Water Quality Objective Monitoring, Klondike River Watershed, 2009

Hydrologic and Geomorphic Characteristics of the Klondike River Drainage Basin

The Klondike River, a major tributary to the Yukon River, drains an area of approximately 7800 square kilometers and has an overall channel length, including the North Klondike River, of approximately 160 Km.

The North Klondike River, a tributary of the Klondike River, drains an area of approximately 1100 square kilometers. From its headwaters in the Ogilvie Mountains, the North Klondike flows in a southerly direction for approximately 75 kilometers until its confluence with the Klondike. It then flows west, down the valley as the Klondike for approximately 42 kilometers until it joins the Yukon River near Dawson.

The North Klondike, for its first 58 kilometers, flows through a narrow valley entrenched between high mountains, the remaining length of the Klondike River flows south through relatively flat topography. The banks of the river are stable with relatively little erosion except during flood periods.

Water Survey of Canada's gauging stations are located near the mouth of the north Klondike (09EA004, Km 9.5 Dempster Highway), and at the mouth of the Klondike River (09EA003) near Dawson.

North Klondike

Topographical drainage Basin	1100 Sq. Kilometers
Area of Lakes	<2%
Area of Forest	<44%
Channel Length	76.5 Kilometers
Terrain	glaciated

Klondike

Topographical drainage Basin	7800 Sq. Kilometers
Area of Lakes	<1%
Area of Forest	<30%
Channel Length	160 Kilometers
Terrain	Left Limit: non-glaciated Right Limit: glaciated

In 2009, water samples were collected at 15 different sites in the Klondike River basin. Sampling commenced on May 20th, 2009 and a total of 469 samples were collected up until the end of the season on September 18th, 2009. A combination of automatic composite sampling and grab sampling methods were used in the basin. An additional 76 samples were collected by E.M.R staff during routine mine inspections.

Atmospheric data was collected using two portable weather stations, one located near the mouth of Bonanza Creek, the other at the Solomon Dome lookout. Additional information was

provided through the Yukon Government Community Services weather station at the Klondike Fire Center, located at the Dawson City Airport.

Basin total flow data was provided to us by the Water Survey of Canada station located near the mouth of the Klondike River. Flow data for the individual tributaries to the Klondike River was collected at the time of sampling by the staff of E.M.R CS&I using the methodology outlined in the Yukon Placer Secretariats, Water Quality Monitoring Protocol.

Site Codes and Global Position of Water Quality Sampling Locations in the Klondike River Watershed

SITE CODE	LOCATION	LAT_Y	LONG_X
K 01	Klondike River at mouth	64.05348	-139.43961
K 02	Klondike River at bridge u/s of Bonanza Creek	64.08163	-139.40922
K 03	Klondike River at Marcel's Sauna	64.04693	-139.12772
K 04	Klondike River u/s of Hunker Creek	64.05810	-139.03092
K 05	Klondike River at Dempster hwy	63.99030	-138.74612
K 06	Klondike River d/s of Too Much Gold Creek bridge	63.95778	-138.69030
K 07	Klondike River u/s of Too Much Gold Creek	63.95131	-138.66690
K 08	Klondike River at highway washout d/s of Flat Creek	63.95782	-138.69005
K ADAM 01	Adams Gulch Creek mouth	63.93412	-139.33099
K ALLG 01	All Gold Creek Below All Mining (BAM)	63.94263	-138.61734
K ELDO 01	Eldorado Creek mouth	63.91909	-139.31386
K ELDO 01A	Eldorado Creek Left Fork	63.86261	-139.24573
K ELDO 01B	Eldorado Creek Right Fork	63.86261	-139.24573
K ELDO 02	Eldorado Creek d/s of French Gulch	63.91267	-139.31483
K ELDO 03	Eldorado Creek u/s of French Creek	63.90855	-139.31382
K ELDO 04	Upper Eldorado Creek background	63.86187	-139.24578
K FLAT 01	Flat Creek Below All Mining (BAM)	64.02940	-139.17860
K FREN 01	French Gulch mouth	63.90865	-139.31442
K GOLDB 01	Gold bottom Creek mouth	63.96247	-138.96675
K LAST 01	Last Chance Creek mouth	64.01028	-139.09018
K TOO 01	Too Much Gold Creek mouth	63.95132	-138.66708
K VICT 01	Victoria Creek mouth	63.91262	-139.20933
KB 01	Bonanza Creek Below All Mining (BAM)	64.04054	-139.40814
KB 02	Lower Bonanza Creek	64.01295	-139.37022
KB 03	Lower Bonanza Creek d/s of bridge	63.97027	-139.35472
KB 04	Bonanza Creek d/s of Adams Gulch	63.93550	-139.32798
KB 05	Bonanza Creek u/s of Adams Gulch	63.93415	-139.32977
KB 07	Bonanza Creek d/s of Eldorado Creek	63.92047	-139.31600
KB 08	Upper Bonanza Creek u/s of Eldorado Creek	63.91963	-139.31329
KB 09	Upper Bonanza Creek u/s of Victoria Creek	63.91282	-139.20921
KH 01	Hunker Creek Below All Mining (BAM)	64.02943	-139.17859
KH 02	Hunker Creek d/s of Henry Gulch	64.02838	-139.17522
KH 04	Hunker Creek d/s of Last Chance Creek	64.01103	-139.08967
KH 05	Hunker Creek u/s of Last Chance Creek	64.01015	-139.09148
KH 06	Hunker Creek d/s of Gold bottom Creek	63.96833	-138.97324
KH 08	Hunker Creek u/s of Gold bottom Creek	63.96833	-138.97324
KH 09	Hunker Creek Above All Mining (AAM) left fork	63.91105	-138.88522
KH 10	Hunker Creek Above All Mining (AAM) right fork	63.89025	-138.92522
KH 11	Hunker Creek Above All Mining (AAM), d/s of forks	63.91319	-138.88727

Water Quality Objective monitoring, Klondike River Watershed – Summary

The degree of disturbance of all mined tributaries is recognized by the Previous Development designation. The development of Hunker and Bonanza Creeks is considered to be "Extensive" and appropriate discharge and downstream water quality standards apply. The Water Quality Objectives and related discharge standards that are set are designed to mitigate the potentially negative downstream effects of placer mining. In the case of both Hunker and Bonanza creeks, the effect of these slightly less stringent discharge standards and reduced water quality objectives is decreased naturally by the geographical positioning of these creeks and the nature of the receiving waters they discharge into, in this case the Klondike River, a 5th order stream. The Klondike's high volume, near clear water flow, has a huge dilution and carrying capacity and is capable of easily dispersing the relatively low flow of turbid water from both creeks. In addition, the confluence of both creeks with the Klondike River is but a short distance upstream from the confluence of the Klondike River with the Yukon River, a highly turbid category 8 stream.

Because of extensive monitoring activities conducted in this watershed between 2004 and 2008 which provided vast amounts of data for comparative purposes, and due to a large number of both active and historic mines in the drainage area, the Klondike River Watershed was once again designated a '*major'* watershed for monitoring in 2009.

Four automatic water sampling stations were set up and maintained from June 10th, 2009 until shutdown on September 15th, 2009 as well as two portable weather monitoring stations. Water sampling sites in the Klondike received multiple visits during the monitoring season due to their close proximity to Dawson and their location along the access route to the Indian River Watershed.

From the data obtained by these instruments and through on site visits and sampling conducted by CS&I staff, the following observations regarding the water quality in the basin can be made:

> On average, the water quality in the basin, met the minimum objectives set under the *Fish Habitat Management System* throughout the monitoring season. On those occasions when the WQO were not met and the Total Suspended Solids levels were greater than the objectives, a direct correlation between environmental conditions and the volume of solids in the water was observed.
>
> In most cases, rain fall, either as localised events or basin wide occurrences, increased the amount of surface run off and subsequent soil erosion from the land, increasing the input of sediment into the receiving waters. These increases occurred simultaneously at the time of the rain event or immediately in a period of one or two days after the rain event, as surface water continued draining from the land and ground water infiltrated the water course.
>
> Increases in sediment laden ground and surface water entering the system add to the amount of sediment in the water. The ability of the receiving water to dilute these inputs of sediment is negated by the re-suspension of stream bed material and by the further erosion of the streams banks that occurs along with the increased flows that are generated by the aftermath of these rain events.

All of these factors; precipitation leading to increased sediment input and increased flows from these rain events re-suspending and further eroding material, lead to an increase in suspended solids concentrations and a decrease in water quality.

The Fish Habitat Management System - Klondike River Watershed (Category A)
Sample Results that Exceed Water Quality Objectives for 2009

Sampling Station	K 01	KB 01	K 02	KH 01	K 03	K 04	K 05	K 06	K FLAT 01	Other
Location Description	Mouth	BAM	u/s KB 01	BAM	at Marcel Sauna	u/s KH 01	at demptser hwy	u/s dempster hwy	Mouth	
Sample Type	Grab	Auto/Grab	Auto/Grab	Auto/Grab	Auto/Grab	Grab	Grab	Grab	Grab	
Lat Y	64.05348	64.04054	64.04237	64.02943	64.04693	64.05810	63.99030	63.95778	63.94316	
Long X	-139.43961	-139.40814	-139.40956	-139.17859	-139.12772	-139.03092	-138.74612	-138.69030	-138.60188	
Habitat Classification	Area of special consideration	Moderate-L	Area of special consideration	Moderate-L	High	High	High	High	Moderate-L	
Water Quality Objective (mg/L)	**25**	**300**	**25**	**300**	**25**	**25**	**25**	**25**	**80**	
Date of Sampling										
05/07/09				**1447.4**						
05/14/09				**594.1**						
06/12/09		**6.0**	**4.4**	**13.7**	**33.0**					
06/13/09		**39.8**	**84.8**	**296.0**	**22.8**					
06/14/09			**68.4**	**757.7**	**16.4**					
06/15/09			**53.9**	**823.0**	**6.8**					
06/20/09		**256.6**	**7.3**	**352.6**	**4.3**					
06/21/09		**364.9**	**7.6**	**304.4**	**5.0**					
08/30/09		**109.5**	**4.4**	**369.0**	**6.4**					
09/18/09		**333.7**	**66.7**	**344.8**	**381.0**					
Total Seasonal Average TSS (mg/L) by site		**22.2**	**6.1**	**35.1**	**7.1**		**3.8**			
Number of days sampled		**99**	**96**	**100**	**97**		**3**			

Legend **Not continuously monitored**

Water Samples that are: Above / Below the Water Quality Objective