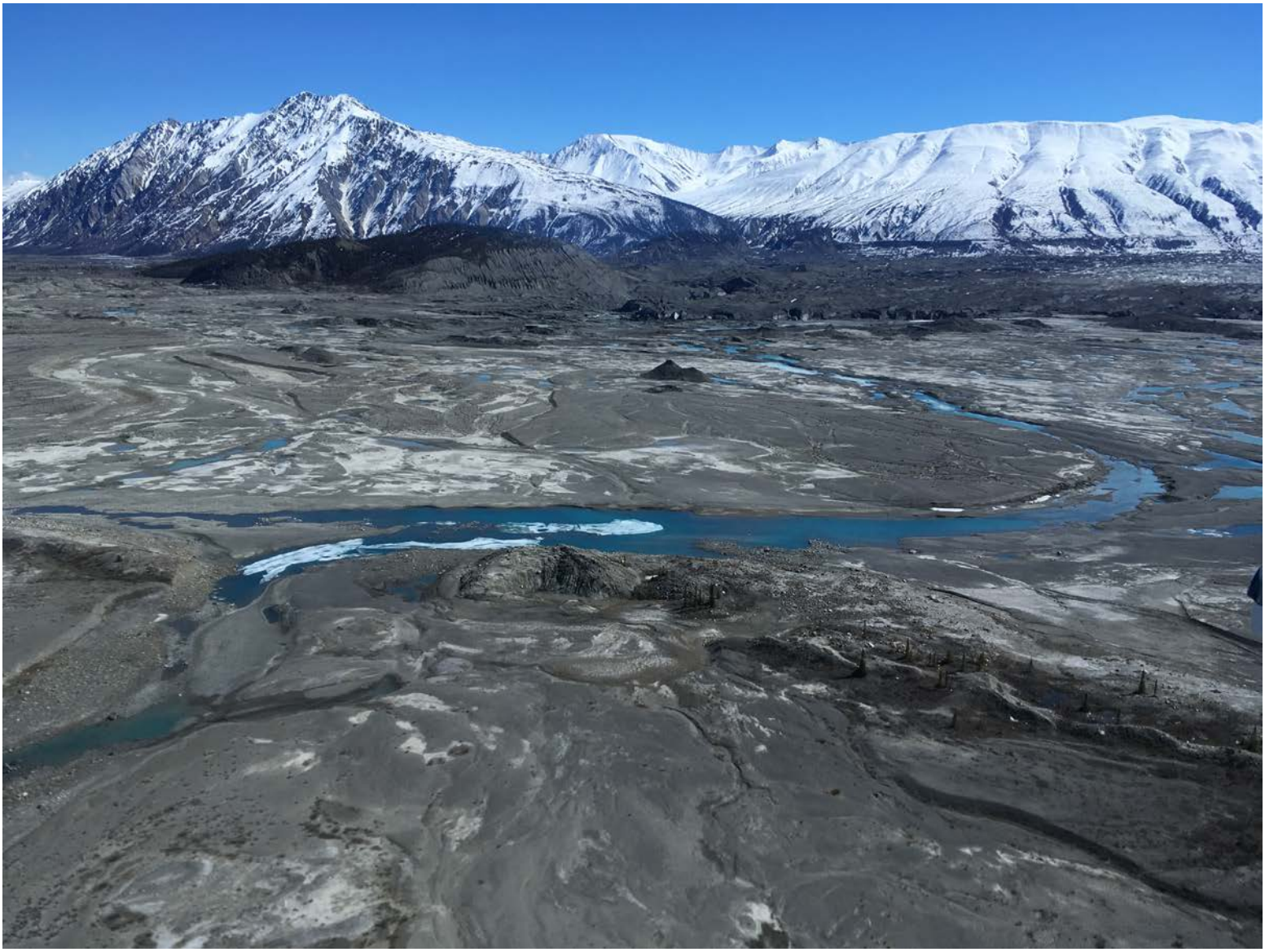
YUKON PLACER SECRETARIAT

Water Quality Monitoring Annual Report 2017



Alsek River Watershed

Mark Nowosad
Angele Leduc
Jeffrey Van Zandvoort

Water Quality Objective Monitoring, Alsek River Watershed, 2017

Hydrologic and Geomorphic Characteristics of the Alsek River Drainage Basin

The Alsek River originates in Yukon Territory in Kluane National Park, and flows south into British Columbia before turning west to flow through the Alaskan Panhandle to the Pacific Ocean at Dry Bay, Alaska. Glaciers dominate the watershed, and the Alsek transports vast quantities of sediment eroded by the glaciers. This process causes high levels of suspended solids and turbidity in the river during the open water season. High concentrations of cadmium, chromium, cobalt, copper, iron, lead, manganese, phosphorus and zinc accompany the high levels of suspended solids, indicating that these elements are in a particulate form and therefore probably not biologically available. The water is moderately hard and has a low sensitivity to acids. The northern latitude and glacial melt water cause cold-water temperatures year round.

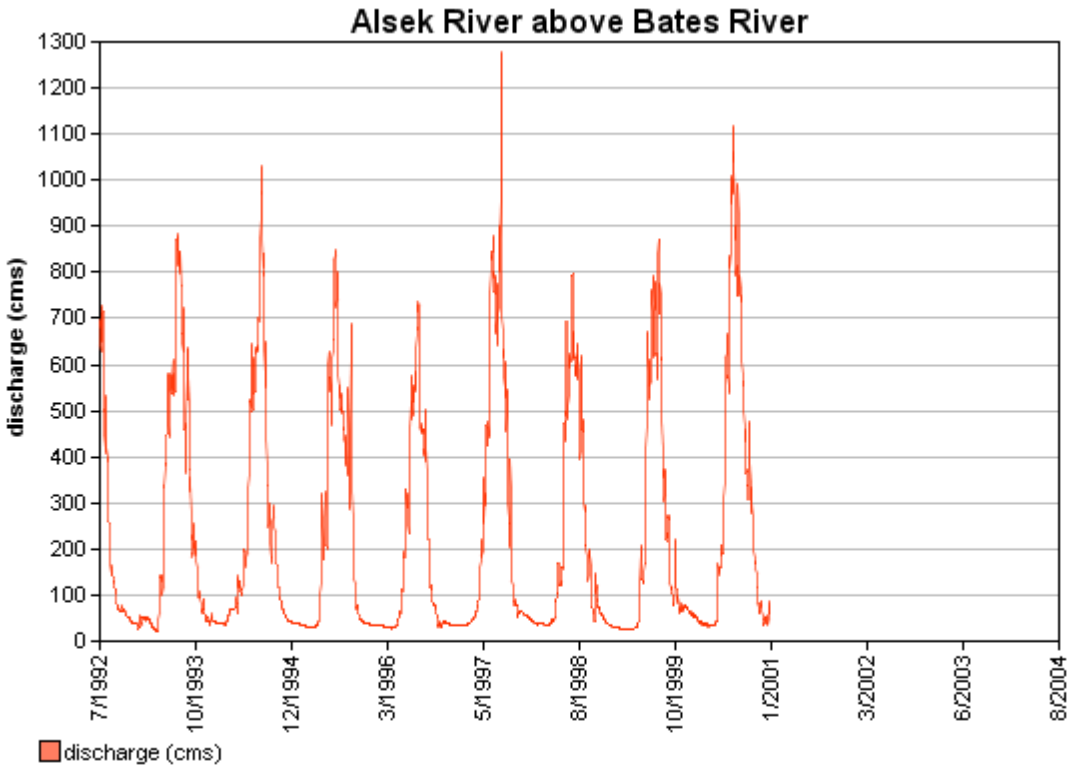
Alsek River Basin drains the southwestern portion of the Yukon to the Pacific Ocean. It is classified as a Canadian Heritage River because of its significant natural resources: massive ice fields, high mountain peaks, unique geologic history, coastal and interior plant communities, significant grizzly bear population, and diverse bird species.

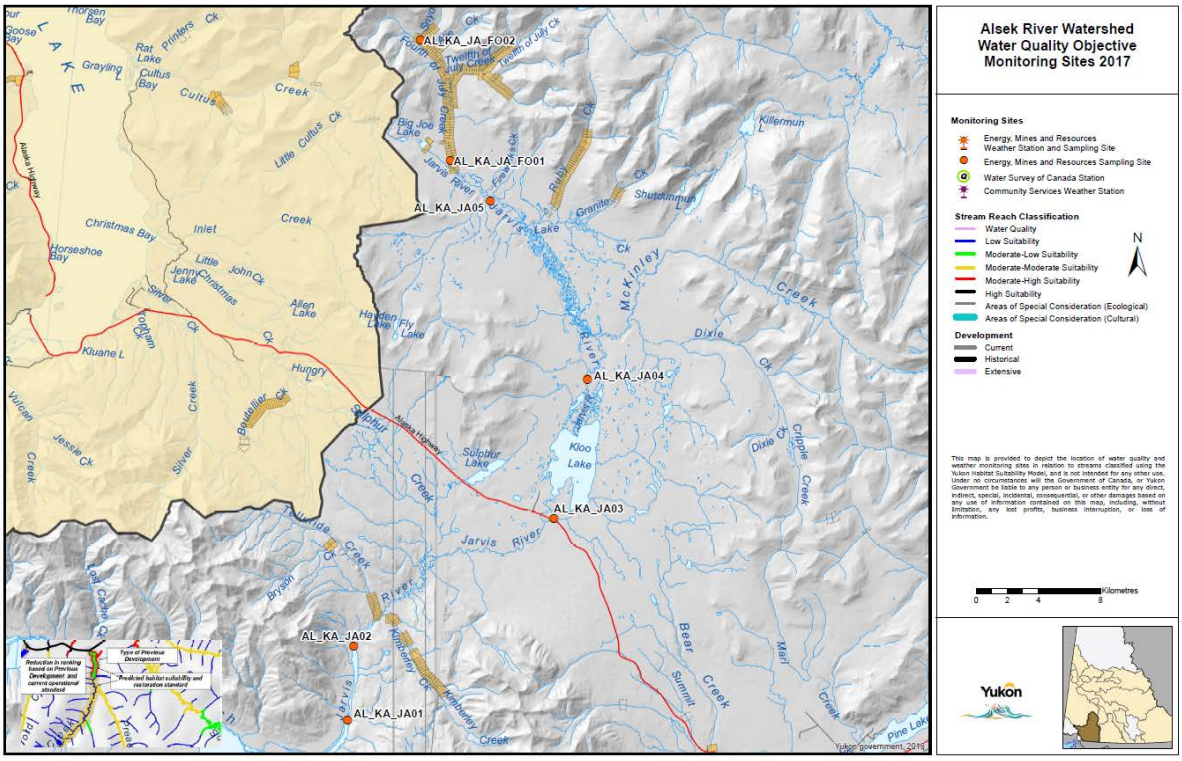
The Alsek River is considered a “transboundary” system; one which rises in Canada and flows to the ocean through the United States. Management of salmon originating in the Alsek River is done so through agreements outlined in the Transboundary chapter (Annex IX) of the Pacific Salmon Treaty (PST). Biologically based escapement goals form the basis for management decisions related to transboundary stocks. Currently, only the Klukshu River (an Alsek tributary) has a PST accepted escapement goal (7,500 – 15,000 Sockeye salmon), based on analyses conducted in 2000. The PST Transboundary agreement (2010) commits to establishing updated biologically based escapement goals for both the Alsek and Klukshu Rivers, and to review of the proposed escapement goals by both the Transboundary Technical Committee (TCC) and the Salmon Standing Committee of the Centre for Science Advice Pacific (CSAP).

The Alsek River drains approximately 19,000 square kilometers of Alaska and Canada into the Gulf of Alaska. The river is home to all five species of Pacific salmon; with sockeye migrating from May to October. Sockeye salmon are harvested in commercial and subsistence set gillnet fisheries below the border in the U.S. portion of the Alsek River and in U.S. surf waters near the terminus of the Alsek River. Harvests from the commercial fishery are enumerated from fish tickets (sales receipts issued to fishers from processors when their catches are sold). Commercial harvests are considered a census with no sampling error Numeric escapement information for sockeye salmon spawning in the Klukshu River is annually obtained by Fisheries and Oceans Canada (DFO) staff with the aid of a weir constructed across the lower portion of the Klukshu River. Counts of sockeye salmon as they pass the Klukshu River weir have been made each year since 1976. DFO provides estimates of the number of sockeye salmon that spawn each year by subtracting from the weir counts the estimated upstream catches and brood stock removals. These annual estimates provide a continuous database of monitored annual escapements to the Klukshu River system. There is some degree of uncertainty in the annual Klukshu sockeye salmon escapement estimates due to the uncertainty in the fishery catch above the weir. However, in most years (particularly since 1980), removals are relatively small in comparison to weir counts so the escapement estimates, in many cases, represent almost a complete census and sampling error is relatively low. The run of sockeye salmon at the Klukshu weir is very

protracted, beginning in late June and continuing through late October. Inspection of daily weir counts from 1976–2008, shows a very consistent temporal pattern of weir counts between years.

Water Survey of Canada also has water flow monitoring station nearby. The following graph shows the flow of the river at the site. Generally, the river exhibits low flows in the order of 20 m3/s in wintertime and freshet flows as high as 1,000 to 1,300 m3/s during the July to August period. This site is considerably downstream of the water quality reporting sites for 2017. Therefore, we could not apply this data to our research.





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

SITE_DESCRIPTION	SITE_CODE	LATITUDE_DD	LONGITUDE_DD
Fourth of July Creek Mouth	AL_KA_JA_FO01	61.12384	-138.04135
Upper Fourth of July Creek	AL_KA_JA_FO02	61.19151	-138.08942
Jarvis River Mouth	AL_KA_JA01	60.79667	-138.10414
Jarvis River downstream Telluride Creek and Kimberly Creek	AL_KA_JA02	60.83935	-138.10455
Jarvis River at highway bridge downstream of Kloo Lake	AL_KA_JA03	60.92278	-137.88222
Jarvis River upstream of Kloo Lake	AL_KA_JA04	61.00475	-137.85637
Upper Jarvis River	AL_KA_JA05	61.10278	-137.98935

Water Quality Objective monitoring, Alsek River Watershed – Summary

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

In 2017, water samples were collected at five sites in the Alsek River basin. Sampling commenced on May 16, 2017 and 608 samples were collected up until the end of the season on September 19, 2017. A combination of automatic composite sampling and grab sampling methods were used in the basin. In addition to automated sampling equipment, level-monitoring instrumentation was installed at one site, on upper Fourth of July Creek. This 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. An additional 10 samples were collected by CMI staff during routine mine inspections.

Atmospheric data was collected using two portable weather stations located on upper Fourth of July Creek and on the Jarvis River upstream of Kloo Lake. Flow data for these sites was collected at the time of sampling by the staff of E.M.R CMI using the methodology outlined in the Yukon Placer Secretariat's, Water Quality Monitoring Protocol.

Water Quality Objective monitoring, Alsek River Watershed – Summary

The Alsek River Watershed was again designated a 'watershed of interest' for monitoring in 2017 as a result of Canyon Mining Ltd proposing a placer mining operation on Fourth of July Creek, Twelfth of July Creek, Larose Creek, Alie Creek, and Snyder Creek. Their claims are located approximately 25 km northeast of Silver City.

The Haines Junction Designated Office (YESAA) sought views and information on the project from February 14th to March 22nd, 2017. During this time comments were received form the governments of Canada, Champagne Aishihik First Nations, and Yukon. Based on the project's scope, location, and comments received, three valued environmental or socio-economic components were identified: wildlife and wildlife habitat, heritage resources, and the aquatic environment.

In addition to the determinations of significance and application of terms and conditions, the Designated Office also determined that the application of section 110 of YESAA was warranted in two instances in relation to project activities. These recommendations involve traffic along the project access road and water quality downstream of the project.

The Decision Bodies, Government of Yukon and Department of Fisheries and Oceans, will review the Recommendation and the accompanying reasons described in this Evaluation Report. The Decision Bodies will issue a Decision Document within 30 days, as prescribed under s. 2 of the Decision Body Time Periods and Consultation Regulations that will either - a) accept the recommendation, - b) vary the recommendation, or - c) reject the recommendation.

The project's effects to water quality have the potential to act cumulatively with other projects in affecting the aquatic environment with effects to fish and fish habitat, human health, traditional land uses, and the ability to harvest fish. These effects occur within the context of climate change and changes to permafrost regimes that generally lack detailed baseline information.

Given that placer projects are increasingly located in areas that have not been mined extensively historically, the Jarvis River watershed (and other nearby watersheds) will likely see increased attention from placer miners. Most recently, the Designated Office received a placer proposal for a project near Kloo Lake, downstream of the project.

Currently, the density of placer operations is low and regional waterbodies are unlikely to be affected in significant and adverse ways if the discharge from existing operations adheres to water quality objectives due to extra dilutive capacity in the drainage. While the Designated Office considers significant adverse effects to be unlikely, it agrees with the sentiment expressed by CAFN on the importance of ensuring the continued health of Kloo Lake and the importance for "pre-project baseline water quality monitoring, and frequent monitoring during the operations for this and other projects.

To better inform future assessments – which as project numbers increase, assessments will be more likely to result in significant adverse cumulative effects – and to better inform land use decisions that will affect harvest rights of CAFN citizens, the Designated Office recommends under section 110 of YESAA that effects monitoring take place on the Jarvis River at locations from the project to, and including, Kloo Lake.

Under section 110 of YESAA, results from the effects monitoring conducted under section 110 will be submitted to the Designated Office, where the Designated Office will make the results available to other interested parties. The results of this effects monitoring will inform assessments and inform understandings of baseline conditions.

Water Quality Objective monitoring, Alsek River – Summary

The objective of the monitoring is to answer two key questions:
(1) Are the WQO established in the new regime being achieved?
(2) If not, is this due to placer mining activity or to other causes?

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

Question #1 - Are the WQO established in the new regime being achieved?

> On average, over this monitoring period, the water quality objectives (WQO) were met at our monitoring sites. However, on several days of monitoring, the WQO were not met at all sites.
>
> Out of the 608 water samples collected in the Alsek watershed, the water quality met the minimum objectives set under the Fish Habitat Management System 93.1 percent of the time.
>
> 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, 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.

Question #2 - If not, is this due to placer mining activity or to other causes?

In order to fully understand the root cause of the WQO not being achieved, the following information and data will be required:

a. Extent of placer mining upstream from monitoring sites.

b. The distance between monitoring sites and placer activity

c. The timing, flow volume, and duration of effluent discharge from upstream sites.

d. History of forest fire upstream of the monitoring site.

e. Recent flood events / high water at the time of sampling.

f. Natural water quality or background.

PROGRAM REQUIREMENTS AND RECOMMENDATIONS

Before sample collection can begin, field personnel must take steps to ensure that the samples collected will be representative of the aqueous system under investigation. A representative sample is one that typifies ("represents") in time and space that part of the aqueous system to be studied, and is delineated by the objectives and scope of the study.
Obtaining representative samples is of primary importance for a relevant description of the environment. In order to collect a representative sample that will yield the information required:

(1) Program objectives, including data-quality requirements, must be understood in the context of the water system to be sampled, and
(2) Artifacts of the sampling process must be minimized.

Field personnel must be alert to conditions that could compromise the quality of a sample.

What does the data represent?

Data collectors need to know what questions the data being collected is meant to address, and understand the level of accuracy and precision that are needed in the data to answer those questions. The data is no better than the confidence that can be placed in how well the sample represents the aqueous system. Therefore, understand the purpose for which the various types of data will be collected and the aqueous system that each sample should represent.

SAMPLING PERSONNEL
Designated Sampling and Field Staff

Programs that conduct water sampling on a routine basis can benefit from having a core group of personnel highly trained in sample collection. Such personnel produce the most reliable data and can be cost effective because of their familiarity with the needs of sample collection. Especially if the more difficult aspects of sample collection are needed, e.g., field pH, trace metals, and calibration of complex instruments, it may save time to have someone who is more qualified rather than someone who happens to be available but has little or no formal training.

The following requirements are key to ensure the success of the program:

- Having a clear understanding of the programs objectives.
- Use of up to date, state of the art equipment and instrumentation.
- Strict compliance with QA/QC procedures and sampling methodology.
- Use of highly trained, designated field sampling personnel that apply a consistent approach to their work and thus collect the best representative data and information possible.

Failure to follow any of these requirements may lead to data and information errors and nonaccomplishment of the programs intended goals. If these requirements are met, the first key question of this protocol, "*Are the WQO established in the new regime being achieved?*" will be easier to answer. However, in order to answer the second key question "*If not, is this due to placer mining activity or to other causes?"*, and fully understand the root cause of the WQO **not** being achieved, the following information, and data will be required:

a. Extent of placer mining upstream from monitoring sites.
b. The distance between monitoring sites and placer activity
c. The timing, flow volume, and duration of effluent discharge from upstream sites.
d. History of forest fire upstream of the monitoring site.
e. Recent flood events / high water at the time of sampling.
f. Natural water quality or background.

Heightened sediment inputs and diminished water quality is thought to be due to rain events in the monitored areas. Surface water runoff and ground water infiltration into a body of water will intensify the sediment-loading while at the same time increase the rate of flow. The increased flow can scour bank and bed material, compounding the loading. These increases are generally well correlated in the frequency and duration to recorded rain events however, not every time. Spikes in solids concentrations have been observed during periods of no precipitation. Why this occurs is yet to be determined. The additional information requirements listed above would assist in answering this and other related questions.

Knowing exactly from where and when these non-point sources of this additional sediment originate or why they occur is a critical question. Are previously or current mined areas more susceptible to ground and surface erosion than primary old growth and regenerated areas? Are there non-mitigated sources of input and could there be better control of these areas? If results indicate that point source effluent discharge appears to have little to no effect when discharge standards are maintained, and generally, compliance has been the norm, then what is the effect of multiple non-point sources on water quality?

Without the monitoring and evaluation of water quality upstream and downstream of stripped, mined, and reclaimed sites and without the collection of additional water quality and flow data of mine effluent discharge in a watershed, most of these questions detailed above will remain unanswered. Any causal direct relationship to mining activity versus other natural environmental occurrence cannot be categorically determined if the additional information and data listed above is not collected, a task which is beyond the scope of this protocol and will have to be addressed through another *regime* component within the Fish Habitat Management System.

The Fish Habitat Management System -Alsek River Watershed
Sample Results that Exceed Water Quality Objectives for 2017

Sampling Station	AL_KA_JA01	AL_KA_JA02	AL_KA_JA03	AL_KA_JA04	AL_KA_JA05	AL_KA_JA_FO01	AL_KA_JA_FO02
Location Description	Jarvis River Mouth	Jarvis River d/s Telluride Creek	Jarvis River at highway bridge	Jarvis River u/s Kloo Lake	Upper Jarvis River	Fourth of July Creek Mouth	Upper Fourth of July Creek
Sample Type	Auto/*Grab*	Auto/*Grab*	Auto/*Grab*	Auto/*Grab*	Auto/*Grab*	Auto/*Grab*	Auto/*Grab*
Lat Y	60.79667	60.83935	60.92278	61.00475	61.10278	61.12384	61.19151
Long X	-138.10414	-138.10455	-137.88222	-137.85637	-137.98935	-138.04135	-138.08942
Habitat Classification	High	High	High	Moderate-L	Moderate-L	Moderate-L	Moderate-L
Water Quality Objective (mg/L)	25	25	25	80	80	80	80
Date of Sampling							
16-May-17					361.2	12.8	*4.4*
17-May-17			7.6	125.6		5.6	4.4
19-May-17			3.6	116.4		63.6	6.0
2-Jun-17			1.2	8.4		163.6	1.6
3-Jun-17			6.0	27.6		80.8	1.6
8-Jun-17			2.8	4.8	300.0	627.6	1.6
9-Jun-17			1.2	36.0	570.0	456.4	1.6
10-Jun-17			2.8	20.0	183.6	30.8	1.2
17-Jun-17			6.8	67.6		164.8	1.2
18-Jun-17			0.0	267.6		1013.2	12.8
19-Jun-17			0.8	154.0		842.8	1.2
20-Jun-17			3.2	128.0		96.4	0.0
3-Jul-17			5.2	14.4	21.6	1272.3	0.8
5-Jul-17			5.6	42.4	184.8	291.6	0.4
7-Jul-17			8.0	50.8	87.2	97.3	0.4
11-Jul-17			5.6	129.6	84.0	233.3	0.8
12-Jul-17			8.4	182.8	23.6		1.2
13-Jul-17			6.4	181.2	57.2	22.8	0.8
15-Jul-17			10.0	105.2	74.0	67.2	0.4
16-Jul-17			4.8	74.0	89.6	50.0	1.2
17-Jul-17			3.2	46.4	69.2	119.3	0.0
18-Jul-17			5.6	38.4	90.8	109.0	2.0
19-Jul-17			7.2	100.0	186.7	59.0	6.4
20-Jul-17			2.0	75.2	0.4	199.2	2.8
26-Jul-17			1.6	27.2	0.8	107.6	4.0
5-Aug-17			1.2	7.6	20.0	80.0	2.8
8-Sep-17			2.0	5.2	54.8	110.4	0.8
9-Sep-17			5.2	4.4	31.6	114.4	1.2
10-Sep-17			2.8	9.6	86.8	156.4	2.4
12-Sep-17			1.6	10.8	60.4	134.4	3.2
15-Sep-17			5.6		68.8	127.2	1.6
16-Sep-17			2.8		70.0	94.0	3.2
17-Sep-17			5.6		75.2	140.4	1.6
19-Sep-17			6.0	*10.8*	37.2	84.8	6.5
Total Seasonal Average TSS (mg/L) by site			3.6	29.5	43.3	75.8	2.5
Number of days sampled			126	113	90	126	127

Legend: Not continuously monitored

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