EDI ENVIRONMENTAL DYNAMICS INC.
Natural Resource Consultants

MT. NANSEN TERRESTRIAL AND AQUATIC EFFECTS STUDY DESIGN

Prepared for:

Government of Yukon
Abandoned Mines Branch (Type II)
Energy, Mines and Resources
Box 2703
Whitehorse, YT
Y1A 2C6

Prepared by:

EDI Environmental Dynamics Inc.
Suite 206-4133 4th Avenue
Whitehorse, YT
Y1A 1H8

In association with:

C.E. Jones & Associates Ltd.
104 – 645 Fort Street
Victoria, BC

and

Allnorth Consultants Ltd.
Box 5, 2011 PG Pulp Mill Road
Prince George, BC.

October 2005

TABLE OF CONTENTS

Page

1.0 INTRODUCTION

EDI Environmental Dynamics Inc. was retained in August 2005 to design and complete a Terrestrial and Aquatic Effects study for the Mt. Nansen minesite. Mt. Nansen was operated by BYG Natural Resources Inc. between November 1997 and February 1999, when mining and milling stopped (Conor Pacific 2000). Since then, the mine has been under receivership with the mine maintenance and other responsibilities first being overseen by the Federal Government, and later (through devolution) by the Yukon Government Abandoned Mines Branch.

Conor Pacific (2000) listed several major operational problems that were encountered, and which BYG Natural Resources Inc. was unable to remediate. These include:

1. Seepage through the tailing impoundment(s) resulting in water quality issues.
2. An inadequate cyanide treatment system creating water quality issues.
3. Mining below the oxide zone on the Brown-McDade open pit, which resulted in sulphide oxidation and metal leaching in the lower pit walls and floor. The sulphide rich tailings were deposited in the northwest corner of the tailing impoundment.

Since July of 1999, the mine maintenance has been overseen by government agencies. During this time water leaking from the tailings pond through the tailings dam has been captured in a seepage recovery pond and pumped back into the tailings pond. Prior to 2005, the water was treated on a regular basis (during the summer months) before being released into the Dome Creek system. In the summer of 2005 untreated water met effluent quality standards and was released directly into Dome Creek.

In order for the Yukon Government to design a reclamation plan it needs to understand the potential of elevated metal levels in the terrestrial and aquatic ecosystems. The site is located within the Little Salmon Carmacks First Nation Traditional Territory and the First Nation has strong traditional ties to the area. First Nations members as well as other local residents collect and consume many plant, berry, fish, bird and mammal species from the area. This Terrestrial and Aquatic Effects Study will determine the level and extent of contamination in the vicinity of the Mt. Nansen minesite and provide direction that will assist with planning final reclamation of the site.

Nicholson (2002) collected lichens and other plant tissues in the Mt. Nansen area and analyzed these tissues for arsenic. In general, the results showed that lichens contained high arsenic immediately adjacent to sources of contamination.

This Terrestrial and Aquatics Effects Study will build on the existing information using an extensive range of samples over a broad spatial area and measure a wider range of metals to determine possible metal contamination.

The Terrestrial and Aquatic Effects Study will be undertaken during the late summer and fall of 2005. This study will focus on determining if elevated metal levels are present within the Mt. Nansen area, and if so, determine the spatial extent of contamination and whether the release of contaminants is continuing.

2.0 METHODOLOGY

In order to become familiar with the minesite, the area, and the issues at the site, the study team has reviewed existing information, visited the minesite and spoken with agency personnel. In terms of existing information, numerous reports and data sets exist covering the geology, soils, water quality and review of specific issues at the site. This information has assisted with the study design and will be a significant resource throughout the duration of the project.

In August 2005, a community survey was conducted in association with the Little Salmon Carmacks First Nation. A researcher from the First Nation assisted *Environmental Dynamics* staff in identifying, locating and interviewing local people. A summary of the results of the survey is presented in Appendix A. The information gathered by this survey has been used extensively to determine the species to be collected and analyzed. It should be noted that as the study progresses, additional people who can provide significant insight, will be interviewed.

On August 23, 2005, the study design team along with staff from the Abandoned Mines Project Office (Type II) visited the Mt. Nansen site to become familiar with the minesite and site dynamics. Considerable knowledge was gained on the mine's operations, maintenance requirements, potential sources of contamination, geology and botany of the area.

On August 24, 2005 the study design team met in Whitehorse with staff from the Abandoned Mines Project Office to discuss the project and to refine the study design and methodology. The following sections of this report outline the approach to determine the terrestrial and aquatic effects of the Mt. Nansen mine.

3.0 STUDY DESIGN

The minesite has three potential sources of aerial contamination; the tailings pond, the Brown-McDade pit (and associated water dumps) and waste rock dumps, and stockpiles of low-grade ore material adjacent to the mill site. In addition, Dome creek and to a lesser extent, Pony Creek[1] both are potential receivers and transport pathways of contamination.

The main goal of this study is to determine if elevated metal levels exist in the terrestrial and aquatic ecosystems within the vicinity of the minesite. If so, the secondary goals will be to determine the spatial extent of potential contamination, determine if aerial contamination is continuing and determine if the levels are related to the mine and past mine operations.

3.1 Terrestrial Effects Component

The terrestrial ecosystem within the vicinity of Mt. Nansen could potentially be impacted through both aerial and aquatic pathways. As such both upland sites (subject to aerial contamination) and riparian sites (subject to aquatic contamination) will be sampled.

[1] Pony Creek is a potential receiver because of connection via the open adit which connects to the flooded surface workings in the Brown McDade pit.

Lichens, vascular plants, soils and animals will be investigated to evaluate the terrestrial component. At the upland sites, lichens, vascular plants and soils will be sampled to assist with the determination of airbourne contamination. At the riparian sites, vegetation will be sampled to determine if it has been impacted by contaminants in the aquatic environment (Note: Aquatic Effects component will also evaluate the aquatic pathway.) Animals will be evaluated within the vicinity of the sources of aerial and aquatic contamination.

Ninety (90) upland sample plots will be established along six transects radiating outwards from each of the main sources of potential contamination, the tailings pond, mill site and open pit/waste rock dumps (Figure 1). The first plot on each transect will be located immediately adjacent to the disturbances. From this location, additional plots will be established at distances of 50, 200, 450 and 950 meters from the first plot respectively. Some adjustment will be made where transects intersect one-another. This pattern will allow for close inspection of the contamination immediately adjacent to the disturbances and allows for spatial analysis in all directions. The outermost plot on many transects are located outside of the Dome and Pony Creek watersheds and thus should provide control information (assuming the contamination has not reached these points).

In order to evaluate potential road dust impacts, three upland sites will be located immediately adjacent to the main access road between the Dome Creek bridge and the mill site. An additional three upland reference samples will be located in each of the following mineralized zones: the Spud, Webber and Flex zones. These sites will provide controls within known areas of mineralization, which is somewhat reflective of the mineralization within the minesite. It should be noted that although the control areas have not been mined there is some surface disturbance due to exploration in the area.

Five plots intended to sample riparian vegetation will be located on Dome Creek at a 300 meters spacing between the tailings seepage impoundment and the Mt. Nansen road. A further three plots will be located on Dome Creek between the tailings pond and the mill site. Three sampling plots will also be located downstream along Pony Creek.

Three plots will also be established to sample the blackened vegetation and soils located along Dome Creek below the seepage impoundment where it occurs alongside each riparian site. Vegetation (willow, wheatgrass) growing directly on the tailings and waste rock dumps will also be analyzed for metals.

3.1.1 Lichens

The potential for airborne dispersal of metals, will be investigated in detail through sampling of lichens. As lichens mainly receive their nutrients from air and rainfall, they are excellent indicators of airborne contamination. Lichens, specifically Caribou Moss (*Cladina mitis)* will be collected from each upland sample site location (Figure 1). Lichens will be collected using un-powdered gloves, which will be replaced with new uncontaminated gloves at each sample site. Several lichens at each location will be combined into one sample for analysis. Non-lichen material will be removed from the samples to ensure that only lichen material is analyzed. Samples will be immediately placed in new zip-lock bags. Duplicate samples will be taken from 5-10% of the sites to allow for quality assurance /quality control (QA/QC) testing. These will be submitted to the lab in a blind manner (i.e., the lab will not know that the samples are duplicate).

N
W E
S

Klaza River

Rory Creek

Dome Creek

Verssen Creek

Brown McDade Pit

Mill Site

Tailings Pond

P
Q
R
O
N
M
K
L
G
J
H
E
F
D
C
A
B

Figure 1. Terrestrial Effects Sampling Locations

Scale: 1:15,000

- Streams
- Contours (5m intervals)
- Treeline
- Gravel Roads
- Trails
- Waterbodies
- Buildings
- Terrestrial Sampling Transects
- Upland Terrestrial Sampling Sites
- Control Upland Terrestrial Sampling Sites
- Riparian Terrestrial Sampling Sites
- Mineralized Areas

Additional Sites will be located in the blackened vegetation along Dome Creek and vegetation growing on the tailings and waste rock dumps

ENVIRONMENTAL DYNAMICS INC.
Natural Resource Consultants

Lichen samples will be sent to the lab immediately for analysis. The results will give an indication of the aerial contamination levels and will provide a basis to select which of the already collected plant and soil samples should also be analyzed. The results will also assist the study team in determining whether or not we need to sample for lichens in other locations (i.e., for additional control or to answer specific questions).

3.1.2 Berries/Plants

In addition to lichen samples which will be collected at each upland site, significant occurrences of the species listed in the below table will also be collected. Samples will also be collected on an opportunistic basis at the riparian sites. Again composite samples taken from a number of plants within the general vicinity of the sample site will be collected (using the same protocol as lichens). Duplicate samples will be taken for 5-10% of the sites and submitted to the lab as separate samples without indication that they are duplicates.

From review of the existing information, species that will be collected may include:

Table 1. Vegetation species that are important to local First Nations.

Species	Scientific Name	Portion of Plant/Lichen Utilized
Blueberries	*Vaccinium spp.*	Berry (Leaf for medicinal)
Labrador Tea	*Ledum groenlandicum and/or L. decumbens*	Shoot
Crowberries	*Empetrum nigrum*	Berry
lowbush cranberries	*V. vitis-idaea*	Berry
soapberries	*Shepherdia canadensis*	Berry
bolete mushroom	*Leccinum spp.*	Stem
Rose	*Rosa spp.*	Fruit
Caribou Horn (lichen)	*Masonhalea richardsonii*	Whole plant
Willow	*Salix spp.*	Leaf, bark, branch
Paper birch	*Betula papyrifera*	Bark, cambium
Juniper	*Juniperus communis*	Stem, berry
Spruce, black /white	*Picea spp.*	Fresh pitch/sap
Trembling aspen	*Populus tremuloides*	Leaf
Bear Root *	*Hedysarum alpinum*	Root
Red raspberry*	*Rubus ideaus*	Berry
Cloudberry*	*Rubus chamaemorus*	Berry
Highbush cranberry*	*Viburnum edule*	Berry
Black Currant*	*Ribes hudsonianum*	Berry
Red Currant*	*Ribes triste*	Berry
Subalpine fir*	*Abies lasiocarpa*	Cone, branch, bark

* These species are utilized by the Little Salmon Carmacks First Nation but are not likely to occur at the site.

Plant samples collected will be frozen. Once the analytical results of the lichens have been received and analyzed, decisions will be made by the study team as to the specific sample site locations of plants and species of plants that will be submitted to the lab for analysis.

3.1.3 Soils

To support the lichen and plant data, considerable sampling and soil analysis will be conducted for all upland sites. Soil sampling will focus on analyzing samples taken from different soil layers throughout the minesite. At each upland plot a 125 ml sample of L, FH, and B horizon will be collected (as available). If there is volcanic ash present, a sample of the ash and the B horizon below the ash will be collected. This stratification by depth will allow for further evaluation of the significance of airborne contamination and well as giving the study team a thorough understanding of natural metal levels.

Extensive pre-mine development soil data has been obtained for the general study area. This data will provide a base for comparison and provides information on high metal levels in certain areas. Soil samples will be collected using stainless steel shovels and trowels and placed in glass jars provide by the laboratory. Samples will be kept until the results of the lichens and plants are analyzed. Selected samples will be analyzed for the areas that have been determined to contain high levels of metals in lichen and plants. Less intensive analysis of non-contaminated areas (i.e., 1 in 3 plots) will be conducted to confirm this pattern. Duplicate samples will be taken for 5- 10% of the samples and submitted to the lab as separate samples without indication that they are duplicates.

3.1.4 Wildlife

Tissue from wildlife may indicate if any contamination is bio-accumulating up the food chain. While most of the animals hunted by people in the area are big game species, there is significant value in sampling small mammals that spend most, if not all of their lives, within close proximity to the minesite. Various species will targeted due to their importance in the food chain (Table 2).

Table 2. Wildlife groups that will be targets.

Type of Wildlife	Rationale for analysis
Small Mammals (voles, shrews, squirrels, weasels)	Are an important food source of many other animals.
Small Game Species (grouse / ptarmigan and porcupine)	Are an important food source for larger wildlife as well as people.
Large Game Species	Food source for people.

3.1.4.1 Trapping Program

Small mammals will be trapped close (within 500 m) to the three main potential sources of aerial contamination (the tailings pond, the mill area, and the pit) within the minesite. Small mammals will also be trapped in a control area near Rowlinson Creek which is approximately 20 km from the minesite. Generally speaking, small mammals have small home ranges which make them good indicators of contamination accumulation. As small mammals must be sacrificed to be analyzed for contaminants, two lethal sampling approaches will be used. Snap traps and pit fall (drowning traps) traps will be set at each sampling site. The snap traps will be of various sizes (i.e. normal mouse trap and rat trap size) and will be baited with various baits to target a variety of species. The traps will be set on the ground and in trees in a variety of habitats. These traps may catch voles, squirrels, weasels and gray jays (*Perisoreus canadensis*; as a by-catch). This type of catch would provide samples from different trophic levels (i.e.

voles/herbivores, weasels/carnivores). As mentioned by Jung (pers. comm. 2005), it would be desirable to sample animals that eat rodents, such as weasels as they are more likely to accumulate heavy metals.

Gray jays have been caught in some of the early trapping events. However, they may also provide some insight to the contaminants at the site. Gray jays are not migratory and according to Alexander et al. 2003, breeding territory size in study conducted in the Kluane Lake area was documented as 23.2 ha. They are omnivores (eat both plants and animals) and thus may be accumulators of contaminants.

Pitfall traps, consisting of a bucket dug into a hole on a natural pathway, have been filled with distilled water to target shrews. Shrews, due to their feeding habitats (insectivores with a very high metabolism), are classified as good indicators of monitoring contaminants in terrestrial environments (Hirvi, Henttonen and Suortti 2005).

3.1.4.2 Collection of Samples from Hunters

While it is likely that small mammals will provide the most insight into contamination uptake, there will be significant efforts expended to test small game species (grouse/ptarmigan), porcupines and larger mammals that are consumed by humans to ensure that concerns about potential contamination are addressed. Animal parts that can be obtained from animals that have been harvested in the area (within 25 km of the site[2]) can be analyzed for metals. The study team has and will put considerable effort into obtaining samples from harvested game birds and mammals using a number of different methods.

First, the study team has been in communications with the Northern Contaminants Program and will be informed of any local specimens that have been turned in to Yukon Environment under the current voluntary programs to collect and analyze ungulate parts (as outlined in the hunting regulations). It should be noted that the contaminants program has already provided the study team with data from some animals collected in the past and has allowed us access to additional samples they have in stock. To inform hunters of the Northern Contaminants Programs voluntary program as well as the Terrestrial Effects study, the study team has produced a sign that is posted on the Mt. Nansen Road (Appendix B; along with posters in Carmacks and in the community's newsletter [The Hooter]). The sign and posters describe the Terrestrial Effects study and need of tissue samples from any animals harvested in the Mt. Nansen area. It also provides the hunters with options for pick-up and informs people of a draw for a hunting knife set for samples donated from within the vicinity of Mt. Nansen. To help target a caribou sample, notices will be sent to individuals who hold caribou permits in this area (when mailing addresses can be obtained).

In addition, the study team has hosted an open house in the community of Carmacks. General information on the study and identifying the need for tissue samples was spread during this event. Also we envision that the Little Salmon Carmacks Lands and Resources contact(s) and the mine caretaker (Bruce Wheeler) will assist with finding hunter killed samples.

Given the time of year and limited sampling window for the trapping program and the unknown response of the hunting community, the number of specimens of each species is difficult to predict. In early November, a review of the captured specimens will be completed and decisions on what species

[2] While the collection area for hunted species is 25 km of the minesite, analysis will be focused on samples collected closest to the minesite (depending on species and knowledge of migration).

and parts that will be analyzed will be made. It is possible, additional efforts may be required to get an appropriate number of samples of each trophic level. Liver, kidneys and muscle tissue from a representative number of larger animals harvested from the Mt. Nansen area will be analyzed for metals. In cases of small mammals whole samples may be analyzed (i.e., shrews) or several livers will be combined to form a composite sample (i.e., voles).

3.2 Aquatic Effects Component

The aquatic effects component will focus on determining levels of contamination in water, sediments and fish. Generally, efforts will be focused on fish and sediment, as they will provide the most insight to longer-term effects (i.e., compared to doing additional significant water quality sampling). Additional water quality sampling will be conducted in areas where there is a lack of information.

3.2.1 Water Quality

There is a significant water quality-sampling program which is continuing at the minesite that is separate from this study and, therefore, a large amount of water quality data will be available. This data combined with other past studies will provide an excellent "starting point" to analyze the effects that the mine has had on the aquatic environment. To complement this data set samples will be collected at the locations listed in Table 3 and Figure 2.

Table 3. Proposed additional one-time water sample locations.

LOCATION	RATIONALE
Dome Creek directly downstream of mill site	Characterize water quality upstream of tailings pond.
Dome Creek below between mill site and tailings pond.	Characterize water quality upstream of tailings pond.
Dome Creek below mill site in bypass channel adjacent to tailings pond.	Characterize water quality upstream of tailings pond.

N
W
E
S
Victoria
Placer
Back
Creek
Brown-McDade
Pit
Placer
Mill
Site
Dome
Creek
Nansen
Creek
Creek
Victoria
Lake
Nisling
River

ENVIRONMENTAL DYNAMICS INC.
Natural Resource Consultants

Figure 2. Aquatic Sampling

Scale: 1:30,000

- Streams
- Waterbodies
- Roads
- Mined Areas
- Sediment Sampling Sites
- Water Sampling Sites
- Fish Sampling Sites

3.2.2 Fish

Slimy sculpin (*Cottus cognatus*) was chosen as the primary sentinel species used to monitor metal concentrations within the aquatic environment in the vicinity of the Mt. Nansen Mine because it is less mobile and less migratory than other fish in the region. Thus, slimy sculpin would be the best fish to indicate whether or not the Mt. Nansen mine has resulted in elevated metal concentrations. Also, slimy sculpin likely occur in relatively high numbers in the project area (Victoria Creek) and have the added benefit of a benthic lifestyle. Small-bodied fish, such as the slimy sculpin, are generally recommended for use as sentinel species, primarily due to the increased probability of longer exposure times as a result of reduced mobility and their non-migratory nature. Sculpin will be tested from a number of sites within and outside the influence of the minesite (Table 4; Figure 2). Other species known to occur in the Victoria Creek watershed (Arctic grayling *[Thymallus arcticus]* and burbot *[Lota lota]*) are either highly mobile or migratory or are found in lower densities, all of which makes them poor choices for monitoring metal contamination. As the First Nation does have significant concerns about Arctic grayling, we propose to collect some samples in the areas of greatest concern (Victoria Creek near mouth of Dome Creek)., Due to their small size whole slimy sculpin will be analyzed, while Arctic grayling liver, kidney and flesh will be analyzed as available[1].

Table 4. Proposed locations to sample sculpin.

LOCATION	RATIONALE
Victoria Creek 500 m downstream mouth of Dome Creek (*this and the site above site may have to be combined due to the low numbers of fish captured at this site thus far*).	Test Sample in area of influence of Dome Creek
Victoria Creek downstream of main road	Test Sample in potential area of influence of Dome Creek
Victoria Creek 2 km upstream of Back Creek	Upstream Control
Nisling River downstream of confluence with Victoria (*few sculpin samples available*)	Test Sample in potential area of influence of Dome Creek
Outlet of Victoria Lake.	Upstream Control
Lower Dome Creek (*dropped as no fish present)*	Test sample

[1] Due to analysis weight requirements (5 grams wet), livers kidneys and flesh and from several fish may be combined to form a composite sample.

3.2.3 Sediments

Sediment sampling will be conducted in some of the same locations as the Conor Pacific (2000) study and as per past water license sampling requirements. Comparisons to the past sediment sampling works will provide a good indication of the recent effects of the mine. Samples will be collected (with stainless steel trowels) from depositional areas, dried and screened though a 100-mesh sieve (as outlined in the water license). The sites to be sampled are listed in the Table 5 and presented on Figure 2.

Table 5. Locations for sediment sampling.

LOCATION	RATIONALE
Dome Creek upstream of Tailings Pond (3 sites)	Test to determine contamination upstream of tailings ponds.
Dome Creek below Seepage Pond	Test sample same as D-3 in Conor Pacific
Dome Creek at Road	Test sample same as D-2 in Conor Pacific
Victoria Creek 500 m downstream from mouth of Dome Creek	Test Sample in area of influence of Dome Creek same as sample V4 in Conor Pacific
Victoria Creek 500 m upstream of Back Creek	Upstream Control. Same as V1 in Conor Pacific.
Victoria Creek downstream of main road	Test Sample in potential area of influence of Dome Creek same as V5 in Conor Pacific

3.3 On-going Aerial Contamination

Moss bags will also be set-up around the three sources of potential aerial contamination and one control area to allow for determination of the extent of on-going contamination. Moss bags are a standard low-technology method for assessing both dry and wet (i.e., airbourne and precipitation-based) deposition of airborne contaminants (Temple *et al.*, 1981). Moss bags will be set-up as per the protocol outlined by Temple *et al.,* (1981). The moss bags will be held by polypropylene mesh about 2 mm in size. Each bag will contain 3 g dry weight of moss from an 'uncontaminated area'. Moss will be sent to the lab to be homogenized (i.e., the moss materials are rinsed, dried and analyzed for pre-exposure metal concentrations, and are then sewn into polypropylene mesh bags). Bags will be secured by nylon zip ties and the bag will be hung with nylon rope. Moss bags will be hung from trees or poles and will be left out for 8-10 weeks. The analysis of moss bags will only be completed if the results of lichen analysis indicate contamination. Where lichen analysis indicates past contamination, moss bags can be used to determine whether contamination at the site is ongoing. If the lichen analysis results determine no contamination there will be no reason to analyze the moss bags. However, as they are inexpensive and easy to deploy they will be hung out in the early fall to take advantage of the study season in the event they are needed for further analysis.

Depending on the results of this study, there may be a desire to deploy moss bags for a longer period of time. Additional moss has been collected and can be deployed to replace the first batch of bags to

provide data for the winter and spring seasons; however, this effort and data will not be part of this study.

3.4 Summary

Table 6 summarizes the proposed number of samples and type of analysis to be conducted. Adaptations will be made as required with the YG Abandoned Mines Project Manager being kept up to date on a regular basis. It is felt that significant adaptive management will be critical (in terms of choosing which samples should be analyzed) so that specific questions can be addressed as they arise. It should be noted that these numbers have been altered from the workplan identified in our team's project proposal; however, this was deemed necessary following our field visit and study design meeting. In addition, the total number of samples has been increased as we were able to find a better rate from the laboratory to analyze the samples.

Table 6. Details regarding the sample types proposed to be sampled within this study.

Category	Purpose	Laboratory Analysis Parameters	Estimated # of Samples
Lichens	To determine the presence and extent of airborne contamination.	Metals ICP-MS[1]	100
Soils	Assist with determining the presence and extent of airborne contamination. Confirm lichen results and determine natural non-mine related sources.	Metals ICP pH	130
Berries/Plants	Determine if plants and berries are safe to eat.	Metals ICP-MS	210
Blackened Vegetation and Soils	Determine what impacted the blackened vegetation on bank of Dome Creek.	Metals ICP-MS Cyanides & Nutrients	12 12
Small Mammals	Investigate extent of metal accumulations in the food chain.	Metals ICP-MS	50
Ungulates	Investigate extent of metal accumulations in the food chain. Determine if they are safe to eat.	Metals ICP-MS	40
Fish	Determine impacts on fish.	Metals ICP-MS	25
Sediment	Determine if metals are accumulating in sediments.	Metals ICP	20
Water	Answer specific questions pertaining to point sources.	Metals ICP-MS Cyanides Nutrients Conductivity / pH / temperature	3
Moss Bags	Determine if airbourne contamination is on-going	Metals ICP-MS	20
Estimated Total			**622**

All samples will be taken using appropriate protocols that will prevent contamination of the samples. Duplicate samples for QA/ QC will be taken at approximately 5 to 10% of the total number of sample

[1] ICP-MS will be completed for 33 metals.

sites. In addition, an accredited laboratory (Cantest) will complete the appropriate laboratory splits. Detection limits are listed in Appendix C.

Results will be reviewed by the team members and the project advisors. Soils and geology will be taken into consideration during the review process to determine if high levels are the result of mine activities or natural factors.

4.0 REFERENCES CITED

Alexander, S.A., F.I. Doyle, C.D. Eckert, H. Grunberg, N.L. Hughes, M. Jensen, I. Johnson, D.H. Mossop, W.A. Nixon, and P.H. Sinclair 2003. *Birds of the Yukon Territory*. Canadian Wildlife Server and Environmental Canada.

Conor Pacific Environmental Technologies Inc. 2000. *Mount Nansen Minesite. Historical Review, Site Assessment and Field Sampling Program.* Prepared for Indian and Northern Affairs, Whitehorse, YT.

Hirvi, J.P., H. Henttonen and A.M. Suortti 2005. *Common shrew (Sorex araneus) as indicator for monitoring of airborne contaminants in Finland.* Scientific Article from website: http://www.ivb.cz/ecm4/pdf/ECM4_Poster%20nr9_GenSession%20II.pdf

Jung, T. 2005. *Personal Communications*. Letter to Chris Alway re: Mount Nansen Terrestrial and Aquatic Effects Project. Dated September 13, 2005.

Nicholson, H.C. 2002. *Arsenic in Plants Important to Two Yukon First Nations: Impacts of Gold Mining and Reclamation Practices.* Prepared for the Mining Environment Research Group, Whitehorse, YT.

Temple, P., D. McLaughlin, S. Linzon and R. Wills 1981. *Moss Bags as Monitors of Atmospheric Deposition.* Journal of the Air Pollution Control Association, Vol. 31, No. 6.

Appendix A:

Summary of Community Survey

Mt. Nansen Terrestrial and Aquatic Effects Community Survey Summary.

August 29, 2005

1.0 SURVEY DESCRIPTION

A survey was conducted on August 11 to August 22 in and around the community of Carmacks for the Mt. Nansen Terrestrial and Aquatic Effects Study. The questions asked related to the use of the renewable resources within a 15 km area surrounding the Mt. Nansen minesite. The objectives of the survey were to determine what types of plants, animals and fish are harvested and consumed within the described area. The survey also investigated the extent of use, general location and food parts consumed. In addition, concerns regarding the site and the various species affected were also discussed.

2.0 METHODOLOGY

Most of the participants in the survey were contacted beforehand by Leta Blackjack, a resident of Carmacks and a Little Salmon/Carmacks First Nation (LSCFN) member. Together, with Matt Power from *Environmental Dynamics Inc*., a total of 15 surveys were completed targeting the First Nation members who used the resources within the area described. Those surveyed answered questions related to their personal use of the area. Any extra information given, that was deemed important, was also documented and is included with the completed survey forms.

3.0 SUMMARY OF RESULTS

Upon completion of the survey, several food items stood out as possible study targets. One of those items is the porcupine. This animal was not originally included in the survey; however, it came up often in many interviews. Although, porcupine is not as substantial as moose or caribou, in dietary terms, the porcupine seems to be an animal of great importance to the LSCFN; and would likely migrate less than the aforementioned ungulate species. At least one porcupine is taken or consumed each year by those interviewed. Also of paramount importance and significant value are moose and caribou. In general, one of each animal is harvested on a yearly basis. As well, grouse and ptarmigan were also harvested (up to 35 per year in recent years). Rabbits and ground squirrels are also taken in and around the site.

Various fish species have been observed within the described 15 km study zone. Victoria Lake proved to be the most valuable fishing area with Arctic grayling, whitefish and northern pike being harvested. Arctic grayling are also harvested in Victoria Creek.

Fall was found to be an important period for the LSCFN. Most of the berry picking tends to peak during the fall months and coincides with hunting of large game such as moose and caribou. Harvested plants are extensively utilized by the LSCFN from the area in terms of a nutritional and medicinal resource. Labrador tea and ‘caribou horn’ were widely used for medicinal purposes for a number of various ailments. In terms of food sources, blueberries, cranberries and currants appeared to be most valuable.

3.1 Plants for food.

The LSCFN harvests a significant amount of plant-life around the Mt. Nansen minesite. Various types of berries are among the most vital in terms of a dietary resource and are harvested extensively throughout the area. Berries from such plants as blueberries and cranberries are used in a variety of

dishes such as jams, juices and jello. Other significant plants are cloudberries and currants. Of those surveyed, most tended to stay some distance away from the minesite due to contamination concerns. Table 1 outlines the types of plants consumed for food.

Table 1. Plants consumed for food.

Food Plants	*Parts consumed*	*Location*	*Comments*
Blueberry (*Vaccinium uliginosum*)	Berry	Harvested within 15 km	Alpine/swampy areas
Lowbush cranberry (*Vaccinium vitis-idaea*)	Berry	Harvested within 15 km	Mainly boggy situations
Red raspberry (*Rubus ideaus)*	Berry	Harvested within 15 km	Low to moderate elev.
Highbush cranberry (*Viburnum edule*)	Berry	Harvested within 15 km	Woodland thickets
Cloudberry (*Rubus chamaemorus*)	Berry	Within and beyond 15 km	Peaty/turfy places
Black Currant (*Ribes hudsonianum*)	Berry	Harvested within 15 km	Moist wooded areas
Red Currant (*Ribes triste*)	Berry	Harvested within 10 km	Moist woods/clearings
Bear root (*Hedysarum alpinum)*	Root	Harvested within 10 km	Sands and gravels
Crowberry (*Empetrum nigrum*)	Berry	Harvested within 15 km	Tundra, swamps/bogs
Rosehip (*Rosa acicularis*)	Rose bud	Harvested within 10 km	Streambanks/woodland clearings

While picking berries many consumed the berries unwashed; however, most did wash the berries once they arrived home, with the exception of one who preferred not to wash the berries on account that it took away from the taste. Most of the harvesting took place behind the mine in the vicinity of Mt. Nansen, Victoria Mountain, and Mt. McDade. Most of the harvesting of the berries takes place in the fall or summer (cloudberry) depending on their ripeness.

3.2 Medicinal Plants

Medicinal plants are essential to the well-being of the LSCFN and is considered a valuable resource where information relating to a certain plant is passed down from generation to generation. One plant was discussed that remained unnamed and only a general location was given; so valuable was the plant that no specific information was disclosed in order to protect it. Labrador tea, which grows in abundance, was noted to have some medicinal properties and was harvested by a few of those surveyed. In general, there was a wide variety of plant life taken for medicinal purposes such as paper birch, subalpine fir and willow (Table 2).

Caribou horn lichen, as referred to by the LSCFN, was the most important in terms of medicinal use as it was used extensively by most of those surveyed. Concerns arose regarding the medicinal properties of the plants harvested in terms of contamination through airborne dust particles and ground contaminants.

Table 2. Plants used for medicinal purposes.

Medicinal Plants	*Parts Used*	*Location*	*Comments*
Caribou Horn (*Masonhalea richardsonii*)	Whole plant	Harvested within 15 km	Also known as tumble lichen – extensively used
Labrador tea (*Ledum groenlandicum*)	Leaf	Harvested within 15 km	Leaf is boiled for tea
Subalpine fir (*Abies lasiocarpa*)	Cone, branch, bark	Harvested within 15 km	Found in subalpine zones & moist, lower elevations
Willow (*Salix spp.*)	Leaf, bark, branch	Harvested within 15 km	Cures ailments such as headaches
Caribou Moss (*Cladina rangiferina)*	Whole plant	Within and beyond 15 km	Entire plant is harvested and boiled
Paper birch (*Betula paperifera*)	Bark, cambium	Harvested within 15 km	Bark is boiled
Juniper (*Juniperus communis)*	Stem, berry	Harvested within 10 km	Medicinal properties were not disclosed
Spruce, black /white (*Picea spp.)*	Fresh pitch/sap	Harvested within 10 km	Mixed with Vaseline, will cure many skin irritations
Blueberry (*Vaccinium uliginosum)*	Leaf	Harvested within 15 km	Tundra, swamps/bogs
Trembling aspen (*Populus tremuloides*)	Leaf	Harvested within 10 km	Leaves are eaten fresh off the branch
Bear Root (*Hedysarum Alpinum*)	Root	Harvested within 10 km	Located in sands & gravels

Wildlife

The most valuable wildlife resource harvested in the vicinity of the Mt. Nansen minesite is moose. It was found that hunting moose has been a mainstay for many years for the LSCFN with everyone surveyed either harvesting or consuming moose from this area. It appeared that gathering of plants and other wildlife seemed secondary to harvesting a moose (i.e., collection of plants/berries is often conducted while hunting moose).

Caribou and porcupine were also found to be of great significance and were harvested whenever the opportunity arose. The Klaza caribou herd, according to one LSCFN member is in decline as he sees less and less each time he hunts in the area. However, this may be access related and due to the high traffic in the area. The occurrence of marmot, referred to as 'whistler' by some of the LSCFN, was an interesting discovery and information regarding it was indefinite as the population of these rodents was believed to be low and have been harvested sporadically at best. Table 3 lists the animals harvested in the minesite and adjacent areas.

Table 3. Animals harvested in the vicinity of Mt. Nansen.

Wildlife	*Parts Consumed*	*Location*	*Comments*
Moose (*Alces alces*)	All edible parts	Harvested throughout area	Significant numbers have been encountered in winter
Caribou (*Rangifer tarandus*)	All edible parts	Harvested throughout area	Klaza herd is known to migrate through minesite
Porcupine (*Erithizon dorsatum*)	Tissue and organs	Harvested throughout area	Meat is believed to have medicinal properties
Ptarmigan (*Lagopus spp.*)	Tissue, kidneys, heart and gizzards	Harvested in higher elev. behind minesite	Usually >5 taken/trip
Spruce Grouse (*Dendragapus Canadensis*)	Tissue, kidneys, heart and gizzards	Harvested mainly along access routes	Usually >5 taken/trip
Snowshoe Hare (*Lepus americanus*)	Tissue and organs	Harvested mainly along access routes	Population thought to be increasing
Ground Squirrel (*Spermophilus parryii*)	Tissue	Harvested throughout area	No significant hunting pressures
Marmot (*Marmota spp.*)	Tissue	Harvested in higher elev. behind minesite	Only few taken in recent years

3.4 Fish

Fishing appeared to be the least important activity for the LSCFN in the Mt. Nansen area. This may be due to the salmon fishery along the Yukon River. It was found that fishing in the lakes and streams around Mt. Nansen played a much more vital role in past times when the First Nations lived as nomads and were not centralized in a community environment. Evidence of this, as explained by one LSCFN women, is a described cabin situated along the shores of Victoria Lake.

Arctic grayling were reported to be abundant in the area and could be caught easily. Some of those surveyed often spoke of large size grayling being caught throughout. Oddly enough, there are also reports of grayling being present in high elevations where one wouldn't expect to see them. Burbot is said to be present in some regions of the Mt. Nansen drainage, most notably in Victoria Creek. Other sites that have been fished are Victoria Creek, Rawlinson Creek, Nisling River, Lonely Creek and Nansen Creek.

Table D. Fish species harvested within the vicinity of Mt. Nansen.

Fish	*Parts Consumed*	*Location*	*Comments*
Arctic Grayling (*Thymallus arcticus*)	All edible parts, including innards	Harvested within streams throughout area	Large grayling observed in all creeks throughout
Whitefish (*Corgonus clupeaformis*)	All edible parts	Victoria Lake and Nisling Lake	Mainly reported to inhabit chain of lakes to south of minesite
Northern Pike (*Esox lucius linneaus*)	All edible parts	Victoria Lake and Nisling Lake	Mainly reported to inhabit chain of lakes to south of minesite

4.0 LSCFN CONCERNS

There were mixed concerns regarding the Mt. Nansen minesite ranging from levels of contamination in the food chain to the total reclamation of the site. While some members of the LSCFN showed no concern, others were very apprehensive about their ongoing use of the area.

The items of major concern seemed to stem from the on-going use of the land in the area. There was an apparent concern regarding the large ungulate population in the area. However, there may be evidence that a seemingly declining caribou population can be caused as a result of the area being very accessible to vehicles and ATV's.

When asked to provide any information regarding the minesite, most of those surveyed spoke of buried items such as fuel containers and transformers. Others spoke of oil/fuel spills and the leaking of the tailings pond. Those who were surveyed believed that there was an apparent disregard for the area by the mine's past operators. The present state of the open pit and tailings pond is an on-going issue and most LSCFN would like to see the entire site reclaimed to some degree.

Appendix B:

Notice to Hunters Sign

Appendix C:

Laboratory Detection Limits