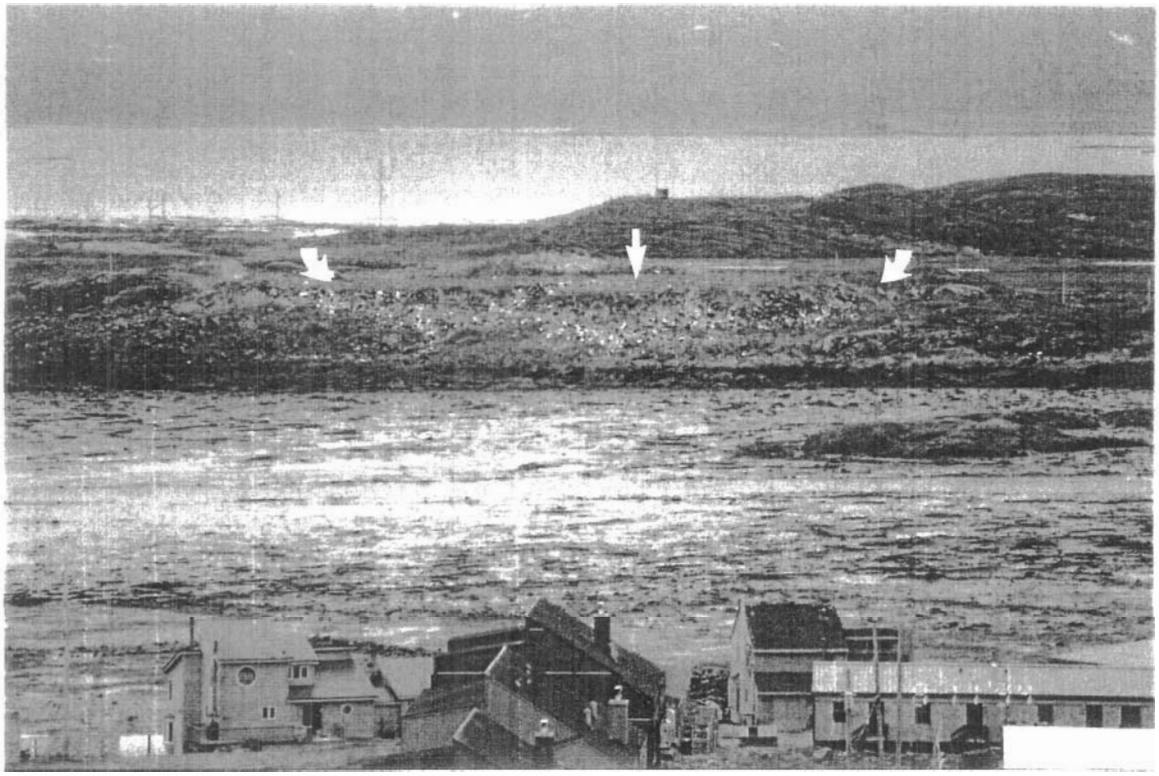


Photograph V-43: Dump Site #4 overlooking the foreshore flats of Koojesse Inlet as seen from the town of Iqaluit.

from 1992 through 1994, obtained from DIAND (1994) showed the 1992 sample was analyzed for a very limited suite of parameters (10) which did not include metals or organic compounds. Ammonia concentrations (15.6 ppm) were reported to have exceeded the CCME FAL Remediation Criteria (1.37-2.2 ppm) in this sample and nitrate plus nitrite levels were elevated, although no FAL criteria exists for their combined concentrations in water. Total suspended solids in the sample (500 ppm) exceeded the BCMOE Effluent Quality criteria for discharges to embayed marine receiving waters (45 ppm for maximum seven day average). Where present all other analytes fell within existing criteria.

The sample collected in 1993 was analyzed for a wider range of parameters (20) including some priority pollutants. Potassium (156.7 ppm), ammonia nitrogen (5.8 ppm), phenols (0.042 ppm), arsenic (0.4 ppm), cadmium (0.4 ppm), copper (32 ppm), iron (137 ppm), lead (3.3 ppm), nickel (8 ppm), zinc (102 ppm) and chromium (2 ppm) were all detected at levels which exceeded the CCME FAL Remediation Criteria for water. Oil and grease values (4.7 ppm) exceeded the Quebec Level B guideline (1 ppm) and approached the Level C guideline (5 ppm) for ground water. As well, total suspended solids (997 ppm) were considerably higher than the BCMOE effluent quality criteria.

The sample collected in June 1994 contained concentrations of ammonia nitrogen (24.5 ppm), aluminum (0.38 ppm), cadmium (4.6 ppb), copper (0.24 ppm), lead (7.9 ppb), selenium (0.1 ppm), iron (2.6 ppm), mercury (0.41 ppb) and zinc (2.8 ppm) which exceeded the CCME FAL Remediation Criteria. In addition, concentrations of manganese (12.9 ppm) and sodium (0.7 ppm), for which there are no freshwater aquatic life criteria, exceeded the CCME Drinking Water remediation criteria.

In 1993 the consulting firm Avati Ltd. conducted an environmental assessment of several sites around Iqaluit, including Dump Site #4. TPH, PCB and inorganic contaminant results were reported for a total of six soil samples collected from the dump. None of the analytes were detected at levels which exceeded or approached the Quebec Level A criteria, the CCME Remediation Criteria or the DCC. Making reference to the National Classification System for Contaminated Sites (NCSCS) the report concluded that

Dump Site #4 represented a medium low risk to the environment, just slightly greater than that calculated for Dump Site #2. Recommendations for the cleanup of the site included three options: (1) complete excavation and removal of wastes to a southern disposal facility; (2) complete excavation followed by sorting of hazardous and non-hazardous wastes and incorporation of each into two new landfills in the Iqaluit region; and (3) decommissioning (i.e. removal of hazardous wastes, capping and recontouring) with leachate collection and treatment as well as gas venting and treatment.

In 1994 UMA Engineering, Ltd. produced a preliminary report proposing measures for cleanup of the four dumps in the West 40 and the Apex dump based on visual inspection and a survey of the sites. Their recommendations for cleanup of the municipal dump (Site #4 in their report) included the following: removal of loose debris from around and beyond the toe of the dump; stabilization of the slope face with the addition of fill, and possible slope reduction with the addition of geotextile; toe berming to decrease the potential influence on stability of tidal action within Koojesse Inlet; rerouting of drainage away from the face of the slope by construction of a swale; and reseeding of areas to which fill is added to enhance their stability.

A brief summary of the state of solid waste disposal in Iqaluit was completed in 1994 by Mr. C. Finley of the University of Toronto (Finley 1994). Mr. Finley reviewed information available on the four West 40 dumps, the North 40 dump and the Upper Base, and in particular, the information which was presented in the Avati report (1993, see below). The report included the results of leachate analyses for samples which the municipality collected from Station 87-4 in order to obtain a water license renewal (see DIAND 1994, below). The results of water analyses on samples reportedly collected by Avati in its 1993 study were also detailed in the review by Mr. Finley, although no water samples were collected by Avati at this site.

3. Current Sampling Program

Sampling of Dump Site #4 by the Environmental Sciences Group took place on August 14th, 1995. The focus of the sampling program was on drainage from the main area of waste deposition, which ultimately enters Koojesse Inlet. A total of six soil samples, including one field duplicate, were collected from five drainage paths running off the north face of the dump (Map V-23). Three vegetation samples were collected from each of three different sampling locations where sufficient material was available. Detailed descriptions of individual sampling locations and vegetation collected and surveyed are provided in Section G, Chapter IV of the Appendices. As part of the concurrent Historical Ocean Disposal study, two samples of marine sediment were collected on the tidal flats below the dump (FB028 and FB029, Bright et al. 1995).

4. Analytical Results

The analytical results for samples from this and all other sites can be found in Chapter V of the Appendices. One sample collected in the municipal dump (Dump Site #4) contained inorganic elements in excess of the DCC (Map V-24).

i. Inorganic Elements

Four of the six soil samples collected at Dump Site #4, including one field duplicate, were analyzed for inorganic elements. Mean concentrations of all elements investigated were well below the DCC, although the maximum concentration of copper exceeded the DCC Tier II value (Figure V-14).

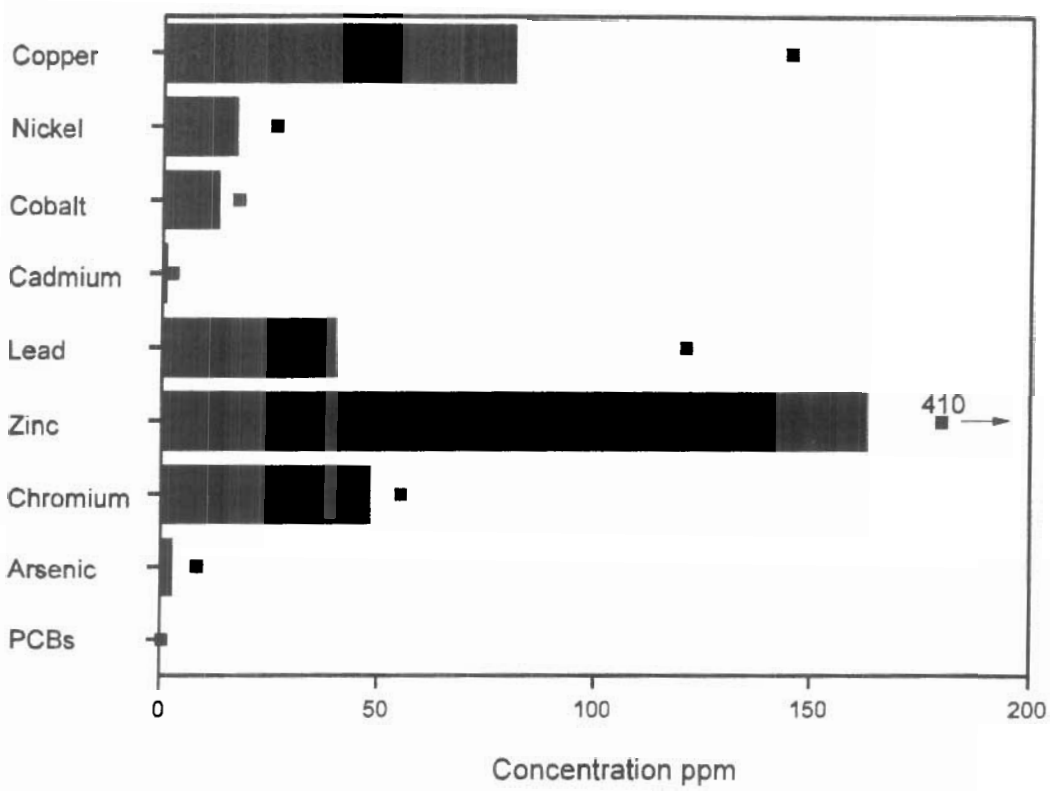
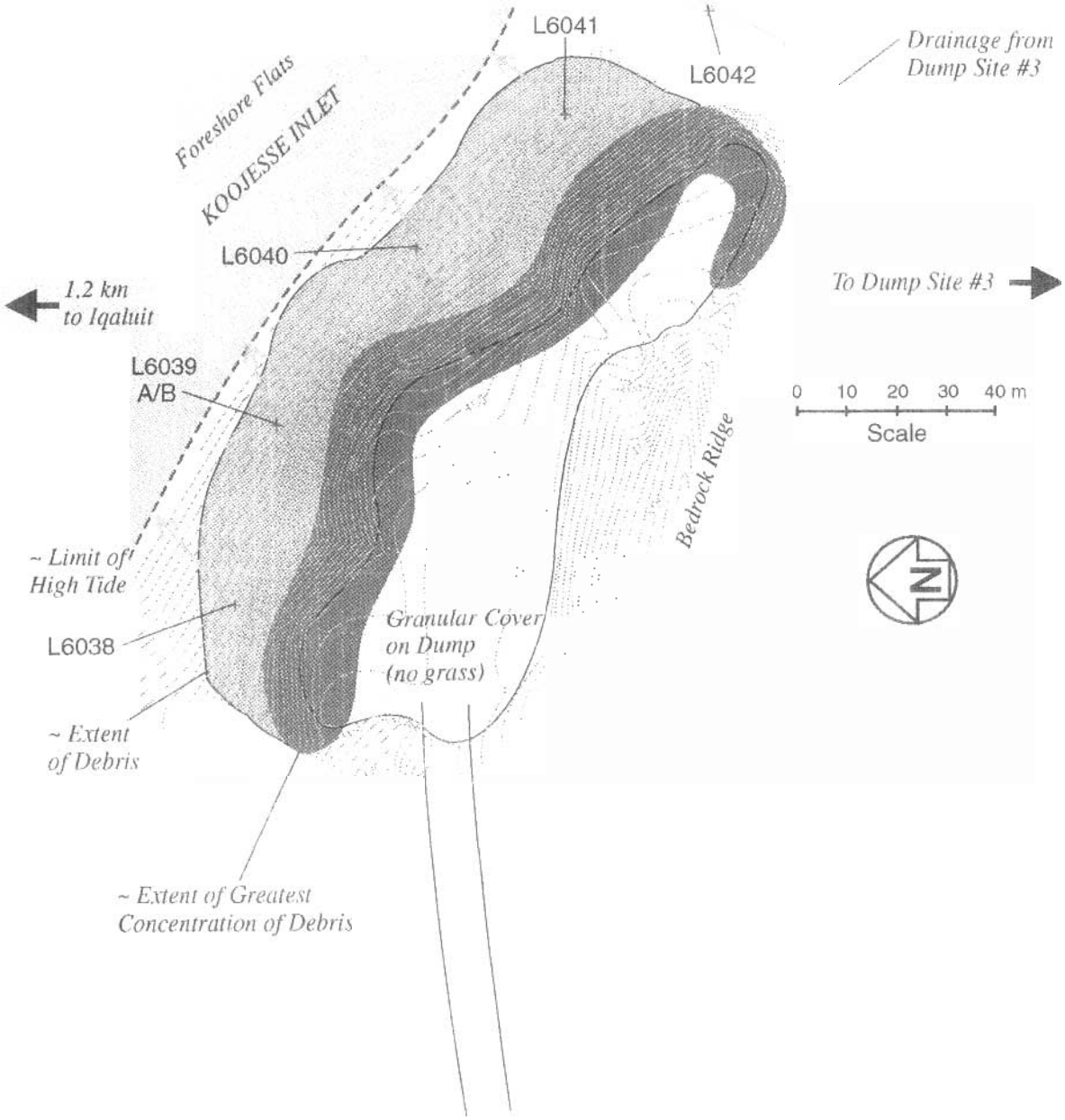


Figure V-14: Mean and Maximum Inorganic Element and PCB Concentrations in Soils Collected at Dump Site #4.

Sample L6041 collected in a drainage path below and east of the area of concentrated debris contained copper (145 ppm) in excess of the DCC Tier II level (Photograph V-44). This element is typically present in municipal waste materials. Levels of zinc in the same sample (410 ppm) approached the DCC Tier II level for that element (500 ppm).

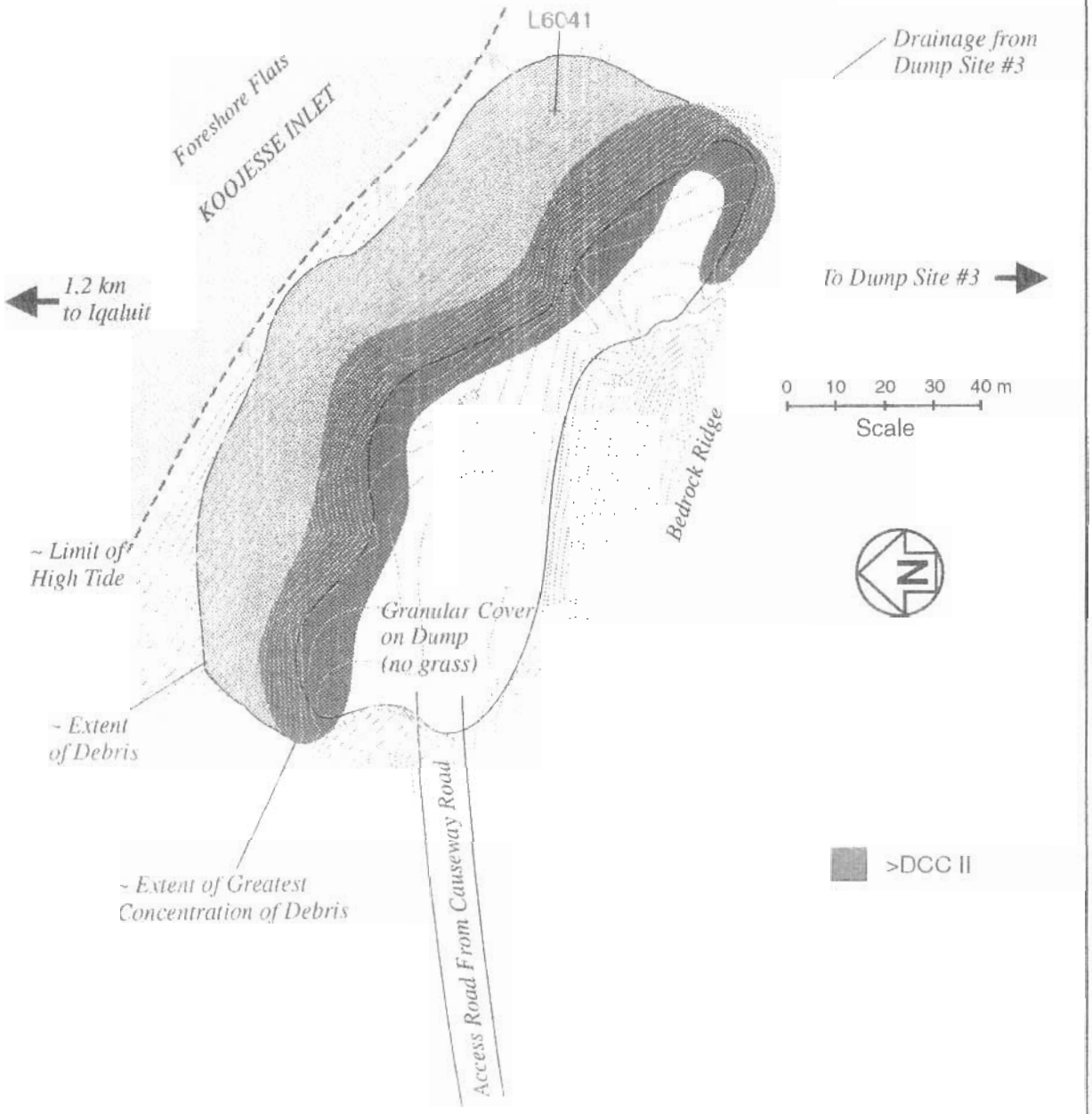
One of the three plant samples collected was analyzed for inorganic contaminants. The plant sample collected at the same location as soil sample L6041 had a concentration of zinc (600 ppm) which was 2.4 times the mean background concentration in plants (252 ppm). Levels of all other analytes in the same plant sample (L6041P) were not significantly higher than those observed in background vegetation.

Map V-23: Sample Locations at Dump Site #4, the Iqaluit Municipal Dump



Map adapted from the Preliminary Report on Cleanup of Waste Disposal Sites Near the Town of Iqaluit, NWT
Prepared by UMA Engineering Ltd., April 1994

Map V-24: Sample Exceeding the Cleanup Criteria, Dump Site #4



Map adapted from the Preliminary Report on Cleanup of Waste Disposal Sites Near the Town of Iqaluit, NWT
Prepared by UMA Engineering Ltd., April 1994

Neither of the two marine sediment samples collected as part of the HOD study (Bright et al. 1995) were analyzed for inorganic elements.

Copper and zinc concentrations in soil from Dump Site #4 were found to be elevated. Copper concentrations exceeded the DCC. Impact on vegetation in the dump by contamination in the soils was detected.

ii. Polychlorinated Biphenyls (PCBs)

Five of the six soil samples collected, including one field duplicate, were analyzed for PCBs. Mean PCB concentrations in soils (0.094 ppm) from the dump were 94 times greater than those in background soil samples (0.001 ppm, Figure V-14). None of the soil samples contained PCBs at concentrations which exceeded the DCC, but the concentration (0.34 ppm) detected in one sample (L6040) was significantly elevated with respect to background. This sample was collected in a well-defined drainage path approximately two-thirds of the way down the slope, in the eastern half of the dump (Photograph V-45). Of the three plant samples collected none were analyzed for PCBs because of the low levels of PCBs found in the corresponding soils.

Both the marine sediment samples collected as part of the HOD study (Bright et al. 1995) were analyzed for PCBs. Concentrations of PCBs were identical in the two samples (1.6 ppb) and were not significantly elevated above concentrations detected for background marine sediments (0.77 ppb).

Although significantly higher than background soil levels, concentrations of PCBs in Dump Site #4 soils did not exceed the DCC. Chronic low-level inputs of PCBs to Koojesse Inlet were not apparent in marine sediments collected on the foreshore flats below the dump.

iii. Other Organic Contaminants

One soil sample (L6040) from Dump Site #4 was analyzed for pesticides. The total concentration of pesticides (0.14 ppm) detected did not exceed the BC (2 ppm), Québec

(2 ppm) or Netherlands (3 ppm) Level B remediation criteria. Fifteen of 22 pesticide analytes were detected, but none of the pesticides detected were present at concentrations which exceeded the Netherlands criteria for individual chlorinated or non-chlorinated pesticides.

Although several of the pesticide analytes were detected in a soil sample from Dump Site #4, none of these were present at levels requiring remediation.

5. *Cleanup Recommendations*

Due to the proximity of Dump Site #4 to the marine environment, the focus of the current assessment has been to determine whether the site poses a significant threat to this habitat. The presence of elevated levels of contaminants in samples collected in drainage paths leading to the inlet as part of this study and previous monitoring programs (DIAND 1992, 1993, 1994) has demonstrated that contaminants are leaching from materials within the dump and migrating down the slope, and may be entering Koojesse Inlet.

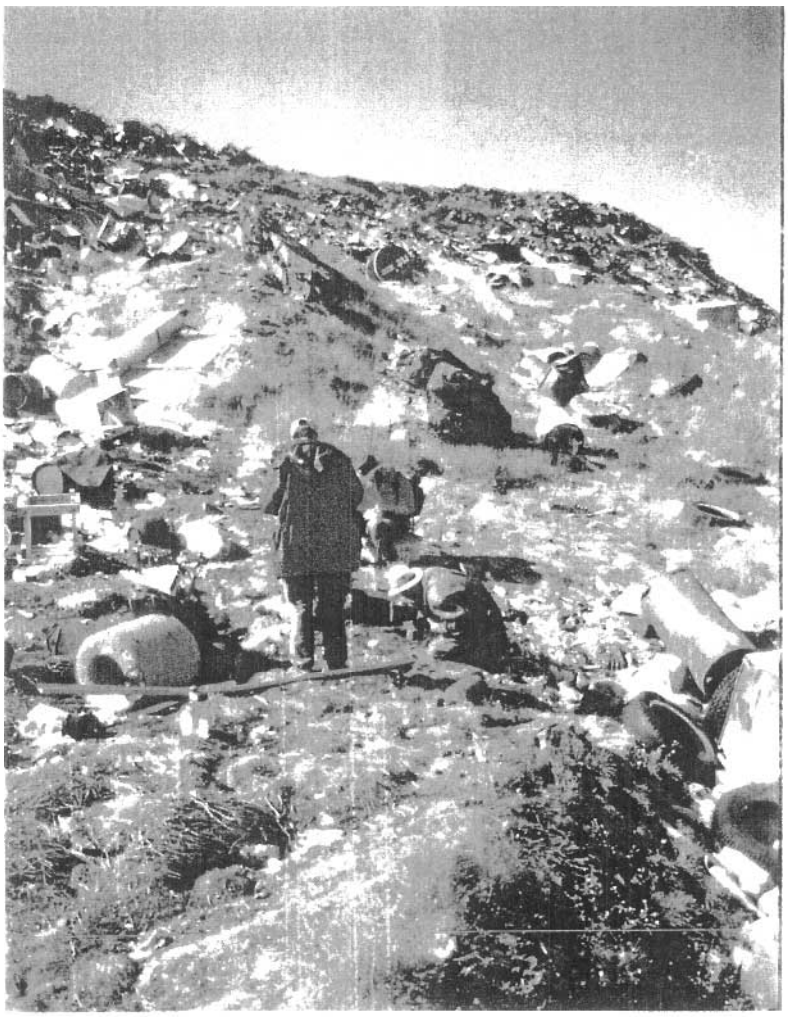
Hazardous and non-hazardous loose debris should be removed from the site. Hazardous materials should be shipped south for disposal; however, non-hazardous materials should be buried in the engineered landfill proposed for construction at the North 40 (see Implementation section, Chapter II). Metallic debris could be shredded and shipped South for recycling.

Control of leachate production within the dump requires implementation of the following measures: pulling back the top accumulated debris from the edge of the slope and depositing it as far to the south as possible within the area currently occupied by the dump; capping it with sufficient clean fill to promote permafrost infiltration of the waste-containing layer; and diverting drainage, which could potentially infiltrate the waste, away from the slope. Further mediation of leachate production within the dump could be accomplished by the placement of a synthetic membrane or amended soils over the regraded area. Revegetation of the area should be encouraged by reseeding with endemic early successional species, as outlined for Dump Site #1.

Should the volume of material present within Dump Site #4 be too great to effectively move it away from the edge of the slope which overlooks Koojesse Inlet, some material could be moved to the area west of the new municipal landfill (Dump Site #3). Further leachate control measures within Dump Site #3 would be required if this option was implemented. Problems inherent in the excavation of a dump - in particular, the liability it represents to any firm contracted to complete the removal of unknown buried wastes - may limit the feasibility of this option.

Regardless of the choice of cleanup method, loose bulk wastes should be removed and incorporated into the engineered landfill proposed for the North 40.

Photograph V-44: Soil Sample L6041 collected in drainage off the east side of Dump Site #4 contained elevated levels of copper.



Photograph V-45: Soil Sample L6040 collected in a well-defined drainage path in the eastern half of Dump Site #4 contained pesticides and elevated levels of PCBs.

H. Dump Site #5: Apex Dump

1. General

Dump Site #5 is situated on the top of a near-vertical, south-facing slope overlooking Tarr Inlet, approximately 150 m southeast of the community of Apex and 4 km from Iqaluit (Map V-1). The top of the dump is accessible by vehicle from an access road maintained during active use of the dump. A second road forks off from the first to access the eastern edge of the toe of the dump. The toe may be accessible to heavy equipment at low tide.

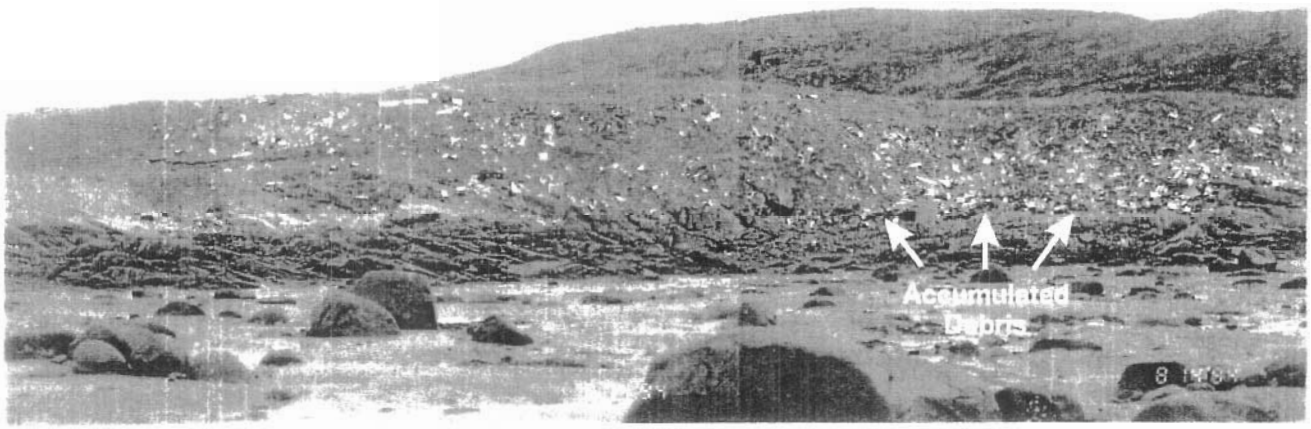
Before the arrival of the US Air Force and the development of the town now known as Iqaluit, the dump was likely used by members of the small community of Apex including Hudson's Bay Company employees, missionaries and local people. The types of waste present in the dump suggest that the Apex Dump may have been used by the military following their arrival in 1943. Disposal of waste in the Apex dump increased with the closure of the site at Sylvia Grinnell River (Dump Site #1) in the early 1970's. Operation of the site involved dumping the waste at the top of the slope and then bulldozing it to the dump face at the edge of the inlet (OMM 1983). UMA (1994) reported a lack of organic material on the face of the slope, and suggested that operations included burning. However, the amount of paper and plastic evident at the time of our field investigation suggests that burning may not have occurred or was been carried out only sporadically.

In 1979 the dump was closed due to a combination of factors: (1) it was full and (2) its location made transport of waste from the larger community of Frobisher Bay increasingly expensive. Closure of the site was not due to the proximity of the site to Apex or to the inlet waters, as suggested in the 1983 report by OMM. Shortly after closure the town added some local gravel to the top and face of the slope (DIAND File #B5565-5-F15-1, March 23, 1995). The top was well covered, while the slope was only partially covered.

In 1981, an inspection of the site was carried out by the Environmental Protection Service (PCB Inter-Agency Committee 1988), in order to identify transformers rumoured to be present at the dump. A study of the site was carried out in 1983 by OMM as part of its evaluation of solid waste disposal practices in the town of Frobisher Bay. Erosion of the face of the slope had not occurred to a significant extent at that time; nevertheless, the OMM report recommended further action be taken to stabilize the slope (OMM 1983). In October of 1987 GNWT was advised by Environment Canada that equipment likely to contain PCBs had been identified within the Apex Dump (PCB Inter-Agency Committee 1988). Three transformers were removed from the dump on September 15, 1988 (PCB Inter-Agency Committee 1988), by an undetermined agency. Erosion of the face of the slope has since resulted in the deposition of more material onto the beach, including barrels and electrical equipment. Some of this material may be hazardous.

The dump covers an area of approximately two hectares and is bounded by bedrock to the east and northeast. A gravel deposit is located southwest of the site and the tidal flats border it to the south. The top of the dump constitutes about half the total dump area and slopes gently towards the face of the dump. It is well covered with granular material and there is little visible evidence of waste. The face of the dump is approximately 240 m long and is nearly vertical at its eastern end (Photograph V-46). Large pockets of combustible and non-combustible waste, surrounded by grass-covered fill, are present in the face of the slope. Fifty to 75 percent of the slope face consists of exposed waste materials (UMA 1994). The toe of the dump has undergone extensive erosion due to tidal action and ice scouring, and is littered with material eroded from the face of the dump (Photograph V-47). At the time of the ESG field investigation, these materials appeared to comprise both military era and municipal wastes and included vehicle bodies, tires, many barrels, domestic water heaters, and construction material consisting of wood, metal culverts, rebar, and aluminum siding (Photograph V-48). Electrical equipment was found lying on the beach at the eastern toe of the dump (Photograph V-49). The tidal flats immediately south of the dump are extensively littered (Photograph V-50).

There is an absence of any pooling on the surface of the top of the dump. However, there is drainage emanating from the base of the slope, and water can be heard trickling through the inside of the slope, indicating that infiltration of the dump is occurring. In particular, two active drainage pathways - one coming out from the base of the middle of the slope, and one from the east side of the slope - were noted during the field investigation. This leachate enters the inlet; at high tide the eastern end of the toe of the dump is in direct contact with water from the inlet, and the entire toe of the dump is likely contacted during exceptionally high tides or storms.



Photograph V-46: View of the face of Dump Site #5, showing a large accumulation of bulk wastes at the toe of the dump.

Photograph V-47: Extensive erosion of the toe of Dump Site #5 by tidal action and ice scouring.

Photograph V-48: Metallic wastes, including a vehicle body, within the limit of high tide.

Photograph V-49: Electrical equipment previously buried within the slope, deposited on the beach at the east end of the dump.

Photograph V-50: The intertidal zone south of the dump, littered with a great deal of debris.

2. Results of Previous Studies

In comparison to the number of studies on dump sites in the West 40, few studies of the Apex dump site have been undertaken to date. None of the studies previously undertaken at the Apex dump site included a contaminant assessment.

A report produced in 1983 by Oliver, Mangione, McCalla & Associates, Ltd. (OMM) examined Dump Site #5 as part of an evaluation of the state of solid waste disposal in Iqaluit. A brief summary of the history of waste disposal in the region is provided in the report and includes activities undertaken by the town as part of decommissioning the Apex dump. The report provides a physical description of the site, including its location, degree of exposure of wastes, the state of leachate production, and the presence of any loose debris. Potential contamination within the site was not addressed in this study. The authors describe the face of the slope as consisting of uncovered waste, suggesting that the exposed steep face creates a negative aesthetic impact and is unstable due to potential wave and ice erosion. Recommendations by OMM (1983) for the cleanup and stabilization of the dump were based on visual inspection of the site and included the following: addition of armour rock fill to the toe of the dump to protect it from erosion; addition of large amounts of rock fill to the face of the slope to reduce the angle of the slope to a horizontal:vertical ratio of 1.5:1; addition of gravel fill to cover rock fill resulting in at least 30 cm of fill over the waste; and excavation of shallow interceptor ditches around the periphery of the site to minimize leachate production within the dump. The report includes a cost estimate of $134,000 (1983) for cleanup and stabilization of the dump, as outlined above.

A review of the literature on solid waste disposal sites in the town of Iqaluit was produced in 1992 by Public Works Canada. The review summarizes the history of waste disposal at the site and includes information concerning the identification and removal of electrical equipment likely to contain PCBs within the dump. A transformer was located at the toe of the dump by members of Public Works when they visited the site in 1992. It is suggested in the Public Works document that disposal of wastes at the Apex site only

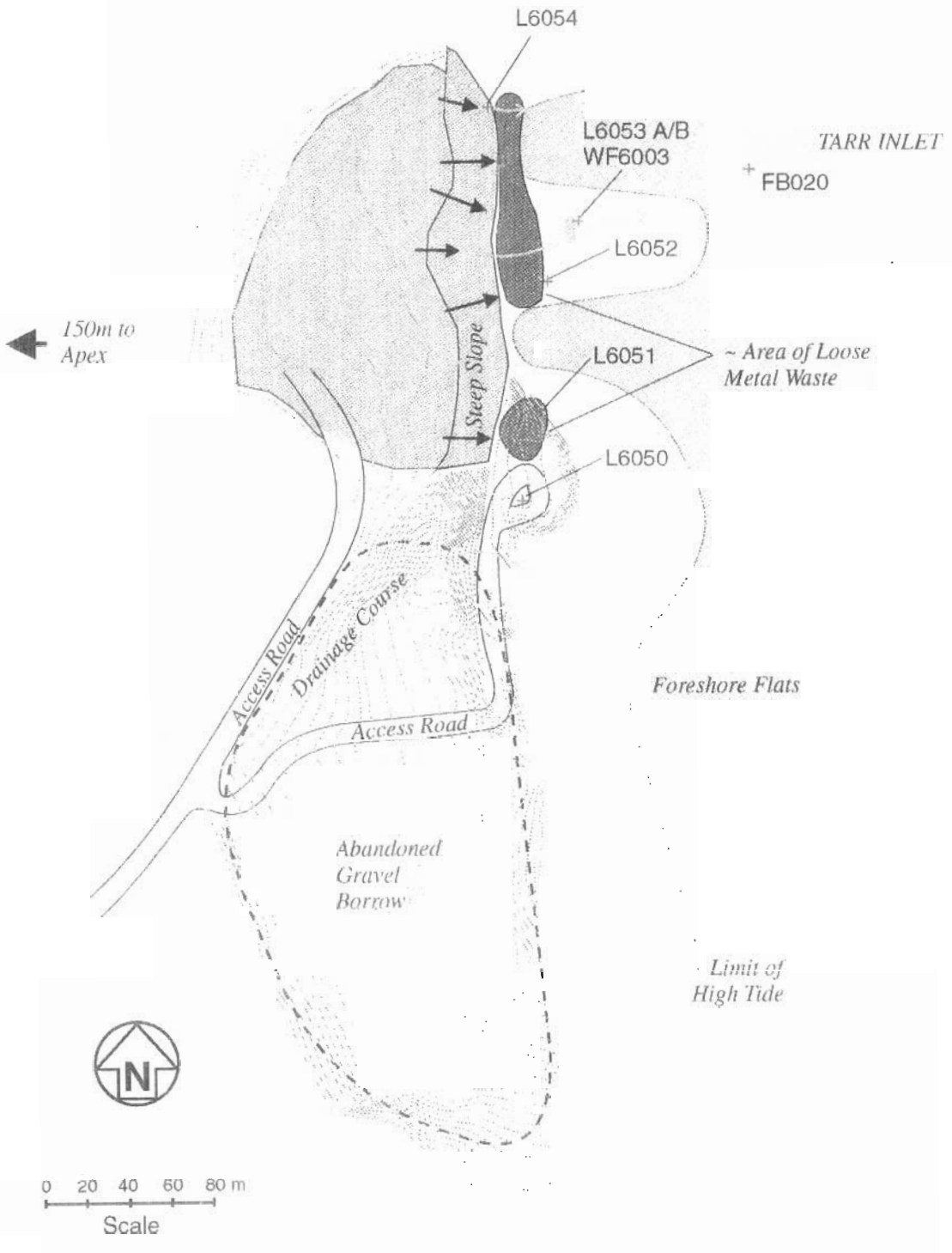
began in the mid-1970s. Use of the site as early as 1943 is reported in a document outlining USAF operations in Iqaluit (DND 1958).

UMA Engineering, Ltd. assessed the dump site at Apex in its 1994 preliminary report on the cleanup of this site and the dump sites in the West 40 (sites 1-4). Recommendations made in the UMA report are based on a possible stability problem and potential leachate production within the dump as observed during their field investigations, and include the following: a swale should be constructed along the edge of the top of the site to reduce leachate production and erosion of the face of the slope; the stability of the slope should be assessed to determine if risk is sufficient to require stabilization; a toe berm should be constructed to improve stability on a short-term basis; loose waste at the toe of the slope and on the tidal flats should be removed; and any worked areas should be reseeded. It was also suggested that areas with abundant vegetative cover on the face of the slope should be left intact, and that revegetation of areas without cover should be enhanced through seeding. Reseeding without the addition of fill to the unvegetated areas would not be successful, however, as the areas on the face of the slope lacking vegetative cover are those areas where waste is the only substrate.

3. Current Sampling Program

The ESG conducted its sampling program at Dump Site #5 on August 14th, 1994. Leachate migration from Dump Site #5 into Tarr Inlet may represent a threat to marine organisms including fish and hence is in direct conflict with Section 36 of the Fisheries Act. Therefore, potential pathways of contaminant migration into the marine environment formed the focus of the ESG sampling program. Six soil samples, including one field duplicate, were collected in drainage paths from the south toe of the dump (Map V-25). Two samples of vegetation were collected from each of two different sampling locations where sufficient plant material was available. A single water sample was obtained from a pool of water collecting drainage from the middle of the dump. Detailed descriptions of individual sampling locations and vegetation collected and surveyed are provided in Section H, Chapter IV of the Appendices.

Map V-25: Sample Locations at Dump Site #5, the Apex Dump



Map adapted from the Preliminary Report on Cleanup of Waste Disposal Sites Near the Town of Iqaluit, NWT
Prepared by UMA Engineering Ltd., April 1994