YUKON PLACER SECRETARIAT

Water Quality Monitoring Annual Report 2015

Livingstone/South Big Salmon Watershed

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Water Quality Objective Monitoring, Livingstone/South Big Salmon Watershed, 2015

Hydrologic and Geomorphic Characteristics of the South Big Salmon drainage

The Big Salmon Range is a remote mountain range in the Yukon, Canada. It has an area of 9001 km² and is a subrange of the Pelly Mountains, which in turn form part of the Yukon Ranges. Most of its peaks are unnamed. Northwest-trending valleys, occupied by the Nordenskiold and Big Salmon rivers, the Frenchman Lakes, and the Yukon River downstream of Minto, coincide with inactive fault zones that separate terrains and truncate rock formations.

The upper reaches of the Liard flow to the southeast from the Cassiar Mountains, while the upper reaches of the intermediate-sized Big Salmon River flow to the west from the Pelly Mountains. Other significant smaller streams include the Meister, Hoole, Smart, and Rose, Lapie and North Big Salmon rivers. The ecoregion has relatively few waterbodies, Little Salmon and Drury lakes are the two most major water bodies in the drainage. The coverage by wetlands in the basin is also relatively small, less than 2%.

There are four representative active and historical continuous hydrometric stations: Rancheria, Big Salmon, and South Big Salmon rivers; and Sidney Creek. Annual streamflow in the basin is characterized by a rapid increase in discharge in May, due to snowmelt at lower elevations, rising to a peak in June.

Because of the mountainous topography, there are a number of streams likely to produce a streamflow response that tends to be rapid and flashy. Because this area is also susceptible to intense summer rainstorms, maximum annual flows are frequently produced by these storm events. Some steep, smaller streams are susceptible to mud flows triggered by these summer rainstorms.

Mean annual runoff is moderate with a range in values of 244 to 366 mm, and an ecosystem mean value of 309 mm. Mean seasonal and summer flows are moderate with values of 19 X 10–3 and 15 X 10–3 m3/s/km2, respectively. The mean annual flood and mean summer flood are moderately low values of 70 X 10–3 and 35 X 10–3 m3/s/km2, respectively. The minimum annual and summer flows are high and moderate, with values of 1.7 X 10–3 and 6.1 X 10–3 m3/s/km2, respectively.

Minimum streamflow generally occurs during April, with the relative magnitude higher than more eastern or northern ecoregions because of higher winter temperatures and subsequently greater groundwater contributions. Only very small streams may experience zero winter flows during cold winters.

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Livingstone/South Big Salmon Basin

Topographical drainage Basin	515 Sq. Kilometers
Area of Lakes	5%
Approximate land cover:	Boreal/subalpine coniferous forest, 50% Alpine tundra, 35% Alpine Rockland, 10%
ELEVATION RANGE:	600–2,400 m ASL Mean elevation 1,350 m ASL
Channel Length (approx.)	102.7 Kilometers
Terrain	75% non-glaciated / 25% glaciated

The Water Survey of Canada gauging station (09AG003) was located just below the confluence of Livingston Creek with the South Big Salmon River and operated continuously from 1982 until 1998.

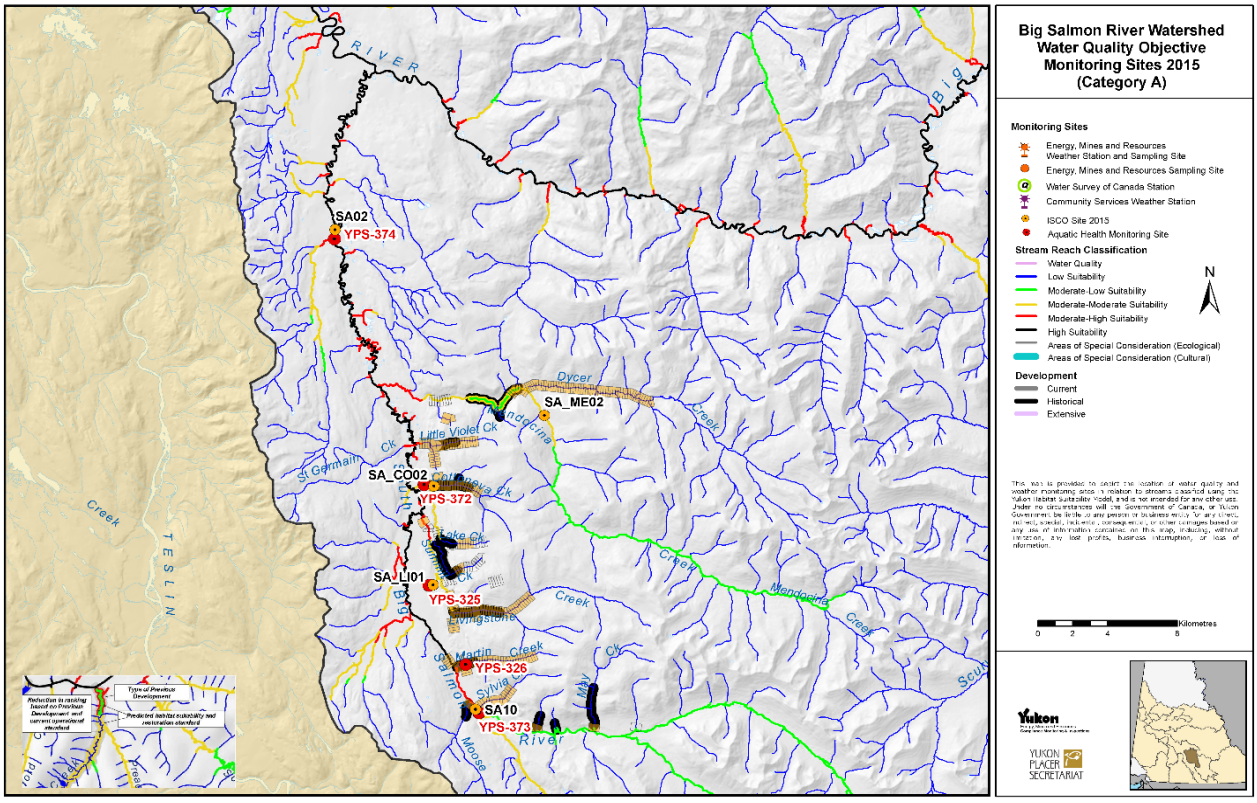
Placer deposits in the Livingstone / South Big salmon lie well within the McConnell glacial limit, the most recent glacial advance. Auriferous interglacial gravels formed between the Reid and the McConnell glaciations occupy east-west trending valleys, which are transverse to the direction of ice movement. These placers were buried by several metres of glacial drift, which protected them from the erosive action of the ice, which later scoured the ridges as the ice sheet moved northwestward. The gravels were later re-exposed by a large amount of fluvial down cutting at the end of the glaciation and during a period of post-glacial fluvial reworking. The six major creeks in the area that have received most of the exploration and mining are Martin, Livingstone, Summit, Lake, Cottoneva, and Little Violet. Livingstone and Cottoneva Creeks have the longest drainages and are the most mined, past and present.

In 2015, water samples were collected at five different sites in the South Big Salmon Watershed. Sampling commenced on June 9th, 2015 and 510 samples were collected up until the end of the season on September 21st, 2015. A combination of automatic composite sampling and grab sampling methods were used in the basin.

Atmospheric data was collected using two portable weather stations; one located on the South Big Salmon River, downstream Sylvia Creek, the second on the South Big Salmon River, downstream ‘Unnamed Creek’.

Total basin flow data is available from the Water Survey of Canada station located near the mouth of the South Big Salmon, but only for the period between 1982 until 1998. Flow data for the individual tributaries to South Big Salmon was collected at the time of sampling by the staff of E.M.R CMI using the methodology outlined in the Yukon Placer Secretariats, Water Quality Monitoring Protocol.

Water Quality Objective Monitoring, Livingstone/South Big Salmon Watershed, 2015



Site Codes and Global Position of Water Quality Sampling Locations in the South Big Salmon Watershed

SITE DESCRIPTION	SITE CODE	LATITUDE	LONGITUDE
Cottoneva Creek mouth	SA_CO01	TBD	TBD
Cottoneva Creek upstream tributary	SA_CO02	61.39361	-134.37056
Livingstone Creek mouth	SA_LI01	61.34224	-134.37056
Mendocina mouth	SA_ME01	TBD	TBD
Mendocina upstream Dycer Creek	SA_ME02	61.43176	-134.24377
Dycer Creek mouth	SA_ME_DY01	TBD	TBD
South Big Salmon River mouth	SA01	TBD	TBD
South Big Salmon River downstream Unnamed Creek - YPS-374	SA02	61.52524	-134.47385
South Big Salmon River downstream Mendocina Creek	SA03	TBD	TBD
South Big Salmon River downstream Little Violet Creek	SA04	TBD	TBD
South Big Salmon River downstream Cottoneva Creek	SA05	TBD	TBD
South Big Salmon River downstream Summit Creek	SA06	TBD	TBD
South Big Salmon River downstream Livingstone Creek	SA07	TBD	TBD

South Big Salmon River downstream Martin Creek	SA08	TBD	TBD
South Big Salmon River downstream Moose Creek	SA09	TBD	TBD
South Big Salmon River downstream Sylvia Creek	SA10	61.27718	-134.30847
South Big Salmon River downstream Discovery Claim Pup	SA11	TBD	TBD
South Big Salmon River downstream May Creek	SA12	TBD	TBD
Upper South Big Salmon River	SA13	TBD	TBD

Water Quality Objective monitoring, South Big Salmon Watershed – Summary

Five automatic water-sampling stations were set up and operated from June 9th until shutdown on September 21st as well as two portable weather-monitoring stations. In addition to this equipment, newly acquired level monitoring instrumentation was installed at three sites, at Livingstone Creek's mouth, Mendocina Creek upstream of Dycer Creek and on Cottoneva Creek. This new monitoring equipment has provided us with additional data that correlates with the precipitation data collected via our portable weather stations and has allowed us to derive changes in stream flow and water velocity at these sites.

At three of the five South Big Salmon basin sites monitored during the 2015 season (South Big Salmon River downstream of Unnamed Creek, Mendocina Creek at the mouth, South Big Salmon River downstream of Sylvia Creek), the water quality met the minimum objectives set under the *Fish Habitat Management System*. At the two other sites (Cottoneva Creek and Livingstone Creek), the water quality failed to meet the minimum water quality objectives on most occasions. As previously mentioned both Cottoneva Creek and Livingstone Creek have the longest drainages and are the most heavily mined, past and present, and there has been limited mining restoration in the area. This has left large sections of exposed ground open to surface erosion and non-point sources of sediment runoff into the creek channels.

On those occasions when the WQO was 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, rainfall, as either localized 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; unstable open ground, 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 - South Big Salmon Watershed (Category A)

Sample Results that Exceed Water Quality Objectives for 2015

Sampling Station	SA02	SA03	SA_ME02	SA05	SA_CO02	SA07	SA_LI01	SA10	SA13
Location Description	d/s Unnamed Creek - YPS-374	d/s SA_ME01	u/s SA_ME_DY01	d/s SA_CO01	u/s tributary	d/s SA_LI01	Mouth	d/s Sylvia Creek	Upper South Big Salmon
Type of sampling	Auto/Grab	Auto/Grab	Auto/Grab		Auto/Grab		Auto/Grab	Auto/Grab	
Lat Y	61.52524		61.43176		61.39361		61.34224	61.27718	
Long X	-134.47385		-134.24377		-134.37056		-134.37056	-134.30847	
Habitat Classification	High	High	Moderate-M	High	Moderate-M	High	Moderate-M	Moderate-H	Moderate-L
Water Quality Objective (mg/L)	25	25	50	25	50	25	50	25	80
Date of Sampling									
2-Jul-15	3.7		3.0		1.6		4.0	76.3	
3-Jul-15	13.3		12.7		2530.0		1844.0	50.0	
4-Jul-15	294.7		9.7		5932.5		2263.0		
5-Jul-15	54.0		2.8		297.6		116.0		
6-Jul-15	21.2		2.4		131.6		41.6		
7-Jul-15	14.0		3.2		161.2		28.0		
8-Jul-15	12.0		2.0		240.4		63.2	4.8	
9-Jul-15	36.0		2.8		381.3		87.6	3.6	
10-Jul-15	24.8		4.0		228.0		57.6	3.2	
11-Jul-15	16.0		2.3		182.7		26.4		
12-Jul-15	14.4		4.4		119.0		13.2	4.0	
13-Jul-15	8.4		3.0		420.7		17.2	4.4	
14-Jul-15	11.6		1.6		192.5		23.6		
15-Jul-15	13.2		2.4		118.0		5.6	3.2	
16-Jul-15	11.2		2.4		122.5		5.2	4.3	
17-Jul-15	8.4		2.0		89.0		11.6	5.2	
18-Jul-15	6.8		4.0		132.0		6.4	4.3	
19-Jul-15	7.6		1.7		96.0		4.4	3.2	
20-Jul-15	9.2		2.3		107.0		7.6	3.2	
21-Jul-15	6.4		2.3		82.5		6.4	4.4	
22-Jul-15	4.0		2.7		115.5		5.2	4.4	
23-Jul-15	6.8		1.2		96.5		8.4	4.3	
24-Jul-15	8.7		4.7		204.0		19.5	3.6	
25-Jul-15	7.3				131.5		44.5	4.4	
26-Jul-15	7.7				75.5		10.0	2.8	
27-Jul-15	5.3				77.0		7.0	4.8	
28-Jul-15	6.4				114.0		106.5	3.2	
29-Jul-15	5.6				107.0		7.2	3.2	
30-Jul-15	5.2				262.7		11.0	0.8	
31-Jul-15	5.2				104.7		5.5	2.8	
1-Aug-15	5.6				104.0		11.6	3.6	
2-Aug-15	12.0				139.3		8.4	3.6	
3-Aug-15	6.8				82.0		6.4	4.0	
7-Aug-15	5.2				291.0		12.4	3.6	

Sampling Station	SA02	SA03	SA_ME02	SA05	SA_CO02	SA07	SA_LI01	SA10	SA13
Location Description	d/s Unnamed Creek - YPS-374	d/s SA_ME01	u/s SA_ME_DY01	d/s SA_CO01	u/s tributary	d/s SA_LI01	Mouth	d/s Sylvia Creek	Upper South Big Salmon
Type of sampling	Auto/Grab	Auto/Grab	Auto/Grab		Auto/Grab		Auto/Grab	Auto/Grab	
Lat Y	61.52524		61.43176		61.39361		61.34224	61.27718	
Long X	-134.47385		-134.24377		-134.37056		-134.37056	-134.30847	
Habitat Classification	High	High	Moderate-M	High	Moderate-M	High	Moderate-M	Moderate-H	Moderate-L
Water Quality Objective (mg/L)	25	25	50	25	50	25	50	25	80
Date of Sampling									
8-Aug-15	5.2				103.5		8.8	2.0	
9-Aug-15	4.4				71.0		2.8	4.4	
10-Aug-15	3.6				57.5		2.8	2.4	
11-Aug-15	4.3		3.3		45.5		2.8	4.0	
12-Aug-15			0.8		52.0		4.8	2.4	
13-Aug-15			2.4		64.0		0.8	0.4	
15-Aug-15			0.8		63.6		1.2	1.2	
16-Aug-15			2.0		53.6		0.4	0.4	
17-Aug-15			4.0		139.6		1.2	0.4	
18-Aug-15			4.4		470.0		2.4	1.2	
19-Aug-15			2.8		36.8		73.2	0.8	
20-Aug-15	9.2		16.8		795.2		63.2	0.8	
21-Aug-15	20.0		2.8		520.4		28.0	0.4	
22-Aug-15	4.4		5.6		93.6		8.0	1.2	
27-Aug-15	4.4		2.8		82.0		25.6	1.6	
28-Aug-15	2.0		1.6		274.8		132.4	8.4	
29-Aug-15			2.0		200.0		35.2	2.8	
30-Aug-15			4.0		105.2		48.0	1.6	
31-Aug-15			3.2		186.0		56.8	0.4	
1-Sep-15			0.4		217.6		28.0	6.8	
2-Sep-15	0.4		1.2		70.8		18.0	4.0	
3-Sep-15	12.0		2.0		115.2		31.2	1.2	
4-Sep-15	14.4		2.0		156.4		50.4	0.8	
5-Sep-15	16.8		1.2		257.6		100.0	1.2	
6-Sep-15	54.4		3.2		496.0		250.0	1.6	
7-Sep-15	46.4		2.8		96.8		128.4	2.8	
8-Sep-15	32.0		0.0		39.6		60.4	1.6	
9-Sep-15	28.0		1.2		32.0		46.8	0.0	
10-Sep-15	36.4		1.2		40.8		85.2	0.8	
11-Sep-15	46.8		5.2		104.8		109.6	1.6	
12-Sep-15	50.4		12.0		81.6		38.4	1.6	
13-Sep-15	32.0		0.0		56.0		22.0	0.4	
14-Sep-15	16.0		2.8		69.2		24.4	14.8	
15-Sep-15	8.0		1.2		69.2		21.2	0.4	
16-Sep-15	10.0		2.4		92.8		18.4	0.8	
17-Sep-15	10.0		0.0		95.2		13.6	1.6	
18-Sep-15	14.0		0.4		60.0		51.6	2.0	
Total Seasonal Average TSS (mg/L) by site	14.0		2.8		181.0		61.6	4.0	
Number of days sampled	93		88		104		104	98	

Legend	Not continuously monitored
	Water Samples that are: Above / Below the Water Quality Objective