Climate Adaptation Strategies

An Intergenerational effort to combine Indigenous Knowledge and Western Science

A 2013-14 community report prepared for
Selkirk First Nation
by the Yukon River Inter-Tribal Watershed Council

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Yukon River Inter-Tribal Watershed Council
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This 2013-14 community report was prepared for Selkirk First Nation by the Science Department of the Yukon River Inter-Tribal Watershed Council and by Dr. Shannon Donovan of University of Anchorage Alaska. For further information, please contact Jody Inkster (jinkster@yritwc.org) or Dr. Edda Mutter (emutter@yritwc.org) via email or by phone: 867-393-2199.

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Máhsi Cho!

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Introduction

The YRITWC

The Yukon River Inter-Tribal Watershed Council (YRITWC) is an Indigenous grassroots organization, consisting of 70 First Nations and Tribes, dedicated to the protection and preservation of the Yukon River Watershed. The YRITWC accomplishes this by providing First Nations in Yukon and northern British Columbia and Tribes in Alaska with technical assistance. We facilitate the development and exchange of information, coordinate efforts between First Nations and Tribes, undertake research, and provide training, education and awareness programs to promote the health of the Watershed and its Indigenous peoples.

Our Mission

> "We, the Indigenous Tribes/First Nations from the headwaters to the mouth of the Yukon River, having been placed here by our Creator, do hereby agree to initiate and continue the clean up and preservation of the Yukon River for the protection of our own and future generations of our Tribes/First Nations and for the continuation of our traditional Native way of life."

Previous collaborations between the YRITWC and SFN

This report presents the results of the second project the YRITWC has successfully implemented together with Selkirk First Nation (SFN) through Health Canada's "Climate Change and Health Adaptation Program for Northern First Nations and Inuit Communities."

The first project, "Integrating Indigenous Knowledge and Public Health Concerns into a Community Contaminant and Climate Change Monitoring Program", was delivered in 2012-13. The project involved the YRITWC working with five First Nations (Selkirk, Kluane, White River, Tr'ondëk Hwëch'in and Carcross/Tagish) to identify various forms of environmental change and related public health challenges.

Over 100 people, including 33 Elders, participated in the first project: 61 community members were interviewed and 49 participated in focus groups. One of the consistent conclusions from each community called for a greater inclusion of youth to transfer traditional knowledge and help formulate climate change and heath adaptation strategies.

The five First Nations collectively identified 95 sites of concern for contamination. Each community specifically prioritized five sites that were suspected of degrading water quality due to climate change and human activities (mining, wastewater discharge, fuel delivery and storage, etc.). 65 surface water grab samples were collected and analyzed for a suite of indicator parameters selected to address to community concerns. Each of the partner First Nations emphasized the need to continue monitoring the sites for 3-5 years.

Current project overview

Over the course of the past year, the YRITWC has continued to work with the same five First Nations (Selkirk, Kluane, White River, Tr'ondëk Hwëch'in and Carcross/Tagish) to implement a second project through Health Canada's "Climate Change and Health Adaptation Program for Northern First Nations and Inuit Communities."

This year's project involves developing climate adaptation strategies based upon intergenerational traditional knowledge and cutting-edge western science. The project is titled, "Climate Adaptation Strategies: An Intergenerational Effort to Combine Indigenous Knowledge and Western Science" and has two primary objectives:

1. Continue monitoring sites of concern for contamination, and
2. Facilitate an intergenerational dialogue between youth and Elders on climate change adaptation planning to promote community health.

The following pages detail the implementation of our project, organized according to the objectives mentioned above.

Water quality in the traditional territory of SFN

What is "water quality?"

Water quality is really just a measure of the suitability of water for a particular use. Some water is great for drinking and is referred to as being "potable." Some water is not potable (not suitable for drinking) but might make healthy fish habitat or be great for watering your garden.

We cannot tell if a water sample is safe for drinking, or suitable for any other use, just by looking at it. We need to measure certain characteristics of the water, which might be physical, chemical or biological. We can divide the characteristics we are measuring into a few groups, which are discussed below.

Water quality standards

In order to decide whether water is suitable for a particular use or unsuitable for that use, we need water quality standards. Basically, we need to designate the use of a water body (river, creek, pond, lake, etc.) and use water quality criteria to protect that use and prevent contamination. "Designating the use" of a water body, means deciding if it is fit or safe for swimming, fishing, drinking, watering crops or some other function. "Water quality criteria" are numbers and other requirements that our samples have to meet in order to prove that the water is suitable for its use. In this report, we use the Canadian Guidelines for the Protection of Aquatic Life (CCME, 1987) to evaluate water quality in SFN's traditional territory.

Sites with suspected contamination

As part of the previous project, "Integrating Indigenous Knowledge and Public Health Concerns into a Community Contaminant and Climate Change Monitoring Program" (2012-13), the YRITWC facilitated a participatory mapping with citizens of SFN. Participants identified, discussed, and mapped (using ArcGIS) sources of contamination and potential impacts on water resources.

A total of 15 sites of concern were identified. The YRITWC then coordinated a voting process whereby participants prioritized the sites of concern. Water samples were collected between August and October of 2012 from the five sites decided to be of highest priority:

1. Yukon River at Minto Barge (yucfq1b)
2. Big Creek (bicfq1b)
3. Minto Creek (mncfq1b)
4. Mica Creek (mccfq1b)
5. Willow Creek (wicfq1b)

Descriptions of each of these sites can be found in Appendix A. These five sites are illustrated on the accompanying map of SFN's traditional territory (Figure 1).

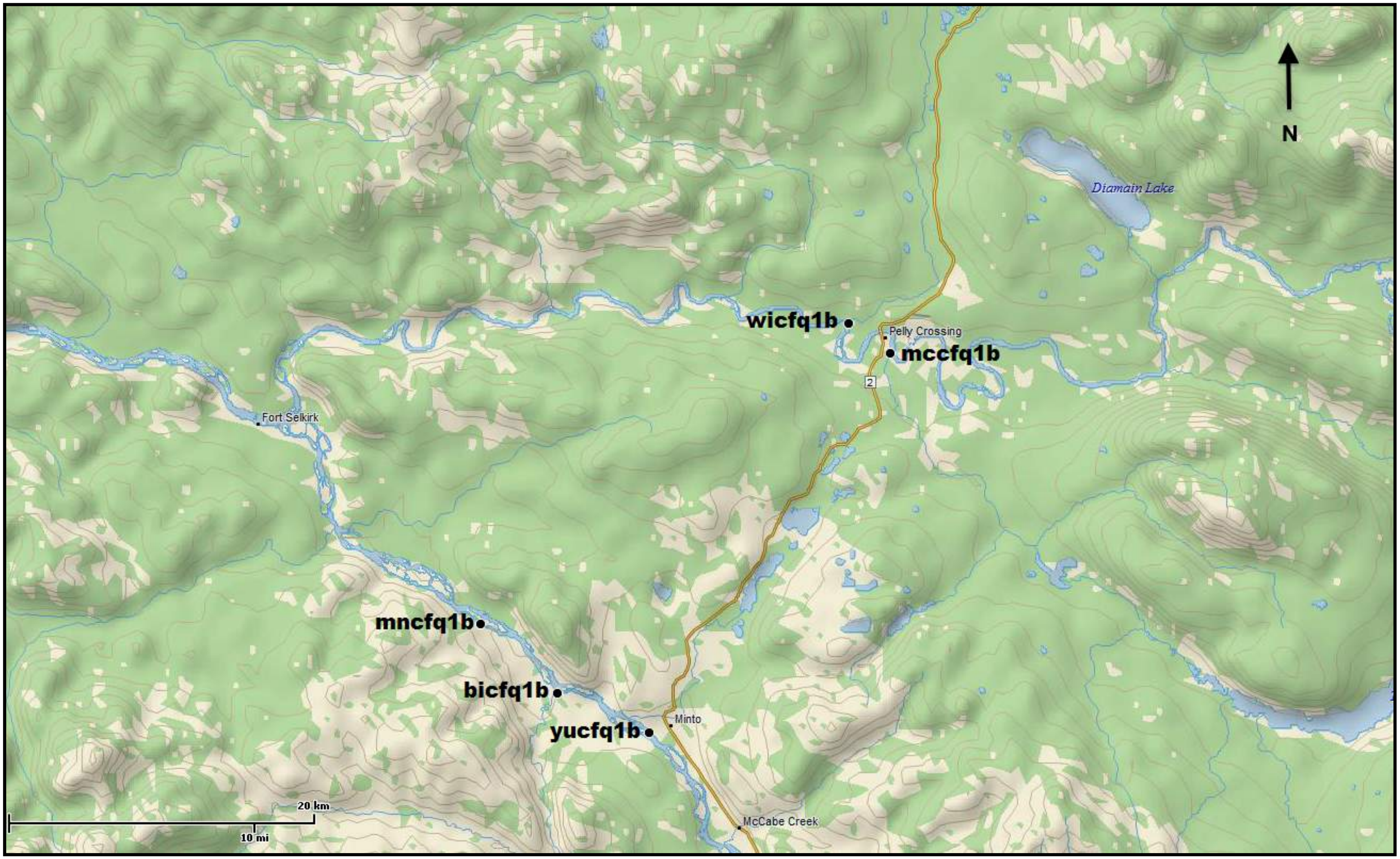
Water samples were again collected from these five sites in 2013. Table 1 presents the dates of sample collection for each of the sites.

Table 1: Dates of sample collection and class of contaminants analyzed

Sample Date	Site Name	Hydrocarbons	Metals	Bacteria	Nutrients
Oct. 2	Yukon River at Minto Barge	x	x		
	Big Creek		x		
	Minto Creek		x		
Oct. 3	Mica Creek	x	x	x	x
	Willow Creek		x	x	x

The results of analysis of water samples collected in 2012 and 2013 are presented in Appendix B. The results are discussed in detail in the following sections (Field parameters and Laboratory parameters).

Figure 1: Map of SFN's Sampling Sites



Field parameters

Field parameters are the characteristics of water that we measure directly in the field when we go out and collect water samples. Field parameters include temperature, pH, dissolved oxygen, and conductance.

TEMPERATURE

Temperature tells us how hot or cold the water is. Temperature can affect the ability of water to conduct an electrical current, to hold oxygen and certain dissolved solids, and to undergo various reactions so it is very important to measure every time we take a sample. While temperatures can vary greatly (even within the day), consistently high water temperatures are detrimental to many fish species (including salmon, whitefish, and others).

pH

pH is a measure of how acidic or basic the water is. The range of pH values goes from zero to fourteen. Low values of pH indicate acidic waters whereas high values of pH indicate basic waters. The number seven is right in the middle so it is considered neutral. pH can affect the concentration of the other parameters that are dissolved in the water (particularly metals) so it is a very important indicator of water quality. The Canadian Guidelines for the Protection of Aquatic Life establish a range of acceptable pH values from 6.5 - 9.0 (CCME, 1987). No exceedances of the Canadian Guidelines for the Protection of Aquatic Life were found (Appendix B).

DISSOLVED OXYGEN

Even though you cannot see it, water contains a dissolved gas: oxygen. Oxygen gets into the water from the surrounding air and from plants that are undergoing photosynthesis. The oxygen dissolved in water is critical for aquatic life (fish and other organisms) living in it. If dissolved oxygen levels become too low, aquatic life could be stressed or even die. The Canadian Guidelines for the Protection of Aquatic Life state the following lowest acceptable dissolved oxygen concentrations (CCME, 1987):

- For cold water biota: early life stages = 9.5 mg/L
- For cold water biota: other life stages = 6.5 mg/L

No exceedances of the Canadian Guidelines for the Protection of Aquatic Life were found (Appendix B).

Conductance

Conductance is a measure of how well water can conduct an electrical current. Water can conduct electrical currents because it contains dissolved charged particles called ions (discussed below). Conductance depends on the amount of solids dissolved in the water: pure water has a low conductance whereas seawater has a high conductance. When the conductance goes up or down, it is telling us something about the amount of dissolved solids in the water.

Laboratory parameters

Laboratory parameters are the characteristics of water that are measured in a laboratory using the samples collected earlier in the field. Laboratory parameters include major ions, nutrients, bacteria, metals, and hydrocarbons. Analysis of major ions, select nutrients, and select metals was conducted in 2012 at the United States Geological Survey (USGS) National Research Laboratory in Boulder, Colorado. Analysis of bacteria, nutrients, metals, and hydrocarbons was conducted in 2012 and 2013 at a private laboratory (ALS) in Whitehorse and Vancouver.

MAJOR IONS

Ions are dissolved particles that have charge; anions are negatively charged ions whereas cations are positively charged ions. *Major* ions represent the vast majority of what is dissolved in water and include bicarbonate, sulphate and chloride (the major anions) and calcium, magnesium, sodium and potassium (the major cations).

All water samples contain ions, which typically come from natural sources. The rocks and soil around the Yukon River watershed naturally contain abundant anions (mostly bicarbonate) and cations (mostly calcium). When water (from rainfall, snowmelt or any other source) comes into contact with rocks and soil, reactions take place and ions dissolve into the water. We measure these ions to understand how the water is reacting with its environment, to assess the quality of the water and to monitor for possible sources of contamination.

Samples collected from SFN's traditional territory were only analyzed for major ions in 2012. No exceedances of the Canadian Guidelines for the Protection of Aquatic Life were found (Appendix B).

NUTRIENTS

A nutrient is a chemical that an organism needs to live and grow. Nutrients are essential for life but too many of them can degrade habitat for aquatic life and pollute drinking water. Too many nutrients in the water can cause algae to grow excessively and lower the dissolved oxygen in the water, which can impact fish and other aquatic life. This is called eutrophication. Natural sources of nutrients include soils and decaying plant materials (fallen leaves, grass, etc.).

Sometimes nutrients dissolved in water come from human or animal wastes, fertilizers, or industrial wastewater.

There are three nitrogen-bearing nutrients that we analyzed in your water samples: nitrate, nitrate and ammonium. We also analyzed total phosphorus, orthophosphate, and dissolved organic carbon (commonly referred to as "DOC"). DOC is a measure of many organic molecules that are dissolved in water. No exceedances of the Canadian Guidelines for the Protection of Aquatic Life were found (Appendix B).

BACTERIA

Samples were collected for analysis of total coliforms and Escherichia coli (E. coli). The term "total coliforms" refers to a group of rod-shaped bacterial species commonly found in water, in soil, and on vegetation. It is common for raw or untreated water samples to contain total coliforms. Total coliforms are analyzed in standard tests of <u>drinking water</u> because their presence indicates contamination of a water supply by an outside source. Total coliforms were detected in Mica Creek and Willow Creek in both 2012 and 2013 (Appendix B). The presence of total coliforms is not a threat to aquatic life or recreational water use; however, water containing total coliforms should not be used as drinking water without appropriate, prior treatment.

Fecal coliform bacteria are a subset of total coliform bacteria that are generally, but not necessarily, fecal in origin (i.e., related to excrement). E. coli is a species of fecal coliform bacteria that is specific to fecal material of warm-blooded animals, including humans. The presence of E. coli in water samples therefore indicates recent fecal contamination and the potential presence of microorganisms (viruses, protozoa, other bacteria) capable of causing illness. Most strains of E. coli are harmless but certain strains (such as E. coli O157:H7) are pathogenic (able to cause disease). E. coli was detected in Mica Creek and Willow Creek in both 2012 and 2013 (Appendix B), indicating recent fecal contamination and the potential presence of microorganisms capable of causing illness. Caution should be exercised when handling water from Mica Creek and Willow Creek. <u>Water from these creeks should never be used as drinking water without appropriate, prior treatment.</u>

METALS

In both 2012 and 2013, we analyzed samples for a suite of 19 metals. The analysis was for “total metals”, which includes the metals content both dissolved in the water and present in the particulates suspended in the water. Analysis of select dissolved metals was also conducted in 2012. Metals dissolved and suspended in water are often naturally occurring; however, their concentration can be elevated by human-derived sources including mining, sewage effluent, landfill run-off, and industrial waste.

In 2012 and 2013, the total aluminum concentrations in Big Creek and Minto Creek were found to exceed the Canadian Guideline for the Protection of Aquatic Life (Figure 2). In 2013, the total aluminum concentration in the Yukon River at Minto Barge exceeded the guideline (Figure 2). In 2012, total aluminum was not analyzed for the Yukon River at Minto Barge but dissolved aluminum was and it was not found to exceed the guideline in that year.

In 2012 and 2013, the total copper concentration in Big Creek was found to exceed the Canadian Guideline for the Protection of Aquatic Life (Figure 3).

In 2012 and 2013, the total iron concentrations in Willow Creek and Minto Creek were found to exceed the Canadian Guideline for the Protection of Aquatic Life (Figure 4). The total iron concentrations in Big Creek exceeded the guideline in 2013 but not in 2012 (Figure 4).

The dissolved zinc concentrations in Mica Creek and Minto Creek exceeded the guideline in 2013 but not in 2012 (Figure 5). Conversely, the dissolved zinc concentrations in the Yukon River at Minto Barge and Big Creek exceeded the guideline in 2012 but not in 2013 (Figure 5). Total zinc analyses yielded results below the laboratory detection level in all cases.

Aluminum, copper, iron and zinc are commonly found in relatively low concentrations in surface water samples because they tend to dissolve in water that is in contact with rocks and soils that naturally contain these elements. Continued monitoring of these sites is recommended to better understand the natural variation of these four metals in the region.

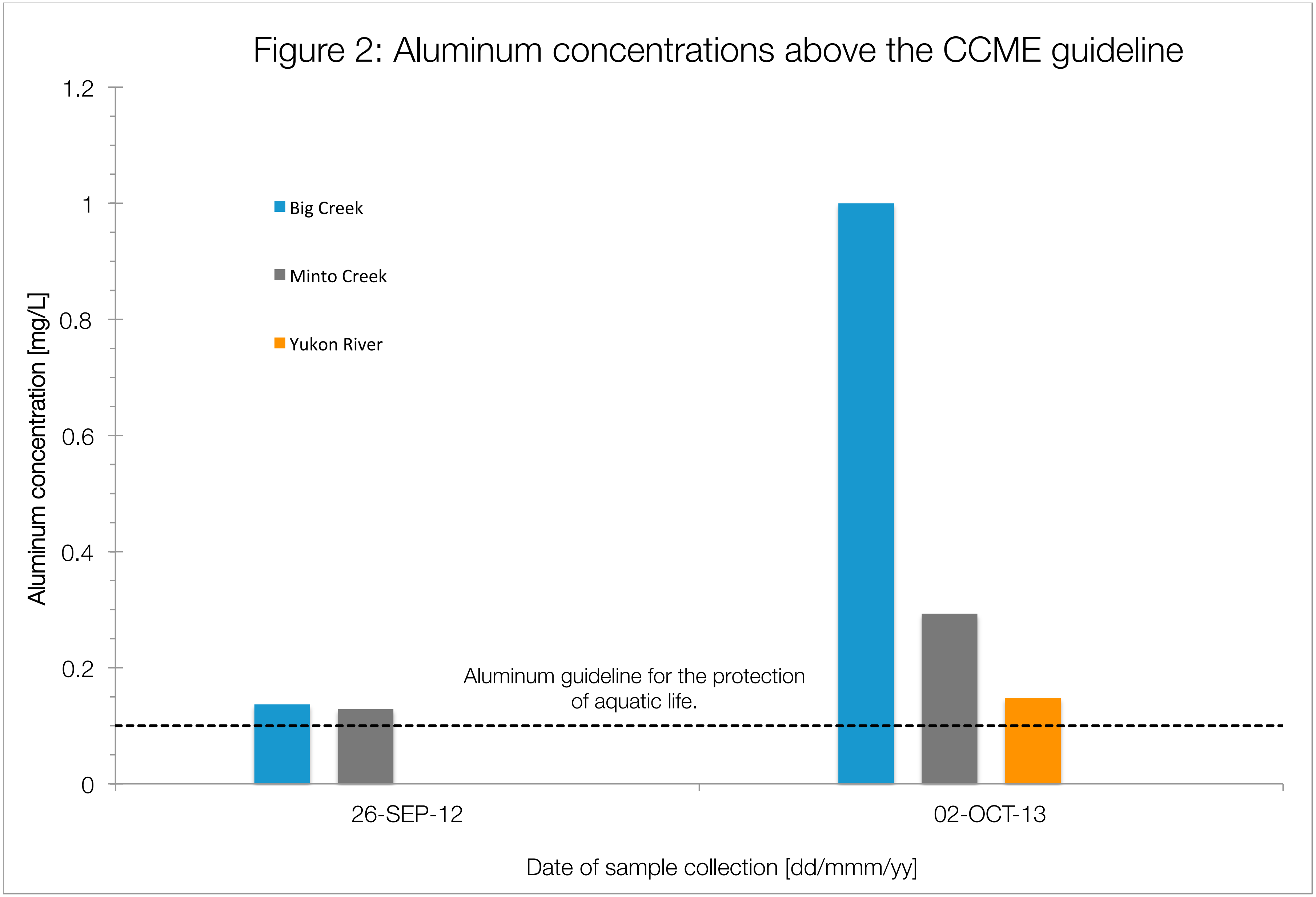


Figure 2: Aluminum concentrations above the CCME guideline
1.2
1
0.8
0.6
0.4
0.2
0
Aluminum concentration [mg/L]
Big Creek
Minto Creek
Yukon River
Aluminum guideline for the protection of aquatic life.
26-SEP-12
02-OCT-13
Date of sample collection [dd/mmm/yy]

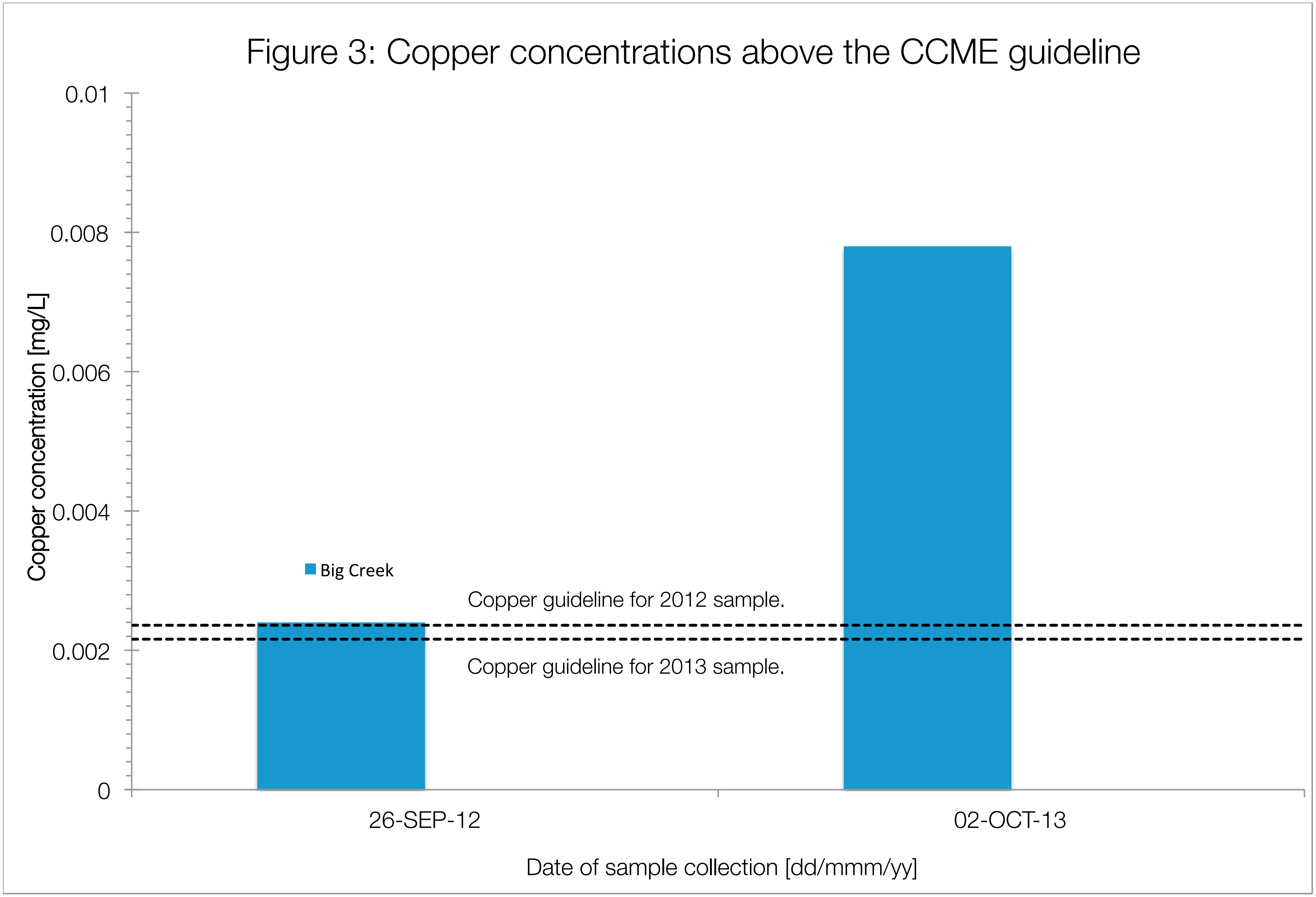


Figure 3: Copper concentrations above the CCME guideline
Copper concentration [mg/L]
0.01
0.008
0.006
0.004
0.002
0
Big Creek
Copper guideline for 2012 sample.
Copper guideline for 2013 sample.
26-SEP-12
02-OCT-13
Date of sample collection [dd/mmm/yy]

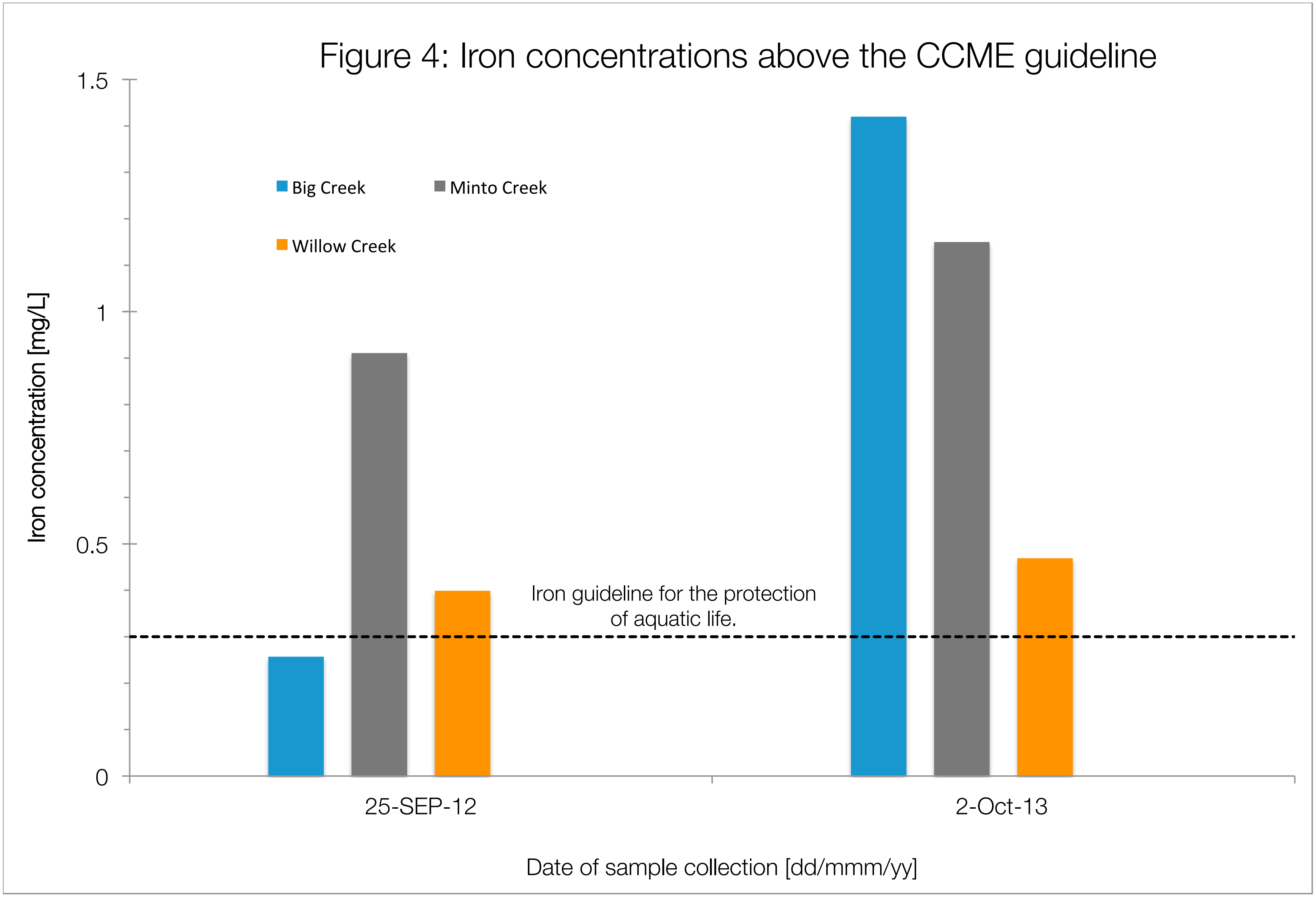


Figure 4: Iron concentrations above the CCME guideline
Iron concentration [mg/L]
1.5
1
0.5
0
Big Creek
Minto Creek
Willow Creek
Iron guideline for the protection of aquatic life.
25-SEP-12
2-Oct-13
Date of sample collection [dd/mmm/yy]

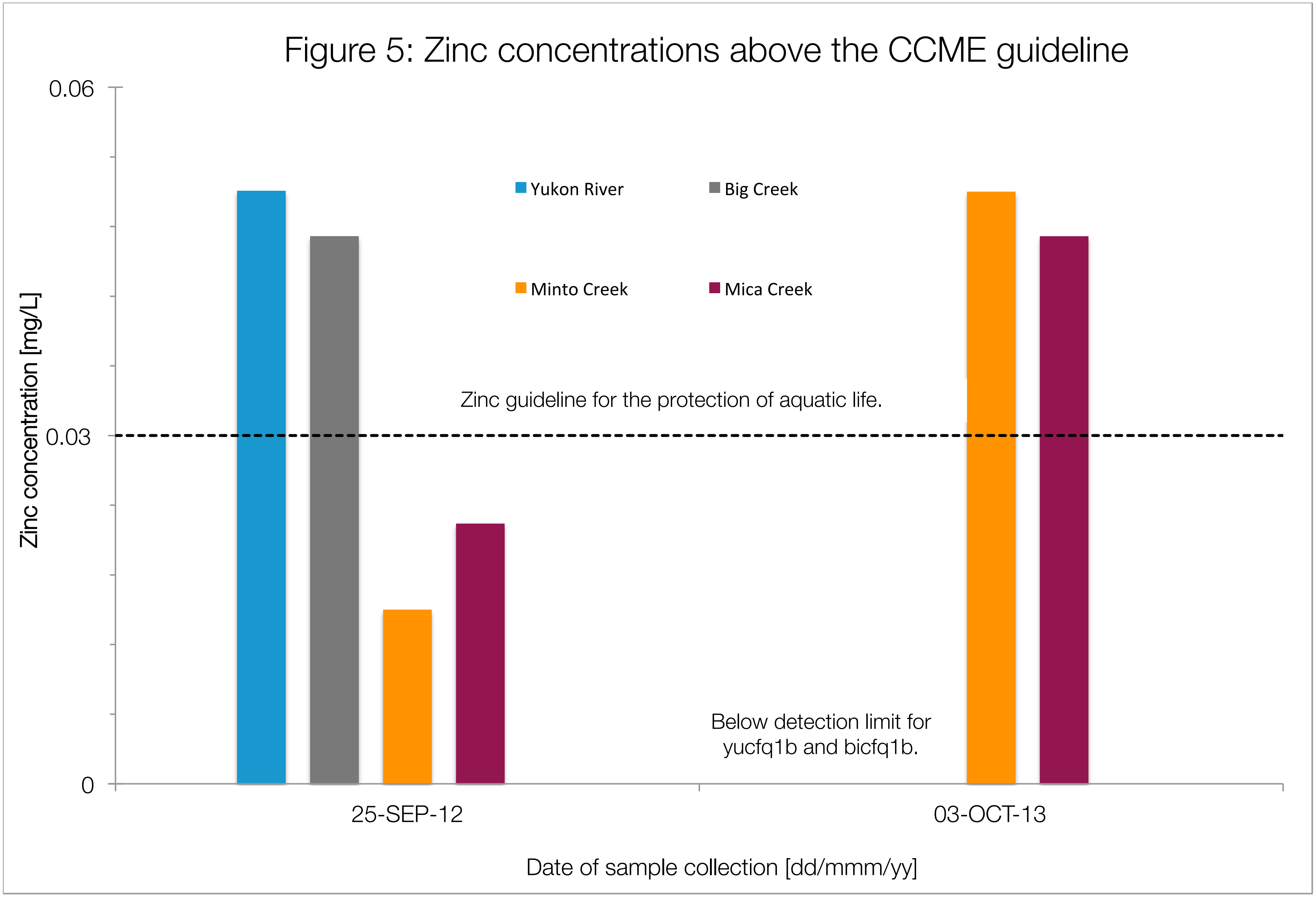


Figure 5: Zinc concentrations above the CCME guideline
0.06
0.03
0
Zinc concentration [mg/L]
Yukon River
Big Creek
Minto Creek
Mica Creek
Zinc guideline for the protection of aquatic life.
Below detection limit for
yucfq1b and bicfq1b.
25-SEP-12
03-OCT-13
Date of sample collection [dd/mmm/yy]

Petroleum hydrocarbons

Petroleum is a complex mixture of many organic compounds consisting entirely of hydrogen and carbon, known as hydrocarbons. Some petroleum hydrocarbon (PHC) compounds have been shown to have greater toxicity than others. In both 2012 and 2013, we analyzed samples for two groups of discrete PHC compounds:

1. Volatile organic compounds (including benzene, toluene, ethylbenzene, xylene and styrene; collectively referred to as “BTEX + styrene”), and
2. Polycyclic aromatic hydrocarbons (PAH).

Similarly, we analyzed samples for five groups representing the summation of all PHC compounds within a certain carbon range:

1. Volatile hydrocarbons (VH),
2. Volatile petroleum hydrocarbons (VPH),
3. Extractable petroleum hydrocarbons (EPH),
4. Light extractable petroleum hydrocarbons (LEPH), and
5. Heavy petroleum hydrocarbons (HEPH).

None of the PHC compounds analyzed in 2012 or 2013 was found to exceed the minimum detection limits of the laboratory (ALS; Appendix B).

Intergenerational dialogue

Background

During the first year of our project, we conducted focus groups and interviews to elicit concerns regarding the impacts of contaminants and climate change on water and public health with Elders and concerned citizens from the participating First Nations. These participants identified many climatic and non-climatic changes, many of which are impacting livelihoods. Participants also identified the need to engage with youth to find ways to mitigate or adapt to the impacts these changes are having on their communities. So in the second year of this project we facilitated an intergenerational dialogue related to climate change between youth and Elders from the five participating First Nations.

The purpose of this dialogue was to create a platform for sharing intergenerational Traditional Knowledge (TK) regarding contaminants and climate change. Traditional knowledge has been defined as "a cumulative body of knowledge and beliefs handed down through generations by cultural transmission, about the relationship of living begins (including humans) with one another and with their environment" (Berkes 2008: 7). The sharing of TK is essential to the formation of mitigation and adaptation strategies and has been identified as a priority by our First Nations partners.

To help facilitate shared learning about TK between youth and Elders we developed a three-part workshop, which we ran with each of the five First Nations. Lands and Resources managers identified youth interns that assisted with workshop development and execution in each of the First Nations. Youth interns worked with YRITWC staff and Lands and Resource managers to recruit workshop participants, resulting in a total of 61 individuals participating in the five workshops. Workshops included the following three components: youth PhotoVoice activity, intergenerational knowledge sharing, and youth interviews.

Workshop description

YOUTH PHOTOVOICE ACTIVITY

Workshop days began by engaging the youth in a PhotoVoice activity. PhotoVoice is a method of sharing ideas through a combination of photographs and written descriptions. Photography provides a unique opportunity for individual expression and when paired with a narrative explanation can give a glimpse into someone else's view of the world. It is a way to share experiences and communicate thoughts. Beginning two weeks prior to the workshop date, cameras were made available at each of the Lands and Resources offices and interns contacted youth workshop participants to help explain the PhotoVoice activity. As part of the activity, youth were asked to bring 3-5 digital photos representing how the effects of climate change have impacted the health of their community. In advance of the workshop, youth were asked to write a brief narrative explaining the significance of each photo. To help in creating their narrative, youth were asked to consider questions like:

- What makes up your community?
- What kinds of environmental changes have you seen in your community?
- How have these changes affected your way of life?
- What do you think of when you hear the words "Climate Change"?

At the workshop, the digital photos taken by the youth were uploaded onto a laptop and projected using an LCD projector. The youth participants took turns discussing their photos and associated narratives. In an effort to capture the significance of the photos, the youth worked together to develop a one-two sentence narrative summarizing what the photo means to them. YRITWC staff created a PowerPoint presentation of the photos and narratives. A collection of these photos and narratives were also made into a calendar for each participating First Nation.

INTERGENERATIONAL KNOWLEDGE-SHARING

During the second part of the workshop, we brought together Elders, youth and other interested community members for a luncheon to discuss strategies for addressing environmental and public health concerns. In an effort to build on the relationships and TK established in during year 1 of this project, we invited the same Elders to participate in the 2013 luncheons. During the luncheon, Elders talked to youth about their concerns regarding the environment and the impacts climate change has had on their community. Youth then presented the PowerPoint of their PhotoVoice activity to the Elders. Elders and youth then engaged in a guided-discussion facilitated by YRITWC staff related to the changes seen and potential strategies for adapting to them. Through this discussion, the participants were asked to help complete a table that contained the following questions by writing answers on sticky notes and sticking the notes to hanging flip chart paper:

- How does this change affect you?
- How do you know the change is happening?
- In what ways can the community adapt to the change now?
- How about in the future?
- Who needs to be involved?
- What timeline should be followed?

At the end of the workshop, the flip chart papers were collected. An example of raw data generated through this exercise can be seen in Figure 6. YRITWC staff recorded a summary of the ideas and strategies discussed.

Figure 6: Example of data generation methodology at SFN workshop

YOUTH INTERVIEWS

To provide youth with an opportunity to share additional thoughts, we asked them to participate in videotaped interviews on a voluntary basis. Unfortunately, no youth volunteered.

Selkirk First Nation's workshop

The Selkirk First Nations workshop was held on November 26, 2013 from 9:30 AM – 4:00 PM at the SFN's Administration Building in Pelly Crossing, Yukon. A total of 10 individuals participated in this workshop and included four youth, four Elders and two community members. The four youth participated in the PhotoVoice activity and produced a PowerPoint presentation that highlights the impacts climate change has had on their community through photos and associated narratives. These photos and narratives can be found in an accompanying calendar or by contacting the YRITWC. No names are associated with the quotes as directed by SFN. Raw data collected during this project are available at SFN's Heritage Department.

As part of our analysis, we compiled the data generated through the workshop and were able to organize the data into the following three themes: Weather Variability, Wildlife, and Changing Hydrology. What follows is a summary of the discussion participants had related to these three themes.

WEATHER VARIABILITY

A theme that emerged through the workshop was regarding increased weather variability as a result of climate change. Participants discussed changes in weather have resulted in increased rain, variable winds, and changes in seasonal weather patterns. Below is a summary of how participants see climate change affecting weather in their community:

- Weather is unpredictable: The sun is hotter but summers tend to be colder and winters tend to be warmer. Fall and spring come later.
- There are more windstorms due to rapid temperature change and the wind direction is variable.
- There is an increase in ice fog and temperatures fluctuate.
- Precipitation has changed. Snow levels are low, there is more rain and there are hailstones.
- There is snow during spring growth but the grass is around until November.

- Vehicles affected by temperature swings.
- Loss of traditional practices and traditional medicine available later in the season.
- Warmth affects fur-bearers pelts and trappers.
- Limited hunting and recreational opportunities.
- Cut-off from traditional areas because river not frozen.
- Property damage from weather and fire.
- Stunted tree growth.
- Ice on trees breaks branches, affects bird habitat.
- Develop community garden to increase harvest options.
- Reducing risk of forest fires by cutting and using barriers.
- Public health problems such as cancer.
- Given weather changes, it is hard to know how to dress.

WILDLIFE

Impacts of climate change on wildlife have been seen by the Selkirk First Nations. Workshop participants included a wide range of effects including: changes in migration patterns, decreased quantity and quality of some wildlife species for harvest, changes in wildlife species present, and increased spread of invasive species and wildlife-borne disease. According to workshop participants, climate change has had the following effects on wildlife species:

- More wildlife coming into town like cougars, bears, wolves, lynx, fox, coyotes coming.
- Changes in wildlife behaviour like crows eating more unnatural foods, bears being habituated by eating garbage.
- Physiological changes in wildlife like softer texture of fish, moose rut starting later, rabbits changing colour at different times.
- Changes in wildlife movement patterns like fish running a month behind and differences in bird migration.
- Berries are depleted.
- Invasive species are problematic like moths eating native vegetation and issues with Aspen Tortrix.
- Needing to adjust hunting, fishing and gathering times like moving the moose hunt later and setting nets in November.
- Changes in wildlife movement make it difficult to know when to take subsistence leave.

- Changes to traditional diet and traditional practices based on changes.
- Increased safety concerns due to more human-wildlife interface.
- Create new hunting grounds and hunt for alternative species.
- Need to learn about traditional ways and laws through stories.
- Impose bigger fines for salmon by-catch.
- Communicate with each other to share what is happening. Use Facebook.

CHANGING HYDROLOGY

Workshop participants noted that changing hydrology as a result of climate change which has impacted the water systems, raised water level, increased river turbidity and raises concerns about landslides, washouts and evacuations. Below is a summary of how climate change has affected the hydrology of SFN's traditional territory from workshop participants' perspectives:

- The river open longer.
- There is a later freeze-up.
- Higher water so there are no sand bars.
- Rising water levels.
- Harder to navigate the river.
- Glaciers melting.
- Water is turbid for a longer time.
- Lots of driftwood in river.
- Swift eddies.
- Potential bridge washouts could mean evacuations.
- Landslides and riverbanks washing out.
- Road washout (Mica Creek).
- Creeks too "dirty" (turbid) to drink.
- Unstable ice on creeks – cannot cross the river with skidoos.
- Limited transportation due to river changes.
- Driftwood clogging/ripping fishnets.
- New ways to conserve water including use of barrels to catch rainwater, grey water-recycling programs and decant water before drinking.
- Use 4-wheelers later so as to not erode riverbanks.
- Move to safer fishing area.
- Create evacuation plans.
- Construct levees (flood protection).
- Develop partnerships.

- Secure government funding.

In an effort to better summarize the data generated through the workshop, we further condensed the data into observations, impacts and adaptations associated with each of the four themes listed above as seen in Table 2.

Table 2: Summary of climate change impacts seen by SFN workshop participants

	Weather Variability	Wildlife	Changing Hydrology
Observation	• Changes in seasonal weather patterns • Increased rain • Decreased snow • Variable wind direction	• Wildlife coming into villages • Changes in wildlife diets • Changes in wildlife movement and migration patterns • Increase in invasive species • Changes in wildlife physiology	• Changes in river system with later freeze-up • Higher water levels • Increased turbidity • Increased driftwood • Decreased sandbars
Impacts	• Increased public health concerns • Changes in traditional medicine and practices • Changes to wildlife habitat • Increased wildfires	• Moths killing vegetation • Changes to traditional practices and ways of life • Safety concerns	• Increased landslides and roads washed out • Changes in traditional use of river for transportation and harvest
Adaptations	• Increased forest management • Increased use of sunblock • Create more community gardens	• Learn traditional laws and implement fines for breaking laws • Adjust hunting and harvesting times and places • Communicate with others about changes • Participate in international agreements	• Capture and reuse water • Develop evacuation plans • Build levees • Create partnerships and garner government funding

Next steps

The YRITWC developed and submitted a proposal for a third project through Health Canada's "Climate Change and Health Adaptation Program for Northern First Nations and Inuit Communities." We recently received notice from Health Canada that the project will be awarded funding!

The proposed third project is titled, "First Nation Climate Change Policy: a regional, Indigenous approach to climate change adaptation, health and water governance." The proposal included letters of support from SFN and the other four First Nations (White River, Kluane, Tr'ondëk Hwëch'in, and Carcross/Tagish) that have been working closely with the YRITWC. The proposed project will build on the two years of work the YRITWC and these First Nations have successfully completed. The primary objective of the project is to facilitate the development of a Water Action Plan outlining how First Nations and their traditional knowledge can take action to address their concerns regarding the impacts of climate change and contaminants on water and health.

The proposed project would involve the YRITWC co-developing and hosting a workshop to unite these five First Nations to develop a Water Action Plan based on their concerns about the impacts of contaminants and climate change on water and health in their traditional territories. The action plan will address the need to implement the YRITWC's "Yukon River Watershed Plan" (which was approved at YRITWC's summit in Mayo in August 2013) and articulate the role of First Nations in the Yukon Government's "Yukon Water Strategy."

References

Canadian Council of Ministers of the Environment (CCME), 1987. Water Quality Guidelines for the Protection of Aquatic Life. Accessed online (http://st-ts.ccme.ca/): January 2014.

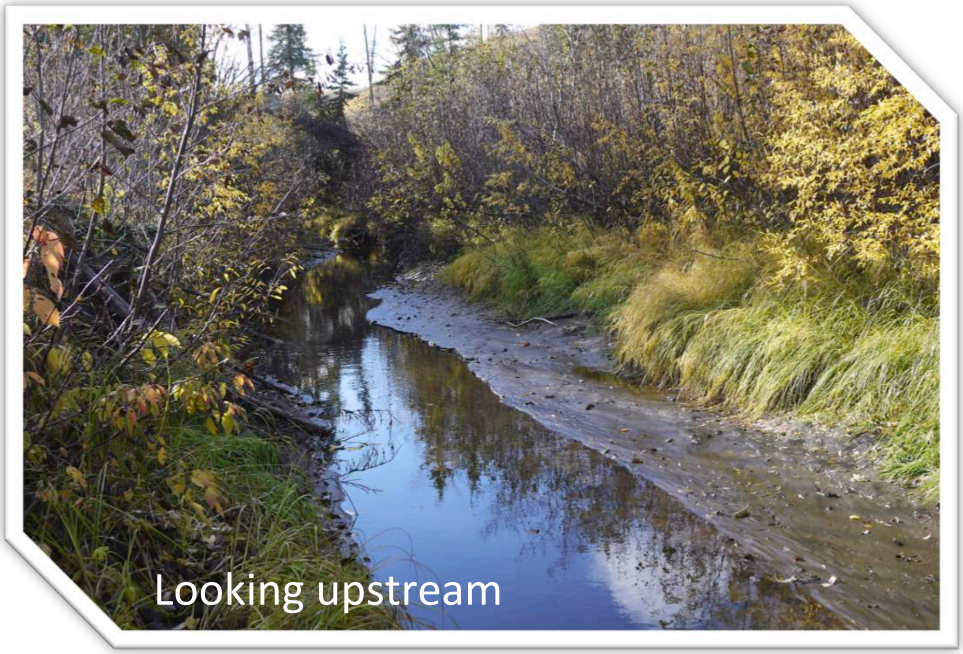
Berkes, Fikret. 2008. Sacred Ecology. Routledge.

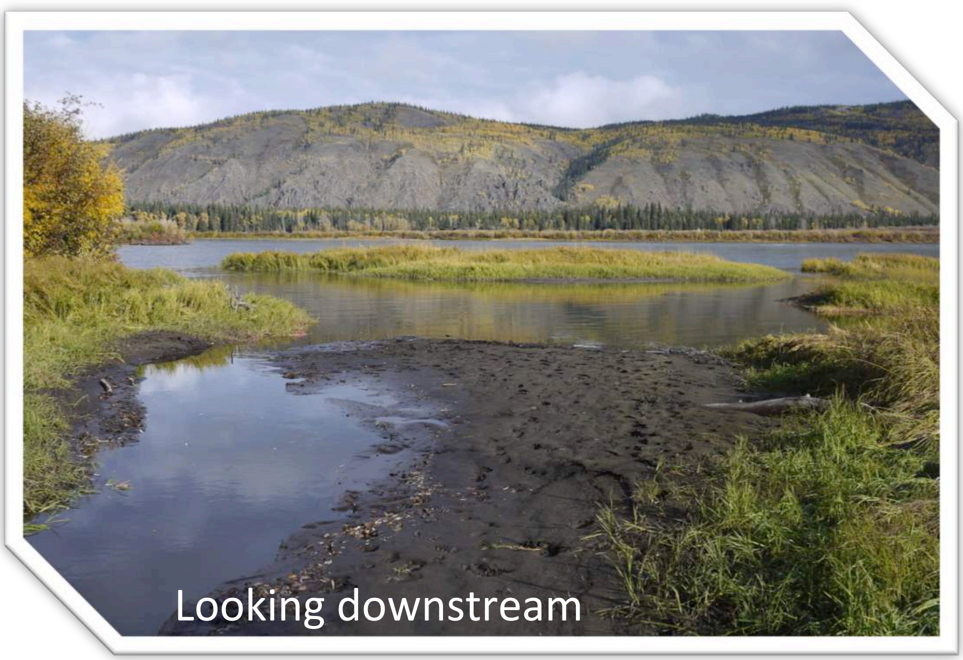
Appendix A: Site descriptions

Traditional territory:	SFN
Water body:	Big Creek
Site name:	bicfq1b
Coordinates:	N. 62.61565° W. 136.99142°
Contaminants of concern:	Metals from mining activity
Date sampled:	Oct. 2, 2013

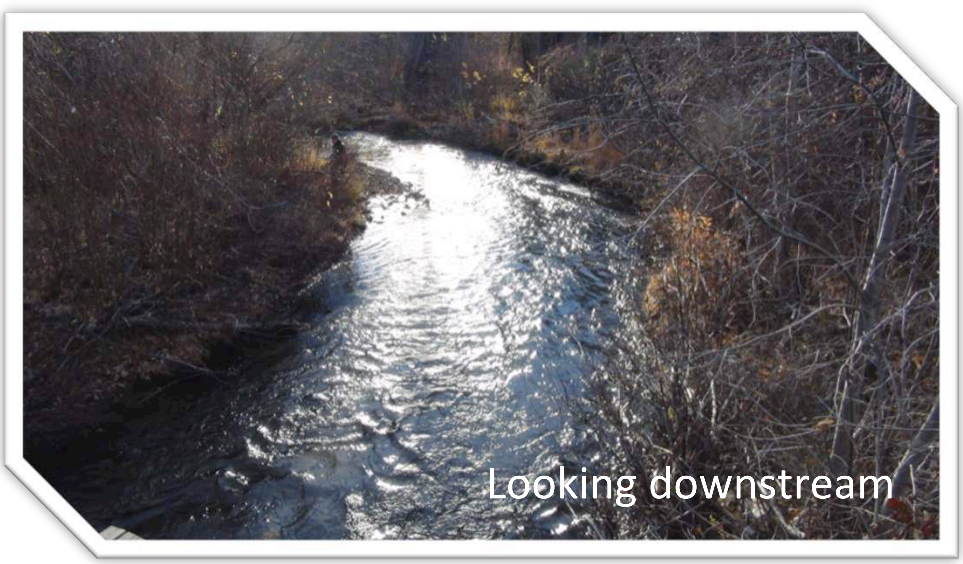
Traditional territory:	SFN
Water body:	Mica Creek
Site name:	mccfq1b
Coordinates:	N. 62.81670° W. 136.56660°
Contaminants of concern:	Landfill seepage
Date sampled:	Oct. 3, 2013

Traditional territory:	SFN
Water body:	Minto Creek
Site name:	mncfq1b
Coordinates:	N. 62.65643° W. 137.09502°
Contaminants of concern:	Metals from mining activity
Date sampled:	Oct. 2, 2013

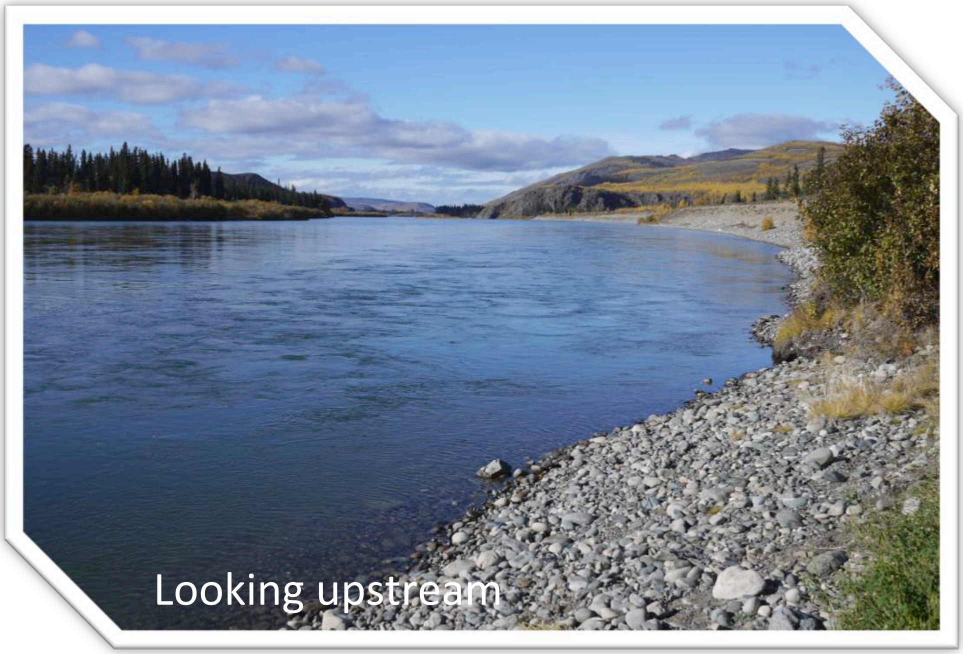


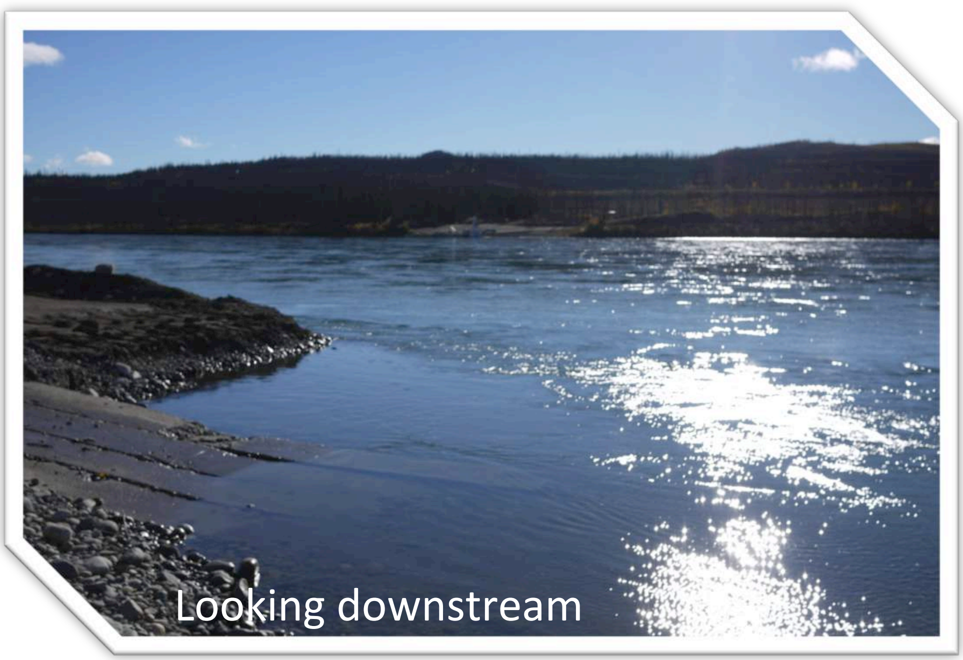


Traditional territory:	SFN
Water body:	Willow Creek
Site name:	wicfq1b
Coordinates:	N. 62.83683° W. 136.62105°
Contaminants of concern:	Bacteria from houses
Date sampled:	Oct. 3, 2013



Traditional territory:	SFN
Water body:	Yukon River at Minto Barge
Site name:	yucfq1b
Coordinates:	N. 62.59180° W. 136.87804°
Contaminants of concern:	Hydrocarbons from mining activity
Date sampled:	Oct. 2, 2013


Looking upstream


Looking downstream

Appendix B: Water quality data

RESULTS OF ANALYSIS Legend: (shaded) *Exceeds Guideline* | - *Not analyzed* | "<x" or "n.d." *Below detection level*

Sample ID	**CCME**	mccfq1b		wicfq1b		yucfq1b		bicfq1b		mncfq1b	
Date Sampled	*Water Quality*	25-SEP-12	03-OCT-13	25-SEP-12	03-OCT-13	26-SEP-12	02-OCT-13	26-SEP-12	02-OCT-13	26-SEP-12	02-OCT-13
Time Sampled	*Guidelines*	15:20	10:30	16:10	11:00	17:00	14:35	15:15	13:30	13:00	12:30
ALS Sample ID	*for the Protection*	L1216083-1	L1372865-4	L1216083-2	L1372865-5	L1216083-3	L1372865-1	L1216083-4	L1372865-2	L1216083-5	L1372865-3
Matrix	*of Aquatic Life*	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Field Parameters											
pH	6.5 - 9.0	8.38	7.69	8.18	7.95	8.27	8.02	8.22	7.87	8.33	7.95
Water temperature		7.3	4.15	4.7	2.2	9.2	8.55	5.7	4.22	3.6	3.05
Dissolved oxygen	6.5, 9.5	13.36	14.16	13.24	15.43	10.72	13.4	12.51	15.69	12.43	16.22
Specific conductance		282.8	200.87	245.4	200.29	149.8	50.0	205.4	65.00	300.7	105
Physical Tests											
Hardness (as CaCO3)		160	153	145	126	77.36	70.6	100	90.0	172	160
Major Ions											
Alkalinity		154.9	-	149.7	-	80.1	-	114.2	-	186.4	-
Chloride (Cl)	640	0.9	-	0.6	-	1.4	-	0.7	-	2.5	-
Sulphate (SO4)		24.1	-	13.1	-	10.2	-	11.2	-	14.2	-
Calcium (Ca)		40.6	-	37.0	-	21.8	-	24.4	-	42.5	-
Magnesium (Mg)		12.2	-	10.9	-	5.6	-	10.2	-	13.9	-
Sodium (Na)		3.0	-	2.4	-	2.4	-	4.9	-	7.2	-
Potassium (K)		1.7	-	0.7	-	0.3	-	0.5	-	0.9	-
Nutrients											
Dissolved Organic Carbon (DOC)		12.33	-	10.20	-	2.46	-	9.52	-	14.69	-
Ammonium (NH4)		0.0	-	1.0	-	0.2	-	0.6	-	0.4	-
Nitrate and Nitrite (as N)		0.0346	0.0081	<0.0051	0.0435	-	-	-	-	-	-
Nitrate (as N)	13	0.0306	0.0081	<0.0050	0.0435	-	-	-	-	-	-
Nitrite (as N)	0.06	0.0040	<0.0010	<0.0010	<0.0010	-	-	-	-	-	-
Orthophosphate-Dissolved (as P)		0.0019	0.0033	0.0134	0.0137	-	-	-	-	-	-
Phosphorus (P)-Total	Guidance framework	0.0206	0.0188	0.0254	0.0325	-	-	-	-	-	-

RESULTS OF ANALYSIS Legend: (shaded) *Exceeds Guideline* | - *Not analyzed* | "<x" or "n.d." *Below detection level*

Sample ID	CCME	mccfq1b		wicfq1b		yucfq1b		bicfq1b		mncfq1b	
Date Sampled	*Water Quality*	25-SEP-12	03-OCT-13	25-SEP-12	03-OCT-13	26-SEP-12	02-OCT-13	26-SEP-12	02-OCT-13	26-SEP-12	02-OCT-13
Time Sampled	*Guidelines*	15:20	10:30	16:10	11:00	17:00	14:35	15:15	13:30	13:00	12:30
ALS Sample ID	*for the Protection*	L1216083-1	L1372865-4	L1216083-2	L1372865-5	L1216083-3	L1372865-1	L1216083-4	L1372865-2	L1216083-5	L1372865-3
Matrix	*of Aquatic Life*	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Bacteriological Tests											
E. coli		1	8	22	18	-	-	-	-	-	-
Coliform Bacteria - Total		248	649	411	548	-	-	-	-	-	-
Total Metals											
Aluminum (Al)-Total	Fxn of pH	0.045	0.037	0.015	0.034	-	0.148	0.137	1.00	0.129	0.293
Antimony (Sb)-Total		<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic (As)-Total	0.005	0.00071	0.00074	0.00190	0.00195	-	0.00049	0.00091	0.00358	0.00092	0.00102
Barium (Ba)-Total		0.081	0.075	0.090	0.082	-	0.034	0.067	0.073	0.074	0.074
Boron (B)-Total	1.5	<0.10	<0.10	<0.10	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium (Cd)-Total	Fxn of hardness	<0.00020	<0.00020	<0.00020	<0.00020	-	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Calcium (Ca)-Total		44.0	42.0	40.4	35.1	-	20.4	23.8	21.3	46.8	43.3
Chromium (Cr)-Total		<0.0020	<0.0020	<0.0020	<0.0020	-	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Copper (Cu)-Total	Fxn of hardness	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	0.0024	0.0078	0.0019	0.0020
Iron (Fe)-Total	0.3	0.195	0.192	0.399	0.469	-	0.183	0.257	1.42	0.911	1.15
Lead (Pb)-Total	Fxn of hardness	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	0.00065	<0.00050	<0.00050
Magnesium (Mg)-Total		12.2	11.8	10.8	9.29	-	4.80	9.83	8.95	13.4	12.7
Manganese (Mn)-Total		0.0240	0.0357	0.0626	0.0885	-	0.0066	0.0229	0.0416	0.0680	0.0768
Mercury (Hg)-Total	0.026	<0.00020	<0.00020	<0.00020	<0.00020	-	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Potassium (K)-Total		2.44	2.47	1.02	0.84	-	0.83	0.80	0.90	1.09	1.01
Selenium (Se)-Total	0.001	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Sodium (Na)-Total		5.2	5.1	4.0	3.4	-	<2.0	7.4	7.1	8.1	8.3
Uranium (U)-Total	0.015	0.00069	0.00075	0.00072	0.00062	-	0.00086	0.00200	0.00184	0.00115	0.00102
Zinc (Zn)-Total	0.03	<0.050	<0.050	<0.050	<0.050	-	<0.050	<0.050	<0.050	<0.050	<0.050

RESULTS OF ANALYSIS	Legend:		*Exceeds Guideline*		-	*Not analyzed*		"<x" or "n.d."	*Below detection level*	
Sample ID	**CCME**	mccfq1b		wicfq1b		yucfq1b		bicfq1b		mncfq1b
Date Sampled	*Water Quality*	25-SEP-12	03-OCT-13	25-SEP-12	03-OCT-13	26-SEP-12	02-OCT-13	26-SEP-12	02-OCT-13	26-SEP-12	02-OCT-13
Time Sampled	*Guidelines*	15:20	10:30	16:10	11:00	17:00	14:35	15:15	13:30	13:00	12:30
ALS Sample ID	*for the Protection*	L1216083-1	L1372865-4	L1216083-2	L1372865-5	L1216083-3	L1372865-1	L1216083-4	L1372865-2	L1216083-5	L1372865-3
Matrix	*of Aquatic Life*	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Dissolved Metals											
Dissolved Metals Filtration Location		FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved	Fxn of pH	0.0086	0.0213	0.0074	0.0117	0.0030	0.0086	0.0213	0.0074	0.0117	0.0030
Antimony (Sb)-Dissolved		-	-	-	-	-	-	-	-	-	-
Arsenic (As)-Dissolved	0.005	-	-	-	-	-	-	-	-	-	-
Barium (Ba)-Dissolved		0.0702	0.2231	0.0756	0.0662	0.1761	0.0702	0.2231	0.0756	0.0662	0.1761
Boron (B)-Dissolved	1.5	-	-	-	-	-	-	-	-	-	-
Cadmium (Cd)-Dissolved	Fxn of hardness	-	-	-	-	-	-	-	-	-	-
Calcium (Ca)-Dissolved		40.6	24.4	37.0	42.5	21.8	40.6	24.4	37.0	42.5	21.8
Chromium (Cr)-Dissolved		-	-	-	-	-	-	-	-	-	-
Copper (Cu)-Dissolved	Fxn of hardness	0.0009	0.0004	n.d.	0.0024	0.0011	0.0009	0.0004	n.d.	0.0024	0.0011
Iron (Fe)-Dissolved	0.3	0.121	0.168	0.279	0.164	0.006	0.121	0.168	0.279	0.164	0.006
Lead (Pb)-Dissolved	Fxn of hardness	-	-	-	-	-	-	-	-	-	-
Magnesium (Mg)-Dissolved		12.2	10.2	10.9	13.9	5.6	12.2	10.2	10.9	13.9	5.6
Manganese (Mn)-Dissolved		0.0145	0.0194	0.0541	0.0650	0.0016	0.0145	0.0194	0.0541	0.0650	0.0016
Mercury (Hg)-Dissolved	0.026	-	-	-	-	-	-	-	-	-	-
Nickel (Ni)-Dissolved	Fxn of hardness	n.d.	0.0013	n.d.	n.d.	n.d.	n.d.	0.0013	n.d.	n.d.	n.d.
Potassium (K)-Dissolved		1.7	0.5	0.7	0.9	0.3	1.7	0.5	0.7	0.9	0.3
Selenium (Se)-Dissolved	0.001	-	-	-	-	-	-	-	-	-	-
Sodium (Na)-Dissolved		3.0	4.9	2.4	7.2	2.4	3.0	4.9	2.4	7.2	2.4
Uranium (U)-Dissolved	0.015	-	-	-	-	-	-	-	-	-	-
Zinc (Zn)-Dissolved	0.03	0.022	0.047	0.013	0.015	0.051	0.022	0.047	0.013	0.015	0.051

RESULTS OF ANALYSIS	Legend:		Exceeds Guideline		-	Not analyzed		"<x" or "n.d."	Below detection level	
Sample ID	**CCME**	mccfq1b		wicfq1b		yucfq1b		bicfq1b		mncfq1b	
Date Sampled	*Water Quality*	25-SEP-12	03-OCT-13	25-SEP-12	03-OCT-13	26-SEP-12	02-OCT-13	26-SEP-12	02-OCT-13	26-SEP-12	02-OCT-13
Time Sampled	*Guidelines*	15:20	10:30	16:10	11:00	17:00	14:35	15:15	13:30	13:00	12:30
ALS Sample ID	*for the Protection*	L1216083-1	L1372865-4	L1216083-2	L1372865-5	L1216083-3	L1372865-1	L1216083-4	L1372865-2	L1216083-5	L1372865-3
Matrix	*of Aquatic Life*	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Volatile Organic Compounds											
Benzene		<0.00050	<0.00050	-	-	<0.00050	<0.00050	-	-	-	-
Ethylbenzene		<0.00050	<0.00050	-	-	<0.00050	<0.00050	-	-	-	-
Methyl t-butyl ether (MTBE)		<0.00050	<0.00050	-	-	<0.00050	<0.00050	-	-	-	-
Styrene		<0.00050	<0.00050	-	-	<0.00050	<0.00050	-	-	-	-
Toluene		<0.00050	<0.00050	-	-	<0.00050	<0.00050	-	-	-	-
ortho-Xylene		<0.00050	<0.00050	-	-	<0.00050	<0.00050	-	-	-	-
meta- & para-Xylene		<0.00050	<0.00050	-	-	<0.00050	<0.00050	-	-	-	-
Xylenes		<0.00075	<0.00075	-	-	<0.00075	<0.00075	-	-	-	-
Surrogate: 4-Bromofluorobenzene (SS)		82.2	99.3	-	-	84.1	101.4	-	-	-	-
Surrogate: 1,4-Difluorobenzene (SS)		84.7	99.8	-	-	85.0	99.8	-	-	-	-
Hydrocarbons											
EPH10-19		<0.25	<0.25	-	-	<0.25	<0.25	-	-	-	-
EPH19-32		<0.25	<0.25	-	-	<0.25	<0.25	-	-	-	-
LEPH		<0.25	<0.25	-	-	<0.25	<0.25	-	-	-	-
HEPH		<0.25	<0.25	-	-	<0.25	<0.25	-	-	-	-
Volatile Hydrocarbons (VH6-10)		<0.10	<0.10	-	-	<0.10	<0.10	-	-	-	-
VPH (C6-C10)		<0.10	<0.10	-	-	<0.10	<0.10	-	-	-	-
Surrogate: 3,4-Dichlorotoluene (SS)		99.9	115.5	-	-	101.7	115.7	-	-	-	-

RESULTS OF ANALYSIS	Legend:		*Exceeds Guideline*		-	*Not analyzed*		"<x" or "n.d."	*Below detection level*		
Sample ID	**CCME**	mccfq1b		wicfq1b		yucfq1b		bicfq1b		mncfq1b	
Date Sampled	*Water Quality*	25-SEP-12	03-OCT-13	25-SEP-12	03-OCT-13	26-SEP-12	02-OCT-13	26-SEP-12	02-OCT-13	26-SEP-12	02-OCT-13
Time Sampled	*Guidelines*	15:20	10:30	16:10	11:00	17:00	14:35	15:15	13:30	13:00	12:30
ALS Sample ID	*for the Protection*	L1216083-1	L1372865-4	L1216083-2	L1372865-5	L1216083-3	L1372865-1	L1216083-4	L1372865-2	L1216083-5	L1372865-3
Matrix	*of Aquatic Life*	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Polycyclic Aromatic Hydrocarbons											
Acenaphthene		<0.000050	<0.000050	-	-	<0.000050	<0.000050	-	-	-	-
Acenaphthylene		<0.000050	<0.000050	-	-	<0.000050	<0.000050	-	-	-	-
Acridine		<0.000050	<0.000050	-	-	<0.000050	<0.000050	-	-	-	-
Anthracene		<0.000050	<0.000050	-	-	<0.000050	<0.000050	-	-	-	-
Benz(a)anthracene		<0.000050	<0.000050	-	-	<0.000050	<0.000050	-	-	-	-
Benzo(a)pyrene		<0.000010	<0.000010	-	-	<0.000010	<0.000010	-	-	-	-
Benzo(b)fluoranthene		<0.000050	<0.000050	-	-	<0.000050	<0.000050	-	-	-	-
Benzo(g,h,i)perylene		<0.000050	<0.000050	-	-	<0.000050	<0.000050	-	-	-	-
Benzo(k)fluoranthene		<0.000050	<0.000050	-	-	<0.000050	<0.000050	-	-	-	-
Chrysene		<0.000050	<0.000050	-	-	<0.000050	<0.000050	-	-	-	-
Dibenz(a,h)anthracene		<0.000050	<0.000050	-	-	<0.000050	<0.000050	-	-	-	-
Fluoranthene		<0.000050	<0.000050	-	-	<0.000050	<0.000050	-	-	-	-
Fluorene		<0.000050	<0.000050	-	-	<0.000050	<0.000050	-	-	-	-
Indeno(1,2,3-c,d)pyrene		<0.000050	<0.000050	-	-	<0.000050	<0.000050	-	-	-	-
Naphthalene		<0.000050	<0.000050	-	-	<0.000050	<0.000050	-	-	-	-
Phenanthrene		<0.000050	<0.000050	-	-	<0.000050	<0.000050	-	-	-	-
Pyrene		<0.000050	<0.000050	-	-	<0.000050	<0.000050	-	-	-	-
Quinoline		<0.000050	<0.000050	-	-	<0.000050	<0.000050	-	-	-	-
Surrogate: Acenaphthene d10		76.3	82.8	-	-	87.2	81.8	-	-	-	-
Surrogate: Acridine d9		85.5	79.9	-	-	77.4	81.0	-	-	-	-
Surrogate: Chrysene d12		86.5	80.9	-	-	83.5	80.0	-	-	-	-
Surrogate: Naphthalene d8		77.7	83.0	-	-	82.8	81.3	-	-	-	-
Surrogate: Phenanthrene d10		90.2	79.8	-	-	77.5	79.3	-	-	-	-