Water Quality Objective Monitoring, Stewart River Watershed, 2010

Hydrologic Characteristics of the Stewart River Drainage Basin

The Stewart River, a major tributary to the Yukon River, drains an area of approximately 51,000 square kilometres and has an overall channel length of approximately 533 km. The Stewart River is one of the principal tributaries of the Yukon River, flowing more than 480 kilometres from its headwaters in the Mackenzie Mountains and joining the Yukon River 112 kilometres above Dawson City. The river is navigable for most of its length and is a transportation route for lead ore from its upper reaches. It was explored (1850) by Robert Campbell of the Hudson's Bay Company

In 2010, water samples were collected at 14 different sites in the Stewart River basin. In the past, sites on the Stewart River were accessed primarily by air as most of the WQO sites are inaccessible by road. In 2010 a new approach, with mixed results, was tried in order to reduce the high cost of air transportation. Four separate boat trips were conducted along the main stem of the Stewart River on June 16th, July 13th, August 10th and August 30th. A total of 58 water samples and 7 flow measurements were collected. This is substantially down from the 2009 total of 238 samples collected when automated sampling equipment was deployed utilizing air access to the sites. Although using boats to gain access to sites along the river is slightly more cost effective than by air, difficulties arise in gaining clear access to some of the more obstructed tributaries when water levels were low, especially in June and July. Crews could not navigate into and up certain tributaries by boat and ground access to virgin tributary water is, in some cases, impossible due to poor boat landing sites, swamps and heavy vegetation. These accessibility problems are avoided when traveling by helicopter. Nonetheless, in the future, a boat will be utilized for accessible WQO sites allowing for the deployment and retrieval of automated water sampling equipment and weather monitoring stations. This will increase the data collection efforts in the watershed while reducing the costs associated with air travel.

No portable weather stations were deployed in the basin this monitoring season and only site specific measurements of temperature / weather observations were made during each boat trip.

Basin total flow data was provided by the Water Survey of Canada station located near the mouth of the Stewart River. Flow data for the individual tributaries to the Stewart River was collected any time it was possible using the methodology outlined in the Yukon Placer Secretariat's Water Quality Monitoring Protocol.

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

Site Code	Alias	Site Description	Latitude	Longitude
ST01	ST 01	Stewart River mouth	63.29113	-139.41042
ST02	ST 02	Stewart River upstream of Henderson Creek	63.35333	-139.46181
ST03	ST 03	Stewart River upstream of Barker Creek	63.18350	-138.90445
ST04	ST 04	Stewart River upstream of Scroggie Creek	63.19949	-138.85118
ST05	ST 05	Stewart River upstream of Maisy May Creek	63.23539	-138.81273
ST06		Stewart River upstream Black Hills Creek	63.25479	138.68283
ST07	ST 06	Stewart River upstream of Clear Creek	63.61183	-137.63992
ST08	ST 07	Stewart River above all mining	63.45445	136.94208
ST_BA01	ST BAR 01	Barker Creek below all mining	63.17785	-138.89928
ST_BL01	ST BLAC 01	Black Hills Creek below all mining	63.32137	-138.76973
ST_CL01	ST CLEA 01	Clear Creek mouth	63.61630	-137.64114
ST_CL02	ST CLEA 02	Clear Creek upstream highway bridge	63.62825	-137.60947
ST_MA01	ST MAIS 01	Maisy May Creek mouth	63.25449	-138.84766
ST_SC01	ST SCR 01	Scroggie Creek mouth	63.18696	-138.83366

Water Quality Objective monitoring, Stewart River Watershed – Summary

From the data obtained through on-site visits and sampling conducted by employees of the Department of Energy, Mines and Resource's Client Services and Inspections Branch, the following observations regarding the water quality in the basin can be made:

> The water quality in the basin, above Scurvy Creek, met the minimum objectives set under the *Fish Habitat Management System* during the majority of the monitoring season. On those occasions when the WQO were not met and the Total Suspended Solids levels were greater than the objectives, there is a direct correlation to geological / environmental conditions influencing the amount of solids concentrations in the water.
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> The water quality in the basin, below Scurvy Creek, did not meet the minimum objectives set under the *Fish Habitat Management System* when monitored during the season. On those occasions, Total Suspended Solids levels were greater than the objectives and again there is a direct correlation to geological / environmental conditions influencing the amount of solids concentrations in the water. Very fine, easily suspended, but hard to settle material is entering the system through the discharge of both Barker and Scurvy Creeks. Freshly exposed, previously undisturbed areas on both creeks are being eroded by rainfall and through permafrost degradation, a direct result of mining ground preparation. Ground cover has been removed and this stripped land is now more exposed and vulnerable to the elements.
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> In most cases, rain fall, either as localized events or basin wide occurrences will increase the amount of surface run off and subsequent soil erosion from the land, increasing the input of sediment into the receiving waters. These increases occur either 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.
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> 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.

In addition to environmental factors influencing the water quality in the drainage (i.e. rapidly decreasing mean water levels, high volume, short and long term rain events, high mean daily temperatures further degrading permafrost effecting ground water penetration and releasing additional sediment into receiving waters), placer mining operations on Scurvy, Barker, and Black Hills Creek had an influence on the water quality of the Stewart River.

The Placer deposits in these areas contain disproportionate fractions of extremely fine grained, colloidal material that is very hard to settle and is easily put into suspension. This sediment consists mostly of non-aggregated clays and organic material that when analysed produces extremely low levels of settleable solids versus abnormally high levels of suspended solids. Generally Placer sediments found in and around the Klondike area produce levels of Total Suspended solids (TSS) to settleable solids (SS) in a ratio of 1500 mg/L TSS: 1.0 ml/L SS.

The material currently being mined or disturbed in the Stewart basin through the mining process produce TSS concentrations that are approximately 13000 mg/L TSS: 1.0 ml/L SS.

That being said, in **all cases** the mining licensees currently operating on Scurvy, Barker and Black Hills Creek have discharged effluent levels well below their allowable effluent discharge permit level of 1.5 ml/l Settleable Solids. However, extremely high Total Suspended Solids concentrations, which are non-regulated, were detected in the receiving waters of the Stewart River during monitoring this past season.

The Fish Habitat Management System -Stewart River Watershed (Category A)
Sample Results that Exceed Water Quality Objectives for 2010

Sampling Station	ST01	ST02	ST_BA01	ST03	ST_SC01	ST04	ST_CL01	ST06	ST07	ST08
Location Description	Mouth	u/s YN_HE01	BAM	u/s ST_BA01	Mouth	u/s ST_SC01	Mouth	u/s ST_CL01	O	AAM
Sample Type	Auto/Grab	Grab	Grab	Grab	Grab	Grab	Auto/Grab	Grab	Grab	Grab
Lat Y	63.29113	63.35333	63.17785	63.18350	63.18696	63.19949	63.61630	63.61183	63.45445	63.45445
Long X	-139.41042	-139.46181	-138.89928	-138.90445	-138.83366	-138.85118	-137.64114	-137.63992	136.94208	136.94208
Habitat Classification	Moderate-H	Moderate-H	Moderate-L	High	Moderate-M	High	Moderate-H	High	High	High
Water Quality Objective (mg/L)	25	25	80	25	50	25	25	25	25	25
Date of Sampling										
16-Jun-10							16.9		106.8	41.9
17-Jun-10	39.4		37.8	119.8	13.5	42.1		37.3		
13-Jul-10	25.3	27.0	1487.0		15.8	16.0	14.0	19.5	11.7	
10-Aug-10							4.6		28.5	12.5
11-Aug-10	21.8		206.0	26.2	101.3	24.4		20.1		
25-Aug-10	43.8									
31-Aug-10	17.5		454.0	18.0	113.3					
Total Seasonal Average TSS (mg/L) by site	29.6	27.0	546.3	54.6	86.5	17.0	11.3	21.7	38.5	15.5
Number of days sampled	5	1	4	3	4	4	4	4	4	4

Legend: Not continuously monitored

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