

# TECHNICAL MEMO

CREATING AND DELIVERING BETTER SOLUTIONS

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**TO:** David Morrison  
Yukon Energy Corporation

**DATE:** October 13, 2009

**C:** Stephan Klump, Dipl.-Geol., Ph.D.

**MEMO NO:** 1

**FROM:** Lea Menzies, B.Sc., B.I.T  
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**FILE:** W23101159.015

**SUBJECT:** Yukon Geothermal Exploration Program - Open Water Survey

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## 1.0 INTRODUCTION

Yukon Energy Corporation (YEC) has retained EBA Engineering Consultants Ltd. (EBA) to conduct an exploration program to locate and evaluate potential geothermal prospects in the Yukon. The Geothermal Exploration Program consists of numerous phases, including aerial reconnaissance, geological mapping, water analysis, air photo interpretation (API), remote sensing and hydro-geological studies. This information is being collected to enhance our understanding of geothermal activity in the Yukon and to acquire pre-development data at potential energy sources.

As part of this program, open water surveys were conducted in March 2009 during winter conditions in selected areas around southern Yukon with known or potential geothermal activity. Aerial transect-based winter surveys were conducted to search for open water that could indicate thermal anomalies. Six study areas were selected for open water surveys: Shakwak Trench (Haines Junction Area), Volcano Mountain (Fort Selkirk Area), Nash Creek (north of Mayo, YT), McArthur Hotsprings Area, Takhini-Alligator Lake (Whitehorse Area) and Larsen Creek – Beaver River (southeast Yukon) (Figure 1).

This report summarizes the open water surveys conducted in the Shakwak Trench, Volcano Mountain, Nash Creek, McArthur Hotsprings Area and Takhini-Alligator Lake Areas. The results of open water surveys in the Larsen Creek – Beaver River study area, which was conducted as a separate phase of the overall program, are documented in a separate report.

## 2.0 METHODS

Areas with favourable geological environments and/or known geothermal activity were selected for detailed exploration. Transects in each survey area were flown between 250 m (820 ft) and 700 m (2296 ft) elevation at a speed of 70 knots (130 km/hr). Transect line spacing was adjusted from 500 m (1640 ft) to 2000 m (6561 ft) based on topography, density of vegetation or other factors that

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influenced the practical width of the observation corridor. Transect spacing was adjusted based on local conditions to increase efficiency without compromising quality.

The winter open water surveys were designed to locate open water that could be the result of a thermal anomaly (i.e. warm or hot water). Depending on the characteristics of open water (e.g. round pond vs. open stream channel), the open water features were rated as high, moderate or low priority for follow-up evaluation. The general criteria for rating these are summarized in Table 1.

TABLE 1. CRITERIA FOR THE PRIORTIZATION OF THERMAL INFLUENCE	
Priority for Follow-up Evaluation	Criteria
HIGH	Round ponds not associated with a water course; may have snow-free ground vegetation and algae growth; open streams may have flow from the ponds; may be associated with channel openings in adjacent water courses.
MODERATE	Open water in streams, rivers or lakes that does not appear to be solely the result of current or other non-thermal influence; unusually long reach of open water in a small, shallow-gradient stream.
LOW	Open water in a stream channel that may be due to current or other non-thermal influence.

Surveys were conducted using fixed wing aircraft (Cessna 180, Cessna 206 or Maul M-7-235) with two EBA observers. When using the Cessna 180 and the Maul M7-235, the navigator/observer was positioned front right and the recorder observer was position back left. When using the Cessna 206 both observers were seated in the rear seats (one observer left, one right) for optimum visibility. Each open water site was recorded, described and rated for follow-up evaluation. The UTM location of the aircraft, close to the open water target, was recorded with a Garmin Colorado 300 GPS. Most open water sites were circled by air for additional observations, accurate location and description. Photographs were taken at most of the sites that were rated as high or moderate priority for follow-up evaluation.

### 3.0 RESULTS

Open water surveys were conducted in March 2009. Survey results for each study area are presented in Sections 3.1 to 3.5. A summary of the open water sites is included as Table 2. Data for all open water observations is included as Appendix A. Note that each open water observation has a unique waypoint number which corresponds to a location in Figures 2 to 6. The total aerial survey flight time for all five survey areas reported in the document was approximately 30 hours.

TABLE 2. SUMMARY OF OPEN WATER SITES.			
Study Area	Total Open Water Observations	Open Water Sites with High Priority for Follow-up Evaluation	Open Water sites with Moderate Priority for Follow-up Evaluation
Shakwak Trench	64	1	14
Volcano Mountain	8	0	3
Nash Creek	11	5	4
McArthur Hotsprings	12	1	1
Takhini-Alligator Lake Areas	16	0	0

### 3.1 SHAKWAK TRENCH

The Shakwak Trench study area is 160,000 ha and extends from Dezadeash Lake north-west to Kluane Lake and includes Haines Junction (Figure 2). The total survey time for the Shakwak Trench area was 21.5 hours and was conducted over four days (March 17-19 and 23, 2009).

During the March 17 and 18 surveys, the weather conditions consisted of temperatures of -18°C and -20°C respectively with less than 10% cloud cover and no precipitation. On March 19 and 23, the temperatures for the survey were -14°C and -16°C respectively with 100% cloud cover, intermittent light snow and low fog on March 19 and no precipitation on March 23.

Surveys in the Shakwak Trench area resulted in the observation and documentation of 64 open water observations (see Appendix A and Photographs 1-8). Of these, 14 were rated as having 'moderate' priority for follow-up evaluation. Only one observation was ranked as 'high' priority for follow-up evaluation, the Jarvis River Warm Springs, which was documented prior to initiation of the survey.

### 3.2 VOLCANO MOUNTAIN

The Volcano Mountain study area is located near Fort Selkirk, Yukon and is approximately 8700 ha in area (Figure 3). Total survey flight time for this area was 4.5 hours over two days (March 25 and 27, 2009). Surveys were planned for March 26 but were postponed due to heavy snow.

On March 25 the average temperature was -8°C with 100% cloud cover. The ground was snow covered. On March 27, it was -4°C with less than 20% cloud cover and no precipitation.

Eight open water sites were observed in the Volcano Mountain study area including three observations moderate and five low priority for follow-up evaluation. Descriptions of open water sites are included as Appendix A. The moderate priority sites are recorded in Photographs 9 to 11.

### 3.3 NASH CREEK

Nash Creek Hotsprings are located approximately 118 km northeast of Mayo, Yukon and 80 km from Elsa (Figure 4). The Nash Creek study area was selected to investigate terrain along geological structures identified by air photograph interpretation and research of geology mapping that could be related to the Nash Creek Hotsprings. This study area encompasses approximately 8700 ha. The survey was conducted on March 25, 2009 with a survey flight time of about one hour.

The temperature was  $-7^{\circ}\text{C}$ . Snow covered 100% of the ground. Unfavourable weather conditions of low cloud cover and snow flurries reduced visibility; however transects were successfully completed throughout the study area.

Eleven open water sites were recorded. Five of these are high priority sites, including Nash Creek Hot Springs (Photograph 12), and four were moderate priority sites. Descriptions of all sites are included in Appendix A.

### 3.4 MCARTHUR HOT SPRINGS AREA

The McArthur study area, located 60 km south of Mayo, Yukon, is comprised of two smaller survey areas with a combined area of 4000 ha (Figure 5). Approximately one hour was spent surveying the McArthur area.

Surveys were conducted in the McArthur Hot Springs area on March 25 and 27, 2009. The March 25 survey was terminated due to low cloud cover that precluded access to the higher elevation areas including McArthur Hot Springs (Photographs 13 and 14). The temperature on March 25 was  $-2^{\circ}\text{C}$ . The survey was conducted on March 27 with 30% cloud cover and no precipitation.

Twelve open water sites were recorded in the McArthur study area. One high priority site, the McArthur Hot Springs, was observed. One moderate priority site was documented outside of the study area. Six low priority open water sites were observed within the McArthur study area boundaries and four low priority sites were observed outside of the study area along the access routes to the areas of focus. Site descriptions are summarized in Appendix A.

### 3.5 TAKHINI-ALLIGATOR LAKE AREAS

The open water survey of the Takhini-Alligator Lake study area was limited as known warm springs and hot springs in this area are assumed to have already been discovered. The open water survey in this area mainly focused on recent volcanism (Miles Canyon Basalt) and related young tectonic structures.

The Takhini-Alligator Lake study area is located to the west of Whitehorse from the Takhini Hot Springs through the Ibex Valley and includes two warm ponds near Alligator Lake (Figure 6). The combined survey area is 51,800 ha. Surveys of this area resulted in very few open water observations. The southern portion of the Ibex Valley block was also studied during travel between Whitehorse and the Shakwak study area. Surveys were conducted on March 16 and 23, 2009. The total survey time for this area was 1.7 hours.

Weather during the March 16 survey was less than 25% cloud cover with no precipitation and a temperature of -10°C. March 23 was overcast with no precipitation.

All open water sites observed in the Takhini-Alligator Lakes study area were classified to have low priority for follow-up evaluation (n=16). Photograph 15 illustrates a typical open water site in the Takhini-Alligator Lake area.

### 4.0 DISCUSSION AND RECOMMENDATIONS

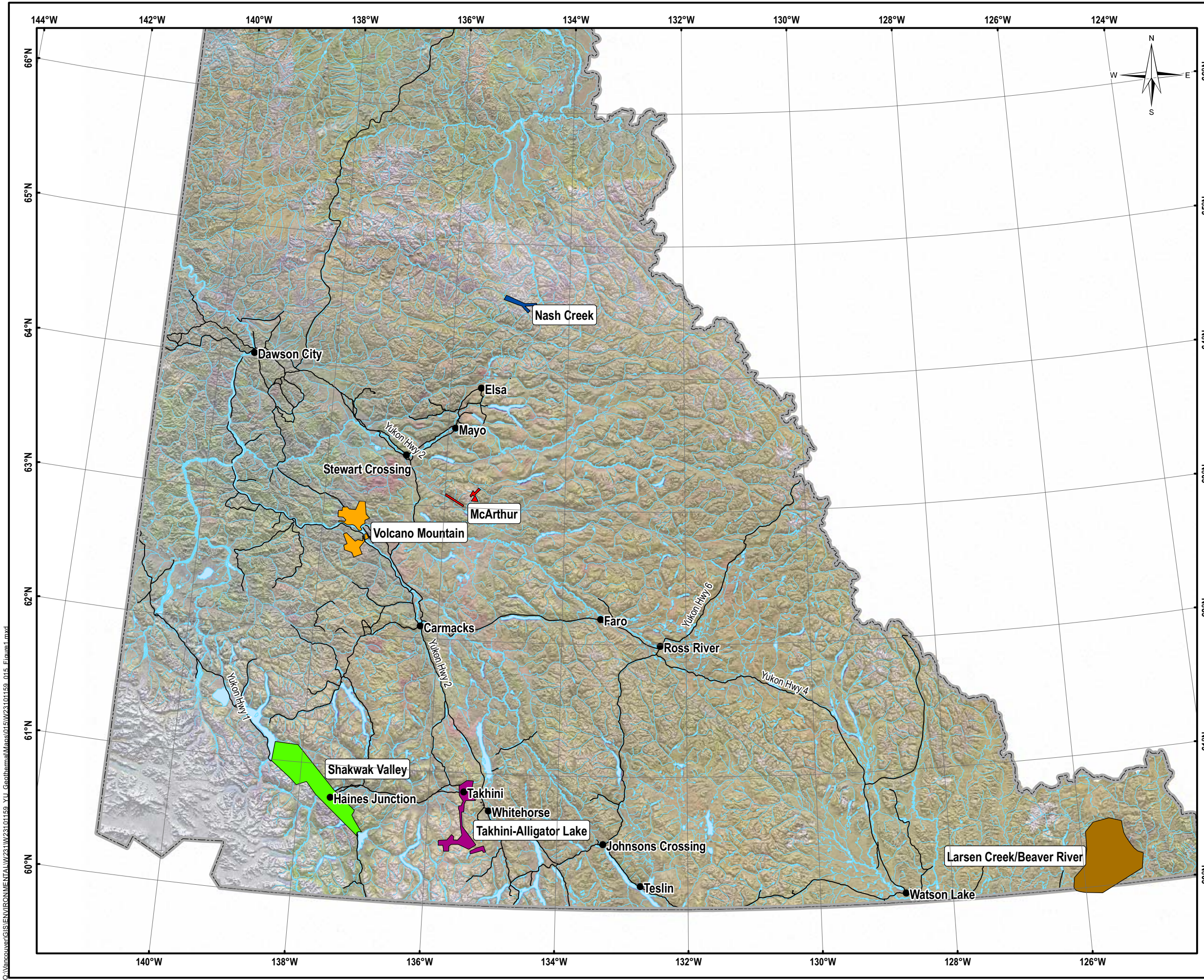
A total of 111 open water sites were recorded within the five study areas of the Open Water Survey (Phase 015) of the 2009 Yukon Geothermal Assessment Program. These included seven sites judged as high priority for follow-up evaluation and 22 sites judged as moderate priority. Previously documented hot springs or warm springs (Jarvis River Warm Springs, McArthur Hot Springs and Nash Creek Hot Springs) were used as control sites and are included as three of the seven high priority sites.

The aerial reconnaissance surveys were successful in identifying numerous open water targets that have potential to be caused by thermal springs. Linear transect-based winter surveys for detecting open water are determined to be a cost-effective regional exploration method to identify targets for follow-up assessment.

Following the open water surveys, EBA recommended that all high and moderate priority sites should be evaluated with summer aerial reconnaissance. High priority sites, and those moderate priority sites that were of interest following the summer aerial reconnaissance, should be further assessed on the ground. Follow-up ground assessments should include recording of temperature, pH and conductivity. Water sampling for detailed analysis should be done at selected sites of interest and where basic parameters are anomalous.

During the summer of 2009 follow-up assessments of the open water survey targets were conducted in the Shakwak Trench, Volcano Mountain, Nash Creek and McArthur Hot Springs study areas. Results of those assessments will be documented in a separate technical memo.

Open water surveys and the follow-up assessments of open water targets were part of the preliminary phases of the YEC Geothermal Exploration Program.



**LEGEND**

**Survey Areas**

- McArthur
- Nash Creek
- Shaktwak Trench
- Volcano Mountain
- Takhini-Alligator Lake
- Larsen Creek/Beaver River

- Populated Centre
- Road
- Watercourse
- Waterbody
- ▭ Yukon Territory Border

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**NOTES**  
Base data source: Geomatics Yukon

**2009 GEOTHERMAL ASSESSMENT PROGRAM**

**Open Water Survey Areas Overview**

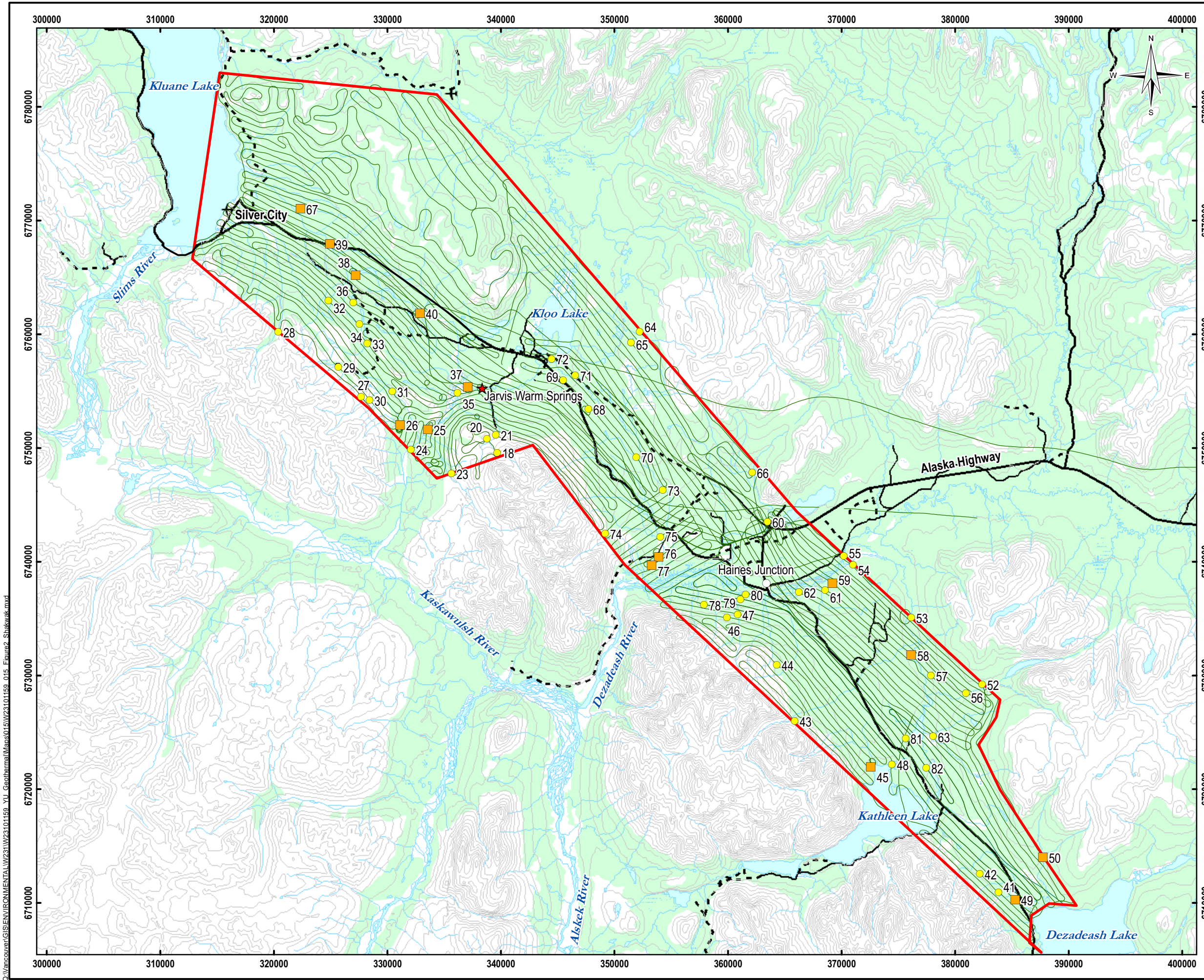
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PROJECT NO. W23101159.015	DWN MEZ	CKD LM	REV 1
OFFICE EBA-VANC	DATE October 13, 2009		

**YUKON ENERGY**

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**Figure 1**

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**LEGEND**

**Probability of Thermal Influence**

- ★ High
- Moderate
- Low

**Study Area Boundary**

- ✈ Airstrip
- Contour (100m)
- - - Trail
- Limited Use Road
- Road
- Flight Lines
- Watercourse
- Waterbody
- Wetland
- Vegetation

**Criteria for Priority Follow-up Evaluation:**

High	Round ponds with openings not associated with a water course
Moderate	Unusual stretch of open water
Low	Stretch of open water within a watercourse



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**NOTES**  
Base data source: NTDB 1:250K

**2009 GEOTHERMAL ASSESSMENT PROGRAM**

**Shakwak Valley  
Open Water Survey**

PROJECTION UTM Zone 8	DATUM NAD83
Scale: 1:325,000	
5 2.5 0 5 Kilometers	

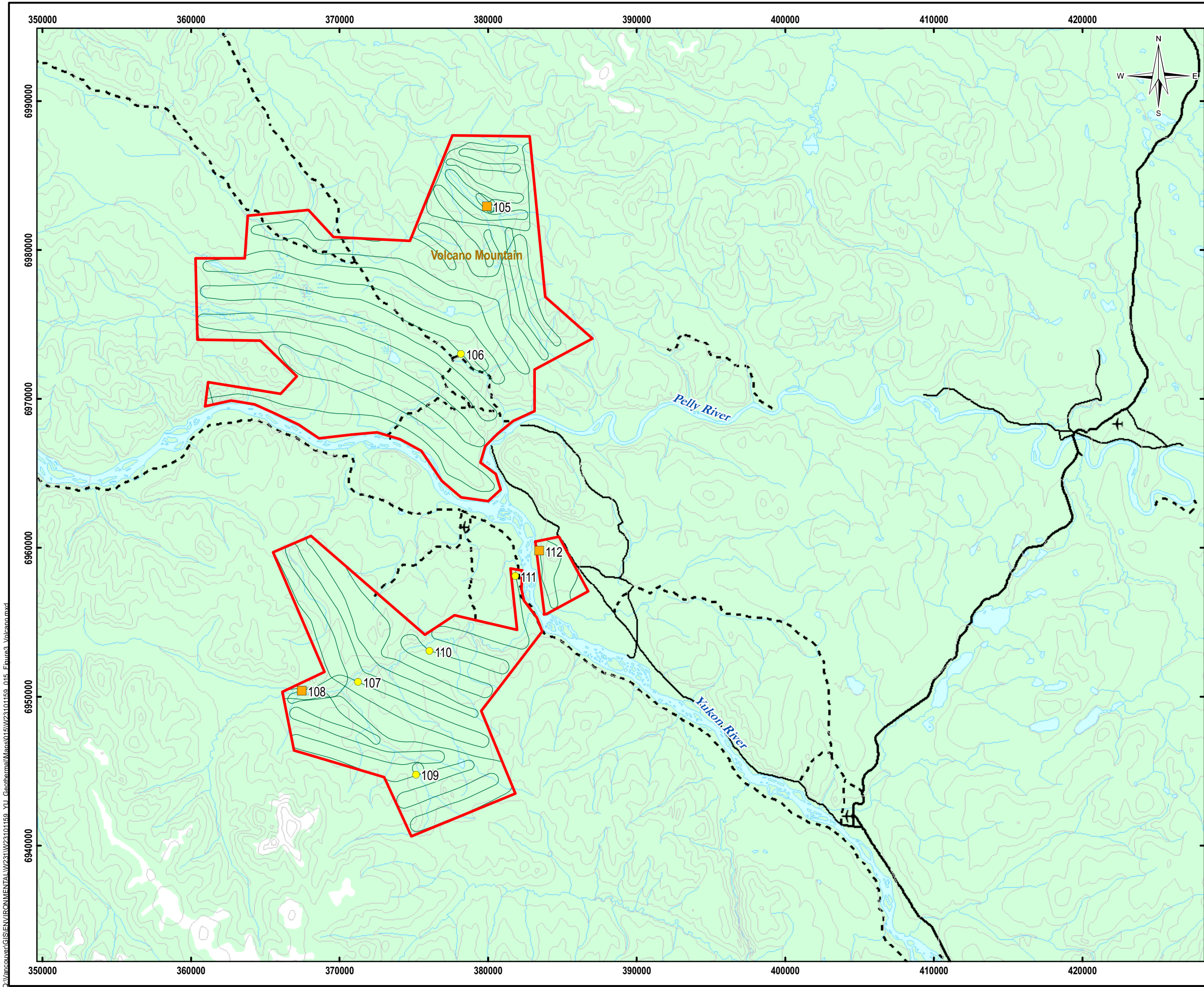
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FILE NO. W23101159_015_Figure3_Shakwak.mxd
PROJECT NO. W23101159.015
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REV 0
DATE July 31, 2009

**Figure 2**

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**LEGEND**

**Probability of Thermal Influence**

- ★ High
- Moderate
- Low

✈ Airstrip  
 — Contour (100m)  
 - - - Trail  
 — Limited Use Road  
 — Road  
 — Flight Lines  
 — Watercourse  
 Waterbody  
 Wetland  
 Vegetation

**Criteria for Priority Follow-up Evaluation:**

High	Round ponds with openings not associated with a water course
Moderate	Unusual stretch of open water
Low	Stretch of open water within a watercourse



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**NOTES**  
Base data source: NTDB 1:250K

**2009 GEOTHERMAL ASSESSMENT PROGRAM**

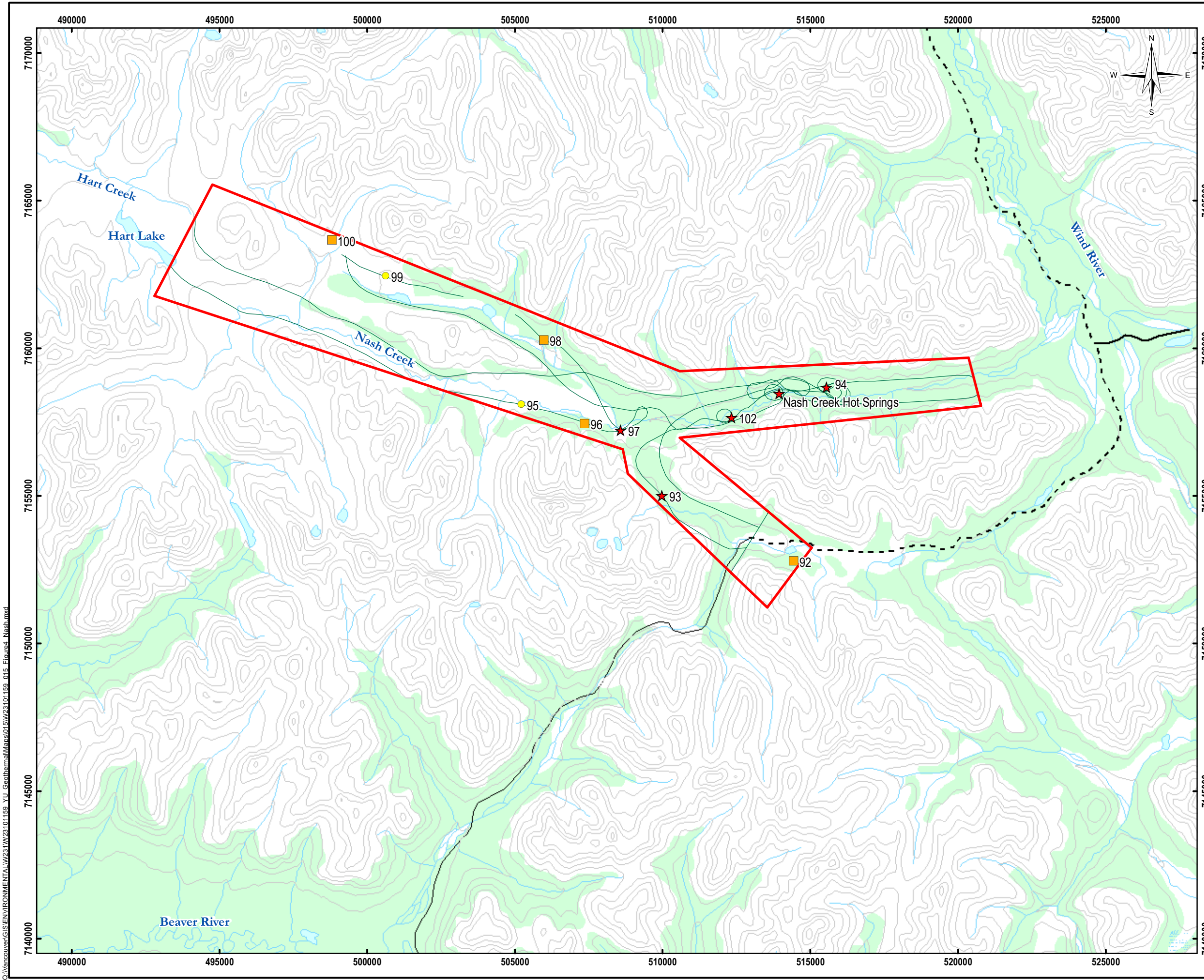
**Volcano Mountain  
Open Water Survey**

PROJECTION UTM Zone 8	DATUM NAD83
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PROJECT NO. W23101159.015	DWN MEZ
OFFICE EBA-VANC	CKD LM
DATE July 31, 2009	REV 0



**Figure 3**

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**LEGEND**

★ High	— Contour (100m)
■ Moderate	- - - Trail
● Low	— Limited Use Road
— Flight Lines	— Road
□ Study Area Boundary	— Watercourse
	— Waterbody
	Wetland
	Vegetation

**Criteria for Priority Follow-up Evaluation:**

High	Round ponds with openings not associated with a water course
Moderate	Unusual stretch of open water
Low	Stretch of open water within a watercourse



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**NOTES**  
Base data source: NTDB 1:250K

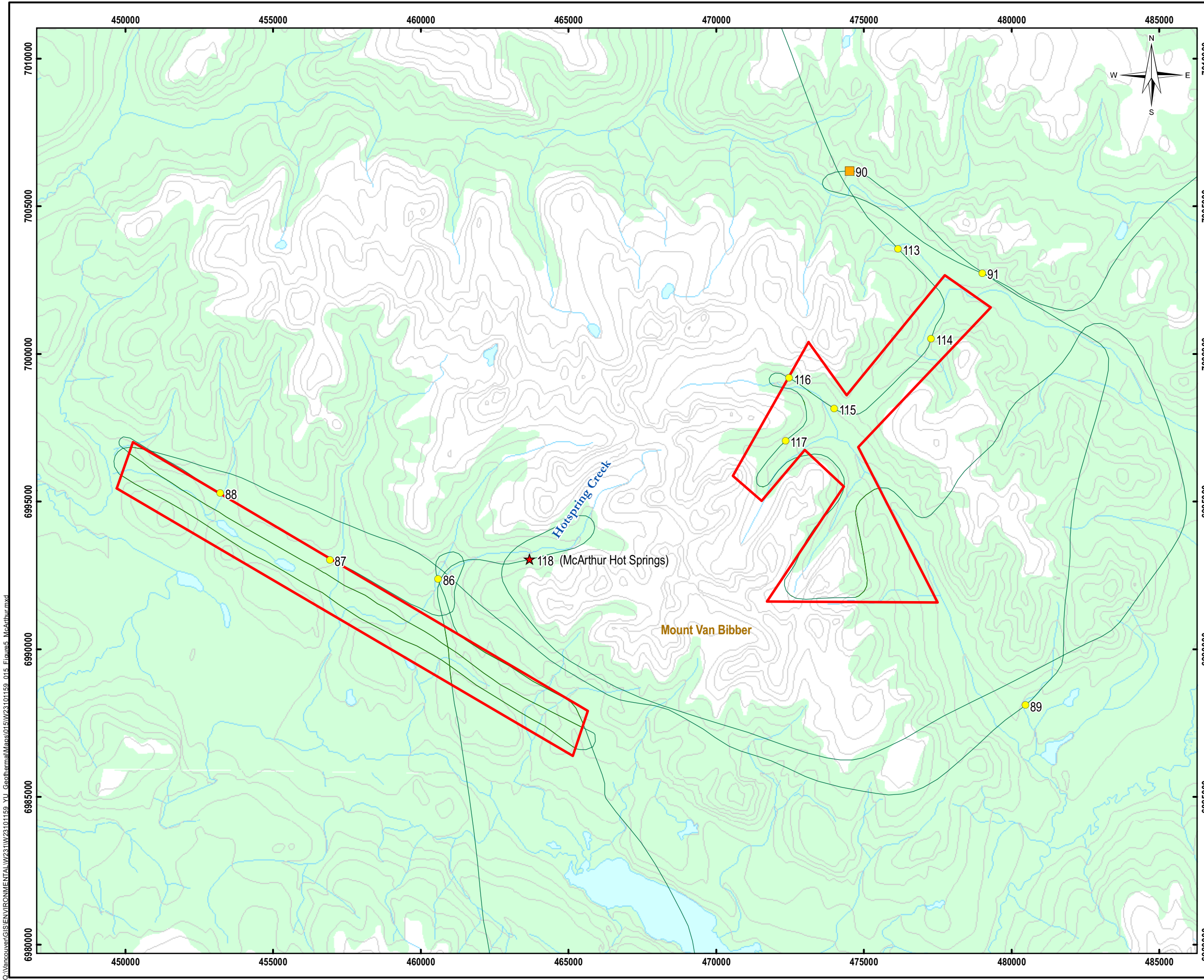
**2009 GEOTHERMAL ASSESSMENT PROGRAM**

**Nash Creek Hot Springs Area  
Open Water Survey**

PROJECTION UTM Zone 8	DATUM NAD83	
Scale: 1:125,000 		
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PROJECT NO. W23101159.015	DWN MEZ	CKD LM
OFFICE EBA-VANC	DATE October 5, 2009	REV 1

**Figure 4**

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**LEGEND**

★ High	— Contour (100m)
■ Moderate	- - - Trail
● Low	— Limited Use Road
— Flight Lines	— Road
□ Study Area Boundary	— Watercourse
	— Waterbody
	Wetland
	Vegetation

**Criteria for Priority Follow-up Evaluation:**

High	Round ponds with openings not associated with a water course
Moderate	Unusual stretch of open water
Low	Stretch of open water within a watercourse



**ISSUED FOR USE**

**NOTES**  
Base data source: NTDB 1:250K

**2009 GEOTHERMAL ASSESSMENT PROGRAM**

**McArthur Hot Springs Area  
Open Water Survey**

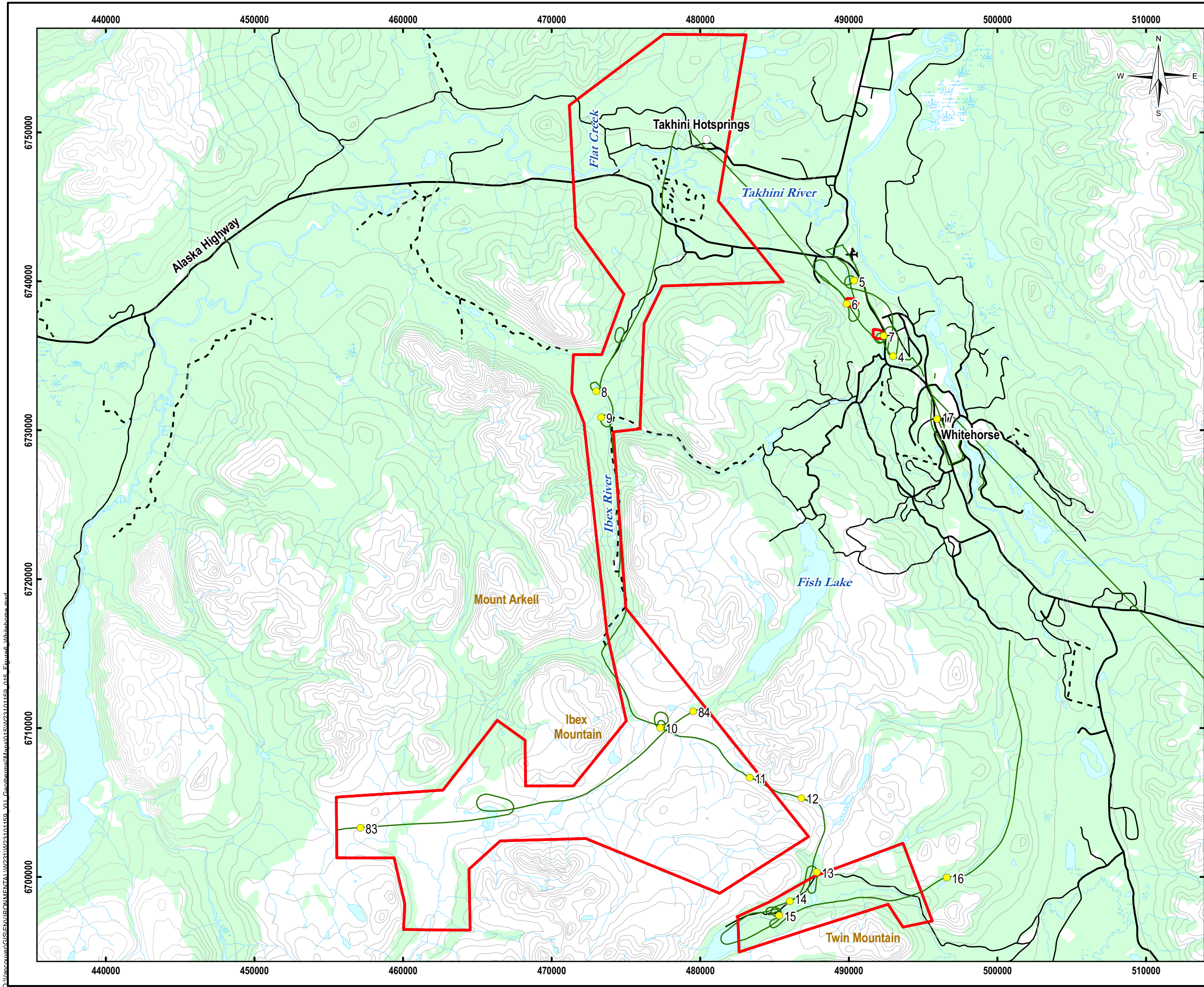
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PROJECT NO. W23101159.015	DWN MEZ
OFFICE EBA-VANC	CKD LM
DATE October 5, 2009	REV 1

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**Figure 5**

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**LEGEND**

**Probability of Thermal Influence**

- ★ High
- Moderate
- Low

**Study Area Boundary**

- ✈ Airstrip
- Contour (100m)
- - - Trail
- Limited Use Road
- Road
- Flight Lines
- Watercourse
- Waterbody
- Wetland
- Vegetation

**Criteria for Priority Follow-up Evaluation:**

High	Round ponds with openings not associated with a water course
Moderate	Unusual stretch of open water
Low	Stretch of open water within a watercourse



**ISSUED FOR USE**

**NOTES**  
Base data source: NTDB 1:250K

**2009 GEOTHERMAL ASSESSMENT PROGRAM**

**Takhini - Alligator Lake Area  
Open Water Survey**

PROJECTION UTM Zone 8	DATUM NAD83	
Scale: 1:250,000 		
FILE NO. W23101159_015_Figure2_Whitehorse.mxd		
PROJECT NO. W23101159.015	DWN MEZ	CKD LM
OFFICE EBA-VANC	DATE July 31, 2009	REV 0

**Figure 6**



**Photograph 1**  
March 17, 2009. Jarvis Warm Springs. Shakwak Study Area.



**Photograph 2**  
March 17, 2009. WP25. Open water section approximately 20 m in length. Shakwak Study Area.



**Photograph 3**

March 17, 2009. WP38. Openings on the shore of a small lake. It appeared that water was seeping from upslope. Shakwak Study Area.



**Photograph 4**

March 18, 2009. WP45. Opening in a tributary to the Dezadeash River. Shakwak Study Area.



**Photograph 5**

March 18, 2009. WP49, WP50, and WP51. Large open section of stream. Shakwak Study Area.



**Photograph 6**

March 19, 2009. WP58. Open water in a wetland and associated side channel. Shakwak Study Area.



**Photograph 7**

March 19, 2009. WP67. Circular opening within a creek. Creek had sections of open water both up and down stream of this site. Shakwak Study Area.



**Photograph 8**

March 23, 2009. WP77. Circular opening off of main stream channel. Stream channel also had sections of open water. Shakwak Study Area.



**Photograph 9**

March 25, 2009. WP105. Section of open water on perimeter of lava flow at Volcano Mountain site.  
Volcano Mountain Study Area.



**Photograph 10**

March 27, 2009. WP108. Some openings in creek and some sections that have re-frozen.  
Volcano Mountain Study Area.



**Photograph 11**

March 27, 2009. WP111. Open sections on a side channel of the Yukon River. Volcano Mountain Study Area.



**Photograph 12**

March 25, 2009. WP94. Open water near Nash Creek Hot Springs.



**Photograph 13**

March 27, 2009. WP118. McArthur Hot Springs. Large sections of open water and some vegetation was visible.



**Photograph 14**

March 27, 2009. WP118. McArthur Hot Springs.



**Photograph 15**

March 16, 2009. WP15. Small openings in streams and wetlands. Takhini - Alligator Lake area.

## APPENDIX A: FIELD DATA FOR OPEN WATER SURVEYS – SHAKWAK TRENCH

Waypoint	Priority	Open Water Type	Vegetation Cover	Vegetation Type	Date of Survey	Location (UTM)			Field Notes
						Zone	Northing	Easting	
Jarvis River Warm Springs	H	>1 pond	dense	mixed	17-Mar-09	8V	6755284	338335	Jarvis River Warm Springs
18	L	1 pond/stream	open	shrubs	17-Mar-09	8V	6749603	339669	Small oval openings ~2 m and a few openings in mountain stream, mostly open at the convergence of the two streams
20	L	stream	open	shrubs	17-Mar-09	8V	6750817	338767	~200 m of open channel
21	L	stream	sparse	mixed	17-Mar-09	8V	6751161	339555	Same stream as WP 20; flow seems to cause opening; several openings downstream
23	L	river	open	-	17-Mar-09	8V	6747766	335641	Openings in river valley; placer mining; more open downstream
24	L	river	dense	mixed	17-Mar-09	8V	6749891	332062	Jarvis River - high current
25	M	1 pond	sparse	conifer	17-Mar-09	8V	6751625	333554	Drop shape ~20 m long; 2 - 3 m wide; very dark in colour; photo
26	M	>1 pond	sparse	conifer	17-Mar-09	8V	6752052	331113	< 2 m in size; numerous ponds, no distinct channel; moose ~ 30 m away
27	L	stream	open	-	17-Mar-09	8V	6754525	327681	Small patch of open water in creek
28	L	river	open	-	17-Mar-09	8V	6760240	320385	Small opening in river; several other openings all the way down to the lake; also over flow downstream
29	L	stream	open	-	17-Mar-09	8V	6757135	325667	Small opening in creek
30	L	stream	open	-	17-Mar-09	8V	6754244	328411	Several openings in stream; more openings downstream
31	L	river	open	-	17-Mar-09	8V	6754998	330421	Openings in river valley; placer mining; more open downstream
32	L	stream	sparse	shrubs	17-Mar-09	8V	6762976	324794	Open pools within channel
33	L	stream	open	shrubs	17-Mar-09	8V	6759218	328228	Small openings in channel, only a few
34	L	stream	sparse	conifer/shrubs	17-Mar-09	8V	6760912	327533	Open section in channel; ~ 40 m long
35	L	stream	open	shrubs	17-Mar-09	8V	6754876	336176	Open pockets in channel
36	L	stream	open	mixed	17-Mar-09	8V	6762796	326983	Open pockets in stream over ~ 100 m section
37	M	stream	sparse	conifer	17-Mar-09	8V	6755367	337092	A lot of open pockets in river
38	M	1 pond	open	conifer	17-Mar-09	8V	6765222	327206	Large opening on lake (at least 20 x 50 m); looks like it seeps from hillside and then open channel near outlet and downstream
39	M	stream	open	-	17-Mar-09	8V	6767973	324930	Side channel of stream coming out of WP38 Lake is also open
40	M	< 1 pond	open	mixed	17-Mar-09	8V	6761867	332867	Opening at toe of slope; odd shapes
41	L	stream	open	shrubs	18-Mar-09	8V	6710956	383811	Open areas on creek
42	L	stream	open	shrubs	18-Mar-09	8V	6712585	382163	Open holes on creek
43	L	river	open	-	18-Mar-09	8V	6726001	365873	Several open circular areas along river
44	L	stream	sparse	conifer	18-Mar-09	8V	6730949	364294	Open hole ~ 20 m long
45	M	stream	dense	conifer	18-Mar-09	8V	6721966	372577	Tributary to Dezadeash Lake is open for the last >200 m; then creates an opening in lake
46	L	stream	open	-	18-Mar-09	8V	6735096	359906	Small size creek with several small open areas; confined mountain stream
47	L	stream	open	-	18-Mar-09	8V	6735385	360829	Small meandering creek with multiple openings; confined mountain stream
48	L	stream	open	conifer	18-Mar-09	8V	6722180	374434	Stream tributary to open lake
49	M	1 pond/stream	open	shrubs	18-Mar-09	8V	6710278	385293	Seepage system mostly open; meandering stream and 1 pond open in lake
50	M	stream	open/dense	mixed	18-Mar-09	8V	6714036	387723	Small (<1 m wide) creek open in several areas; drains into WP 49 (in lake)
51		same as WP50			18-Mar-09	8V	6712478	387628	
52	L	stream	dense	conifer	18-Mar-09	8V	6729211	382368	Some open areas in stream along ~ 150 m stretch
53	L	river	dense	conifer	18-Mar-09	8V	6735129	376131	Open main and side channel

## APPENDIX A: FIELD DATA FOR OPEN WATER SURVEYS – SHAKWAK TRENCH

Waypoint	Priority	Open Water Type	Vegetation Cover	Vegetation Type	Date of Survey	Location (UTM)			Field Notes
						Zone	Northing	Easting	
54	L	stream	open	shrubs	18-Mar-09	8V	6739755	371006	Small openings in main and side channel
55	L	stream	open	shrubs	18-Mar-09	8V	6740526	370210	1 bigger opening in river
56	L	stream	sparse	conifer	19-Mar-09	8V	6728442	380950	Open section in the creek; only ~10 m
57	L	river	open	-	19-Mar-09	8V	6730016	377869	Kathleen river, very large openings
58	M	1 pond/river	open	conifer	19-Mar-09	8V	6731821	376134	Lots of openings in wetland off side channel
59	M	1 pond	sparse	conifer	19-Mar-09	8V	6738108	369205	Small openings in trees associated with small stream (~ 1 m diameter), abnormal shape, long pond.
60	L	1 pond	open	-	19-Mar-09	8V	6743538	363472	Outlet of Pine Lake has open water on downstream end of culvert - manmade
61	L	river	open	mixed	19-Mar-09	8V	6737524	368558	Lots of large openings in Dezadeash River over large section of river
62	L	1 pond	open	mixed	19-Mar-09	8V	6737346	366245	Small pond on side channel open 1 m x 2 - 4 m long
63	L	stream	open	shrubs	19-Mar-09	8V	6724666	378056	Open section at outlet into Rainbow Lake
64	L	stream	sparse	conifer	19-Mar-09	8V	6760254	352209	Narrow opening for ~ 20 m of the creek
65	L	stream	sparse	conifer	19-Mar-09	8V	6759283	351450	Narrow openings on creek (max 30 m long section)
66	L	stream	sparse	mixed	19-Mar-09	8V	6747867	362109	Narrow opening along stream for ~ 80 m
67	M	1 pond with/in stream	open	conifer	19-Mar-09	8V	6771073	322330	~5 m diameter circular pond; creek that flows into and out of pond also has open water
68	L	stream	open	conifer	23-Mar-09	8V	6753461	347696	Narrow channel open; ~ 100 m section open in patches
69	L	stream	open	-	23-Mar-09	8V	6755985	345484	Narrow web of channel open in some areas; looked like seepage
70	L	stream	sparse	conifer	23-Mar-09	8V	6749221	351919	Open channel in gully over large section of the stream (~1-2km)
71	L	stream	sparse	conifer	23-Mar-09	8V	6756412	346537	Open channel in sections along stream; related to WP 69
72	L	river	open	conifer	23-Mar-09	8V	6757847	344466	Outflow into lake is open
73	L	stream	open	mixed	23-Mar-09	8V	6746317	354250	Openings in stream
74	L	stream	open	mixed	23-Mar-09	8V	6742491	349176	Some sections of channel open ~100m (likely from current); numerous openings along Bear Creek all the way down to the flood plain; some open meanders in Kaskawulsh flood plain
76	L	stream	open	mixed	23-Mar-09	8V	6742195	354042	Narrow openings in channel
77	M	1 pond/stream	dense	mixed	23-Mar-09	8V	6740423	353884	Not connected to any streams, pool created at start of meander going downhill, mostly open water
78	M	stream	open	mixed	23-Mar-09	8V	6739697	353268	Small round openings off main channel; main channel is also open
79	L	stream	open	conifer	23-Mar-09	8V	6736251	357880	Small stream partially open
80	L	1 pond/stream	sparse	mixed	23-Mar-09	8V	6736708	361081	1 round ponds and open patches of stream
81	L	river	open	-	23-Mar-09	8V	6737122	361555	Multiple openings on the river, up to 15 m long
82	L	stream	dense	conifer	23-Mar-09	8V	6724495	375636	Meandering opening of stream/lake junction

## APPENDIX A: FIELD DATA FOR OPEN WATER SURVEYS – VOLCANO MOUNTAIN

Waypoint	Priority	Open Water Type	Vegetation Cover	Vegetation Type	Date of Survey	Location			Field Notes
						Zone (UTM)	Northing	Easting	
105	M	stream	sparse	conifer	25-Mar-09	8V	6982938	379914	Open section of stream within 200 m section along side of lava flow; lots of mineralization (rusty orange/yellow); some frozen over but a lot open
106	L	river	dense	conifer	25-Mar-09	8V	6973042	378177	Overflow
107	L	stream	sparse	conifer	27-Mar-09	8V	6950997	371241	No open water but a lot of overflow several km along creek and mineralization
108	M	stream	sparse	conifer	27-Mar-09	8V	6950408	367453	2 -3 openings on stream ~ 3km
109	L	stream	sparse	conifer	27-Mar-09	8V	6944783	375138	A lot of over flow and mineralization; no visible open water - similar to the creek by the lava flow.
110	L	stream	sparse	conifer	27-Mar-09	8V	6953076	376048	Downstream of WP107 (same creek) - lots of overflow but no open water - looks interesting
111	L	river	-	conifer	27-Mar-09	8V	6958117	381830	Note - lots of open patches in Yukon River between lower 2 blocks
112	M	river	open	conifer	27-Mar-09	8V	6959809	383443	Very open section - could see gravel - potentially warm

## APPENDIX A: FIELD DATA FOR OPEN WATER SURVEYS – TAKHINI-ALLIGATOR LAKE AREA

Waypoint	Priority	Open Water Type	Vegetation Cover	Vegetation Type	Date of Survey	Location			Field Notes
						Zone (UTM)	Northing	Easting	
17	L	stream	sparse	conifer	17-Mar-09	8V	6730769	495937	Meandering, seems to be hydrologic effect.
83	L	stream	open	shrubs	23-Mar-09	8V	6703308	457124	Open stream channel
84	L	stream	open	shrubs	23-Mar-09	8V	6711121	479526	Large section of creek open
004	L	1 pond	open	-	16-Mar-09	8V	6734985	492983	Stream flowing out of pond
005	L	1 pond	open	-	16-Mar-09	8V	6740054	490357	Open linear stream in pond
006	L	1 pond	open	-	16-Mar-09	8V	6738519	489861	Channel open within a pond
007	L	stream	dense	-	16-Mar-09	8V	6736341	492350	Stream open along Alaska Highway
008	L	river	sparse	conifer	16-Mar-09	8V	6732640	473005	Ibex River - open patches for at least 1 km
009	L	1 pond	open	-	16-Mar-09	8V	6730887	473341	Stream channel ending in a wetland
010	L	1 pond	open	-	16-Mar-09	8V	6710033	477321	Small open patch, < 2 m long, 1 m wide, not steaming
011	L	stream	open	-	16-Mar-09	8V	6706683	483327	Flat area is open for 20 m or so with a few smaller openings and then stream opens up, long stretches of open water
012	L	stream	open	-	16-Mar-09	8V	6705302	486817	Same as WP012
013	L	stream	sparse	shrubs	16-Mar-09	8V	6700330	487847	Open section of stream < 50 m in length
014	L	stream	open	-	16-Mar-09	8V	6698376	486038	Open channel in beaver pond/wetland area
015	L	1 pond and stream	open	-	16-Mar-09	8V	6697418	485318	Opening within pond, slightly beside channel
016	L	1 pond	open	-	16-Mar-09	8V	6699973	496592	Small open patch, likely just outflow from lake.

APPENDIX A: FIELD DATA FOR OPEN WATER SURVEYS – NASH CREEK HOT SPRINGS AREA									
Waypoint	Priority	Open Water Type	Vegetation Cover	Vegetation Type	Date of Survey	Location (UTM)			Field Notes
						Zone	Northing	Easting	
92	M	stream	open	-	25-Mar-09	8V	7152796	514444	2 open areas in main channel
93	H	stream	open	mixed	25-Mar-09	8V	7155014	509984	Main channel of Nash creek open in several areas for at least 1 km; likely more; open in several other areas (i.e. side channels); looks like there are a few springs coming to the surface in this area (~ 3)
94	H	river	sparse	mixed	25-Mar-09	8V	7158677	515557	Side channel and small pools all open
95	L	river	open	mixed	25-Mar-09	8V	7158097	505219	Side of main channel open
96	M	river	open	mixed	25-Mar-09	8V	7157456	507371	~ 100 m of open water in main channel open
97	H	river	open	mixed	25-Mar-09	8V	7157224	508585	~ 150 m of open water with a lot of algae growing
98	M	stream	open	mixed	25-Mar-09	8V	7160278	505986	~ 50 m of open channels in 2 different areas; also upstream
99	L	stream	open	mixed	25-Mar-09	8V	7162456	500619	Small narrow creek open
100	M	stream	open	mixed	25-Mar-09	8V	7163667	498811	The whole creek is open - could not fly up valley to further investigate due to low clouds; potential for thermal activity - should check out when back in the area
102	H	stream	open	mixed	25-Mar-09	8V	7157660	512342	Side channels open for large sections
Nash Creek Hot Springs	H	Stream	Open	Mixed	25-Mar-09	8V	7158466	513948	Nash Creek Hot Springs

APPENDIX A: FIELD DATA FOR OPEN WATER SURVEYS – MCARTHUR HOT SPRINGS AREA									
Waypoint	Priority	Open Water Type	Vegetation Cover	Vegetation Type	Date of Survey	Location (UTM)			Comments
						Zone	Northing	Easting	
86	L	stream	dense	conifer	25-Mar-09	8V	6992378	476158	Open stream channel - most of it open (Hot Springs Creek)
87	L	stream	dense	conifer	25-Mar-09	8V	6993025	477283	~2 m opening in creek
88	L	stream	dense	conifer	25-Mar-09	8V	6995291	473998	Open creek for ~ 200 m, almost continuously open
89	L	stream	dense	conifer	25-Mar-09	8V	6988105	472478	Open sections on the creek
90	M	stream	open	mixed	25-Mar-09	8V	7006206	472352	Creek in valley bottom mostly open for 1 - 2 km
91	L	stream	open	conifer	25-Mar-09	8V	7002735	463683	Inlet and outlet of lake are both open
113	L	stream	sparse	conifer	27-Mar-09	8V	7003558	476158	Open stream channel to the south of WP113
114	L	stream	dense	conifer	27-Mar-09	8V	7000513	477283	Open channel up a large portion of this valley
115	L	stream	sparse	conifer	27-Mar-09	8V	6998148	473998	Open stream channel in sections
116	L	stream	sparse	conifer	27-Mar-09	8V	6999187	472478	Open stream channel in sections
117	L	stream	sparse	conifer	27-Mar-09	8V	6997057	472352	Open stream channel in sections; stream is completely frozen upstream
118	H	stream	sparse	conifer	27-Mar-09	8V	6993041	463683	McArthur Springs - open channel all around the springs and all downstream; some algae;