- Quarry permits for existing DND gravel sources located within the existing DND reserves;
- Water licences, as existing on-site or commercial sources will be used; and
- Research or archaeological permits, as scientific or archaeological research activities in support of the clean up requiring such permits has been completed.

Legislative Framework affecting the project

During the implementation of the DEW Line Clean Up Project, all applicable environmental laws, regulations and requirements of federal, territorial and other authorities, will be adhered to. The contractors effecting the work will acquire and comply with those permits, approvals and authorisations as may be required. Annex A is a list of those permits that may be required. The Contractor will be subject to and must comply with those permits and approvals obtained on behalf of and by DND to conduct this work. The Contractor, through all project phases, will work in close cooperation with regulatory authorities and DND to ensure compliance.

Federal Regulatory Overview

- The *Canadian Environmental Protection Act* regulates toxic substances from their production or import, to consumption, storage and disposal. Key Regulations associated with this *Act* are the *Chlorobiphenyl Regulations* and the *Storage of PCB Regulations*.

- The *Transportation of Dangerous Goods Act* and *Regulations* promote public safety in the transportation of dangerous goods. The Act applies to all handling, offering for transport and transporting of dangerous goods by any means of transport whether or not the goods originate from or are destined for any place or places in Canada.

- The *Fisheries Act* protects fish and fish habitat from pollution, negative alteration or disturbance, or impediments to fish movement. Fisheries and Oceans Canada will be given the opportunity to review permit applications or restoration plans.

- The *Arctic Waters Pollution Prevention Act* and *Regulations* govern development and shipping activity in Arctic waters adjacent to the mainland and islands of the Canadian Arctic, to ensure the continuing welfare of the residents of the areas, and to protect the ecological balance in water, ice and land areas.

- The *Migratory Birds Convention Act* provides for the protection of designated migratory species, including birds of prey, their habitats, and the regulated harvest of certain species.

- The *Canada Wildlife Act* provides for the involvement of the Government of Canada in cooperative research and management programs involving wildlife species normally the responsibility of provinces or territories. This is particularly relevant to rare and endangered species or species such as caribou which seasonally move across regulatory boundaries.

- The *Canada Shipping Act* regulates shipping activities under the jurisdiction of Canada. Regulations cover technical standards of operation safety and pollution aspects related to shipping activities in Canadian waters.

- The *Constitution Act* is the enabling legislation for the Nunavut Land Claims Agreement. The Nunavut Land Claims Agreement in turn details the terms and conditions for developments and other uses of lands within the Nunavut Settlement Area.

- The *Navigable Waters Protection Act* pertains to the erection of structures or facilities used to enhance or impede navigation in waters under the jurisdiction of Canada.

- The *Territorial Lands Act* provides the authority for administering and protecting lands under the direct control of the Minister of Department of Indian Affairs and Northern Development (DIAND) (Territorial Lands). The following regulations are pursuant to this act:

    - *The Territorial Land Use Regulations* provide regulatory control for maintaining sound environmental practices for any land use activities on Territorial lands. These regulations require that land use permits be issued for such operations as work involving the use of heavy equipment, establishment of camps, use of explosives, and clearing of lines, trails and rights-of-way, including construction of access roads.

    - *The Territorial Quarrying Regulations* establish the fee schedule and procedures for extracting Crown-owned limestone, granite, slate, marble, gypsum, loam, marl, gravel, sand, clay or stone from Territorial Lands. The regulations specify permits, applications, staking and dimensions of quarries.

- The *Northwest Territories Waters Act* and *Regulations* provide for the conservation, development and use of the water resources of the Northwest Territories and for the establishment of a Water Board to license all such water usage and waste disposal activities.

- *Atomic Energy Control Act* and *Regulations* describe the packaging requirements and approvals needed for the transportation of radioactive materials.

- *Explosives Act* and *Regulations* define explosives, the permitting requirements needed to use explosive substances, packaging, handling and transporting requirements, and safety requirements.

- *National Fire Code (NFC)* establishes the standard for fire prevention, fire fighting and life safety in buildings in use, including standards for the conduct of activities causing fire hazards, maintenance of fire safety equipment and egress facilities, standards for fire extinguishers, etc. In addition, the NFC establishes the standard for prevention, containment and fighting of fires originating outside buildings which may present a hazard to a nearby

community and sets the standards for the storage and handling of dangerous goods, flammable liquids and combustible liquids.

Northwest Territories Regulatory Overview

The Territorial Government and DIAND jointly administer the part of the NWT that contains DEW Line sites. The Territorial seat of government and the DIAND regional office are in Yellowknife. DIAND regional offices within the Nunavut Settlement Area are present in Yellowknife and Iqaluit.

In addition to the Federal and Territorial Acts and Regulations above, the clean up of the DEW Line sites in the NWT is also governed by:

- The Explosive Use Act provides controls for surface blasting other than for mining purposes.
- The NWT Wildlife Act provides for the protection of wildlife and wildlife habitats as well as regulated harvest of selected species.
- The NWT Environmental Protection Act provides for protection of the environment from the discharge of contaminants, clean up of contaminants and unsightly premises. In addition, the powers of inspectors as well as offences and penalties are defined. The Act applies only to situations not authorised by other Canadian Acts in the NWT.
- The *Spill Contingency Planning and Reporting Regulation* outline requirements for filing of a contingency plan and for reporting of spills.
- The *Northwest Territories Archaeological Sites Regulations*, pursuant to the *Northwest Territories Act*, protects archaeological sites in the Northwest Territories from disturbance and prohibits the removal of archaeological specimens, except under permit.
- *Occupational Health Regulations* outline the health and safety standards to be maintained at workplaces to ensure the health and safety of persons.

Environmental Guidelines

- *National Guidelines for Decommissioning Industrial Sites* provides the recommended process for undertaking site assessment studies.
- *Guidelines for Effluent Quality and Wastewater Treatment at Federal Establishments* indicate the degree of treatment and effluent quality that will be applicable to all wastewater discharged from existing and proposed Federal installations.
- *National Guidelines for the Landfilling of Hazardous Waste* (CCME Report, April 1991) are to be used by regulators, designers, owners, and operators of hazardous waste facilities. They

cover site selection, design, construction, closure and post-closure care, monitoring, and operation. They are intended for new, not existing facilities.

- *Guidelines for Preparation of Hazardous Material Spill Contingency Plans* identify factors that should be considered in the development of hazardous material spill contingency plans and the information that should be incorporated into a comprehensive contingency plan.

- *Code of Good Practice on Dump Closing or Conversion to Sanitary Landfill (1977)* outlines the guidelines to improve operation and properly close existing dumps. It is intended to promote a consistent approach to the clean up of existing dumps to prevent contamination of water, air and land and to ensure that the best particular control technology is used.

- *Code of Practice for Used Oil Management in Canada* describes environmentally sound options for the handling, storage, collection, transportation, recycling, reuse and disposal of used oils in Canada. It is intended to provide guidance for used oil generators and to regulatory authorities in the formulation of provincial or regional used oil management strategies.

- *Canadian Drinking Water Guidelines* are compiled by CCME for Canadian Drinking Water Quality for specified uses of water likely of concern at contaminated sites.

- *NWT Guidelines for Removal of Materials Containing Friable Asbestos* outline guidelines to be used to remove friable asbestos.

- *NWT Guidelines for Municipal Type Wastewater Discharges* outline requirements for water quality effluent from these facilities.

- *NWT Guidelines for Discharge of Treated Municipal Wastewater* outline requirements for water quality effluent from these facilities.

List Of Previous Environmental Assessments

As a federal proponent, the Department of National Defence is required to conduct an environmental assessment for the clean up of each DEW Line site. As an early planning tool, these assessments were drafted in 1991 by the Department of National Defence under the auspices of the *Environmental Review Process Guidelines Order*. Subsequent changes to overall project planning have been assessed from time to time and the assessment document updated.

A similar environmental assessment was completed in 1996 for the clean up of the six DEW Line sites in the Inuvialuit Settlement Region. Through an ongoing project program of quality assurance and post assessment/implementation monitoring, conclusions and predictions have been validated or modified from the lessons learned in the ISR sites and incorporated into the assessment for the Nunavut sites.

These assessments have been preceded by extensive on-site environmental and engineering investigations completed by the Environmental Sciences Group at Royal Military College and UMA Engineering Limited. The initial investigations, which took place from 1989 to 1994 were used to provide a baseline study of the existing environment (both biological and physical) and ecological pathways and possible transport mechanisms that will exist during the clean up. Detailed socio-economic analysis, including a detailed archaeological survey of the sites, were completed during this time. Since 1996, DND has conducted a series of further site investigations in order to update the original information and to address further data and analysis requirements.

Environmental Assessment Process

The environmental assessment undertaken in support of this project has used a process in which potential environmental impacts have been assessed on Valued Ecosystem Components identified during an initial scoping exercise.

The following sections provide a summary of the activities that were undertaken in conducting this environmental assessment:

Scoping

As a self directed environmental assessment, the initial step taken was to conduct a series of social and ecological scoping exercises designed to:

- Determine the temporal and spatial boundaries of the assessment; and
- Focus the analysis on the environmental issues directly related to the clean up project itself (i.e. identification of Valued Ecosystem Components).

In scoping the project, clean up activities to be assessed were identified. Possible additional activities were examined using the Canadian Environmental Assessment Agency's "Principal Project/Accessory" test, which is used to determine if other activities demonstrate an interdependence, linkage and/or geographical/ecological proximity with the primary clean up.

The assessment scope included a determination of the environmental effects to be assessed and the effects that are to be considered in making decisions regarding the project. The following chart outline the scope of the project and of the assessment:

Scope of the Project.

Project: Clean Up of 15 DEW Line sites in the Nunavut Settlement Area

EA Trigger: Funding from Department of National Defence

Scope of the project:
Principal Project: physical clean up of the 15 DEW Line sites within the Nunavut Settlement Area.
Accessory physical works: Transportation of waste (including hazardous) materials, debris disposal, mobilisation and demobilisation of contractors equipment and personnel
Other undertakings in relation to the physical work: None.

Scope of the Assessment:

Project: Clean Up of 15 DEW Line sites in the Nunavut Settlement Area

EA Trigger: Funding from Department of National Defence

Scope of the assessment:
The environmental assessment is to consider the effects of all project related activities (i.e. those related to the clean up of the site) and associated physical works on both biophysical (terrestrial, aquatic) and socio-economic assessment factors.

As a result of scoping, the following factors were identified for assessment:

- The need to evaluate environmental effects of the project, including those relating to cumulative effects that are likely to result from carrying out this project.
- Project undertakings performed in conjunction with other off site projects/activities that have been or will be carried out.
- The relative levels of significance.
- Public comments.
- Mitigation measures deemed to be technically and economically feasible.

Interested parties were identified and consulted during the assessment process including:

- 'Expert' federal departments (Environment Canada, GNWT Natural Resources, GNWT Health, DIAND);
- 'Other' federal departments (DND, Defence Construction Canada, Parks Canada);
- Aboriginal organisations (Nunavut Tunngavik Incorporated, Nunavut Planning Commission); and

- The community leadership of the various eastern Arctic hamlets and the general public.

Assessment of Environmental Effects

The initial step following the scoping exercise was to undertake a determination of the possible environmental effects of the project. This assessment involves providing a detailed overview of the project, a description of the existing environment (including inventories and ecological processes) and, finally, the identification of project-environment interactions.

The aim of describing the project was to clearly outline the constituent components and activities that were to occur on each of the DEW Line sites. Activities include mobilisation, project layout and design, plans and scheduling, specifics related to each of the activities (i.e., how would contaminated soil be identified, excavated, transported and disposed of), operating procedures, control procedures and demobilisation plans. Detailed data concerning each of the activities (i.e., material volumes) was included with this description.

During the scientific studies described above, the site teams collected all relevant information concerning the existing environment components of the study area. This information included a description of the physical, biological and social characteristics of the study area.

Using the information that was obtained on the project and the existing environmental setting, the assessment study determined interactive links between these two components. Particular concern was focused on the location, sensitivity, seasonal presence and abundance of these components. In general, these interactions were shown using a matrix table which are shown in the environmental assessment reports that accompany this submission.

Also included in the assessment of environmental effects were possible impacts relating to socio-economic factors (heritage, culture, archaeological, employment and business opportunities), land use and human health.

During the assessment stage, conclusions were made as to the type of impact (i.e. level of adversity) and its level of significance, based on comments received during public consultation sessions.

Identification of mitigation options

The third stage of the assessment process was to undertake the identification of mitigation measures that would result in a reduction or elimination of likely environmental effects associated with the clean up of each of the sites. In the case of this project, all potential adverse effects were addressed and not simply those deemed to be significantly adverse, the minimum required by assessment legislation. Mitigative actions now form part of the overall project design and planning documentation, which resulted in the Environmental Protection Plan. The requirement for on-site personnel to adhere to these mitigative measures is contractual in nature as the Environmental Protection Plan forms part of the clean up contract.

PART 2 - PROJECT IDENTIFICATION INFORMATION

Project Title

DEW Line Clean Up in the Nunavut Settlement Area

Type of Activity

Construction activities in support of the environmental clean up of 15 DND DEW Line sites in the Nunavut Settlement Area.

Summary of Operation

Scope

The physical and environmental restoration of the DEW sites requires the removal of structures and debris including hazardous material such as batteries, waste oils, asbestos and inorganic elements (principally copper, lead, and zinc) and polychlorinated biphenyls (PCBs). An environmental monitoring program will also be undertaken following the clean up activities.

Background

From 1955 to 1993, the Distant Early Warning System - the DEW Line - provided radar surveillance of the northern approaches to the North American continent. This now inactive chain of radar stations, at approximately 70 degrees latitude, stretches several thousand kilometres across the breadth of the Arctic. The DEW Line originally consisted, in Canada, of 42 sites but was reduced to half this number in 1963. The 21 sites (6 in the Inuvialuit Settlement Region and 15 in the Nunavut Settlement Area), which were decommissioned in the 1960's, are now the responsibility of the Department of Indian Affairs and Northern Development (DIAND).

In March 1985, Canada and the United States agreed to modernise the North American Air Defence System by closing the remaining 21 DND DEW sites and building the North Warning System (NWS). The DEW Line Clean Up (DLCU) focuses on closing out the former DEW Line sites, including the remediation of chemically contaminated soils, the stabilisation of landfill areas and the demolition/burial of surplus infrastructure and debris.

In 1996, the clean up of the FOX-4 Cape Hooper site was the first Nunavut based site to be started and is expected to be completed in the summer of 1998.

Rationale for the project and primary goals

The process of biomagnification, which is defined as positively sloped variation in concentrations through increasingly higher tropic levels of the food chain, is a well-documented phenomenon. The process of biomagnification is a particularly important phenomenon in Arctic

organisms, where, as a result of their dependency on a high fat content in their diets, are extremely sensitive to contamination inputs, especially chlorinated contaminants such as PCBs. In some cases, top carnivore levels of the Arctic food chain (i.e. Polar Bears) may experience a contaminant (i.e. PCB) biomagnification factor in excess of 3×10^9 times when compared to the first order (primary) source of these contaminants, namely sediment and adjacent waters.

The aim of the DEW Line Clean Up Project is to decommission those facilities used by the former DEW Line which have been declared surplus to the requirements of the new North Warning System and to restore the sites to an environmentally safe condition. Environmental restoration includes the setting of remediation objectives that are designed to preclude the continued migration of contamination (and hence biomagnification) into the Arctic ecosystem/food chain. To accomplish this, remediation will include:

- The excavation of soils in cases where parameters exceed those that have been set for the project (i.e. believed to cause significant input into the lower levels of the food chain, for example, higher plants and detritus); and

- The remediation of landfills which may serve as a source of water contamination and may enter the lower levels of the marine food chain (i.e. algae).

Given the fragile nature of the highly sensitive Arctic ecosystems, it is important that past anthropogenic activities, such as the operation of the DEW Line, not causes any significantly adverse affects on any one of the trophic levels of the Arctic food chain. The limited availability of species at any given trophic level leaves little opportunity for another species to negate the effects of the loss of another. In addition, negative biological effects (i.e. plant loss) may lead to physical disturbances, such as damage to permafrost.

In anticipation of the close out of the existing DEW Line system, DND sponsored a five year environmental and engineering study of the 15 DND DEW Line sites in Nunavut. The purpose of this study was to ascertain the baseline condition and to propose realistic clean up objectives and strategies. The protection of the food chain from DEW Line contaminants was established as the aim of the clean up. These studies confirmed that physical restoration would involve considerable quantities of materials, including limited quantities of hazardous materials such as waste oil, batteries and asbestos. Conclusions reached by independent analyses indicated that inorganic elements (principally copper, lead and zinc) and polychlorinated biphenyls (PCB's) pose the greatest threat to the biophysical environment.

Project Location

The location of each DEW Line site in the Nunavut Settlement Area is shown in Annex B and listed in Annex C. There is no requirement to select alternative sites. There is no special land status that has been designated for this site.

Enclosed with this submission are the 1:50000 NTS topographical maps for each site.

Project Components and Alternatives

Evaluation of Alternatives to the Project

The capability deficiency that has been identified is that DEW Line facilities at these locations no longer required by the Department of National Defence. These facilities therefore pose both a safety hazard and a potential long term source of contaminant input to the sensitive Arctic environment and, as such, must undergo a clean up process that will preclude further input into the environment, in general, and, specifically, the food chain.

As a project strictly dedicated to the clean up of these military establishments, the range of *alternatives to* this project are limited in nature. Two alternatives to the clean up of these sites that can be identified have been rejected or implemented in a limited fashion based on either military operational requirements and/or environmental reasons. These two alternatives were as follows:

Commercial or other Government use of the facilities. This alternative involves the sale of those facilities no longer required by the Department of National Defence to commercial interests. Two possibilities are present, namely on-site commercial development or sale of these capital assets themselves and movement off-site. The federal government, as facility managers, and continuing operational requirements of the se sites (i.e. most sites remain part of the North Warning System) preclude the on-site option from being followed. The Department of National Defence has, however, put up all facilities that can be safely reused up for sale through the federal Crown Assets Disposal Corporation. The transactions of those facilities sold to local or regional interests and subsequent removal off-site have been completed.

No clean up action (*Null alternative*). The second alternative involved examining the environmental impact of maintaining the *status quo* at the sites. It was quickly realised that failure to address the environmental problems identified during the site investigations could lead to the following:

- Placing the Arctic environment/food chain at risk;
- Possible future legal liabilities for the federal government; and
- Greater clean up costs in the future.

Description of Planning, Designing, Operation, decommissioning and post-decommissioning phases of the project

As discussed in the section immediately above, DND initiated this project with a number of scientific and engineering investigations to examine the current baseline conditions of the site. The objectives of these studies were as follows:

- to identify the nature and extent of chemical contamination at the sites;
- to determine the possible impact of these contaminants on the Arctic ecosystem in general and the food chain in particular; and
- to develop practical environmental clean up strategies appropriate for the Arctic.

The results of these two studies resulted in the identification of the baseline conditions, principal contaminants and possible impact pathways/effects hypotheses. As a result of these studies, DND has acquired a detailed physical and chemical inventory of all of the DEW Line sites and, in fact, the largest Arctic contaminant database available.

During the radar upgrade program in the early 1990's, a Canadian consultant consortium was initially contracted to carry out an initial environmental clean up study of the DEW Line sites in Canada. The objectives set for this study were to identify and investigate areas impacted by past waste disposal practices and spills. Additionally, the study determined and evaluated remedial action alternatives for these waste disposal and spill areas and for debris arising from the demolition of excess facilities.

This initial study was carried out in accordance with the Canadian Council of Ministers of the Environment's *National Guidelines for Decommissioning Industrial Sites* which uses a six phase approach:

Phase I	Site information assessment
Phase II	Reconnaissance testing program
Phase III	Detailed testing program
Phase IV	Preparation of decommissioning and clean up plans
Phase V	Implementation of decommissioning and clean up plans
Phase VI	Confirmatory sampling and completion reporting

The scope of this initial study was to conduct a screening using Phases I to III and a recommendation of the decommissioning alternatives for Phase IV. Phases V and VI are in the process of being implemented.

The objective of the Phase I review was to familiarise the study team with past site operations and practices. In particular, the review was used to identify the types of chemicals commonly used on the sites, possible spill locations and waste disposal methodologies and locations.

During Phase I a review of the available documentation pertaining to each site was undertaken. Included in these documents were asbestos, PCB, and hazardous materials inventories for each of the sites as well as spill reports and retrograde histories for hazardous wastes. Subsequent to this initial record search, the study team undertook a literature search with the goal of providing background information on the environmental setting within each particular ecoclimatic region. The scope of this environmental overview included descriptions of the physiography, geology, hydrology, vegetation, wildlife, fisheries and marine mammals, heritage resources and land use. In addition, an initial examination and evaluation into available clean up technologies and methodologies were carried out. The final part of this review included an overview of the then present Canadian Federal and Provincial clean up standards, criteria, guidelines and regulatory framework.

The following outlines the results of this initial study:

- Hazardous materials (as defined by the Canadian *Transportation of Dangerous Goods Act*) that were identified on the sites included Class 1 (explosives), Class 2 (compressed gas cylinders), Class 3 (flammable liquids), Class 5 (oxidizing substances), Class 6 (poisonous and infectious substances), and Class 8 (corrosives).

- Various materials were identified that are not classified as hazardous but may be considered as a cause for concern includes diesel, grease, oil, lubricants, and hydraulic fluids.

- There was very little information available on fuel spills at each of the sites.

- A detailed survey of the biophysical environment (i.e. climate, geology, hydrology, flora and fauna survey, heritage resources, and land use) was obtained.

Phases II and III were combined into a field investigation program in accordance with the *Guidelines* referenced above. Field and laboratory work was carried out by the study team to:

- Collect and analyse soil, water, cooling oil, asbestos and paint samples;

- To determine site specific environmental parameters for a baseline risk assessment;

- To note sites of historical and archaeological significance; and

- To locate and determine the extent of contamination associated with landfills.

The results of the Phase II/III study are summarised below:

- Facilities overview: The design of the structures (including buildings and miscellaneous towers) for each of the 15 sites is essentially the same. Facility layout, however, is site specific. All sites were constructed on granular pads over the natural ground. All site activity centred around the main building, referred to as the 'modular train', which housed the majority of activities, including radar and communications operations, offices, workshops,

power generation, and accommodation of personnel. Other facilities included vehicle and equipment maintenance/storage areas, petroleum facilities, communication dishes and ancillary facilities (i.e. storage, weather stations, etc). Each site also had an airstrip and, in some cases, a hangar. The types and quantities of facilities being demolished as part of this project varies for each site as there are varying requirements for these facilities as part of the new North Warning System.

- Asbestos surveys found that asbestos was located at all 15 sites in sheet and pipe forms. Analysis found that the typical samples were chrysolite.

- Paint samples identified several heavy metals (lead was of greatest concern) and PCB's.

- PCB's were also found in a variety of equipment, including communications and lighting equipment.

- Analytical results from laboratory testing were reviewed and compared with applicable soil and drinking water guidelines as well as background values from both literature and off site samples. Analysis was carried out in two stages. In most cases, a first round of samples was analysed for a full suite of compounds. The results of the first round were reviewed and, in sample locations where the results exceeded the guidelines, a second round of down gradient (or below) samples were taken. Contaminants that were analysed include inorganic (i.e. metals) and organic (i.e. PCB's) compounds.

- Landfills were assessed for contents and leachate potential. Landfills were found to contain a variety of materials and, in some cases, are the source of contaminated leachate. In addition, many open dump sites were found at each location. These dumps contained scrap metals (i.e. barrels), wire, and paper remains. In some cases, old equipment was found around the site. The majority of waste materials were, however, either located within landfills or in pallet lines awaiting disposal.

At the same time as this initial study, the Canadian Department of National Defence conducted a second, parallel study of the sites. In 1989/90, an environmental study of ten of the 21 sites provided a detailed physical and chemical inventory of the stations and considered the impact of chemical contaminants on the Arctic ecosystem. This first part also presented a basis for the general approach to the clean up of the DEW Line, as well as specific clean up recommendations for each station. This was followed up, in 1992, by an assessment program, including the provision of recommendations for clean up, for the remaining eleven sites. In conjunction with these studies, an overview document discussing the environmental impact of the DEW Line on the Arctic. This report proposed the major migration pathways by which chemical contamination from these sites was distributed throughout the Arctic ecosystem.

In conjunction with the station assessments, several Canadian government departments conducted two studies in 1993/1994 designed to assess the impact of the historically common practice of disposing debris into the ocean through the ice. The first study, which took place in

the waters of Cambridge Bay and the second study, which took place along the east coast of Baffin Island, included assessing the marine environment adjacent to three DEW Line sites, including the Cambridge Bay site. The first of these ocean disposal studies concluded that there was a large variety and amount of debris on the ocean floor but that there were no significant chemical effects arising from its presence (i.e. it was concluded that PCB contamination emanated from anthropogenic sources near the study site and not the ocean disposed equipment). The second historic ocean disposal study reported that very little debris in each of the study areas were present and that there is no evidence that historic ocean disposal activities have contributed to contamination of the near shore marine environment.

Given the small amount of historical data on contaminant disposal for the study teams for both studies, this second scientific study of the DEW Line sites sampled all areas of the sites and analysed for a wide suite of contaminants. During the initial stages of this study, patterns of waste disposal common to all of the sites became evident. This was supported by the following observations:

- Debris in varying quantities were found scattered over the sites and often included hazardous materials (i.e. batteries, waste oils, and asbestos);
- The contents of some landfills were exposed, the result of erosion and spring runoff;
- Fuel handling and storage facilities were often the sites of spills. In addition, contamination was consistently found at less obvious locations (i.e. PCBs that were found in older household products which were believed to have been dumped outside buildings or down drains);
- Chemical analyses showed the following patterns of contaminant dispersal:

  (1) PCBs and inorganic elements such as copper, lead and zinc were found to be the contaminants of primary concern in soil and water. Pesticides, polyaromatic hydrocarbons, phthalates and chlorinated compounds were either absent or in low concentrations,

  (2) Inorganic element contamination was, in general, confined to outfalls and landfills, and in the case of lead, to fuel spills,

  (3) PCBs were present in elevated levels around outfalls and, to a lesser degree, in landfills and stained areas near pallet lines and buildings,

  (4) Leachate waters and soils collected at the base of some landfills contained detectable concentrations of contaminants, indicating a more concentrated source within the landfill, and

(5) The remaining contamination appeared to be restricted to isolated spills within the station area.

Future sampling was based on the knowledge gained from the initial sampling and the distribution parameters discussed above.

Evidence was found at many of these sites that showed the migration of contaminants (primarily copper, lead, zinc and PCBs) along adjacent water systems or, in the case of PCBs, by aerial transport. Point sources for such migration were identified for remediation action.

While the DEW Line sites were operational, barrels (i.e. 45/55 gallon drums) were used extensively to transport petroleum products. As a result, some sites have up to several thousand barrels remaining, many of which were simply discarded onto the surrounding landscape. In most cases these barrels are empty but some contain unidentified residues. In addition, initial studies indicate that barrels are buried in landfills. The status of these barrels is unknown but information can be extrapolated from the analytical results of the surface barrels (i.e. types of contaminants, etc). Random sampling of barrels at the stations showed the following:

- Most of the discarded barrels were empty but some contain waste oil, water, or remnants of the original contents (or a combination of these three);
- A small proportion of the barrels contain glycols, fuel and lubricants, waste oils or PCBs; and
- In most cases barrel contents can be incinerated on-site, but some contain substances (i.e. cadmium, chromium, lead, chlorine and/or PCBs) in excess of regulations and, as such, must be disposed of in southern disposal facilities.

The results that were obtained from both DEW Line Clean Up scientific assessment studies were subsequently reviewed using an impact, or risk, assessment philosophy. The mere presence, or input, of a chemical contaminant is not alone cause for concern; an impact on the ecosystem must be assessed. Chemical contaminants are considered to have an adverse effect on the environment if a negative impact can be demonstrated (i.e. levels of chemical contamination that may affect reproductive success). Specifically, an adverse effect was defined as the significant introduction of a chemical contaminant into the terrestrial or marine food chains. The initial part of the risk assessment evaluated contaminant persistence and mobility and determined the circumstances under which they would be a potential threat to the environment.

As part of the ecological risk assessment process, both terrestrial and marine impacts were examined. In examining terrestrial impact, the study team used plants (a primary food source in the Arctic ecosystem) as an indicator to determine to what extent contaminants had entered the food chain. As a result of these studies, the study team was able to determine the maximum concentration of contaminants that could be present in soils without posing a significant effect on higher levels of the food chain. This evaluation was a key assessment factor in determining the Arctic soil remediation criteria for contaminants found on the DEW Line sites. In determining

marine impact, the results of a historic ocean disposal studies concluded that evidence for biomagnification of PCBs in bottom dwelling marine organisms, which act as food sources for larger organisms such as birds and marine mammals, suggest that low level inputs have a significant impact on the ecosystem. As a result of this conclusion, it was determined that it is important that contaminants be prevented from entering the ocean, even at low concentrations. As such, contaminant flow must be contained at the source. Furthermore, assessment of the underwater debris found during this study concluded that, despite the extensive nature of the debris, chemical contamination was insignificant when compared to shoreline runoff and, as such, clean up actions should be restricted to the land and foreshore areas and not deep waters unless there is evidence to the contrary.

As a result of these studies, three reports were completed which presented the conclusions that arose from these investigations along with practical recommendations for remediation strategies appropriate to the Arctic. Supporting information was provided through other reports, including a specific study on archaeological resources. These reports were supplied to a number of libraries throughout Canada (including a number throughout the Northwest Territories).

Environmental Working Group

In 1997, the Department of National Defence and Nunavut Tunngavik Incorporated (NTI) agreed to form an **Environmental Working Group** (EWG). The EWG is comprised of scientific and technical experts representing both the Inuit (NTI) and DND. The purpose of the EWG is to examine environmental issues related to the DEW Line Clean Up project and to provide recommendations to a joint DND/NTI core group consisting of senior management from both organisations. Specific tasks that have been assigned to the EWG included:

- Development of a landfill risk evaluation matrix;
- Evaluation of, and recommendations for, a post-construction/remediation landfill monitoring program;
- Identification of hydrocarbon clean up requirements;
- Establishment of confirmatory testing protocols; and
- Preparation of a list of items suitable for landfilling at the DEW Line sites.

Pre-clean up Activities

Prior to the clean up of each site, the Department of National Defence undertakes a final site assessment. The aim of these site visits is several-fold, including:

- To fully delineate the extent of contaminated areas in order to prepare accurate construction drawings;

- To confirm the structural and environmental status for buildings and other facilities that are to be demolished;

- To re-confirm the baseline environment of the site prior to implementation; and

- To examine landfills, where required, to confirm details pertaining to the remediation of these areas.

PCB's in Paint

During the final site investigations conducted in 1996 at Tuktoyaktuk and Cape Parry, the DND investigation team discovered that the paint on many of the buildings contained PCBs in excess of 50 ppm. Materials containing such concentrations of PCBs are currently regulated under the *Canadian Environmental Protection Act*. Painted materials containing PCB levels higher than 50 ppm constitute a PCB solid waste and must be disposed of in accordance with the existing legislation. It is not permissible under Canadian law to landfill solid PCB waste.

The PCBs in the paint is chemically bound in the paint itself and, in tests conducted to date by scientists at the Royal Military College of Canada and the University of British Columbia, there is evidence that PCBs do not leach out of the paint to escape into the environment. If PCBs do not leach out, it is probable that there would be no risk to the environment or to public health and safety, if these waste construction materials are isolated in a suitably engineered and monitored landfill.

Further study has revealed that PCBs in paint are common throughout the world, including Canada. DND has therefore requested that Environment Canada review these scientific studies and consider revising the regulatory definition of a PCB solid in order to permit the landfilling of construction debris that contains PCB paint. Environment Canada is examining the issue and will make a decision in due course. In June, 1998, there will be a scientific and technical conference on this issue. The NTI, on behalf of the Inuit, are being kept up to date on developments related to this issue.

Until a decision on the PCB in paint issue is rendered, construction materials containing PCBs in excess of 50 ppm will not be landfilled. At some sites, the material may be containerised and stored in accordance with the *PCB Waste Storage Regulations*.

Inclusion of Traditional Knowledge

One of the guiding principles of the DEW Line Clean Up project is to ensure the meaningful participation of local residents in both the planning and execution phases. One way of ensuring this is to incorporate traditional knowledge into site specific planning. Traditional and local knowledge is being collected as part of the site-specific pre-construction phase (described immediately above) of the project. An Inuit representative who is familiar with both the DEW

Line site and traditional use of the area will be chosen by the relevant Regional Inuit Association to be on-site during the pre-construction delineation phase of each clean up. The Inuit representative will work closely with the EWG to identify Inuit use of the area, wildlife patterns and past activities and occurrences that may have impacted on landfills (i.e., dumping, hazardous waste storage, natural occurrences). This information will be used in order to assist in the scoring of the landfill matrix (the scoring methodology is described in the EWG reports included with this submission).

Additionally, DND and the NTI will attempt to establish a community DEW Line Clean Up committee which will facilitate the flow of local knowledge to the EWG prior to and during each site visit. To effect this, the EWG will visit local communities most affected by each DEW Line site and conduct one on one interviews with a number of residents, the Hamlet Administrative Officer and/or Mayor, the local HTA and other relevant community organizations.

Project Design - Development of the DEW Line Clean Up Criteria and Protocol and DND/NTI Agreement on the Environmental Provisions for the project

The purpose of the DEW Line Clean Up project is to:

- Demolish and remove existing facilities that are not required for the operation of the North Warning System;
- Remove contaminated soils from the sensitive Arctic food chain;
- Clean up surface debris; and
- Physically restore the unused portion of the site to as natural a state as possible.

In cooperation with several federal departments (Environment Canada, Fisheries and Oceans, Indian and Northern Affairs) and the Government of the Northwest Territories (Renewable Resources and Health departments), DND initially drafted the *General Protocol for DEW Line Clean Up*. This protocol served as the basis for the DND/NTI Agreement on environmental provisions for the clean up of these sites (Annex D). As there are no established standards for the Arctic, existing federal guidelines, such as the Interim Canadian Environmental Quality Criteria for Contaminated Sites, have been modified to account for the unique northern environment. These adjustments to existing guidelines reflect both the sensitivity of the Arctic food chain to ecological processes such as biomagnification and the close dependence of the Inuit on the land for food. In addition, a secondary, barrel specific, protocol has been promulgated. The barrel protocol outlines the process for dealing with barrels and barrel contents found on the DEW Line sites.

The protocol outlined in the DND/NTI Agreement (Annex D), was developed from the conclusions and recommendations resulting from the biophysical, socio-economic, and engineering site assessments (mediated through the DND/NTI EWG). The end result of the

protocol development process is the documenting of contaminant clean up criteria and specific physical actions that are to be undertaken, if required at a particular site. These criteria have been developed based on existing federal and provincial criteria in conjunction with studies that show the functional relationships and/or pathways for biological uptake from soil. The resulting protocol defines two concentration tiers of soil contamination (see Appendix E of Annex D). Soil substrates containing Tier I concentrations may be placed in appropriate on-site landfills while those soils in excess of the Tier II standard are to be disposed of in a manner that provides additional measures to permanently segregate these contaminants from the Arctic ecosystem. Soils exceeding federal legislative limits (i.e., *Canadian Environmental Protection Act* and *Chlorobiphenyl Regulations*) will be disposed of off-site at a licensed disposal or destruction facility. On-site containment measures are discussed below.

Project Design – Engineering

The elements of the engineering design are directly related to specific clean up requirements as established by the DND/NTI Agreement.

Visible debris in the vicinity of each station will be removed and sorted. Non-hazardous debris will be placed in an on-site engineered landfill. Hazardous materials will be removed from the site and disposed of at a licensed hazardous material disposal facility. All facilities at the site which are not required for the operation of the North Warning System will be wither sold (where building conditions permit and if a suitable buyer can be identified) demolished and placed on-site in suitable landfills (in accordance with the limitations placed by federal legislation). Portions of the previously disturbed areas of the site will also be recontoured to establish natural drainage patterns.

Specific activities for the 15 DEW Line sites include the following:

Landfill Development

- Landfills will be developed at this site to accommodate non-hazardous site and demolition debris. Where available, existing landfills are to be used.

Landfill Closure

- Closure of all former DEW Line landfills not being used by the North Warning System will be in accordance with Section 6.0 and Appendix B of the DND/NTI Agreement (Annex D).

Disposal of Site Debris

- All visible debris will be collected and sorted. Non-hazardous debris will be placed in an engineered landfill on-site provided a suitable location and sufficient borrow materials can be found. Materials suitable for landfill have been examined by the EWG and are shown in the

DND/NTI Agreement. This listing is summarised in Appendix C of Annex D. Hazardous debris will be shipped disposed of in accordance with federal legislation.

- All debris which is attributable to the operation of each DEW Line site and is within two metres of the surface at low tide or within tow meters of the surface on an inland water body will be removed by DND.

- Where there is reasonable evidence of additional off site contamination and/or debris which is solely attributable to the operation of the DEW site, DND will undertake testing to determine the extent of contamination in consultation with the NTI and remediate the site in accordance with the DND/NTI Agreement.

Disposition of Contaminated Soils

- Soils containing DCC-I and DCC-II contamination are present at all DEW Line sites within the Nunavut Settlement Area. They will be disposed of in accordance with the DND/NTI Agreement.

Removal of Hazardous Materials

- Materials identified in the DND/NTI Agreement as not suitable for landfill **or** are otherwise designated as hazardous (see Appendix C of Annex D of this submission) are to be disposed of in an appropriate (licensed if required) disposal facility off-site.

Demolition of Facilities

- All structures not required for the operation of the North Warning System are to be demolished and /or removed to the top of their concrete foundations, sorted into non-hazardous and hazardous components and treated as described in subsections above (Disposal of Site Debris and Removal of Hazardous Materials).

- Prior to demolition, DND will attempt to sell or otherwise transfer ownership of certain facilities through the Crown Assets Disposal Corporation (CADC). These transactions will occur in accordance with existing legislation or CADC policies governing these activities. Normally, other federal government departments, followed by territorial and municipal governments are offered these facilities before they are put up for sale to private individuals or organisations.

Transportation of Hazardous Materials Off Site

- Hazardous materials are to be removed by air or sealift in compliance with the *Transportation of Dangerous Goods Act* and the *Transportation of Dangerous Goods Regulations*. These materials may be temporarily stored in order to transport them in