1. Sample site descriptions are presented in Appendix B.

Table 1.1

CAM-5, MACKAR INLET: NUMBER OF SAMPLES TAKEN AND NUMBER OF SAMPLES ANALYZED

Sample Type	Samples Taken*	Samples Analyzed*	Samples Not* Analyzed
Soil	53	25	28
Water	7	6	1
Paint	5	5	0
Asbestos	7	7	0
Transformer Oil	1	1	0

* Does not include duplicates or replicates.

The general approach to field survey and laboratory analysis are described in Volume 2 Section 3.2. Quality assurance and quality control measures are described in Volume 24.

1.3 DATA ASSESSMENT CRITERIA

An assessment of the indicator chemicals was made using the Contaminated Sites Rehabilitation Policy from the Province of Quebec (Quebec Soil Guidelines) (1988) and the Guidelines for Canadian Drinking Water Quality (1987). The Quebec guidelines recommend three levels, A, B and C, for the evaluation of the degree of contamination.

Level A represents background for metals which occur naturally in the environment. For organic chemicals, Level A is the analytical detection limit. The implications of Level A are that minimal environmental impact has occurred and land use should generally be unrestricted. In this study, if the concentration of metals was greater than 50 percent of the Level A guideline, or if organic compounds were detected, the results were used in the baseline risk assessment.

Level B is defined as a point at which thorough investigation of the source and extent of contamination is warranted. The implications of Level B are that contaminants are present above background levels and that land use restrictions or mitigation may be required. For the DEW line stations, concentrations exceeding Level B were identified as potential areas requiring remediation and/or further evaluation where:

- the areal extent was expected to be large
- the compound had a significant impact on the risk assessment
- a point source was not readily definable, or;
- a sample was obtained from a location downgradient of an area which may contain higher concentrations.

Level C constitutes a significant environmental impact as health and safety risks may be present and where prompt remedial action may be required. The DEW Line sites were evaluated as industrial sites; therefore, Level C would be the threshold concentration at which remediation would be required.

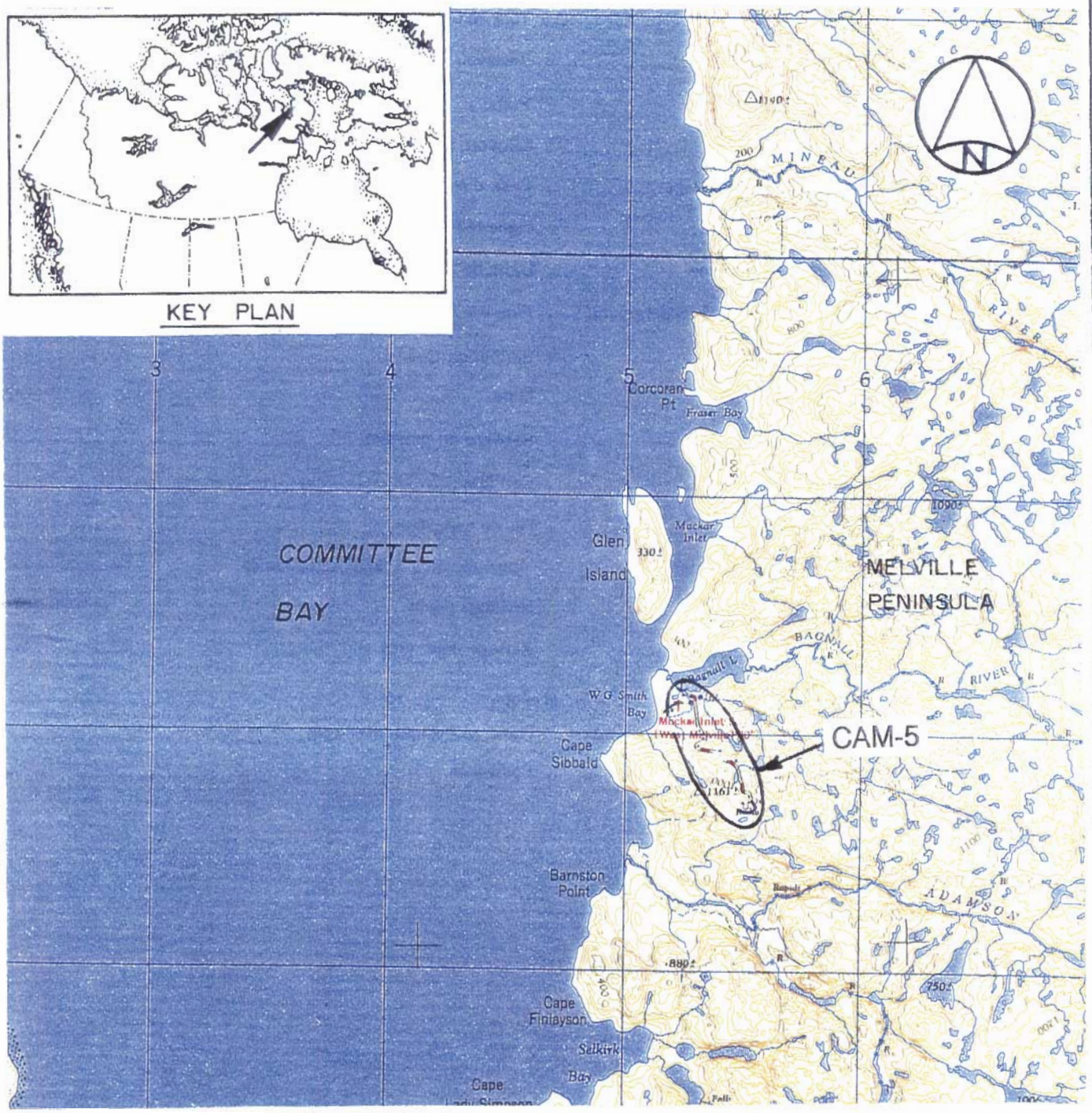
The evaluation of chemical constituents in water samples was based on the Maximum Allowable Concentrations (MAC) indicated in the Guidelines for Canadian Drinking Water Quality (1987). Where the allowable concentration was expressed as a range, the most stringent value was applied.

The rationale of this evaluation method was given in Section 3.2.3.1 of Volume 2.

2.0 SITE OVERVIEW

CAM-5 MacKar Inlet is located on the western shore of Melville Peninsula at 68° 17' 49" north latitude and 85° 07' 30" west longitude on Melville Peninsula in the Committee Bay area of the Northwest Territories. The station is located about 7 km inland from the west side of the peninsula. The nearest community with charter aircraft and a full range of commercial and public services available is Hall Beach, 180 km to the northeast. Access to the site is limited to charter aircraft. The site cannot be accessed by water as the harbour is ice-bound year round. Airlift operations occur in late winter with Hercules aircraft landing on a winter ice strip on the lake east of the airstrip. Figure 2.1 shows the general location of the station in the area and Plate 1 provides an aerial view of the site. The land use of the area is summarized in Section 3.7.

The site is still part of the DEW Station system but is scheduled for decommissioning in the period 1992 to 1994. The site will be restored under the Department of National Defence/Department of Indian Affairs and Northern Development (DND/DIAND) 1989 Memorandum of Understanding for Restoration of Distant Early Warning and North Warning System Sites, as discussed in Volume 2, Section 1.0.



STATION DATA

LATITUDE: 68° 17' 49" N
LONGITUDE: 85° 07' 30" W
ELEVATION: 400 m
MEAN RAINFALL: 82 mm
MEAN SNOWFALL: 97 cm
ACCESS: AIR - CHARTER
WATER - NONE

CAM-5 MACKAR INLET

LOCATION PLAN

SCALE - 1:250,000

FIGURE 2.1

3.0 BIOPHYSICAL ENVIRONMENT

3.1 CLIMATE

MacKar Inlet site is situated on the west side of Melville Peninsula, approximately 399 m asl. Climate data are presented in Table 3.1.

3.1.1 PRECIPITATION

Mean total annual precipitation is 179 mm, of which 81.7 mm occurs as rain and 97.0 cm as snow. The mean number of days a year with measurable precipitation is 63, 20 with rain and 46 with snow. Snow and rainfall from May to October accounts for the majority of annual precipitation.

3.1.2 TEMPERATURE

Mean annual temperature is -14.8 °C while mean monthly temperature ranges from 6.0 °C in July to -31.7 °C in February. Extreme temperatures of 21.7 °C in July and -50.0 °C in January have been recorded.

3.1.3 WIND AND FOG

The mean annual wind speed is 12.2 km/hr. Winds are fairly steady throughout the year. Cloud cover ranges from approximately 30 percent in January to over 90 percent in September. The frequency of cloud cover peaks in spring and fall, as does the occurrence of fog and ice fog, which range from 12 to 47 percent from January to September.

3.2 GEOLOGY

3.2.1 OVERVIEW

The landscape is comprised of a glacially scoured bedrock terrain characterized by rugged hills separated by narrow elongate valleys. Numerous small lakes irregular in outline and typically interconnected by poorly defined runways and drainage channels are scattered throughout the landscape. A single large lake emptying into the ocean and the penultimate catchment basin of the region occurs along the northern perimeter of the study area.

Parts of the landscape are mantled by a gently rolling till blanket and others by raised marine sequences. The extent of the raised marine sequences suggests relative sea level drop of at least 160 m since deglaciation.

Periglacial and frost processes have modified the landscape and imparted distinct patterned ground features within the unconsolidated sediments. Exposed bedrock is typically frost-shattered.

Elevations range from sea level along the coastal zone to approximately 450 m asl within the uplands.

Three general kinds of surface material occur within the landscape. These include bedrock/felsemeer/grass, till and raised marine (glacio-marine). Fluvial materials are present but constitute a comparatively small proportion of the surface materials, particularly at higher elevations.

TABLE 3.1: CLIMATE NORMALS FOR CAM-5, MACKAR INLET

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Precipitation													
Mean Rainfall	0.0	0.0	0.0	0.0	T	6.2	32.0	33.3	9.3	0.9	0.0	0.0	81.7
Mean Snowfall	1.9	2.6	3.0	7.7	16.0	5.8	1.6	3.9	21.7	22.1	8.3	2.4	97.0
Mean Total	1.9	2.6	3.0	7.7	16.0	12.0	33.7	37.2	31.2	23.0	8.3	2.4	179.0
1 No. Days w/meas rain	0	0	0	0	*	2	7	8	3	*	0	0	20
No. Days w/meas snow	2	1	2	4	7	4	1	2	9	9	3	2	46
No. Days w/meas precip	2	1	2	4	7	5	8	9	11	9	3	2	63
Greatest rain in 24 hrs	0.0	0.0	0.0	T	0.8	13.5	42.2	23.1	18.8	10.2	0.0	0.0	42.2
Greatest snow in 24 hrs	6.2	12.7	9.5	7.9	17.8	6.4	3.8	6.1	12.6	25.7	16.0	5.1	25.7
Greatest precip in 24 hrs	6.2	12.7	9.5	7.9	17.8	13.5	42.2	23.1	18.8	25.7	16.0	5.1	42.2
Temperature (C)													
Mean Daily Max	-28.1	-28.5	-25.5	-17.1	-6.7	1.8	9.2	7.2	-1.5	-9.5	-18.8	-24.2	-11.8
Mean Daily Min	-34.3	-35.1	-32.3	-23.8	-12.4	-3.3	2.7	1.5	-5.6	-14.9	-25.3	-30.5	-17.8
Mean Daily	-31.3	-31.7	-28.9	-20.5	-9.6	-0.8	6.0	4.4	-3.6	-12.2	-22.1	-27.3	-14.8
Extreme Max	-2.8	-5.6	-4.5	4.4	6.1	18.3	21.1	21.7	12.8	1.7	3.3	1.1	21.7
Extreme Min	-50.0	-49.5	-46.7	-39.4	-27.8	-16.1	-5.0	-7.8	-17.2	-34.0	-42.2	-45.0	-50.0
Wind													
Mean Wind Speed (km/hr)	12.2	10.5	9.8	12.2	12.4	11.6	10.3	11.4	15.0	15.6	13.8	11.3	12.2
and prevailing direction	M	M	M	M	M	M	M	M	M	M	M	M	M
Mean Vector Speed (km/hr)	M	M	M	M	M	M	M	M	M	M	M	M	M
and direction	M	M	M	M	M	M	M	M	M	M	M	M	M

1. measurable rain > 0.2 mm — rainfall in mm
measurable snow >0.2 cm — snowfall in cm
measurable precipitation >0.2 mm water equivalent — total precip in mm water equivalent

T = trace

M = missing data

* less than 0.5 greater than 0.0

The bedrock within the study area consists mostly of massive or foliated granitoid rocks of Precambrian age. The bedrock is typically jointed and two distinct trends, east-west and north-south, are evident. The jointing is best developed below 180 m elevation. At elevations greater than 180 m the joints are typically incised and widened by erosion with fluvial and talus material collecting within the bottoms.

Quartz and feldspar are dominant components of the mineral assemblage comprising the bedrock. Weathered surfaces are rusty brown or drab grey and typically lichen-covered.

Till deposits blanket the bedrock within parts of the upland areas. The tills are bouldery with little cobble-, gravel-, and sand-sized material. Frost action and water has crudely sorted the tills and a distinct meshed or netted pattern has developed within the tills throughout the landscape.

Raised marine sediments occur along the northern perimeter of the map area. The sediments are wedge-like in outline, broadest nearest sea level gradually tapering to a point several kilometres inland. The surface materials consist mostly of cobble-, gravel-, and sand-sized sediments. Remnant strandlines and broad, shallow, poorly defined drainage courses occur throughout.

General considerations for development of a landfill in permafrost areas were summarized in Section 6.3.3 of Volume 2. The availability of the capping materials required to insulate the landfill contents, and prevent frost heaving of debris from the landfill is discussed in Section 3.2.3 of this volume.

3.2.2 TERRAIN UNITS

The terrain units in the vicinity of the facilities are provided in Figure 3.1. Eight terrain units are described in the following sections.

3.2.2.1 Terrain Unit 1

Terrain Unit 1 encompasses most of the area surrounding the upper base facilities. The unit, which lies approximately 350 to 400 m asl, is comprised of a till (ground moraine) which blankets underlying bedrock. Surface materials are typically coarse-grained and boulders cover the landscape.

The surface is gently rolling. Frost processes and water have crudely sorted the surface materials and have imparted a netted pattern throughout the landscape. Slopes are variable throughout, ranging from long and gentle to comparatively short and steep.

Surface materials drain rapidly and drainage is predominantly below the boulder cover. Drainage patterns are not well defined.

Two subunits designated 1a and 1b are delineated.

Subunit 1a consists of an inclined disturbed terrain. Warehouse storage and POL facilities are sited within this unit. Surface materials typically consist of sands and gravels. Drainage is generally parallel to direction of the slope. Drainage ditches have improved drainage from the area.

Subunit 1b comprises the undisturbed terrain.

3.2.2.2 Terrain Unit 2

Terrain Unit 2 ranged from 350 to 2300 m asl and consists of a bouldery till distributed in a discontinuous veneer throughout the landscape. Three terrain subunits designated 2a, 2b and 2c (Figure 3.1) are delineated within Terrain Unit 2.

The surface expression ranges from predominantly ridged in parts to predominantly rolling in others. Slopes are typically long and gentle along ridge tops to short and steep, perpendicular to ridges. Terrain Unit 2 is similar to Terrain Unit 1 in that frost processes and frost sorting have modified the landscape, producing patterned ground and frost induced ridge movement.

Surface materials are highly pervious. Drainage channels are comparatively well developed in this terrain. Flow is generally northward.

Subunit 2a consists of a flat-topped knoll on which the module train is sited. Within undisturbed parts of subunit 2a, surface materials are typically coarse textured and occupy interstices between boulders. Drainage radiates from the hill crest flowing in poorly defined channels down the steeply inclined slopes.

Subunit 2b consists of comparatively flat terrain gently inclined toward the northwest. Surface materials are relatively fine-grained. Sewage outfall from the upper base flows along poorly defined drainage paths within the subunit.

Subunit 2c comprises the remaining terrain which is largely removed from the influence of base activity with exception of land activity adjacent to the road leading to the lower base area (Figure 3.1).

3.2.2.3 Terrain Unit 3

Terrain Unit 3, approximately 370 m asl, consists of a talus covered bedrock scarp. The terrain is steeply inclined toward the north. Drainage is parallel to the slope direction.

3.2.2.4 Terrain Unit 4

Terrain Unit 4 is comprised of a raised glacio-marine succession. Elevations range from a few metres asl to approximately 180 m asl. This Terrain Unit can be subdivided into six distinct subunits which have been designated subunits 4a, 4b, 4c, 4d, 4e and 4f.

Subunit 4a consists of undulating to nearly flat-lying terrain, gently inclined toward the north, dissected by poorly defined drainage channels. The surface consists of a layer of fine-grained, organic-rich material overlying coarser grained sediments. The terrain is imperfectly drained.

Surface materials comprising subnit 4b consist of cobbles, gravels, and sands distributed across gently inclined terrain. Well-developed marine strand lines are prominent within the landscape and have imparted a gently undulating surface expression. Surface materials are highly permeable and drainage channels are not well developed in the landscape.

Subunit 4c consists of coarse material, predominantly gravels and cobbles distributed in a belt oriented east to west. The terrain is moderately inclined toward the north. Movement of the surface materials is evident by a succession of closely spaced, elongate steps perpendicular to regional slope. Surface materials are highly permeable. Several comparatively well defined drainage channels have developed parallel to the regional slope.

Subunit 4d is comprised of a low lying, poorly drained terrain. Surface materials consist of a wet or water saturated organic-rich silt or sand layer several centimetres thick, overlying coarser grained sands and gravels. Surface materials are moderately to highly permeable; however, shallow, subcircular ponds are common throughout the landscape. The terrain is slowly drained by poorly defined channels. Drainage is toward a large lake adjacent the lower base facilities.

Subunit 4e consists of a narrow, gently curved ridge comprised of gravels overlying bedrock. Surface materials are highly permeable and the landscape is well drained. Gravel has been excavated along its southern end.

Subunit 4f consists of terrain that is extensively altered by excavation and landfilling activities. The terrain is comparatively well drained, aided by improvements to the natural drainage channels.

3.2.2.5 Terrain Unit 5

Terrain subunits 5a and 5b are comprised of a fluvially dominated terrain. Northwesterly - southeasterly elevations range from sea level to 75 to 100 m asl. Subunit 5a consists of comparatively narrow, northwesterly - southeasterly trending V-shaped channels which cut the raised marine succession (Terrain Unit 4) near its eastern perimeter.

Subunit 5b consists of low lying terrain and includes a small deltaic build-up at the mouth of the channel. Surface materials are partly comprised of thin (less than 20 cm thick) organic-rich sediments overlying coarser grained materials. The terrain is undulating and is gently inclined toward the northwest. The drainage is imperfect or poor with standing water common on both sides of the channels which cut through the unit.

Water erosion along the steep embankments of landfill has partly exposed the contents underlying the surface materials. Continued downcutting and erosion could potentially expose more debris.

The remaining terrain units fall outside the area of primary interest. These include Terrain Units 6, 7, and 8.

3.2.2.6 Terrain Unit 6

Terrain Unit 6 is gently inclined toward the sea and is characterized by successive marine strandlines along its length. The unit is comprised of recent exposed marine reworked material.

3.2.2.7 Terrain Unit 7

Terrain Unit 7 is comprised of the predominantly granitic rock outcrops within the map area. The terrain is typically ridged and rolling with extensive jointing and possible faulting throughout.

3.2.2.8 Terrain Unit 8

Terrain Unit 8 includes raised deltaic sediments along the mouth of a river which drains the uplands.