Collection and Contaminant Analysis of Samples from Ungulates from the Faro Mine Area

Prepared for
Government of Yukon
Assessment and Abandoned Mines Branch
Whitehorse, Yukon

March 10, 2011

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Attached to this report:

- Invoice including itemized expenses and receipts*
- Maxxam Analytical Certificate of Analysis and analytical results
- Wildlife Export Permit
- Poster used in advertising
- Summary report of 'Tay Caribou Facilitated Hunt' project

*Note that the invoice from Maxxam Analytical ($768.60) does not include shipping the remaining samples back to Whitehorse for archiving. The shipping cost is included in the total amount charged ($819.84) for which receipts are photocopied on the last page of the Maxxam analytical results.

Background
A terrestrial effects study for the Anvil Range Mine, carried out in 2004 by Gartner Lee Ltd., Whitehorse, showed clearly that the presence of the mine has resulted in elevated concentrations of several elements both at the mine site and in the surrounding area. In terms of ungulates, the most significant elevation was seen in lead in caribou, although selenium in moose and iron in sheep were also elevated. Mercury and silver may also be of concern.

Request for Wildlife Samples
A poster was created to request samples (kidneys, liver, muscle and incisors) from moose, caribou and sheep from successful hunters in the Faro area. Specifically, samples were requested from caribou hunted in designated game management zones 2-83 to 2-93 and all of zone 4 (except for 4-03 and 4-51) and from moose and sheep hunted in designated game management zones 4-41 to 4-47. This poster was developed with extensive consultation with EMR and Yukon Environment staff, until all parties involved were comfortable with the wording, the choice of game management zones and the advertising venues. It was recognized during this process, that choosing to minimize the advertising (ie. choosing not to do a radio interview or newspaper article on this project specifically) may ultimately reduce the samples submitted to the project. EMR staff was most comfortable with this approach.

Hunters were asked to submit samples to their local Environment Yukon office. Yukon Environment staff received the samples and stored them in freezers until transported to Whitehorse for processing. Collection information was recorded on a Yukon Biological Submission form, and the information made available to the consultant by Yukon Environment.

In order to increase sampling success, Gamberg Consulting committed to entering each hunter participating in the program in a draw for a charter flight (with Alpine Aviation of Whitehorse) up to a value of $1000. This draw is a normal part of the annual Arctic Moose and Caribou Contaminant Program conducted by Gamberg Consulting in the Yukon.

Posters were distributed electronically and in hard copy to

- Yukon Environment staff
    - Communications staff
    - Conservation officers and clerks in Faro, Ross River and Whitehorse
    - Regional biologist for Ross River and Faro
    - Moose, caribou and sheep biologists
- Ross River Dena Council
- Fish and Wildlife Management Board
- Yukon Conservation Society
- Fish and Game Association
- EMR community coordinator in Ross River
- Local outfitter (Jarrett Deuling)
- Alpine Aviation Ltd. (sponsoring aircraft company)

Posters were put up in public venues (public library, government buildings etc.). Posters were also converted to ad format and published in the Yukon News once/week for four weeks during the hunting season and a pdf version of the poster was put on the Yukon Environment website.

In addition, an agreement was reached with the outfitter operating in the Faro area, for him to supply samples from any moose of caribou taken in the 2010 hunting season.

Note that all samples were collected under a Wildlife Act Permit issued to Gamberg Consulting.

Sample Submissions

Only one set of samples was received for this project – a moose from the Faro area from a licensed hunter.

The moose taken for this project was an 8 year-old bull taken from game management zone 4-45 (Anvil Creek) on Sept 18, 2010. Two entire kidneys, a liver and muscle sample and the incisor bar were submitted by a licensed hunter from Faro. The outfitter brought back samples from four caribou, but unfortunately misplaced them.

The participating hunter from this project was included in the draw for the charter flight (along with hunters participating in the annual Caribou Contaminant Program) and he was in fact, the winner. He was sent a gift certificate from Gamberg Consulting and Alpine Aviation entitling him to one charter flight with Alpine Aviation up to a value of $1000. He was also sent a letter thanking him for his contribution to the program, letting him know the age of his moose and giving him some background on the contaminant program in general.

Sample Analysis

Tissue Preparation

Tissue samples were processed for analysis in a 'trace element clean' fashion. Kidney capsules were removed and the clean kidneys placed in clean whirl-paks. The outer portions of liver and muscle tissue were carved away leaving a clean inner subsample. These samples were stored in clean 20 ml polyethylene scintillation vials. Duplicate subsamples of liver and muscle were archived in the tissue archive maintained by INAC, Whitehorse. Subsamples of liver and muscle, and both entire kidneys were frozen and shipped to Maxxam Analytics Inc. in Vancouver for analysis (Wildlife Export Permit # 11056). An incisor from the moose was used to age the animal using the tissue cementum technique.

Tissue Analysis

Kidneys were each thoroughly homogenized before being analyzed (because kidney tissue is not homogeneous in terms of metal concentrations). The liver and muscle tissue was analyzed directly. All tissues were analyzed for 41 elements by atomic spectroscopy (inductively coupled plasma technique with mass spectroscopy), and also for percent moisture. Remaining samples were shipped back to Whitehorse to be archived in the INAC tissue archive.

Results and Discussion

Raw results for moisture and element concentrations for two moose kidneys, liver and muscle are presented in Appendix 1. One quality control standard, one method blank and one set of duplicates were analyzed along with the samples for quality control. Results were within acceptable standards.

Table 1. Element concentrations in tissues of moose taken for this project (Faro*), moose taken from Faro in previous years, and moose from other parts of the Yukon (excluding Faro). All data are for 8-year-old male, fall-collected moose and are presented as μg/g wet weight.

Tissue	Kidney			Liver		Muscle	
Zone	Yukon	Faro	Faro*	Yukon	Faro*	Yukon	Faro*
Year	1997-2003	2000-2003	2011	1994-98	2011	1994-98	2011
N	15	3	1	4	1	3	1
% Moisture	79.8	80.4	82.5	68.8	59.0	76.6	75.0
Aluminum	0.64	0.76	<0.2	0.34	<0.2	0.39	<0.2
Antimony	0.01		<0.001	0.01	<0.001	0.10	<0.001
Arsenic	0.05	0.02	<0.01	0.02	0.01	0.00	<0.01
Barium	0.28	0.24	0.17	0.31	0.19	0.06	<0.02
Beryllium	<0.02		<0.02	<0.02	<0.02	<0.02	<0.02
Bismuth	0.003		<0.02	<0.02	<0.02	<0.02	<0.02
Boron	0.15	0.24	<0.4	0.17	<0.4	0.28	<0.4
Cadmium	45.5	57.6	57.0	6.9	12.1	0.06	0.04
Calcium	88.3	79.2	81.0	55.1	38.0	64.2	34.0
Cesium			0.03	0.01	<0.02	0.01	0.04
Chromium	0.17	0.15	<0.04	0.42	<0.04	0.24	<0.04
Cobalt	0.07	0.06	0.05	0.16	0.04	0.01	<0.004
Copper	2.7	2.8	2.5	37.5	33.6	0.9	0.6
Iron	53.2	44.4	30.0	136.7	112.0	31.1	17.0
Lanthanum			<0.02	<0.02	<0.02	<0.02	<0.02
Lead	0.008	0.027	0.003	0.038	0.003	0.014	0.004
Lithium	0.008		<0.1	0.003	<0.1	0.002	<0.1
Magnesium	152	156	153	197	198	199	266
Manganese	1.10	1.08	1.03	1.83	1.90	0.16	0.08
Mercury	0.006	0.003	0.021	<0.02	0.005	<0.02	0.003
Molybdenum	0.19	0.22	0.16	0.90	0.93	0.01	<0.01
Nickel	0.05	0.07	0.05	0.03	<0.01	<0.01	<0.01
Phosphate			2375		3450		2200
Potassium			2210	894	2910	670	3790
Rubidium	7.88		7.77	3.55	7.23	1.58	5.74
Selenium	1.04	0.82	0.93	2.28	3.41	0.37	0.33
Silicon			<10		<10		<10
Silver	0.002	0.001	<0.004	0.072	0.087	0.001	<0.004
Sodium			1925		565		635
Strontium	0.11	0.08	0.06	0.04	0.02	0.04	<0.02
Sulphur			1830		2450		2580
Tellurium			<0.02		<0.02		<0.02
Thallium	0.003	0.001	0.002	<0.0004	<0.0004	<0.0004	<0.0004
Thorium			<0.01		<0.01		<0.01
Tin	0.16	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Titanium	0.10		<0.2		0.20		<0.2
Tungsten			<0.01		<0.01		<0.01
Uranium	0.0004	<0.0004	<0.0004	0.001	<0.0004	<0.0004	<0.0004
Vanadium	0.07	0.03	<0.04	0.03	<0.04	0.04	<0.04
Zinc	30.9	32.6	27.4	35.0	18.5	57.5	54.9
Zirconium			<0.1		<0.1		<0.1

Although statistical comparisons are impossible (since we have only one sample from the current project), element concentrations from the current project can be subjectively compared with moose of the same age collected previously from the target area as well as moose from other parts of the territory. Table 1 presents results for the moose from this project (2 kidneys were averaged) compared with previous results from fall-collected 8-year-old moose from the Faro region and from other parts of the Yukon (excluding the Faro region).

The detection limits from the current analytical laboratory (Maxxam Analytical Inc.) are, for some elements, higher than measured concentrations from previous years (boron, lithium, titanium and hepatic and muscle mercury). In these cases no comparisons can be made.

Non-essential elements silver, strontium and lead concentrations were lower in the moose sampled in 2010 than moose collected previously from the target area or from the Yukon in general (with the exception of hepatic silver which was slightly higher). Whether this indicates a general lowering of two of the elements of concern (silver and lead) in this area is will have to be clarified with further sampling of wildlife from the area.

Other non-essential elements cadmium (liver), mercury (kidney) and rubidium (liver and muscle) were all higher in the 2010 moose. The concentration found for renal mercury would still be considered normal for domestic cattle while rubidium concentrations are within the very wide range considered normal for chickens (comparative data for cattle were unavailable)(Puls 1994). Cadmium has been shown to be very high in Yukon moose compared to moose from other areas (Gamberg et al. 2005). The hepatic cadmium concentration found in the 2010 moose is unlikely to cause renal dysfunction (threshold range thought to be 100-200 μg/g wet weight; Kjellström 1986), but could cause sublethal effects (found at 30 μg/g wet weight; Outridge et al. 1994).

Calcium in liver and muscle, as well as zinc and iron in all three measured tissues were lower in the moose sampled in 2010 than moose collected previously from the target area or from the Yukon in general. This may be due to an interaction with other elements present in higher concentrations than normal. However, although low, concentrations of these essential elements are still not what would be considered deficient in domestic cattle (Puls 1994). Other essential elements potassium (liver and muscle) and magnesium (muscle) were higher in the 2010 moose but still what would be considered normal for domestic livestock (Puls 1994).

Most elements measured in the single 2010-collected moose were at levels that should be considered normal for Yukon moose. It is possible that two of the elements of concern (silver and lead) have declined in the Faro area in recent years, but it is impossible to draw a reasonable conclusion based on one animal.

Recommendations

In order to evaluate whether levels of contamination in wildlife from the Faro area have changed significantly over time it is essential to obtain more samples. Ideally ten samples from each species in question would be taken each year, but a minimum for useful analysis could be as low as six samples per year.

It can be difficult to obtain reasonable numbers of samples from licensed hunters, even with a long-term and well-advertised program like the successful Arctic Moose and Caribou Contaminant Program that was run in the Yukon for about 15 years. Given that this program targeted hunter-killed animals from a very specific area with minimal advertising and for only one season, it is not surprising that the return was very small. In order for this type of project to be successful a great deal of advertising must be done.

An alternative to requesting samples from licensed hunters would be to work with the Ross River Dena First Nation to collect samples. A meeting was held with Norman Sterriah of the Ross River Dena to discuss possible options to accomplish this work. Two approaches are presented here, but it should be noted that these are not mutually exclusive.

Option 1

Request samples from RRD hunters already hunting. This could be done in either of two ways (these are not mutually exclusive):

1) Employ a biologist/technician to be in the community of Ross River/Faro to accompany hunters on their hunts. Samples could then be taken from successful hunts.

    Advantages
    - At least some samples are likely
    - Some community interaction

    Disadvantages
    - Extremely expensive in terms of time and money

2) Request that hunters submit their own samples from their successful hunts. Incentives would be required to ensure a good return of samples, but it is illegal to offer cash (or goods) for samples (wildlife parts under the wildlife act). We could conduct a lottery similar to the one offered by the Arctic Moose and Caribou Contaminant Program where participating hunters would have their name put into a draw for a prize. The prize would have to be carefully chosen and be appropriate to the project. The success of this approach would depend on the attractiveness of the prize.

    Advantages
    - Cost effective in terms of time and money

    Disadvantages
    - Minimal community interaction

Option 2

Facilitate or sponsor a community hunt. This could follow the model that was used for a hunt of the Tay caribou herd in the spring of 2010 by the Arctic Moose and Caribou Contaminant Program. Hunters, youth and elders were invited to a one-week hunt in a traditionally used area. Tents, food and gas for snow machines were provided, and cooks and camp maintenance workers were hired for the duration of the camp. Two biologists and two technicians were also present for the full camp to take contaminant samples (and other samples and measurements for other projects) and train interested community members in those procedures. Emphasis was placed on fostering interaction among the scientists, elders, hunters and youth so that all could learn from each other. This project also included an educational portion which introduced school children to ecological concepts associated with the program. (A final report on the educational portion of this project is attached).

In a facilitated hunt, there would also be opportunities to employ youth as technicians (and/or camp helpers), allowing work and learning opportunities to overlap while potentially fostering leadership skills. It is also an ideal situation to integrate and record the use of traditional knowledge (RRD is currently working on a number of projects involving traditional knowledge that may be able to be incorporated into a facilitated hunt).

Note that any such planned hunt should work closely with the Ross River Dena Council and Yukon Environment (biologists and conservation officers). The Ross River School is also a potential partner in such a venture. Some communication with the local outfitter would be courteous and every effort should be made to ensure that his cabins and equipment are not utilized without his express permission.

The success of a hunt such as this relies heavily on developing trusting relationships with the community members involved. It would be critical not only to work closely with the Ross River Dena Council, but also to spend time with potential participants planning things such as the location, timing and duration of the camp.

Advantages

- High level of community interaction
- Foster good working relationships among scientists, biologists and community members
- Provide opportunities for youth to learn technical and leadership skills
- Provide a bridge between scientific and traditional knowledge
- Provide an opportunity for community members to spend time on the land with their families pursuing traditional activities
- High probability of obtaining some samples

Disadvantages

- High cost

Challenges

- Achieving a high level of community participation (incentives may be useful)
- Designating specific game management subzones to be hunted for moose (caribou are less of an issue), since they may not be traditional hunting areas

References

Gamberg M, Palmer M, Roach P. 2005. Temporal and geographic trends in trace element concentrations in moose from Yukon, Canada. Sci Total Environ: 351-352: 530-538.

Kjellström T. Critical organs, critical concentrations and whole body dose–response relationships. In: Friberg LTCadmium and health: a toxicological and epidemiological appraisal. Boca Raton, Florida7 CRC Press; 1986. p. 231– 46.

Outridge P, MacDonald D, Porter E, Cuthbert I. An evaluation of the ecological hazards associated with cadmium in the Canadian environment. Environ Rev 1994;2:91– 107.

Puls, R. 1994. Mineral levels in animal health: diagnostic data. Sherpa International, Clearbrook, BC. 356 pp.

Appendix 1. Element concentrations in moose tissues (wet weight)

	Units	32516A KIDNEY	32516B KIDNEY	32516 MUSCLE	32516 LIVER
Total Metals by ICPMS					
Total Aluminum (Al)	mg/kg	<0.2	<0.2	<0.2	<0.2
Total Antimony (Sb)	mg/kg	<0.001	<0.001	<0.001	<0.001
Total Arsenic (As)	mg/kg	<0.01	<0.01	<0.01	0.01
Total Barium (Ba)	mg/kg	0.16	0.17	<0.02	0.19
Total Beryllium (Be)	mg/kg	<0.02	<0.02	<0.02	<0.02
Total Bismuth (Bi)	mg/kg	<0.02	<0.02	<0.02	<0.02
Total Boron (B)	mg/kg	<0.4	<0.4	<0.4	<0.4
Total Cadmium (Cd)	mg/kg	57.4	56.6	0.038	12.1
Total Calcium (Ca)	mg/kg	81	81	34	38
Total Cesium (Cs)	mg/kg	0.03	0.03	0.04	<0.02
Total Chromium (Cr)	mg/kg	<0.04	<0.04	<0.04	<0.04
Total Cobalt (Co)	mg/kg	0.049	0.047	<0.004	0.042
Total Copper (Cu)	mg/kg	2.57	2.56	0.59	33.6
Total Iron (Fe)	mg/kg	30	33	17	112
Total Lanthanum (La)	mg/kg	<0.02	<0.02	<0.02	<0.02
Total Lead (Pb)	mg/kg	0.003	0.002	0.004	0.003
Total Lithium (Li)	mg/kg	<0.1	<0.1	<0.1	<0.1
Total Magnesium (Mg)	mg/kg	155	151	266	198
Total Manganese (Mn)	mg/kg	1.10	0.96	0.08	1.90
Total Mercury (Hg)	mg/kg	0.023	0.019	0.003	0.005
Total Molybdenum (Mo)	mg/kg	0.16	0.16	<0.01	0.93
Total Nickel (Ni)	mg/kg	0.05	0.04	<0.01	<0.01
Total Phosphorus (P)	mg/kg	2410	2340	2200	3450
Total Potassium (K)	mg/kg	2240	2180	3790	2910
Total Rubidium (Rb)	mg/kg	7.96	7.58	5.74	7.23
Total Selenium (Se)	mg/kg	0.95	0.90	0.33	3.41
Total Silicon (Si)	mg/kg	<10	<10	<10	<10
Total Silver (Ag)	mg/kg	<0.004	<0.004	<0.004	0.087
Total Sodium (Na)	mg/kg	1880	1970	635	565
Total Strontium (Sr)	mg/kg	0.06	0.06	<0.02	0.02
Total Sulphur (S)	mg/kg	1870	1790	2580	2450
Total Tellurium (Te)	mg/kg	<0.02	<0.02	<0.02	<0.02
Total Thallium (Tl)	mg/kg	0.0022	0.0021	<0.0004	<0.0004
Total Thorium (Th)	mg/kg	<0.01	<0.01	<0.01	<0.01
Total Tin (Sn)	mg/kg	<0.02	<0.02	<0.02	<0.02
Total Titanium (Ti)	mg/kg	<0.2	<0.2	<0.2	0.2
Total Tungsten (W)	mg/kg	<0.01	<0.01	<0.01	<0.01
Total Uranium (U)	mg/kg	<0.0004	<0.0004	<0.0004	<0.0004
Total Vanadium (V)	mg/kg	<0.04	<0.04	<0.04	<0.04
Total Zinc (Zn)	mg/kg	27.6	27.2	54.9	18.5
Total Zirconium (Zr)	mg/kg	<0.1	<0.1	<0.1	<0.1

ATTENTION
Hunters near the Faro area

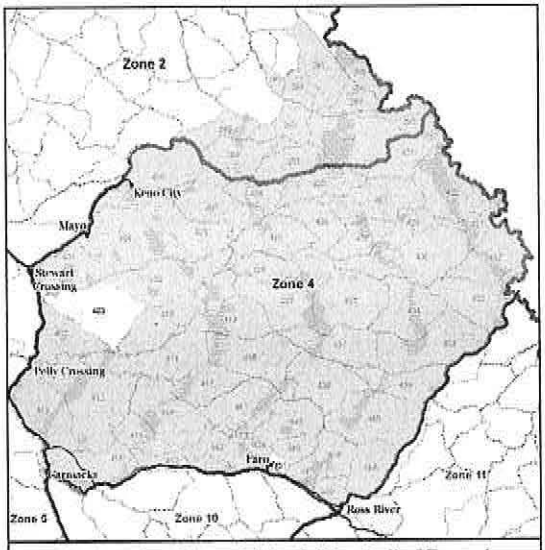
Yukon government needs your help in monitoring the health of wildlife in the Faro area.

Please donate samples of:

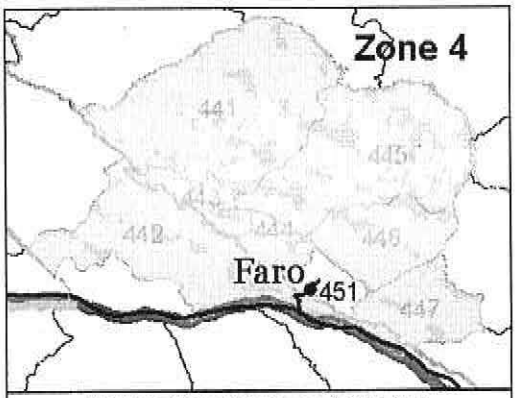
- kidney (whole)
- liver
- muscle
- incisor bar (front teeth)

From **caribou** hunted in Designated Game Management Zones 2-83 to 2-93 and all of Zone 4 (except for 4-03 and 4-51) or

From **moose and sheep** hunted in Designated Game Management Zones 4-41 to 4-47.



Caribou from Zones 2-83 to 2-93 and all of Zones 4 (except 4-03 and 4-51).



Moose or Sheep from Zones 4-41 to 4-47.

WHAT TO DO

- Please prepare liver and muscle samples to be the size and shape of a pound of butter.
- Put each sample in clean plastic bags.
- Freeze samples as soon as possible.
- Samples from different animals should be bagged separately.
- Please deliver the samples to any Environment Yukon Office before:

Monday, November 1, 2010

Thank you for your participation!

WIN A FREE CHARTER FLIGHT!

All hunters who bring in requested samples will be entered into a draw to win a free flight from Alpine Aviation. The flight, valued at $1,000, can be used to fly the winner to their favourite spot next year.

The draw will occur on **Tuesday, February 1, 2011**

Gamberg Consulting
Environmental Research

alpine aviation

Yukon Government

For more information, please contact Yukon government at 867-456-6772 or toll free within Yukon at 1-800-661-0408, extension 6772.

Title: Tay Caribou Facilitated Hunt: School and Community Education Programs in Ross River, Yukon

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Project Team Members: Troy Pretzlaw, Troy Hegel, Remy Rodden, Randy Fraser, Environment Yukon; Norman Sterriah, Gordon Peter, Norman Barichello, Ross River Dena Council; Thomas Jirousek, Dept. of Education, Yukon Territorial Government (Ross River School).

Abstract

This is a companion project to the Northern Contaminants Program core project 'Arctic Caribou and Moose Contaminant Monitoring Program' which sampled the Tay caribou herd as part of a facilitated traditional spring harvest in cooperation with the Ross River Dena, Environment Yukon and Yukon Education. The objective of this project was to provide an education component to the facilitated hunt and to encourage youth to experience a traditional hunt alongside traditional hunters and community elders. Nineteen community members (eleven youth) attended a firearms safety and hunter education program offered in the Ross River School and in the community in general by Environment Yukon. A one-day school program was given in the Ross River School including programs on contaminants, caribou ecology, general ecology and caribou physiology, and using games, videos, music and hands-on activities as educative tools. A one-week hunting camp was held in the Tay caribou traditional area that included 23 community members. Seven caribou and one wolf were taken during the hunt. Measurements were taken for management purposes, samples were taken for contaminant analysis and then the animal was treated in a traditional way (butchered in the case of caribou, and skinned in the case of the wolf). This provided youth an opportunity to learn scientific methods as well as traditional techniques. Some of the older youth participated in the hunting activities while the younger children spent time in the camp with the elders, cutting and cooking caribou, ice-fishing and listening to stories. Throughout the camp there were opportunities for informal discussions and questions on a wide array of topics, ranging from contaminants in caribou to traditional wisdom on climate change. A video was made of the camp, which will be used to educate local youth about traditional practices.

Key Messages

- It is important to provide opportunities for northern youth to experience traditional knowledge first-hand and to learn from elders in their communities.
- Hunting camps can provide an invaluable opportunity for the transfer of knowledge among youth, hunters, elders and scientists.

Objectives:

- To provide an education component to the facilitated hunt planned for the Tay caribou herd under the Northern Contaminants Program core project 'Arctic Caribou and Moose Contaminant Monitoring Program.
- To encourage youth to experience a traditional hunt alongside traditional hunters and community elders

Introduction

Moose and caribou provide an important food resource for Northerners across the Arctic, and have been designated in the NCP blueprint as key species for monitoring contaminants in the terrestrial Arctic ecosystem. Under the Northern Contaminants Program core project 'Arctic Caribou and Moose Contaminant Monitoring Program', the Tay herd from the Ross River area of the Yukon was scheduled to be sampled in 2009/10. This herd was selected because it is one of two Yukon caribou herds found to have unusually high concentrations of cadmium in the early 1990's. The other herd (Finlayson) receives more hunting pressure since it is more accessible, so wildlife managers supported this program as an effort to facilitate a shift to concentrate hunting pressure more on the Tay herd.

The intent of the project was to involve Kaska youth , traditional hunters and elders in the collection of the caribou, to use the opportunity to educate camp participants about caribou management and contaminants in the environment, to provide training specifically on taking samples from caribou for contaminant analysis and to allow the biologists and scientists involved to learn traditional knowledge directly from the hunters and elders.

While the underlying purpose of this activity was to acquire caribou samples for the contaminant program, collecting the

samples as part of a community hunt and adding the education components to the program brings general education enrichment to this small community. Youth from Ross River have few of the education opportunities available in bigger northern centers such as Whitehorse, so bringing opportunities to the community is invaluable, and is fully supported and encouraged by the Ross River School. In addition it encourages local youth to view their elders as positive and successful role models.

Activities in 2009-2010

In preparation for this program, a firearms safety and hunter education program was offered in the Ross River School in January 2009 and in the community in general in October 2009, by Environment Yukon (Randy Fraser). Both programs were considered a success, with eleven youth attending the school program and eight community members attending the community program.

A one-day school program was given in the Ross River School on March 2, 2009. 'Caribou Day' began with the students being welcomed into the school by a full size stuffed caribou (transported to Ross River for the occasion) and local musician/environmental educator Remy Rodden playing and singing his own composition 'Caribou'. The classes were divided into four groups, and four environmental educators cycled through the classrooms during the day and delivered programs on contaminants, caribou ecology, general ecology and caribou physiology. The educators used games, videos, music and hands-on activities throughout the programs. A community lunch of caribou smokies was provided (with the assistance of the school principal and secretary) for the school and community members.

A 7-day hunting camp was held March 6-12, 2010 in the Tay caribou traditional area. Participating in the camp were: 2 biologists, 2 technicians, 1 conservation officer (from the community), 1 videographer and 23 community members. Of the community members, 6 were youth, 5 were elders and 10 were hunters. Over the course of the week, 7 caribou and one wolf were taken. In each case, measurements were taken for management purposes, samples were taken for contaminant analysis and then the animal was treated in a traditional way (butchered in the case of caribou, and skinned in the case of the wolf). During this process, youth were taught how to take measurements and samples by the biologists and technicians, and how to skin and butcher caribou by the hunters. Some of the older youth also participated in the hunting activities. The younger children did not actually hunt, but spent time in the camp with the elders, cutting and cooking caribou, ice-fishing and listening to stories. Throughout the camp there were opportunities for informal discussions and questions on a wide array of topics, ranging from contaminants in caribou to traditional wisdom on climate change. A video was made of the camp, which will be used to educate local youth about traditional practices.

Capacity Building and Training

Capacity building and training were to be found throughout this project. The Firearms Safety and Hunter Education Program provided not only training and education in this area, but also the opportunity for community members to obtain their Possession and Acquisition License. The school program provided education to the school students as well as the teachers, providing them with a list of resources for accessing more information and/or assistance with teaching contaminants and ecology. The camp environment was invaluable in providing opportunities for youth to learn current scientific methods as well as traditional knowledge and wisdom. The informal atmosphere fostered many casual conversations among all the camp members regarding contaminants, wildlife, wildlife management, traditional knowledge about caribou, wolves, the land in general and climate change, to the benefit of all involved.

Communications

A summary of the project will be communicated to the Yukon Contaminants Committee and presented at the NCP results workshop anticipated for the fall of 2010. A meeting may be held in Ross River to discuss results of this and the associated 'Contaminants in Arctic Moose and Caribou Project', or the communication may be in the form of a brochure (or both), at the discretion of and request by the Ross River Dena. A video was made of the camp by the Ross River Dena, which included interviews with scientists and elders. This video will be used to educate local youth about traditional practices.

Traditional Knowledge

This program used traditional knowledge throughout, beginning with hunting the caribou. An early spring had initiated caribou movement earlier in the year than usual, so hunters and elders had to plan carefully to find any caribou in the area. The structure of the camp made it possible for youth to learn hunting techniques and wisdom from the hunters and elders, as well as how to butcher caribou and skin a wolf. Some of the younger children were interested to learn how to ice-fish from

the elders as well as how to cook caribou. A 'smoke-rack' was set up to smoke some of the meat and roast the caribou heads. For this, the fire had to be tended constantly, which created an ideal opportunity for children (and others) to listen to stories and traditional wisdom from the elders.

While the school and community programs were very valuable educative tools, the hunting camp provided an ideal structure for the casual and free flow of information and wisdom among scientists, hunters, elders, youth and other community members. Equally valuable was the opportunity for local youth to experience other community members as hunters, fishers and elders in a natural environment and interacting with the land in traditional ways. These positive role models will encourage respectful and wise use of the land by the youth participating in the camp.

NCP Performance Indicators

- Number of northerners engaged in this project: 96 (including Yukon territorial government, school students and teachers, camp participants, and firearms safety and hunter education program participants). Note that 100% of people involved in this project were northerners.
- Number of meetings/workshops held in the North: 8 (4 meetings, 1 camp , 2 school workshops, 1 community workshop)
- Number of students involved in the work: 40 (elementary school students)
- Number of citable publications: 0

Expected Completion Date: The project has been completed.

Acknowledgements

The project leader would like to acknowledge the strong support of Yukon Environment in this project, specifically: Randy Fraser (Firearms Safety and Hunter Education Programs), Remy Rodden, Maurice Lamrock, Olivia Hell (School Program), Troy Pretzlaw, Ryan Drummand, Kyle Russel, Debra Morris (Hunting Camp). I would also like to acknowledge the support of the Ross River School, particularly principal Thomas Jirousek and administrative support Judy Sisson, and the Ross River Dena Council, particularly Gordon Peter, Norman Sterriah and Norman Baricello. Finally I would like to acknowledge the support of the hunters and elders who participated in the camp and were so generous with their stories and their knowledge.

Yukon
Environment
Environnement

WILDLIFE EXPORT PERMIT

FORM 10 • *FORMULAIRE 10*

PERMIS D'ACHEMINEMENT D'UN ANIMAL SAUVAGE À L'EXTÉRIEUR DU YUKON

11056

Issue Date • *Date de délivrance*: Year • *Année* 11 | Month • *Mois* 01 | Day • *Jour* 10

Last name • *Nom de famille*	First name and initials • *Prénom usuel et autres prénoms*
Gamberg	Mary

Business Name • *Nom de l'entreprise*: Gamberg Consulting

Address • *Adresse*: Box 10460

Town, city • *Ville*	Territory, province, state • *Territoire, province, État*
Whitehorse	Yukon

Postal code • *Code postal*	Telephone Number • *Téléphone*
Y1A 7A1	867-668-7023

2. The shipper certifies that he or she is in legal possession of the wildlife described below, that he or she obtained by:

L'expéditeur[1] atteste qu'il a en sa possession légale l'animal sauvage décrit ci-dessous et qu'il l'a obtenu en vertu :

Lic. Year • *Année*

- A Hunting licence number / *Du permis de chasse n°* — | | |
- B Trapping licence number / *De la licence de piégeage n°* — | | |
- C Trader/dealer licence number / *De la licence de commerce de fourrures* — | | |
- D Wildlife Act Permit number / *Du permis délivré en vertu de la Loi sur la faune n°* — | | |
- E First Nations / *Autochtone* —
- F Other / *Autre* Research Permit — 01/01/11 | 31/10/11
- G Purchased/received from / *D'un achat ou d'un don de* — name • *nom*

Licence number / *Permis n°* — year • *année* — community • *lieu*

is hereby authorized to export from Yukon the following wildlife:

est par la présente autorisé à acheminer à l'extérieur du Yukon l'animal sauvage suivant :

Species / *Espèces*	Quantity / *Quantité*	Description (fur, horns, meat, live) / *Description (fourrure, cornes, viande, animal vivant)*	Supp. Doc. / *Documents*	Species / *Espèces*	Quantity / *Quantité*	Description (fur, horns, meat, live) / *Description (fourrure, cornes, viande, animal vivant)*	Supp. Doc. / *Documents*
Beaver / *Castor*				Black bear / *Ours noir*			
Coyote / *Coyote*				Grizzly Bear / *Grizzli*			
Fisher / *Pékan*				Polar Bear / *Ours polaire*			
Arctic fox / *Renard arctique*				Caribou / *Caribou*			
Coloured fox / *Renard roux*				Mule Deer / *Cerf mulet*			
Lynx / *Lynx du Canada*				Whitetailed Deer / *Cerf de Virginie*			
Marten / *Martre*				Elk / *Wapiti*			
Mink / *Vison*				Moose / *Orignal*	4	tissue samples	
Muskrat / *Rat musqué*				Mountain Goat / *Chèvre de montagne*			
Otter / *Loutre*				Mountain Sheep / *Mouflon*			
Squirrel / *Écureuil*						Sheep horn plug no / *Bouchon de corne de mouflon n°*	
Weasel / *Hermine/Belette*				Wood Bison / *Bison des bois*			
Wolf / *Loup*				Other / *Autre*			
Wolverine / *Carcajou*				Other / *Autre*			

C.I.T.E.S. number / *Numéro de la CITES* | O.H.E. number / *R.R.P. n°* | Export fee no GST $ / *Droits de permis d'acheminement sans TPS ($)*

No. of packages / *Nbre de paquets*: 01

Shipment inspected / *Inspection*: Yes / *Oui* ☐ No / *Non* ☐

Addtional supporting information / *Renseignements supplémentaires*

Conditions/remarks / *Conditions, observations*

Shipped to (name and address or as above) / *Destinataire (nom et adresse ou voir la case 1)*

Name • *Nom*: Maxxam Analytics.

Address • *Adresse*: 4606 Canada Way.

City • *Ville*: Burnaby, B.C.

Postal code • *Code postal*: V5G 1K5

Telephone • *Téléphone*: 604-639-2618.

8.

Issued at, / *Délivré à*: Whitehorse, Yukon / *Yukon*

Expiry date / *Date d'expiration*: yy • *aa* 11 | mm • *mm* 04 | dd • *jj* 10

Conservation Officer / *Agent de conservation*

Declaration: The information I have provided is true. / *Je déclare que les renseignements fournis dans la présente sont vrais.*

Permittee / *Titulaire du permis*

Personal information contained on this form is collected under the *Wildlife Act* and associated Regulations and will be used by Environment Yukon for research, statistical and enforcement purposes. For further information, contact Environment Yukon at (867) 667-5652 or 1-800-661-0408 within Yukon.

Les renseignements personnels contenus dans le présent formulaire sont recueillis en vertu de la Loi sur la faune *et des règlements d'application, et ils seront utilisés par Environnement Yukon à des fins de recherche, de compilation de statistiques et d'exécution de la* Loi. *Pour obtenir de plus amples renseignements, communiquez avec Environnement Yukon au 867-667-5652 ou au 1-800-661-0408 (au Yukon).*

YG(3354)NC5 Rev. 02/2010

[1]Dans le présent document, les expressions désignant des personnes visent à la fois les hommes et les femmes.

Distribution: 1, 2–Exporter • *Expéditeur* (Green • *Vert*); 3–Whitehorse Officer • *Bureau de Whitehorse* (Yellow • *Jaune*); 4–District Office • *Bureau de district* (Buff • *Beige*); 5–Leave in book • *Laisse dans le carnet* (White • *Blanc*)

Maxxam

Success Through Science®

Your C.O.C. #: 11056

Attention: Mary Gamberg
Gamberg Consulting
Box 10460
Whitehorse, YT
CANADA Y1A 7A1

Report Date: 2011/02/03

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B102152
Received: 2011/01/11, 13:25

Sample Matrix: TISSUE
Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Elements by CRC ICPMS - Tissue Wet Wt	4	2011/01/17	2011/01/29	BBY7SOP-00002	Based on EPA 200.8
Moisture	4	N/A	2011/01/19	BBY8SOP-00017	Ont MOE -E 3139

* Results relate only to the items tested.

Encryption Key

Raoul Jain
03 Feb 2011 15:34:20 -08:00

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

RAOUL JAIN, BBY Customer Service
Email: RJain@maxxam.ca
Phone# (604) 639-2618

==========

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 1

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Maxxam ID		Z36690	Z36691	Z36692	Z36693		
COC#		11056	11056	11056	11056		
	Units	32516A KIDNEY	32516B KIDNEY	32516 MUSCLE	32516 LIVER	RDL	QC Batch
Total Metals by ICPMS							
Total Aluminum (Al)	mg/kg	<0.2	<0.2	<0.2	<0.2	0.2	4565219
Total Antimony (Sb)	mg/kg	<0.001	<0.001	<0.001	<0.001	0.001	4565219
Total Arsenic (As)	mg/kg	<0.01	<0.01	<0.01	0.01	0.01	4565219
Total Barium (Ba)	mg/kg	0.16	0.17	<0.02	0.19	0.02	4565219
Total Beryllium (Be)	mg/kg	<0.02	<0.02	<0.02	<0.02	0.02	4565219
Total Bismuth (Bi)	mg/kg	<0.02	<0.02	<0.02	<0.02	0.02	4565219
Total Boron (B)	mg/kg	<0.4	<0.4	<0.4	<0.4	0.4	4565219
Total Cadmium (Cd)	mg/kg	57.4	56.6	0.038	12.1	0.002	4565219
Total Calcium (Ca)	mg/kg	81	81	34	38	2	4565219
Total Cesium (Cs)	mg/kg	0.03	0.03	0.04	<0.02	0.02	4565219
Total Chromium (Cr)	mg/kg	<0.04	<0.04	<0.04	<0.04	0.04	4565219
Total Cobalt (Co)	mg/kg	0.049	0.047	<0.004	0.042	0.004	4565219
Total Copper (Cu)	mg/kg	2.57	2.56	0.59	33.6	0.01	4565219
Total Iron (Fe)	mg/kg	30	33	17	112	2	4565219
Total Lanthanum (La)	mg/kg	<0.02	<0.02	<0.02	<0.02	0.02	4565219
Total Lead (Pb)	mg/kg	0.003	0.002	0.004	0.003	0.002	4565219
Total Lithium (Li)	mg/kg	<0.1	<0.1	<0.1	<0.1	0.1	4565219
Total Magnesium (Mg)	mg/kg	155	151	266	198	2	4565219
Total Manganese (Mn)	mg/kg	1.10	0.96	0.08	1.90	0.02	4565219
Total Mercury (Hg)	mg/kg	0.023	0.019	0.003	0.005	0.002	4565219
Total Molybdenum (Mo)	mg/kg	0.16	0.16	<0.01	0.93	0.01	4565219
Total Nickel (Ni)	mg/kg	0.05	0.04	<0.01	<0.01	0.01	4565219
Total Phosphorus (P)	mg/kg	2410	2340	2200	3450	2	4565219
Total Potassium (K)	mg/kg	2240	2180	3790	2910	2	4565219
Total Rubidium (Rb)	mg/kg	7.96	7.58	5.74	7.23	0.02	4565219
Total Selenium (Se)	mg/kg	0.95	0.90	0.33	3.41	0.01	4565219
Total Silicon (Si)	mg/kg	<10	<10	<10	<10	10	4565219
Total Silver (Ag)	mg/kg	<0.004	<0.004	<0.004	0.087	0.004	4565219
Total Sodium (Na)	mg/kg	1880	1970	635	565	2	4565219
Total Strontium (Sr)	mg/kg	0.06	0.06	<0.02	0.02	0.02	4565219
Total Sulphur (S)	mg/kg	1870	1790	2580	2450	60	4565219
Total Tellurium (Te)	mg/kg	<0.02	<0.02	<0.02	<0.02	0.02	4565219
Total Thallium (Tl)	mg/kg	0.0022	0.0021	<0.0004	<0.0004	0.0004	4565219
Total Thorium (Th)	mg/kg	<0.01	<0.01	<0.01	<0.01	0.01	4565219
Total Tin (Sn)	mg/kg	<0.02	<0.02	<0.02	<0.02	0.02	4565219
Total Titanium (Ti)	mg/kg	<0.2	<0.2	<0.2	0.2	0.2	4565219

RDL = Reportable Detection Limit

Maxxam Job #: B102152
Report Date: 2011/02/03

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Maxxam ID		Z36690	Z36691	Z36692	Z36693		
COC#		11056	11056	11056	11056		
	Units	**32516A KIDNEY**	**32516B KIDNEY**	**32516 MUSCLE**	**32516 LIVER**	**RDL**	**QC Batch**
Total Tungsten (W)	mg/kg	<0.01	<0.01	<0.01	<0.01	0.01	4565219
Total Uranium (U)	mg/kg	<0.0004	<0.0004	<0.0004	<0.0004	0.0004	4565219
Total Vanadium (V)	mg/kg	<0.04	<0.04	<0.04	<0.04	0.04	4565219
Total Zinc (Zn)	mg/kg	27.6	27.2	54.9	18.5	0.04	4565219
Total Zirconium (Zr)	mg/kg	<0.1	<0.1	<0.1	<0.1	0.1	4565219

PHYSICAL TESTING (TISSUE)

Maxxam ID		Z36690	Z36691	Z36692	Z36693		
COC#		11056	11056	11056	11056		
	Units	**32516A KIDNEY**	**32516B KIDNEY**	**32516 MUSCLE**	**32516 LIVER**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	82	83	75	59	0.3	4566684

RDL = Reportable Detection Limit

QUALITY ASSURANCE REPORT

			Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
4565219	Total Arsenic (As)	2011/01/29	<0.01	mg/kg	NC	35	87	75 - 125
4565219	Total Cadmium (Cd)	2011/01/29	<0.002	mg/kg	1.0	35	100	75 - 125
4565219	Total Copper (Cu)	2011/01/29	<0.01	mg/kg	0.3	35	100	75 - 125
4565219	Total Iron (Fe)	2011/01/29	<2	mg/kg	1.5	35	98	75 - 125
4565219	Total Mercury (Hg)	2011/01/29	<0.002	mg/kg	1.6	35	99	75 - 125
4565219	Total Selenium (Se)	2011/01/29	<0.01	mg/kg	1.1	35	107	75 - 125
4565219	Total Silver (Ag)	2011/01/29	<0.004	mg/kg	NC	35	98	75 - 125
4565219	Total Zinc (Zn)	2011/01/29	<0.04	mg/kg	1.1	35	103	75 - 125
4565219	Total Aluminum (Al)	2011/01/29	<0.2	mg/kg	NC	35		
4565219	Total Antimony (Sb)	2011/01/29	<0.001	mg/kg	NC	35		
4565219	Total Barium (Ba)	2011/01/29	<0.02	mg/kg	1.7	35		
4565219	Total Beryllium (Be)	2011/01/29	<0.02	mg/kg	NC	35		
4565219	Total Bismuth (Bi)	2011/01/29	<0.02	mg/kg	NC	35		
4565219	Total Boron (B)	2011/01/29	<0.4	mg/kg	NC	35		
4565219	Total Calcium (Ca)	2011/01/29	<2	mg/kg	4.6	35		
4565219	Total Cesium (Cs)	2011/01/29	<0.02	mg/kg	NC	35		
4565219	Total Chromium (Cr)	2011/01/29	<0.04	mg/kg	NC	35		
4565219	Total Cobalt (Co)	2011/01/29	<0.004	mg/kg	1	35		
4565219	Total Lanthanum (La)	2011/01/29	<0.02	mg/kg	NC	35		
4565219	Total Lead (Pb)	2011/01/29	<0.002	mg/kg	NC	35		
4565219	Total Lithium (Li)	2011/01/29	<0.1	mg/kg	NC	35		
4565219	Total Magnesium (Mg)	2011/01/29	<2	mg/kg	0.07	35		
4565219	Total Manganese (Mn)	2011/01/29	<0.02	mg/kg	1.1	35		
4565219	Total Molybdenum (Mo)	2011/01/29	<0.01	mg/kg	0.9	35		
4565219	Total Nickel (Ni)	2011/01/29	<0.01	mg/kg	NC	35		
4565219	Total Phosphorus (P)	2011/01/29	<2	mg/kg	0.1	35		
4565219	Total Potassium (K)	2011/01/29	<2	mg/kg	0.6	35		
4565219	Total Rubidium (Rb)	2011/01/29	<0.02	mg/kg	1.3	35		
4565219	Total Silicon (Si)	2011/01/29	<10	mg/kg	NC	35		
4565219	Total Sodium (Na)	2011/01/29	<2	mg/kg	0.1	35		
4565219	Total Strontium (Sr)	2011/01/29	<0.02	mg/kg	NC	35		
4565219	Total Sulphur (S)	2011/01/29	<60	mg/kg	1.2	35		
4565219	Total Tellurium (Te)	2011/01/29	<0.02	mg/kg	NC	35		
4565219	Total Thallium (Tl)	2011/01/29	<0.0004	mg/kg	0.5	35		
4565219	Total Thorium (Th)	2011/01/29	<0.01	mg/kg	NC	35		
4565219	Total Tin (Sn)	2011/01/29	<0.02	mg/kg	NC	35		
4565219	Total Titanium (Ti)	2011/01/29	<0.2	mg/kg	NC	35		
4565219	Total Tungsten (W)	2011/01/29	<0.01	mg/kg	NC	35		
4565219	Total Uranium (U)	2011/01/29	<0.0004	mg/kg	NC	35		
4565219	Total Vanadium (V)	2011/01/29	<0.04	mg/kg	NC	35		

Gamberg Consulting

Maxxam Job #: B102152
Report Date: 2011/02/03

QUALITY ASSURANCE REPORT

			Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
4565219	Total Zirconium (Zr)	2011/01/29	<0.1	mg/kg	NC	35		
4566684	Moisture	2011/01/19	<0.3	%	0.5	20		

N/A = Not Applicable
RPD = Relative Percent Difference
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
QC Standard: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.

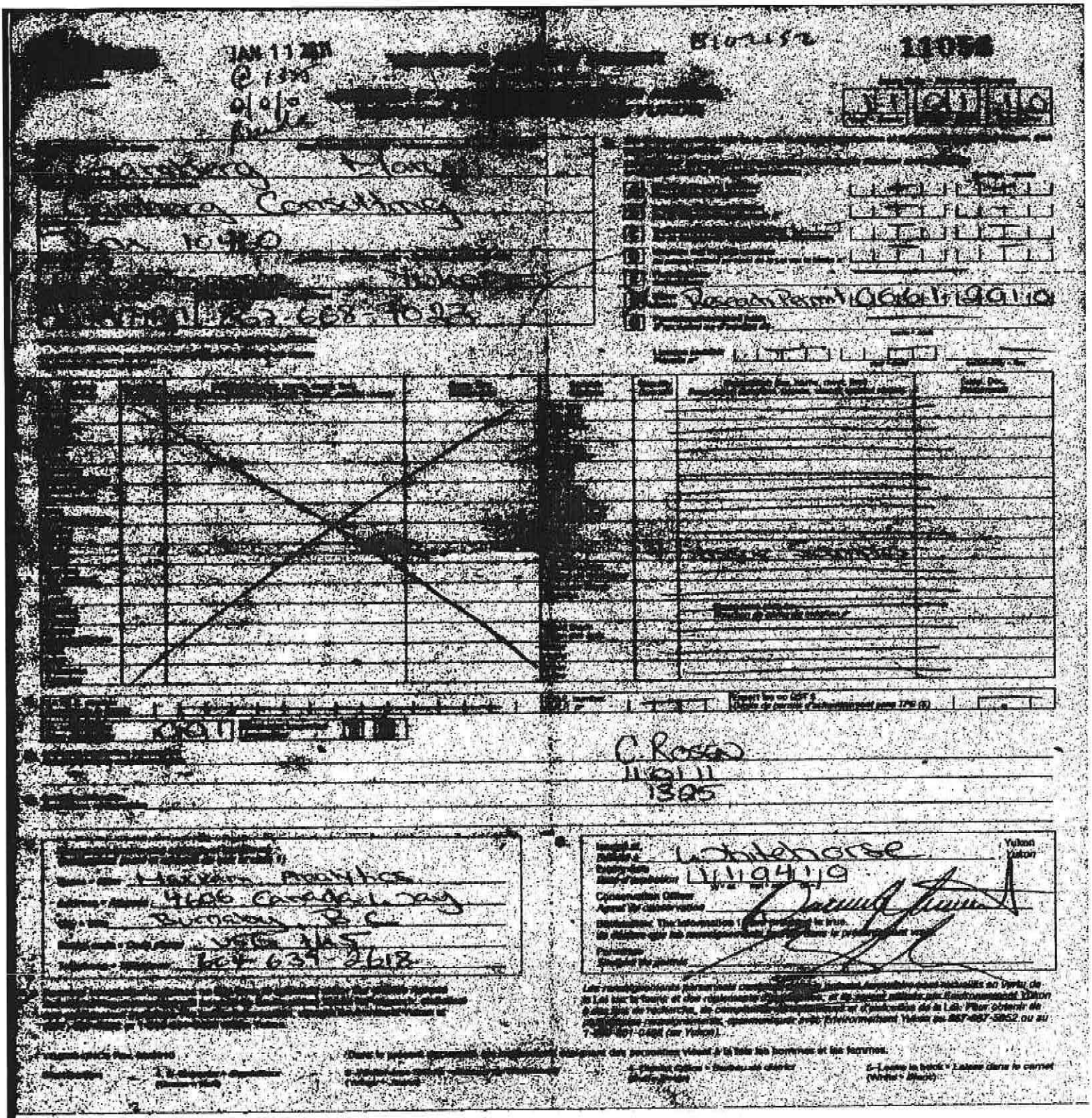
Validation Signature Page

Maxxam Job #: B102152

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

ROB REINERT, Data Validation Coordinator

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.



C. Rosso
11/9/11
1305

Whitehorse
11/9/11

Page 7 of 8

MAXXAM ANALYTICS
4606 CANADA WAY
BURNABY BC

CARD 4500********3693
EXPIRY ****
CARD TYPE VISA
DATE 2011/02/03
TIME 6940 15:04:52
INVOICE # B102152
RECEIPT NUMBER
M30741719-001-001-097-0

PURCHASE
TOTAL

$819.84

APPROVED

AUTH# 035534 01-027
THANK YOU

CARDHOLDER SIGNATURE

MERCHANT COPY

MAXXAM ANALYTICS
4606 CANADA WAY
BURNABY BC

CARD ********3693
CARD TYPE VISA
DATE 2011/02/03
TIME 6940 15:04:52
INVOICE # B102152
RECEIPT NUMBER
M30741719-001-001-097-0

PURCHASE
TOTAL

$819.84

APPROVED

AUTH# 035534 01-027
THANK YOU

CARDHOLDER COPY

IMPORTANT - RETAIN THIS
COPY FOR YOUR RECORDS