Figure 4 A typical side channel that was vacant of chum salmon downstream of the old community of Forty Mile on the McQuesten River, September 2012.

Figure 5 Barriers such as beaver dams that prevented the upstream movement of fish were common at many side channel and oxbows, September 2012.

APPENDIX I Biological Data

Fish #	Date	Sex	POHL (mm)	MEF (mm)	NF (mm)	Scale Book	Scale	Condition	Comments
1	29-Sept-12	F	545	620	680	65573	1 - 41	Carcass	Full of residual eggs

Sampling location: N 63° 40.550' W 136° 43.564' (WGS 84)

Appendix 3. 2012 Miner River Genetic Sampling and Aerial Index Survey.

2012 Miner River Genetic Sampling and Aerial Index Survey

Prepared for:

Fisheries and Oceans Canada
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EDI Contact:
Ben Snow
867.393.4882

EDI Project No:
12-Y-0331
December 2012

2012 ENVIRONMENTAL EMPLOYER OF THE YEAR

EDI ENVIRONMENTAL DYNAMICS INC.

PRINCE GEORGE • VANCOUVER • NANAIMO, BC • GRANDE PRAIRIE, AB • WHITEHORSE, YT

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EXECUTIVE SUMMARY

The Miner River is major Chinook salmon spawning tributary in the upper Porcupine River watershed, and annual counts of Chinook salmon have been conducted on this river since 2001. A helicopter based aerial survey of the Miner River was conducted August 16 and 17, 2012. The objectives of the survey were to enumerate spawning Chinook salmon and redds, and to collect genetic samples from the Chinook salmon on the spawning grounds. The aerial survey was completed on August 16, 2012; a total of 46 Chinook salmon and 74 redds were located. Genetic samples were collected from a total of 9 Chinook salmon carcasses on August 16 and 17, 2012. A comparison of the aerial index counts to the result of previous aerial counts (2009 and 2011) indicated that the number of spawning Chinook salmon observed was lower than in either of the two past comparative years; however, the number of redds was higher than 2011. The 2012 survey was conducted later in the season, which may account for the low number of spawning fish observed. In contrast, the survey timing was advantageous to the collection of genetic samples, and considerably more samples were collected than during previous attempts. The 2012 Miner River Chinook salmon enumeration and genetic collection program provided valuable information related to the timing and relative run strength of the Miner River Chinook salmon spawning event and has contributed valuable data to the continued development of an index of Chinook salmon run strength in the upper Porcupine River.

ACKNOWLEDGEMENTS

Logistical funding for this project was provided by the Polar Continental Shelf Program (PCSP). Fisheries and Oceans Canada (DFO) provided technical support and funding for the genetics sampling component of this project; Elizabeth MacDonald reviewed the draft version of this report. William Josie of the Vuntut Gwitch'in Government (VGG) Natural Resources Department provided general project direction and assistance with logistics. Field crewmember Keith Rispin (VGG) assisted will all field program activities, and provided practical input to ensure the project's success.

AUTHORSHIP

This report was prepared by EDI Environmental Dynamics Inc. (EDI). EDI staff who contributed to this project include:

Ben Snow, B.Sc., R.P.Bio .....Primary Author, Field Program Supervisor

Meighan Kearns, B.Sc., R.P.Bio, P.Biol..... Primary Editor

Pat Tobler, B.Sc., R.P.Bio, CPESC ..... Editor

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1 INTRODUCTION

The Miner River is understood to be a productive spawning area within the upper Porcupine River watershed (Snow 2009). A basin-wide radio telemetry program conducted on the Yukon River in 2003 and 2004 led to the recovery of a proportionally higher number of tags in the Miner River than in any other upper Porcupine River tributary, supporting the rationale for further studies to understand the Miner River's contribution to Chinook salmon stocks (Anderton 2003b, Anderton 2005a).

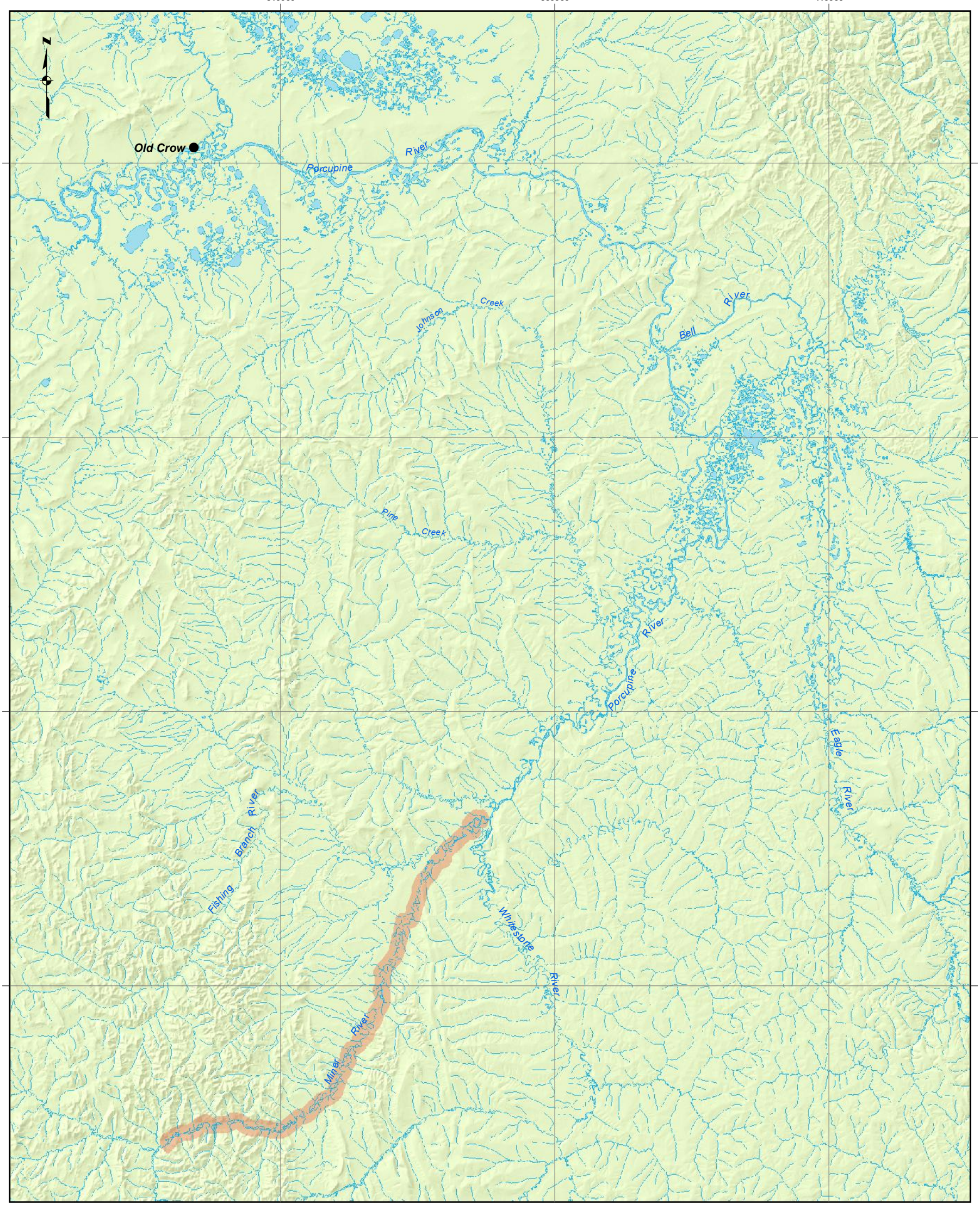
1.1 PROJECT BACKGROUND

Aerial and ground-based spawning investigations of the Miner River have been conducted annually since 2001. Since 2009, the Vuntut Gwitch'in Government (VGG) has standardized the surveys. VGG has conducted an annual aerial index survey of the Miner River mainstem by helicopter to locate and enumerate spawning Chinook salmon and redds. Surveys have documented patterns of Chinook salmon habitat use, provided a count of Chinook salmon and redds.

In 2010, VGG secured funding from the Polar Continental Shelf Program (PCSP) to cover the cost of the helicopter charter for the survey. PCSP funding has covered the cost of the helicopter charter in 2011 and 2012, which has allowed for the continuation of this program. In 2011, Fisheries and Oceans Canada (DFO) was approached regarding the opportunity to collect genetic samples from Chinook salmon during the aerial survey. DFO expressed interest and provided the necessary funding in 2011 and 2012. In 2012, as in past years, EDI Environmental Dynamics Inc. (EDI) was contracted to assist with the field work and reporting.

1.2 STUDY AREA

The Miner River study area extends from mouth of Fishing Creek, downstream to the confluence of the Miner and Fishing Branch rivers with the Porcupine River, a distance of approximately 100 km (Figure 1). This area has been flown during the 2009, 2010 and 2011 surveys and is known to contain suitable habitat for Chinook salmon. Previous studies have indicated the bulk of spawning occurs in this portion of the river (Anderton 2003b, Anderton 2005a, Snow 2009, EDI 2011).



Project Specific Features

Extent of Aerial Survey

Drawn By: L. Grieve
Checked By: M. Power / B. Snow
Date: 06 November 2012
EDI Project #: 12-Y-0331

Digital Data Sources

Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Project specific data digitized / derived by EDI Environmental Dynamics Inc. (2012).

Disclaimer
This document is not an official land survey and the spatial data presented is subject to change without any notice.

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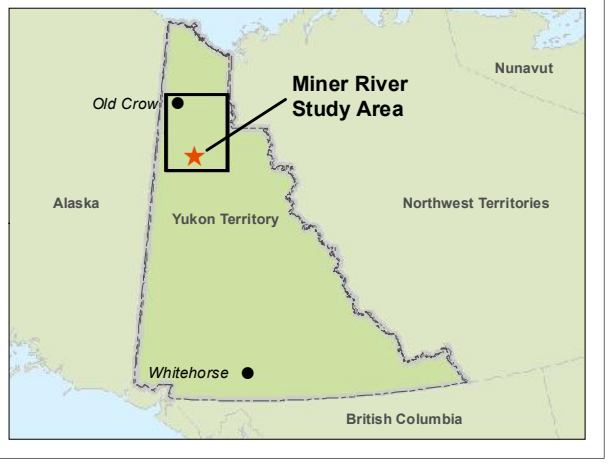
kilometres

Map Scale 1:750,000 (printed on 11 x 17)
Map Projection: North American Datum 1983 UTM Zone 7

Vuntut Gwitchin First Nation

EDI

Figure 1. Overview of the 2012 Miner River Survey Area



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2 METHODS

2.1 SURVEY TIMING

Prior to the field program, EDI consulted various sources of information to determine survey timing, including previous survey reports, water level data, and local knowledge. Available information from past aerial surveys on the Miner River indicated previous surveys were conducted between August 1 and 10 (EDI 2011).

Real-time water level data for the nearest Water Survey of Canada (WSC) water level gauging station (station 09FC001) was monitored to help ensure that conditions were conducive to aerial surveys and genetic sample collection. In general, lower water levels within the upper Porcupine River watershed provide higher water clarity and optimal survey conditions. EDI also examined information on the timing of the spawning run. Local knowledge from Old Crow residents indicated the 2012 Chinook salmon spawning run was later than in previous survey years.

Based primarily on the water level data and local knowledge, the Miner River survey was conducted on August 16 and 17, 2012.

2.2 AERIAL SURVEY

Aerial surveys were conducted using a Raven R44 helicopter chartered from Whitehorse; the survey crew included an EDI Professional Biologist and a VGG Natural Resource Technician.

The aerial survey was conducted August 16, 2012 along the mainstem of the Miner River, starting at the southern end of the survey area (i.e., the confluence of Fishing Creek). The survey proceeded in a northerly direction, to keep the sun behind the observers. The river channel was flown at a slow speed, at an elevation of approximately 50 m.

Spawning Chinook salmon and redds were tallied using click counters. UTM coordinates were collected at the location of each sighting or group. In areas where several fish or redds were sighted, the pilot was asked to hover or conduct a second overflight of the area to ensure an accurate count. Photos were taken along the length of the survey area, to document the spawning habitat.

2.3 GENETIC SAMPLE COLLECTION

Genetic samples were collected from Chinook salmon carcasses on August 16 and 17, 2012. Carcasses were easily identifiable from the helicopter; when a carcass was identified, the field crew set down and retrieved it using a large dipnet. At some locations, carcasses in deeper water could not be retrieved from shore; the field crew utilized a dry suit and snorkel to retrieve these carcasses.

Several carcasses located in the northern portion of the survey area were identified on August 16 and retrieved on August 17. On the return flight to Whitehorse on August 17, the field crew continued to search the river channel and several additional carcasses were located and retrieved at this time.

Genetic sample collection methodology was based on standard DFO protocol. A pair of axillaries processes (i.e., the pointed tissue or 'spine' at the base of each pelvic fin) was removed with clippers and immediately preserved in a vial of ethanol. Paired samples were collected to allow for one of each axillary sample pair to be sent to be analyzed by DFO, while the other was delivered to fisheries managers in Alaska (delivered by DFO). All genetic samples were preserved as one bulk sample. Additional data collected and recorded included: three scale samples, carcass length (mid-eye to fork length), sex, photos and UTM coordinates. Upon return to Whitehorse, genetic samples and scales were delivered to DFO staff in Whitehorse for further analysis.

3 RESULTS

3.1 AERIAL SURVEY COUNTS

At the time of the survey, weather conditions were clear skies with little to no wind; the Miner River was shallow and clear with relatively laminar flow. Much of the bed material within the surveyed area was light in colour, which provides a contrasting background ideal for salmon and redd identification.

A total of 48 Chinook salmon and 74 redds were observed during the aerial survey on August 16, 2012. It should be noted that the sampled carcasses were included in the total number of observed fish as they were all spawned out females assumed to have contributed to the 2012 spawning run; in 9 carcasses and 36 live Chinook were observed. The locations of all observed Chinook salmon, redds and carcasses are included in Appendix A.

Most of the Chinook salmon and redds observed were in the middle portions of the surveyed area (Figure 2 and 3). No Chinook salmon were observed in the southern section of the survey area (i.e., upstream end) for a distance of 45 km, or in the northern section (i.e., downstream end) for a distance of 20 km. Sixty percent of all Chinook observations were of single individuals; however, groups of 2 - 4 Chinook salmon were also observed.

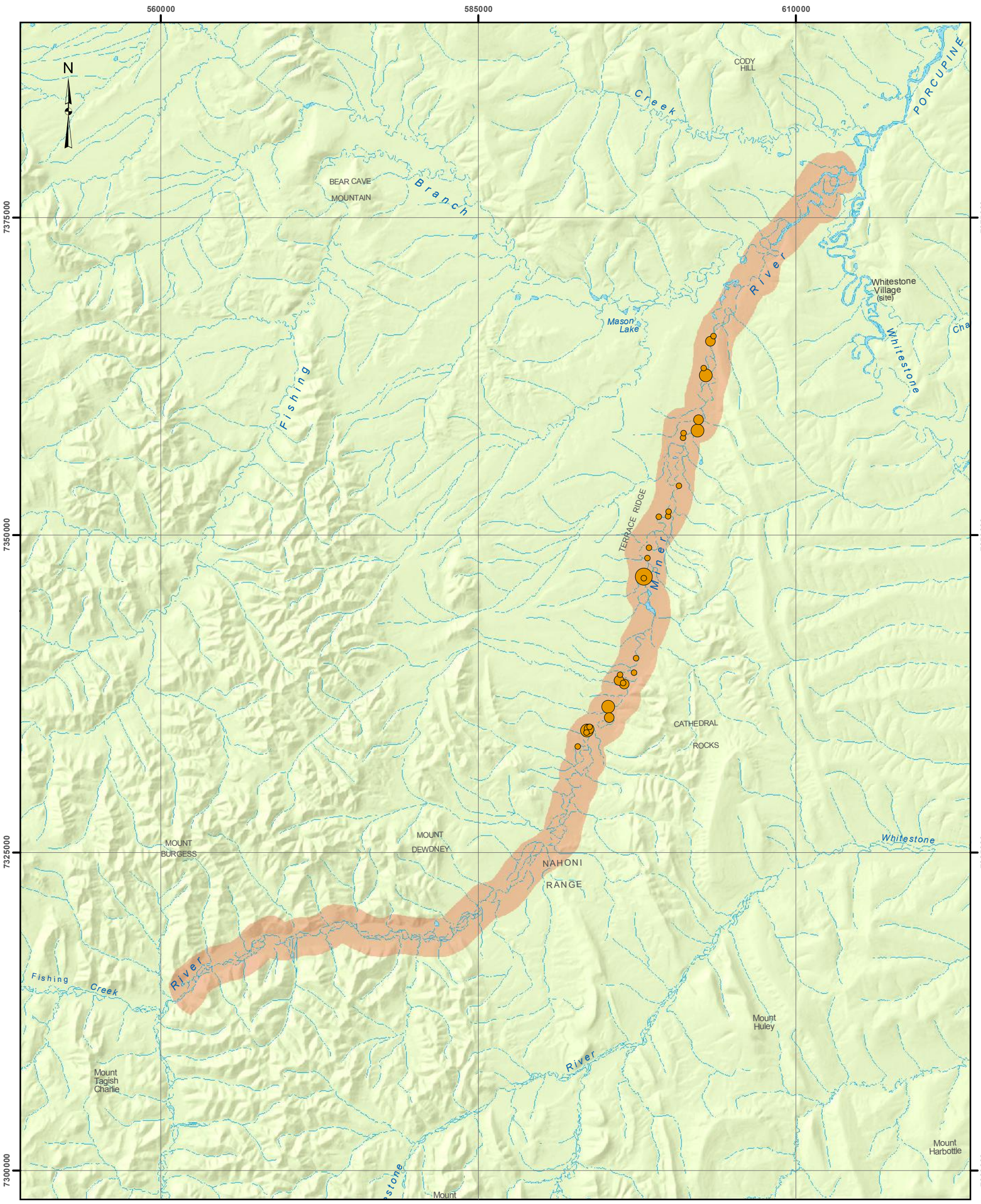
Redds were distributed along a greater portion of the survey area than spawning Chinook salmon. No redds were found in the southern 10 km of the survey area, nor in the northern 15 km. The number of observed redds at each location varied from 1 - 5. With the exception of two singular Chinook salmon, all live Chinook salmon were located on redds

3.2 GENETIC SAMPLE COLLECTION

Nine Chinook salmon carcasses were located and sampled. Four carcasses were sampled on August 16, and the remaining five carcasses were sampled on August 17. Carcasses were in various states of decomposition; however, the required data was successfully collected from all sampled carcasses. Genetic sampling data is summarized in Table 1.

Table 1: Summary of genetic sampling data collected from Miner River Chinook salmon, August 16 and 17, 2012.

UTM Location (Datum NAD 83; Zone 07W)		Collection Date	Sex	Mid-eye to Fork Length (cm)	Scale Number	Scale Book Number	Number of Axillary Processes Collected
Easting	Northing						
596098	7338532	Aug-16	Female	93	1-21	95454	2
596098	7338532	Aug-16	Female	90	2-22	95454	2
597437	7340292	Aug-16	Female	91	3-23	95454	2
598306	7348171	Aug-16	Female	86	4-24	95454	2
598440	7348985	Aug-17	Female	85	5-25	95454	2
600787	7353893	Aug-17	Female	88	6-26	95454	2
600787	7353893	Aug-17	Female	92	7-27	95454	2
596542	7338167	Aug-17	Female	85	8-28	95455	2
603522	7365266	Aug-17	Female	85	9-29	95455	2



Project Specific Features

Densities of Chinook Salmon

- 1 Salmon
- 2 Salmon
- 3 Salmon
- 4 Salmon
- Extent of Survey

Vuntut Gwitchin First Nation

EDI

Drawn By:	L. Grieve
Checked By:	M. Power / B. Snow
Date:	06 November 2012
EDI Project #:	12-Y-0331

Data Sources

Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Project specific features were derived by EDI Environmental Dynamics Inc. (2012).

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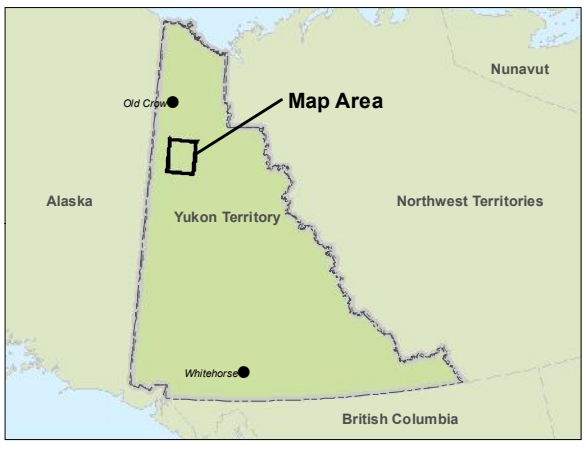
Map Projection: North American Datum 1983 UTM Zone 7

Figure 2. Chinook Salmon Densities in the Surveyed Area of the Miner River



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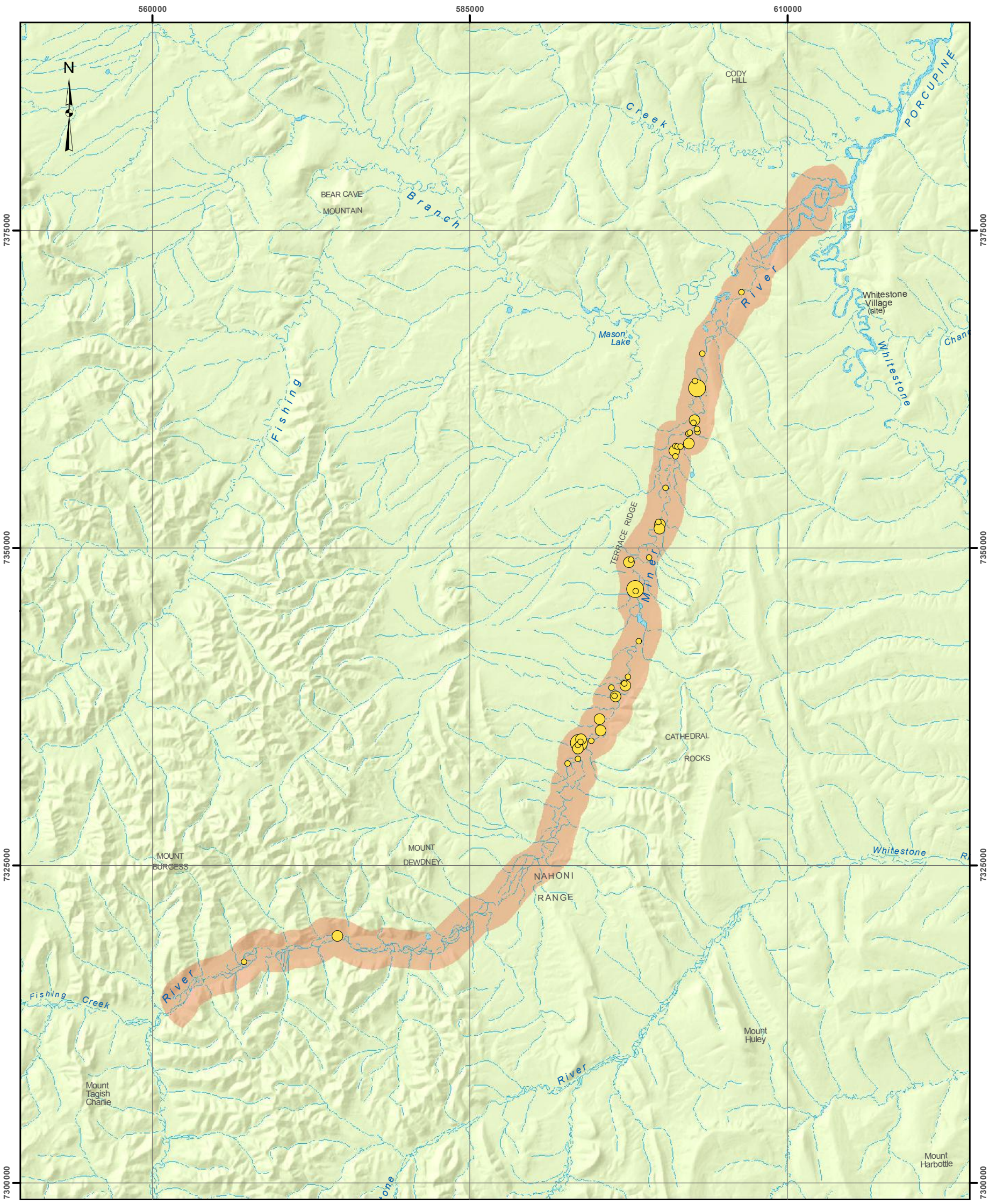

Project Specific Features

Densities of Chinook Salmon Redds

- 1 Salmon Redd
- 2-3 Salmon Redds
- 4-5 Salmon Redds
- Extent of Survey

Vuntut Gwitchin First Nation

EDI

Drawn By: L. Grieve
Checked By: M. Power / B. Snow
Date: 06 November 2012
EDI Project #: 12-Y-0331

Data Sources

Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Project specific features were derived by EDI Environmental Dynamics Inc. (2012).

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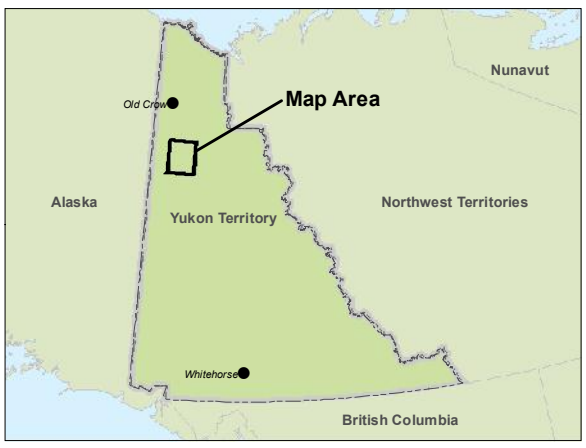
Map Scale 1:320,000 (printed on 11 x 17)
Map Projection: North American Datum 1983 UTM Zone 7

Figure 3. Chinook Salmon Redd Densities in the Surveyed Area of the Miner River



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4 DISCUSSION

The results of the 2012 Miner River aerial survey have contributed valuable information to the understanding of Chinook salmon habitats, distribution and abundance in the upper Porcupine River. These results are discussed in the following sections.

4.1 AERIAL SURVEY COUNTS AND TIMING

Similar to previous aerial surveys, the 2012 data indicate the Miner River is a suitable index stream for Chinook salmon. Miner River Chinook salmon spawning data collected to date is summarized in Table 2. Prior to 2009, much of the data was qualitative in nature and not suitable for quantitative comparison. It should also be noted that the 2010 survey was completed (by others) during a flood event; high, turbid water levels severely hampered counting efforts. As such, the 2010 counts are excluded from comparisons made in the following sections.

Table 2. Summary of available data for Chinook salmon spawning surveys on the Miner River.

Survey Date	Method of Survey	Number of Chinook salmon	Number of Redds
August 8, 2001	Fixed wing aircraft	Data not collected	102
August 10, 2002	Fixed wing aircraft	1	42
August 1 - 2, 2003	Fixed wing aircraft	Data not collected	8[a]
August 1, 2004	Fixed wing aircraft	Numerous [b]	Numerous [b]
August 4, 2005	Boat	Numerous [c]	Numerous [c]
August 3, 2009	Helicopter	319	110
August 9, 2010	Helicopter	2	None [d]
August 5, 2011	Helicopter	67	53
August 16, 2012	Helicopter	48	74

Data sources: Anderton (2001, 2002, 2003a, 2005a, 2005b), Snow (2009), ELR (2011), and EDI (2011)

Notes:

[a] Poor visibility during this survey did not allow for an accurate count.

[b] Opportunistic observations collected during telemetry survey.

[c] Qualitative data collected while minnow trapping.

[d] Extreme flooding event, poor visibility during survey did not allow for an accurate count.

The 2012 counts of observed Chinook were lower than previous years, specifically 2009 and 2011 (Table 2). In contrast, the number of redds counted in 2012 is considerably higher than the 2011 count. A likely explanation for the low number of Chinook salmon relative to the number of redds is the later timing of the 2012 survey, compared to past years (Table 2). The decision to conduct the survey at a later date in 2012 was based on information indicating the 2012 Chinook salmon run was late, as well as a desire to improve the chance of collecting genetics samples from spawned out Chinook salmon and/or carcasses - it was thought that conducting the survey later than in past years would increase the chances of finding Chinook salmon carcasses on the spawning grounds. It appears that the 2012 aerial survey was conducted well after the peak spawning event. This supposition is supported by the fact that few live spawned out fish were observed. In addition, all sampled Chinook salmon were female, and no other carcasses were observed

during the survey. Female salmon often persist longer than males on the spawning ground; therefore, the observation of only female carcasses suggests spawning activities were nearing the end.

The 2012, 2011 and 2009 Chinook and redd counts provide three years of comparable data, and allow for a general comparison between runs. However, salmon numbers are variable during the run and counts of salmon are dependent on the timing of the survey. In contrast to the variability of observed Chinook salmon counts, the number of redds increases steadily as the season progresses and more fish spawn. A comparison of the number of observed Chinook salmon to the number of observed redds can provide better insights into run timing and run strength than relying solely on counts of observed Chinook and survey dates.

Surveys where substantially more Chinook than redds are observed are indicative of the earlier stage of spawning; many fish have yet to spawn and excavate redds. In 2009, a large number of Chinook salmon were observed, and approximately a third as many redds were observed (2.9 Chinook/redd). This survey was likely conducted in the early or middle of the spawning period; the relatively early date of the survey (August 3) supports this supposition. In 2011 and 2012, fewer Chinook salmon were observed and relatively more redds were observed (1.26 Chinook/redd in 2011, and 0.65 Chinook/redd in 2012). Based on these ratios, it is apparent that the 2011 and 2012 surveys were conducted later in run. When compared as a group, the ratios of observed Chinook to observed redds during each survey can give a better indication of run timing than can be derived from the date of the survey. In regards to later season surveys (2011 and 2012), the number of redds observed likely represent the majority of the spawning that has taken place. Redd counts during these surveys could provide a better indication of run strength than observed Chinook counts.

Considering the survey timing from the three years of standardized data collection (2009, 2011 and 2012), 2009 was obviously the strongest year and the total redd count (at the end of the spawning period) would have been higher than the 110 observed. In 2012 the redd count was higher than in 2011; however, the 2011 survey was completed at a time when some spawning was still likely occurring. Regardless, given that the 2011 was also late in the run it appears likely that the 2012 run was at least as strong as the 2011 run. The information gained thus far provides important information on the timing of the Miner River Chinook salmon spawning event, and can be used to better time aerial surveys in future years so that data is more comparable. As this project is typically limited to one flight, timing it for the peak spawning period is difficult. Conditions on the Miner River are favourable for seeing redds, a shift to post spawning redd counts could be considered.

4.2 GENETIC SAMPLE COLLECTION

With the exception of high water events, the typically shallow depth and high water clarity in the Miner River facilitate aerial surveys for Chinook salmon. Conversely, these characteristics have complicated the collection of genetics samples from Chinook salmon in past years. In 2011, attempts were made to capture live Chinook salmon via beach seining; however, fish could easily see the field crew approaching and were able to avoid the beach seine (EDI 2011). Deep pool areas further hampered sampling efforts in 2011 (EDI

2011). Angling and beach seining were considered for live fish collection in 2012; however, these methods were not employed due to the high water velocity and low density of Chinook salmon.

The later timing of the 2012 survey likely accounts for the higher relative number of carcasses located during the survey. The collection of carcasses via dipnet and snorkel was an effective method that allowed for the collection of a considerable number of carcasses (i.e., 9 of 46; or 20% of all Chinook salmon observed). The addition of a second day of sampling also allowed for the collection of considerably more samples than would have been possible in a single day.

5 CONCLUSIONS

Given that the Miner River is a high quality index stream with an existing dataset, the continuation of annual aerial surveys would provide a useful index of Chinook salmon spawning escapement in the upper Porcupine River watershed. No other index of Chinook salmon spawning escapements exists for this area. VGG greatly desires knowledge of Chinook salmon run strength in the upper Porcupine River, to help ensure a sustainable local fishery. This program helps address these goals by providing a repeatable and cost-effective means to gauge the strength of the Chinook salmon run. Developing a data set of annual run strength also helps to anticipate strength of each brood year, and management objectives can be planned accordingly.

The later timing of the 2012 program was beneficial to the genetic sampling portion of the program, as more carcasses were found on the spawning ground than in past years. On the Miner River low densities of salmon are spread out over a large area and as such, a large amount of time and effort can be expended to sample a single Chinook salmon. The sampling of Chinook salmon carcasses is an easier and more rapid means to collect genetic samples from the Miner River than attempting to capture and sample live fish.

The comparison of the three years of standardized aerial survey data (2012, 2011 and 2009) has highlighted the importance of the redd counts, and the ratio of observed Chinook salmon to observed redds. In the future, counts of redds could be used to provide an index of run strength. This would favor surveys later in the year, after the majority of redds had been created. This data would likely be subject to less variability than counts of observed salmon and the later season timing would be much more favorable for continued genetic sample collection. As shown in 2012, a survey conducted closer to the middle of August could meet both redd count and genetic sample collection goals.

6 REFERENCES

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6.2 SPATIAL DATA

1:50,000 CanVec topographic data from Government of Canada, Natural Resources Canada, Earth Sciences Sector, Centre for Topographic Information. Geogratis website (http://geogratis.cgdi.gc.ca).

1:20,000 TRIM positional files from the Land and Resource Data Warehouse (http://lrdw.ca). Copyright belongs to Her Majesty the Queen in Right of the Province of British Columbia.

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APPENDIX A CHINOOK SALMON AND REDDS COUNTS, MINER RIVER AUGUST 16, 2012

UTM Coordinates (Datum NAD 83; Zone 7W) Easting	Northing	Number of Chinook Salmon Observed	Number of Redds Observed	Notes
567228	7317424		1	
574585	7319422		2	
592704	7333015		1	
592837	7333335	1		
593514	7333387		1	
593523	7334204		3	
593516	7334462	1	1	
593580	7334627	3	5	
593722	7334728	2	1	
593750	7334913	1	2	
594557	7334805		1	
595322	7335624	2	2	
595235	7336492	3	3	
596480	7338283	2	2	
596413	7338329	1	1	
596098	7338532	2		Carcasses
596170	7338988	1	1	
596542	7338167	1		Carcass
597256	7339151	1	3	
597184	7339311		1	
597447	7339823		1	
597437	7340292	1		Carcass
598305	7342652		1	
598049	7346603	1	1	
598020	7346737	4	5	
598306	7348171	1		Carcass
597522	7348872		3	
597686	7349055		1	
598440	7348985	1		Carcass
599131	7349218		1	
599199	7351450	1		
599929	7351495	1	2	
599985	7351850	1	3	
599875	7352016		1	
600787	7353893	2		Carcasses
600422	7354717		1	
601212	7357197		1	
601133	7357645	1	2	
601179	7358007	1	1	

UTM Coordinates (Datum NAD 83; Zone 7W)		Number of Chinook	Number of Redds	Notes
601377	7357959		1	
601604	7357982		1	
602241	7358230	3	3	
602196	7358994		1	
602355	7359082	2	1	
602957	7359091		1	
602906	7359353		1	
602639	7359835		1	
602711	7360038		2	
602913	7362566	3	4	
602733	7363133	1	1	
603291	7365266	2	1	
603522	7365663	1		Carcass
606386	7370118		1	
	Total	**48**	**74**	