

Water Quality Objective Monitoring, Klondike River Basin, 2012

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 2012, water samples were collected at 27 sites in the Klondike River basin. Sampling commenced on May 15, 2012 and 604 samples were collected up until the end of the season on September 8, 2012. A combination of automatic composite sampling and grab sampling methods were used in the basin.

Atmospheric data were collected using two portable weather stations, one located at a site on the Klondike River just upstream of Bonanza Creek, the other at the North Klondike Fork. Additional information was provided through the Yukon Government Community Services weather station at the Klondike Fire Center, located at the Dawson City Airport.

Blitz sampling events took place in the Klondike River basin on May 15, 16 and 17, June 5, 6 and 7, June 28 and 29, July 23 and 24, August 14 and 15 and September 21 and 22, 2012.

Basin total flow data were provided 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 were collected at the time of sampling by the Compliance Monitoring and Inspections Branch (CMI) using the methodology outlined in the Yukon Placer Secretariat's Water Quality Objectives Monitoring Protocol.

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

SITE_DESCRIPTION	SITE_CODE	LATITUDE_DD	LONGITUDE_DD
Klondike River mouth	KL01	64.05348	-139.43961
Klondike River upstream of Bonanza Creek	KL02	64.04311	-139.40936
Klondike River upstream of Hunker Creek	KL03	64.03619	-139.20204
Klondike River downstream of Goring Creek and upstream of Hunker Creek	KL04	64.05810	-139.03092
Klondike River at Dempster Highway	KL05	63.99030	-138.74612
Klondike River downstream of Too Much Gold Creek and upstream of Dempster highway	KL06	63.95778	-138.69030
Klondike River upstream of Too Much Gold Creek	KL07	63.95131	-138.66690
Klondike River at highway washout downstream of Flat Creek	KL08	63.95782	-138.69005
North Klondike River upstream of confluence with Klondike River	KL_NK01	64.00195	-138.59622
Adams Creek mouth	KL_BO_AD01	63.93412	-139.33099
All Gold Creek below all mining	KL_AL01	63.94263	-138.61734
Eldorado Creek mouth	KL_BO_EL01	63.91943	-139.31390
Eldorado Creek Left Fork	KL_BO_EL06	63.86261	-139.24573
Eldorado Creek Right Fork	KL_BO_EL05	63.86261	-139.24573
Eldorado Creek downstream of French Gulch	KL_BO_EL02	63.91267	-139.31483
Eldorado Creek upstream of French Creek	KL_BO_EL03	63.90855	-139.31382
Upper Eldorado Creek background	KL_BO_EL04	63.86187	-139.24578
Flat Creek below all mining	KL_FL01	63.94308	-138.60225
French Gulch mouth	KL_BO_EL_FR01	63.90865	-139.31442
Goldbottom Creek mouth	KL_HU_GO01	63.96433	-138.96706
Last Chance Creek mouth	KL_HU_LA01	64.01050	-139.09091
Too Much Gold Creek mouth	KL_TO01	63.95132	-138.66708
Victoria Gulch mouth	KL_BO_VI01	63.91261	-139.20930
Bonanza Creek below all mining	KL_BO01	64.04054	-139.40814
Lower Bonanza Creek	KL_BO02	64.01295	-139.37022
Lower Bonanza Creek downstream of bridge	KL_BO03	63.97027	-139.35472
Bonanza Creek downstream of Adams Gulch	KL_BO04	63.93550	-139.32798
Bonanza Creek upstream of Adams Gulch	KL_BO05	63.93415	-139.32977
Bonanza Creek downstream of Eldorado Creek	KL_BO06	63.92047	-139.31600
Upper Bonanza Creek upstream of Eldorado Creek	KL_BO07	63.91943	-139.31390
Upper Bonanza Creek upstream of Victoria Gulch	KL_BO08	63.91261	-139.20930
Hunker Creek below all mining	KL_HU01	64.02943	-139.17867
Hunker Creek mouth - most upstream fork	KL_HU01C	64.03619	-139.20204
Hunker Creek mouth fork with multiple channels - larger creek bed	KL_HU01B	64.03592	-139.20201
Hunker Creek mouth behind Fischer's gas station	KL_HU01A	64.03382	-139.20634
Hunker Creek downstream of Henry Gulch	KL_HU02	64.02838	-139.17522
Hunker Creek downstream of Last Chance Creek	KL_HU03	64.01345	-139.09187
Hunker Creek upstream of Last Chance Creek	KL_HU04	64.01050	-139.09091
Hunker Creek downstream of Goldbottom Creek	KL_HU05	63.96918	-138.98291
Hunker Creek upstream of Goldbottom Creek	KL_HU06	64.96433	-138.96706
Hunker Creek above all mining left fork	KL_HU07	63.91105	-138.88522
Hunker Creek right fork	KL_HU08	63.89025	-138.92522
Hunker Creek above all mining and downstream of right and left fork	KL_HU09	63.91503	-138.88501

Water Quality Objective monitoring, Klondike River Watershed – Summary

Because of extensive monitoring activities conducted in this watershed between 2004 and 2011, 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 2012.

Four automatic water-sampling stations and two portable weather-, 2012. Water sampling sites in the Klondike received multiple visits during the monitoring season monitoring stations were set up and maintained from May 15, 2012 until shutdown on September 8 owing to their close proximity to Dawson.

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

On average, at the five Klondike River sites monitored during the 2012 season, the water quality of the Klondike River met the minimum objectives set under the Fish Habitat Management System for Yukon Placer Mining. On those occasions when the WQO were not met and the Total Suspended Solids (TSS) 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, rainfall, as either 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 watercourse.

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 streambed 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 in 2012 when compared with the results from 2011 and a decrease in overall water quality. The seasonal average TSS for 2012 was 27.8 mg/L, which is approximately 15 mg/L higher than in 2011 at 12.7 mg/L.

This is a direct result of increased surface water runoff and increased ground water infiltration, which can be attributed to above average seasonal rainfall and higher than average seasonal air temperatures, resulting in more saturated ground, warmer ground temperatures and a greater degradation of the permafrost, as well as higher discharge flows from disturbed and previously developed areas.

It is important to note that the average water quality of the Klondike River at site KL03, which is up stream of the major discharge of Hunker and Bonanza Creeks, both areas of significant previous development, was 15.2 mg/L, 9.8 mg/L lower than the water quality objective of 25 mg/L. This means that the drainage area downstream of KL03 had a significant effect on the contribution of solids to the watercourse and an increase in the downstream concentration vs. flow gradient.

The Fish Habitat Management System - Klondike River Watershed (Category A)
Sample Results that Exceed Water Quality Objectives for 2012

Sampling Station	KL01	KL_BO01	KL02	KL_HU01A	KL_HU01	KL03	KL05	KL06	KL_NK01	KL_FL01
Location Description	Mouth	BAM	u/s KL_BO01	Mouth	BAM	u/s KL_HU01	at dempster hwy	u/s dempster hwy	u/s of Klondike R	Mouth
Sample Type	Grab	Auto/Grab	Grab	Auto/Grab	Auto/Grab	Grab	Grab	Grab	Auto/Grab	Grab
Lat Y	64.05348	64.04054	64.04237	64.03382	64.02943	64.03529	63.99030	63.95778	64.00195	63.94316
Long X	-139.43961	-139.40814	-139.40956	-139.20634	-139.17867	-139.20909	-138.74612	-138.69030	-138.59622	-138.60188
Habitat Classification	Area of special consideration	Moderate-L	Area of special consideration	Moderate-L	Moderate-L	High	High	High	High	Moderate-L
Water Quality Objective (mg/L)	25	80	25	80	80	25	25	25	25	80
Date of Sampling										
16-May-12		49.0		26.0	269.0				25.0	
21-May-12		134.0		30.0					14.0	
5-Jun-12	74.0	135.0	84.0	13.0		61.0	10.0		8.0	12.0
6-Jun-12	150.0	75.0	148.0	26.0	72.0				70.0	
7-Jun-12		37.0	144.0	21.0	48.0					
8-Jun-12		55.0	140.0	45.0					425.0	
9-Jun-12		13.0	161.0	21.0					509.0	
10-Jun-12		11.0	133.0	37.0					378.0	
11-Jun-12		8.0	65.0						326.0	
12-Jun-12		13.0	64.0						207.0	
13-Jun-12		22.0	46.0						123.0	
14-Jun-12		155.0	47.0						68.0	
15-Jun-12		28.0	35.0						40.0	
16-Jun-12		10.0	41.0						24.0	
17-Jun-12		14.0	32.0						22.0	
18-Jun-12		11.0	29.0						21.0	
19-Jun-12		10.0	26.0						25.0	
22-Jun-12		15.0	20.0						27.0	
11-Jul-12		1212.0	14.0	144.0					28.0	
12-Jul-12		417.0	57.0	177.0					15.0	
13-Jul-12		62.0	30.0	26.0					12.0	
Total Seasonal Average TSS (mg/L) by site	27.8	35.7	17.4	18.8	85.5	15.2	5.4	NA	26.8	11.7
Number of days sampled	10	123	102	104	6	6	6	0	115	6
Legend	<p align="center">Not continuously monitored</p> <p align="center">Water Samples that are: Above / Below the Water Quality Objective</p>									