Canada-Déline Uranium Table – Final Report

Concerning Health and Environmental Issues Related to the Port Radium Mine

Canada

Déline First Nation

Canada-Déline Uranium Table

Final Report

Concerning Health and Environmental Issues Related to the Port Radium Mine

August 2005

Canada Déline Uranium Table

September 6, 2005

Chief Walter Bayha
Délı̨ne First Nation

The Honourable Andy Scott
Minster of Indian Affairs and Northern Development
Government of Canada

Dear Sirs:

On behalf of the Canada- Délı̨ne Uranium Table (CDUT), we are pleased to present to you *The CDUT Final Report Concerning Health and Environmental Issues Related to the Port Radium Mine.* This report includes the CDUT's key findings and recommendations from over 25 studies and activities undertaken by the CDUT since 1999.

The objective of the CDUT was to gather information about the Port Radium mine. This work has included historical research, gathering of traditional knowledge, health studies, environmental studies, social studies, communications activities and more. These studies and activities were carried out in partnership by Canada and Délı̨ne, and the findings are being presented jointly by representatives of both governments.

One factor that has been important in carrying out these studies is the extensive level of community participation in the work. Many of the studies were led by staff from the CDUT office in Délı̨ne. Over 30 Délı̨ne community members were employed by the CDUT at various times and in various capacities. Staff at Indian and Northern Affairs Canada, with the support of Health Canada and Natural Resources Canada, participated in all stages of the studies.

The complexity of the issues surrounding the Port Radium mine required expertise from many fields. We used experts to advise us and to undertake the scientific and technical studies of the environmental impacts of the mine site and of the potential health effects of radiation exposure on ore transport workers. The CDUT hired peer reviewers for the studies at critical points, and we believe the scientific information produced is strong.

We consider this report to be an accurate representation of the findings of the CDUT, and respectfully submit it for your consideration, along with our recommendation to accept the report and implement its recommendations.

Danny Gaudet
Délı̨ne First Nation

Chris Cuddy
Indian and Northern Affairs Canada

ACKNOWLEDGEMENTS

In just over five years, the Canada Délı̨ne Uranium Table (CDUT) has planned and undertaken a comprehensive program of studies and activities. The CDUT would like to acknowledge the important contributions of many organizations and individuals who have worked to make this project a success.

Acknowledgement must be given to the Délı̨ne leaders and advisors who formed the Délı̨ne Uranium Committee and requested that the Government of Canada address Délı̨ne's concerns about the Port Radium mine. Subsequently, representatives from the Délı̨ne First Nation and the federal government worked hard to negotiate terms of reference for the CDUT joint process. This partnership did not happen easily or overnight, and was a difficult and emotional process for many.

Throughout the implementation of the CDUT Action Plan, Délı̨ne community members played a crucial role in the successful completion of studies and activities. Community members participated in a variety of ways, including: as advisors in the design of community-based research projects, as field guides and assistants during environmental studies, and as translators for community events and presentations. Perhaps the most significant contribution of community members was the provision of traditional knowledge about life during the operation of the Port Radium mine. This information was invaluable in the assessment of the historic impacts of the mine on people and the environment.

The CDUT was also supported, through INAC's participation at the Table, by Natural Resources Canada, Health Canada, the Canadian Nuclear Safety Commission, and the Government of the Northwest Territories Department of Health and Social Services.

Finally, the CDUT recognizes the contributions of many individuals who worked on the Port Radium issue, and whose efforts were key to the completion of this work. Their work is gratefully acknowledged, and their names are included in Appendix 3. Of particular note, the representatives of Canada and Délı̨ne wish to acknowledge the two lead authors of this report, Ms. Jennifer Blomqvist and Mr. David Kennedy, for their efforts.

CDUT Final Report Summary

Key Findings and Recommendations

The former Port Radium mine, located on the northeast shore of Great Bear Lake, Northwest Territories, operated as a radium and uranium mine from 1931-1960. The Dene people who lived around Great Bear Lake provided support services for the mine and assisted in the transportation of radium and uranium ore and other goods to and from the site. In the 1980s, people in Délı̨nę began to learn about the damage to human and environmental health that can be caused by radium and uranium mining. Community members began to fear for the safety of their environment and traditional foods. The belief that radium and uranium exposure caused cancer in Délı̨nę became prevalent in the community.

The Canada-Délı̨nę Uranium Table (CDUT) was formed by the Délı̨nę First Nation and the federal government in 1999 to address concerns about the human health and environmental impacts of Port Radium. In 2000, the CDUT, community members and experts from various fields contributed to the development of a three-year Action Plan; this document identified studies and activities that, when completed, would provide the information necessary to enable the community of Délı̨nę and the federal government to make informed decisions about the Port Radium mine site and any community health issues relating to the mine.

This final report of the CDUT describes the studies and activities that were carried out during Action Plan implementation, and presents all associated findings and recommendations. The summary below follows the same sequence as the full report; each section contains a brief outline of key findings, followed by a complete list of recommendations. For more detailed descriptions of projects, activities and findings, please refer to the corresponding chapter in the Final Report.

Chapter II - Community Involvement

Role of Traditional Knowledge (TK)

Several TK projects were carried out to gather information from Délı̨nę elders and community members who lived and worked at Port Radium and transportation route sites. This information supported other human health and environmental studies. In particular, information about employment and land use during the mining period was critical in the reconstruction of historical radiation exposures and was unavailable through other sources.

A team of community researchers underwent extensive training to do the fieldwork for these projects, in order to ensure that collected data was recorded, translated and transcribed accurately. TK studies were very effective in involving community members as active participants in the CDUT research process.

Recommendations:

1. TK should be incorporated in to the implementation of CDUT recommendations, such as the design of a site remediation and long-term monitoring plan and continued healing activities.
2. Given the development of community capacity around TK research, it is recommended that the community consider other areas that would benefit from TK research (e.g. self-government, resource management, etc.).

Capacity-Building

The capacity-building that took place during Action Plan implementation represents a major achievement of the CDUT. Thirty-two Déline community members were employed at various times and in various capacities by the CDUT.

Although long-term employment was most effective in developing skills and generating commitment among employees, project-based and part-time employment maximized the number of community members who were involved in the project overall. Community based research and activities (TK, communications) provided more opportunities for community involvement and capacity development than scientific studies. Lack of formal accreditation for training and skill development was recognized as a weakness of capacity-building efforts.

Recommendations:

3. Training initiatives should be included in remediation and long-term monitoring of the Port Radium site.
4. Local students should be encouraged and provided with financial support to pursue formal education in areas related to environmental management, such as environmental science or engineering, so that in the future the community can have its own expertise in these areas. Scientists and developers who visit the community should talk to students about the employment opportunities and educational requirements associated with their work.

Communications

The CDUT initiated productive communication between Déline and Canada on issues related to the Port Radium mine. The CDUT recognized the importance of communications to its mandate, and used a variety of methods to keep Déline community members updated on CDUT research and activities.

According to a survey of Déline community members, the most effective methods of communication about CDUT research and activities were (in order): workshops and public events, the Déline Uranium Team (DUT) newsletter and word of mouth (the DUT refers to staff employed by Déline First Nation for the CDUT, based in the community of Déline). CDUT staff learned that accurate translation is very important when discussing scientific and technical projects, and that different age groups require different methods of communications.

Recommendations:

5. For future public presentations, translators/fieldworkers should be given adequate preparation time to ensure accurate translation, especially of technical and scientific terms.
6. When conducting long-term research in the future that involves or is of great significance to the community, it is recommended that a community liaison person is based in Déline to maximize community involvement in the project and assist in the communication of research results.
7. Communications activities should continue during the implementation of CDUT recommendations (e.g. site remediation, development of community healing programs).

Information Collection and Management

A large volume of information was collected by the CDUT during four years of Action Plan implementation. The hiring and training of a full-time data manager in Déline was necessary for efficient organization and easy local access to the material. The photo database, library, audio-video collection and oral history collection comprise an important archive about Port Radium and related topics for the community of Délı̨nę.

Recommendations:

8. Délı̨nę is currently working toward the establishment of a permanent research facility in the community to promote and manage scientific and TK research conducted in Délı̨nę and surrounding districts ("Délı̨nę Knowledge Centre", or DKC). Such a facility would be the ideal place to house Port Radium related materials and information collected through CDUT projects in the long term. Therefore, the CDUT recommends that the DKC initiative should be considered and supported in planning follow-up activities to the Final Report (e.g. site remediation and long-term monitoring, community healing programs).
9. For the short term, all materials, information and office equipment currently held in the DUT office should pass to the Délı̨nę First Nation (DFN). The DFN should consider how collections may be used in the community, and what human resources would be required to facilitate these uses.

Chapter III - Fact Finder

Part of the mandate given by the Action Plan was to gather all known information about the mine and its operations. A team of consultants was selected by the CDUT to carry out this project. There are no recommendations specifically associated with this project; the findings listed below have been selected or developed from the Fact Finder report and are considered most pertinent to the CDUT mandate. Please refer to Chapter 3 for a complete list of study findings.

CDUT Findings:

- No employment records were available for Délı̨nę Dene people involved with ore transport or other activities to support the mine at Port Radium. Information about working conditions and employment histories was largely gathered from oral histories.
- No Délı̨nę Dene people were ever directly employed by Eldorado at the Port Radium mine or mill.
- Oral histories contain many testimonies of exposure to "yellow powder". This was originally assumed to be uranium concentrate (yellowcake), but further research indicated that it was most likely sulfur powder, which was shipped to the mine site from 1950-1960 for use in the acid leach plant. Yellowcake was produced at the Port Radium site from 1958-60 only, and was shipped out by air in metal drums. This finding had implications for the dose reconstruction and epidemiology projects because it means that Délı̨nę Dene people were exposed to sulfur powder, not yellowcake.
- There is no evidence that Dene people were treated differently than non-Dene with respect to occupational health and safety standards.
- There is no evidence that Dene or non-Dene transportation route workers were informed about the potential hazards of the products they were handling.
- During the uranium mining period, knowledge of radiation health effects, particularly with respect to low-level exposure and long-term effects, was not very advanced and as a result Canadian and international radiation protection standards were much lower than they are today.
- During this period, health and safety standards were implemented for certain occupations that involved

radiation exposure, particularly radium refining (c.1930) and radium/uranium mining and milling (c.1950). Also, uranium ore became subject to federal regulations governing the safe transport of radioactive materials in 1946. However, at that time, none of these standards or regulations was applicable to workers involved in the transport of uranium ore.

- The Port Radium uranium mine was generally in compliance with regulations relevant to the mining and milling of uranium.
- Early theories about the health effects of radiation exposure focused on short-term, acute effects. A major advancement in the understanding of long-term radiation health effects occurred around the time of the closure of the Port Radium uranium mine in 1960.

Chapter IV - Health

Human Health Studies

A variety of human health studies were carried out to assess current and historical impacts of Port Radium on the health of the Délı̨nę community. Some study findings also pertain to overall health and health care.

The community health needs assessment identified a number of broad organizational and service delivery issues, including insufficient community participation and cultural sensitivity in the development and delivery of health policies and programs. Consultants also noted that health promotion activities and disease management services were minimal. Concerns about inadequate staffing at the health centre were frequently expressed by community members. A key finding of the community health profile was that the overall cancer rates for Délı̨nę are not statistically significantly different from the Northwest Territories (NWT). However researchers acknowledged that cancer statistics should be interpreted cautiously because of gaps in the NWT cancer registry prior to 1990 and the small populations in both Délı̨nę and the NWT. Despite this finding, community-based health studies determined that cancer is the predominant health concern in Délı̨ne. Many community members feel that cancer services in Délı̨ne, including detection, treatment and support services, are seriously deficient.

Community-based health studies demonstrated that fear and anxiety about the human health and environmental impacts of Port Radium have severely affected the community of Délı̨nę. Analysis of collected oral histories showed that the majority of significant past and present health problems within the community continue to be strongly associated with perceived environmental threats. The perceptual link between exposure to mining activities and illness and death has affected people's sense of harmony with nature, which is a crucial component of their cultural identity.

The psychologist who conducted mental health assessments in the community concluded that the psychological impacts of Port Radium have resulted in low morale and diminished community and personal identity. She also found that many elders suffered from feelings of isolation and depression, often because illness or disability had restricted their quality of life, and thus were not able to fulfill their role as advisors and leaders to younger people. These factors, exacerbated by the premature loss of many elders, have led to a loss of sense of community in Délı̨ne.

A detailed dose reconstruction was carried out to estimate historical radiation exposures to ore transport workers and their families. The average dose estimated for ore transport workers was 76mSv/y. Radiation doses to family members who lived near Port Radium or along the transportation route were estimated to be similar in magnitude to background doses. The epidemiology feasibility study predicted that theoretically, due to the radiation doses calculated in the dose reconstruction, 1 or 2 cancer deaths would be expected among the 35 ore transport workers, in addition to the 9 or 10 cancer deaths that would "normally" be expected in a similar, non-exposed group of 35 people. A full epidemiology study of former ore transport workers was not recommended for the following reasons: it would be difficult to establish an accurate baseline reference rate; the predicted number of excess cancer deaths due to radiation exposure is relatively small and; the small sample size (35) limits the likelihood of a statistically significant outcome.

It is not possible to know for certain if the illness or death of any individual ore carrier was directly caused by radiation exposure, due to the small number of predicted excess cancers and the presence of other risk factors. The risk of radiation-related cancer to family members is small compared to the increased risk to ore carriers, and for both groups the risk of radiation-related cancers is not much greater than "normal" cancer risk.

Recommendations:

10. It is recommended that the results of CDUT health studies should be used in the development of a health care system that is based in the region and responds to local needs.
11. It is recommended that the Délı̨nę Health Centre should be staffed continuously at a level that meets community needs.
12. Nurses and physicians working in Délı̨nę should be made aware of factors that may be unique to the community, such as cultural aspects and prevailing physical and mental health problems. It is recommended that health care staff be required to read the educational material on mining-related health impacts that was prepared for the CDUT.
13. It is recommended that mental health screening programs and long-term mental health services, particularly focusing on bereavement, depression and addictions, should be implemented within the existing framework of health services in the community. Community access to a qualified mental health therapist should be improved, and service providers in this area should receive cultural awareness training.
14. Findings contained in this report directly address the community's concerns about Port Radium-related issues (i.e. cancer, environmental contamination, mine site clean-up). Therefore it is recommended that every effort should be made to ensure that this material has been thoroughly and effectively communicated to Délı̨nę community members. Information that has been gathered by the CDUT should be used to develop other communications and educational materials for use in the community.
15. It is recommended that the seniors' home in Délı̨nę be reopened to provide health and social care programs. These programs should be established with input from local people and attention to cultural values.

Recommended programs include:

- elderly care
- chronic disease management
- palliative care
- respite care, day services and support
- traditional healing
- social and public events

16. Educational materials should be provided to the public on types of cancer, stages of diagnosis, treatment options and treatment provided within the community.
17. The Canadian Cancer Control Strategy (CCCS) contains guidelines for cancer prevention, surveillance, detection, treatment and follow-up. The GNWT and other authorities should work with Délı̨nę in adapting and applying the CCCS to meet community needs, and to serve as a model for other communities.

Community Healing

The psychological and social impacts of Port Radium have been particularly damaging to the community of Délı̨nę. To address these impacts, the CDUT conducted community healing programs in Délı̨nę.

Healing activities that focused on the affirmation of Dene culture and identity (e.g. traditional activities, healing journeys) were very successful. These healing strategies had the greatest influence on the Délı̨nę community and helped people to begin regaining collective feelings of confidence and optimism. Healing journeys on the land were particularly effective in beginning to restore people's security in their environment and fostering social cohesion.

People who attended the workshops and public information sessions were eager to learn more about mental and physical health issues. The provision of educational opportunities allowed people to gain insights into their own health and wellbeing.

For many years, the people of Délı̨nę did not receive appropriate information about the potential risks of their exposure to mine-related contaminants, which compounded the anxiety experienced by community members. The mistrust of government officials and scientists that developed over the years was expressed many times during healing activities and public meetings. The desire for public recognition from the federal government for the contribution of Délı̨nę Dene people to the Port Radium mine, and the legacy that this involvement has had on the community, has been strongly expressed by community members. It appears that this would be a potentially significant contributor to the healing process.

Recommendations:

18. It is recommended that the DFN and Canadian governments should decide on and undertake a mutually agreeable form of public recognition of the contribution of Délı̨ne Dene people to the Port Radium uranium mine, and the legacy of this experience for the community of Délı̨ne.
19. The remediation of the Port Radium mine site and the sites along the Northern Transportation Route is important for the psychological healing of community members and should be undertaken as soon as possible.
20. The community's role in future man-made activities and development in and around the waters of Great Bear Lake should be maximized. Increased community participation in environmental management and

policy decisions will ensure that traditional and local knowledge are enshrined in resource management practices, and will ensure that the people of Délı̨nę play a central role in the stewardship of their natural environment.

21. The CDUT recommends the continued development and implementation of community programs and activities to affirm cultural identity and foster social cohesion between generations. These programs should include the enhancement of current on-the-land activities and the development of other culturally based activities that will accommodate the needs and interests of all age groups. Funding and resources for these programs should be sought from appropriate federal or territorial health and social service agencies.

Chapter V - Environmental Studies

Environmental studies were conducted to determine the impacts of the Port Radium mine site on people and the environment. Based on the findings of these studies, a remediation plan for the Port Radium site was developed. Key findings from the environmental studies program are presented below, followed by a summary of the remediation plan and overall recommendations. Please refer to the *Port Radium Remediation Plan* for a detailed description of planned cleanup activities.

Study findings indicate that the site has had, and continues to have, impacts on the water quality on the mine site and in Great Bear Lake immediately adjacent to the site. Great Bear Lake water samples taken around the site show that in general, the closer the sample was taken to the shore, the higher the metal concentrations. However, the metal and radionuclide levels in Great Bear Lake adjacent to the site are below levels that could adversely affect fish or any other aquatic life. Samples taken from areas not expected to be impacted by the mine site show that the overall water quality in Great Bear Lake is good.

On the mine site, the water contained within the buried tailings is the most contaminated, yet fairly inaccessible to animals and immobile. The surface water and runoff on site, which is intermittent and seasonal, is less contaminated, but well above guidelines for some metals.

Mapping of the lakebed around Port Radium identified several general areas where tailings are located in the immediate vicinity of the mine site, as well as in a trough approximately 500 metres northwest of Murphy Bay which appears to be a repository for tailings. The regional and detailed bathymetric survey indicates that the tailings are located in the deeper parts of Great Bear Lake near the site from which they are extremely unlikely to move.

The results of the soil sampling program show elevated metal levels in mine-impacted areas. Soil samples showed significant differences between the tailings/waste rock sites and non-impacted sites, particularly for uranium, chromium and arsenic. Radionuclides in soils showed the same general spatial trends that were found with metals. Metal concentrations in plants followed similar trends to soils, with the highest concentrations found in the Cobalt Channel drainage area.

The environmental radiation findings showed that gamma radiation is the largest contributor to radiation doses at the mine site. Air quality at the Port

Radium site is relatively clean and not impacted by local site conditions. The analysis confirms that dust levels are extremely low and not an issue of concern for the site.

The ecological risk assessment for radiation exposures from internal and external doses found that the radionuclides present at the Port Radium mine site are not a cause for concern from an ecological perspective.

Arsenic, copper and uranium levels in water overlying tailings in the McDonough Lake Tailings Containment Area (TCA) were greater than the toxicity benchmarks for some aquatic life. It should be noted that there is no outflow from McDonough Lake into Great Bear Lake so the effects on aquatic life, if any, are restricted to the McDonough Lake TCA.

Arsenic was identified as a potential issue for three animals (fox, duck and hare). The primary exposure pathways were attributed to consumption of contaminated vegetation and associated soil. Elevated concentrations of cobalt and uranium in the localized areas of the Cobalt drainage, Murphy Tailings and the exposed tailings near Murphy Bay are a cause for potential concern for local species such as the hare.

Even though caribou would only be present at the site for a minimal time period, they were included in the assessment as they are an important source of food for Dene people. The assessment determined that there are no adverse impacts to caribou using the site.

Scenarios were developed for hypothetical land use situations for the assessment of potential health risks to people from Déline, or others, who visit the site.

To this end, the following situations were considered:

- Campers (adult and child) on site for three months per year;
- Inspectors present on site two days per year;
- Fisherman/hunter at the site for one week per year; and
- Fishing lodge worker on site for two months per year.

For radiation exposure, the assessment showed that a seasonal camper (the highest exposure scenario) would not exceed the guidelines established by the Canadian Nuclear Safety Commission (CNSC) for the protection of human health. Predicted metals intakes were within the acceptable intake levels for all contaminants of potential concern. Therefore, it has been concluded that the presence of radionuclides and metals at the Port Radium mine site are not a cause for concern under the exposure scenarios described above for campers, fishermen or others, who might occasionally visit the site.

Results of this study agree with other studies from around Great Bear Lake and the NWT and show that traditional foods are safe to eat. Sampling of traditional foods and the risk assessment study both showed that it is safe for people to consume traditional foods taken from Port Radium, and safe to drink water taken from Great Bear Lake at Port Radium.

Levels of radiation exposure through a diet of traditional foods in Délı̨nę is the same as other areas of the NWT and at levels much lower than what could cause human health effects. There are low levels of natural and man-made radionuclides in all food items. Both radium-226 and uranium, two of the major concerns at Port Radium, are at very low levels in all samples from mammals, birds and fish.

Recommendations:

22. The Port Radium site should be remediated as soon as possible. The CDUT developed the *Remediation Plan for Port Radium*, which should be implemented. The Remediation Plan represents the CDUT's preferred options for remediation at the site. The table below summarizes the CDUT's preferred remediation activities at the site.
23. Remediation of Port Radium should involve Délįne people. Employment, training, capacity building and procurement should be maximized where possible.
24. All remediation work at Port Radium must be done safely, with appropriate training and safety planning.
25. There should be long-term monitoring at Port Radium. A long-term monitoring plan is a component of the Remediation Plan and should be implemented.
26. Traditional foods from Great Bear Lake should be monitored periodically to confirm that they continue to be safe to eat.

Summary of CDUT Preferred Remediation Option

	Site Issues	Preferred Remediation Method
Access to the Underground	Mine openings	Vertical surface openings will be sealed with a concrete cap/or plugged, horizontal openings will be rock sealed. Where such is not possible the area will be fenced.
Site Infrastructure and Potential Physical Hazards	Concrete Foundations, Walls and Slabs	Where accessible, vertical structures will be demolished and slabs on grade will be covered. All other remaining structures will be left as they are to naturally erode.
	Dock Areas	Docking areas will be removed and left with a more stable, natural slope. Potential sediment impacts to the water will be minimized during cleanup.
	Roads	Roads will be left to naturally re-vegetate. Where radiation levels are above 250µR/hr they will be covered.
	Airstrip	No remediation of the airstrip is planned.
	Miscellaneous Equipment	Drain engine fuels and dispose of equipment on site unless equipment is valuable and can be easily removed from site in a safe manner.
	Miscellaneous Scrap	Pick up and dispose of on site.
	Wood Frame Structures	All structures (Cross Fault Lake Head-frame, wooden sheds, cabins and the wooden "Mountie Cabin") will be demolished.

	Site Issues	Preferred Remediation Method
Contaminated Areas, Chemical and Radiological Concerns	Site Drainage	Protect small terrestrial animals from ingesting metals by putting a layer of coarse rock over identified surface drainage routes and removing all exposed tailings where water drainage flows through. Monitor as part of long-term monitoring program.
	Elevated Gamma Radiation	Cover accessible areas with approximately 0.5m of native cover material where gamma radiation levels exceed 250µR/h. The cover will reduce these areas to below 100µR/h. Therefore, the maximum gamma level in accessible areas will be less than 250µR/h.
	McDonough Lake TCA	Monitor water level and quality as part of long-term monitoring plan.
	Silver Point TCA	Fill in surface ponds with tailings or native material and cover entire TCA with a clay/bentonite liner which will eliminate slumping and reduce metal loading in Great Bear Lake. Native fill and a protective cap will be placed above the impermeable liner.
	Murphy TCA	Relocate exposed tailings into local depression and cover with native fill materials.
	Radium (North and South) TCAs	Tailings are stable, vegetation is clean and radiation levels are at background. No physical remedial actions required however, monitoring will continue to ensure conditions remain the same.
	Murphy Bay Hillside Exposed Tailings	Difficult to access area. Will be left undisturbed and flat lying tailings will be covered with native cover material.
	West Adit/ Plant Area Exposed Tailings	Excavate and dispose of exposed tailings in a containment area such as: Murphy, Silver Point or McDonough TCA.
	Tailings in Great Bear Lake	Leave undisturbed and continue monitoring water quality and health of fish
	Fuel Storage Areas	Will be covered or remain covered by rock.
	Hazardous Materials	If encountered, remove off-site for disposal.

Ékanį́ Gorukw'ı Gogha Hə́ Ékagúut'é

Northwest Terrıtorıes ekúhdə́ Sahtu báe Sǫ́bak'ə́ sį́į kwəh ka nę yíı ghalagıdá sį́į 1931 gots'ę 1960 gots'ę́ godaadénįtǫ́. Sahtu báe denewá kə nádə́ sį́į asį́į łǫ t'á gots'ę́ nágįdí hə́ gogha k'ola kwəh yúwə́ ʔéhną́ xageréla ǫt'e. 1980's ekúu Délįnę gots'ę dene kə sį́į eyı kwəh radıum hə́ uranıum xageréla gokǫ́ht'é dene ts'ılį hə́ nę k'ə tségoįwə kegogį́hʔǫ. Kǫ́tah sį́į denewá béré hə́ nę k'ə tségoįwe sį́į ghǫ déedegeredí t'á gogha dzá ǫt'e. Radıum hə́ uranıum hə́ hekǫ́ht'é dene kǫ́tah cancer nátse at'į genįwę.

1999 ekúu Délįnę gots'ę k'áowə kə hə́ federal government kə hə́ gogháré Canada Délįnę Uranıum Table (CDUT) hohłə́ sį́į Sǫ́bak'ə́ gokǫ́ht'é eyáa hə́ nę k'ə́ dánį́ gohə́ dzá góʔǫ sį́į ghǫ gok'ə ghálagudá gogha kágoaya. 2000 ekúu kǫ́tah gots'ę dene kə hə́ goną́ą dene kə asį́į k'ə́ déhkw'ı kə sį́į tae xae gogha Actıon plan k'ə ełehə́ ghálagįdá; eyıı ts'ę godı hohłə́ dahxáré sį́į ayíı gok'ə ghálagudá hə́ ayíı dánį́ yeghálgudá, eyı beghǫ enagǫ́t'e nįdé, godı t'á kǫ́tah gots'ę dene kə hə́ federal government keogerįhshǫ nįdé begháré Sǫ́bak'ə́ nę yíı ghálagįdá hə́ eyáa dahk'ə́ hə́ edegha dágude gogha nǫde godı hohłə́ gha góʔǫ.

Edıre CDUT nǫde goghǫ sénédarę́t'ǫ sį́į Actıon Plan dágúut'é gedı k'ə k'énagogeʔa sį́į ghǫ areyǫnę́ eratł'e ǫt'e, areyǫnę́ dánį́ dúle dene hə́ sá goderewı gonįwę hə́ dágut'é gedı k'ə godı hohłé sį́į ghǫ eratł'é. Godı datł'e sį́į eyı nǫde godı hohłə́ sį́į k'áhjįnę hę́ht'e ǫt'e; łə́ə t'į́ dágǫ́ht'e sį́į, ékanį́ nįdé dánį́ bek'ə gorukw'ı gonįwę kola beghá gok'eréhtł'é. Suré ełaot'e beghǫ ayíı t'á kek'ə egháolaúdá goghǫ keorúyá nahwhę nįdé eyıı nǫde godı t'á sénedarę́t'ǫ hałé eyı begháehda.

Chapter II - Kǫ́tah Gohə́ Dene

Náowerė́ Goʔeghálaídá

Délįnę gots'ę ʔǫhda kə hə́ amį́į Sǫ́bakə́ náįdə́ kə hə́, ǫdé kwəh déhya eyı k'ola náįdə́ ts'ę edıre dene náowerė́ gok'ə ghálageda gılį sį́į godı chegelə k'ə ghálagįdá ǫt'e. Eyáa gǫ́hłį dahk'ə́ hə́ nę k'ə dágǫ́ht'e sį́į edıre godı chegéla dahxáré gok'ə ghálagįdá hə́ bets'ę godı hohłə́. Ekúhdə́ dene kə eghálaįdá hə́ ǫde areyǫnę́ nę yíı eghálagįdá hə́ edıre radıatıon t'á ékagújá haredı sį́į areyǫnę́ begodı ełaot'e chegelə gogha kéoredíle.

Kǫ́tah gots'ę dene kə, dene hə́ eghálagudá gogha gogháonétę eyı sį́į godı chegelə areyǫnę́ tł'uh k'ə agehʔį hə́ suré nezǫ godı łetagehtį sį́į areyǫnę́ geretł'é k'ola gogha gok'ə ghálagįdá. DUT eghálaeda kə sį́į edıre CDUT ayíı gok'ə ghálageda gha nįdé edıre Dene Náowerė́ godahxáré kǫ́tah gots'ę dene kə dene hə́ goget'į sį́į suré got'áoréʔa keogerįhshǫ.

Ékagúut'é Gogha Godı Hohłə́:

1. Actıon Plan ghǫ godı hohłə́, eyı sį́į dánį́ ségots'ule hə́ hįdó dáréwha gots'ę́ gok'ə k'énagenuhta hə́ hįdó nįdé dánį́ edıre eyáa hə́ nats'ujú dahk'ə́ t'á dene ts'ę́ nágudí gogha sį́į dene náowerė́ láanį́ t'á gok'ə gohə́ ghálagudá.

2. Dene Náoweré t'á gohə́ gok'ə eghálageda dahxáré kǫ́tah gots'ę dene kə sį́ į hį̨ʔǫ́ (edegha government ts'ulə́ hə́ nę k'ə dágot'į k'egukw'e) eyı t'á dene hə́ dúle gok'ə ghálaguda.

Ékagúʔǫ́ Hesénégǫ́t'ǫ

CDUT eyı Actıon Plan dánį́ bek'ə ghoghálaguda gedı t'á gohə́ alé kéogenį́hwhe t'á eyı dahxáré dánį́ gogeruʔá gogha edets'ę́ k'áogeruwə t'á kéogogenį́hwhe ǫt'e. Actıon plan k'ə goghálageda t'á CDUT godahxáré kǫ́tah gots'ę dene táonǫʔǫ́ nákə gohə́ eghálaįdá ǫté.

Amį́į whá gohə́ eghálagedá sį́į eyıá godahxáré asį́į łǫ t'á gogeréʔǫ t'á k'egoįkw'e, gots'ę ayíı k'ə eghálageda sį́į dene ʔéhdáa łáhtare gohə́ agat'į k'ola suré gogh//áré asį́į łǫ eghálagįdá goghǫ enagįt'e. Ayíı gok'ə eghálagudá sį́į k'ola goghǫ kǫ́tah godı t'á dene gotah nageredá nįdé eyıá suré dene kə gohə́ eghálageda kúlú scıentıfıc ékanį́ k'ə goghálageda nįdé, dene łǫ gohə́ eghálaeda láagǫ́ht'éle hə́ kéoredíle. Łǫ t'á goghágonétę sǫ́ǫnį kúlú goʔeghálaídá goghǫ ʔerįhtł'é goghǫ́yále.

Ékagúut'é Gogha Godı Hohłə́:

3. Nę tseágówə k'ə sénagogehʔį hə́ hįdó dáréhwa gots'ę́ gok'ə k'énagenuhta sį́į goghǫ k'ola gogháogenéhtę nįdé nezǫ.
4. Kǫ́tah gots'ę ts'ǫ́dane kə sǫ́ba gogha néts'ulə hə́ gogha nezǫ́ négots'énįʔǫ t'á edıre nę k'ə dágǫ́ht'e t'á nezǫ bek'ə goghálats'udá gogha scıence le nįdé engıneerıng gįlį gogha gogháonetę nįdé nezǫ gha, ékanį́ nįdé hįdó dene kǫ́tah gogha got'áoréʔá gha góʔǫ.

Kədə

CDUT kə sį́į Délįnę got'įnę kə hə́ Canada gogha edıre Sǫ́bak'ə́ kweh kagoghálagįdá sį́į goghǫ godı t'á suré nezǫ́ ełehə́ goghálagudá gogha sédagogį́lá ǫt'e. CDUT sį́į Actıon Plan goghǫ ayíı t'á k'egokw'e sį́į dene keogerįhshǫ nįdé nezǫ hagenįwę t'á k'ola areyǫnę́ ékanį́ dene hə́ gok'ə goghálageda.

Délįnę gots'ę dene kə dagogerįhkə gots'ę, CDUT ayíı t'á gok'ə goghálageda goghǫ dene keorįhshǫ sį́į la, edıre workshop agehʔį hə́ goghǫ łénagehdə́ hə́ ʔerįhtł'é t'á kola gots'ę dene yeghǫ łéagogíde t'á dágot'į sį́į goghǫ dene keorįhshǫ. DUT eghálageda gįlį sį́į edıre scıentıfıc hə́ asį́į gonįchá gogha łetats'ehtę nįdé suré gha góʔǫ ghǫ keogerįhshǫ gots'ę dene areyǫnę́ ełę́ht'é godı híhchu ǫt'éle.

Ékagúut'é Gogha Godı Hohłə́:

5. Hįdó nįdé dene kə asį́į got'áoréʔá ghǫ łénagehdə́ nįdé edıre łetahtį gįlį hə́ godı chelə gįlį sį́į suré nezǫ́ łetaguhtį gogha gohé gok'ə goghálatséda nįdé nezǫ gha, edıre scıentıfıc ékanį́į gogha gots'ede nįde kéoredı ǫt'éle.
6. Hįdó nįdé k'ola asį́į got'áoréʔa gogha gok'ə goghálagudá nįdé amį́į gogha henédegénutł'é sį́į areyǫnę́ ayíı t'á dágut'į́ k'egokw'ę sį́į goghǫ godı k'énalə hįlį gha ǫt'e t'á eyıı dene sį́į Délįnę nágwə gots'ę eghálaudá gogha godı nátse weʔǫ nįdé.
7. Actıon Plan gogha godı hohłə́ sį́į gok'ə eghálageda hégǫ́ht'é edıre (nę k'ə dánį́ k'egokw'e hə́ kǫ́tah dene kə naujú) gogha gohə́ eghálageda sį́į k'ále k'egokw'e nįdé nezǫ gha.

Godı Chegéla Hǝ́ Bek'é Godí

Hı̨dí dı̨ı̨ xae gots'ę edıre Actıon Plan gok'ǝ gohálageda sı̨́ı̨ gogha suré godı łǫ chegéla ǫt'e. Data manager gha dene łǝ́ǝ henéedets'énı̨tł'é sı̨́ı̨ suré got'áoréʔa, eyıı godahxáré asį́ı̨ gok'ǝ gohálatséda nı̨dé goʔǫ́ náotı̨́le. Edıre Sǫ́bak'ǝ́ hǝ́ edıre kǫ́tah dene kǝ amı̨́ı̨ eyı aıt'ı̨́ sı̨́ı̨ goghǫ, ʔerı̨htł'échu k'égehła, ʔerı̨htł'é gehła gots'ę goghǫ k'ola areyǫnę́ tłúh yágı̨́htsı̨ sı̨́ı̨ bet'áoréʔá ǫt'e.

Ékagúut'é Gogha Godı Hohłǝ́:

8. Hı̨dú nı̨dé Délı̨nę hǝ́ gots'ę Sahtú kǫ́ káyúurı̨́ı̨la gogha got'áoréʔa ǫ́t'e t'á asį́ı̨ łǫ k'égudí hǝ́ scıentıfıc hǝ́ wáa Dene Náoweré goghǫ godı chegulǝ gogha ékanı̨́ godahk'ǝ́ láanı̨ négots'énǫʔǫ́ nı̨dé genı̨wę gogha gok'ǝ gohálageda. Ékanı̨́ kǫ́ láanı̨ dene gha góʔǫ nı̨dé edıre Sǫ́bak'ǝ́ goghǫ areyǫnę́ CDUT gohálagı̨dá sı̨́ı̨ eyı łánı̨ wela gha suré got'áoréʔá. Eyıı t'á ghǫ CDUT kǝ sı̨́ı̨ edıre Dene Náoweré kǫ́ láanı̨ gúuʔǫ́ gogha godı nátse hohłǝ́ k'ǝ gohálagı̨dá sı̨́ı̨ nǫde goghǫ łánagehdǝ́ nı̨dé goghǫ gogude są́, (edıre nę k'ǝ ségogı̨́lá k'ǝ k'énagenehta hǝ́ nats'ejú hǝ́ nı̨dé)
9. Hı̨dú gogha gots'ę areyǫnę́ asį́ı̨ DUT eghálageda godahk'ǝ́ asį́ı̨ wela sı̨́ı̨ Délı̨nę Fırst Natıon gots'ę́ łáhtareyǝ gha ǫt'e. DFN sı̨́ı̨ edıre areyǫnę́ sı̨́ı̨ gots'ę́ łáhtaréhya sı̨́ı̨ kǫ́tah dánı̨́ yet'áoruhwhí gots'ę ayíı k'ola t'á got'áoréʔá gonı̨wę sı̨́ı̨ k'ola kǫ́tah gogha gehłá nı̨dé nezǫ.

Chapter III -
Dágoat'į́ Goghǫ Hegút'ǫ

Actıon Plan godahxáré edıre goʔeghálaídá łóə sį́į la edıre nę yíı eghálagįdá sį́į areyįnę́ goghǫ godı gots'ę gonáą asį́į areyǫnę́ chegéla; CDUT sį́į dene kágįla t'á godahxáré ayíı k'ə k'énagukw'e sį́į kéonį́wə. Gok'ə oghálageda sį́į godı hohłə́ t'á ekanį́ bek'ə k'egokw'e ǫt'éle; areyǫnę́ hįyo gok'eréhtł'é sį́į beghǫ godı ékanį́į chéhya gokǫ́ht'é goghǫ ʔeratł'é ǫt'e, CDUT ékanį́ got'áoréʔa genįwę k'ə k'egoįkw'e. Chapter 3 k'ə k'ola ayíı hegút'ǫ sį́į ka begháahda.

CDUT Hegút'ǫ:

- Sǫ́bak'ə́ nę yíı kwəh ka oghálagįdá hə́ ǫdéhyə́ kwəh xaréhya goghǫ Délįnę gots'ę dene kə amį́į ekǫ́ eghálagįdá sį́į goghǫ ʔerįhtł'é asį́ welále gedı. Goghǫ gots'ede t'á zǫ amį́į areyǫnę́ ekǫ́ dánį́ hə́ ǫde eghálagįdá gots'ę sį́į k'áhjįnę areyǫnę́ goghǫ godı chegéla.
- Sǫ́bak'ə́ nę yíı oghálahda gógedı t'á Délįnę gots'ę dene kə eyı nę yíı eghálaįdá ǫt'éle.
- ''Kwəh dekoe'' gedı sį́į k'áhjįnę dene areyǫnę́ yeghǫ goįde. Ale sį́į eyı kwəh díıkǫ́nę́ ǫté ts'enįwę haįlé gotł'áą edıre sulfurlə́ ǫt'e nǫ́, eyı sį́į 1950 gots'ę 1960 gots'ę́ ekǫ́ nę yíı kwəh kágelə tah yet'á yeghálagudá gogha ekǫ́ sulfurlə́ déhya ǫt'e. 1958 gots'ę1960 k'énahta ekúu Sǫ́bak'ə́ eyı kwəhdíıkǫ́nę́ sį́į lébaré kə́ wetł'ı hə́ ʔelágenet'a t'á zǫ xaréhya. Ékanį́į godı hegút'ǫ gháré edıre eyáa ékanį t'á gok'ə goghálageda gha haįlé Délįnę gots'ę dene kə eyı sulfurlə́ hə́ zǫ eghálagįdá gots'ę kwəhdíıkǫ́nę́ hə́ eghálagįdá ǫt'éle.
- Denewá kə kárаʔa hə́ gots'ę mǫ́la kə hə́ ełek'éch'a gots'ę́ k'énagoįkw'ę t'á ékagǫ́ht'e gedı t'á godı hugút'ǫ ǫt'éle.
- Denewá kə hə́ mǫ́la kə hə́ ǫdéhyə́ areyǫnę́ asį́į xageréla sį́į béonejį ǫt'e t'á ékanį́ gógedí t'á goghǫ godı hegút'ǫ ǫt'éle.
- Nę yíı uranıum ka goghálagįdá ekúu, kwəhdíıkǫ́nę́ sį́į goʔǫ́ nátse aįt'éle hə́ whá gorewə tł'áa nįdé zǫ ékanį́ ékagǫ́hté gedı gogha ekúu Canadıan standards oghárе́ ékanį́ k'e k'énagenehta eyı dahxáré suré łǫ́le gedı, hįdúhdzene goakw'e gots'ę suré nátséle.
- Ekúhnį́į k'ola edıre eyáa godahk'ə́ hə́ kwəhdíıkǫ́nę́ hə́ eghálageda sį́į gohə́ nezǫ́ egúut'é gogha areyǫnę́ kéogehdı, eyı radıum ka kwəh nágerede dahk'ə́ (c.1930) gots'ę kwəhdíıkǫ́nę́ hə́ uranıum ka nę yíı goghálagįdá (c.1950). 1946 ekúu uranıum k'ola xagerelə ekúu federal ʔeʔá dahxáré k'egokw'e eyıı sį́į bedíıkǫ́nę́ dzá aode ch'á suré gok'ə k'énagenįhta. Edıre ʔeʔa guıle kúlú amį́į eyıı ékanį́į areyǫnę́ xáréla kə sį́į ʔeʔa ékanį́ gedı t'á k'egoįkw'e ǫt'éle.
- Sǫ́bak'ə́ whanę ékanį́ uranıum ka nę yíı goghálagudá hə́ ékanį́ xaruyə gedı k'ə ékanį́ goghálagįdá.
- Gowere sį́į edıre kwəhdíıkǫ́nę́ t'á eyáa kéoníwı sį́į dene hįdú whale eyáa béréhdı hə́ eyı kǫ́ht'é ajá gedı t'á zǫ dene ghágeda haįlé. Kúlú 1960 godáaretį́ gots'ę́ nǫwále ekúu k'onį́hdí dene eyáa ka yeghágeda gha nįdé whá gorewə kúlú eyı eyáa ka yeghágeda.

Chapter IV Eyáa Dahk'ə́

Eyáawá Kagok'énagenı̨hta

Hı̨dú eyáa at'ı̨ hə́ yahnı̨́ı̨ Sǫ́bak'ə́ dahxáré eyáa at'ı̨ gedı sı̨́ı̨ ékanı̨́ t'á agot'ı̨ keotgeruhshá gogha eyáawá ka Délı̨nę́ kǫ́tah dene hə́ goghálagı̨dá. Gots'ę goną́ą k'ola areyǫné eyáa dahk'ə́ k'ola goghágı̨dá.

Kǫ́tah eyáa ts'ı̨lı̨ dahk'ə́ areyǫné ayíı t'á dzá góʔǫ sı̨́ı̨ goghánagudá gogha got'áoréʔá, eyıı sı̨́ı̨ kǫ́tah godahxáré hə́ gonáowerwé dahxáré k'egokw'e nı̨dé k'ola got'áoréʔá gha góʔǫ. Ékanı̨́ kagóht'e gedı dahxáré edıre eyáawá ghǫ dene keoruhshá hə́ dánı̨́ eyáawá k'éts'enę aode gogha k'ola suré kétaorat'ı̨nę ghǫ keogerı̨hshǫ. Eyáa ts'ı̨lı̨kǫ́ k'ola
dene hə́ sá góʔǫ́le gots'ę dene whá eyı eghálagedále gedı ghǫ dene ło káyaʔı̨htı̨.

Kǫ́tah, eyáa kárаʔa kagoghágı̨dá gots'ę Délı̨nę cancer at'ı̨ hə́ goną́ą Northwest Terrıtorıes gogha gots'ę goʔǫ́ gok'éch'a ǫt'éle ghǫ keogerı̨hshǫ. Researchers kə sı̨́ı̨ cancer ghǫ dene keoruhshá nı̨dé gotí godı ʔehkw'ı t'á dene ts'ę́ kats'erudí gedı, eyı sı̨́ı̨ 1990 were cancer hə́ ékagǫ́ht'e t'á gedı ghǫ ʔerı̨htł'é welá kúlú Délı̨nę gots'ę hə́ goną́ą NWT gots'ę dene cancer t'á wíle sı̨́ı̨ łǫ́lıá zǫ gozí gok'eréhtł'é. Eyáa ghǫ ékagǫ́ht'e kegogı̨́hʔǫ kúlú Délı̨nę gots'ę dene kə sı̨́ı̨ cancer t'á eyıá suré agot'ı̨ hagenı̨wę. Cancer t'á Délı̨nę gots'ę dene ts'ę́ dúenı̨ʔále gedı, kút'í begút'ále, yeghǫ k'ola dene ghálagedále gots'ę dene ts'ę́ nádats'eredı láagǫ́ht'éle.

Kǫ́tah eyı eyáa dahk'ə́ gok'ə́ goghálagı̨dá gots'ę edıre Sǫ́bak'ə́ godahxáré ékanréhcha dene łǫ tsı̨́ı̨wə eyı sı̨́ı̨ beghárе́ dene kə nejı̨ láagı̨t'e k'e hə́ náadıgewə t'á k'ola dene tsíwı ghǫ keogı̨́hʔǫ. Kǫ́tah godı chéhya sı̨́ı̨ gogodí gháré yahnı̨́ı̨ hə́ hı̨dú goráwə́ sı̨́ı̨ edıre dánı̨́ tsı̨́gı̨hwhə dahxáré dene kə dechı̨tah aget'ı̨ gha gotí genejı̨ láagǫ́ht'e. Dene eyı eghálaı̨dá hə́ dene eyáa gı̨lé hə́ dene bet'á łǫ́də t'á ghǫ gotí dene dechı̨tah aget'ı̨ sı̨́ı̨ gogha horíla láagǫ́ht'e agújá, eyı sı̨́ı̨ denewá náowere ǫt'e kúlú eyı k'ola gotí dene ch'á negots'ríchú láagǫ́ht'e.

Eyıı psychologıst kǫ́tah dene kə ʔéhdáa goghaı̨dá gots'ę gohə́ ékagǫ́ht'e hadı sı̨́ı̨ eyıı Sǫ́bak'ə́ gokǫ́ht'é dene kə gotí gokǫ́tah gogha got'áoréʔále láanı̨́ hə́ gots'ę edeghǫ k'ola gonı̨́ nátse láanı̨́le, hadı. Gots'ę godaaréhcho dene ʔǫhdá kə náadıgewə hə́ whane genı̨wę t'á k'ola gotsíıgorewı, godaréhcho k'ola eyáa tsígohwhı t'á edenı̨́ k'ə́ edegha k'énagogeʔale, eyı ékanı̨́ gokǫ́ht'é ts'ǫ́dane kə ts'ę́ gogede gha sı̨́ı̨ gohə́ horíla láagǫ́ht'e. Dene ʔǫhdá kə łǫ dene xaréwə gokǫ́t'é gotí Délı̨nę dene dekǫ́détł'ı láagújá.

Gowere amı̨́ı̨ eyı kwəh xaréla kə hə́ góot'ı̨nę kə eyı náı̨də́ sı̨́ı̨ areyǫné radıatıon ghǫ kegogíhʔá kagohə́ eghálagı̨dá. Kwəh xaréla kə sı̨́ı̨ eyı náídíı łı̨nę gotah at'ı̨ sı̨́ı̨ la 76mSv/y ǫt'e. Amı̨́ı̨ kə Sǫ́bak'ə́ hə́ ǫdéhyə́ kwəh xayéhya eyı náı̨də́ kə sı̨́ı̨ edıre radıatıon at'ı̨ sı̨́ı̨ goʔǫ́ nátse ǫt'éle gots'ę hı̨ʔǫ́ ts'enahka areyǫné nę k'ə ékanı̨́ gǫ́hłı̨ ǫt'e. Edıré náedíıłı̨nę dene tah at'ı̨ ka gok'ə goghálagı̨da gokǫ́ht'é eyıı amı̨́ı̨ kə kwəh xaréla kə sı̨́ı̨ 16% ékanáréhtse zo̜ cancer agule só̜o̜nı̜ gho̜ keogı̜́hʔo̜. Eyı hə́ k'ola goʔó̜ dene nákə ekúhyə dúle cancer agole gha dúle gots'e̜ dene taono̜ʔó̜ so̜láe nı̜dé dúle dene k'áhjı̜ne̜ honéno̜ ekúhyə́ cancer t'á gowə́ gha dúle genı̜we̜. Edıre ékanı̜́ só̜o̜nı̜ genı̜we̜ k'ə o̜t'e t'á sure ʔehkwí ékagó̜ht'e tsédı gha kéoredí. Eyıı dahgháré k'ola edıre dene ékanéht'e cancer t'á wıle ts'edı sı̜́ı̜ suré dene łó̜lıa zo̜ wíle o̜t'e. Dene dánéht'e nádə́ goghárə́ ékanı̜́ o̜t'e gha kúlú dene gha gots'e̜ góʔó̜ dene ło̜ cancer t'a xaréwə o̜t'éle.

Amı̜́ı̜ kwəh xaréla ke sı̜́ı̜ ayíı eyáa t'á le nı̜dé cancer t'á gowíle sı̜́ı̜ keots'íhʔá gha asáanı̜le, kúlú gowere eyı dene kə sı̜́ı̜ goʔó̜ łó̜ geret'éle hə́ gonáa̜ ası̜́ı̜ cancerwá k'ola gó̜hłı̜ t'á sure ékanı̜́ agó̜ht'ı̜ ts'edı gha keórıdíle. Amı̜́ı̜ kə kwəh xaréla sı̜́ı̜ godaréhcho dúle gots'é̜ cancer nátse kúlú amı̜́ı̜ góot'ı̜ne̜ kə eyı gohə́ náı̜dé sı̜́ı̜ goʔó̜ gohə́ cancer nátse chóle gots'e̜ ʔó̜hła areyo̜né̜ geret'e gogha nı̜dé radıatıon dahxáré cancer agule sı̜́ı̜ goʔó̜ nátse o̜t'éle hə́ cancerwá t'ə́ agude hégó̜ht'e.

Ékagúut'é Gogha Godı Hohłə́:

10. CDUT eyáa dahk'ə́ gok'ə gohálagı̜dá sı̜́ı̜ godahxáré godı hohłə́ sı̜́ı̜ begháré edıre eyáa ts'ı̜lı̜ godahk'ə́ łáne̜ góʔo̜ ts'e̜ areyo̜né̜ dene ts'é̜ nádagerudí nı̜dé nezo̜.
11. Délı̜ne̜ eyáa ts'ı̜lı̜kó̜ k'ola dene eghálageda sı̜́ı̜ whá eyıı agı̜t'e t'á dene ts'é̜ nágudí k'ola gedı gha godı hohłə́.
12. Nurses kə hə́ náedíık'éoreyo̜ hə́ Délı̜ne̜ dene hə́ dene kó̜táh dágó̜ht'e hə́ gots'e̜ ayíı eyáa t'á dene tséegorewı sı̜́ı̜ gho̜ keogerı̜hsho̜ nı̜dé nezo̜ gha. Gots'e̜ CDUT kə eyı ne̜ yíı gohálagı̜dá sı̜́ı̜ gogho̜ ası̜́ı̜ ło̜ chegéla haı̜lé eyıı eyáa ts'ı̜lı̜kó̜ dene gha déhkw'ı kə sı̜́ı̜ areyo̜né̜ yegho̜ keogerı̜hsho̜ nı̜dé nezo gha góʔo̜.
13. Denenı̜́ tsíwı gho̜ keots'ehdı hə́ denenı̜́ tsíwı ka dene hə́ eghalagudá, kúlú godaréhcho dene benı̜́ t'á begha dúwə́ hə́ ası̜́ı̜ jıre t'á betséegerıwı sı̜́ı̜ eyıá godaréhcho gots'é̜ nágudí nı̜dé nezo̜ gha. Gots'e̜ denenı̜́ tsíwı gogha nárédíık'éoreyo̜ k'ola gó̜hłı̜ gots'e̜ dene gha ékanı̜́ gonárédíık'éoreyo̜ weda nı̜dé denewá gonáoweré gho̜ keorı̜hsho̜ nı̜dé kola nezo̜ gha.
14. Edıre ʔerı̜htł'é datł'é sı̜́ı̜ Só̜bak'ə́ gogho̜ kó̜tah gots'e̜ dene yegho̜ náadıwə sı̜́ı̜ (cancer, ne̜ k'ə náedíıłı̜ne̜, ne̜ yíı gohálagı̜dá, o̜de ségogule). Ékagó̜ht'e t'á areyo̜né̜ dágó̜ht'e sı̜́ı̜ Délı̜ne̜ gots'e̜ dene kə sı̜́ı̜ suré nezó̜ keogeruhshá gogha gots'é̜ kats'edı gha góʔo̜. Gots'e̜ CDUT areyo̜né̜ ayíı chegéla hı̜lı̜ sı̜́ı̜ kó̜tah yet'áoruhwhí gogha sá góʔo̜ nı̜dé nezo̜ gha.
15. Délı̜ne̜ ʔo̜hda kó̜ k'ola godákánaots'eruchu gháré dene yet'á agut'ı̜́ hə́ eyáa gohk'ə́ gogho̜ ełegháots'enuhte̜ gogha ékanı̜́ dene gha góʔo̜ genı̜we̜. Edıre t'á k'egokw'e nı̜dé:
    - ʔohda k'étsúdí
    - whá dene eyáa t'á tsíwı
    - dene beʔeyáa nejúle
    - whále gots'é̜ gok'éts'udí, dzene gháré gogho̜ ts'ehdı
    - dene náoweré t'á nats'ejú
    - łáne̜ hə́ areyo̜né̜ ełehtah ats'et'ı̜
16. Cancer gho̜ dene gháots'enuhte̜

hə ʔerı̨htł'é wela nı̨dé beghárė ayíı gocancer hə dáréhwhá aı̨t'é, ayíı t'á dúle nats'ejú gots'ę dene kǫ́tah ayíı k'ola dene gha gehła goghǫ́ keotsérı̨hshǫ gha.

17. Canadıan Cancer Control Strategy(CCCS) sı̨́ı̨ cancer ghǫ ʔerı̨htł'é gehła sı̨́ı̨ dánı̨́ cancer ch'á edek'əts'edí, keghǫ ets'ehdı, keots'íhʔá hə łáxǫné keghánaídá. GNWT kə hə k'áowə kə sı̨́ı̨ Délı̨nę zí CCCS ayíı kǫ́tah gogha bet'áoréʔá sı̨́ı̨ t'á edets'ę́ nágudí gha sá négogénı̨ʔǫ nı̨dé got'áoréʔá gha, kǫ́ káyúrı̨́ı̨la k'ola gots'ę́ nágedı gha dúle.

Kǫ́tah Nats'ejú

Sǫ́bak'ə dene ʔehta aı̨t'ı̨́ sı̨́ı̨ godahxáré kǫ́tah gots'ę dene hə suré gúlúu agújá. Edıre ayíı t'á gúlúu agújá genı̨wę k'ə CDUT kə dene naojú gogha gots'ę́ gohə eghálagı̨dá eyıı k'ále Actıon Plan ghálageda ekúu.

Denewá dánı̨́ edegoredí sı̨́ı̨ k'ę́ láanı̨́ t'á dene naujá hagenı̨wę t'á (edek'ę́ edegha k'egots'eʔa, nats'ujú gha łánı̨ nats'eredə) eyı sı̨́ı̨ suré nezǫ. Ékanı̨́ goka goghálagedá t'á ghǫ, begháré kǫ́tah gots'ę dene kə yáaze edeghǫ hə ełeghǫ nezǫ́ agenı̨wę láagújá. Dechı̨tah, dene naujú gogha gohə eghálats'ı̨dá sı̨́ı̨ begháré nę k'ə anaget'ı̨ sı̨́ı̨ gogha nezǫ hə ełehtah aget'ı̨ k'ola suré nezǫ.

Dene kə, amı̨́ı̨ workshops hə łénagehdə nı̨dé, wáa dánı̨́ dene benı̨́ tsíwı hə eyáawá t'á dene dát'ı̨ sı̨́ı̨ ghǫ keorúyá genı̨wę. Edıre ékanı̨́ı̨ ghǫ goghánetę dahxáré edeghágeda sı̨́ı̨ dánı̨́ dúle nezǫ́ edets'ę́ nágudí gha dúle.

Łǫ xae gots'ę́ Délı̨nę gots'ę dene kə eyı gowere nę yíı eghálagı̨dá sı̨́ı̨ náedíı̨łı̨nę dahxáré ékagǫ́t'e gha sǫ́ǫnı̨ gedı t'á kágógerı̨dí ǫt'éle, eyı t'á dene kə sı̨́ı̨ gogha sǫ́ǫnı̨ lágǫ́ı̨t'é. Łǫ náyaʔetı̨ gha hə ası̨́ı̨ goghǫ łénagehdə nı̨dé, government chelekú kə hə scıentısts kə sı̨́ı̨ gogha kúukare agedı. Kǫ́tah gots'ę dene kə sı̨́ı̨ government of Canada dene ts'ę́ nágenı̨də gháré, Sǫ́bak'ə godahxáré ékagúʔǫ́ t'á ékagǫ́ht'e gedı t'á areyǫné nezǫ́ dene hə gogı̨de nı̨dé nezǫ gha góʔǫ genı̨wę, eyıı sı̨́ı̨ sure łǫ yeghǫ dene káyaʔı̨htı̨ ǫt'e. Ékanı̨́ nı̨dé beghárė dene łǫ gohə sá náagúkw'ı hə goghǫ gonı̨́ nezǫ gha gonı̨wę.

Ékagúut'é Gogha Godı Hohłə:

18. DFN kə hə Canadıan government kə hə goghǫ godı hohłə sı̨́ı̨ ełehə godı guhtsı̨ t'á ełehə gerúukw'í gonı̨wę, ékanı̨́ nı̨dé dene ts'ę́ nágudə gháré denewá kə Sǫ́bak'ə karéhchá gots'ę́ nágı̨dí hə ekúu dágoat'ı̨́ sı̨́ı̨ goghǫ dene ts'ę́ négenı̨də nı̨dé nezǫ gha.
19. Sǫ́bak'ə nę dáréhchá tsı̨́ı̨wə hə ǫdéhyə kwəh déhya (Northern Transportatıon Route) sı̨́ı̨ goghǫ denenı̨́ tsíwı ǫt'e t'á whıre eyı t'á gots'ę́ nágedı gha k'ə gogeruʔá gonı̨wę.
20. Hı̨dó k'achu Sahtú mǫnę ası̨́ı̨ t'á kénaogenúhwhı gha nı̨dé keghǫ dene keorı̨hshǫ nı̨dé nezǫ gha. Ası̨́ı̨ bet'áoréʔa goghǫ ʔeʔa hohłə hə nę k'ə dánagúkw'e gedı nı̨dé kǫ́tah gots'ę dene kə wáa gohə gok'ə goghálagudá eyı hə k'ola denewá gonáoweré gots'ę dene nęné k'ola suré heogerı̨hshǫ t'á ékanı̨́ı̨ t'á godaoréhcho gots'ę́

goréʔá t'á edeghá k'áoguwə láanį k'ę́ eghálageda gha góʔǫ.

21. CDUT sį́į edıre kǫ́tah gogha ayíı got'áoréʔá sį́į gogha k'egokw'e wáa k'ola eyı nezǫ t'á goghǫ keorįhshǫ nįdé nezǫ gha, ékanį́ nįdé sį́į areyǫnę́ kǫ́tah gogha ǫt'e. Edıre asį́į kára?a t'á k'egukw'e sį́į wáa dechįtah láanį́ zǫ́ asį́į ełehə́ kagot'į nįdé k'ola nezǫ gha, eyı sį́į areyǫnę dene kǫ́tah nádə gogha ǫt'e. Ékanį́ edegha k'egukw'e gha nįdé federal le nįdé terrıtorıal hə́ socıal servıces gots'ę́ dúle edegha sǫ́ba hets'ereké.

Chapter V - Nę Ghǫ Kegháodegenetę

Sǫ́bak'ə́ nę yíı goghálagįdá gokǫ́ht'é dene kə hə́ nę hə́ tsíwı gedı dahxáré ekúhdə́ nę k'ə́ dágǫ́ht'e goka goghálagįdá. Edıre gogha keogį́hʔǫ t'á, dánį́ Sǫ́bak'ə́ sénaguts'ule gogha gok'ə goghálagudá. Nę k'ə́ dágǫ́ht'e areyǫnę́ ayíı goghǫ keogį́hʔǫ sį́į k'ola hįyó gok'eréhtł'é, eyıı k'ə́ areyǫnę́ ayíı t'á goghálats'udá hə́ ékanį́ bek'e gorukw'ı gha k'ola kede beghǫ ratł'é. Sǫ́bak'ə́ Ékanį́ Ségots'ele Gha goghǫ kede sį́į begháahda eyıı sį́į areyǫnę́ ayíı dáts'ule sį́į goghǫ eratł'é ǫt'e.

yıı kwəh goka eghálagįdá sį́į eyı asį́į goghǫ keogį́hʔǫ, eyı beghárе́ tu dzá ǫt'e. Eghálagįdá gomǫnę tu ghágįdá, kúlú tł'ánę tu eyıá betah kwəh kára?a leré nátse gedı. Ékanį́ kúlú, Sahtu tu sį́į edıre kwəh kára?a leré hə́ nę ts'ę asį́į kára?a tu tah at'į sį́į (radıonuclıde) goʔǫ́ dzá ǫt'éle hə́ beʔídzá sį́į łǫ ǫt'éle t'á tu yíı łue hə́ gonǫ́ą ayíı tu yíı nádə́ hįlį sį́į beghárе́ asáanį́le gháele ghǫ́ keogerįhshǫ. Gonǫ́ą ǫde dzá agǫ́ht'é keogerįhshǫ sį́į gots'ę tu k'ola ghágįdá gots'ę tu asáanį́le, t'á Sahtú tu sį́į ekáa nezǫ.

Nę yíı goghálagįdá godahk'ə́, tu tah kwəh tégeréhtł'ı sį́į eyıá kwəh bedíıkǫ́nę́ nátse, kúlú ekúhyə́ tu híhdəle hə́ łue gots'ę́ at'į chóle. Eghálagįdá dahk'ə́ tu ka hə́ tu yánįlį, sį́į ǫdenę́ xae náagorewə́ nįdé tu yánįlį́le anagot'į́, eyı sį́į goʔǫ́ betah dzá agǫ́ht'e ǫt'éle, kúlú betah sį́į kwəh kára?a leré nátse.

Eyı nę yíı goghálagįdá godahk'ə́ hə́ gonǫ́ą ǫdé kwəh areyǫnę́ tégerétł'ı sį́į areyǫnę́ tu tł'ah dágǫ́ht'e keghájdá eyı hə́ k'ola k'áhjįnę 500 gokə́ ékaréhwha sǫ́ǫnį eyı Murphy Tatł'a ekúhyə́ k'ola kwəh tégeréhtł'ı ǫt'e keorįhshǫ. Ǫde kwəh tégerétł'ı ka tu yíı goghágįdá sį́į suré Sahtu tu tahłǫ ekúhyə́ tégerétł'į hə́ suré tu yíı tu tł'ah nénįtł'ı ǫt'e t'á tekánagegə́ gha kéorıdíle.

Nę yíı goghálagįdá godahk'ə́ ʔehtł'é ékanį́į ghágįdá gots'ę betah kwəh kára?a leré łǫ heogerįhshǫ. Eyı ʔehtł'é dahxáré eyı ǫde kwəh tégeréhtł'ı hə́ ǫde kwəh nę k'ə nakageréhtł'ı sį́į ʔǫ́hła ek'éch'a béorat'į, eyı sį́į ʔǫhła uranıum, chromıum hə́ arsenıc ka areyǫnę́ keghájdá. Nę ts'ę ʔehtł'é tah Radıonuclıdes ka goghátsʼįdá sį́į kwəh kára?a leré tah hę́ht'e láįt'e. Kwəh kára?a leré, ʔįt'ǫ́ yáníhshə́ tah at'į, sį́į ǫde nę yíı tu yánįlį gha satsǫ́nę́ wele yáwela sį́į eyıá betah nátse.

Sǫ́bak'ə́ eyı nę yíı goghálagįdá ekúhyə́ kare, aır dáįt'e ka goghágįdá gots'ę ekáa goʔǫ́ dzá ǫt'éle keorįhshǫ. ʔehtł'é ékanį́į daezho sį́į goʔǫ́ agǫ́ht'éle t'á beghǫ goʔǫ dúwé ats'enįwę́le. Nę yíı goghálagı̨dá godahk'ə́ sį́į eyı gamma radıatıon leré eyıá łǫ.

Nę k'ə hə́ kare areyǫnę́ asį́į yágǫ́hłį tah dzá ǫt'e láanį́ genı̨wę sį́į radıatıon kakegháı̨dá gots'ę betah radıonuclıdes hegút'ǫ kúlú areyǫnę́ nę k'ə kare asį́į goʔǫ́ dzá ǫt'e chóle.

McDonough Túé TCA tah kwəh tégeréht'ı beka nǫwále sį́į ka arsenıc, kwəh dekoe hə́ uranıum kagoghágı̨dá sį́į suré tu dzá ǫt'e hə́ ayíı tah gots'ę́ hélə́ sį́į k'ola dzá ǫt'e. Gots'ę McDonough Túé sį́į tu betə retł'í t'á Sahtú tu tah gots'ę́ dewí ǫt'éle, eyı t'á McDonough Túé gots'ę́ asį́į gots'ę́ hélə́ ǫt'e.

Arsenıc sį́į tı̨ch'ádíı netséle tae káraʔa tah at'ı̨ keogį́hʔǫ eyı la (nǫgéré, turı hə́ gah). Ékanı̨́ gotah at'ı̨ sį́į ʔı̨t'ǫ́ yáníhshə́ hə́ kwəhya yágíʔá ts'ę at'ı̨. Ǫde satsǫ́nę́ wele nę yíı yáwela ts'ę hə́ gots'ę uranıum sį́į bets'ę yánı̨lı̨ la, Murphy kwəh nakageréhtł'ı hə tégeréhtł'ı eyı dahxáré Murphy Túé ekúhyə́ tı̨ch'ádíı netséle ayát'ı̨ sį́į gah ékanį́ı̨ gha dzá agǫ́ht'e.

Ɂekwę́ k'ola łáhtare ekúhyə́ nę yíı goghálagı̨dá godahk'ə́ narehʔá sį́į, Dene wá kə gogha bé ǫt'e t'á hə́ got'áoréʔá t'á eyı k'ola kagoghágts'ı̨dá. Gogh※ts'ı̨dá gots'ę eyı godahk'ə́ ʔekwę́ at'ı̨ sǫ́ǫnı̨ kúlú asáanį́le. Eyı nę k'ə agot''ı̨ nı̨dé Délı̨nę gots'ę dene kə eyáa t'á gohə́ dágude gha sǫ́ǫnı̨ genı̨wę t'á la:

- (Dene hı̨chá hə́ ts'ǫ́dane) ekúhdə́ godahk'ə́ łə́ xae, tae sa gots'ę́;
- Dene gok'ə k'énanehta hı̨lı̨ ekúhdə́ godahk'ə́ łə́ xae, nákə dzené;
- Łue got'ı̨nę hə́ dene názé kə hə́ ekúhdə́ godahk'ə́ łə́ xae, łə́ dáedzené; hə́
- Mǫ́larétí łue agehʔı̨ gı̨lı̨ ekúhdə́ godahk'ə́ łə́ xae, nákə sa.

Radıatıon t'á eyıá dene tae sa gots'ę́ aget'ı̨ gı̨lı̨ sį́į (eyıá godaréhcho dúle gots'ę́ nátse) eyı Canadıan Nuclear Safety Commıssıon(CNSC) dene gha eyáawá yágǫ́hłı̨ sį́į bedahxáré eyı ékanį́ goʔǫ dzá ǫt'éle. Eyı ekúhdə́ nę dene at'ı̨ t'á eyı náedíıłı̨nę ékanı̨́ı̨ ka hə́ kwəh káraʔa leré ka gok'ə k'énats'enı̨htá gots'ę, asáanį́le ghǫ keogerı̨hshǫ. Eyı godahxáré, radıonuclıdes hə́ gonáą kwəh káraʔa leré ékanį́ı̨, Sǫ́bak'ə́ yágǫhłı̨ sį́į dene kə, łue got'ı̨nę kə dáúdíle nı̨dé gonáą dene kə ekúhdə́ at'ı̨ kə sį́į gogháré goʔǫ gohə́ dzá agode gha góʔǫ́le.

Edıre ékanį́ı̨ goka gogh※ts'ı̨dá sį́į eyı godahxáré Sahtú hə́ gonáą Northwest Terrıtorıes eyı k'ola asį́į ʔéhdá ka goghágı̨dá hı̨lı̨ dahxáré eyı denewá béré ékanį́ı̨ ghǫ shéts'eyə sį́į asáanį́le. Denewá béré káraʔa k'ola ghágı̨dá gots'ę gonáą asį́į ghágı̨dá eyı godahxáré, Sǫ́bak'ə́ gots'ę dene, denewá béré heʔá hə́

CDUT Dúle Ékanį́ Ségots'ule Ghǫ Godı Ratł'é

	Godahk'ə́ Goghǫ	Ékanį́ Ségots'ule Ghǫ Eratł'é
Nę yíı gónįʔa	Mıne Godákáaratǫ	Nę yíı gónįʔá nįdé areyǫnę́ cement láanį́ t'á yedáodegenuhtsé, gots'ę nę yíı xagerį́la sį́į kwəh yeyíı dánéhʔǫ agele dáódí nįdé yemǫnę neshekwelé láanį́ agule ǫdéhyə́ dúle nįdé.
Asį́į Dánį́ Hohłə́ Dahk'ə́ hə́ Asį́į Dzá Wela Sį́į Béorat'į	Kwəh láanį́ k'ə asį́į t'áré hə́ beka gogha	Kwəh láanį́ t'á hįdə́ nágonéhtsé sį́į areyǫnę́ nágerewa ghá gots'ę nę k'ə hohłé sį́į asį́į yeka agele gha. Gonáą asáanį́le nįdé ékanį́ ʔaį́hłį́ gha.
	Bek'ə danaʔeyə dahk'ə́	Ǫde bek'ə danaʔeyə sį́į nágerewa hə́ bedahk'ə́ Hįkwə́ tégoréʔa sį́į nezǫ́ anagogela gha. Tu tah kwəh tégeréhtł'ı sį́į séts'ele gha kéonejį nįdé ayíı t'á dúle zǫ yeghálagudá.
	ʔek'élu	ʔek'ə́lu yánįʔá sį́į radıatıon bets'ę́ héhłéle nįdé ékanį́ yeghágúudí. Kúlú radıatıon 250µR/hr ʔǫ́ ǫt'e nįdé areyǫnę́ kek'ə asį́į agule.
	ʔelágenet'a dahk'ə́	Transport Canada goʔeʔa dahxáré ʔelágenet'a dahk'ə́ goghálagudá.
	Bet'á Eghálageda gozhú	Satsǫ́nę́ tá tłeh yáwetł'ı sį́į káguhtł'é hə́ gonáą eghálageda gozhú zhǫ́ą areyǫnę́ ségule (McDonough túé tah náedíıłįnę dahk'ə́ TCA dúle sáanį́le t'á káts'ewa nįdé zǫ dúle ékanį́ beghálats'eda.
	Asį́į kw'élé	Chegewa gháré łánę łégehwha gha.
	Dechįh Nákanéhtsé	Kǫ́ yáwela sį́į areyǫnę́ nádegerewa gha,(łuekǫ́, kǫ́ yánetsélıa, dechįkǫ́ ''ʔekw'ahtį kǫ́).
Ǫde Náedíıłįnę T'á Dzá Agǫ́ht'e Hə́ Bedíıkǫ́nę́ Ghǫ ʔehkw'ı Agǫ́ht'éle	Godahk'ə́ K'énawí	Tu k'énatł'é gha satsǫ́nę́ náweʔa sį́į tįch'adíı yehə́ shúuyə ch'á areyǫnę́ yek'ə kweh agele hə́ ǫdé kwəh ket'á aıt'į́ nę k'ə nakageréhtł'ı betah tu narewí sį́į areyǫnę́ kwəh wíle agule. Łáxǫnę́ yeghánagídá gha.
	Gamma Radıatıon Bek'énawı	Ǫdéhyə́ gamma radıatıon gǫ́hłį sį́į 250µR/h hénáréhtse nįdé whah k'áhjįnę 0.5m kadanéht'e yeka agule. Keka ʔahʔį́ t'á 100µR/h k'éts'enę hénáréhtse zǫ at'į́. Eyı t'á gamma béʔídzá sį́į ghálagįdá sį́į 250µR/h k'éts'enę hénáréhtse gha.

	Site Issues	Preferred Remediation Method
	McDonough Túé TCA	Łáhxǫnę́ tu dánéht'e anat'į́ hə́ tu dáįt'e goka yeghánagídá gha.
	Sılver ʔehdá TCA	Tu netsélıa yáwela sį́į kwəh nakageréhtł'I t'á le nįdé eyıı łánį gots'ę whah yeka agele gháré asį́į t'á datéɂehchú agule gháré TCA sį́į ɂehtł'é areyǫnę́ yeka agule, ékanį́ nįdé begháré hįyó neorį́ɂá gháele hə́ gots'ę k'achu whah yek'ə anagule.
	Murphy TCA	Kwəh nakageréhtł'ı héorat'į sį́į
	Radıum(Hįdə́ hə́ Hįkwé)TCA	Kwəh nagageréhtł'I sį́į aká a asáanį́le, ɂįt'ǫ́ yánįhshə́ sį́į ekáa nezǫ hə́ radıatıon híɂídzá sį́į ékanį́ hóhłį́ ǫt'e. Asáa ts'ele gháele kúlú łáhxǫnę́ yek'ə k'énagenehta gha.
	Murphy Tł'áa Nę Ka Kwəh Nakaréhtł'ı	Ch'ánágóɂá t'á beghǫ kéoredíle, ékanį́ begháts'úudí gháré ǫde gǫt''ale nįdé eyı gots'ę whah yek'ə agule.
	West Adıt/Kwəh Náreda Dahk'ə́ Kwəh Nakaréhtł'ı	Kwəh nę nagageréhtł'ı héorat'į sį́į kánagekə gha eyıı la: Murphy, Sılver ʔehdá dáódíle nįdé McDonough TCA
	Sahtu Tu Tah Kwəh Nakaréhtł'ı	Ékanį́ begháts'úudí kúlú łáhxǫnę́ tu hə́ łue hə́ k'ə k'énagenuhta
	Tłeh K'égedí Dahk'ə́	Kedáadenewa gha gots'ę dáódí le nįdé ékanį́ kwəh yek'ə agule
	Asį́į Béonejį Gozhú	Ǫdéhyə béorat'į nįdé ǫ́gerewa gha

TABLE OF CONTENTS

SUMMARY

CHAPTER 1. HISTORY AND ACTION PLAN DEVELOPMENT

CHAPTER 2. COMMUNITY INVOLVEMENT

CHAPTER 5. ENVIRONMENTAL STUDIES

LIST OF CDUT REPORTS

LIST OF TABLES AND FIGURES

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1
HISTORY AND ACTION PLAN DEVELOPMENT

1.1 The Sahtúot'ine (Bear Lake People)

Dene people have lived, since time immemorial, on and around the shores of Great Bear Lake. More recently, the term Sahtúot'įnę has been adopted to refer to the Aboriginal people of this district. The Sahtúot'įnę consider themselves to be the original inhabitants of this place and have an intimate and direct link to the lands and waters in and around Great Bear Lake (also known as Sahtú).

The Sahtúot'įnę lived a traditional Dene lifestyle until only about 50 years ago. They were semi-nomadic hunters and gatherers, practicing their traditional way of life and culture throughout the lands and waters of the Sahtú region. In 1799, the Northwest Company built a trading post at the head of the Bear River. This site came to be known as Fort Franklin after the Franklin expedition used the post as its winter headquarters in 1825. In the 1950s, the establishment of a Roman Catholic Mission and a school drew Dene people to settle permanently at the site. Today, the community is known by its Dene name of Délįne, which means "place where the river flows".

Délįnę residents today maintain strong links to their traditional Dene way of life. In 1993 the *Sahtú Dene and Métis Comprehensive Land Claim* Agreement was signed to, among other things, "...recognize and encourage the way of life of the Sahtú Dene and Métis which is based on the cultural and economic relationship between them and the land"[1]. Great Bear Lake remains the central defining feature of the community and traditional territory of the Sahtúot'įnę.

Figure 1.1
Location and Setting of Port Radium

Figure 1.2 Port Radium Mine Site *c. 1950*

As people continue to harvest the plants and animals of the region for food and fuel, the Sahtú provides not only physical sustenance for the people of Délı̨ne, but also the spiritual and cultural sustenance that comes from practicing the skills and lifestyle of their ancestors. While caribou and fish are harvested most frequently, many other animals and plants are also important traditional foods.

Délı̨ne's population today is approximately 550, mostly Sahtú Dene and Métis. Délı̨ne can be reached by ice road from January to March; the rest of the year Délı̨ne is accessible only by plane or boat. While many people in Délı̨ne can speak English fluently, North Slavey is the first language of most residents and is taught in the local school.

1.2 The Development of the Port Radium Mine in the Sahtú

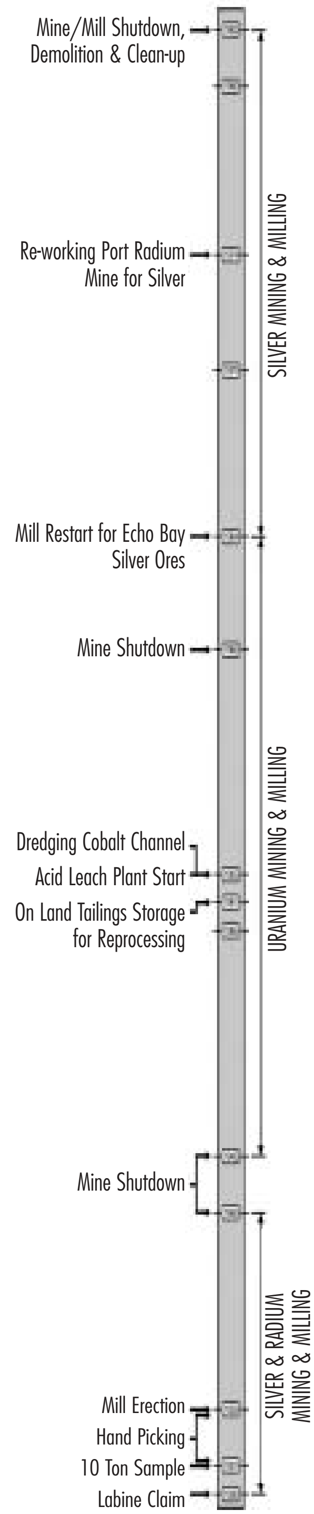
1.2.1 Discovery of the mine

According to histories passed down through Dene oral tradition, pitchblende was first discovered at the Port Radium site by a local Dene man known as Old Beyonnie. He was traveling with a group of people to go hunting at Caribou Point, and the party camped at Port Radium on the way. Beyonnie picked up a strange looking rock, and later gave it to a prospector who passed on the rock to Gilbert Labine. Labine visited and staked the site in 1930 and sent samples of pitchblende, which he correctly believed to be rich in radium, to the Department of Mines in Ottawa for analysis. Thus began an era of mine development, operation and related activities in the Sahtú, which lasted more than 50 years. The Port Radium discovery intensified mineral exploration efforts in the eastern and southern Great Bear Lake area and resulted in several other mineral discoveries.

1.2.2 History of Production at Port Radium

Mining operations took place at Port Radium almost continuously between 1932 and 1982 (see Figure 1.3). Radium, uranium and silver and copper were mined at different times at this site. The site was mined for radium-containing pitchblende until 1940. From 1942 to 1960, a uranium mine was operated at the site by then Crown-owned Eldorado Mining and Refining. The site was used by Echo Bay Mines, a private company, from 1964 to 1982 as a silver mine. Echo Bay mines ceased mining operations at Port Radium in 1982 and covered most tailings and garbage with waste rock, moved all valuable equipment to other mining operations and demolished buildings on-site. At that time, the land reverted back to the Crown.

Figure 1.3 Timeline of Mining Operations at the Port Radium Mine Site



Records indicate that during the mine's life, Eldorado and Echo Bay operations produced 37 million ounces of silver, 10.5 million pounds of copper and 13.7 million pounds of uranium oxide (U_3O_8) before final shutdown and closure in August 1982. Total tailings production is estimated to be in the order of 910,000 tons of uranium tailings and about 800,000 tons of silver tailings. Assessments of historical records and discussions with past operators have confirmed that the silver tailings, with some minor exceptions and spills, were deposited into McDonough Lake.

Through the recent on-land site sampling, measurements, and assessment work, it is estimated that about 170,000 tons of tailings, or 19% of the total amount of uranium tailings, were placed within local surface depressions or in the Silver Point area of the site. The remaining 740,000 tons of tailings (81%) were deposited in Great Bear Lake at various locations around the mine site.

Figure 1.4
Prince Phillip's Visit

HRH the Duke of Edinburgh (Prince Phillip) visits Port Radium during a tour of the Northwest Territories in August, 1954

1.2.3 The Role of Port Radium in a National Context

Port Radium began in 1932 as a private enterprise, mining for radium. Copper and silver were also recovered during the process. In the 1930s, the price of radium ranged from $50,000 to $70,000 per gram; it was primarily used for luminescent dials and medical treatment of cancer and various other ailments. From 1930 to 1940, the mine was important to the region because it acted as a catalyst for other mineral exploration. It also provided employment, opened up a northern transportation network and served as a centre of activity on the eastern shores of Great Bear Lake. It was not until 1942 that the Port Radium mine became important nationally and internationally.

The Second World War increased global demand for uranium oxide. Research on atomic weapons accelerated under the Manhattan Project in the U.S. In order to supply wartime demand for uranium, the Canadian government requested that LaBine reopen the Port Radium mine (temporarily closed due to high mining costs), but this time the objective was uranium. In 1944, the federal government nationalized the mine and it continued under federal control until it closed in September 1960. During this time, the federal government was in charge of all operations and policies, including security and negotiations with uranium buyers.

Due to its importance as a uranium ore supplier for the war effort and its relative proximity to northern military installations, Port Radium assisted, and was assisted by, both Canadian and United States military forces. Luminaries including Lord Tweedsmuir and Prince Phillip visited the mine, further demonstrating its importance to the Allied efforts. At one point during the war, the Port Radium site was reported to be a target for attack by the Japanese.

A lasting legacy of Port Radium is the continuing presence of the Northern Transportation Company Limited (NTCL) on the Mackenzie River system. The Port Radium operations required considerable air and water support to supply the mine and to ship out mine product. NTCL was created principally for Port Radium, but has since become a valued transportation link from the north to the south.

The Port Radium mine played a central role, along with other mineral developments, in the transition of Great Bear Lake from a large, undisturbed northern lake to a centre of activities in northern Canada. This, in turn, impacted the activities and the lifestyles of the Sahtúot'įnę .

1.2.4 Involvement of the Sahtúot'ine with Port Radium

Since the beginning of mining operations at Port Radium, the Sahtúot'įnę provided crucial support services to the mine and in the transportation of goods to and from the site. The families that traditionally lived and traveled on that side of the lake were among the first Dene to work for the Port Radium mine. They provided lumber for fuel and building material, as well as fresh meat and fish to the increasing numbers of non-Dene living there. These services were provided until the closure of Port Radium as a uranium mine in 1960. Dene families did not reside at the mine but stayed nearby, sometimes in close proximity to the site. While the men did most of the work as loggers and hunters, women worked alongside their husbands, hauling logs, preparing meat and making clothes and crafts to sell at Port Radium.

Dene people also played an indispensable role in the seasonal transportation of goods to and from the mine. Goods were barged across the lake to the head of the Great Bear River, and then transferred to smaller, river-going vessels. Portages along the river necessitated the transfer of freight across land and back onto a boat. This labour was done manually until 1950, when the work became somewhat easier with the introduction of pallets and forklifts. Many Dene men worked at these sites along the Great Bear River during the months when the lake and river were passable (July-September), and their families often lived at the sites with them. It is these men who are commonly referred to as "ore carriers". Other Dene men worked as deckhands and river-boat pilots, the latter being a particularly important role because of the difficulty of navigating the river.

While they were working for the mine, Dene people were not aware of the potentially toxic effects of radium and uranium exposure, nor were they aware that the uranium was destined for use in the development of atomic bombs. It was not until the 1980s that people in Délįne began to learn about the damage to human and environmental health that can be caused by uranium mining. Community members began to fear for the safety of their environment and traditional foods. The belief that uranium exposure caused cancer in their community became prevalent.

1.3 The CDUT Action Plan

1.3.1 Development of the Action Plan

Although long a concern in Délįne, the issues surrounding the Port Radium mine

Figure 1.5
Dene Men Delivering Meat

Edward Blondin and Jean Baptiste delivering meat to the Port Radium mine, 1940

Figure 1.6
NTCL Dock at Great Bear

Northern Transportation Company (NTCL) dock at the head of the Great Bear River, c. 1950 first received national attention when they were brought forward by the Délı̨ne Uranium Committee (DUC) at a meeting in Ottawa in June 1998. The DUC presented the document "They Never Told Us These Things"[2] to three federal Ministers: Indian and Northern Affairs Minister Jane Stewart, Natural Resources Minister Ralph Goodale and Health Minister Allan Rock. The document details the community's concerns and outlines 14 points of redress. After this meeting with Ministers, Canada prepared three draft papers (called "First Thoughts papers") to: produce terms of reference for structuring a Délı̨ne-Canada Committee; identify the types of health and environmental assessments required to address the community's concerns; and engage a fact finder(s) to establish a common understanding on the factual information relating to Délı̨ne's concerns.

The DUC representatives did not agree with the results of the meeting as reported by Canada. Dialogue was stalled for nearly one year, as Délı̨ne was divided on whether to engage with the government in partnership, or pursue remedy in the courts. Finally in August 1999, at a self-government meeting between Canada and Délı̨ne, Canada asked the Délı̨ne Dene Band Council to indicate formal support for a new cooperative process regarding Port Radium. This was accomplished in September 1999 by the passing of a Band Council Resolution (BCR 003-99) which mandated a joint process with Canada and stated the three main areas of concern to the community:

1. clean-up and containment of the Port Radium site;
2. health and environmental studies and long-term monitoring; and
3. compensation.

In October 1999, the Canada-Délı̨ne Uranium Table (CDUT) was formed (the Terms of Reference are included in Appendix 1). The CDUT is comprised of representatives and advisors from the community of Délı̨ne and from Indian and Northern Affairs Canada (INAC). INAC represents Canada on behalf of Health Canada and Natural Resources Canada, with assistance from the Government of the Northwest Territories on issues of health service delivery in the Northwest Territories. The CDUT was supported by core staff in Délı̨ne (known as the Délı̨ne Uranium Team, or DUT) and INAC staff.

The early work of the CDUT led to a visit by INAC Minister Nault to Délı̨ne in January 2000. At that time, Minister Nault and Chief Leroy Andre formally endorsed and announced the CDUT joint process. The CDUT then hosted a workshop in May 2000 to identify the community's specific questions and concerns regarding the mine, and to scope future CDUT work. The purpose of this workshop was to have the CDUT members produce a preliminary list of questions that would form the basis of discussion at a future meeting with various experts and members of the community. These questions are known as the "77 Questions" and are listed, along with answers that have been developed through Action Plan studies, in Appendix 2. During the scoping workshop, it was identified that the issue of overriding concern was the potential risk to human health from exposure to radiation from the former Port Radium mine.

Recognizing the need for a multidisciplinary approach to address the concerns of the community, the CDUT hosted the Community and Experts Workshop in

Figure 1.7
Experts and Community Workshop, May 2000, Déline

Standing: Ron Christianson (teacher, Délįne); Colin Macdonald (wildlife and aquatic health); Chris Clement (Low-level Radioactive Waste Management Office, AECL); Erica Myles (GNWT Health and Social Services); Victor Clulow (environmental contaminants); Barbara Brown (facilitator); Randy Knapp (mine site remediation); Peter Usher (traditional knowledge); Chris Cuddy (INAC); Raul Urtasun (oncology); Doug Chambers (health physics); Rafik Gardee (general health); John McLaughlin (epidemiology); Leroy Andre (Chief, Déline); Kevan Flood (INAC); Geoffrey Grenville-Wood (lawyer for Délįne); Cathy Mackeinzo (Délįne); Ronald Mackeinzo (Délįne); Gina Neyelle (Délįne); Sharon Baillie-Malo (NRCan); Adrian Menacho (Délįne); Bella Menacho (Délįne); Délįne health centre staff

Seated: Cindy Jardine (risk communication); Josée Sarazin (comprehensive plan developer); Ron Brecher (risk assessment); Gary Juniper (Délįne advisor); Shelagh Montgomery (Délįne science advisor); Charlie Neyelle (Délįne); Danny Gaudet (Chief Negotiator, Délįne); Bruce Kenny (Délįne); Walter Bayha (Délįne); Morris Neyelle (Délįne); John Tutcho (Délįne); Joe Blondin Jr. (Délįne); Raymond Taniton (Délįne); William Sewi (Délįne); David Kennedy (INAC); Alice Mackeinzo (Délįne); Elizabeth Kodakin (Délįne)

Délįne in October 2000 (see Figure 1.7). The major goal of the workshop was to provide a framework for an Action Plan to answer the community's questions.

The Action Plan was then developed by the CDUT, using advice from the experts and community members, and sent to the INAC Minister and the Délįne Chief and Council in September 2001 for their approval. While awaiting formal endorsement of the document, the CDUT continued to implement the recommended studies and activities that would move the process forward. The Action Plan was formally and publicly endorsed by Chief Tutcho and Minister Nault in February 2003.

1.3.2 Action Plan Summary

The purpose of the three-year Action Plan is to scope and describe studies and activities that, when completed, would provide the information necessary to enable Délįne and the federal government to make informed decisions about the long-term management of the Port Radium mine site and any ongoing community health requirements relating to the mine site (past or present).

The Action Plan identifies several discrete environmental and human health studies and activities to address Délįne and Canada's concerns. The overall objectives of these studies were to:

1. determine whether the health of the Délįne people has been, is being or will be affected by contamination from the Port Radium site;
2. verify that the fish, plants and animals in the Port Radium area and elsewhere around the lake have levels of chemical and radioactive elements that are safe to eat and that animals are not harmed by exposure to contaminants;
3. provide information about the mine site to enable the government to do what is necessary to prevent the release of contaminants from the Port Radium mine site in the long-term; and,
4. provide the healing that has long been sought by the widows of ore carriers, elders and families directly affected during the period that they lived at Port Radium.

The Action Plan's studies and activities were clearly linked, and were carried out in a stepwise and coordinated way. In summary, the studies and activities included:

- Gathering of existing historical, environmental and community health information.
- Collection of traditional knowledge (TK)
- Site assessment

- Human health risk assessment
- Ecological risk assessment
- Community health assessment
- Epidemiology
- Medical surveillance of identified risk groups
- Risk communication and education
- Community healing initiatives
- Community capacity building

The cost estimates for the studies and activities were developed from the Experts and Community Workshop and further refined through follow-up with the experts and review of comparable undertakings in the North. The three-year Action Plan budget was initially estimated at $6.5 million. The project was completed in its fifth year for a total of $6,787,500; the budget is presented below (Table 1).

This budget does not include costs associated with regulatory requirements for remediation work (e.g., licensing, environmental assessment) or actual clean up costs.

1.3.3 Action Plan Implementation

As the CDUT was developing the Action Plan, community members and experts recognized the importance of community involvement in CDUT research and activities. This became a guiding principle for Action Plan implementation. Community involvement was achieved through TK studies, communications, capacity-building and community healing; these activities are described in Chapters 2 and 4.

An important consideration for the CDUT in the development of the Action Plan was the inter-linked nature of the studies. Figure 1.8 shows the flow of information from and between the various studies/activities. Experts recommended that all studies adhere to accepted research objectives and have a strong study design with linkages clearly identified. Furthermore, all of the planned work was to be done in close consultation with the community and, where applicable, with careful regard for traditional knowledge protocols.

Table 1.1 Summary of Action Plan Expenditures

Study/Activity Area	Actual Costs					TOTALS
	2001/2002	2002/2003	2003/2004	2004/2005	2005/2006	
Traditional Knowledge and Archival Gathering	$152,400	$305,775	$48,997	$45,930	$0	$553,102
Environmental Studies	$480,825	$32,990	$380,551	$191,231	$30,000	$1,115,598
Human Health Studies	$258,687	$156,000	$90,270	$198,950	$13,650	$717,557
Community Healing	$45,075	$89,440	$73,177	$0	$0	$207,692
Communications and Education	$30,000	$82,439	$39,270	$189,700	$85,400	$426,810
Core Capacity Délı̨nę and Project Management	$585,450	$592,650	$762,272	$747,048	$249,300	$2,884,420
DIAND Core	$200,000	$200,000	$200,000	$200,000	$30,000	$830,000
TOTALS	$1,752,437	$1,459,295	$1,594,538	$1,572,859	$408,350	$6,787,480

Independent peer review of CDUT studies was also incorporated at the project design stage.

One of the challenges for the CDUT was managing the information gathered through the implementation of the Action Plan. A significant amount of data on the Délı̨ne community and the Port Radium mine site were accumulated through research and oral histories. Database and GIS technology were valuable tools for organizing and storing information, making it accessible and easier to combine as required in a multidisciplinary study.

1.3.4 Acknowledging Uncertainty

It is important to acknowledge that the Action Plan has not produced conclusive answers to all the Action Plan questions. As with all scientific studies and modeling exercises, some amount of uncertainty remains. In carrying out the studies, the CDUT attempted to reduce uncertainty as much as possible, identify where and how much uncertainty remains, and discuss how the uncertainty could impact decisions. The CDUT has made findings and recommendations based on the best attainable information.

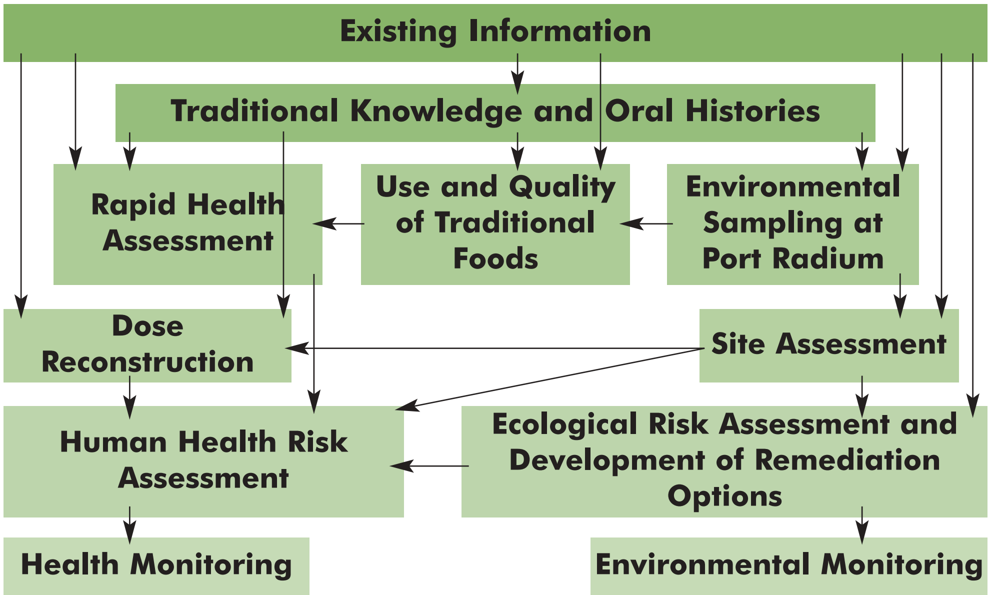
REFERENCES

1 *Sahtú Dene and Métis Comprehensive Land Claim Agreement*, Vol. 1 (Ottawa: Public Works and Services Canada, 1993), 2.

2 *"They Never Told Us These Things": A Record and Analysis of the Deadly and Continuing Impacts of Radium and Uranium Mining on the Sahtú Dene and Métis of Great Bear Lake, Northwest Territories, Canada* (Délı̨ne: Dene First Nation of Délı̨ne, 1998).

Figure 1.8
Action Plan Flow Chart

Schematic illustration of proposed studies and linkages from CDUT Action Plan (2002)



CHAPTER 2
COMMUNITY INVOLVEMENT

Guiding principles for Action Plan implementation were established to promote meaningful community involvement in CDUT research and activities. One of the major challenges to achieving this objective was language translation, since North Slavey is the first language of most Délı̨ne residents, especially elders. Community-based fieldworkers were employed by the CDUT for the duration of the project; they developed terminology related to mining and health in order to translate oral histories into English and present scientific findings back to the community in their language. Other means of involving the Délı̨ne community in the implementation of the Action Plan are discussed in this chapter, while findings from the research will be discussed in subsequent chapters.

2.1 Traditional Knowledge

Traditional knowledge (TK) is defined in the Action Plan as "personal experience and learning that comes from sharing experiences with others". In this case, Délı̨ne elders and community members shared their personal experiences of living and working at Port Radium and transportation route sites with Délı̨ne Uranium Team (DUT)[a] researchers through the Oral History and Land Use Mapping projects.

It is also noted in the Action Plan that TK is crucial to provide information for other environmental and health studies. This was particularly true with respect to studies about the impacts of the mine *in the past*, because people's stories provided information that was not recorded anywhere else. In particular, the reconstruction of historical radiation exposures drew heavily from information gathered through the Oral History and Land Use Mapping projects. The Community Profile, Photo Collection and Commemorative Book projects allowed the Délı̨ne community to collect materials and develop tools to understand its collective history in relation to the Port Radium mine.

2.1.1 Oral History Project

The Oral History project accomplished several objectives that were identified in the Action Plan, the most significant being the collection of information about Dene workers and residents at Port Radium and transportation route sites. The Oral History project provided community members with an opportunity to share their stories, and ensured that these stories were used and preserved in an appropriate and respectful way.

This project was conducted by a project manager and a team of community fieldworkers. In order to ensure that oral history interviews were conducted,

Figure 2.1
Oral History Interview

CDUT Fieldworker Irene Betsidea interviewing elder Rosie Sewi, 2000.

a The Déline Uranium Team (DUT) refers to staff employed by the Déline First Nation for the CDUT, based in the community of Déline; see also section 2.3.1.

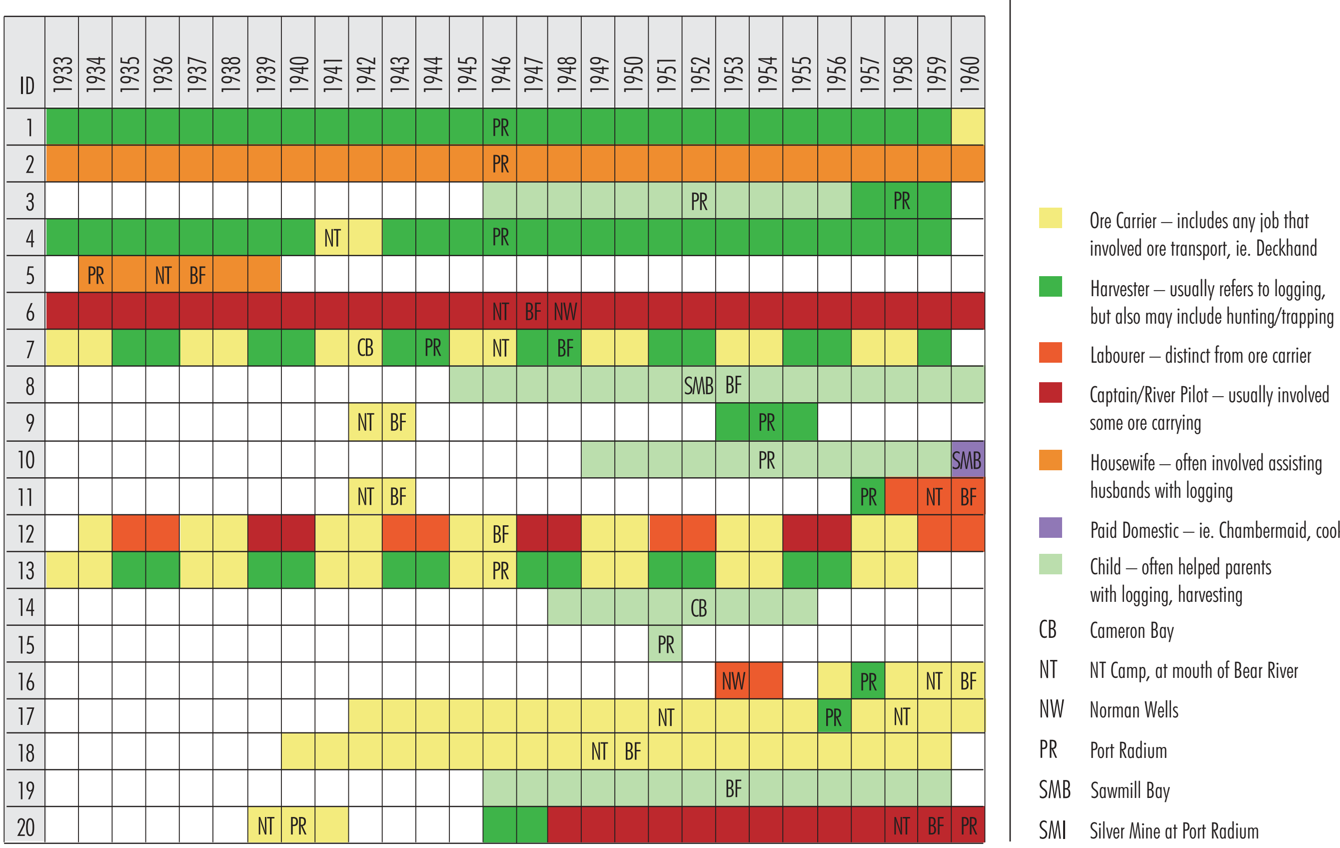
recorded, translated and transcribed accurately, the fieldworker team underwent training in a variety of areas. There were two components to the project: the translation and transcription of 80 previously completed interviews and the completion of 63 new interviews. The respondents comprised virtually all surviving Délı̨ne Dene who were involved with Port Radium or the transportation route.

Oral histories about how people lived during the uranium mining period were critical to the investigation of the historical impacts of radiation exposure on human health. Information collected through this project also contributed to the compilation of a detailed list of all the Délı̨ne Dene people who lived or worked at Port Radium or at transportation route sites along the Great Bear River. The list identified the names, roles and occupations of 175 individuals, as well as approximate timelines and locations for their involvement with uranium production and transport. A representative sample from the list is presented in Figure 2.2, with names removed to protect privacy. This information allowed the dose reconstruction project to consider exposure scenarios on a case-by-case, rather than a generic, basis.

The oral histories contained valuable information about the socio-cultural

Figure 2.2 Port Radium/Transportation Route Former Workers and Residents List

Sample section of "Port Radium/Transportation Route Déline Dene Former Workers and Residents List" (names removed), developed from CDUT Oral History Project



impacts of the Port Radium mine on Dene people. These findings, as well as the results of the dose reconstruction, will be discussed in Chapter 4.

2.1.2 Land Use Mapping

The objective of this project was to collect information about land use and occupancy of the Port Radium and transportation route areas, and to visually represent the data in maps. An innovative approach was used to document traditional knowledge in an accurate and accessible format.

The interview process is called particip-atory land-use mapping. Community members were interviewed and shown regional maps projected on a large screen and were able to point to specific and relevant areas on the map. This information was then mapped directly with Geographical Information Systems (GIS), and simultaneously entered into a spreadsheet format.

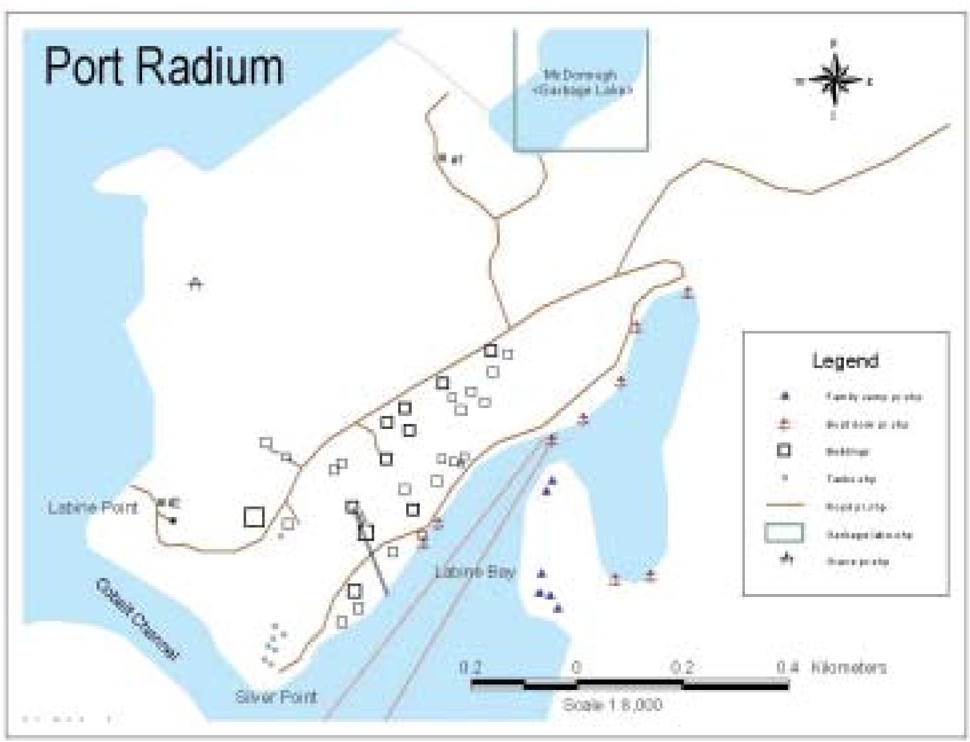
During the analysis, the individual maps were combined to illustrate the following themes: local land and resource use (including habitation, hunting, trapping, fishing, gathering, logging, and gathering of plants and berries), archaeological and historic sites and contaminated areas.

Information from this project provided a better understanding of traditional land use during the mining period and was considered in the dose reconstruction project.

2.1.3 Community Profile (Genealogy database)

The Community Profile project created a genealogy database for the population of Délı̨ne and has been used to store information collected during CDUT research and activities. Originally intended to identify potentially exposed persons, the database was used by staff to quickly access information about individual community members'

Figure 2.3
Land Use Mapping Project: Port Radium



occupational histories, family relationships, and birth/death dates.

Information for this project was gathered from multiple sources including the Roman Catholic Mission in Délı̨ne, INAC and the Délı̨ne Dene Band. Questionnaires were developed to gather genealogically relevant information from community members; a total of 80 such interviews were conducted by DUT community researchers. The genealogy database was maintained and periodically updated by the DUT data manager.

2.1.4 Commemorative Book

During the course of the CDUT Oral History project, more than 130 interviews with Délı̨ne community members about their involvement with uranium mining and transport were collected, transcribed and translated. The oral histories are much more than a data source; they constitute the collective historical record of a crucial period in the history of the Sahtúot'ı̨nę, as seen through their own eyes and retold with their own voices.

During community consultation and healing activities, elders said that Délı̨ne youth are largely unaware of the history of Port Radium and of the involvement of Délı̨ne people in this history. This is a painful realization for many elders, especially widows who feel that they have suffered personal loss because of this history. The desire to educate the Canadian public generally about this history has been clearly expressed by the people of Délı̨ne[1].

Recognizing the value of the material and its potential as an educative tool, the CDUT sponsored the creation of a commemorative book about the Délı̨ne Dene and the Port Radium mine based on oral history transcripts. DUT staff selected and wrote the content of the book, and a contractor was hired to assist with layout and graphic design. Copies of the book were produced and distributed to community members, government agencies and other interested persons or organizations.

Figure 2.5 Presentation of Oral History Book

DUT staff handing out commemorative book to Délı̨ne community members, June 2005

Figure 2.4
"If Only We Had Known": The History of Port Radium as told by the Sahtúotine

Cover and sample pages from CDUT commemorative book, about the involvement of Délı̨ne Dene people with the Port Radium mine.

2.1.5 CDUT Findings and Recommendations on Traditional Knowledge

There are two types of findings arising from TK studies: findings about the role of TK research in Action Plan implementation, and findings that contributed to other human health and environmental research. The latter will be discussed in other sections of this report.

Findings:

- Information about employment and historic land use and occupancy was critical in the reconstruction of historical radiation exposures and was only available from oral histories.
- TK studies were very effective in involving community members as active participants in the CDUT process.
- A high level of training and attention to detail is crucial to ensure the accuracy of oral history evidence.
- Elders and other community members would like to see Délįne youth and the public in general educated about the history of Port Radium and the involvement of Délįne people in this history.
- Interview projects should be designed carefully to ensure that the information gathered fulfills all intended objectives.
- Extensive involvement of community members in TK research was empowering for individuals and in some cases contributed to the healing process.

Recommendations:

1. TK should be incorporated into the implementation of CDUT recommendations, such as the design of a site remediation plan, long-term monitoring plan and community healing activities.
2. Given the development of community capacity around TK research, it is recommended that the community consider other areas that would benefit from TK research (e.g. self-government, resource management, etc.).

2.2 Capacity Building

As stated in the Action Plan, "[the] involvement of the community is essential to improve community capacity development and should be a part of all processes and studies", and "of prime importance is the role of Délįne in planning, implementing and interpreting, i.e., managing the studies".

For DUT core staff, capacity was developed by working alongside experienced researchers to design and implement community-based research. Other positions were project-based or temporary, and a variety of education and training opportunities were provided for DUT staff and community members.

2.2.1 Capacity Building through Employment

2.2.1.1 Core staff

Manager

The manager's duties included overseeing the financial and logistical requirements of all DUT projects, as well as participating in all CDUT meetings and fulfilling the reporting requirements for both the Délı̨ne First Nation (DFN) and the CDUT. Given the size and complexity of CDUT projects and budgets, the various individuals who occupied this position developed significant capacity in project management skills.

Data Manager

This position was initially created to maintain the Community Profile (Genealogy) database, and eventually included the setup and maintenance of the DUT library, oral history, digital photo collection and GIS databases. The data manager became proficient in general database design and management skills, as well as several software applications including Roxio Media Creator, MS Access, MS Powerpoint, Total Recorder and ArcView.

Communications Manager

This position implemented a community communications strategy and provided technical support to the DUT office. Communications products included a DUT newsletter series and website. The communications manager gained skills in layout and graphic design, including software applications like MS Publisher, MS Powerpoint, Adobe Photoshop and Micromedia Flash.

Fieldworkers

The DUT fieldworkers were the cornerstone of CDUT traditional knowledge research. Their involvement ensured that a comprehensive base of information about Port Radium and the ore transportation route was collected from community members. Training was provided through Aurora College and a community research trainer. Through their involvement with a wide range of projects and communications activities, these individuals developed significant capacity in many areas including community-based research, facilitation, public speaking and language translation.

Figure 2.6 DUT Fieldworkers

DUT Fieldworkers Marlene Tutcho, Edith Mackeinzo and Irene Betsidea preparing for a focus group with community members, 2003

2.2.1.2 Temporary/ Project-based staff

Community Wellness Worker

This position was created to assist with mental health and community healing activities. The community wellness worker developed capacity around counseling (individual and group), event management and report-writing by working with a mental health therapist and the CDUT health and social programs coordinator.

Environmental Monitor Trainees

Two trainee positions were created in order to build community capacity in environmental sampling and monitoring. The trainees worked with a biologist to collect and prepare samples for laboratory analysis, and participated in several training initiatives. One of the trainees continues to work as a field assistant on visits to Port Radium and other former mine sites.

Field Guides/Assistants

Community members accompanied scientists as guides and field assistants and helped conduct sampling of the water, air, soil, vegetation and wildlife at the Port Radium site. In total, 9 community members assisted with site assessment activities. The experience and skills developed by community members will be useful in long-term monitoring at Port Radium.

Summer Students

Two summer students were employed each year and were involved in the following projects: DUT library cataloguing, community profile (genealogy) project, oral history analysis, environmental assessments and general office administration.

Work Experience Student

During the school year 2002/2003, a grade 10 student from ?ehtseo Ayha School in Délįne worked in the DUT office for three hours per day. This was not a paid position, but the student received academic credit for assisting in a wide range of projects and activities such as scanning and digitizing photos, preparing public presentations, library cataloging and event planning.

Figure 2.7 Environmental Monitor Trainees

Lee Tutcho, Gordon Mackeinzo and Colin Macdonald preparing traditional food samples for laboratory analysis, December 2003

Education and training initiatives undertaken by DUT staff and others are shown in Table 2.1.

Table 2.1 Education and Training Initiatives

Education/ Training Program	Participants	Notes
Action Plan development workshops	Community members, Chief and Council, CDUT staff	Experts discussed the role of traditional knowledge research and risk communication
Aurora College courses	Fieldworkers, data manager	Courses included basic computers, workplace literacy and English upgrading
Dene language training	Fieldworkers	This was an ongoing component of the Oral History project to ensure accurate translation of interviews
Community Research Training	Fieldworkers	Skills that were taught included questionnaire development, interview techniques and operation of recording equipment
GIS Training	Fieldworkers, data manager, communications manager, DFN and Land Corp. staff	A trainer from Aurora College conducted several phases of GIS training; it enabled DUT staff to create land use and occupancy maps based on oral histories
Database Management	Data manager	While focused on the operation of the Community Profile database, the trainer also taught general database design and management skills
CILDI (Canadian Indigenous Languages and Literacy Development Institute) Course at University of Alberta	Fieldworkers	Participants obtained three university credits through this three week course
Graphic Design Course at University of Alberta	Fieldworkers, data manager, communications manager	Introduction to graphic design techniques and software programs
Wildlife sampling	Environmental monitor trainees	Trainees assisted a wildlife biologist in the collection, preparation and cataloguing of traditional foods samples
Climate change monitoring	Environmental monitor trainees	Climate change biologist taught basics of climate change research and associated monitoring techniques (wildlife track counts, snow/ice measurement)
Taiga Lab program: Environmental Sampling, Analysis and Interpretation	Environmental monitor trainees	Basics of environmental sampling and lab procedures; included a visit to Colomac mine site
Mine site remediation conference	DUT Manager, Negotiator, Band councilors	In preparation for remediation options selection, key decision makers in Délı̨ne learned about how other mine sites have been cleaned up
Proposal and report writing workshop	DUT, DFN and Land Corp. staff	
Team leadership and facilitation workshop	DUT, DFN and Land Corp. staff	

2.2.2 CDUT Findings and Recommendations on Capacity Building

Findings:

- Thirty-two Délı̨ne community members have been employed at various times and in various capacities by the CDUT since the beginning of Action Plan implementation.
- Long-term employment was more effective than short-term employment in developing skills and generating commitment, but project-based and part-time employment opportunities maximized the number of community members who were involved in the project overall.
- Community based research and activities (TK, communications) provided more opportunities for community involvement and capacity development than scientific studies.
- Capacity-building has to be a sustained effort in order for it to attract motivated individuals and achieve real results.
- Lack of formal accreditation for training and skill development was recognized as a weakness of capacity-building efforts.

Recommendations:

1. Training initiatives should be included in remediation and long-term monitoring activities for the Port Radium site.
2. Local students should be encouraged and provided with financial support to pursue formal education in areas related to environmental management, such as environmental science or engineering, so that in the future the community can have its own expertise in these areas. Scientists and developers who visit the community should talk to students about the employment opportunities and educational requirements associated with their work.

2.3 Communications

Communication is identified as one of the guiding principles for Action Plan implementation. Communication is at the heart of the CDUT mandate to resolve the human health and environmental issues surrounding the Port Radium mine, because resolution of these issues will not happen unless community members feel that their concerns have been sincerely and effectually addressed.

Through the activities described below, the CDUT sought to keep community members informed of all its research and activities. Communications about CDUT projects also took place through informal means, as the employment of many community members in CDUT research and activities educated other people in the community through word of mouth.

2.3.1 Déline Uranium Team Office

After the formal establishment of the CDUT, an office was set up in Délı̨ne to maximize community involvement in research and activities. The Délı̨ne Uranium Team (DUT) consisted of project management and support positions that were filled by community members (see section 2.2.1.1, above) as well as several professional staff positions related to respective project areas (science advisor, TK project manager, health research coordinator). The DUT office was located in the Band office complex, which provided the opportunity for community members to visit the DUT office and learn about the research and activities that were being conducted on their behalf.

2.3.2 Chief and Council/ DUT Advisors

DUT staff held bi-monthly meetings to update the DFN Chief and Council and CDUT advisors on Action Plan progress and obtain feedback and input on project design and implementation.

2.3.3 Focus Groups

Focus groups were conducted often to ensure community involvement in the design and implementation of community-based studies. Participants were usually selected based on their knowledge of and interest in Port Radium issues (i.e. former Port Radium and transportation route workers and residents).

2.3.4 Newsletter

The first DUT newsletter was produced in March 2003. Five subsequent issues (500 copies each) were produced and distributed in the community and mailed to other interested people who live outside of the community. The newsletters provided updates on CDUT research, and often included photo spreads of archival material or current DUT activities such as healing journeys or workshops.

2.3.5 Website

A DUT website was created in 2004 to provide information about the history of Port Radium and the CDUT, updates on CDUT projects and activities and profiles of CDUT staff.

2.3.6 Photo Shows

Several public exhibitions of photographs collected by the DUT were held in the community. Two of these displayed archival photos of Port Radium, the transportation route and Délı̨ne, while a third featured photos from the healing journey to Cloud Bay. (see section 4.2.1).

Figure 2.8 DUT Focus Group

Alfred Taniton, Leon Modeste, Rosie Sewi, Dora Blondin, Joe Blondin Jr. and Betty Takazo at DUT focus group re: research guidelines, October 2003

Figure 2.9
Presentation of Port Radium Site Remediation Plan

Délı̨ne community members with a model of the Port Radium former mine site during the community presentation of the Port Radium Site Remediation Plan, June 2005

2.3.7 Workshops/Open Houses

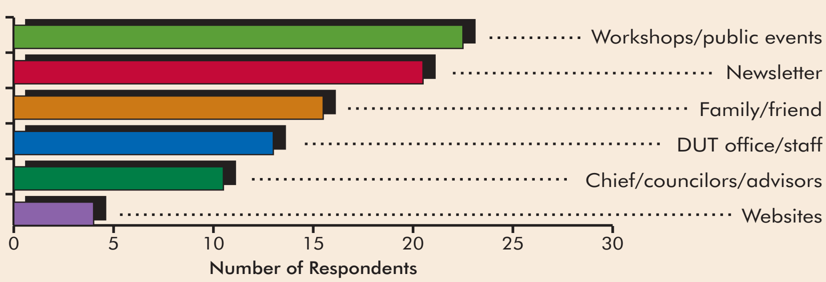
Workshops and information sessions were often used to educate the community about pertinent issues, or provide updates on Action Plan research and activities. Workshops on cancer, depression, stress/anxiety and grieving were primarily aimed at fulfilling the community healing aspect of the CDUT mandate, but also gave staff an opportunity to update community members and answer questions about Action Plan progress. An information session was held in July 2003 to present results of environmental studies. Community members provided input and feedback for the development of the Port Radium site remediation plan during public meetings held in November 2004 and June 2005.

2.3.8 CDUT Findings and Recommendations on Communications

Findings:

A random survey of Délı̨ne community members (n=30) was conducted in January 2005 to gauge the effectiveness of various communications tools. Respondents were asked to identify all methods through which they had received information about the Délı̨ne Uranium Team. The results of the survey are presented below (Fig. 2.10).

Figure 2.10 Communications Survey



Additional findings include:

- The CDUT initiated productive communication between Délı̨ne and Canada on issues related to the Port Radium uranium mine.
- Communications activities within the community have been crucial to the successful implementation of CDUT research and activities; in particular, initial communications and education efforts (e.g. Risk Communication Workshop, Experts and Community Workshops) legitimized the work of the CDUT for the community.
- Accurate translation is very important, and very difficult when discussing scientific projects because many terms have no direct translation.
- Different age groups need different methods of communications; i.e. most elders are not literate in Dene or English, therefore information must be presented orally whereas youth and adults are a better audience for written material.
- The DUT website has been effective in communicating with audiences outside of Délı̨ne.
- It is very difficult to reach everyone in the community or to know if information has been fully understood.

Recommendations:

1. For future public presentations, translators/fieldworkers should be given adequate preparation time to ensure accurate translation, especially of technical terms.
2. When conducting long-term research in the future that involves or is of great significance to the community, it is recommended that a community liaison person is based in Délı̨ne to maximize community involvement in the project and assist in the communication of research results.
3. Communications activities should continue during the implementation of CDUT recommendations (e.g. site remediation, development of community healing programs).

2.4 Information Collection and Management

A large volume of information was collected by the DUT during four years of Action Plan implementation that had to be managed and organized efficiently. Major achievements in this area, as well as considerations for future use or storage of collected materials, are described in this section.

2.4.1 Library

Copies of all documents related to Port Radium held by INAC formed the basis of the DUT library. Other literature about Great Bear Lake and the Sahtu Settlement Area was gathered from the Sahtu Land Use Planning Board library and the University of Edmonton library. Currently there are 1030 entries in the library database.

If space is available, the library should be made available for future use by the public or school; a computer will be required to maintain the library database and the DFN should consider whether additional staff and resources may be required to facilitate public access.

2.4.2 Audio/Video Collection

The DUT office holds all original audio tapes and CDs of interviews with elders and other community members about Port Radium. Some were produced during the CDUT Oral History project, while others were previous interviews conducted by the Délı̨ne Dene Band. The DUT also obtained copies of all video-taped interviews conducted during the production of the *Village of Widows* documentary, as well as copies of archival and current videos related to Port Radium, the Northern Transportation Route and the general history of the area.

DUT staff have copied all the materials in the collection. Originals have been labeled and stored in secure, locked containers and should be kept by the DFN in a safe location. The duplicate collection will be passed over to the DFN, which should consider its potential as an educative tool in the school or community. Protocols for the use of this material, which included considerations about confidentiality, were developed only for CDUT purposes; therefore the DFN should develop protocols for other possible future uses as required.

2.4.3 Photo Collection

The DUT built a sizable photo collection during the past four years. Archival photographs were gathered from various sources, including Délı̨ne community members, the National Archives (Ottawa), and the Prince of Wales Heritage Centre (Yellowknife). As well, staff members kept a photographic record of current CDUT activities such as healing journeys, Port Radium site visits and community events.

This collection consists of over 3500 digital copies, which are currently stored on a removable hard drive; all originals were scanned and returned to their respective owners. The collection has been copied to CDs for safekeeping and the hard drive will be turned over to the DFN.

2.4.4 Databases

Databases created by the DUT to manage and store information are listed below. The DFN should assume responsibility for the future administration and management of these databases. This may require training, which could be provided by the former DUT data manager.

- Community Profile (Genealogy) database: contains linked genealogical records for all community members, living or deceased, as far back as could be recalled or documented. The database requires periodic updating by a trained administrator, and the information it contains is considered confidential.
- Photo Collection database: all photographs collected by DUT staff, digitized and entered into a MS Access database (see above).
- Library database: MS Access database catalogues all documents (see above).
- GIS database: contains information about current and historic land use of Port Radium and transportation route sites. When used in conjunction with mapping software, this information can be used to generate maps. Besides land-use information recorded for the CDUT, this database

Figure 2.10
Photo Collection

Photo displays from DUT photo collection at the Délı̨ne Cultural Centre, March 2004

includes local and regional base maps which may be useful in the future for local development or land management projects.

- Oral History database: 168 interviews are catalogued in a MS Access database which can be searched by name of respondent, interviewer, interview project or dates. Each interview exists as an original audio/video recording (see section 2.4.2), a digital transcript and a digital audio file.

2.4.5 CDUT Findings and Recommendations on Information Collection and Management

Findings:

- The hiring and training of a full-time data manager was necessary for efficient organization and easy local access to the material.
- The visual presentation through the photo collection of Délı̨ne's history with Port Radium has been a very effective way to raise the profile of the CDUT in the community.
- The CDUT library is a potentially valuable source of information if administered effectively.

Recommendations:

1. Délı̨ne is currently working toward the establishment of a permanent research facility in the community to promote and manage scientific and TK research conducted in Délı̨ne and surrounding districts ("Délı̨ne Knowledge Centre", or DKC). Such a facility would be the ideal place to house Port Radium related materials and information collected through CDUT projects in the long term. Therefore, the CDUT recommends that the DKC initiative should be considered and supported in planning follow-up activities to the Final Report (e.g. site remediation and long-term monitoring, community healing programs).
2. For the short term, all materials, information and office equipment currently held in the DUT office should pass to the DFN. The DFN should consider how collections may be used in the community, and what human resources would be required to facilitate these uses.

REFERENCES

1 *" They Never Told Us These Things": A Record and Analysis of the Deadly and Continuing Impacts of Radium and Uranium Mining on the Sahtú Dene and Métis of Great Bear Lake, Northwest Territories, Canada* (Délı̨ne: Dene First Nation of Délı̨ne, 1998), 88; see also p.6, ch.1 of this document.

CHAPTER 3
FACT FINDER

The Action Plan proposed a Fact Finder study to gather all relevant information about the mine and its operations. To this end, a thorough search for documentary and archival records related to the Port Radium mine site and its operations was undertaken.

3.1
Research Objectives

A list of research objectives was compiled by Natural Resources Canada and the Délı̨ne Uranium Team (DUT). Researchers were instructed to focus on the period during the lifespan of the Port Radium uranium mine (1931-1960). General research topics included:

- Issues related to Dene workers and residents at the Port Radium uranium mine and transportation route sites, including: names; occupations; working conditions; living conditions and; health and safety measures
- Description of the uranium mines and their operations, including: description of ore bodies and ore grades; methods of tailings disposal and; mine decommissioning
- Evolution of general mining and ore handling, particularly radium and uranium, practices and regulations
- General knowledge of radiation health effects and evolution of national and international radiation protection standards
- Compliance with safety requirements at the Port Radium uranium mine
- Identify substantive gaps in documentation regarding all of the above questions

3.2
Research Methods

A Fact Finder study was commissioned in October 2003 by Natural Resources Canada in cooperation with the community of Délı̨ne. Intertec Management Ltd. was selected as the consultant for the project through a joint Natural Resources Canada - DUT selection process.

A wide variety of information resources were reviewed by the Fact Finder team, with government reports and scientific literature comprising the largest sources. Community records, researched and developed by the DUT, were also an important part of the information resources utilized by the researchers.

The DUT and departmental officials of the Government of Canada and Atomic Energy of Canada Limited cooperated fully with the consultants. However, a request for information to Canada Eldor Inc., which now holds records related to the operation of the Port Radium uranium mine, was declined with no reasons provided. However, other records were available which indicated that no Délı̨ne Dene had ever been Eldorado employees, either as underground miners, mill workers, or in any other capacity. The Northern Transportation Company Ltd. (NTCL), a former federal crown corporation that oversaw the transportation of mine product and supplies along the Northern Transportation Route, notified the consultants that employment records from this period had been destroyed. Therefore, most of the above questions related to working and living conditions

Figure 3.1 Dene Loggers

Edward Blondin cutting logs for the Port Radium mine at Cameron Bay, c. 1950

for Dene people in the vicinity of Port Radium and at the Great Bear River sites were answered primarily through to oral histories gathered by DUT staff.

3.3 Study Findings

The Fact Finder report includes the following major findings:

1. Issues relating to Dene people

- No record was found that any people of Délı̨ne Dene ancestry had ever been employed or resided at the Port Radium mine site although there was evidence that people of Délı̨ne Dene ancestry resided in the vicinity, sometimes in close proximity to the mine site.
- Trade occurred between the Délı̨ne Dene and Eldorado at Port Radium. This trade pertained to the provision of caribou or moose meat and logging.
- Information was found that at least two residents of Délı̨ne Dene ancestry acted as pilots on the boats that moved the barges along the Great Bear River and possibly along the Mackenzie River.
- People of Délı̨ne Dene ancestry were engaged, along with others, in loading and unloading bags of ore and other goods along the water transport route at three locations on the Great Bear River. Although no direct evidence was found, it is possible that some Dene workers were also involved in loading/ unloading barges at Port Radium.
- No evidence could be found that any safety precautions or protective clothing were provided to any of the personnel along the transportation route, not only with respect to radiological hazards but to all hazards including corrosive chemicals, combustible materials and explosives which were also transported on the barges.
- No evidence was found to indicate that people of Dene ancestry were treated differently than non-native employees with respect to health and safety issues.
- Evidence was found that indicates that Eldorado mine was a good neighbour toward Délı̨ne Dene people, as that term would be understood during the period. For example, information was found that Délı̨ne Dene people used the Eldorado commissary on a periodic basis. Many instances were found of general medical help and health services being provided to Délı̨ne Dene people through the Port Radium hospital/nursing station that was operated by Eldorado. Eldorado aircraft were also used to transport patients of Aboriginal ancestry to facilities in Edmonton and other locations.

2. Mining operations

- The ore products from the mine included radium and uranium concentrates and cobbed ore, pitchblende, silver-pitchblende, silver-copper concentrate and cobalt cobbed ore. Most of this ore was

Figure 3.2: Bennet Landing

Bennet Landing, one of three cargo transfer sites on Great Bear River, c. 1950

Figure 3.3 Plane Landing

Plane landing at Port Radium site, c. 1954; acid leach plant visible at left

Figure 3.4 Hand Cobbing Uranium Ore

Port Radium mine workers hand cobbing ore, c. 1938

shipped to the Eldorado Port Hope refinery while some of the silver and copper concentrates were sent to a refinery in the United States.

- The grades of ore that were milled and shipped from the mine were initially high, but declined steadily. In 1934, the average grade was 46.7% uranium oxide, and by 1946 had declined to 13.4%. Hand picked and gravity concentrate ore was packed and shipped in double bags paper or canvas and jute.
- From 1952-1958, in addition to gravity concentrate, chemical concentrate ore was produced at an acid leach plant at the Port Radium site, using sulfur that was shipped into the site as a yellow powder. Yellowcake, or sodium diuranate, was produced from 1958-1960. Both these products (chemical concentrate and yellowcake) were shipped by air in metal drums.
- During the initial 15 to 20 years of operation, tailings were discharged directly into Cobalt Channel adjacent to the gravity mill. After the installation of the leach plant in 1952, 340,000 tons of uranium tailings were dredged from Cobalt Channel for reprocessing and subsequently discharged into the deeper waters of Great Bear Lake.
- The mining and milling practices employed by Eldorado were found generally to be within the acceptable technology and regulatory practices as prescribed by governments at the time the project was in operation. If judged by current standards, they would be considered dangerous and hazardous and would not be permitted in any jurisdiction in Canada.
- When Eldorado closed the Port Radium mine in 1960, there were no requirements for the formal decommissioning of uranium mines in Canada other than to secure the entrances and prevent unauthorized entry. Eldorado removed the diesel generators and some of the leach plant equipment, and most of the remaining facilities were taken over by Echo Bay Mines.

3. Radiological protection

- Early scientific theories about the health risks of radiation exposure focused on short-term effects from high doses, rather than the cumulative effect of longer term exposures. It was not until 1962 that the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) published a report that reflected the scientific consensus that radiation doses substantially lower than those producing acute effects may occasionally give rise to a wide variety of harmful effects, including cancer.
- The Fact Finder study concluded that the operation of the Port Radium mine and mill took place several decades in advance of the practical understanding of the effects of exposure to radiation. Mine workers and those who worked with such products during the period in question (1930-1960) were exposed to much higher radiation levels than would be acceptable by current standards.
- In general, Canada was as advanced as other countries in developing laws, regulations, standards and measures to protect workers from harmful exposure to radiological sources. It neither led, nor lagged, other countries in this regard.

4. Policy of secrecy

- For much of the period between 1931 and 1960, the Port Radium project was operated within an overall policy of secrecy due to its commercial and military significance.

- This secrecy surrounding the mine was further enhanced by its isolated location and limited access. Furthermore, for some periods of time, Port Radium facilities assisted, and were assisted by, both Canadian and United States military forces.
- As a consequence of the various secrecy arrangements, certain information may exist but still be unavailable. The authors of the Fact Finder report have no basis to evaluate the amount or the nature of what, if any, information may continue to be held in that category.

3.4
CDUT Findings from Fact Finder

- No employment records were available for Délı̨ne Dene people involved with ore transport or other activities to support the mine at Port Radium. Information about working conditions and employment histories was largely gathered from oral histories.
- No Délı̨ne Dene people were ever directly employed by Eldorado at the Port Radium mine or mill.
- Oral histories contain many testimonies of exposure to “yellow powder”. This was originally thought to be uranium concentrate (yellowcake), but CDUT research indicates that it was most likely sulfur powder that was shipped to the mine site from 1950-1960 for use in the acid leach plant. Yellowcake was produced at the Port Radium site from 1958-60 only, and was shipped out by air in metal drums. This finding had implications for the dose recon-struction and epidemiology projects because it meant that Délı̨ne Dene people were exposed to sulfur powder, not yellowcake.
- There is no evidence that Dene people were treated differently than non-Dene with respect to occupational health and safety standards.
- There is no evidence that Dene or non-Dene transportation route workers were informed about the potential hazards of the products they were handling.
- During the uranium mining period, knowledge of radiation health effects, particularly with respect to low-level exposure and long-term effects, was not very advanced and as a result Canadian and international radiation protection standards were much lower than they are today.
- During this period, health and safety standards were implemented for certain occupations that involved radiation exposure, particularly radium refining (c.1930) and radium/uranium mining and milling (c.1950). Also, uranium ore became subject to federal regulations governing the safe transport of radioactive materials in 1946. However, at the time, none of these standards or regulations was applicable to workers involved in the transport of uranium ore.
- The Port Radium uranium mine was generally in compliance with regulations relevant to the mining and milling of uranium.
- Early theories about the health effects of radiation exposure focused on short-term, acute effects. A major advancement in the understanding of long-term radiation health effects occurred around the time of the closure of the Port Radium uranium mine in 1960.

CHAPTER 4 HUMAN HEALTH STUDIES AND COMMUNITY HEALING

This chapter presents the community healing activities and the findings of human health studies that were undertaken by the Canada-Délı̨ne Uranium Table (CDUT). The overall objective of the human health studies was to investigate the past and present impacts of the Port Radium mine on Délı̨ne Dene people. This has been a complex undertaking that considered varying degrees of physical, psychological, spiritual and social impacts.

4.1 Human Health Studies

The Action Plan clearly outlined the need for very specific human health studies to determine whether the health of the people from Délı̨ne is or will be affected by contamination from the Port Radium mine site. More specifically, the CDUT attempted to answer the following questions:

- Is there a present day health risk? If so what is the source of the risk and how much are Délı̨ne residents exposed to this risk?
- What have been the impacts of Port Radium, and the perception of the impacts of Port Radium, on the physical, social and cultural health of Délı̨ne? What can be done about this?

The first question regarding present day health risks is addressed by the Human Health Risk Assessment, the results of which are presented in Chapter 5. In order to address the second question, a variety of health studies and activities were undertaken and are described in this chapter.

4.1.1 Community Health Needs Assessment

During the Experts' Workshop in 2000, the importance of understanding the current health needs of the community of Délı̨ne was identified. In 2001, public health consultants Gardee and Jackson undertook a preliminary community-based health needs assessment. This assessment focused on a number of key organizational and service delivery issues and identified several significant problems with existing services.

The assessment took into account various data sources, including personal interviews with Government of the Northwest Territories (GNWT) officials and community members. The authors concluded that the administrative efforts of the GNWT and the Inuvik Regional Health Board are disproportionately greater than the level of health services within the community and the appreciable health gain for the people of Délı̨ne. Gardee and Jackson noted an absence of any meaningful participation at the community level in health policy or program development.

The quality of existing health information in the Northwest Territories (NWT) was described by Gardee and Jackson as poor, and reliable data is often unavailable or inaccessible, which is hindering the development and evolution of effective health service delivery at a local or regional level. At the time of the assessment, local health services were significantly detached from the local community, programs lacked cultural sensitivity, were unable to respond to local needs and community members were highly critical of the service delivery and care they were receiving.

The health care service focuses primarily on physical symptomology, with minimal health promotion or prevention efforts. Issues of staff recruitment and retention are persistent; there is an absence of standards for treatment and no effort is

Figure 4.1
Déline Health Centre

made for joint and integrated health and social service delivery within the community.

Concerns about health service delivery, collected from local community members during the community health needs assessment, include:

- Even when serious physical health problems are presented they are being told they are only signs of old age.
- Slow speed of referrals for diagnostic services and slow detection of cancer.
- People often are sent away from Délįne for further tests and treatments and upon returning home find little support from current services. This was particularly the case for palliative care.
- There is no psychological support to assist people in the grieving process, which in some cases is manifested in symptoms of depression.

Three strategic objectives were developed by the authors in order to address the deficiencies identified above:

- To identify and promote the public health of the community. Programs need to be preventative, educational and capacity building in nature.
- To increase the effectiveness, efficiency and responsiveness of service delivery. This includes finding a balance between preventative, secondary and tertiary care.
- To develop and nurture partnerships between health service agencies and local community services. Local community services need to have control over policies in order to deliver culturally sensitive health care that addresses community concerns, sets local goals, involves front line staff and recognises the contributions of local and traditional knowledge.

4.1.2 Community Health Profile

In 2004, KAVIK-AXYS Inc. developed a statistical community health profile. Fifty-three indicators were identified to provide a historical and current overview of descriptive epidemiological data (KAVIK-AXYS Inc., 2004). As part of the health profile, the consultants looked at health status indicators, determinants of health, health system performance indicators, as well as community and health system characteristics. The data was largely obtained from existing national and territorial databases. A number of indicators were unavailable at the community level.

Relevant findings of this study include:

- Overall cancer rates for Délįne are not statistically significantly different from the Northwest Territories (NWT). The most common type of cancer reported in Délįne was lung cancer (28% of all cases), followed by kidney/bladder cancer (24%) and colorectal cancer (20%). The observed lung cancer incidence in males was higher in Délįne compared to NWT; kidney cancer among women was higher in Délı̨ne compared to Canada, but not the NWT[a].

- The three main causes of death within the community from 1991-2001 are: cancer, injury, and circulatory disease (see Figure 4.2). This is comparable to the NWT. The most common causes for hospitalizations from 1997 to 2001 in Délı̨ne were related to respiratory or digestive ailments, gum and oral caries, injuries and poisonings, or mental disorders.

Figure 4.2 Causes of death in Déline and NWT, 1991-2001

Because of the small numbers of total deaths, especially in Délı̨ne (N=43), the difference in percentages are not statistically significant. For example, number of deaths due to cancer in Délı̨ne is about 5% higher than the NWT, but this difference represents only two additional cancer deaths in Délı̨ne over a ten year period.

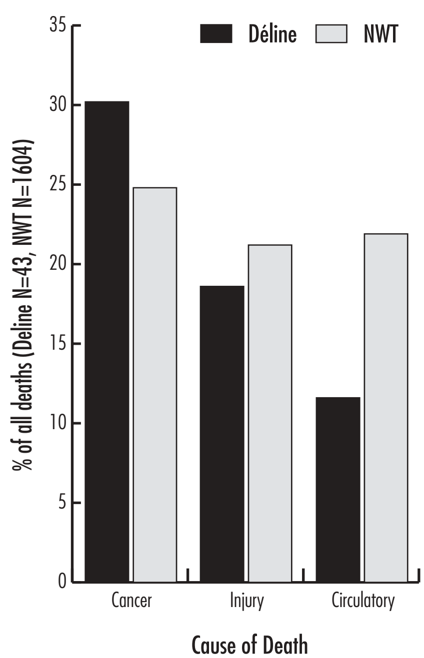
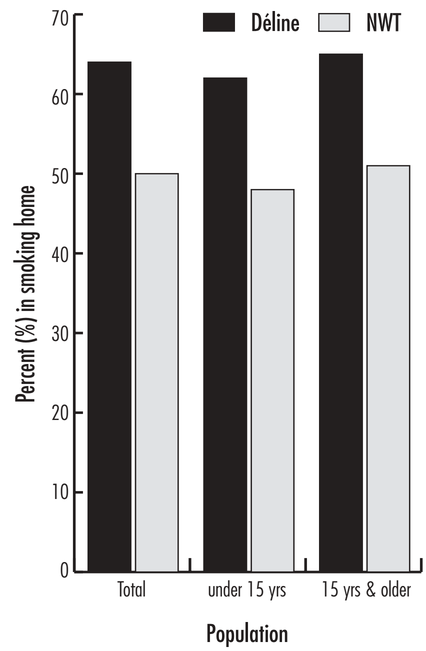


Figure 4.3 Smoking homes in Déline and NWT, 1999



- Based on the latest available data (1999), smoking rates are higher in Délı̨ne for adults (60%) compared to NWT (42%) and Canada, and more people live in homes where a family member(s) smokes (see Figure 4.3).
- The unemployment rate in Délı̨ne is the highest within the Sahtú region (30% compared to a regional average of 13.8%). More than 35% of households in Délı̨ne earn less then $20,000/year and the average income from 1994 to 2002 has fluctuated from $20,000 to $25,000.
- In 2001, all adults in Délı̨ne could speak or understand their primary language. In the same year 87% of children in Délı̨ne could speak or understand an Aboriginal language compared to 50% in the NWT.

a These findings are based on a statistical comparison of cancer rates in *Délı̨ne*, the NWT and Canada for the period 1986-1995. The study was conducted by Health Canada using statistics obtained from the NWT Cancer Registry. Statistics should be interpreted cautiously because of gaps in the NWT Cancer Registry prior to 1990 and the small numbers of people in both Déline and the NWT.

- Hunting and fishing increased from 40.6% in 1993 to 52.4% in 1998. Approximately 50% of women in Délı̨ne have been involved in crafts from 1993-1998.
- The most common reason for people to visit the health centre was emergency care; few preventative care visits were identified.

4.1.3 Individual Physical Assessments

Health experts that helped develop the Action Plan recommended screening Délı̨ne residents considered to be at greatest risk for experiencing health impact due to uranium mining and transport, for early identification of health problems requiring medical intervention. This group included the silver miners, ore carriers, surface workers, their widows and the first generation of persons who lived at Port Radium. The early detection and diagnosis of cancer was one of the key priorities of this project.

From the beginning of this project, several methodological concerns were identified. One of the most difficult obstacles was the history of poor record keeping and the gaps in individual records. The consultant leading the assessment also noted that chart reviews revealed the often sub optimal or poor quality care people had received.

Complete or partial health assessments were carried out on 53 people, the majority of whom had lived or worked at the mine/ transportation route sites. Of the people assessed, approximately half were older than 70 and almost half had lived along the transportation route for more then five years. The complete health assessments included: a chart review, review of body systems, a physical examination and a mental health assessment.

The major past or present health conditions identified by examining physicians were tuberculosis and pulmonary disease, followed by cardiovascular disease. Five people were identified to have cancer, and no new diagnosis of cancer was made during the health assessments. During the health assessments, a high level of substance use, including alcohol use, was identified. Family violence was also recognised as a significant problem.

One of the key findings by the physicians who conducted the assessments was a profound and pervasive fear of radiation and a tendency to blame any and all health problems on the mine and the legacy of the mining activities. It was also noted that many elders believe that the young people, as a result of the multiple deaths in the community, are suffering from an extreme sense of loss and abandonment.

The consultants also noted the absence of any prior screening or health assessment process for former ore transport workers or any other persons who may have been exposed to radiation, despite the belief held by community members and political leaders in Délı̨ne that mining activities at Port Radium are linked to cancer in the community.

4.1.4 Mental Health Assessments

In July 2002, a psychologist carried out mental health assessments with 47 individuals using structured interviews and other evaluative methods. The mental health assessments were conducted in two parts: a series of individual assessments with individuals belonging to the identified high risk group, and several focus group meetings with community members and professionals.

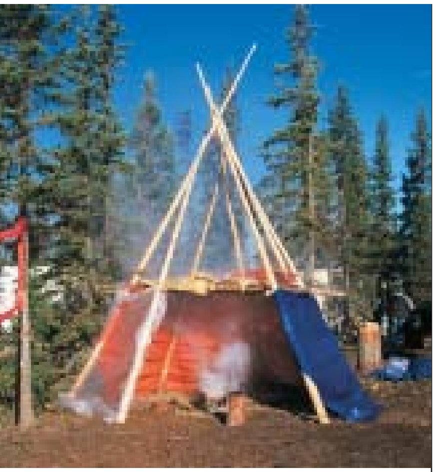


Figure 4.4 Tipi at Cloud Bay

Délı̨ne elders believe that good mental health is linked with the ability to live on the land.

The focus group meetings identified some key mental health issues, such as the number and kinds of deaths of family members which people had experienced, the feeling of being overwhelmed by grieving and sadness, the lack of appropriate assistance and support and the gulf between young and old people in the community. Members of the focus group also identified a number of strengths that assist community members in dealing with mental health issues; these include, but are not limited to: the closeness and willingness of family members to support each other, the ability to live and survive on the land by hunting, fishing and trapping and continued consumption of traditional foods. Manneschmidt noted that Dene elders hold very specific notions about mental health. The elders described that a person will be in good mental health if he/she is able to survive and enjoy living on the land, knows how to deal with interpersonal and group conflicts and how to be spiritually strong.

The clinical interviews with individuals gathered information on family history, personal history, particulars relevant to their psychological history, the experience of traumatic events, personal difficulties and strengths, as well as information gathered through the use of the two standardized scales. Several individuals displayed unresolved grieving issues, particularly those who had experienced multiple deaths of family members. Those with unresolved grieving issues often had family members who experienced a long period of suffering prior to their death, or the bereaved did not comprehend the causes of death. These events did not fit the traditional cultural pattern of loss, and in some cases family members died away from home and their bodies were not returned for burial.

Overall 44 % of the individuals assessed showed clinically significant problems in the area of non-psychotic depression and anxiety and 17% in the area of intra-familial stress. One person required and was referred for immediate professional help. At times, these problems appeared to be inter-generational. Anxiety and depression among the elders were often due to their inability to fulfil traditional roles. Due to disabilities and illness, many are confined to their homes and are cut off from any social network. Some also feared that their disabilities might lead to another illness, primarily cancer. People were rarely informed about treatment options and believed that their conditions were inevitable and fatal.

Some of the individuals assessed also displayed symptoms of Post Traumatic Stress Disorder (PTSD), as well as symptoms of alcoholism, depression and anxiety. Dr. Manneschmidt states that years of abuse can lead to PTSD, particularly when many of the perpetrators have not been challenged to be responsible for their actions and the abuse continues over long time periods. Five of the elders assessed clearly described elder abuse and seven individuals reported high levels of anxiety around marital stress and abuse.

One of the key findings of the individual assessments and the focus groups was the loss of a sense of community within Délı̨ne. Some elders are unable to fulfil their role as advisors and leaders to young people, as many suffer from anxiety and depression. The often described gap between youth and elders can be linked to this phenomenon. As one elder pointed out "youth are lost; they don't have an identification and they don't seem to have a connection to either their culture or the old people."

Manneschmidt noted that fear of environmental contamination and associated health impacts have affected the community as a whole, resulting in low collective morale and diminished personal and community identity. Further, many community members felt that their concerns about the impacts of Port Radium were not taken seriously, which caused feelings of apathy and depression.

Manneschmidt recommended hiring a mental health therapist who would be located in the community for a period of two years, with training in cognitive-behaviour therapy and family therapy to assist both primarily and secondarily affected individuals.

4.1.5 Mental Health Strategy

As recognised in the health needs assessment, the psychological needs of individuals in the community are not being addressed in a systematic manner; there are no clear strategies to deal with the obvious anxiety and distress experienced by certain sections of the population. In response to these inadequacies, the CDUT sponsored a community mental health workshop in February 2002 and subsequently developed a mental health strategy outlining possible ways to address the identified issues.

During the mental health community workshop, the concerns raised during the community health needs assessment were reiterated, particularly that there are currently no facilities or resources to deal with the health and social effects of Port Radium on the community. Community members pointed out that the effects of cancer and death in the community have led to problems with alcohol and substance use. Elders have been particularly challenged to talk about their feelings and to cope with their grieving issues.

All participants in the workshop recognized that rebuilding a connection between the elders and young people is essential to ensuring the well being and future of the community. Many emphasized the connection between physical and mental well-being. Several people suggested that the establishment or enhancement of cancer-related programs and services in the community, such as early detection, palliative care and support services, would help in alleviating the stress and anxiety experienced by cancer patients and their families. The importance of encouraging people to take more responsibility for their health was also noted.

A mental health strategy was developed by Bernard in 2004. General objectives for the development of a mental health framework included: the development of a cohesive process that focuses on the delivery of health promotion and mental health initiatives; the collaboration of organizations located within the community to develop health promotion and wellness resources; responsive administrative and program delivery structures; and the determination of best practice models. Specific areas of concern identified by community members included substance abuse, (including alcohol and prescription medication), grieving, relationship issues, gambling,

Figure 4.5 Healing Journey

Délı̨ne community members who participated in the development of a mental health strategy emphasized the importance of on-the-land healing activities, like the healing journey to Cloud Bay in September, 2003.

violence - in particular violence against children, women and elders - the loss of cultural identity, and physical health problems. Bernard proposed a variety of strategies to address some of these concerns.

- A key strategy was described by people as "we need to go back to the land! In doing this people get really focused and become more open-minded. There is a transformation of people when they go out!" On-the-land healing projects were seen as the fundamental enterprise to be undertaken. In order to facilitate this, a camp should be established out on the land that is accessible year round, consisting of several cabins and a learning facility
- Develop political strategies that focus on cultural and community relevant policy development
- Combine traditional healing and modern practices in a balanced approach
- Develop a series of workshops that focus on: relationship issues, such as trust and attachment; substance use; grieving; healing from physical and sexual abuse; personal growth; and the recovery of physical health
- Develop sharing/healing circles that provide a safe and caring place for people to disclose and work through personal issues
- A number of facilities are needed; these include a youth centre, a family support centre, a shelter for women and youth, and low-cost housing
- A community protocol for responding to and dealing with violence should be established immediately

All strategies need to be aligned with traditional ways and reflect Dene cultural values, as well as provide opportunities for building capacity in the community. As one person pointed out, "our ancestors' teachings have given us guidance and directions that have kept us strong in the past. We need to hold our ancestors' teachings in high regard, then maybe we have a chance for our future generation."

4.1.6 Oral History Analysis

The oral histories provided detailed information about the people who worked and lived near Port Radium and the Northern Transportation Route, their family structures, their occupations, the length of time people lived in the given area and other activities they engaged in during that time.

The oral histories underwent three different analyses. The first focused on factors relevant to the dose reconstruction study (e.g. lifestyle, diet, exposure to contaminants), the second analysis focused on the identification of general themes, and the third analysis focused on the psychological and social impacts of the mining activities. A number of observations are common and consistent in all three analyses, such as observed historical environmental contamination and effects caused by uranium mining (e.g. oil on the water, yellow powder, abnormal fish, odd colour fire from wood collected along the shorelines near the mining activities), the perceived health impacts associated with the mine (e.g. cancer), new health services that were provided at Port Radium (e.g. hospitalizations, tuberculosis treatment), and the genuine fear of the land at the mine site and along the sites of the Northern Transportation Route. In the transcripts the work conditions were described as hazardous, primitive and labour intensive. No protective clothing or other safety measures were ever provided to ore transport workers.

Vandermeer (2004) in the second analysis of oral histories points out that people truly believe that the effects of the uranium mine have been detrimental to their health; one participant pointed out, "I never heard of cancer before" the mine opened. People continue to be fearful of the land at the mine site and sites along the northern transportation route. This fear has had a tremendous impact on people's lifestyle and worldview, because the intimate relationship of people with their environment is such a crucial part of Dene culture. This changed relationship has led to increased levels of uncertainty and anxiety and an anticipation of adverse health effects for individuals and their families.

Oral histories were also analysed for evidence of social impacts. As pointed out by Meadows (2005), it is important to understand that current scientific knowledge and cultural history are reflected in the oral histories. Care has to be taken to contextualise the interviews; it is sometimes difficult to assess when a change in perception or a re-interpretation of an individual's experiences occurred. The eventual discoveries of the harmful effects of uranium mining, the use of the uranium in the Manhattan project and government involvement and secrecy surrounding the mining operations, may have influenced the way that people remember or characterize their experiences.

Meadows identified a number of categories in her analysis of the social impacts of the mining activities: the natural environment, family structures and impact, economic influences, lifestyle, relations with non-Dene, loss and death, deception and uncertainty, health and cultural environment. In analysing the natural environment, Meadows notes that people believe that the environment was seriously harmed and that many people anticipate long-term harm. Many people said that they would not drink the water, eat the food or collect traditional medicine plants from the site. As expressed in the oral histories, Dene

Figure 4.6:
Warning Sign at Mine Site

A sign warning of elevated radiation levels at the Port Radium mine site, September 2004. The old RCMP cabin is visible in the background.

Figure 4.7 Dene Woman at Port Radium

An unnamed woman (thought to be from Rae Lakes) and her baby standing in front of ore bags at Port Radium, c. 1950.

people feel that by showing such disrespect for the land as the mine operators did, Dene people were also disrespected because their lifestyle was, and still is, dependent on the health of the environment.

Family structures and traditional lifestyles were impacted by mining activities. For the first time Dene men spent part of the year working for wages; they spent long days, and in some cases weeks, away from their families. Dene men that logged or hunted for the mine were usually assisted by their wives and children. Some of the men ate at the work sites or were introduced to non-traditional foods through non-Dene people, while the majority of women and children continued their traditional diet. Some children were introduced to the school system, while other children accompanied their parents during traditional activities. There is very little mention of traditional social activities in the transcripts, such as hand games or drum dances; activities were primarily work or survival oriented.

The advent of mining at Port Radium likely accelerated the transition to a cash economy. People talked about purchasing sugar, tea, flour and non-traditional clothing items. Although the mine provided some income and relief in times of hardship, poverty was a common experience. Sources of income were sporadic, wages were generally low and there were no long-term pensions or financial benefits. Instead of being guided by the need for food and the seasons, the lives of many Sahtúot'įnę were for the first time guided by the availability of work.

The oral histories are permeated by stories of loss and death. For some, the interviews become opportunities to share the memories of loved one, while for others it was an opportunity to talk about their feelings of isolation. A general sense of disorder and confusion is clearly evident in the oral histories; people often seem overwhelmed, left with many questions regarding their own and their families' health, well-being and longevity. The perceptual link between exposure to

Figure 4.8 Eldorado Hospital

The Eldorado hospital at Port Radium, c. 1955. It was the first facility in the region that provided medical services for Dene people.

mining activities and illness and death affects people's sense of harmony with nature. This in turn has undermined the Dene worldview that they live in a world where things unfold in a natural way, which in the past resulted in a sense of confidence and positive outlook.

Since Dene people first started using the medical services provided at the Port Radium mine site, patients were occasionally sent away for a long time for treatment when they were sick, and frequently family members did not know the reasons for their ailments or the treatment they underwent. In some cases, people were sent to hospitals in Edmonton and Inuvik, where they passed on and their bodies were never returned to their families or the community. To the dismay of family members, some gravesites in Edmonton remain unidentified and unmarked to this date.

The oral histories also contain many references to uncertainty and confusion about the extent of environmental and health impacts associated with Port Radium, aggravated by the perception that information was not communicated to the Dene over the years, or was even deliberately held back. This lack of information related to many aspects of their lives: not knowing that the debris and dust from uranium mining could affect their health, that of their children and the whole of their environment; secrecy about what was being done with the rocks being taken from their land; mysterious illnesses that were not explained; the decimation of families by deaths, especially related to cancer; and the uncertainty about the current and future health of themselves and their families.

According to Meadows, perceived local threats to health, in particular the threat of unsafe food and water, combined with the lack of adequate information on how to achieve good health, has fractured the holistic harmony of Dene life. She also points out that the social impacts of Port Radium occurred in the context of colonization, which is generally recognized to have profound, widespread and often devastating effects on the health of native peoples and communities.

Dene people are also now aware of the value of the radium and uranium ore and in retrospect question why so little of this value was conveyed to them, either as wages or long-term benefits. Meadows asserts that one of the most critical and enduring impacts of uranium mining activities on the lives of the Dene is the perception of a social injustice that was done to them. This has left a legacy of mistrust with those in authority, whether the government, mine owners or another unnamed 'they'.

4.1.7 Dose Reconstruction

To determine levels of historical exposure to radiation, a dose reconstruction study was undertaken for the CDUT by SENES Consultants Ltd. Key to the dose reconstruction study were the oral histories, the residency list that was developed by the Délı̨ne Uranium Team (DUT) (see Figure 2.2), historical accounts of the mine operation and production record, the Fact Finder report, expert considerations relative to the re-creation of transport activities and scientifically based exposure and dose modelling. The dose reconstruction study was undertaken in two parts. The first part of the study undertaken in 2004 was a feasibility study, which had the following objectives:

- to determine if sufficient data exist to develop reliable dose estimates for ore transport workers

- to determine the feasibility of estimating doses to other groups of people from Délı̨ne who worked at the Echo Bay silver mine or who lived near the Northern Transportation Route.

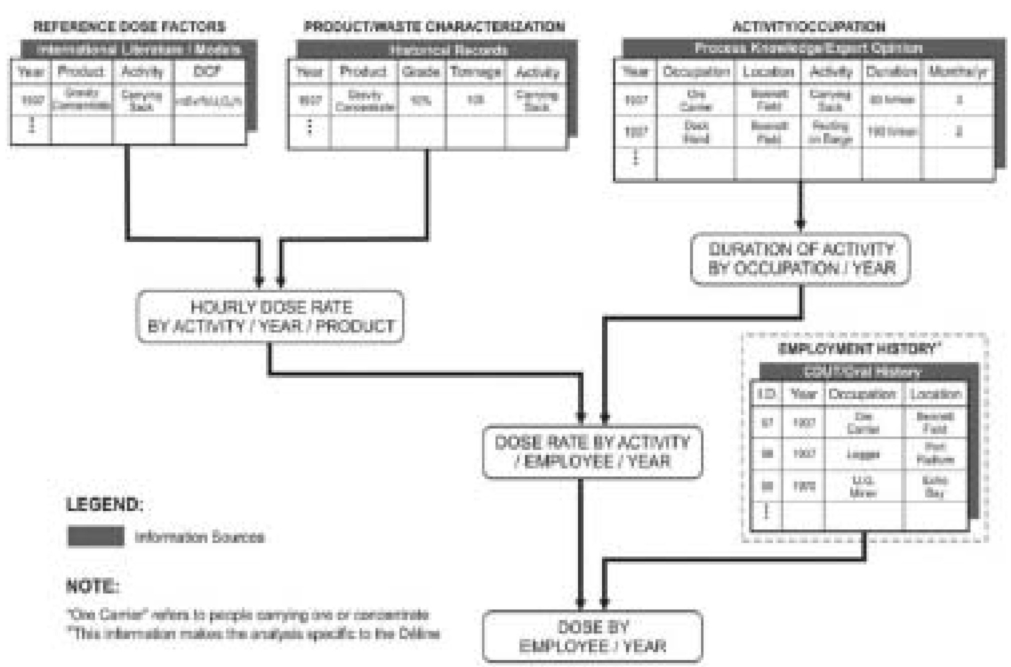
Part way through the pilot study it was determined that it was feasible to estimate potential doses to people from Délı̨ne who worked as ore transport workers (given several uncertainties) and this objective was added to the feasibility study. The results of the feasibility study also concluded that while it is possible, in principle, to estimate doses to other groups of Dene who worked and lived in the area, the doses are likely much smaller and in addition highly uncertain. It was not considered reasonable to reconstruct doses for people from Délı̨ne who had worked at the Echo Bay silver mine, given the lack of data, the relatively brief durations and the low recorded values of exposures.

A number of exposure pathways (the ways people could have been exposed to radiation) were identified: exposure to contaminated soil from the transport of ore concentrate, exposure to gamma radiation arising from the concentrate (ore) bags that were stored along the transportation route, exposure through dust inhalation, dust ingestion and external gamma radiation from contaminated soil. The exposure pathways also took into consideration background natural levels of radiation.

The detailed calculations for the dose reconstruction study for people from Délı̨ne involved estimating the number of hours a person spent at each activity, estimating the dose rate while performing the activity and calculating the dose by multiplying the duration of exposure by the corresponding dose rates for the activity (see Figure 4.9). It became clear that the external gamma radiation exposures from carrying product sacks or

Figure 4.9 Dose Reconstruction Methodology

This figure depicts the sources and flow of information in the estimation of historical radiation doses to ore transport workers.



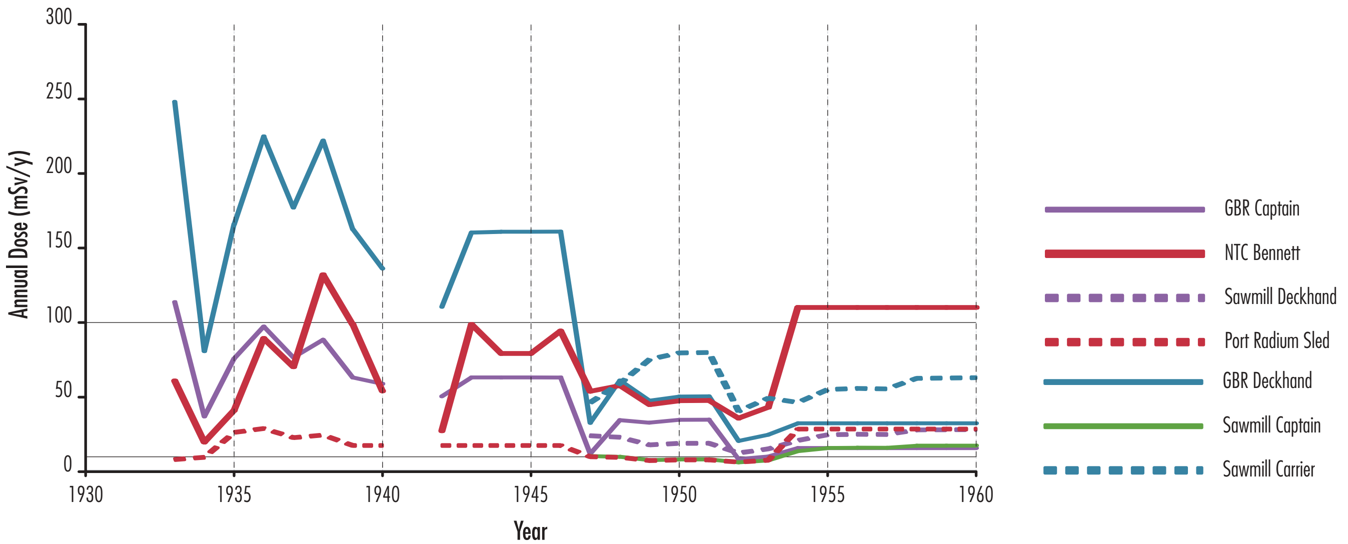
while near stacks of product were the major sources of radiation dose received for all transport occupations and transport locations. These gamma exposures comprise approximately 80% or more of the total dose. Individual doses were calculated for people from Délı̨ne who transported ore bags.

The individuals worked for various lengths of time during the season when water routes were passable, for varying numbers of years. The numbers of seasons worked ranged from 1 to 27, and the upper bound for cumulative lifetime doses ranged from 27 to 3015mSV. The overall average annual dose rate was about 76mSv/y for individuals. The preliminary estimates of average annual dose rates for individuals were in the range of 27 to 201mSv/y, depending on the individual's job. Overall, the highest annual dose rates were estimated for the deckhands that travelled from Port Radium to the Great Bear River during the 1930s and early 1940s (see Figure 4.10). Although researchers acknowledged uncertainties in the calculations, they also emphasized that dose estimates are "upper bound" (i.e. unlikely to be higher) because they were based on conservative assumptions.

Doses were also calculated for groups of people, such as family members of ore carriers and people from Délı̨ne, who had non-transport related employment, such as loggers. Doses were estimated for several age groups at three different locations. Several potential exposure pathways for non-ore carrier groups were identified, such as dust inhalation or ingestion from soil or concentrate bags and external gamma radiation from soil and concentrate bags. The external gamma exposure to the concentrate bags was the dominant contributor to the annual doses for each age group, with

Figure 4.10 Generic Upper Bound Estimates of Radiation Dose Per Year

This figure shows generic estimates of radiation doses to ore transport workers; estimates vary according to location, occupation and ore grade. This information was used in conjunction with individual work histories, reconstructed through traditional knowledge projects, to estimate individual doses to 35 Délı̨ne Dene ore transport workers.



approximately 90% of dose being due to this exposure pathway. The annual dose estimates to hypothetical individuals from six age groups ranged from 0.9mSv/y (adult) to 5.5mSv/y (5 year and 10 year old child). The major uncertainty in these dose calculations was the exposure time, but researchers again noted that these estimates are upper bound.

The present day radiation dose limits for workers are 100mSv over five years with a limit of 50mSV in any single year, while the radiation dose limit for members of the public is 1mSv per year. Researchers identified the difficulties of making a firm estimate of the potential health risks to the transport workers, due to the small number of workers involved in the study and the conservatism and uncertainty in the calculated doses, but also stated that they were unaware of any way to improve the estimation of radiation doses to the ore transport workers and those who lived along the uranium transportation network.

The health risks that can be associated with radiation dose exposures were further explored in the epidemiology feasibility study.

4.1.8 Epidemiology

The Action Plan recommended an epidemiology study be carried out to determine if the population of Délı̨ne is subject to any increased risk of health problems (past or present), compared to the NWT and Canada. Since the CDUT and the community are primarily concerned with health problems that might be related to uranium mining and transport, specifically radiation exposure, researchers focused on cancer.

A full epidemiological study would compare the observed number of cancers in a study group to the expected number of cancers in a group with the same number of people and age characteristics from a representative population. If the difference is found to be statistically significant - that is, unlikely to occur by chance alone - then the study would have detected an excess risk in the study population.

Due to the small size of the population in question, experts advised the CDUT to first conduct a feasibility study. The objectives of the epidemiological feasibility study are to:

- determine if sufficient data exist to conduct an epidemiological study;
- develop recommendations for future studies (if appropriate); and
- assist in developing meaningful health monitoring programs targeting the appropriate groups and outcomes.

The results of the dose reconstruction study concluded that ore transport workers had the highest levels of radiation exposure during the uranium mining period. Family members of these workers, who may have lived in proximity to Port Radium or transportation route sites, would have received very low incremental doses. Therefore, the feasibility study focused on 35 Délı̨ne Dene ore transport workers. Due to the rarity of cancer in small numbers of exposed persons, the study initially used the more common types of cancer for which ionizing radiation is a risk (lung, leukaemia and colon cancers), and then extrapolated to total cancers.

According to risk modelling based on the dose reconstruction, 1.6 excess cancers (more than baseline) are theoretically predicted in a group of 35 individuals with ages and radioactive doses the same as the ore concentrate transport workers. To assess the feasibility of a full epidemiological study, researchers needed to see if the excess number of cancers could be demonstrated in an epidemiological study. In absence of the best attainable reference rate, which would be further developed in a full study, they used a reasonable reference rate (baseline) of NWT cancer rates, corrected for higher smoking rates in Délı̨ne. This number was then used to conduct a computer simulation which would determine if a full study would detect an excess of cancer.

Using the adjusted NWT baseline reference rates, 9.75 cancer deaths would be expected in the group of 35 ore transport workers in the absence of mine-related radiation doses. The radiation doses calculated in the dose reconstruction exercise would theoretically result in a predicted 16% increase, or 1.6 excess cancer deaths, for the group of 35 workers; therefore the total number of expected cancers would be 11.35.

The authors of the study advised against conducting a full epidemiological study. They concluded that although sufficient information was available on ages and causes of death for the study group, it would be difficult to establish a back-ground reference rate for a representative population that accurately captures all other cancer risk factors except radiation exposure from ore transport. Also, because of the small number of people in the study group (35) and the relatively small predicted increase in cancer deaths due to radiation exposure, the level of confidence in any conclusions would be limited. Therefore, the study concludes that a full epidemiological study is feasible, but not recommended because findings would not be sufficiently informative.

4.1.9 Long-term Surveillance

The epidemiology feasibility study contained recommendations for long-term medical surveillance activities. The findings of the feasibility study do not indicate a significantly increased risk of radiation-induced cancer in the community. Furthermore, other CDUT health research (e.g. community health needs assessment, community health profile) has revealed that the potential effects of past radiation exposure are only one of many health issues in the community. Therefore, the study recommends that a broad and comprehensive health promotion strategy, which targets all major health issues, should be developed.

The authors of the study acknowledge that real and logical concerns about radiation exposure and cancer still exist within the community of Délı̨ne. Furthermore, cancer (radiation-related or not) is a significant health problem in Délı̨ne, as it is in most parts of the world. The Canadian Cancer Control Strategy (CCCS) was developed by experts and includes guidelines for cancer prevention, surveillance, early detection, treatment and follow-up. The GNWT has developed a version of this strategy that is adapted to be more regionally and locally relevant. Therefore, the authors recommend that the community of Délı̨ne should work with the GNWT and other authorities in adapting and applying the CCCS to meet community needs, and to serve as a model for other communities.

4.1.10 CDUT Findings and Recommendations on Human Health

Findings:

- The community health needs assessment identified a number of organizational and service delivery issues, including insufficient community participation and cultural sensitivity in the development and delivery of health policies and programs.
- The CDUT found that staffing shortages at the Délı̨ne Health Centre and the difficulty of obtaining medical records hindered the implementation of some CDUT health projects. Concerns about inadequate staffing at the health centre were also frequently expressed by community members.
- Prior to Action Plan implementation, there was no health screening or surveillance of former ore transport workers, despite the belief held by community members and political leaders in Délı̨ne that mining activities at Port Radium are linked to cancer in the community.
- A key finding of the community health profile was that the overall cancer rates for Délı̨ne are not statistically significantly different from the NWT. However researchers acknowledged that these statistics should be interpreted cautiously because of gaps in the cancer registry prior to 1990 and the small numbers of people in both Délı̨ne and the NWT.
- The community-based health studies and activities (community health needs assessment, individual assessments, cancer and mental health workshops) found that cancer is the predominant health concern among Délı̨ne community members.
- Many community members believe that health practitioners do not act quickly enough to identify cancer-related symptoms and refer patients for diagnostic tests, and that this may have resulted in cases where cancer has been diagnosed at a very late stage when treatment options are limited.
- The lack of support services for chronic disease management and palliative care has caused a great deal of stress to families of cancer patients.
- During individual assessments of 53 people, the majority of whom had lived or worked at the mine/transportation route site, the most prevalent health problems identified by examining physicians were tuberculosis, pulmonary (lung) disease, and cardiovascular disease.
- One of the key findings of the individual assessments was a profound and pervasive fear of radiation and a tendency to attribute any and all health problems to the mine and the legacy of the mining activities. As well, analysis of the oral histories supports the assertion that the majority of significant past and present health problems within the community continue to be strongly associated with environmental concerns.
- Individual mental health assessments identified clinically significant problems in the area of non-psychotic depression, anxiety, intra-familial stress and unresolved grieving issues.

- The examining psychologist concluded that many elders suffered from feelings of isolation and depression, often because illness or disability had restricted their quality of life, and thus they were not able to fulfil their role as advisors and leaders to younger people. This, combined with the premature loss of many elders, has led to a loss of sense of community within Délı̨ne.
- The psychologist found that fear and anxiety about perceived environmental contamination has severely affected the community of Délı̨ne, resulting in low morale and diminished community and personal identity. Many community members felt that their concerns about the impacts of Port Radium were not taken seriously, which has caused apathy and depression.
- Analysis of the oral histories revealed a fear of the land at the mine site and along the sites of the Northern Transportation Route. Many people said that they would not drink the water, eat the food or collect traditional medicine plants from the site. The perceptual link between exposure to mining activities and illness and death has affected people's sense of harmony with nature. The health of the wildlife, land and waters of Great Bear Lake are linked to the physical, psychological, cultural and spiritual health of community members.
- Based on the dose reconstruction, the average radiation dose for ore transport workers was about 76mSv/y. Deckhands that travelled from Port Radium to the Great Bear River during the 1930s and early 1940s were estimated to have the highest annual dose rates.
- For non-transport workers, the annual doses ranged from 0.9mSv/y (adult) to 5.5mSv/y (5 year and 10 year old child). These are similar in magnitude to background doses and are not a cause for concern.
- The epidemiology feasibility study predicated that, due to the radiation doses calculated in the dose reconstruction, an excess of 1 or 2 cancer deaths would be expected among the 35 ore transport workers, in addition to 9 or 10 cancer deaths that would "normally" be expected in a similar, non-exposed group of 35 people.
- A full epidemiology study of former ore transport workers is not recommended for the following reasons: it would be difficult to establish an accurate baseline reference rate; the predicted number of excess cancer deaths due to radiation exposure is relatively small and; the small sample size (35) limits the likelihood of a statistically significant outcome.

Recommendations:

The Action Plan identified that the following two questions should be addressed at the end of the human health studies and activities:

- What steps need to be taken for ongoing health care for individuals?
- How do we go forward with questions about historical exposure?

To promote better health, health services and health service utilization a number of recommendations have been made.

1. It is recommended that results of CDUT health studies should be used in the development of an improved health care system that is based in the region and responds to local needs.
2. It is recommended that the Délı̨ne Health Centre should be staffed continuously at a level that meets community needs.
3. Nurses and physicians working in Délı̨ne should be made aware of factors that may be unique to the community, such as cultural aspects and prevailing physical and mental health problems. It is recommended that health care staff be required to read the educational material on mining-related health impacts that was prepared for the CDUT.
4. It is recommended that mental health screening programs and long-term mental health services, particularly focusing on bereavement, depression and addictions, should be implemented within the existing framework of health services in the community. Community access to a qualified mental health therapist should be improved, and service providers in this area should receive cultural awareness training.
5. Findings contained in this report directly address the community's concerns about Port Radium-related issues (i.e. cancer, environmental contamination, mine site clean-up). Therefore it is recommended that every effort should be made to ensure that this material has been thoroughly and effectively communicated to Délı̨ne community members. Furthermore, information that has been gathered by the CDUT should be used to develop other communications and educational materials for use in the community.
6. It is recommended that the seniors' home in Délı̨ne be reopened to provide health and social care programs. These should be established with input from local people and attention to cultural values. Recommended programs include:
   - elderly care
   - chronic disease management
   - palliative care
   - respite care, day services and support
   - traditional healing
   - social and public events
7. Educational materials should be provided to the public on types of cancer, stages of diagnosis, treatment options and treatment provided within the community.
8. The Canadian Cancer Control Strategy (CCCS) contains guidelines for cancer prevention, surveillance, detection, treatment and follow-up. The GNWT and other authorities should work with Délı̨ne in adapting and applying the CCCS to meet community needs, and to serve as a model for other communities.

4.2 Community Healing

The community of Délı̨ne began to have serious concerns about health when incidence of cancer increased in the 1980s, and seemed to rise dramatically in the 1990s. These concerns intensified when people began to learn about the potential risks associated with uranium mining and transport, long after they or their family members worked in the Port Radium area or along the Northern Transportation Route. For community members in Délı̨ne this has led to a continuous preoccupation with health problems, in particular, a perceived threat of cancer. This is consistent with research that has shown that people exposed to man-made contamination frequently reinterpret their past health problems with the discovery of the contamination and they have a changed interpretation of their current health[1].

The psychological and social impacts of Port Radium have been particularly damaging to the community of Délı̨ne. These impacts include grieving and sense of loss due to the deaths of the ore carriers. The transmission of cultural skills and knowledge, especially to a generation of young men, was disrupted because of the premature deaths of elders that people believed were attributable to the mine. The health assessments and interviews undertaken by the CDUT clearly show high levels of anxiety about perceived environmental contamination, cancer and other health problems.

Throughout the community healing activities, it has been recognized that one of the most critical issues to be addressed is trust between the Sahtúot'ı̨nę and federal and territorial government agencies. In the 14 points formulated by the Délı̨ne Uranium Committee, it was recognised that an "acknowledgement of responsibility [from the government of Canada] for what has happened to our people and environment" is considered by Délı̨ne to be an essential point of redress[2]. The CDUT has undertaken a number of healing activities which are outlined in the following sections.

4.2.1 Healing Journeys

The healing journeys organized by the DUT have been a central part of the healing activities since the initiation of the CDUT. The primary purpose of the healing journeys was to build and enhance relationships between elders and youth and to reaffirm the cultural and traditional identity of Dene people. The affirmation of cultural identity was recognized by the elders as a key healing strategy. Both male and female elders acknowledged the loss of identity that came with a changed way of life, a changed relationship with the environment and the rapid loss of many key community elders.

In the first healing journey that was undertaken, elders travelled to the Port Radium area to visit their families' gravesites and to attempt to bring closure to some of their personal experiences. Other journeys were made to culturally significant sites around Great Bear Lake, such as Deerpass Bay and Cloud Bay. The trips included all age groups.

The healing journeys aimed at rebuilding peoples' crucial relationship with the land. Furthermore, the elders recognised the importance of intergenerational activities not only as a way to build community cohesiveness, but also to teach youth

Figure 4.11 Healing Journey to Cloud Bay

More than fifty Délı̨ne community members participated in a healing journey to Cloud Bay in September 2003.

and children about respect for the land and their ancestors. Sharing their ancestors' history has been crucial to the healing process of the elders; it has affirmed their role as teachers and advisors within the community, and has been important in the continuous formation of the collective memory of the community.

The healing journeys have had a significant impact not only for those directly affected by Port Radium, such as the ore carriers, but also for the youth and adults who participated. This was particularly evident in the healing journey to Cloud Bay. Throughout the journey, community members renewed and strengthened their relationships, as evidenced by youth asking community elders long after the healing journey was completed to engage in traditional games, story tellings and teachings. Traditional community activities, such as drum dances, feasts and handgames, were practiced at an increased frequency up to six months following the healing journey. Youth also became more interested in the history of Port Radium, the general history of the Sahtúot'ı̨nę and their respective family histories.

Although no scientific evidence was collected to measure the impact of the healing journeys, anecdotal evidence demonstrates their effectiveness. Key successes include the continuous engagement of elders and youth after the healing journeys, personal accounts of a decrease of at-risk behaviours such as substance use by youth and adults for up to three months after the healing journey, several projects for a science fair at the local school that explored the history and impact of the mine, as well as teachers requesting elders and representatives from the DUT to make presentations at the school.

4.2.2 Elders' Gatherings

Elders' gatherings were initiated to address the pattern of cultural and social isolation of elders within the community. Elders' gatherings were organized as a joint effort by community agencies, such as the Délı̨ne First Nation or the Nursing Station, in conjunction with the DUT. Although the timing and structure of these events varied, an emphasis was placed on the importance of social interaction and regaining a sense of personal control over the current social situation. Some of the meetings focused on the spiritual and emotional well being of the participants.

It was evident that the elders enjoyed the opportunity to socialize, exchange stories and provide mutual support to each other. Over time, people developed common goals and ideas and cultivated interdependence, which in turn provided them with a greater sense of community cohesiveness and stability. Many of the elders looked forward to these gatherings as they provided them with a venue to express their social and political concerns, as well as discuss their personal hardships and joys. The meetings were used by the DUT and other agencies to distribute information about CDUT activities and to listen to the concerns of the elders. The elders' gatherings were important elements in enhancing the public relationship between the DUT and the community.

4.2.3 Traditional Activities

As previously mentioned, the most important activities to address the psychological and social impacts of the Port Radium mine were aimed at re-establishing intergenerational linkages between the youth and elders of the community. Through these linkages, teaching opportunities were created and traditional knowledge was shared and passed on. The benefit of these activities was the reaffirmation of Dene culture and identity.

Traditional knowledge gatherings occurred on a weekly basis during 2003 and 2004. These gatherings focused on the traditional crafts and stories of elders and were open to adults, youth and children. Throughout the events trusting relationships were developed and many of the discussions revealed deep social issues and personal difficulties. At the same, time the women were able to celebrate their abilities, talents and knowledge. During the evenings, key elders took turns telling traditional stories to the group.

Continued attendance of community members at the weekly gatherings and the ability of the group to make everyone feel a part of these gatherings demonstrated the success of these activities. For the children and youth, it was a realization of the knowledge and skills of their elders. It was evident that each group began to take an interest in each others' lives; the children and youth requested that the elders tell stories and often encouraged them to share their memories.

Throughout 2003 and 2004, a number of other public events were sponsored by the DUT, including film nights and a weeklong photo show. During film nights, historic photographs or films about Port Radium or the Northern Transportation Route were shown and followed by discussions. A week-long photo show was undertaken in March 2004. Several school

Figure 4.12
Elders' Gathering

Elders Paul Baton and Alfred Taniton during an elders' gathering at Prophet Ayah's house in Délı̨ne, 2004.

Figure 4.13
Tanning Moosehide

Délı̨ne elder Jane Quitte scraping a moosehide during a traditional activities event organized by the DUT in September, 2003.

classes attended this event, and for many children, it was the first time they learned about the historic events of Port Radium and the Northern Transportation Route. Even if the children had learned about the history of Port Radium or the Manhattan Project in school, it was not until the children saw personal photographs and heard the elders' stories, that this knowledge became relevant to their lives.

4.2.4 Development of Educational Materials

As part of the community healing activities, the CDUT recognised the importance of educating community members, as well as health care professionals who provided medical care and treatment within the community. Most health care providers have never received any special training on the health impacts of mining activities, or in particular, uranium mining.

In 2004, the DUT contracted AXYS Consulting to develop educational materials on the health impacts of uranium mining for use by registered nurses and physicians at the local health centre. These materials provide information on the potential health impacts stemming from exposure to radioactive or other toxic substances associated with uranium mining activities and the most common pathways of exposure. It also includes discussion on cancer in general, its relationship to mining activities, recommended screening and diagnostic tests. The authors noted social and mental health effects and referenced material directly relevant to people at risk for experiencing health impacts from exposure to the activities of the Port Radium mine.

4.2.5 Mental Health Therapist

Recognising the significance of the psychological and social impacts of the mine, a mental health therapist was hired by the DUT in the spring of 2003. In conjunction with a community wellness worker, who was a local person with an interest in the mental health field and an ability to speak North Slavey, the mental health therapist engaged in client home visits. The mental health therapist also coordinated and co-chaired a local women's group, as well as facilitated a workshop about depression. Unfortunately, the mental health therapist remained in the community for less than two months due to personal health reasons. During her brief tenure, several difficulties were identified with running this program out of the DUT office, including lack of clinical supervision and appropriate office space; therefore, the position was not staffed again.

4.2.6 Workshop Series

The CDUT sponsored several community workshops. The specific objectives of these workshops varied, but all were generally aimed at educating community members about prevailing physical and mental health problems in the community.

The first workshop was a cancer workshop, attended by 26 individuals over the course of two days. The workshop featured five guests with expertise in the areas of radiation health effects, cancer, palliative care and regional health services. A cancer survivor also gave a personal account of her experience. Workshop participants learned about the different forms of cancer, the relationship between cancer and uranium mining, preventative cancer care, as well as potential cancer treatments and the psychological and social impact of cancer. Interestingly, many questions throughout the workshop were related to services provided at the health centre, rather than questions about cancer in general.

A depression workshop held in February 2003 was attended by 34 people. Information was presented on the types and causes of depression, and possible treatments. Discussions also focused on issues such as loss and grief, anger, alcoholism and possible ways of healing for the community of Délı̨ne. A stress and anxiety workshop was conducted in April 2003. This workshop explored individual and intra-family stressors.

The final workshop hosted by the DUT in November 2003 addressed issues of grieving. This six-day workshop placed an emphasis on educating men, women, and youth about coping strategies for grief. A facilitated workshop was held for three days; individual counselling, support groups and home visits were offered for the entire six days. A total of 73 people participated in the workshop and/or sought individual counselling.

4.2.7 CDUT Findings and Recommendations on Community Healing

Findings:

- Healing activities that focused on the affirmation of Dene culture and identity (e.g. traditional activities, healing journeys) were very successful. These healing strategies had the greatest influence on the Délı̨ne community and have assisted people in regaining collective feelings of confidence and optimism, which were damaged by many years of widespread fear and uncertainty about the effects of Port Radium on their community and their future.
- The relationship between the Sahtúot’ı̨nę and their traditional territory is crucial to their cultural identity. Healing journeys on the land were effective in beginning to rebuild this relationship.
- People who attended the workshop series were eager to learn more about mental and physical health issues. The provision of educational opportunities allowed people to gain insights into their own health and wellbeing.
- DUT staff encouraged the participation of elders in healing activities and public events through communication efforts and the provision of transportation. Elders attended healing activities in the greatest numbers (proportionately), thereby indicating that efforts to include them in community activities can be effective.

- For many years the people of Délı̨ne did not receive appropriate information about the potential risks of their exposure to mine-related contaminants, which compounded the anxiety experienced by community members The mistrust of government officials and scientists that developed over the years has been expressed many times during healing activities and public meetings. The CDUT has endeavoured to rebuild some of that trust.
- The desire for public recognition from the federal government of the contribution of Délı̨ne Dene people to the Port Radium mine, and the legacy that this involvement has had on the community, has been strongly expressed by community members. It appears that this would be a potentially significant contributor to the healing process.

Recommendations:

Any response to the findings outlined in the previous sections is complex, multifaceted and requires the commitment of all partners, including Délı̨ne, the Government of the Northwest Territories and the federal Government of Canada. One of the key issues is the question of what can be done to restore wholeness and trust within the community.

1. It is recommended that the Délı̨ne First Nation and Canadian governments should decide on and undertake a mutually agreeable form of public recognition of the contribution of Délı̨ne Dene people to the Port Radium uranium mine, and the legacy that this experience has had for the community of Délı̨ne.
2. The environmental restoration of the Port Radium mine site and the sites along the Northern Transportation Route is important for the psychological healing of community members, and should be undertaken as soon as possible. Site remediation should involve community members to the greatest extent possible, and communications efforts should continue so that the people of Délı̨ne will understand what is being done to address their concerns.
3. The community's role in future man made activities and development in and around the waters of Great Bear Lake should be maximized. Increased community participation in environmental management and policy decisions will ensure that traditional and local knowledge are enshrined in resource management practices, and will ensure that the people of Délı̨ne play a central role in the stewardship of their natural environment.
4. The CDUT recommends the continued development and implementation of community programs and activities to affirm cultural identity and foster social cohesion. These programs should include on the land activities and the development of other culturally based activities that will be relevant to all age groups, and will provide the elders with a meaningful place within the community where they can practice their traditional roles as advisors and teachers.[b]

b This recommendation also addresses findings presented in section 4.1.10 related to the psychological and social impacts of Port Radium on the community of *Délı̨ne*.

REFERENCES

1 Edelstein, M. R., *Contaminated communities: The social and psychological impacts of residential toxic exposure* (London: Westview Press, 1988).

2 *"They Never Told Us These Things": A Record and Analysis of the Deadly and Continuing Impacts of Radium and Uranium Mining on the Sahtú Dene and Métis of Great Bear Lake, Northwest Territories, Canada* (Deline: Dene First Nation of Deline, 1998), 85.

CHAPTER 5
ENVIRONMENTAL STUDIES

Environmental studies of the Port Radium mine site were carried out in conjunction with traditional knowledge studies of the Great Bear Lake environment and maximized community participation. The environmental studies undertaken since 2000 are listed in Table 5.1.

The results of these studies are presented here in response to environmental issues identified in the Action Plan:

- Environmental impacts of the mine site
- Risks to animals and people
- Safety of traditional foods
- Remediation Plan for Port Radium

In section 5.5, recommendations are presented for the remediation of Port Radium and for ongoing monitoring work.

Background and Site Description

The Port Radium mine site is located on a peninsula on the eastern shore of Great Bear Lake in the Northwest Territories (66°05′N; 118°02′W). After fifty years of almost continuous mining, the site was closed in 1982. To close the site, the last mine operator demolished most of the buildings, removed/buried equipment, covered tailings with rock and gravel, secured mine entrances and blocked discharge from the tailings pond. Figure 5.1 shows aerial photographs of the site before and after the decommissioning of the Echo Bay silver mine. Past mining and milling activities impacted about 20 hectares of land.

The state of knowledge about the site has improved greatly from 1999 to present. Under the direction of the Canada-Délı̨ne Uranium Team(CDUT), several projects have been carried out to assess site conditions and associated human health and ecological risks. Program activities to date have included collecting information, samples, and measurements from the site and surrounding areas to characterize current

Table 5.1 List of CDUT Studies of the Port Radium Mine Site

Year of Study	Title of Report*
2001	Preliminary Assessment of Environmental Conditions at the Former Port Radium Mine Site
2002	Data Analysis Report for the 2001 Field Program
2002	Human Health and Ecological Risk Assessment
2002	Summary Report on Site Conditions and Decommissioning Considerations
2003	Port Radium Environmental Study**
2004	Human Health and Ecological Risk Assessment**
2004	Port Radium Discussion of Remediation Options and Considerations**
2004	Water Quality Field Program August 2004 (by INAC and community members)

**All reports were completed by SENES Consultants Ltd. unless noted.*
*** These studies update earlier studies with new information.*

Figure 5.1

The Port Radium Mine Site - Then and Now physical, chemical, and radiological conditions at the site and nearby areas. The results of the site assessment are used in calculations for the Human Health and Ecological Risk Assessment (HHERA). The sampling programs and the results are presented below by sampling component. Figure 5.2 is a map of the main site showing the features referenced below.

Waste rock and gravel makes up all roadways, the causeway, the staging grounds (mill, leach plant, buildings, main shaft area, etc.), the docking areas, and covers for Tailings Containment Areas (TCAs).

There are two locations where water drains from the site into Great Bear Lake: Cobalt Channel, and Inner Labine Bay. Drainage into Cobalt Channel originates from the upper mill site and waste rock area and flows west down the hill towards Cobalt Channel. Drainage into Inner Labine Bay is from two intermittent runoff flows which combine into one before entering the bay. The drainage originates from the upper hills towards the east part of the site and flows through waste rock before entering Inner Labine Bay.

During the mining operations at Port Radium, the majority of uranium tailings were disposed of in Great Bear Lake, and the majority of silver tailings were deposited in McDonough Lake. The site also has three contained on-land TCAs with dry covers (Murphy's TCA, Radium North TCA and Radium South TCA); and one semi-contained TCA, also with a dry cover (Silver Point TCA). McDonough Lake was used as a TCA during the Echo Bay silver operations and retains a water cover. There are two areas of exposed on-land tailings: Labine Point, and down the hill towards Murphy Bay.

5.1 Environmental Studies

Environmental studies were carried out to determine the environmental impacts of the site, and to assist in the identification of the contaminants of concern and important contaminant pathways in order to carryout a HHERA of the site. The risk assessment results are summarized in section 5.2. Findings of the environmental studies are summarized below.

5.1.1 Great Bear Lake Water Quality

The results of the 2001, 2003 and 2004 study programs, discussed below, are consistent and indicate that the site has had, and continues to have, impacts on the water quality on the site and in Great Bear Lake immediately adjacent to the mine site.

All water quality guidelines referenced below are Canadian Council of Ministers of Environment (CCME) guidelines for the protection of aquatic life. These guidelines were developed nationally, by consensus of 14 federal, provincial and territorial ministers, for use in water management within each jurisdiction. These guidelines are not always indicative of poor water quality, and do not account for site-specific conditions, such as natural background levels. For this study, whenever CCME guidelines are exceeded, these measurements were carried through the risk assessment to assess potential effects on aquatic life.

Figure 5.2 Main Mine Site Features and Former Land Uses

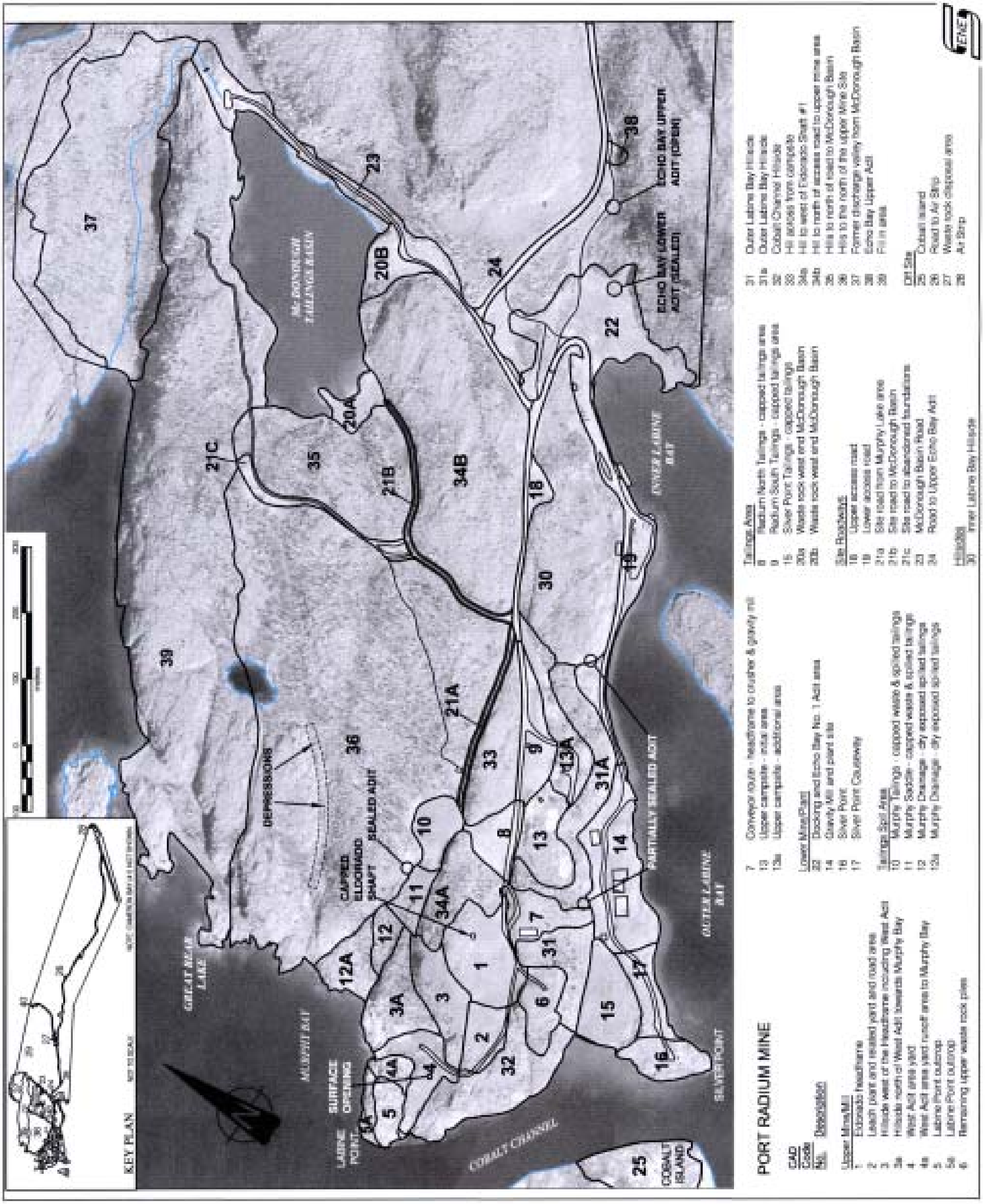


Figure 5.3 2001 Site Assessment Field Crew

From left: Mark Bowman, James Takazo, Roddy Modeste, Gerd Wiatzka (SENES Consultants), Thomas Neyelle, Morris Modeste, Gary Taniton.

Water from Great Bear Lake was collected from six areas around the site (Inner Labine Bay, Outer Labine Bay, Silver Point, Cobalt Channel, Murphy's Bay south and Murphy's Bay North) to determine the environmental impacts of operations at Port Radium. Control samples were collected away from the site, both far from shore and within twenty metres from shore, to give a representation of the radionuclides and metals content in areas where no mining impacts are anticipated. All Great Bear Lake sampling locations are displayed in Figure 5.4, and results summarized in Table 5.2.

For Table 5.2, where there were multiple measurements in an area and measurements through depth, maximum measured values were used (data were not grouped). Specific results for Great Bear Lake water quality are as follows:

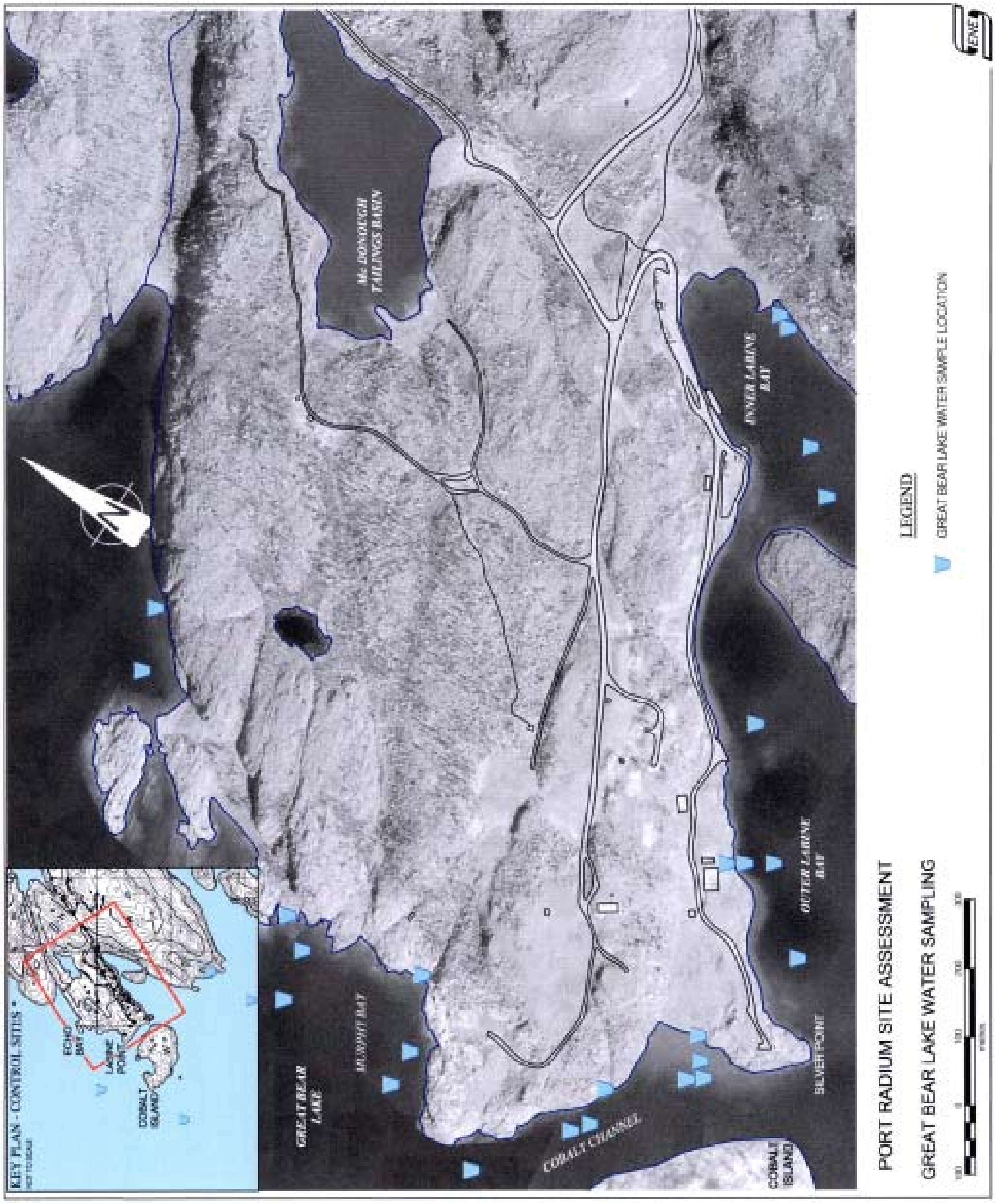
- In general, metal levels 10-20 metres from shore are lower than samples

Table 5.2
Water Quality Guideline Exceedences in Great Bear Lake near the Port Radium Mine

	Control Sites			Sample Areas					
Metals	North	Control	South	Control	Far offshore	Control	Inner Labine	Bay	Outer Labine
Aluminum	X	X		X	X	X	X	X	X
Arsenic				X	X	X			
Copper				X	X	X	X	X	
Lead	X	X	X	X	X	X	X	X	X
Selenium				X					
Silver							X		
Zinc	X			X	X	X			X
Radium-228							X		

Note: X marks an exceedence of CCME guidelines for the protection of aquatic life

Figure 5.4 Great Bear Lake Water Sampling Locations



taken at the shore, and higher than the control samples. This finding demonstrates the localized impacts the mine has on Great Bear Lake.

- Samples collected from Inner Labine Bay, Outer Labine Bay and Silver Point showed higher metal levels than Cobalt Channel, Murphy's Bay South and Murphy's Bay North. These higher levels exceed guidelines for aluminum, arsenic, copper, lead, selenium, silver and zinc. No radionuclides were detectable in any of these samples.
- Samples collected from Cobalt Channel exceeded guidelines for aluminum, copper and lead and reached the guidelines in one sample for silver and radium-228.
- Samples collected from Murphy's Bay south exceeded guidelines for aluminum, copper and lead. Samples collected from Murphy's Bay north exceeded guidelines for aluminum, lead and zinc.
- All metals and radionuclides in the control samples (indicative of background levels) taken far from shore were below guidelines except lead. These results indicate that natural background levels for lead in Great Bear Lake are elevated above CCME guidelines.
- In control samples taken within 20 metres from the shore at locations north and south of the site, aluminum, lead, and in one instance zinc exceeded guidelines. Other metals were below guidelines and a large number of them below the detection levels for the analysis. All radionuclides tested in the control samples were below detectable levels.

The results indicate that drainage from the Port Radium site is impacting water quality on the site and in Great Bear Lake adjacent to Port Radium for some of the metals identified as a potential concern. However, studies also show that the overall water quality in Great Bear Lake is good.

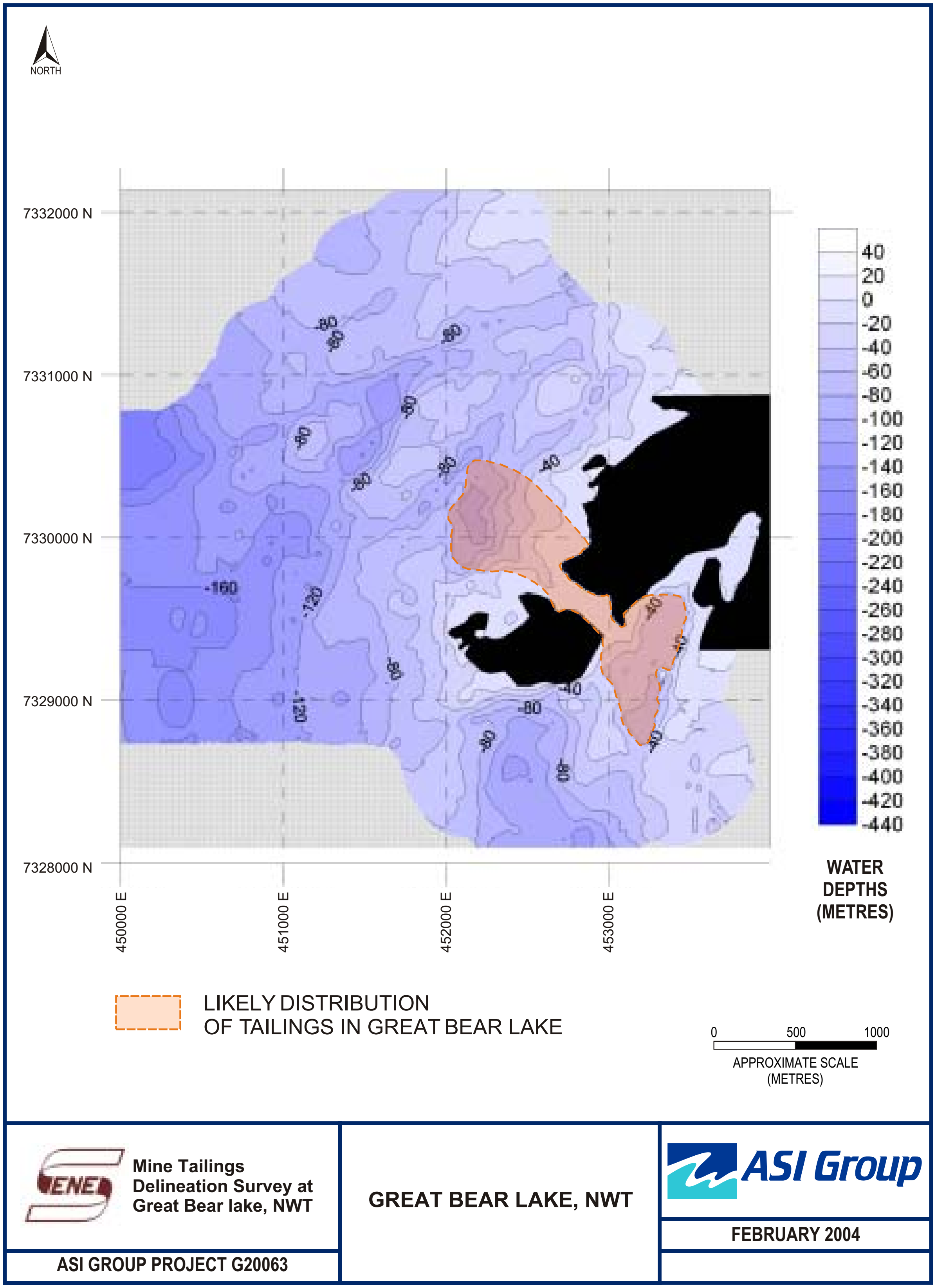
5.1.2 Lake Sediment and Benthic Organisms

One of the goals of the environmental studies was to determine if the tailings in Great Bear Lake are having any effect on the aquatic environment in the area, and if so, to determine the severity and mechanism of these effects.

The in-lake tailings studies carried out included lakebed mapping, tailings and sediment sampling, bioavailability and leachability testing of the tailings, and benthic organism sampling. Due to the rocky substrate, lake-bottom sediments which were not composed of tailings were difficult to collect. All samples collected were from identified tailings locations except one. The results of the lake sediments sampling in Great Bear Lake are:

- The lakebed survey and mapping program identified several general areas where tailings are located in the immediate vicinity of the mine site, as well in a trough approximately 500 metres northwest of Murphy Bay which appears to be a repository for tailings (see Figure 5.5). In addition, the regional and detailed bathymetric survey indicates that, for the most part, the tailings are located in the deep water offshore of the mine site of Great Bear Lake, from which they are extremely unlikely to move. If the tailings do move, they will likely move into even deeper sections in the immediate area and not migrate to the western shores.
- All sediment sites sampled, including the control site, contained arsenic, copper and zinc above Canadian

Figure 5.5 Map of Uranium Tailings Distribution in Great Bear Lake



Interim freshwater Sediment Quality Guidelines (ISQG). These results indicate that in unimpacted areas some metals are naturally high. Samples collected from known tailing locations were also elevated in cadmium, mercury and lead.

Lake benthos is often a primary source of food for both small and large fish and is an important indicator of water and sediment quality. Their life cycle is short compared to that of fish, and they show the effects of changing water or sediment quality much more quickly than fish, which are able to tolerate higher levels of pollution.

- Bioavailability tests were completed on the tailings to determine if metals were in a chemical form that could be taken up or absorbed by organisms. Results of these studies determined that aluminum, boron, chromium, iron, phosphorous, silver, titanium and vanadium are not bioavailable. Arsenic, barium, beryllium, cobalt, copper, lead, manganese, molybdenum, nickel, strontium and zinc are available to varying degrees. The risk assessment considers bioavailability in its models.
- Benthic samples collected in the vicinity of the mine were found to have low density (not many organisms) and low diversity (not many species). This is likely due to the sandy nature of the tailings in Great Bear Lake, and the prevailing boulder and cobble substrate that does not provide suitable habitats for productive benthic communities.

5.1.3 Fish

According to historical observations, lake whitefish were commonly observed feeding in the area immediately offshore of the Port Radium mine site. Despite several attempts since the early 1990s at netting whitefish in spring and fall, none could be captured in the waters near the mine site. In northern lakes, lake whitefish typically move into shallow rocky bays and river mouths between September and October in preparation for spawning. The whitefish samples taken by Dene fieldworkers are from Cameron Bay, approximately 10 kilometres from the mine site. At present, lake trout are readily obtainable in summer around the shores of the former mine site.

Liver and muscle tissue samples were collected from a total of 10 lake trout and 18 lake whitefish and analysed for the presence of radionuclides and five metals that have the most potential to affect biological organisms (arsenic, copper, mercury, zinc and nickel). The latter four of those metals were found at measurable concentrations, and arsenic concentrations were below detection limits in most samples. Radionuclide levels were all below detection limits.

For whitefish liver and muscle tissue, mercury did not exceed Health Canada (2002) human consumption guidelines in fish for any of the samples collected. For lake trout liver and muscle tissue, mercury concentrations (0.62 and 0.22 mg/kg, respectively) are comparable to, or lower than, levels reported in other northern studies. For both lake trout and whitefish liver and muscle tissue, other metals levels did not present any concerns.

Analysis of whether the health of the fish would be affected by the contamination from the mine site is included in section 5.2, Risk to Animals and People.

5.1.4 Surface and Ground Water Quality

The surface water samples were collected from pooled water above tailings deposits and runoff water at three locations on the mine site. Groundwater was collected from wells installed in the subsurface tailings. The on-land water sampling locations are shown in Figure 5.6. The results for surface and groundwater at the site are:

- All surface samples contained metal concentrations higher than concentrations found in Great Bear Lake. The measured concentrations of metals in the surface drainage waters are higher (approximately 5 to 100 times for some metals) than measured in Great Bear Lake, into which most drainage will eventually discharge.
- Groundwater samples were collected from pore water directly in contact with the tailings. As expected, groundwater samples are reflective of the tailings content and contain high concentrations of metals and radionuclides. There is little movement, if at all, of groundwater through the on-land TCAs as evidenced by borehole investigations.

In summary, the subsurface water in contact with the tailings is the most contaminated on the site, yet fairly inaccessible and immobile. The surface water and runoff on site, which is intermittent and seasonal, is less contaminated than subsurface water, but well above guidelines for some metals. Based on a site runoff model, the yearly runoff from the site is 36,000 m^3.

The surface water, including McDonough Lake TCA, is used in the risk assessment as a drinking source for terrestrial animals.

5.1.5 Vegetation and Soil

Through the on-land site sampling, measurements and assessment work carried out, it is estimated that about 170,000 tons tailings, or 19% of the total amount of uranium tailings, were placed within localized surface depressions or in the Silver Point area of the site. The vegetation and soil sampling was carried out to assess the human health and ecological risks associated with the impacted areas of the site.

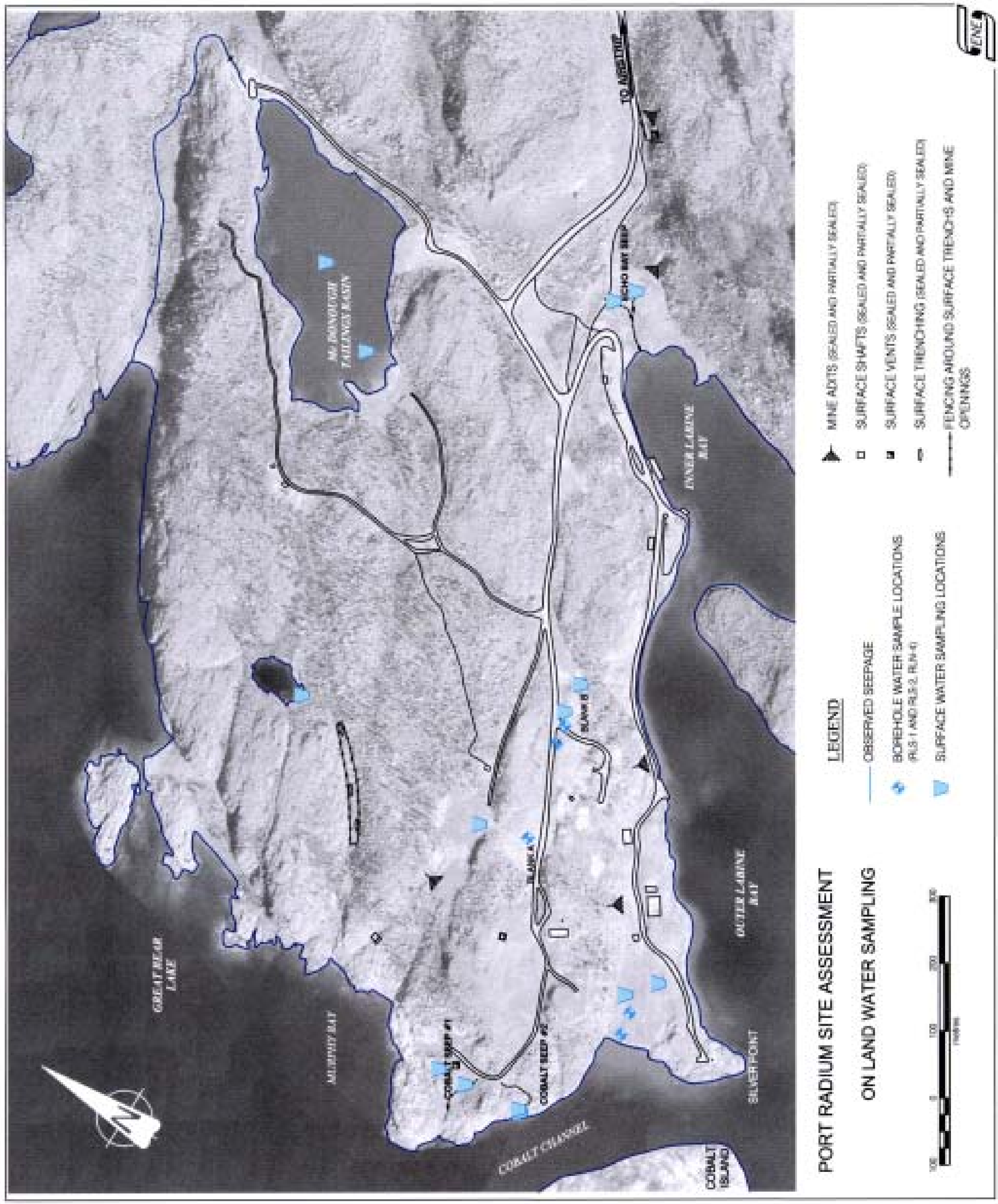
Acid rock drainage (ARD) is an important consideration for the mobility and bioavailability of metal contamination in water. Acid-base accounting tests on waste rock samples from Port Radium show that ARD is not an issue at the Port Radium site.

The program included the collection and analysis of soil and key plant species at several contaminated and control locations across the Port Radium site to determine the concentrations of metals and radionuclides in plants (and in adjacent soils) used as sources of food by wildlife and as Dene traditional foods. A total of 319 samples were collected, including 241 food plants of predominantly seven species (total of 15 species) and 78 soil samples from 10 contaminated areas and 3 control (or unimpacted) sites.

The results of the sampling program show elevated metal levels in mine-impacted areas. The field biologists also created a list of onsite and vicinity plant and animal species in evidence during their time in the field. Findings of the soil sampling are:

- There was no difference in metal concentrations between surface (0-2cm) and subsurface (5-10cm) soils on the site.

Figure 5.6 On-Land Water Sampling Locations



- Soil samples showed significant differences between the tailings/waste rock sites and control sites, particularly for uranium, chromium and arsenic. At individual sites, uranium in the soil at mine-impacted areas was as great as 100 times higher than the control sites, and arsenic was as great as 80 times higher than the control sites. When all samples from mine-impacted areas were averaged, arsenic was over 30 times higher than controls, followed by chromium, which was 28 times higher. Uranium in the disturbed area was 16 times higher than controls. Other soil metal levels higher than control sites are vanadium, manganese and silver. Lead-210 and radium-226, two nuclides in the natural uranium decay chain, reached maximum levels in soils at West Adit and at Murphy Bay exposed tailings (up to 37 $Bq \cdot g^{-1}$), and remained below detection at the control sites.
- Radionuclides in soils showed the same general spatial trends that were found with metals.

Metal concentrations in plants followed similar trends to soils. The results of the vegetation analyses are:

- The three species that were sampled at several disturbed sites and a control site showed significant differences, with the highest contaminant concentrations usually found in the Cobalt Channel drainage area.
- Concentrations of uranium, arsenic and copper were all higher on impacted sites in dwarf birch, willow and Labrador tea than the same species in control sites, although high variability indicates that there are large differences between and within the sampling areas.
- Although relatively few lichen samples were available, both snow lichen and green reindeer lichen had significantly higher concentrations of uranium and arsenic than similar samples at control sites.

5.1.6 Present-Day Environmental Radiation at Port Radium

Several types of radiation measurements were made onsite and at control (or background) sites in the Port Radium area in order to calculate potential radiation doses to receptors and for use in the risk assessment. In order of potential importance (in terms of contributing to total radiation), these are:

- Gamma radiation measurements
- Radon measurements
- Radionuclides in dust

In order to measure average ambient gamma dose rates over long periods (six to twelve months), passive field detectors (thermoluminescent dosimeters (TLDs)) were set out at each monitoring location at the beginning of each exposure period and collected for reading at the end of the period. Terrestrial gamma radiation was continuously measured at several locations on and near the Port Radium site over three six-month periods (two winter and one summer) and one twelve-month period. Gamma data collected shows that the background gamma radiation levels are approximately 10 to 15 µrem/h, with impacted site areas measuring between 20 to 74 µrem/h at those monitoring stations. Figure 5.9 shows the dose rates across the site and at background levels. In addition to the long-term passive gamma monitors, gamma fields across the site and in the immediate vicinity were mapped using a Ludlum gamma radiation meter interfaced with a Global Positioning System. More than 90,000 individual

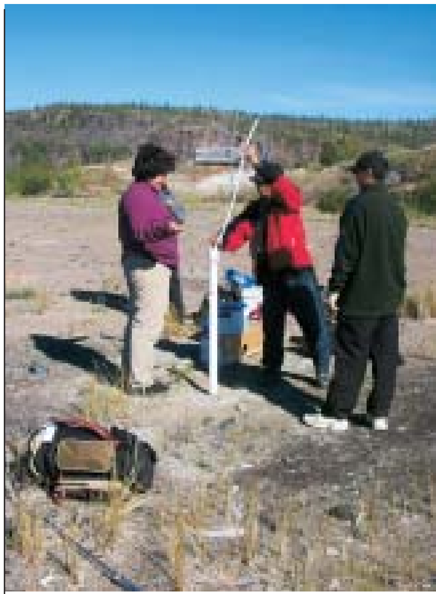


Figure 5.7
Groundwater Sampling

Joella Hogan, Gary Taniton and Lee Tutcho sampling water from the piezometers (wells), June 2003.

Figure 5.8
Logging Data in the GPS

Roddy Modeste using a Global Positioning System to map radiation measurements at Port Radium, 2001.

measurements were made which form the basis for the site gamma mapping (Figure 5.10). This mapping is used in the development of remediation options for ambient gamma radiation on site.

Outdoor levels of radon gas were measured at 2 metres above ground level at 14 monitoring stations on and near areas containing waste rock and tailings. The lowest radon concentrations were measured in the vicinity of McDonough Lake, while the highest radon concentrations were measured near the Murphy Lake and Radium Lake tailings.

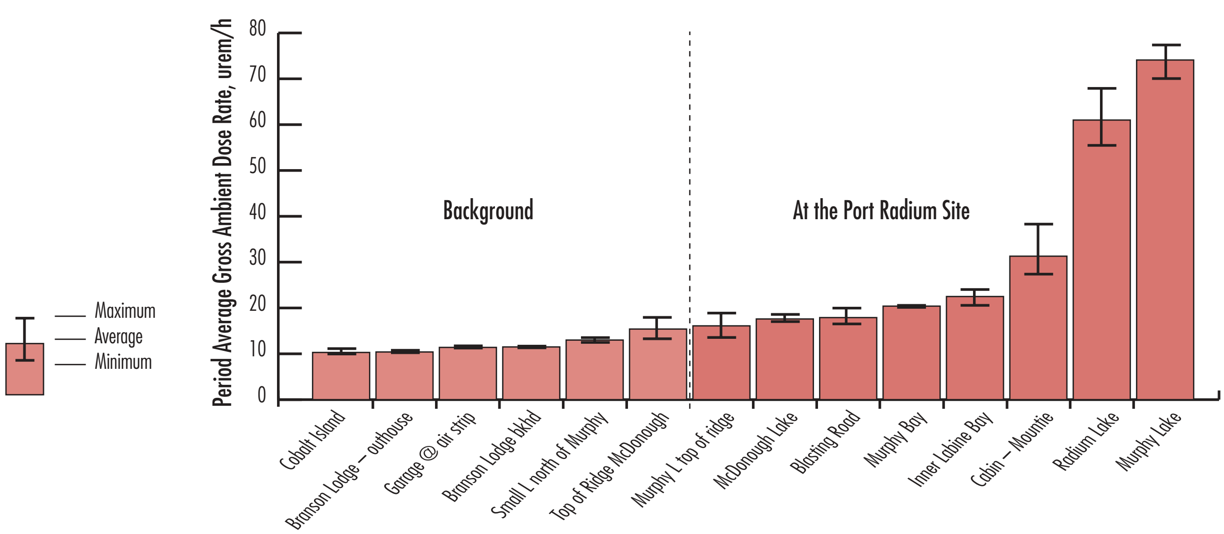
Radon measurements to date indicate that background radon concentrations in outdoor air are in the range of 0.02 to 0.17 pCi/L (pico Curies per litre) and averaged 0.11 pCi/L, which is consistent with background levels measured by others in northern Saskatchewan. Radon measurements on-site ranged from 0.2 to 1.2 pCi/L. These monitors provide sufficient coverage for the purpose of characterizing the airborne radon concentrations for radiation protection purposes considering the natural variability in radon concentrations in air.

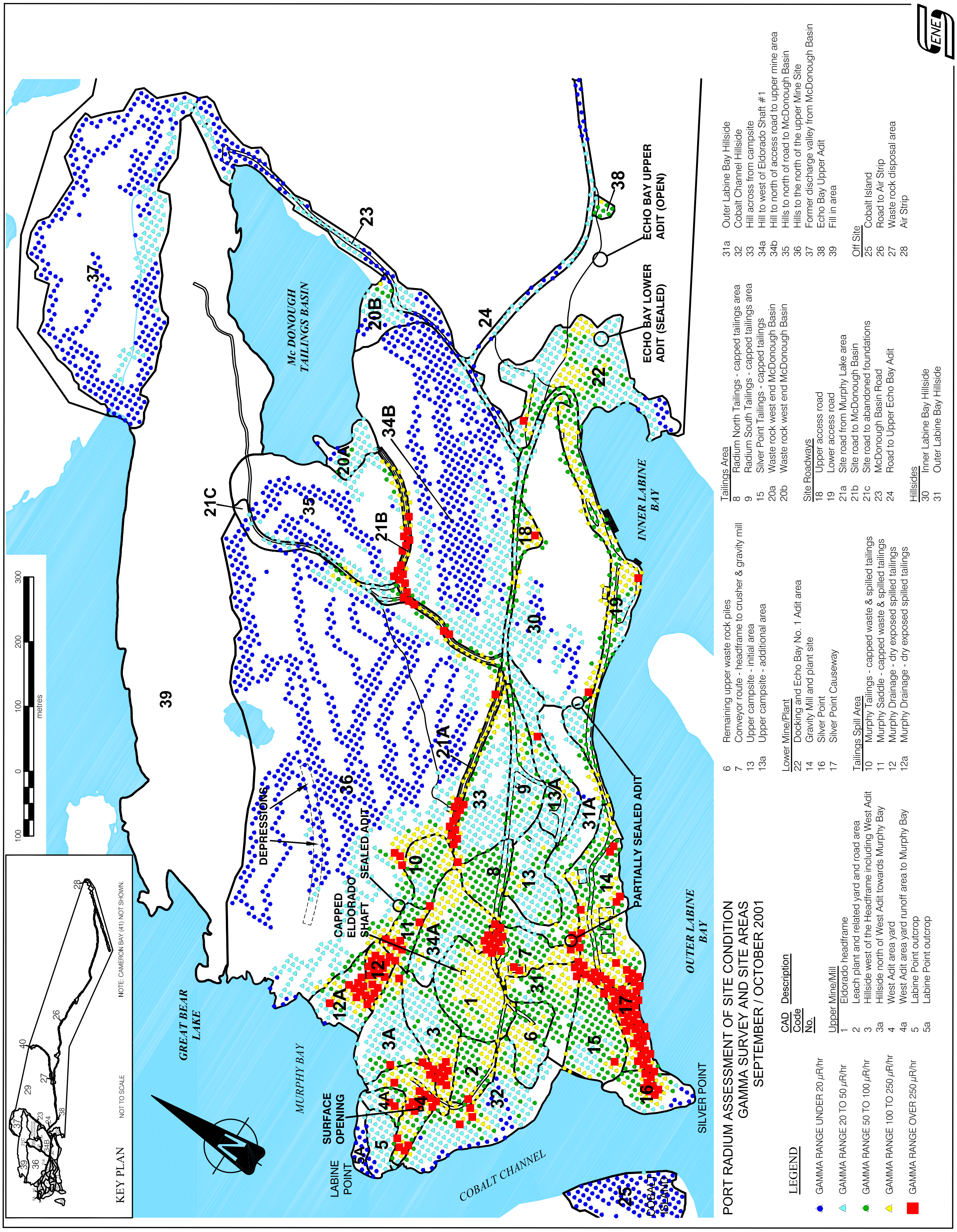
Another measurement used in the calculation of total radiation exposures onsite is the amount and composition of dust in the air. Four dust fall jars were in place on the site for 18 months. Despite the fact that the dust fall jars were open to atmosphere for 518 days, the dust fall collected at the Port Radium site was very low and is far below Ontario's standard for ambient air quality. This is consistent with earlier findings and confirms that site conditions currently have minimal impact on dust fall in the region where the samples were collected.

The environmental radiation findings confirm that air quality of the Port Radium site is relatively clean and not impacted by local site conditions. The analysis confirms that dust levels are extremely low and not an issue of concern for the site.

Gamma radiation remains the largest contributor to radiation doses resulting from the mine site.

Figure 5.9
Gross Ambient Radiation Dose Rate - Background and at the Port Radium Site




PORT RADIUM ASSESSMENT OF SITE CONDITION
GAMMA SURVEY AND SITE AREAS
SEPTEMBER / OCTOBER 2001
LEGEND
GAMMA RANGE UNDER 20 μR/hr
GAMMA RANGE 20 TO 50 μR/hr
GAMMA RANGE 50 TO 100 μR/hr
GAMMA RANGE 100 TO 250 μR/hr
GAMMA RANGE OVER 250 μR/hr
CAD Code No.
Description
Upper Mine/Mill
1 Eldorado headframe
2 Leach plant and related yard and road area
3 Hillside west of the Headframe including West Adit
3a Hillside north of West Adit towards Murphy Bay
4 West Adit area yard
4a West Adit area yard runoff area to Murphy Bay
5 Labine Point outcrop
5a Labine Point outcrop
6 Remaining upper waste rock piles
7 Conveyor route - headframe to crusher & gravity mill
13 Upper campsite - initial area
13a Upper campsite - additional area
Lower Mine/Plant
22 Docking and Echo Bay No. 1 Adit area
14 Gravity Mill and plant site
16 Silver Point
17 Silver Point Causeway
Tailings Spill Area
10 Murphy Tailings - capped waste & spilled tailings
11 Murphy Saddle - capped waste & spilled tailings
12 Murphy Drainage - dry exposed spilled tailings
12a Murphy Drainage - dry exposed spilled tailings
Tailings Area
8 Radium North Tailings - capped tailings area
9 Radium South Tailings - capped tailings area
15 Silver Point Tailings - capped tailings
20a Waste rock west end McDonough Basin
20b Waste rock west end McDonough Basin
Site Roadways
18 Upper access road
19 Lower access road
21a Site road from Murphy Lake area
21b Site road to McDonough Basin
21c Site road to abandoned foundations
23 McDonough Basin Road
24 Road to Upper Echo Bay Adit
Hillsides
30 Inner Labine Bay Hillside
31 Outer Labine Bay Hillside
31a Outer Labine Bay Hillside
32 Cobalt Channel Hillside
33 Hill across from campsite
34a Hill to west of Eldorado Shaft #1
34b Hill to north of access road to upper mine area
35 Hills to north of road to McDonough Basin
36 Hills to the north of the upper Mine Site
37 Former discharge valley from McDonough Basin
38 Echo Bay Upper Adit
39 Fill in area
Off Site
25 Cobalt Island
26 Road to Air Strip
27 Waste rock disposal area
28 Air Strip
KEY PLAN
NOT TO SCALE
NOTE: CAMERON BAY (41) NOT SHOWN.
metres
100 0 100 200 300
GREAT BEAR LAKE
MURPHY BAY
COBALT CHANNEL
OUTER LABINE BAY
INNER LABINE BAY
Mc DONOUGH TAILINGS BASIN
COBALT ISLAND
LABINE POINT
SILVER POINT
SURFACE OPENING
CAPPED ELDORADO SHAFT
SEALED ADIT
DEPRESSIONS
PARTIALLY SEALED ADIT
ECHO BAY LOWER ADIT (SEALED)
ECHO BAY UPPER ADIT (OPEN)

Occupational Exposures During Field Work

As part of SENES Consultants Ltd.'s radiation health and safety program, all team members on the 2001, 2003 and 2005 field teams were issued personal dosimeters to record their exposure while working at and around the site. As in previous campaigns, personal dosimeters were sent to Health Canada for reading after completion of the fieldwork.

Analytical results from Health Canada for the 2003 field program confirmed that the doses received by all members of the field team were below the detection limit of the badge, which is less than 20% of the public dose limit (1 milliseivert per year). This finding is consistent with SENES Consultants' predictions for such activities and durations at the site and is consistent with the results of the previous field programs, both of which also found the personal exposures of the field team members to be less than the detection limit of the dosimeter.

5.1.7 Former Mine Openings

Several mine openings have been identified in the field campaigns. The conclusion of the 2003 hazard assessment of the openings is that they are mostly stable; however, some openings are not closed to the standards used today in mine site decommissioning. Practical and proven methods, such as concrete capping, caving, additional fill placement and fence maintenance should ensure that the mine presents a minimal hazard to anyone traversing the site in the future. Openings identified include:

Mine Adits

Several small openings in existing adits at Silver Point and along the road at Outer Labine Bay were identified. These openings, where they actually provide access to the drift, could be sealed with additional fill placement.

Surface Opening Near West Adit

A shallow surface opening exists on Labine Point near the West Adit. Proper filling and capping of this opening to current standards is required.

Murphy Bay Vent Raise

The metal plate vent cover on the concrete foundations near Murphy Bay needs to either be secured or replaced with a concrete cover.

Open Cuts within Fenced Areas

The remains of surface openings were noted within a fenced off area in a small valley running between Dumpy Lake and Murphy Bay. The actual nature of the previous openings, extent of fill placed, and ground conditions in this area are unclear, although site investigations suggest that the remaining openings pose little hazard as they are quite small and frozen not far from surface.

5.2 Risks to Animals and People

One key objective identified in the Action Plan is to assess whether there are any significant potential ecological and human health risks associated with the Port Radium site, based on current site conditions.

The overall objectives of the Port Radium HHERA were to assess risks associated with chemical and radiological exposures to people and wildlife. Detailed site characterization was carried out to define site conditions, and is described in section 5.1. Based on this information, a preliminary subjective screening of site conditions was carried out to determine if any immediate hazards existed. Subsequently, a more rigorous quantitative HHERA was carried out for the site.

The risk assessment considers the potential impact of "contaminants of potential concern" (COPC) in the environment on either receptors that are exposed directly to these COPC as they live in the environment in which the COPC are present; and/or from consumption of other species in their food chain; and/or ingestion of water. A "receptor" is an animal or human which may come in contact with a COPC.

5.2.1 Contaminants of Potential Concern

As stated in Section 5.1, the site characterization database developed through the field investigations was used to identify COPC. Measured maximums and averages measured onsite were used in the risk assessment calculations, as appropriate, to evaluate the risks to representative ecological species and people for various exposure scenarios.

The COPC were selected based on measured values and potential for having an effect based on CCME guidelines. For the ecological risk assessment, the non-radionuclides of concern, modeled and carried through the ecological risk assessment (ERA) are: aluminum, arsenic, cadmium, chromium, cobalt, copper, lead, molybdenum, nickel, selenium, silver, uranium, and zinc (aluminum is assessed for the aquatic environment only). For the human health risk assessment, the non-radionuclides of concern, modeled and carried through the risk assessment are: antimony, arsenic, cobalt, copper, lead, molybdenum, nickel, and uranium.

All radionculides from the three decay series were considered: uranium-238 (U-238), uranium-235 (U-235) and thorium-232 (Th-232).

This section will present the general methods and findings of the HHERA. Risk assessment requires a very detailed and complex set of exercises; for more information on the risk assessment, please refer to the HHERA report by SENES Consultants.

5.2.2 Selection of Ecological Receptors

In general, ecological receptors considered in an ERA are chosen to capture various levels of potential exposure via the different types of diets that they consume. They may also be selected if they are considered to be important: (1) in the functioning of the ecosystem; (2) in the production of food for subsistence; or (3) due to their cultural significance.

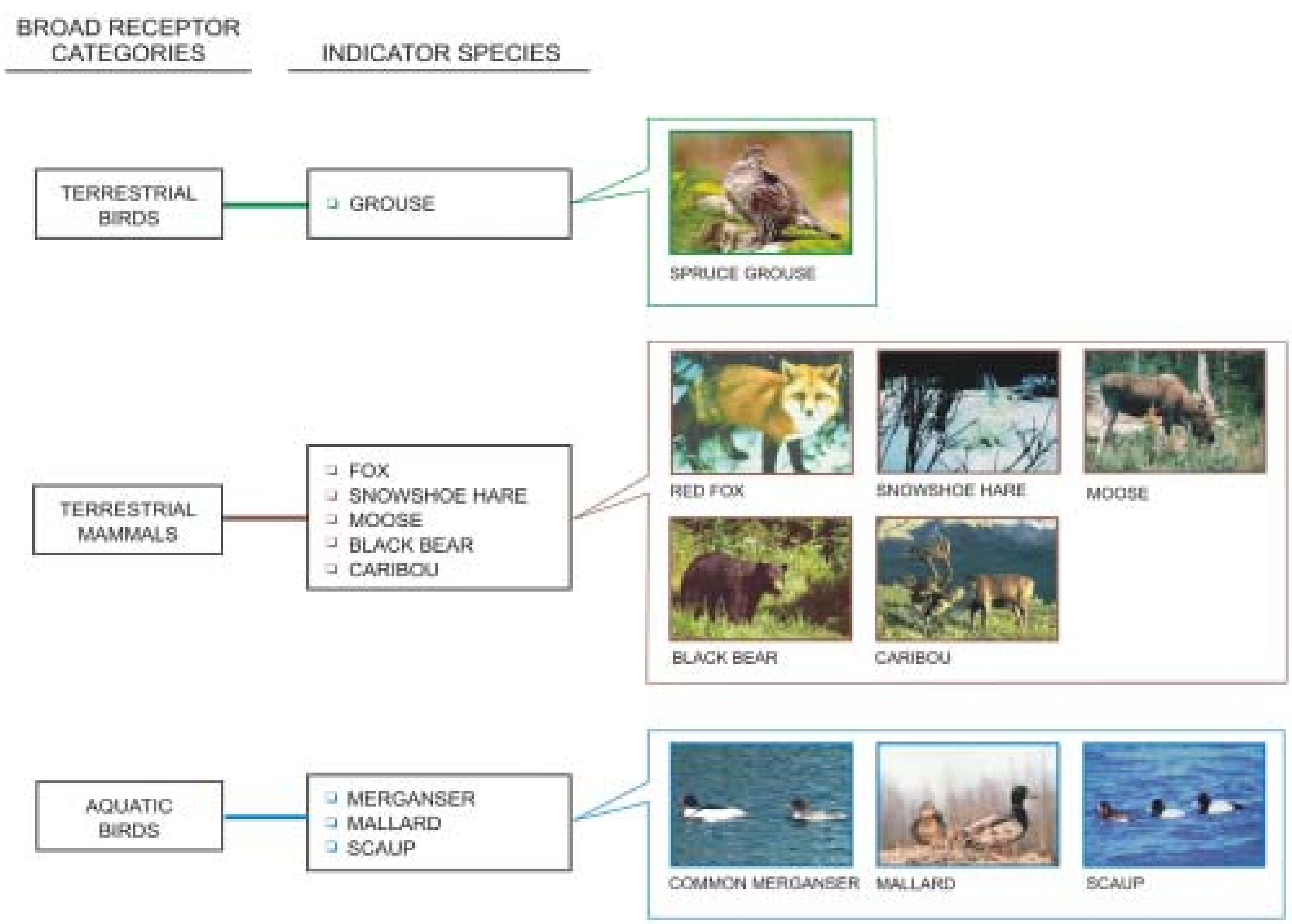
The selection of the various ecological (aquatic and terrestrial) receptors for inclusion in the ERA was based on scientific and community input with respect to species associated with the site. It should be noted that the ERA evaluates the effects on populations rather than individual animals. For the aquatic environment, the species covered the entire food chain starting from aquatic plants and animals, through to fish. For the terrestrial environment, the species considered ranged from small local mammals (e.g. fox, hare) through to large broad-ranging mammals (e.g. bear, caribou moose), as well as water fowl (e.g. ducks) and terrestrial birds (e.g. grouse).

Exposure pathways included intake of contaminants through the consumption of water, sediment, vegetation, soil and flesh at various stages of the food chain. Depending on the size of the home range for the species under consideration, the analysis was based on contaminant levels measured at specific locations on the site or on site-wide averages. The analysis also considered the length of time the various species would be present on the Port Radium site. Figures 5.11 and 5.12 show the aquatic and terrestrial receptors used in the risk assessment.

The potential doses to biota associated with COPC at the Port Radium site are assessed by undertaking a pathways analysis. A typical pathways model encompasses many different pathways, processes and mechanisms. The pathways model requires information about the type and nature of the contamination, the surrounding environment and the location and characteristics of ecological species most likely to be exposed. Figure 5.13 shows the pathways model for the ERA.

Where possible, environmental data gathered in 2001 and 2003 for radionuclide and non-radionuclide COPC were used to characterize the

Figure 5.11 Terrestrial Ecological Receptors Selected for the Port Radium Ecological Risk Assessment



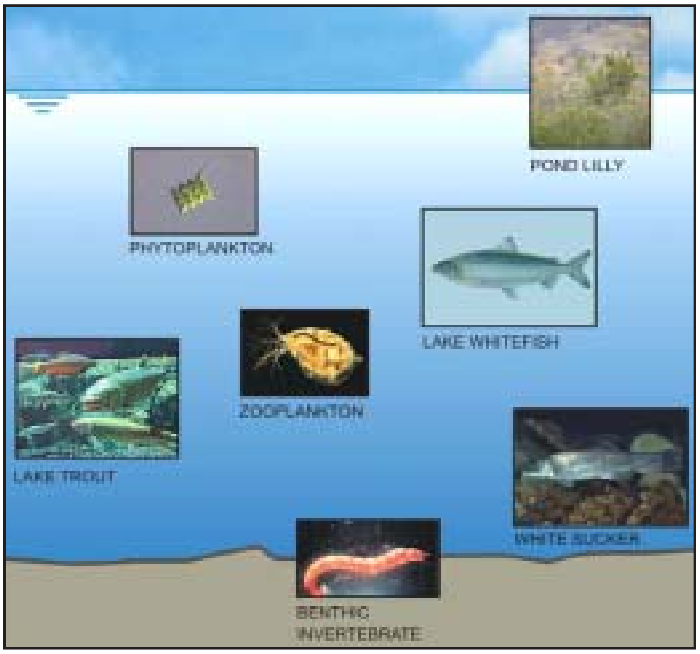


Figure 5.12

Aquatic Ecological Receptors Selected for the Port Radium Ecological Risk Assessment

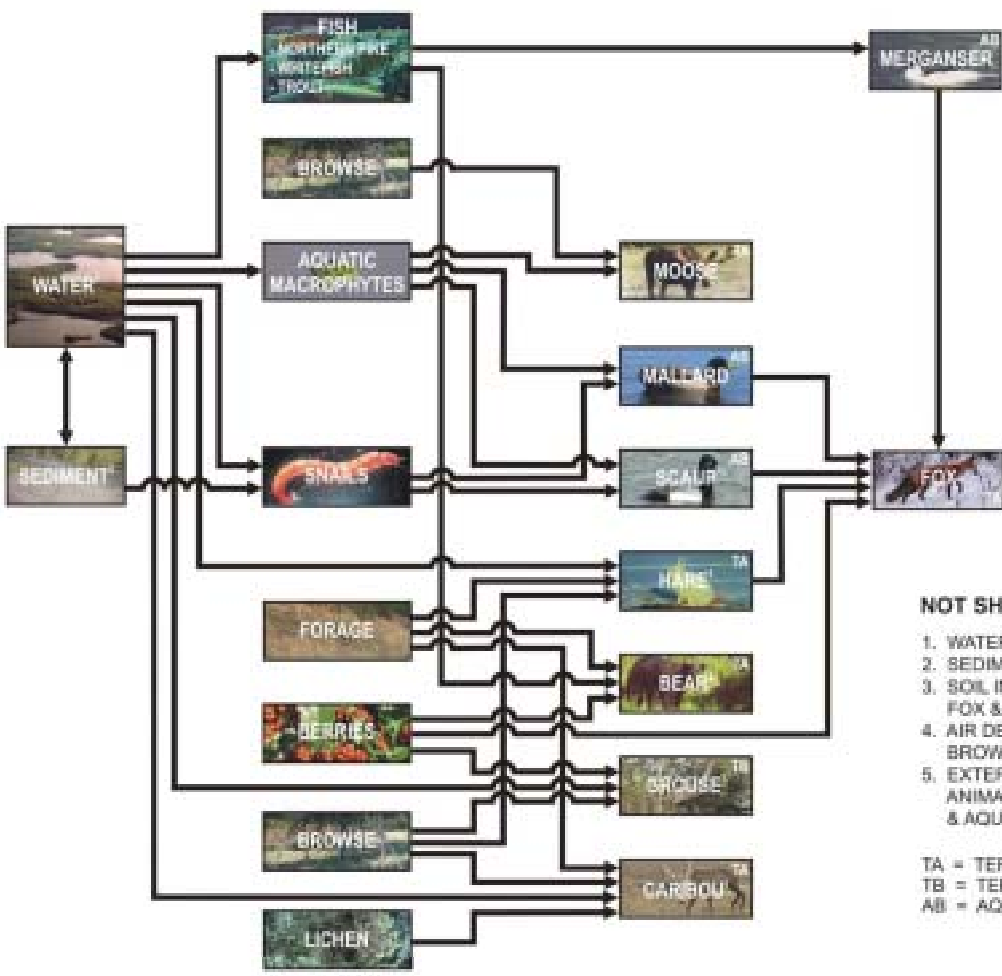


Figure 5.13

Pathways of Exposure Considered for the Ecological Risk Assessment

NOT SHOWN:

1. WATER INGESTION BY SPECIES
2. SEDIMENT INGESTION BY MOOSE & DUCKS
3. SOIL INGESTION BY HARE, GROUSE, BEAR, FOX & CARIBOU
4. AIR DEPOSITION ON FORAGE, BERRIES, BROWSE & LICHEN
5. EXTERNAL GAMMA TO ALL TERRESTRIAL ANIMALS (TA), TERRESTRIAL BIRDS (TB) & AQUATIC BIRDS (AB)

TA = TERRESTRIAL ANIMAL
TB = TERRESTRIAL BIRD
AB = AQUATIC BIRD

current conditions at the site and assess the impacts on the aquatic and terrestrial environments. The exposure of ecological receptors to radionuclide and non-radionuclide COPC present at the site was estimated using the pathways, the receptor characteristics and the measured environmental concentrations (for water, sediments, aquatic vegetation, fish, soil and terrestrial vegetation), as well as the predicted concentrations (for benthic invertebrates, hare and duck) based on food chain transfer factors found in the literature. Bioavailability factors were considered in the pathways of soil and sediment ingestion by terrestrial ecological receptors.

The exposure estimates were then compared to toxicity benchmarks, which are the levels of exposure at which effects of the contaminants on the health of the organisms may be seen. The toxicity benchmarks are contained in the scientific literature and are derived from actual contamination events or from lab experimentation. These benchmarks continually change as new information becomes available. The CDUT had the toxicity benchmarks used in this risk assessment peer reviewed to ensure they were the most appropriate.

5.2.3 Results of the Ecological Risk Assessment (ERA)

The ERA looked at potential effects of radionuclide and non-radionuclide COPC on the various receptors. For radionuclides, no toxicity benchmarks were reached for any species. Tables 5.3 and 5.4 below summarize which metals exceeded the toxicity benchmarks for which species.

The major conclusions drawn from the ERA are as follows:

- The metal and radionuclide levels in Great Bear Lake adjacent to the site are below levels that could adversely affect aquatic life.
- Arsenic, copper and uranium levels in water overlying tailings in the McDonough Lake TCA were greater than the toxicity benchmarks for some aquatic receptors. It should be noted that as there is no outflow from this water body, the effects on aquatic life, if any, are restricted to the McDonough Lake TCA.

Table 5.3 Risk Assessment Results for Aquatic Biota

Pond Weed	None	None
Primary Producers	Arsenic, Copper, Uranium	None
Benthic Invertebrates	None	None
Zooplankton	Uranium	None
Lake Trout	Copper	None
Lake Whitefish	Copper	None
White Sucker	None	None

Table 5.4 Risk Assessment Results for Terrestrial Biota

Bear		None
Caribou		None
Ducks:	Mallard	None
	Merganser	None
	Scaup	Arsenic
Fox		Arsenic
Grouse		Uranium
Hare		Arsenic, Cobalt, Uranium
Moose		None

- Arsenic was identified as a potential issue for three of the terrestrial biota (fox, scaup and hare). The primary exposure pathways were attributed to consumption of contaminated vegetation and associated soil, mainly from localized areas around the Cobalt drainage, Murphy Tailings Containment Area and the exposed tailings near Murphy Bay. The remediation of these areas would result in no predicted effects to the fox.
- Elevated concentrations of cobalt and uranium in the localized areas of the Cobalt drainage, Murphy Tailings and the exposed tailings near Murphy Bay are a cause for potential concern for local species such as the hare. Notwithstanding this finding, it should be noted that a large, apparently healthy, arctic hare was collected near Cobalt Seep during the 2001 sampling campaign.
- The risk assessment for radiation exposures from internal and external doses found that the radionuclides present at the Port Radium mine site are not a cause for concern from an ecological perspective.

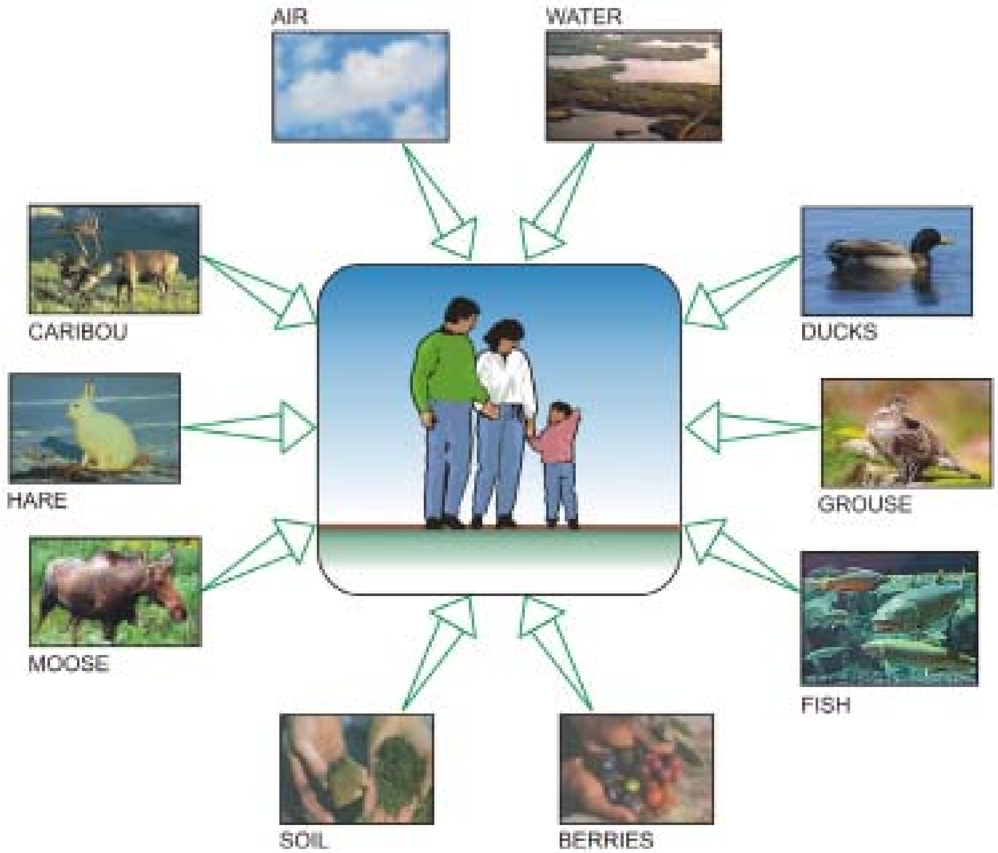
It should be noted that even though caribou would only be present at the site for a minimal time period, they were included in the assessment as they are important source of food for the Dene. The assessment determined that there are no adverse impacts to caribou using the site.

5.2.4 Human Health Risk Assessment (HHRA)

A human health risk assessment (HHRA) evaluates the probability of adverse health consequences caused by the presence of contaminants in the environment. In an HHRA, receptor characteristics (e.g. portion of time spent in the study area, source of drinking water, composition of diet) and exposure pathways (e.g. inhalation and ingestion) are taken into consideration to assess potential effects. Unlike the ERA which is concerned with population effects, the HHRA focuses on effects on individuals. The HHRA uses scenarios that are considered to be realistically conservative for the site that ensure that potential exposures are over

Figure 5.14

Pathways of Exposure Considered for the Human Health Risk Assessment



estimated. In this assessment, the HHRA examined the potential impacts of visiting and using the Port Radium site under current conditions by Dene and others, for varying purposes and periods of time. Figure 5.14 shows the pathways model for ways people could be exposed to contamination while at Port Radium.

As there are no residences at the Port Radium site at this time, scenarios were developed for hypothetical land use situations to facilitate the assessment of potential risks to people from Délı̨ne, or others, who may visit the site. To this end, the following hypothetical receptors were considered:

- Campers (adult and child) on site for three months per year;
- Inspectors present on site two days per year;
- Fisherman/hunter at the site for one week per year; and
- Fishing lodge worker on site for two months per year.

Exposure pathways considered in the analysis for campers included drinking water and eating fish from Great Bear Lake; eating berries from across the site; eating hare exposed to soils and vegetation with elevated contaminant levels; eating ducks exposed to contaminants in McDonough Lake TCA; and eating larger animals (caribou and moose) that traverse the site as part of their range and forage and drink from various areas of the site. With the exception of caribou, duck and moose, the HHRA was based on measured contaminant levels in all other food and water sources. To facilitate the HHRA, a simple pathways model was used to predict contaminant levels in caribou, duck and moose flesh. In addition to the dietary intake, the camper exposure scenario also considered direct exposure to gamma radiation while on site. Similar calculations of dose were also carried out for the other hypothetical human receptors based on specific assumptions for each receptor about sources of food and water, where the person spent their time on site and duration of stay on site.

The HHRA results show that:

- gamma radiation was the primary contributor to the radiological dose to all hypothetical human receptors. A conservative estimate of the radiation dose to the potentially most exposed seasonal camper was less than the 1mSv/y (1000μSv/y) incremental limit established by the Canadian Nuclear Safety Commission (CNSC) for the protection of human health;
- for metals, the predicted intakes were below the acceptable intake levels for all non-carcinogenic contaminants of potential concern; and
- risk levels associated with the carcinogenic properties of arsenic are below risk levels from background exposure to arsenic in Canada.

The presence of radionuclides and metals at the Port Radium Mine site are not a cause for concern under the exposure scenarios described above for campers, fishermen or others who might occasionally visit the site. It should be noted that residual physical site hazards that may pose a risk to human health, including mine openings and miscellaneous scrap, have been identified as part of the site remediation program.

Risk Characterization

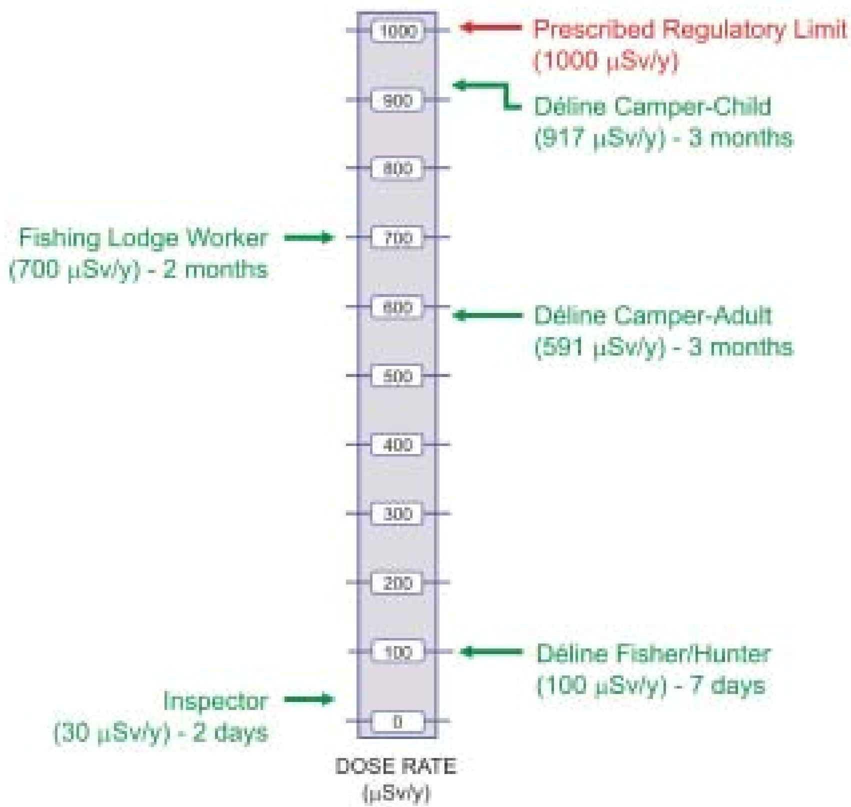
This section presents the potential impacts to people who could be exposed to COPC that are present at the Port Radium Mine site. There are two evaluations, one for radiation exposure or radionuclides, and one for non-radionuclides.

Exposure to radionuclides was assessed by integrating the radiation doses from all pathways to each of the five hypothetical human receptors (i.e. adult and child campers, fisherman, lodge worker and site inspector). The estimated incremental dose rates for the five receptors are summarized in Figure 5.15. The predicted incremental doses range from a low of 30μSv/y (microSeiverts per year) for an inspector who spends two days on site to a high of 917μSv/y for the child who was assumed to camp on site for three consecutive months. By contrast, the adult camper who was also assumed to spend three months on site was predicted to receive a dose rate of 591μSv/y, whereas the adult fishing lodge worker who was assumed to spend two months on site was predicted to receive a dose rate of 700μSv/y. The predicted incremental doses of all five hypothetical receptors are below the regulatory limit, set by the CNSC, of an incremental 1000μSv/y (1 milliseivert) for members of the general public.

Due to the significance of caribou as the primary source of meat for the local population, it was included in the assessment of the potential effects of the Port Radium site on radionuclide levels in caribou flesh, and thus the radiation dose to people who consume caribou flesh.

Figure 5.15

Estimated Incremental Radiation Exposure for Five Hypothetical Human Receptors at Port Radium



The assessment compared the radiation dose to caribou using the site to the radiation dose that would be received from caribou hunted elsewhere in the Northwest Territories (NWT). Considering the small size and limited availability of vegetation on the Port Radium site, it is not expected that caribou would spend more than a day per year on site. Based on the above, it can be reasonably concluded that should caribou consume lichen and soil from Port Radium, there would be very little effect on the dose received by anyone who may consume these caribou.

Human exposure to non-radionuclides at the site, or those not contributing to radioactivity but are potentially harmful, include those substances which were identified as COPC. The results are presented here in two types of effects: chronic (non-cancer) effects, related to exposure from antimony, arsenic, cobalt, lead, molybdenum and uranium, and cancer effects related to exposure to arsenic.

Estimated exposures for the adult and child campers were compared to the non-radionuclide toxicity benchmarks from both Health Canada and the U.S. Environmental Protection Agency. This is shown in Figure 5.16 where the estimated intakes are expressed as a fraction of the respective toxicity benchmarks. While the assessment does not account for all sources (for example, it does not account for metals present in store bought foods), it can be reasonably concluded that exposure to metals on the Port Radium site will not result in adverse effects to anyone who camps onsite and harvests food items from the site.

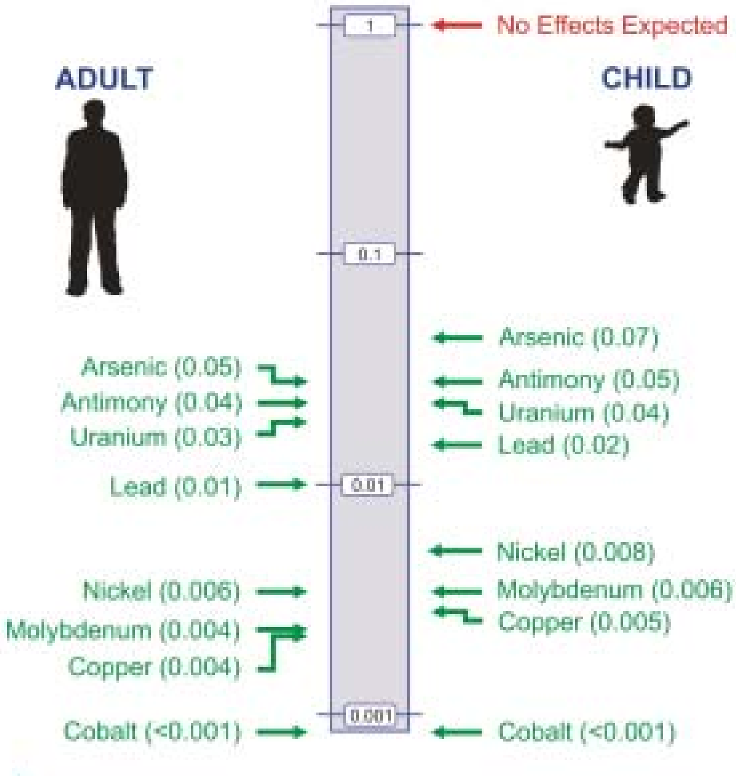


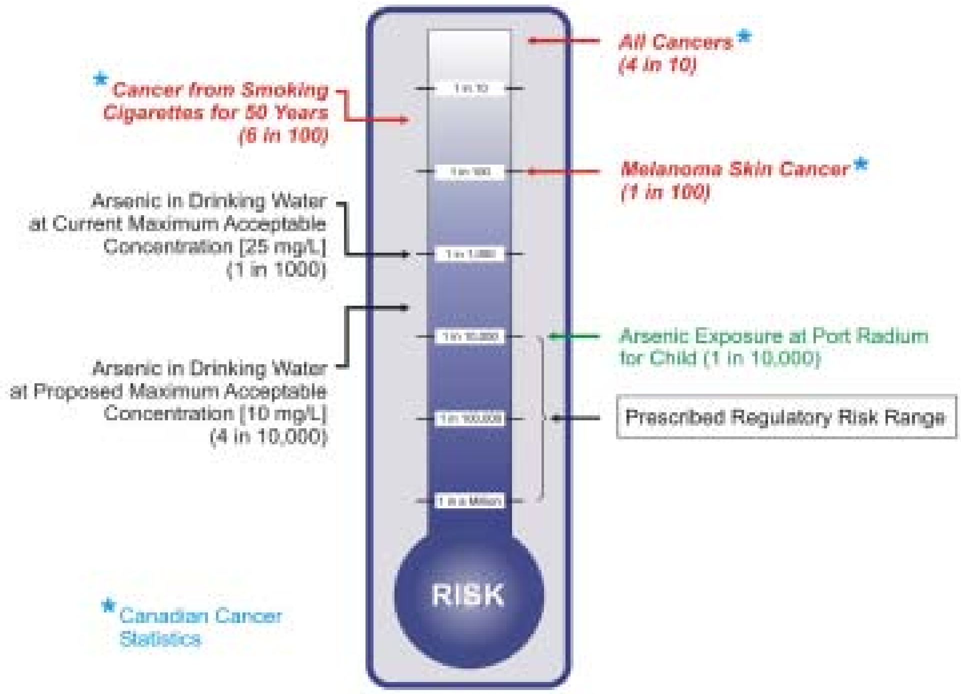
Figure 5.16

Summary of Potential Non-Cancer Risks as a Ratio to Toxicity Benchmarks

The arsenic intake from the Port Radium site is well within the typical range from background levels and at the lower end of the range. The assessment indicates that there are no potential impacts from exposure to arsenic's chemical toxicity in this scenario.

However, arsenic may also have carcinogenic (or cancer-causing) effects. The presence of naturally occurring arsenic varies greatly across Canada, and there is some disagreement about levels at which it may be cancer-causing. Because of this uncertainty, Health Canada and the U.S. Environmental Protection Agency have established very conservative arsenic exposure levels. Based on the exposure scenarios of a child and adult camper on site for three months, the risk assessment shows that the risks associated with exposure to carcinogenic arsenic at the site are within the range of typical background levels in Canada. Figure 5.17 shows the risks and provides some context to the risks.

Even though the intake estimates do not include all possible sources of exposure (e.g., vegetables, juice, air and direct soil ingestion) or the intake of arsenic while not at the Port Radium mine site, the calculated risks indicate that the risks associated with exposure to arsenic are well within typical background. Therefore, negative impacts associated with exposure to arsenic at the levels measured at the Port Radium Mine site are not expected.



Uncertainty in the Human Health and Ecological Risk Assessment

Due to its inherent nature, and indeed for any modeling exercises, risk assessment contains uncertainty. This is due to the fact that assumptions have been made throughout the assessment either due to data gaps, environmental fate complexities, or in the generalization of receptor characteristics. A full description of the nature of the uncertainties can be found in the HHERA. In recognition of these uncertainties, some cautious assumptions are used throughout the assessment to ensure that the potential for an adverse effect would not be underestimated. Local Dene knowledge was utilized where possible, both during the site assessment and for the assumptions used in the risk assessment exercise.

In summary, considering all these uncertainties, it is likely that the estimated exposures calculated in this assessment are overestimates of actual exposures at the site.

5.3 Safety of Traditional Foods

The safety and quality of traditional foods has long been a major concern to the people of Délįne, particularly regarding the levels of radionuclides and other contaminants that may be in traditional food species around Great Bear Lake. These concerns were raised in the Community and Experts Workshop in Délįne in 1999, and were incorporated into a traditional foods testing program within the Action Plan scope of work.

“Food basket” studies were conducted, in which traditional food items were collected directly from harvesters or from freezers of community members. Samples of caribou, snowshoe hare, grouse, ptarmigan, fish and berries were taken from around Délįne and analyzed for a broad range of radionuclides and metals with a focus on those contaminants found at Port Radium. The foods analyzed represent the major foods eaten in Délįne and are harvested from the areas where people usually take their food and cover the range of ages and sizes of animals normally harvested for consumption. Therefore, the food study takes into account bioaccumulation where contaminant levels increase as the animal gets older. It is important to note that the samples were analyzed in the frozen or fresh state and not in the dried or smoked state, which can increase the level of contaminants.

Samples were also taken of hare, whitefish, trout, water and berries from the Port Radium site to see if they present a risk when consumed by Délı̨ne residents, assuming they lived and ate from the land at Port Radium for three months a year. Here is a summary of the results:

Metal Results

- Aluminum, antimony, beryllium, bismuth, tin, silver and vanadium could not be detected.
- Copper, molybdenum, selenium and zinc were found in very small amounts, which is good because they are micronutrients and are very important to maintain health.
- Low levels of chromium and cobalt were found in all food species at levels similar to those found in other areas of the NWT.
- Arsenic could not be found in caribou, hare, grouse and three fish species and was at relatively low levels in lake trout muscle.
- Arsenic was found in berries at low levels, which is probably the result of a natural accumulation from soils.
- Major elements such as magnesium, calcium, phosphorus and potassium were found in the highest amounts which is good because they are important building blocks and are one of the reasons that traditional foods are so nutritional.

Figure 5.18
Traditional Food Sampling

Lee Tutcho preparing samples for the study of contaminants in traditional foods, March 2004.

Radionuclide Results

- Levels of radiation exposure through a diet of traditional foods in Délı̨ne is the same as other areas of the NWT and at levels much lower than what could cause human health effects.
- Low levels of natural and man-made radionuclides are in all food items.
- Both radium-226 and uranium, two of the major concerns at Port Radium, are at very low levels in all samples from mammals, birds and fish.
- The man-made radionuclide cesium-137, produced during atmospheric weapons tests in the 1960's, is present in all samples, but is declining in the Arctic. In caribou, the cesium-137 was the same or lower than found in all other caribou herds in NWT.
- Uranium remains low in all food items and at levels similar to those from other areas in NWT.

In conclusion, results of this study agree with other studies from around Great Bear Lake and the NWT and indicate that the traditional foods are safe to eat. There is no risk to humans from consumption of traditional foods taken from Port Radium.

5.4 Site Remediation

The CDUT has been working on site assessment and risk assessment for Port Radium since 1999 with the goal of developing a remediation plan for the former Port Radium mine that is acceptable to both Canada and Délı̨ne.

The results of the site assessment and risk assessment form the information basis for the selection of remediation measures to be taken at Port Radium. The selection process also incorporated requirements of the community and of government. The process for the selection of the preferred options by the CDUT for each site issue is described below. A summary of the preferred options is also presented. For more information, readers are asked to refer to the *Port Radium Remediation Plan* report.

5.4.1 Remediation Goals and Guiding Principles

The specific cleanup goals and guiding principles for the *Port Radium Remediation Plan* were developed from existing federal policies regarding contaminated sites cleanup, and community-derived goals and objectives. The CDUT has combined these to make them specific to the Port Radium site, and to enable the CDUT to measure potential cleanup actions against these agreed-upon goals.

The following goals and principles were agreed to by CDUT specifically for the Port Radium mine remediation:

Goals

- Minimize human health and safety risks
- Protect fish, wildlife and vegetation
- Protect Great Bear Lake water quality
- Minimize environmental impacts during remediation
- Return the site to its original condition where possible
- Minimize long-term care and maintenance
- Cost effective

Guiding Principles

- Work can be done safely
- Maximize Délı̨ne capacity building and training opportunities
- Maximize Délı̨ne employment and procurement
- Compliance with all legal and regulatory requirements including Health and Safety

5.4.2 Remediation Options Selection Process

In late 2004, SENES Consultants prepared a draft remediation options report for the CDUT to consider. In this report, options were presented ranging from "do nothing" except deal with physical hazards, to digging up and consolidating all buried on-land tailings. This report was peer reviewed by Jacques Whitford Ltd., an environmental consulting firm, who agreed that SENES Consultants had presented an appropriate range of options for consideration by the CDUT. Options evaluation meetings of the CDUT were held in January through March 2005.

The CDUT assessed the options against the agreed-upon goals for the remediation.

The overall approach to evaluating remediation options for the site was as follows:

1. Divide the mine remediation into various "issues";
2. For each issue determine the remediation options;
3. Rank the options on how well they meet CDUT site goals;
   High- meets objectives
   Medium- partially meets objectives
   Low- does not meet objectives
4. Then determine if the option is:
   P = preferred
   A = acceptable
   NA = not acceptable

The list of general "issues" at the site, which are common to other abandoned mine sites in the North, are: site infrastructure, remaining equipment and scrap metal, mine workings (includes openings), and contamination (metals and radionuclides).

To demonstrate how the CDUT selected its preferred remediation options, the mine openings issue will be used as an example. To address the goals at the site, four options were determined: 1) leave it as is and maintain, 2) backfill all openings, 3) backfill and plug with cement, and 4) backfill horizontal openings and cement all vertical openings. These options were rated by the CDUT as illustrated in Table 5.5. The bottom row is the CDUT decision for each of the options, determined as not acceptable, acceptable and/or preferred. In this case, option 4 was the preferred option.

Section 5.1 describes the environmental issues which need to be addressed in the final remediation plan. There are also some common infrastructure issues (e.g. roads, airstrips, buildings, refuse) which may not be environmental issues, but which should be addressed in the remediation plan according to best practices.

Based on the site assessment program findings, the risk assessment, consideration of regulatory, engineering and precedent practice, as well as the community objectives and criteria, a remediation plan has been developed. The preferred remediation options agreed to by the CDUT are included in the recommendations in section 5.5.

Table 5.5
CDUT Ranking of Remediation Options for Mine Openings

Goals /Options	Leave as is and maintain	Backfill all openings	Backfill and plug with cement	Combo of 2 and 3
Health and Safety	Low	Med	High	High
Protect fish, wildlife and vegetation	Low	Med	High	High
Protect GBL water quality	Low	High	High	High
Minimize env. impacts during rem.	High	Med	Med	Med
Minimize Long term care and maintenance	Low	Med	High	High
Return site to its original condition where possible	Low	High	Med	Med
Is cost effective	High	Med	Low	Med
A /P / NA	NE	A	A	P

5.5 CDUT Findings and Recommendations of Environmental Studies

Findings:

Great Bear Lake Water Quality

Study findings indicate that the site has had, and continues to have impacts on the water quality on the mine site and in Great Bear Lake adjacent to the site. Great Bear Lake water samples taken around the site show that in general, the closer the sample was taken to the shore, the higher the metal concentrations. However, the metal and radionuclide levels in Great Bear Lake adjacent to the site are below levels that could adversely affect fish or any other aquatic life. Samples taken from areas not expected to be impacted by the mine site show that the overall water quality in Great Bear Lake is good.

Lake Sediments in Great Bear Lake

The lakebed classification and bathymetry program identified several general areas where tailings are located in the immediate vicinity of the mine site as well in a trough approximately 500 metres northwest of Murphy Bay which appears to be a repository for tailings. The regional and detailed bathymetric survey indicates that the tailings are located in the deeper parts of Great Bear Lake from which they are extremely unlikely to move, and that if they do move, they will likely move into even deeper sections in the immediate area and not migrate to the western shores.

Fish

For whitefish liver and muscle tissue, mercury did not exceed Health Canada (2002) human consumption guidelines in fish for any of the samples collected. For lake trout liver and muscle tissue, mercury concentrations (0.62 and 0.22 mg/kg, respectively) are comparable to, or lower than, levels reported in other northern studies. For both whitefish and trout liver and muscle tissue, other metals levels did not present any concerns.

Surface Water

The sub surface water in contact with the tailings is the most contaminated at the site, yet fairly inaccessible to animals and immobile. The surface water and runoff on site, which is intermittent and seasonal, is less contaminated, but well above guidelines for some metals.

Vegetation and Soil

The results of the soil sampling program show elevated metal levels in mine-impacted areas. Soil samples showed significant differences between the tailings/waste rock sites and control sites, particularly for uranium, chromium and arsenic. Radionuclides in soils showed the same general spatial trends that were found with metals.

Metal concentrations in plants followed similar trends to soils, with the highest concentrations usually found in the Cobalt Channel drainage area. Although relatively few lichen samples were available, both snow lichen and green reindeer lichen had significantly higher concentrations of uranium and arsenic than similar samples at control sites.

Radiation

The environmental radiation findings showed that gamma radiation is the largest contributor to doses resulting from being at the mine site. Air quality of the Port Radium site is relatively clean and not impacted by local site conditions. The analysis confirms that dust levels are extremely low and not an issue of concern for the site.

Ecological Risk Assessment

The metal and radionuclide levels in Great Bear Lake near shore waters are below levels that could adversely affect aquatic biota.

Arsenic, copper and uranium levels in water overlying tailings in the McDonough Lake TCA were greater than the toxicity benchmarks for some aquatic receptors. It should be noted that there is no outflow from McDonough Lake into Great Bear Lake so the effects on aquatic biota, if any, are restricted to the McDonough Lake TCA.

Arsenic was identified as a potential issue for three of the terrestrial biota (fox, scaup, duck and hare). The primary exposure pathways were attributed to consumption of contaminated vegetation and associated soil.

Elevated concentrations of cobalt and uranium in the localized areas of the Cobalt drainage, Murphy Tailings and the exposed tailings near Murphy Bay are a cause for potential concern for local species such as the hare.

The ecological risk assessment for radiation exposures from internal and external doses found that the radionuclides present at the Port Radium mine site are not a cause for concern from an ecological perspective.

Even though caribou would only be present at the site for a minimal time period, they were included in the assessment as they are important source of food for the Dene. The assessment determined that there are no adverse impacts to caribou using the site.

Human Health Risk Assessment

Scenarios were developed for hypothetical land use situations to facilitate the assessment of potential risks to people from Délı̨ne, or others, who may visit the site. To this end, the following hypothetical receptors were considered:

- Campers (adult and child) on site for three months per year;
- Inspectors present on site two days per year;
- Fisherman/hunter at the site for one week per year; and
- Fishing lodge worker on site for two months per year.

For a seasonal camper (the highest exposure scenario), the assessment showed that the campers would not exceed the guidelines established by the Canadian Nuclear Safety Commission (CNSC) for the protection of human health.

For metals, the predicted intakes were within the acceptable intake levels for all non-carcinogenic contaminants of potential concern.

Risk levels associated with the carcinogenic properties of arsenic are below risk levels from background exposure in Canada.

The presence of radionuclides and metals at the Port Radium mine site are not a cause for concern under the exposure scenarios described above for campers, fishermen or others, who might occasionally visit the site.

It can be reasonably concluded that should caribou consume lichen and soil from Port Radium, there would be very little effect on the dose received by anyone who may consume these caribou.

Safety of Traditional Foods

Results of this study agree with other studies from around Great Bear Lake and the NWT and indicate that the traditional foods are safe to eat. There is no increased health risk to humans from consumption of traditional foods taken from Port Radium.

Levels of radiation exposure through a diet of traditional foods in Délı̨ne is the same as other areas of the NWT and at levels much lower than what could cause human health effects. There are low levels of natural and man-made radionuclides are in all food items. Both radium-226 and uranium, two of the major concerns at Port Radium, are at very low levels in all samples from mammals, birds and fish. The man-made radionuclide cesium-137, produced during atmospheric weapons tests in the 1960's, is present in all samples, but is declining in the Arctic. In caribou, the cesium-137 was the same or lower than found in all other caribou herds in NWT.

Uranium remains low in all food items and at levels similar to those from other areas in NWT.

Recommendations:

1. The Port Radium site should be remediated as soon as possible. The CDUT developed the *Port Radium Remediation Plan*, which should be implemented. The Remediation Plan represents the CDUT's preferred options for remediation at the site. Table 5.6 summarizes the CDUT's preferred remediation activities at the site.
2. Remediation of Port Radium should involve Délı̨ne people. Employment, training, capacity building and procurement should be maximized where possible.
3. All remediation work at Port Radium must be done safely, with appropriate training and safety planning.
4. There should be long-term monitoring at Port Radium. A long-term monitoring plan is a component of the Remediation Plan and should be implemented.
5. Traditional foods from Great Bear Lake should be monitored periodically to confirm that they continue to be safe to eat.

Table 5.6 Summary of CDUT Preferred Remediation Options

	Site Issue	Preferred Remediation Method
Access to the Underground	Mine openings	Vertical surface openings will be sealed with a concrete cap/or plugged, horizontal openings will be rock sealed. Where such is not possible the area will be fenced.
Site Infrastructure and Potential Physical Hazards	Concrete Foundations, Walls and Slabs	Where accessible, vertical structures will be demolished and slabs on grade will be covered. All other remaining structures will be left as they are to naturally erode.
	Dock Areas	Docking areas will be removed and left with a more stable, natural slope. Potential sediment impacts to the water will be minimized during cleanup.
	Roads	Roads will be left to natural re-vegetate. Where radiation levels are above 250µR/hr they will be covered.
	Airstrip	No remediation is planned for the airstrip.
	Miscellaneous Equipment	Drain engine fuels and dispose of equipment on site unless equipment is valuable and can be easily removed from site in a safe manner.
	Miscellaneous Scrap	Pick up and dispose of on site.
	Wood Frame Structures	All structures (Cross Fault Lake Head-frame, wooden sheds, cabins and the wooden "Mountie Cabin") will be demolished.
Contaminated Areas, Chemical and Radiological Concerns	Site Drainage	Protect small terrestrial animals from ingesting metals by putting a layer of coarse rock over identified surface drainage routes and removing all exposed tailings where water drainage flows through. Monitor as part of long term monitoring program.
	Elevated Gamma Radiation	Cover accessible areas with approximately 0.5m of native cover material where gamma radiation levels exceed 250µR/h. The cover will reduce these areas to below 100µR/h. Therefore, the maximum gamma level in accessible areas will be less than 250µR/h.
	McDonough Lake TCA	Monitor water level and quality as part of long term monitoring plan.
	Silver Point TCA	Fill in surface ponds with tailings or native material and cover entire TCA with a clay/bentonite liner which will eliminate slumping and reduce metal loading in Great Bear Lake. Native fill and a protective cap will be placed above the impermeable liner.
	Murphy TCA	Relocate exposed tailings into local depression and cover with native fill materials.
	Radium (North and South) TCAs	Tailings are stable, vegetation is clean and radiation levels are at background. No physical remedial actions required however, monitoring will continue to ensure conditions remain the same.
	Murphy Bay Hillside Exposed Tailings	Difficult to access area. Will be left undisturbed and flat lying tailings will be covered with native cover material.
	West Adit/ Plant Area Exposed Tailings	Excavate and dispose of exposed tailings in a containment area such as: Murphy, Silver Point or McDonough TCA.
	Tailings in Great Bear Lake	Leave undisturbed and continue monitoring water quality and health of fish.
	Fuel Storage Areas	Will be covered or remain covered by rock.
	Hazardous Materials	If encountered, remove off-site for disposal.

APPENDIX 1
CDUT TERMS OF REFERENCE

CANADA AS REPRESENTED BY

THE MINISTER OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT
THE MINISTER OF NATURAL RESOURCES CANADA
THE MINISTER OF HEALTH CANADA (Canada)
and
DELINE DENE BAND (Délı̨nę)

Whereas: In June 1998, the Ministers of Indian and Northern Affairs, Natural Resources Canada and Health Canada made a commitment to establish a joint process to address the concerns of Délı̨nę arising from the Port Radium mine and related activities;

Whereas: On September 15, 1999, Délı̨nę Dene Band Council passed Band Council Resolution (BCR) 003-99 mandating a joint process with Canada to address these issues; and

Whereas: The parties agree that the process set out below fulfills the commitments to establish a joint process.

The parties agree follows:

The Canada/Délı̨nę Uranium Table (CDUT) is the forum for discussions between the Parties to fulfill the mandate defined hereafter.

I Mandate

The Canada/Délı̨nę Uranium Table will discuss and decide to recommend jointly to Canada and Délı̨nę measures to address the concerns raised by Délı̨nę with respect to the impacts of the Port Radium Mine and related activities in the Délı̨nę District. In fulfilling this mandate, the CDUT shall:

1. conduct its work based on a cooperative approach;
2. identify, recommend and, on approval by Canada and Délı̨nę, implement such studies, investigations programs and activities required to fulfill this mandate;
3. ensure a comprehensive environmental/health assessment, including cumulative effects, as agreed to by Canada and Délı̨nę, is conducted;
4. ensure the involvement in environmental and health investigations of all agencies with responsibilities for the protection of the natural environment and the health of residents in the Great Bear Lake area. Canada shall endeavour to coordinate the activities of other federal and Territorial departments and agencies who may conduct activities relevant to this mandate with the work of the CDUT;
5. ensure a continuing and free exchange of information associated with this mandate;
6. assist in the communication of findings to community members;
7. promote healing in the community of Délı̨nę;
8. build capacity in the community of Délı̨nę;
9. provide to the Parties Canada and Délı̨nę regular reports on the status of technical work and budgets.

II Core Capacity

To enable Délı̨nę to participate meaningfully, Canada will provide Délı̨nę with a budget to cover core capacity requirements for the development of a work plan and to conduct the jointly developed and approved work plan.

III Transparency and Information Sharing

Subject to relevant laws, and subject to an information sharing protocol to be agreed to by the parties, Canada will provide all of the information in its possession relating to the mandate of the CDUT. Information developed in the execution of the mandate of the CDUT will be shared by the parties.

Three information repositories will be established at the following locations:

- Délı̨nę
- Yellowknife
- Ottawa

In this mandate, "information" has the same meaning as "record" as defined in the Access to Information Act.

IV Membership of the CDUT

1. Each Party will be represented at the Table by its Official Representative;
2. Where a Party removes or replaces its Official Representative, it shall forthwith provide to the other Party written notice of such removal or replacement;
3. Each Party's Official Representative may designate a person or persons to act in their place;
4. The Official Representatives shall jointly be responsible for the conduct of the negotiations;
5. The size and composition of each Party's negotiating team shall be determined by its Official Representative, provided that each party shall notify the other of any significant changes in its team;
6. Individuals who are not members of negotiating teams may attend negotiating sessions meetings of the Canada/Délı̨nę Uranium Table with the approval of the Official Representatives;
7. The Official Representatives may set up working groups and define their tasks through agreed to Terms of Reference.

V Communications

A communications plan and protocol between Délı̨nę and Canada will be developed and appended to these Terms of References.

APPENDIX 2
77 Questions and Answers

A preliminary list of questions about Port Radium and related issues was produced during a scoping workshop held in Délı̨ne in May, 2000. Experts from various fields advised the Canada-Délı̨ne Uranium Table (CDUT) on research and activities that would provide the answers to these questions, and the Action Plan was developed according to these recommendations. The answers to the questions are based on the information, findings and recommendations produced by the CDUT.

This appendix is intended primarily as a communications tool for use within Délı̨ne, since most of the questions came directly from Délı̨nę community members. Readers should also refer to the key findings and associated analyses in the body of this report.

I Health – General

1. What kinds of sickness can radiation cause?

The potential for radiation to cause sickness depends on the dose received; generally speaking, the more radiation you receive, the greater the risk of it impacting your health.

Very high doses of radiation (e.g. from a nuclear bomb explosion) can cause extreme damage to cells and organs in the body, and these effects will be evident very soon after exposure. Lower doses of radiation can cause various types of cancer. The development of cancer is a complex process and can take many years; thus radiation-induced cancer may not become evident until many years after the exposure.

Radiation exposure can cause many types of cancer, including (but not limited to) bladder, bone, stomach, colon, leukemia, liver, lung and skin.

2. Can exposure to radiation cause reproductive problems, deformities or hereditary effects?

Large doses of radiation can cause either temporary or permanent sterility, depending on the dose received. If pregnant women are exposed to very high levels of radiation, there may be effects on their unborn babies, but there is no evidence that these effects are hereditary (i.e. will impact subsequent generations).

To date, no radiation-related hereditary diseases have been observed in studies of humans. However, experimental studies in plants and animals have demonstrated hereditary effects. The United Nations Scientific Committee on Atomic Radiation has developed estimates of hereditary risk based on observed effects in mice, as well as the natural hereditary risk in people.

Based on the doses estimated for ore carriers and their families, it is very unlikely that radiation exposure caused any reproductive problems, fetal abnormalities or hereditary effects.

3. How many different kinds of cancer are there? Which ones are related to us?

The Canadian Cancer Society identifies 25 different specific cancers. According to the NWT Cancer Registry, which tracked cancer incidence from 1969-2002, the three most common types of cancer in Délı̨nę during this period were lung, kidney/bladder and colorectal.

4. What kinds of cancer occur in the community?

Information recorded from community members lists the following types of cancer, believed to have occurred among current and former Délı̨nę residents: breast, colon, leukemia, liver, lung, brain, throat, bladder, prostate, bone, stomach, kidney, mouth and skin.

5. What can you do to detect cancer, or slow/stop it if you have it?

Regular medical check ups (at least once a year) are important for maintaining overall good health. There are symptoms that may be early signs of cancer, and should be immediately checked by a physician. For lung cancer, a persistent cough or shortness of breath may be an early symptom. Bladder or kidney cancer is usually characterized by blood in the urine, or blood in the stool for bowel cancer. General cancer symptoms include lumps, non-healing sores, weight loss, bone pain and fatigue.

There are six types of cancer which can usually be detected at an earlier stage through screening tests or self-examination: breast, skin, colon, prostate, cervix and testes. If your doctor suspects cancer, he/she may order simple tests such as blood tests or x-rays. If these indicate a problem, more targeted tests will be conducted.

There are several ways to treat cancer. Surgery is suitable for some early cancers, depending on location and stage of the tumour. Radiation therapy involves treatment with high-energy x-rays and is commonly used for lung, prostate, breast cancer and cancer that has spread to the bones or brain. Chemotherapy is a treatment involving drugs that are selectively toxic to malignant tumours. It can be used for almost any type of cancer, but requires that patients be in relatively good health in order to withstand the side effects of the treatment.

6. Are cigarettes causing cancer?

Lung cancer is the most prevalent type of cancer in Délı̨nę and smoking is the most common cause of lung cancer. It causes 85% of all lung cancers in Canada. Smoking is also linked to cancer of the bladder, mouth, larynx, oesophagus, stomach, pancreas, cervix, kidney and liver, as well as a possible link to brain tumours.

II Health – Past impacts

7. Who worked there, when, what is the history of the community with the mine?

The Sahtúot'ı̨nę became involved with Port Radium mining activities in a variety of ways. No Dene people worked underground at the uranium mine or lived on the mine site, but families did reside in the area, sometimes on a small peninsula across Outer Labine Bay. Dene people also lived at Cameron Bay, located about 10km southeast of Port Radium. They were primarily engaged in logging for mine timbers or as a source of heat/fuel for the mine operations. Dene hunters also sold or traded caribou and moose meat to Port Radium employees and residents, and Dene women made handicrafts to trade or sell to non-Dene.

However, the most extensive involvement of Délı̨nę Dene people with the Port Radium mine was as workers on the water transportation route that moved goods back and forth across Great Bear Lake and down the Great Bear River on its way to Fort McMurray, Alberta. Some Dene worked as deckhands on the barges, while others were shore-based and worked loading and unloading the barges at several transfer points along the river. During the life of the Port Radium uranium mine, a total of 35 Délı̨nę Dene men worked on the ore transport route in various capacities.

The Délı̨nę Uranium Team (DUT) has compiled a timeline indicating who worked at the mine or on the transportation route, during what time period, and in what capacity. Employment records from the uranium mining period are not available so information is based on oral histories and focus groups with community members; years and durations of employment are approximate.

8. Is it more dangerous to have worked underground in the mines than on the surface?

Yes, with respect to radiation exposure. Radon gas, and other radioactive agents that occur as uranium decays, build up in enclosed spaces and very high levels were often present in mines in the past. Radon and its decay products emit alpha particles which, when inhaled, can cause more damage to lungs than other types of radiation. A 1985 study of workers at Canadian uranium mine facilities showed that underground miners had nearly twice the rate of lung cancer compared to surface mine and mill workers.

Another type of radiation known as gamma radiation can be absorbed simply by being near its source. This is the type of radiation exposure that ore carriers were most exposed to. However, the total radiation doses received by ore carriers through this type of exposure would have been smaller than the doses of gamma radiation received by underground miners who were surrounded by the ore, and very small compared to doses from radon received by underground miners. Dose reconstruction studies show that, for radon alone, underground miners at Port Radium would have received about five times more radiation (1000+ mSv per year on average), than an ore carrier would from all radiation sources (about 200 mSv per year maximum).

9. Are the deaths of the ore carriers related to their exposure?

It is not possible to know for certain if the death or illness of any individual ore carrier was directly caused by radiation exposure. However, studies predicted that some ore transport workers had a higher cancer risk due to their exposure to radioactive ore.

10. How much were the ore carriers informed about the risks?

There is no evidence that Dene or non-Dene transportation route workers were informed about the potential risks of their occupation.

11. What were the effects on the families living in and around Port Radium?

The document "They Never Told Us These Things", produced by the Délı̨nę Uranium Committee, described several ways in which people believed that they were impacted by the Port Radium mine, including: health effects, particularly cancer in ore carriers; grieving and sense of loss due to the deaths of the ore carriers; and because of the deaths people believed attributable to the mine, the disruption of the passing on of cultural pursuits, especially to a generation of young men. The community health needs assessment and oral interviews undertaken by the CDUT clearly show high levels of grief and anxiety about the loss of loved ones to cancer, and fear of getting cancer.

The question of whether the mine caused cancer in family members living at Port Radium or transportation route sites is addressed in the dose reconstruction study, which concluded that radiation doses to family members were quite small and not a cause for concern.

12. What is the effect of the use of the canvas material from ore bags for housing and clothing?

Several people interviewed through the DUT Oral History project were asked about the use of ore bags for domestic purposes. Most said that they did not remember this happening. Some did, but specified that the ore bags were new and therefore uncontaminated by ore dust. A few respondents remembered ore bag material being used to make clothing, tents or other domestic items, but did not specify if the material had been previously used for transporting ore.

Despite the uncertainty, the dose reconstruction assumed that people might have inhaled or accidentally ingested contaminated soil or dust from used ore bags. It was shown that inhalation or ingestion of contaminated dust from ore bags would have contributed approximately 10% to total doses, and overall doses to family members from all sources were estimated to be quite small (0.9 to 5.5 mSv per year).

III Health – Present-day impacts

13. Is the mine causing cancer?

Based on the findings of various human health and environmental studies, there is no indication that contamination at the mine site is causing cancer. The question of whether the mine site has caused cancer from exposures in the past is addressed in Answers 9, 11 and 15.

Environmental and site testing at and around the Port Radium mine site showed that elevated levels of potentially cancer-causing contaminants, including gamma radiation, are localized, and drop down to background levels as you move even a short distance away from the site; this means that people living in Délı̨nę or travelling around the lake are not being exposed to contaminants.

Under present site conditions, people can visit the site for up to three months per year, every year, and still be under the public dose limit for exposure to radiation and other cancer-causing contaminants.

14. Can we know if those exposed at the mine site are still at risk of developing cancer because of their exposure?

The time that elapses between radiation exposure and the potential appearance of cancer symptoms can be very long. Leukemias take an average of 14 years to develop, while solid tumours (e.g. cancer of the lung or thyroid) can take 30 years or more, but 25 years is average. Since the uranium mine closed in 1960, it is still *possible* that a person might develop cancer as a result of their exposure during the mining period, but it is *not likely*.

15. What do we know and not know about the causes of the cancers occurring in the community? Are they related to anything at the mine site?

The causes of a specific cancer in an individual can be difficult, and in some cases impossible to pinpoint, because of the numerous factors that could determine whether someone gets cancer. The three most common types of cancer in Délı̨nę are lung, kidney/bladder and colorectal; these *could* be related to uranium exposure, but are also known to be caused by other factors such as smoking and poor diet.

It is not possible to know for certain if the illness or death of any individual ore carrier was directly caused by radiation exposure. However, studies predicted that some ore transport workers had a higher cancer risk due to their exposure to radioactive ore. Radiation doses to family members who lived at the mine or transportation route sites were estimated to be quite small and therefore not likely to increase cancer risk.

16. How does the cancer incidence in Délı̨nę relate to other areas?

Overall cancer rates for Délı̨nę are similar to cancer rates across the Northwest Territories (NWT). The observed lung cancer incidence in males was higher in Délı̨nę compared to NWT; kidney cancer among women was higher in Délı̨nę compared to Canada, but not the NWT.

17. What are the social impacts of cancer deaths?

During mental health assessments conducted for the CDUT, some individuals who had lost loved ones to cancer exhibited symptoms of depression and anxiety as a consequence of unresolved grieving. It was noted that elders in particular do not usually talk about or seek help for their grief, and are therefore likely to “suffer in silence”. With the loss of many elders to cancer and the debilitation of others due to profound grief, elders do not, as a group, perform the important function of teachers and advisors that they once did, which ensured the passing on of traditional knowledge and Dene culture. There is increasing alienation between elders and youth, as elders’ experiences have left them feeling depressed and isolated. These factors have negatively affected the general sense of community cohesion between generations.

Many people who have lost loved ones to cancer believe that the illness was a result of Port Radium uranium exposure. This had led to a lot of fear and anxiety in the community about the safety of people and the environment, which intensified over the years because people did not receive appropriate information about the dangers of radiation exposure.

18. What will happen to the widows? How do we help them through the grieving process?

Mental health assessments conducted for the CDUT found that many elders (including widows) were suffering from depression and loneliness; often this was related to unresolved grieving for the death of a loved one. The CDUT has sponsored community healing initiatives in Délı̨nę for elders and the general public. Events like the Depression and Stress/Anxiety Workshops taught people about the signs and symptoms of these mental health problems, and what to do about them. The Cancer Workshop educated community members about the disease. Healing journeys on the land brought elders and youth together and fostered community support networks. Traditional craft nights for women have become a popular forum for elder women and widows to get together, practice traditional skills and socialize.

For the long-term, the CDUT has recommended the development of culturally-based community programs that bring elders and youth together. Encouraging elders to share their knowledge and become more integrated into community activities will break the pattern of isolation and depression that was observed during mental health assessments. The CDUT has also recommended that the seniors’ home in Délı̨nę be reopened to provide health and social programs for elders, and that mental health services in the community should be improved.

19. What ways can we help people heal?

The CDUT initiated community healing programs in Délı̨nę, which are described above (see Answer 18).

The CDUT has recommended the following measures to continue the process of community healing: some form of public recognition from the Canadian government of the contribution of Délı̨nę Dene people to uranium mining at Port Radium; clean-up of the Port Radium site; an increased community role in planning future development activities in the Sahtu district; and community programs to bring people together, affirm cultural identity and allow elders to practice and teach traditional skills.

III Environment – Site Conditions

20. What are the safety issues at the site?

Physical hazards, such as scrap metal and mine openings, are the most immediate safety issues at the site. These are things that could be dangerous to someone who is simply walking around the site. The major physical hazards are openings to the underground mine workings; they were sealed in the 1980s but some have reopened over time. There is also a small amount of scrap metal and debris on the site which could be a hazard to people or animals moving around the site. Physical hazards will be fixed during site remediation.

Site testing indicated that radiation does not pose a hazard to people or animals visiting the site; however areas with the highest radiation levels will be remediated during site clean-up.

Testing did indicate elevated levels of metals in some soil, vegetation, water and sediment samples at the site. This may be a concern for some small species of animals using the site, but not for people. The remediation plan addresses the main onsite sources of contamination for animals, particularly contaminated surface water and exposed tailings.

21. What are the hotspots?

"Hotspot" is not a technical term, but is sometimes used to refer to areas where gamma radiation levels are significantly higher than background (natural) levels. At the Port Radium site, areas with elevated radiation levels include some older mine rock, which was used to build roads or cap tailings, and exposed tailings.

22. How long will these remain hotspots?

The CDUT has prepared a remediation plan to immediately reduce radiation levels at the site. If left in their present condition, the elevated radiation levels would remain above background for many thousands of years.

23. Are the levels of radiation getting stronger at the site?

Radiation levels at the site are not getting stronger. They will get weaker over time, but it will take many thousands of years. The remediation planned for the site will reduce levels immediately.

24. What are the naturally occurring (background) radiation levels?

Radiation occurs naturally everywhere in the world. Natural, or background radiation levels, can vary depending on the type of soil and rock that is present in an area. The Geological Survey of Canada determined an average natural background radiation level of 4.4μR/h for the Canadian land surface. The United Nations determined the world natural background average to be 5.2μR/h.

Areas of natural radioactivity are generally 3 to 10 times greater than the world average. Around the Port Radium site, background gamma radiation levels are approximately 10 to 15 μR/h. Gamma radiation levels for areas of the site that are impacted by mining vary greatly from 20μR/h to more than 770μR/h and average ~70μR/h. Radon measurements around the site indicate that background radon concentrations in outdoor air are in the range of 0.02 to 0.17 pCi/L and averaged 0.11 pCi/L, which is consistent with background levels measured in northern Saskatchewan.

25. Are there concerns about the site besides radiation (i.e. heavy metals)?

Besides testing for radionuclides (i.e. radioactive contaminants), samples from the Port Radium site were tested for 25 other non-radioactive contaminants (i.e. heavy metals). Tests showed elevated levels of several of these substances in exposed tailings, vegetation growing over tailings and pooled water above tailings.

There are several places where contaminated water is draining into Great Bear Lake. Water samples taken adjacent to the site do have elevated levels of some heavy metals. However, these impacts are localized, as samples taken farther off-shore show good water quality. Localized impacts of metals on water quality also occur from tailings that have been deposited into the lake near the site.

The ecological risk assessment did not predict any effects on aquatic species in the lake from contaminants at the Port Radium site (heavy metals or radionuclides). The human health risk assessment found that it was safe for people visiting the site to drink water from Great Bear Lake adjacent to the site.

26. What is the full inventory of hazardous waste at the site?

A review of mining records has shown that approximately 910,000 tons of uranium tailings and 800,000 tons of silver tailings were produced.

With respect to uranium tailings, it is estimated that about 170,000 tons (19% of total) were deposited into natural basins on the site or in the Silver Point area, while the remaining 740,000 tons (81%) were dumped into Great Bear Lake immediately off-shore from the site. With a few minor exceptions, silver tailings were disposed into McDonough Lake.

27. How do we measure what's in the dry lakes?

The amount of material and the nature of the tailings are determined by drilling into the dry lakes, taking a core sample, and determining the depth of the tailings. It is estimated that about 170,000 tons of tailings, or 19% of the total amount of uranium tailings, were placed in surface depressions ("dry lakes") or in the Silver Point area of the Port Radium site.

28. What is the makeup of waste rock and tailings?

Tailings are composed of sand, silt and clay particles; waste rock is composed of rock particles. The most prominent trace metals in both tailings and waste rock are copper, arsenic, lead and zinc. Since the mine's prime objectives were to recover radium, uranium and silver from the ore, the tailings (which are the waste product) would have low levels of these metals. Similar to the tailings, the waste rock is also a waste product and was not milled because it didn't have high levels of target minerals.

29. What were the recovery rates of the processing and subsequent reprocessing?

The average grade of ore mined during the life of the mine was approximately 0.69% U_3O_8. This is equal to one pound of U_3O_8 from every 143 pounds of ore that went into the mill. The highest grades of ore were mined in the 1930s, and grades decreased steadily until the mine closed in 1960.

The ore grades of various mine products are summarized as follows:

a) Hand picked (cobbed) high-grade ore that could be as high as 83% U_3O_8 but generally ranged from 20% - 45% U_3O_8

b) Gravity concentrate was produced in the gravity mill. The grade of this material ranged from 15% to 48% U_3O_8

c) Chemical concentrate prepared by first leaching (dissolving) ore with sulphuric acid and then selectively precipitating it with aluminium. This concentrate contained approximately 45% U_3O_8

d) Yellowcake, or sodium diuranate, was produced during the last three years of operation. This material contained approximately 80% - 85% U_3O_8.

30. Is it (contamination at the mine site) airborne?

No. The air is clean. Air quality at the Port Radium site was assessed for radon gas and metals. Dust fall jars, which were left at the site for a year, collected minimal dust and were within air quality standards.

31. What is the groundwater flow on the site?

There is sub-surface water at the site, but the hard rock and permafrost limits how much water is there, and its movement. Underground wells have been installed in tailings areas where water might collect and be in contact with tailings. Scientists concluded that the flow of underground water is slow, because it takes a long time for the wells to fill in after they have been pumped out.

32. What is the drainage basin?

Because the mine site is located on a peninsula, the drainage area of the site is small. There is a small amount of intermittent runoff from the site into Great Bear Lake. There is no river system or watercourse running through the site. McDonough Lake Tailings Containment Area (TCA) does receive water from a small watershed, but studies to date show no outflow from McDonough Lake TCA into Great Bear Lake.

33. Can water currents spread the hazardous waste in Great Bear Lake?

No. With respect to tailings, these are located, and are expected to remain, in areas near to the site. A survey of the lake-bottom around the site was carried out using sonar and underwater cameras in order to provide a picture of where tailings are located and whether they might be moving. The survey showed that tailings are in deep pockets in the lakebed in the area around Port Radium, and researchers predicted that there will be very little disturbance of tailings in these locations.

34. Is the contaminated material moving?

No. With respect to the land-based tailings, most of the tailings are covered up with waste rock and contained in stable areas (i.e. natural basins). McDonough Lake TCA was used as a repository for tailings, but there is no outflow from the water body so it is considered to be a stable containment area.

Concerns have also been raised about the tailings that were dumped into Great Bear Lake. Therefore, a detailed survey of the lake-bottom around the site was carried out using sonar and underwater cameras in order to provide a picture of where tailings are located and whether they might be moving. The survey showed that tailings are in deep pockets in the lakebed in the area around Port Radium, and researchers predict that there will be very little disturbance of tailings in these locations.

35. How far has the contamination spread?

Environmental testing conducted for the CDUT shows that contamination at the Port Radium site is localized and not spreading. Radon detectors and dust fall jars have not revealed any airborne contamination, so contamination is not spreading this way. Water samples taken from Great Bear Lake adjacent to the site do show elevated levels of some heavy metals as a result of contaminated water running off the site and tailings on the lake bottom, but samples taken further off-shore showed good overall water quality in Great Bear Lake. Tailings that were deposited in the lake are in deep pockets in the lakebed around Port Radium, and researchers predict that there will be very little disturbance of tailings in these locations.

36. In a fire, will the wind carry the contaminants?

No. The type of contamination present at the site (rocks and minerals) is not affected by fires.

37. Can we get a blueprint of the whole mine shaft?

The blueprints of the mine, mine site and the shafts are available for viewing in the Délı̨nę First Nation office.

38. Is there a record of what was dumped in the mine shaft?

There are no records available of what was dumped in the shafts. Experts believe that the mine shafts filled with water over time and are now frozen solid.

39. What was dumped in the water? (waste, machinery, oil, household items, etc.)

During the first 15 to 20 years of operation, tailings were discharged directly into Cobalt Channel adjacent to the gravity mill. During the period 1952 to 1960 after installation of the acid leach plant, approximately 340,000 tons of uranium tailings were dredged from Cobalt Channel and most of the subsequent tailings were discharged into the deep waters of Great Bear Lake. Some tailings were also discharged into Radium and Murphy Lakes, which were small lakes that were completely filled in and covered during mining operations. In total, an estimated 740,000 tons of uranium tailings were disposed in Great Bear Lake.

Although there are no mine records that anything other than tailings was deposited in Great Bear Lake, oral histories contain many references to fuel and oil in the waters around Port Radium during the mining period, as well as "yellow powder" (likely sulphur from the acid leach plant), ore dust and other miscellaneous garbage. Some people also recalled that a barge had sunk and remained submerged in Sawmill Bay, and one person said they had observed old trucks underwater in that area. It is also known that McDonough Lake was used as a garbage dump during the uranium mining period, and used during the Echo Bay silver mining operations to receive tailings and other waste material.

40. What happened to the equipment at the mine site (moved, disposed of, etc.)?

When Port Radium ceased uranium mining operations in 1960, Eldorado moved the diesel generators and some of the leach plant equipment offsite. Echo Bay Mines used the remaining facilities and infrastructure for silver mining, which ended in 1982.

Nearly all facilities and equipment associated with the mine have been removed from the site, burned, or demolished (there are a few exceptions, which are listed below). McDonough Lake TCA was used as a dumping ground for garbage and scrap metal. Parts of the mine site have been covered with waste rock; some metal scraps can be seen partially buried.

The only buildings that remain on the site are the "Mountie Cabin" and two small shacks at the end of Inner Labine Bay. Some vehicles are at the site, including a grader/snow-plow, a school bus and a few trucks.

V Environment – Human Health Risks

41. How is the mine site being used now (human and ecological use)?

People do not stay at the mine site for extended periods of time, but they may visit the mine site periodically. However people working in the area do continue to camp at the airstrip, which is located 6 km from the mine site. The Human Health Risk Assessment used occupancy scenarios up to a maximum time period of three months camping at the site, because it was assumed that people would not stay at the site any longer than this.

The field team found signs that the following species of animals were using and/or feeding at the Port Radium site: moose, caribou, bears, wolves, foxes, hare, rabbit, small mammals, grouse and ptarmigan. Twenty-eight species of birds were also observed, but it was acknowledged that there would probably be many more species using the site during fall migration.

42. Is it safe for researchers and others to be at the site?

Yes. Although several mine openings exist at the site which may be hazardous to people walking around the site, these have been marked or fenced off as a temporary measure and will be fixed during site remediation.

The risk assessment concluded that a person could be at the site for up to three months per year, every year, without suffering any adverse health effects from chemical or radiological exposure. This would include the consumption of all edible species of plants and animals at the site, and drinking water from Great Bear Lake adjacent to the site.

Furthermore, researchers doing work at the site were required to wear radiation dosimeters. These badges were sent to Health Canada at the conclusion of the field programs, and it was found that the doses received were all less than the detection limit of the badge (less than 20% of the public dose limit).

Site remediation work will be planned to minimize worker exposure and anyone involved in the clean-up activities at Port Radium will undergo training to learn about radiation risks. Radiation monitoring during the cleanup will also be required.

43. In what ways can people be exposed to contaminants?

In general, exposure to contaminants can occur through eating/drinking, breathing and through your skin (i.e. gamma radiation).

44. In what ways are people in Délı̨nę exposed to contaminants from the site?

Testing shows that people living in Délı̨nę are not being exposed to contaminants from the site.

Some community members expressed concerns about contamination of Great Bear Lake, which is the source of drinking water for people in Délı̨nę. Testing indicates that site drainage has not affected overall water quality in Great Bear Lake. People also asked about possible exposure to airborne contamination. Monitoring of dust and radon, both at the site and at other locations around the lake, showed that airborne contaminant levels were low and that radon levels were the same or similar to expected background levels.

Finally, some people worried that wildlife using the site might become contaminated and then be harvested and consumed by community members. Limited sampling of traditional food species from the site (e.g. hare, grouse) showed that contaminant levels could be elevated above background levels, but the results of the Human Health Risk Assessment demonstrated that the species were safe to eat. Fish sampled from Great Bear Lake near the site were found to have contaminant levels similar to fish caught elsewhere in Great Bear Lake and were safe to eat. Assessment of large game species (e.g. caribou, moose) indicated that they would not be affected by contaminants on the site and would be safe to eat. A traditional food sampling program in Délı̨nę, which included samples from a variety of commonly harvested plant, animal, bird and fish species, did not show any contaminants elevated above background levels.

45. How can people protect themselves from being exposed?

There is no risk of exposure off the site. On the site, the risk assessment has shown that a person could stay up to three months per year, every year, with no expected health risks. To minimize exposure, a person could choose not to camp directly on the site, or consume plants or terrestrial wildlife harvested there. Drinking water should be obtained from Great Bear Lake, and not from any streams or ponds found on the site.

46. What are the changes in contaminant levels over time?

Environmental and site testing conducted for the CDUT spanned a period of approximately 3 years. The results of the sampling campaign showed that, while a few measurements were different in 2003 than in 2001, the levels of contamination at the site are generally consistent.

Although not conclusive, a comparison of older water quality analysis with recent CDUT results indicates that contaminant levels from the site are decreasing.

VI Environment – Effects on Plants and Animals

47. Is the mine affecting the environment?

Studies have shown that the mine is impacting the environment at the mine site, but the impact is limited to the mine site and the waters in Great Bear Lake immediately adjacent to the mine site. Overall water quality in Great Bear Lake has not been affected.

The Port Radium site is contaminated by heavy metals and radioactive elements associated with uranium mining. Soil, vegetation and surface/groundwater at certain areas of the site have elevated levels of various metals and, as a result, there may be adverse effects to some species of small terrestrial wildlife using the site. Also, tailings in McDonough Lake could potentially impact some species of aquatic birds that consume snails and sediment.

There are also places at the site where radiation levels are elevated, primarily where spilled tailings were not covered with waste rock, although radiological exposure is not expected to have any impact on people using the site. Studies also showed that radiation exposure is not an issue for animals.

48. What animals are resident in the contaminated areas?

The field team noted the following species (or, more commonly, signs such as tracks or droppings) at the Port Radium site: moose, caribou, bears, wolves, foxes, hare, rabbit, grouse and ptarmigan. Lake trout were caught immediately offshore of the site; efforts at collecting whitefish were unsuccessful, as they have been in past attempts. Twenty-eight species of birds were also observed, but it was acknowledged that there would probably be many more species using the site during fall migration. Although many migratory birds will fly over Port Radium on their way to and from their breeding sites, there is no major migratory passage or staging area at Port Radium.

49. Is Port Radium affecting the fish?

None of the fish samples from Great Bear Lake, near both the mine site and Délı̨nę, contained levels of contaminants that would affect their health. Metal levels in lake trout caught near the site were found to be similar to lake trout caught elsewhere in the lake. The risk assessment confirms that there are no effects expected on aquatic species in Great Bear Lake. It is expected that aquatic species living in McDonough Lake might be affected, but no fish or other life forms were actually observed in the lake.

50. Are other animals in the food chain affected?

The risk assessment, based on current site conditions, predicts that there may be effects on the following species of wildlife at the site: hare (arsenic, cobalt, uranium), grouse (uranium) and fox (arsenic) from consumption of contaminated plants and water at the site, and duck (arsenic) from consumption of contaminated snails and sediment. There are no effects predicted for any aquatic species in Great Bear Lake.

51. Can caribou pick up radiation on their feet by going through the site?

No. The main way that caribou would pick up contamination from the site would be by eating contaminated lichen. The Human Health and Ecological Risk Assessment predicts that caribou would not spend enough time on the Port Radium site (which is small, and has limited vegetation) for any adverse effects on their health to occur. This is also true for people who may consume the meat of caribou who have been on the Port Radium site.

52. Does the migration of caribou through the site affect their reproduction?

No. The main way that caribou would pick up contamination from the site would be by eating contaminated lichen. The Human Health and Ecological Risk Assessmentdoes not predict that caribou would spend enough time on the Port Radium site (which is small, and has limited vegetation) for any adverse effects on their health to occur.

53. Can people be affected by handling contaminated animals?

No. The only pathway by which contamination could travel from animals to humans would by eating contaminated flesh or organs. Based on the results of the Human Health and Ecological Risk Assessment, all species of plant, fish or wildlife from the Port Radium site, or elsewhere on Great Bear Lake, are safe for human consumption.

54. What is the effect on vegetation at the site?

Fifteen species of vegetation from the Port Radium site were sampled; species chosen for sampling are those that are most likely to be consumed by people or wildlife using the site. Samples that were collected from areas impacted by tailings and/or waste rock were found to have elevated levels of uranium, arsenic and several other metals, as well as radionuclides (although levels of contamination, and specific contaminants varied between samples).

55. What are the long-term effects on the wildlife (such as population size)?

The Human Health and Ecological Risk Assessment has predicted that some small terrestrial and aquatic wildlife might suffer some adverse health impacts from arsenic and metals contamination at the site (fox, grouse, hare, duck), but since the site is not large enough to sustain large numbers of animals (even small animals), it is extremely unlikely that there will be any long-term effects on entire populations of wildlife.

There are no effects predicted for larger animals (e.g. moose, caribou, bear, wolf) or fish in Great Bear Lake.

VII Mine Site Clean-up

56. Can the mine be cleaned up?

The Port Radium area can not be returned to the state it was prior to the commencement of mining operations. However, remedial actions will address immediate physical hazards at the site and minimize impacts on the local environment and wildlife.

57. What is an acceptable level to clean up and contain to?

Délįnę and Canada jointly developed overall objectives for site clean-up (listed below). These objectives were then used to determine clean-up "levels" for specific issues at the site.

- Minimize human health and safety risks
- Protect fish, wildlife and vegetation
- Protect Great Bear Lake water quality
- Minimize environmental impacts of clean-up operations
- Return site to its original condition where possible
- Minimize long-term care and maintenance
- Cost effective

58. Can the effects of Port Radium be reduced?

Yes. The remediation plan for the Port Radium site will reduce the impacts of contamination in the following ways:

- Ponded water over tailings will be filled in and some surface drainage routes will be covered to eliminate potential sources of contaminated drinking water for animals.
- Silver Point tailings will be covered with clay and rock to block water flowing through the tailings and carrying contaminants into Great Bear Lake.
- Accessible exposed tailings will be covered or removed to reduce radiation levels and contamination of water and vegetation.

- Areas with gamma radiation levels over 250μR/hr will be covered to reduce potential radiation exposure.
- Physical hazards such as mine openings and scrap metal will be fixed by improving covers, blocking mine entrances and removing protruding pieces of metal.

59. Can we protect/limit exposure to animals?

The remediation plan will reduce areas where animals could be exposed to contaminated water, soil and vegetation.

60. What about long-term monitoring after clean-up?

There will be some long-term monitoring at the site as part of the licensing and remediation process. This will include monitoring the effectiveness of the clean-up and monitoring the environment.

61. Can we test the fish and animals every six months?

Periodic monitoring of the environment, including traditional food species, will be part of a long-term monitoring plan for the Port Radium site.

62. Can we put in monitoring facilities for the air and water?

Air monitoring at the site has been done for the past 5 years and results indicated that the air is clean; therefore there is no need to continue monitoring air quality. Gamma surveys will be done after site remediation to ensure that levels were reduced as expected. Water monitoring will also be part of the long-term management of the site.

63. How much sampling/monitoring needs to be done and how often?

The results of CDUT environmental studies and the remediation plan will guide the development of a long-term monitoring plan. Right now, it is recommended that there be short and long-term monitoring to ensure the effectiveness of the clean-up. There is also long-term environmental monitoring planned for the area around the site.

64. If we do clean-ups, can we use signs and fences around the hotspots?

Fences are not usually a good long-term solution because they can injure wildlife and require ongoing maintenance, but they may be required in some circumstances. Fences are not being used at Port Radium to manage contamination, but they have and will be used to identify physical hazards (e.g. around mine openings).

Radiation levels will be reduced through remediation work, but Port Radium is and always will be a former mine site; there are signs currently in place advising people of this fact, and they will remain at the site.

65. What are the clean-up options (removal, burial)?

For physical hazards such as old equipment and scrap metal, options include disposal in a contained area (probably McDonough Lake TCA) or removal by winter road. For mine openings, options that were considered included: leave them as they are, cap all with cement, or block entrances with waste rock and fencing.

Exposed tailings can be covered with waste rock, or picked up and disposed in a contained area (such as McDonough Lake TCA). Tailings that are already covered could be excavated and consolidated in one location, left as they are, or undergo minimal cover improvements to ensure that they remain stable.

Specific options were developed for all issues at the site; for each issue, a 'preferred option' was selected by assessing the options against overall clean up objectives for the site. The remediation plan for the site is based on preferred options selected by Délı̨nę and Canada.

66. What are the containment options?

There are currently three containment areas for dry land-based tailings (Radium North, Radium South and Murphy TCAs); one semi-contained tailings area (Silver Point); and one wet tailings containment area (McDonough Lake TCA). Small amounts of exposed tailings may be used to fill in ponds in existing TCAs, then covered up. Scrap metal could be buried on site in appropriate locations. If necessary, McDonough Lake TCA could be used for disposal of scrap or tailings.

67. If there is a clean-up, where will the removed material go?

The vehicles on site will be hauled offsite for disposal. Smaller pieces of metal will be buried on site in appropriate locations. Exposed tailings will be used to fill in depressions in existing TCAs and covered or, if necessary, deposited in McDonough Lake TCA.

68. Can we completely contain the mine site in something like clay or concrete?

This is not a realistic remedial measure because it will do more harm than good and would not be in keeping with our objective of returning the site to its original condition where possible. However, clay, gravel and rock will be used to cover selected areas on the site to reduce radiation levels and/or contaminated runoff.

69. What about the Northern Transportation Route sites?

There are 12 former Northern Transportation Route sites in the Sahtu from Port Radium to Tulita which are currently under the regulatory authority of the Canadian Nuclear Safety Commission (CNSC), formerly known as the Atomic Energy Control Board. In 2003, the CNSC commissioned a team of environmental scientists to measure radiation levels at 10 of these sites, not including Bear Landing and Sawmill Bay, which have been previously assessed. Two of the ten sites were found to have levels of gamma radiation that will require "the maintenance of institutional controls, which may include land use restrictions or site remediation". These sites include the original Bennett (lower) Landing and the waste dump along the road between Bennett camp and the airstrip.

VIII Miscellaneous

70. What are Délı̨nę people's uses of traditional foods?

Délı̨nę remains a very traditional community and is heavily reliant on traditional foods. This explains why Sahtúot'ı̨nę are so concerned about the contamination of their environment.

Caribou, moose, fish, rabbits, muskrat, beaver, ducks, ptarmigan and grouse are the most common food species harvested by people in Délı̨nę. During the late summer and fall season, several different varieties of berries are collected. Besides harvesting for consumption, women tan caribou and moose hides to make slippers and other crafts. People continue to use plants and some animal parts for medicinal purposes.

Traditional foods, and the harvesting of them, also have immense cultural significance to Dene people. There are protocols for killing and handling traditional food species that demonstrate respect for all living things, and reinforce the intimate connection between Dene people and their environment.

71. How do we educate the community about the issues and concerns about Port Radium?

The CDUT has used different methods to keep community members informed of the work that is being done to address concerns about Port Radium. Most CDUT meetings were held in Délı̨nę and were open to community members. The Délı̨nę Uranium Team (DUT) office was established in the community for five years and was open daily for people to visit and learn about the CDUT's work. The DUT fieldworkers interacted with community members in a variety of ways, including interviews, focus groups and public presentations.

Several workshops and community open houses have been held over the past five years to educate the community about health and environmental issues and ongoing research. Beginning in March 2003, the DUT produced a quarterly newsletter to update community members on CDUT research and activities. The DUT also produced a book based on oral history interviews with community members. The CDUT Final Report, which includes this document, will be communicated to community members by fieldworkers through home visits, to ensure that all people have been included and have the opportunity to ask questions and give feedback. Fact sheets based on key research findings and a documentary video that chronicles the CDUT research process will also be available in the future.

72. How was the mine site used before?

Prior to the commencement of mining activities, the Echo Bay area was undoubtedly part of the network of traditional Dene hunting and trapping areas around Great Beat Lake. Although there is no evidence that the mine site was a particularly important harvesting location, hunters would have undoubtedly harvested in that area from time to time. Also, several people interviewed during the Oral History Project mentioned the presence of graves in the Echo Bay area that predate mining activities, confirming its historic use. Because of the unique geological characteristics of the eastern shores of the lake, Dene people obtained material there for making traditional stone tools.

73. How do we make it understandable (process, questions, results)?

The CDUT recognized early on that its work involved some complicated words and ideas. We have tried to explain the difficult concepts like cancer, radioactivity and risk using workshops, with experts coming to explain their work to the community. The newsletters also used plain language to explain difficult concepts.

Translating scientific terms into North Slavey has been an important consideration in communicating our work. Translators have worked on specific topics and words for simultaneous translation as well as translation for the CDUT video and the commemorative oral history book.

The purpose of this document is to present clear answers to the questions that community members asked during the development of the Action Plan. We have tried to express our findings as clearly as possible, so that all community members can understand them.

74. Do we (Délįnę) want to know the truth?

People have indicated that they do want the truth, and that they need the truth in order to move forward on the issue of Port Radium. Representatives of the community of Délįnę have been full and equal partners in the research conducted by the CDUT over the past five years. Research projects were designed and conducted with one goal: to answer the questions that have been asked, and concerns that have been raised, by community members with respect to the historic and present-day impacts of Port Radium mining activities. Through their participation in this process, the people of Délįnę have signified their desire to know the truth.

75. How do we respond if people don't accept the results of the studies?

The CDUT has confidence in the quality and integrity of the Action Plan research. Statements of work, project descriptions, budgets and the selection of contractors for the projects have always been approved by representatives of both Canada and Délįnę.

However, it must also be acknowledged that research, whether TK or science, can not always produce perfect answers to complex questions. Some uncertainty exists in certain answers, and we have tried to be clear and honest about this. It is at an individual level that people will decide if they accept the results of our work or not, and it will be up to the respective governments of Délįnę and Canada to act on CDUT recommendations or choose a different course of action.

76. What do we do if the studies can't produce definitive answers?

It is important to acknowledge that the Final Report does not, in all cases, contain perfect answers to the Action Plan questions. As with all scientific studies, some amount of uncertainty remains. In carrying out the studies, the CDUT has attempted to reduce uncertainty as much as possible, identify where and how much uncertainty remains, and discuss how the uncertainty could impact decisions. Recommendations have been made based on the best attainable information.

If some studies do not result in clear answers, there are two potential outcomes. First, experts may recommend that further study be conducted. In this case, additional funding and commitments for future studies will have to be sought. Second, experts may conclude that studies cannot be improved upon and further research is not possible or will not be helpful. Canada and Délįnę should consider the CDUT recommendations and base their future decisions on the information and answers that have been provided.

77. What is the value of traditional food? Imputed cost (i.e. cost of replacing traditional foods with store-bought foods)? Social value? Health and nutritional benefit?

The message is clear that traditional foods are crucial to Sahtúot'įnę people's lives and Great Bear Lake is the "larder" for the people of Délįnę.

The many benefits of traditional foods are known: they are nutritious, a traditional lifestyle of hunting, fishing and trapping is physically demanding and helps people stay fit, and traditional foods are almost always cheaper than store-bought foods.

Traditional food use has deep social, cultural and spiritual meaning to Sahtúot'įnę; sharing, passing on of knowledge, reinforcement of Dene culture, and development of important qualities such as responsibility, patience and respect are all a part of traditional harvesting and use. But most important is the connection Dene people have with the environment, including land, water, animals, plants and air. It is said often that the health of people and the land is connected, that if one part is unhealthy that affects the other parts. So the health of traditional food species and all species is a primary concern of the people.

APPENDIX 3
Individual Acknowledgements

The following people worked on the Port Radium issue at various times from 1998-2005. Their contributions are gratefully acknowledged.

Canada – CDUT Staff

Chris Cuddy
Kevan Flood
David Kennedy
Isabelle Proulx
Carole Mills
Joella Hogan
Julie Ward
Erica Janes
Ingrid Nielsen

Délı̨nę – CDUT Core Staff

Danny Gaudet
Cathy Mackeinzo
Walter Bayha
Gina Dolphus
Shelagh Montgomery
Jennifer Blomqvist
Sam de Beer
Deborah Simmons
Gina Bayha
Vera Caine
Orlena Modeste
Mark Modeste
Irene Betsidea
Marlene Tutcho
Edith Mackeinzo
Charlie Neyelle
Jane Goulet
Chuck Bloomquist

Délı̨nę – CDUT Project-based/Temporary Staff

Mary Modeste Jr.
Ruby Beyonnie
Lee Tutcho
Roddy Modeste
Morris Modeste
Thomas Neyelle
Gary Taniton
Dave Taniton
James Takazo
Joe Blondin Jr.
George Dolphus
Gordon Mackeinzo
Phoebe Ann Baton
Phoebe Esau
Freda Neyelle
Kirk Dolphus
Tina Bettridge
Jennie Vandermeer
Cynthia Modeste

Délı̨nę – Leaders and Advisors

Raymond Tutcho*
Leroy Andre*
Raymond Taniton*
Walter Bayha*
Maurice Neyelle
Joe Blondin Jr.
Moise Bayha
Betty Tetso
Isadore Yukon
Paul Baton
Hughie Ferdinand
Frank Elemie
Charlotte Tetso
** Chiefs*

Délı̨nę Uranium Committee (preceded CDUT)

Raymond Tutcho
Paul Baton
Alfred Taniton
Gina Bayha
Joe Blondin Jr.
Hughie Ferdinand
Cindy Kenny Gilday
Morris Neyelle
Dolphus Tutcho

APPENDIX 4
List of CDUT Reports

AXYS (2004). *Uranium and human health impacts. A resource binder for health professionals in Délı̨nę, NT.* Calgary, AB: AXYS Environmental Consulting Ltd.

Bayha, G. (2003). *Cancer Workshop Report.* Délı̨nę, NT: Délı̨nę Uranium Team.

Bernard, Betty (2004). *Community Mental Health Strategic Plan.* Délı̨nę, NT: Délı̨nę Uranium Team.

Bettridge, T. and G. Dolphus (2003). *Depression Workshop Report.* Délı̨nę, NT: Délı̨nę Uranium Team.

Blomqvist, J. (2004). *Oral History Analysis: Phase I – Historical Evidence of Exposure to Mining-Related Contaminants at Port Radium and Transportation Route Sites.* Délı̨nę, NT: Délı̨nę Uranium Team.

Caine, V. (2004). *Land Use Mapping Project Phase 1 and 2.* Délı̨nę, NT: Délı̨nę Uranium Team.

Caine, V. (2004). *Sahtúgot'ı̨nę Back to the Land Journey [to Gameti/Rae Lakes].* Délı̨nę, NT: Délı̨nę Uranium Team.

Caine, V. and G. Dolphus (2004). *Community Activities Report.* Délı̨nę, NT: Délı̨nę Uranium Team.

Caine, V. and G. Dolphus (2003). *Délı̨nę Grief Workshop.* Délı̨nę, NT: Délı̨nę Uranium Team.

Caine, V. and G. Dolphus (2003). *Délı̨nę Healing Journey [to] Cloud Bay.* Délı̨nę, NT: Délı̨nę Uranium Team.

Délı̨nę First Nation (2005). *If Only We Had Known: The History of Port Radium as Told by the Sahtúot'ı̨nę.* Calgary, AB: Friesens Press.

Gardee, R. and J. Jackson (2001). *Healthcare Needs in Délı̨nę: A Preliminary Assessment.* Délı̨nę, NT: Délı̨nę Uranium Team.

Gardee, R. (2002). *Délı̨nę health implementation plan: Report on health assessments.* Délı̨nę, NT: Délı̨nę Uranium Team.

Goodjohn, M. (2003). *Délı̨nę Family Tree Project: Final Report.* Délı̨nę, NT: Délı̨nę Uranium Team.

Intertec Management Ltd. (2004). *Port Radium Fact Finder Report.* Regina, SK: Intertec Management Ltd.

KAVIK-AXYS Inc. (2004). *Historical Community Health Profile for Délı̨nę*, NT. Calgary, AB: KAVIK-AXYS Inc.

Kershaw, R. (2003). *Communications Training Evaluation and Recommendations.* Délı̨nę, NT: Délı̨nę Uranium Team.

Macdonald, C. (2005). *Summary Data Report of Contaminants in Traditional Foods in Délı̨nę, NT.* Pinawa, MB: Northern Environmental Consulting and Analysis Ltd.

Manneschmidt, S. (2002). *A Summary Report of the Mental Health Assessments Conducted in Délı̨nę, NWT February to July 2002.* Délı̨nę, NT: Délı̨nę Uranium Team.

Meadows, L. (2005). *Analysis of the Délı̨nę Uranium Team Oral History Project Data: Social Impacts of Port Radium for the Sahtúgot'ı̨nę.* Délı̨nę, NT: Délı̨nę Uranium Team.

SENES Consultants Ltd. (2005). *Port Radium Remediation Plan.* Prepared for Indian and Northern Affairs Canada. Richmond Hill, ON: SENES Consultants Ltd.

SENES Consultants Ltd. (2005). *Dose Reconstruction for Délįnę Dene Uranium Transport Workers and Délįnę Dene Who Lived Along the Historical Uranium Transportation Route*. Richmond Hill, ON: SENES Consultants Ltd.

SENES Consultant Ltd. (2005). *Investigation of Epidemiological Feasibility for Délįnę Uranium Transport Workers*. Richmond Hill, ON: SENES Consultants Ltd.

SENES Consultants Ltd. (2004). *Dose Reconstruction Pilot Study*. Richmond Hill, ON: SENES Consultants Ltd.

SENES Consultants Ltd. (2004). *Port Radium – 2004 Human Health and Ecological Risk Assessment*. Richmond Hill, ON: SENES Consultant Ltd.

SENES Consultants Ltd. (2004). *Port Radium – Discussion of Remediation Options and Considerations*. Richmond Hill, ON: SENES Consultants Ltd.

SENES Consultants Ltd. (2004). *Port Radium – 2003 Environmental Study*. Richmond Hill, ON: SENES Consultants Ltd.

SENES Consultants Ltd. (2002). *Port Radium Site Assessment – Data Analysis Report for the 2001 Field Program*. Richmond Hill, ON: SENES Consultants Ltd.

SENES Consultants Ltd. (2001). *Preliminary Assessment of Environmental Conditions at the Former Port Radium Mine Site*. Richmond Hill, ON: SENES Consultants Ltd.

Vandermeer, J. (2004). *My Impressions Regarding Port Radium and the Délįnę Uranium Team*. Délįnę, NT: Délįnę Uranium Team.

Yakeleya, N. (2003). *Stress and Anxiety Workshop Report*. Délįnę, NT: Délįnę Uranium Team.