



Climate Adaptation Strategies

An Intergenerational effort to combine
Indigenous Knowledge and Western Science



A 2013-14 community report prepared for
Tr'ondëk Hwëch'in First Nation
by the Yukon River Inter-Tribal Watershed Council



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This 2013-14 community report was prepared for Tr'ondëk Hwëch'in 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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Mähsi 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 THFN

This report presents the results of the second project the YRITWC has successfully implemented together with Tr'ondëk Hwëch'in First Nation (THFN) 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 (Tr'ondëk Hwëch'in, Kluane, White River, Selkirk 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 health 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 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 (Tr'ondëk Hwëch'in, Kluane, White River, Selkirk 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 THFN

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 THFN’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 THFN. Participants identified, discussed, and mapped (using ArcGIS) sources of contamination and potential impacts on water resources.

A total of 26 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

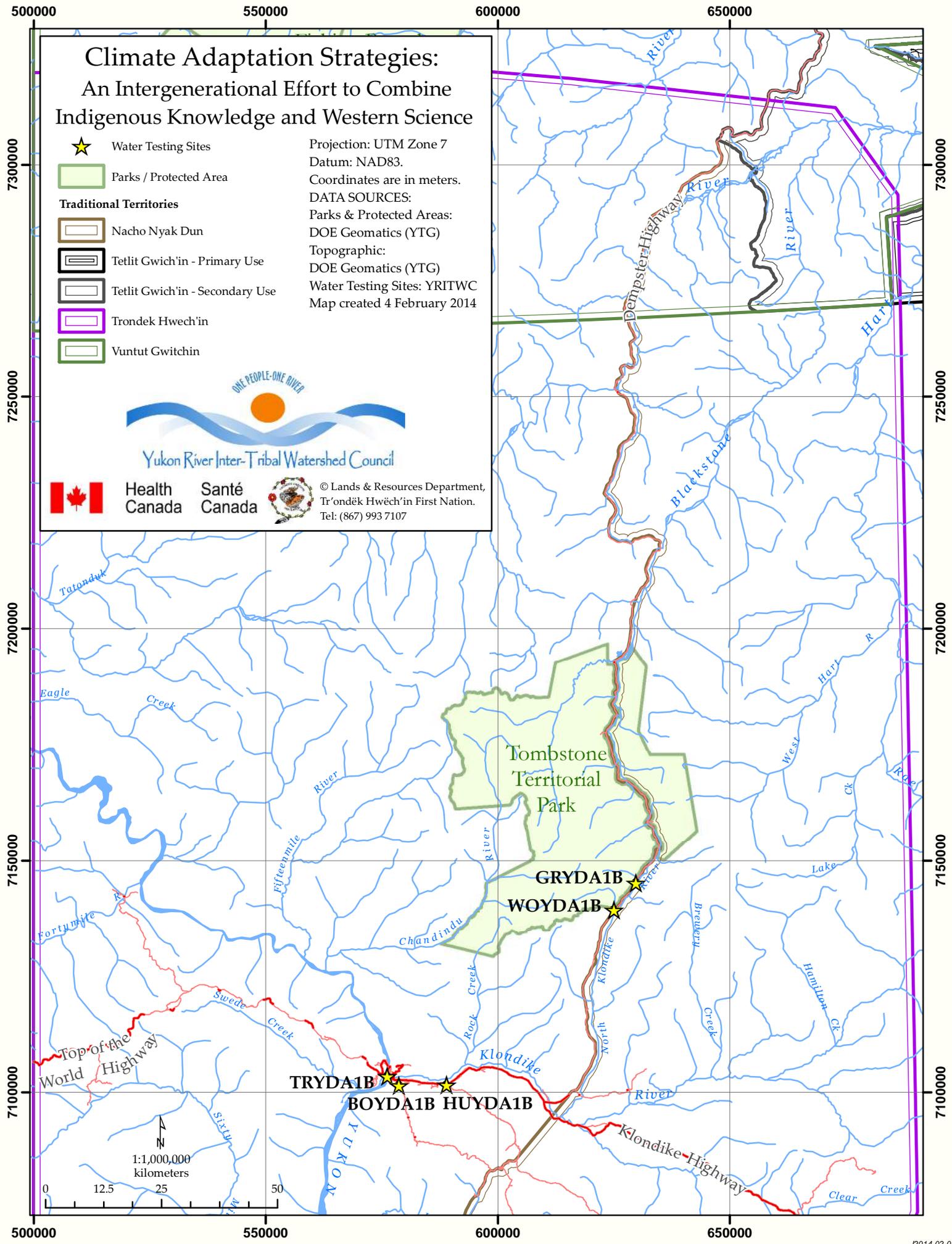
Climate Adaptation Strategies: An Intergenerational Effort to Combine Indigenous Knowledge and Western Science

- ★ Water Testing Sites
- ▭ Parks / Protected Area
- Traditional Territories**
- ▭ Nacho Nyak Dun
- ▭ Tetlit Gwich'in - Primary Use
- ▭ Tetlit Gwich'in - Secondary Use
- ▭ Trondek Hwech'in
- ▭ Vuntut Gwitchin

Projection: UTM Zone 7
Datum: NAD83.
Coordinates are in meters.
DATA SOURCES:
Parks & Protected Areas:
DOE Geomatics (YTG)
Topographic:
DOE Geomatics (YTG)
Water Testing Sites: YRITWC
Map created 4 February 2014



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decided to be of highest priority:

1. Hunker Creek Below (huyda1b)
2. Bonanza Creek Below (boyda1b)
3. Grizzly Creek Below (gryda1b)
4. Wolf Creek Below (woyda1b)
5. Tr'ochëk Swimming Pond (tryda1b)

Descriptions of each of these sites can be found in Appendix A. These five sites are illustrated on the accompanying map of KFN'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
Sept. 17	Hunker Creek	x	x		
	Bonanza Creek	x	x		
Sept. 18	Grizzly Creek		x	x	x
	Wolf Creek		x	x	x
Sept. 19	Tr'ochëk Swimming Pond		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).

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):

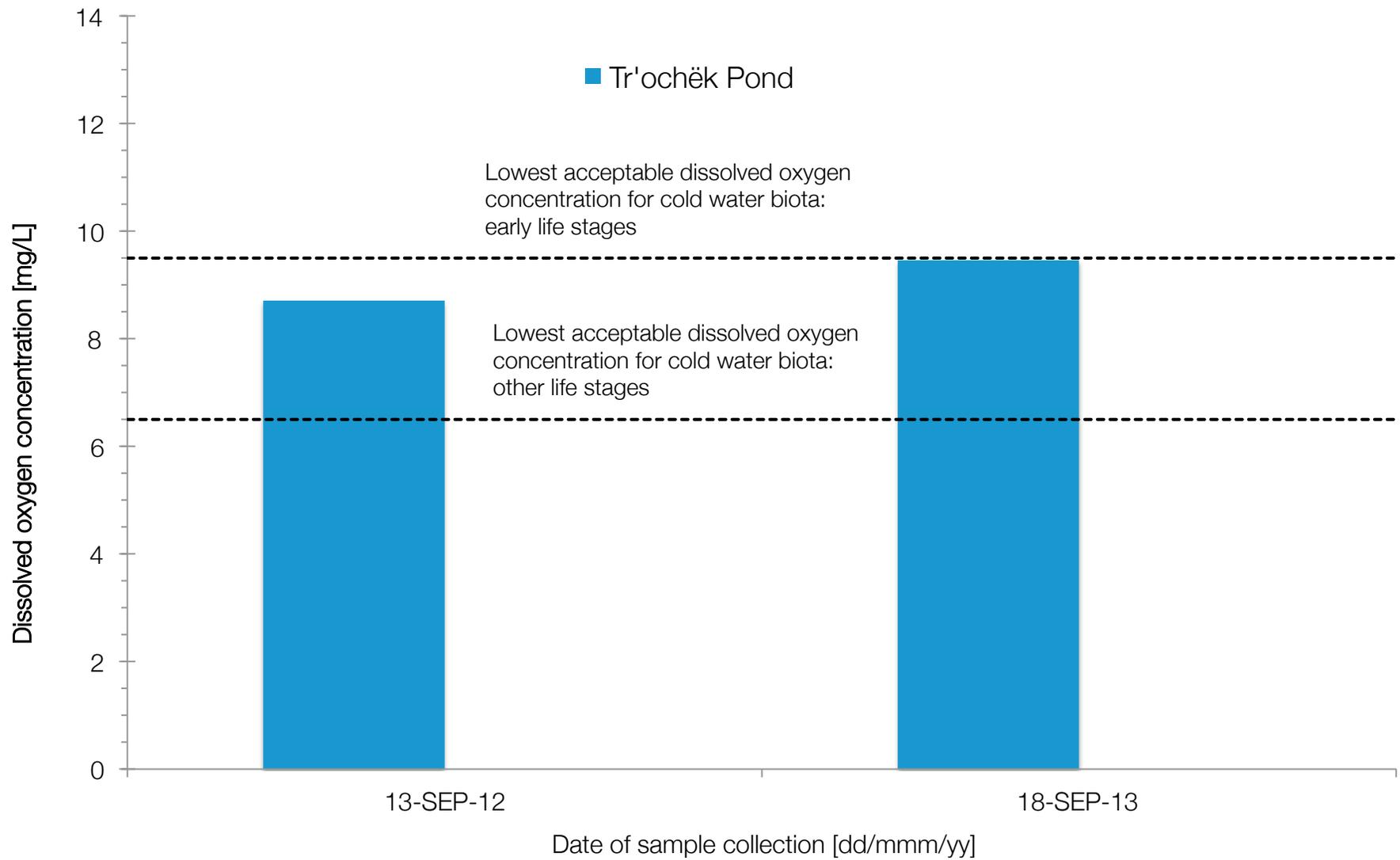
- For cold water biota: early life stages = 9.5 mg/L
- For cold water biota: other life stages = 6.5 mg/L

In 2012 and 2013, the dissolved oxygen concentration in Tr'ochëk Pond was below the lowest acceptable dissolved oxygen concentration for cold-water biota for early life stages established by the Canadian Guideline for the Protection of Aquatic Life (Figure 2). Continued monitoring of Tr'ochëk Pond is recommended to better understand the natural variation of dissolved oxygen concentrations at this site.

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.

Figure 2: Dissolved oxygen concentrations below the CCME guidelines



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 THFN'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 drinking water because their presence indicates contamination of a water supply by an outside source. Total coliforms were detected in all of the samples analyzed for this parameter (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 not detected in any of the samples analyzed for this parameter (Appendix B).

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 concentration in Hunker Creek was found to exceed the Canadian Guideline for the Protection of Aquatic Life (Figure 3). In Bonanza Creek, the *total* aluminum concentration exceeded the guideline in 2013 and the *dissolved* aluminum concentration exceeded the guideline in 2012 (Figure 3). In 2012, note that the total aluminum concentration did not exceed the guideline; this variation may be the result of different laboratory methods used by USGS and ALS (Appendix B).

In 2012 and 2013, the total arsenic concentrations in Hunker Creek and Bonanza Creek were found to exceed the Canadian Guideline for the Protection of Aquatic Life (Figure 4).

In 2012 and 2013, the total iron concentrations in Hunker Creek and Bonanza Creek were found to exceed the Canadian Guideline for the Protection of Aquatic Life (Figure 5). In 2013, the total iron concentration in Tr'ochëk Pond exceeded the guideline (Figure 5). In 2012, total iron was not analyzed for Tr'ochëk Pond but dissolved iron was and it was not found to exceed the guideline in that year.

In 2012, dissolved zinc concentration in Bonanza Creek was found to exceed the Canadian Guideline for the Protection of Aquatic Life (Figure 6). In 2012, note that the total aluminum concentration did not exceed the guideline; again, this variation may be the result of different laboratory methods used by USGS and ALS (Appendix B).

Aluminum, arsenic, copper, iron and zinc are commonly found in relatively low concentrations in surface waters draining areas with mineral deposits. These elements tend to dissolve in water that is in contact with rocks and soils that naturally contain them. Continued monitoring of these sites, particularly Hunker Creek and Bonanza Creek, is recommended to better understand the natural

variation of these five metals in the region. Hunker Creek and Bonanza Creek should be strictly avoided as secondary drinking water sources because both creeks contain arsenic, which is carcinogenic (capable of causing cancer) if ingested. Additional sampling is recommended to determine background arsenic concentrations for these creeks and thereby determine if they have been adversely impacted by upstream mining activity.

Figure 3: Aluminum concentrations above the CCME guideline

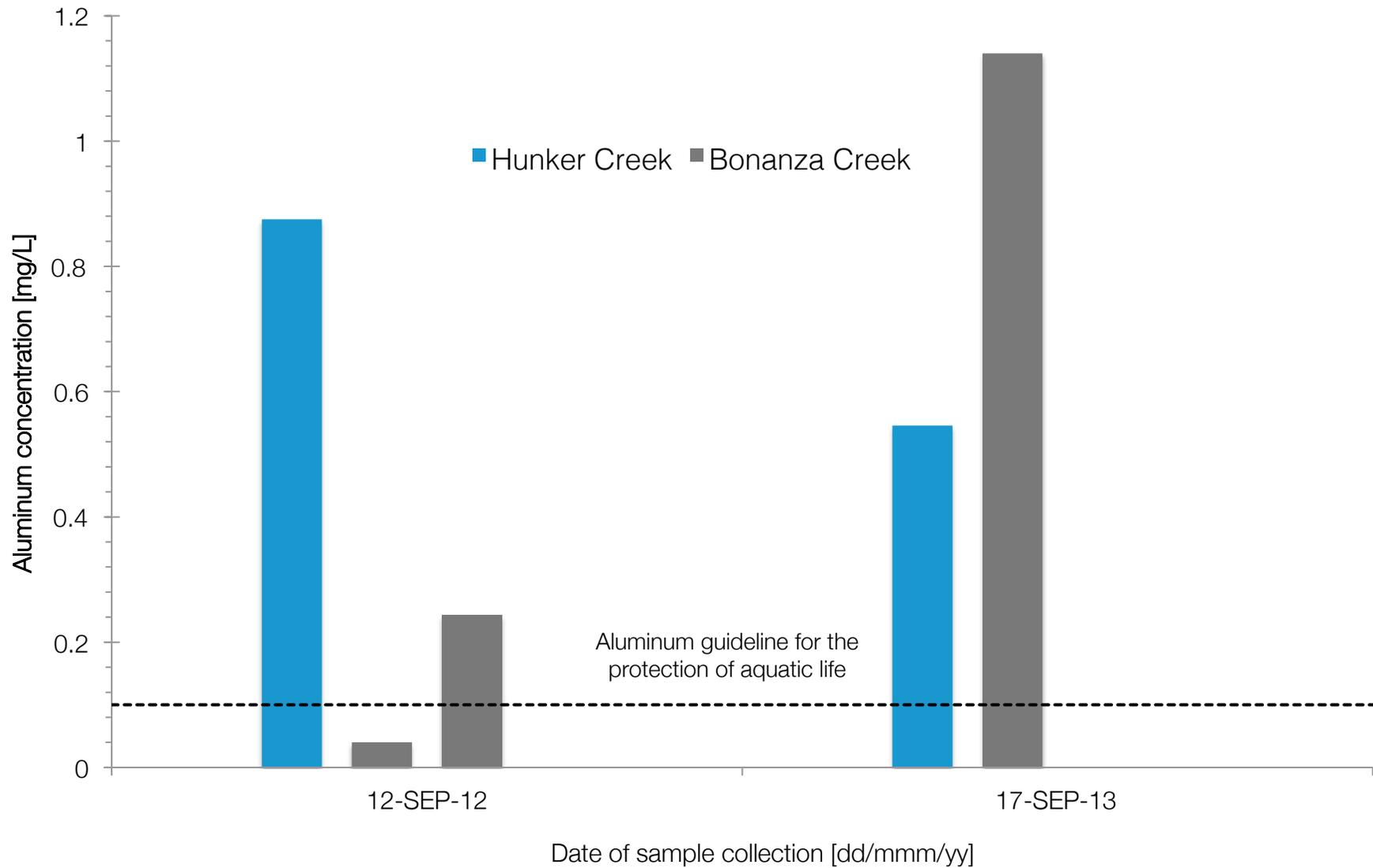


Figure 4: Arsenic concentrations above the CCME guideline

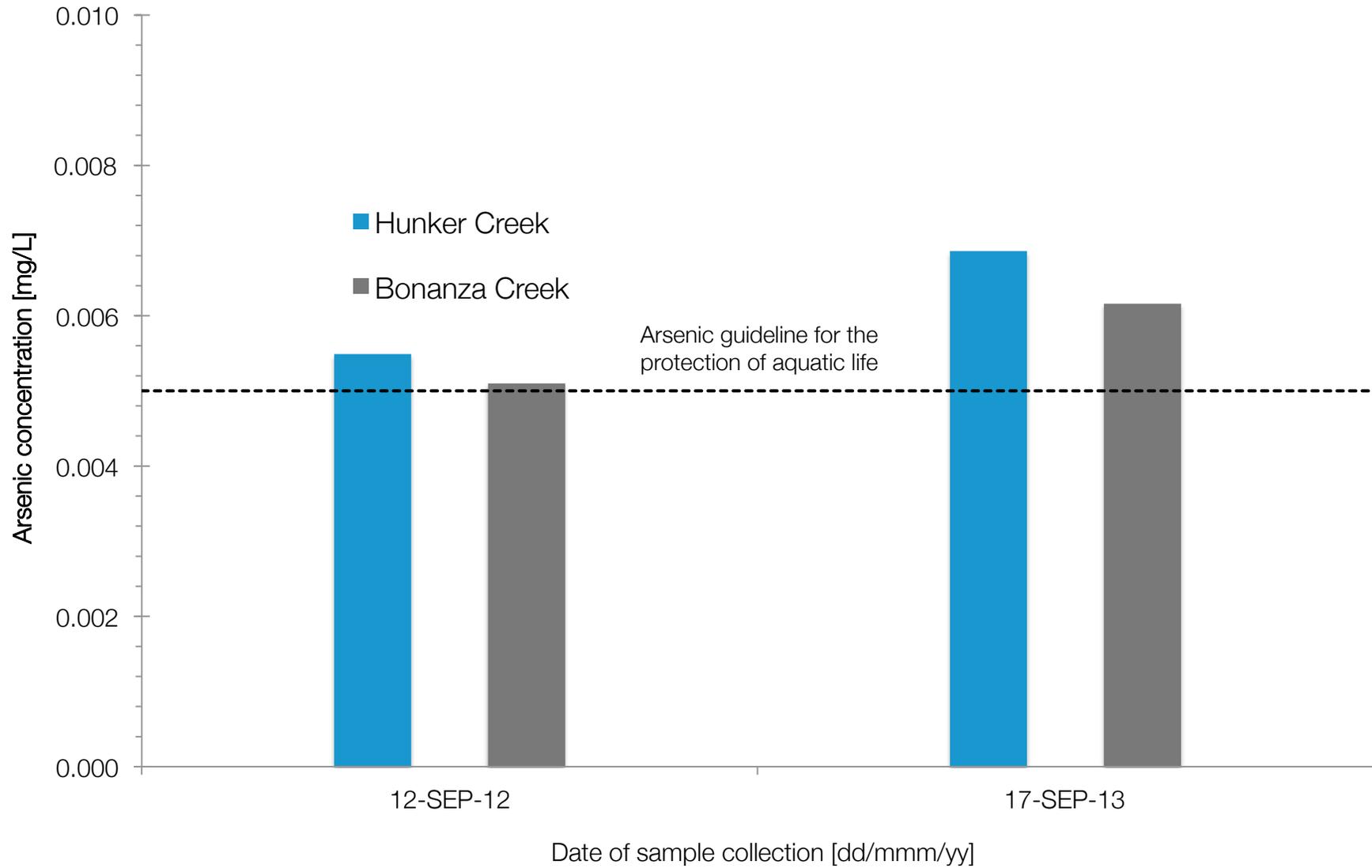


Figure 5: Iron concentrations above the CCME guideline

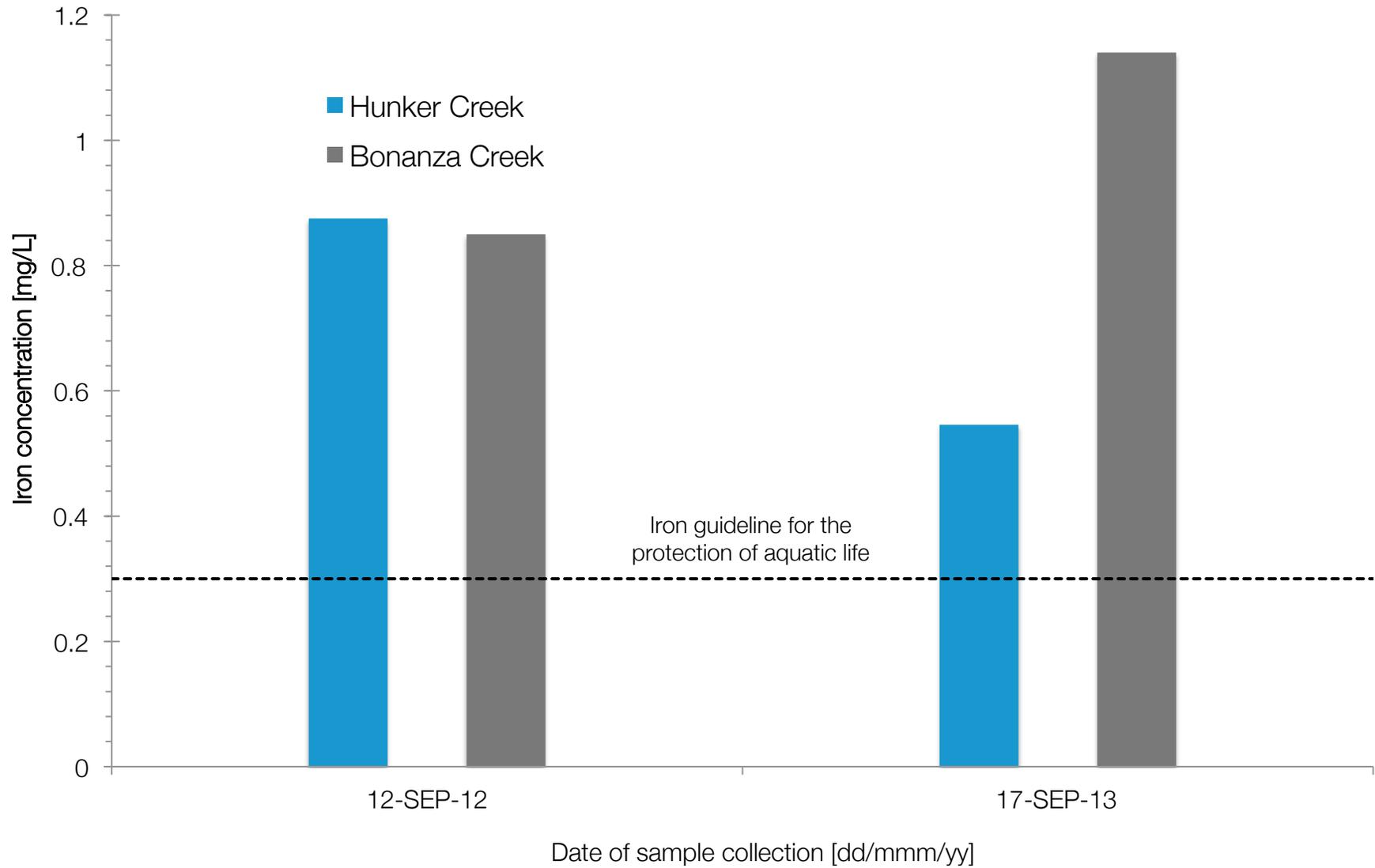
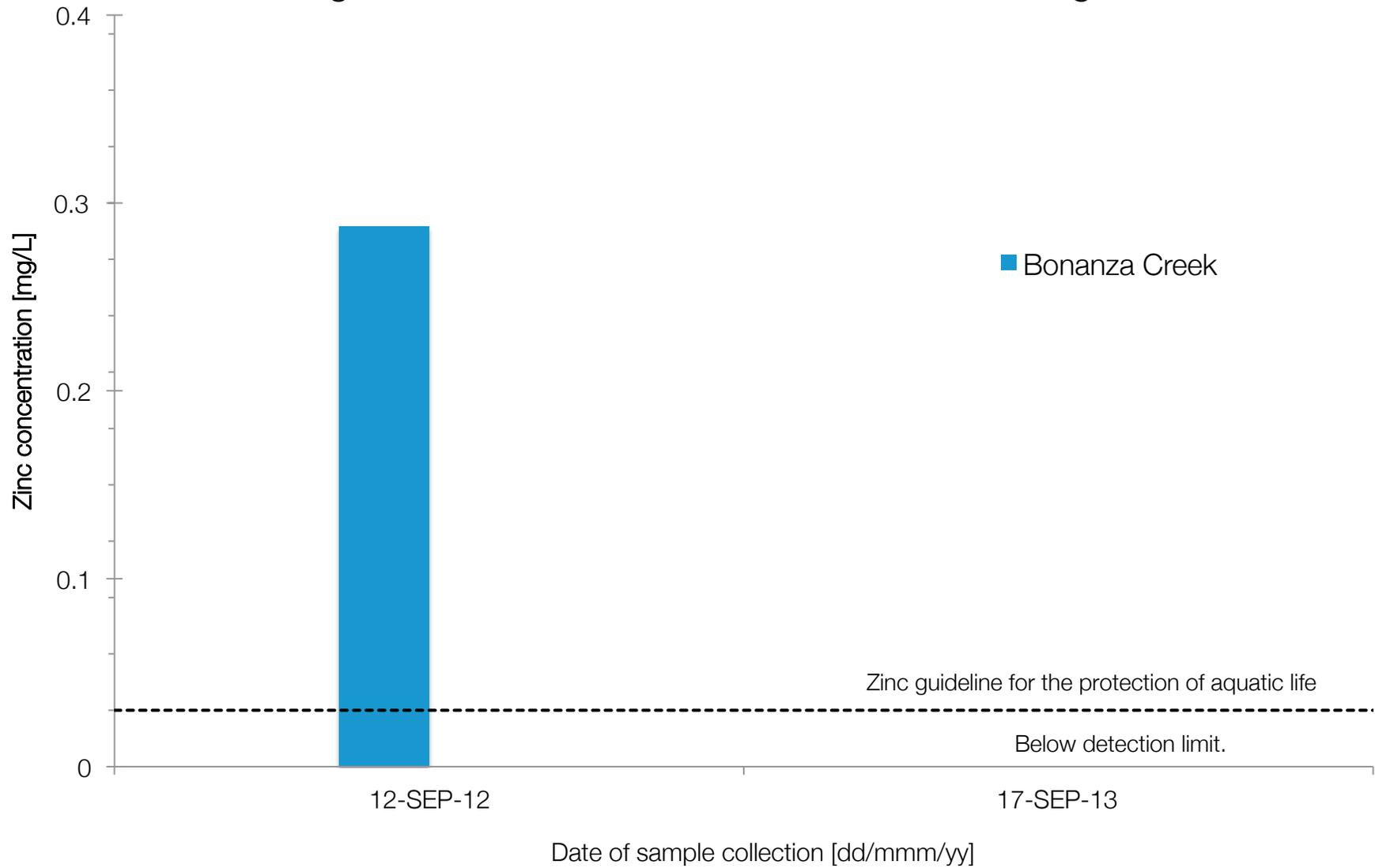


Figure 6: Zinc concentrations above the CCME guideline



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:

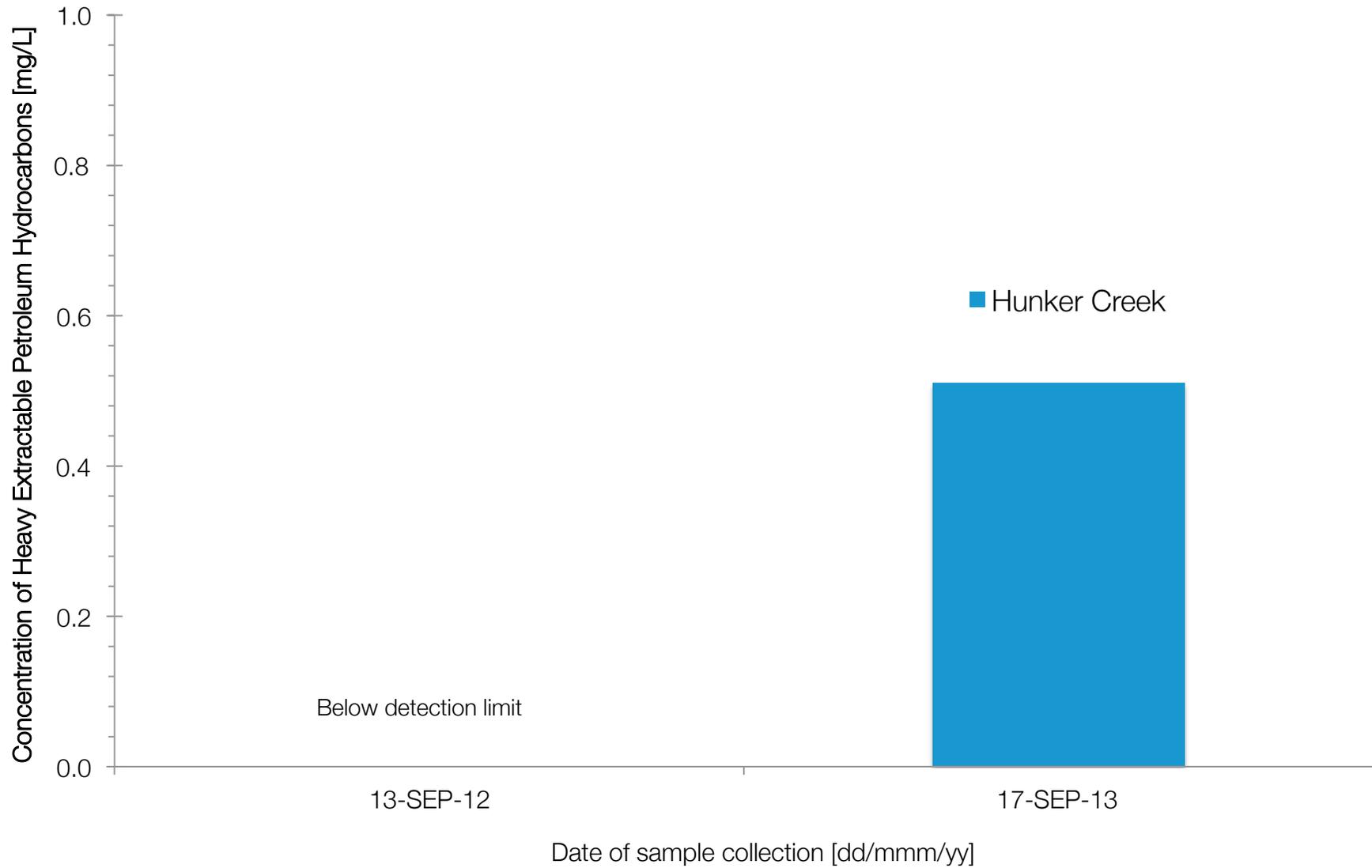
1. Volatile organic compounds (including benzene, toluene, ethylbenzene, xylene and styrene; collectively referred to as “BTEX + styrene”), and
2. Polycyclic aromatic hydrocarbons (PAH).

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 extractable petroleum hydrocarbons (HEPH).

In 2013, HEPH were found to exceed the minimum detection limits of the laboratory in Hunker Creek (Figure 7). HEPH were not detected in Hunker Creek in 2012. Heavy extractable petroleum hydrocarbons (HEPH) contain the petroleum hydrocarbons with a carbon range of C19-32, with the exception of certain PAHs (Benz(a)anthracene, Benzo(a)pyrene, Fluoranthene, and Pyrene) in the same carbon range. Additional sampling of Hunker Creek is recommended to validate these results.

Figure 7: HEPH concentrations above the detection limit



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 subsistence 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 beings (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 custom-made catalog 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 8. YRITWC staff recorded a summary of the ideas and strategies discussed.

Figure 8: Example of data generation methodology at THFN 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.

Tr'ondëk Hwëch'in First Nation's workshop

The Tr'ondëk Hwëch'in First Nations workshop was held on November 28, 2013 from 9:30 AM – 4:00 PM at the Tr'ondëk Hwëch'in Hall in Dawson City, Yukon. A total of 11 individuals participated in this workshop and included three youth and eight Elders. In addition, three community members participated as observers. The three 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 THFN's Traditional Knowledge Policy. Raw data collected during this project are available at THFN'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 Melting Permafrost. 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 melting ice, changes in seasonal weather patterns and opportunities for growing more food and exploring alternative energy. Below is a summary of how participants see climate change affecting weather in their community:

- Changes in temperatures result in ice melting, thinner ice on the Yukon, less huge chunks of ice on the river. Ice bridges can't form. Freeze up happens later.
- Seasonal changes include a late fall. Leaves drop later and it is hard to spot wildlife. Hunting season is happening later.
- More snow and strong storms that move south and Yukon weather moves east.
- Temperatures vary but there is less extreme cold.

- Changes in vegetation especially on the tundra.
- Increased greenhouse gases and smoke over Dawson especially in winter.
- Traditional practices like dogsledding are interrupted. Sled dogs are overheated.
- Changes in weather make it difficult to live off the land.
- Mines are impacted – especially Hunker and Bonanza Creeks.
- Changes in weather have led to public health problems like increased illness and cancer.
- Wildlife species are dying off.
- Variable weather makes it difficult to plan.
- Changes in weather may make it possible to create year-round greenhouses.
- Weather could increase the number of garden boxes at people’s homes.
- Use of solar panels and alternative energy should be explored.

WILDLIFE

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

- Wildlife like deer, cougars and caribou are migrating into Yukon.
- Migration patterns of species like swallows, geese and ducks have changed
- Hunting seasons are later. Moose rut is late.
- Animals are confused by warmer weather.
- Invasive species such as crows are in the area.
- Increased parasites.
- Ravens adapting to changing conditions.
- Chinook salmon declining. Salmon harvest is declining.
- Traditional fishing spots cannot be fished such as Bonanza River.
- Starting to eat other species such as chum salmon and deer.
- Change the diet and consider raising livestock such as chicken and pigs. Start fox farms and caribou herding.
- Share meat with community.
- Use a dry food storage system.

MELTING PERMAFROST

Workshop participants noted that melting permafrost as a result of climate change has impacted the water systems, increased river turbidity and raises concerns about landslides, washouts and sinkholes. Below is a summary of how permafrost degradation affects THFN's traditional territory from workshop participants' perspectives:

- Creeks becoming muddier.
- Houses and other buildings are shifting.
- Slumping along the Dempster.
- Rapid changes in tundra along the Dempster.
- Roads buckling, shoulders splitting.
- Washouts.
- Lakes drying up.
- More run-off.
- Drinking water being threatened.
- Landslide risks. Do not camp near hillside.
- Sink holes developing.
- Hazards along Dome Road and Klondike Highway.
- Elders and engineers say mountains will slide.
- Heat escapes from slumped building (wasted energy).
- Education is needed about problem and new technologies.
- Learn patterns in nature and observe surroundings for change.
- Building on pads; not using concrete foundations.

In addition to the summaries above, workshop participants noted the following things related to climate change:

- More vehicles causing pollution. Create more idle-free zones.
- Southern cities have huge impacts on northern life.
- There are more people due to a growing population in Dawson and increased tourism throughout the region.
- Efforts need to be made to buy local and to develop and support local agricultural activities such as farmer's markets.
- Increase local agriculture by creating a seed bank, conducting agricultural studies like soil testing, and starting composting projects.
- Listen to Elders.
- Create resources for adaptive management plans.

- Monitor energy consumption and use solar panels. Ban plastic bags and recycle plastics.
- Use local, excess wood chips and sawdust for boilers.
- Pressure government for support.
- Never say “I quit” or “I can’t.”

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 three themes listed above as seen in Table 2.

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

	Weather Variability	Wildlife	Permafrost Melting
Observation	<ul style="list-style-type: none"> • Ice melting and river ice is thinner • Changing vegetation patterns (on the tundra, etc.) • More temperature variability and delayed seasons • More snow but less extreme temperatures 	<ul style="list-style-type: none"> • Wildlife migrating into Yukon • Changing migration patterns • Late moose rut • Invasive species (crows) • Chinook salmon declining • Some rivers like Bonanza River not fishable anymore 	<ul style="list-style-type: none"> • Creeks becoming muddier • Houses and other buildings are shifting • Slumping along the Dempster • Rapid changes in tundra along the Dempster • Roads buckling, shoulders splitting • Washouts • Lakes drying up
Impacts	<ul style="list-style-type: none"> • Can't live off the land like before • Traditional practices (dogsledding) disrupted • Mines are impacted • More people from increased population and more tourism • Increase in cancer and other illnesses • Difficult to plan for unknown 	<ul style="list-style-type: none"> • Late hunting season • Animals confused by warmer weather • Parasites • Decreased salmon harvest 	<ul style="list-style-type: none"> • Drinking water being threatened • Landslide risks • Sink holes developing • Hazards along Dome Rd. and Klondike Hwy • Elders and engineers say mountains will slide • Heat escapes from slumped building (wasted energy)
Adaptations	<ul style="list-style-type: none"> • Share meat • Consider raising livestock (chickens, pigs, etc.) • Dry food for storage • Changing our diet • Create fox farms, start caribou herding, eat other species • Continue to use traditional ways and learn from Elders 	<ul style="list-style-type: none"> • Opportunities for increased agriculture • Need to support local agriculture • Compost, create seed banks and buy local • Explore alternative energy • Listen to Elders • Pressure governments 	<ul style="list-style-type: none"> • Do not camp near hillside (landslide risks) • Education • New technologies • Learn patterns in nature • Observe surroundings • Building on pads; not using concrete foundations • Look at Yukon Government studies

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 THFN and the other four First Nations (White River, Kluane, Selkirk, 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://sts.ccme.ca/>): January 2014.

Berkes, Fikret. 2008. Sacred Ecology. Routledge.

Appendix A: Site descriptions

Traditional territory: THFN

Water body: Bonanza Creek

Site name: boyda1b

Coordinates: N. 64.03104°
W. 139.38953°

Contaminants of concern: Metals from mining activity

Date sampled: Sept. 17, 2013



Traditional territory: THFN

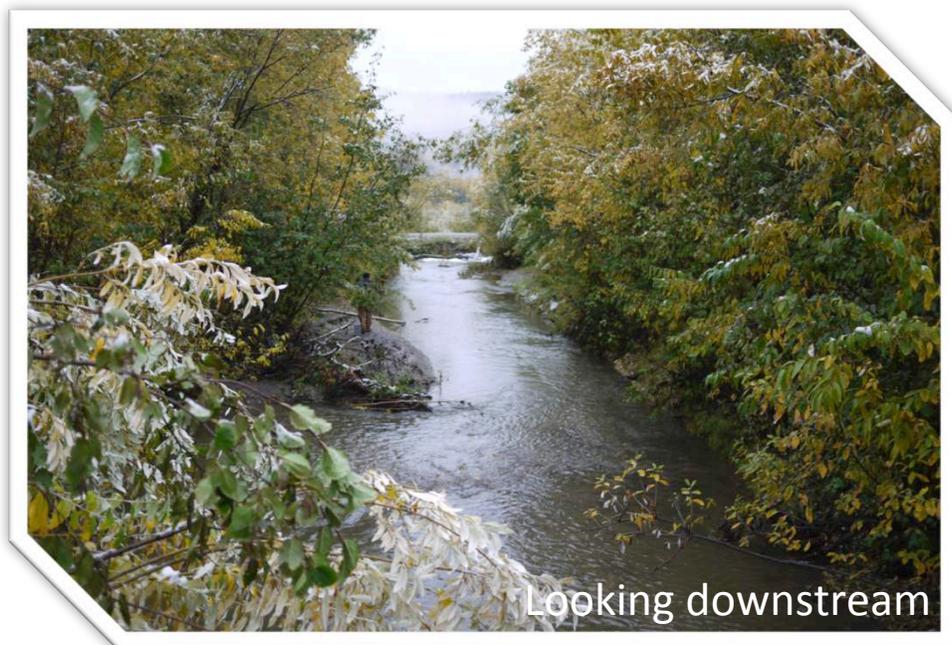
Water body: Hunker Creek

Site name: huyda1b

Coordinates:
N. 64.02972°
W. 139.17839°

Contaminants of concern: Metals from mining activity

Date sampled: Sept. 17, 2013



Traditional territory: THFN

Water body: Tr'ochek Pond

Site name: trydalb

Coordinates: N. 64.04974°
W. 139.43991°

Contaminants of concern: Bacteria from wildlife and livestock

Date sampled: Sept. 18, 2013



Traditional territory: THFN

Water body: Grizzly Creek

Site name: gryda1b

Coordinates: N. 64.40793°
W. 139.30678°

Contaminants of concern: Bacteria in drinking water

Date sampled: Sept. 18, 2013



Traditional territory: THFN

Water body: Wolf Creek

Site name: woyda1b

Coordinates: N. 64.35678°
W. 139.40973°

Contaminants of concern: Bacteria in drinking water

Date sampled: Sept. 18, 2013



Appendix B: Water quality data

RESULTS OF ANALYSIS		Legend:		Exceeds Guideline	-	Not analyzed	"<x" or "n.d."	Below detection level			
Sample ID	CCME	gryda1b		woyda1b		huyda1b		tryda1b		boyda1b	
Date Sampled	Water Quality	12-SEP-12	18-SEP-13	12-SEP-12	18-SEP-13	13-SEP-12	17-SEP-13	13-SEP-12	18-SEP-13	12-SEP-12	17-SEP-13
Time Sampled	Guidelines	11:56	11:25	18:18	11:45	11:05	10:42	10:48	09:30	15:04	11:11
ALS Sample ID	for the Protection	L1209042-1	L1365531-2	L1209042-2	L1365531-3	L1210081-2	L1366143-1	L1209042-3	L1365531-1	L1210081-3	L1366143-2
Matrix	of Aquatic Life	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Field Parameters											
pH	6.5 - 9.0	8.06	7.76	8.02	7.7	8.23	7.79	7.66	7.31	8.17	7.92
Water temperature		2.4	3.22	3.1	2.63	4.4	3.64	7.7	8.35	5.4	3.42
Dissolved oxygen	6.5, 9.5	12.93	14.23	12.76	14.73	12.82	13.82	8.71	9.46	12.95	15.29
Specific conductance		194.7	167	151.8	127	-	272	271.2	288	440.9	318
Physical Tests											
Hardness (as CaCO3)		91.41	82.2	75.6	60.7	431	400	139.02	152	294	261
Major Ions											
Alkalinity		56.6	-	45.7	-	273.2	-	106.4	-	176.5	-
Chloride (Cl)	640	0.2	-	0.9	-	1.3	-	0.4	-	1.6	-
Sulphate (SO4)		49.4	-	35.6	-	145.3	-	55.8	-	137.2	-
Calcium (Ca)		26.7	-	20.8	-	94.5	-	36.1	-	76.8	-
Magnesium (Mg)		6.0	-	4.4	-	43.3	-	11.8	-	24.3	-
Sodium (Na)		0.7	-	1.0	-	10.8	-	2.4	-	5.7	-
Potassium (K)		0.2	-	0.1	-	2.3	-	0.4	-	1.8	-
Nutrients											
Dissolved Organic Carbon (DOC)		0.97	-	0.77	-	11.25	-	3.19	-	9.18	-
Ammonium (NH4)		0.5	-	0.0	-	0.7	-	0.6	-	0.9	-
Nitrate and Nitrite (as N)		0.0562	0.0731	1.35	0.0853	-	-	<0.0051	<0.0051	-	-
Nitrate (as N)	13	0.0562	0.0731	1.35	0.0853	-	-	<0.0050	<0.0050	-	-
Nitrite (as N)	0.06	<0.0010	<0.0010	<0.10	<0.0010	-	-	<0.0010	<0.0010	-	-
Orthophosphate-Dissolved (as P)		<0.0010	<0.0010	<0.0010	<0.0010	-	-	<0.0010	<0.0010	-	-
Phosphorus (P)-Total	Guidance framework	<0.0020	<0.0020	<0.0020	<0.0020	-	-	0.0048	0.0068	-	-

RESULTS OF ANALYSIS		Legend:		Exceeds Guideline	-	Not analyzed	"<x" or "n.d."	Below detection level			
Sample ID	CCME	gryda1b		woyda1b		huyda1b		tryda1b		boyda1b	
Date Sampled	Water Quality	12-SEP-12	18-SEP-13	12-SEP-12	18-SEP-13	13-SEP-12	17-SEP-13	13-SEP-12	18-SEP-13	12-SEP-12	17-SEP-13
Time Sampled	Guidelines	11:56	11:25	18:18	11:45	11:05	10:42	10:48	09:30	15:04	11:11
ALS Sample ID	for the Protection	L1209042-1	L1365531-2	L1209042-2	L1365531-3	L1210081-2	L1366143-1	L1209042-3	L1365531-1	L1210081-3	L1366143-2
Matrix	of Aquatic Life	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Bacteriological Tests											
E. coli		<1	<1	<1	<1	-	-	<1	<1	-	-
Coliform Bacteria - Total		5	16	5	5	-	-	201	101	-	-
Total Metals											
Aluminum (Al)-Total	Fxn of pH	-	<0.010	<0.010	<0.010	0.875	0.546	-	0.014	0.040	1.14
Antimony (Sb)-Total		-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	<0.00050	<0.00050	<0.00050
Arsenic (As)-Total	0.005	-	0.00098	0.00076	0.00076	0.00549	0.00686	-	0.00101	0.00510	0.00616
Barium (Ba)-Total		-	0.035	0.048	0.038	0.159	0.070	-	0.071	0.062	0.114
Boron (B)-Total	1.5	-	<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	0.00024
Calcium (Ca)-Total		-	25.1	23.1	18.6	104	97.7	-	41.7	79.1	71.1
Chromium (Cr)-Total		-	<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	0.0047	0.0029	-	<0.0010	0.0018	0.0035
Iron (Fe)-Total	0.3	-	<0.030	<0.030	<0.030	2.16	2.01	-	0.128	0.850	2.30
Lead (Pb)-Total	Fxn of hardness	-	<0.00050	<0.00050	<0.00050	0.00337	0.00099	-	<0.00050	<0.00050	0.00469
Magnesium (Mg)-Total		-	4.74	4.39	3.46	41.6	38.0	-	11.6	23.6	20.2
Manganese (Mn)-Total		-	<0.0020	<0.0020	<0.0020	0.446	0.558	-	0.0670	0.167	0.278
Mercury (Hg)-Total	0.026	-	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	-	<0.00020	<0.00020	<0.00020
Potassium (K)-Total		-	0.25	0.22	0.23	3.00	2.82	-	0.66	1.80	2.10
Selenium (Se)-Total	0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010	<0.0010
Sodium (Na)-Total		-	<2.0	<2.0	<2.0	10.5	9.3	-	2.6	7.1	6.1
Uranium (U)-Total	0.015	-	0.00042	0.00065	0.00053	0.0122	0.00899	-	0.00089	0.00630	0.00669
Zinc (Zn)-Total	0.03	-	<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	gryda1b		woyda1b		huyda1b		tryda1b		boyda1b	
Date Sampled	Water Quality	12-SEP-12	18-SEP-13	12-SEP-12	18-SEP-13	13-SEP-12	17-SEP-13	13-SEP-12	18-SEP-13	12-SEP-12	17-SEP-13
Time Sampled	Guidelines	11:56	11:25	18:18	11:45	11:05	10:42	10:48	09:30	15:04	11:11
ALS Sample ID	for the Protection	L1209042-1	L1365531-2	L1209042-2	L1365531-3	L1210081-2	L1366143-1	L1209042-3	L1365531-1	L1210081-3	L1366143-2
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	
Aluminum (Al)-Dissolved	Fxn of pH	0.0021	-	0.0025	-	0.0044	-	n.d.	-	0.2433	-
Antimony (Sb)-Dissolved		-	-	-	-	-	-	-	-	-	-
Arsenic (As)-Dissolved	0.005	-	-	-	-	-	-	-	-	-	-
Barium (Ba)-Dissolved		0.0396	-	0.0457	-	0.0795	-	0.0684	-	0.3889	-
Boron (B)-Dissolved	1.5	-	-	-	-	-	-	-	-	-	-
Cadmium (Cd)-Dissolved	Fxn of hardness	-	-	-	-	-	-	-	-	-	-
Calcium (Ca)-Dissolved		26.7	-	20.8	-	94.5	-	36.1	-	76.8	-
Chromium (Cr)-Dissolved		-	-	-	-	-	-	-	-	-	-
Copper (Cu)-Dissolved	Fxn of hardness	0.0018	-	0.0018	-	0.0032	-	0.0017	-	n.d.	-
Iron (Fe)-Dissolved	0.3	n.d.	-	0.001	-	0.015	-	0.000	-	0.480	-
Lead (Pb)-Dissolved	Fxn of hardness	-	-	-	-	-	-	-	-	-	-
Magnesium (Mg)-Dissolved		6.0	-	4.4	-	43.3	-	11.8	-	24.3	-
Manganese (Mn)-Dissolved		0.0003	-	0.0002	-	0.4088	-	0.0013	-	0.1689	-
Mercury (Hg)-Dissolved	0.026	-	-	-	-	-	-	-	-	-	-
Nickel (Ni)-Dissolved	Fxn of hardness	n.d.	-	n.d.	-	n.d.	-	n.d.	-	0.0008	-
Potassium (K)-Dissolved		0.2	-	0.1	-	2.3	-	0.4	-	1.8	-
Selenium (Se)-Dissolved	0.001	-	-	-	-	-	-	-	-	-	-
Sodium (Na)-Dissolved		0.7	-	1.0	-	10.8	-	2.4	-	5.7	-
Uranium (U)-Dissolved	0.015	-	-	-	-	-	-	-	-	-	-
Zinc (Zn)-Dissolved	0.03	0.010	-	0.009	-	0.017	-	0.014	-	0.287	-

RESULTS OF ANALYSIS		Legend:		Exceeds Guideline	-	Not analyzed	"<x" or "n.d."	Below detection level			
Sample ID	CCME	gryda1b		woyda1b		huyda1b		tryda1b		boyda1b	
Date Sampled	Water Quality	12-SEP-12	18-SEP-13	12-SEP-12	18-SEP-13	13-SEP-12	17-SEP-13	13-SEP-12	18-SEP-13	12-SEP-12	17-SEP-13
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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)		-	-	-	-	82.0	101.8	-	-	80.8	103.6
Surrogate: 1,4-Difluorobenzene (SS)		-	-	-	-	85.2	99.9	-	-	85.2	99.9
Hydrocarbons											
EPH10-19		-	-	-	-	<0.25	<0.25	-	-	<0.25	<0.25
EPH19-32		-	-	-	-	<0.25	0.51	-	-	<0.25	<0.25
LEPH		-	-	-	-	<0.25	<0.25	-	-	<0.25	<0.25
HEPH		-	-	-	-	<0.25	0.51	-	-	<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)		-	-	-	-	84.5	105.0	-	-	82.9	112.5

RESULTS OF ANALYSIS		Legend:		Exceeds Guideline	-	Not analyzed	"<x" or "n.d."	Below detection level			
Sample ID	CCME	gryda1b		woyda1b		huyda1b		tryda1b		boyda1b	
Date Sampled	Water Quality	12-SEP-12	18-SEP-13	12-SEP-12	18-SEP-13	13-SEP-12	17-SEP-13	13-SEP-12	18-SEP-13	12-SEP-12	17-SEP-13
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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		-	-	-	-	89.4	97.1	-	-	95.0	96.4
Surrogate: Acridine d9		-	-	-	-	93.4	109.8	-	-	97.7	110.0
Surrogate: Chrysene d12		-	-	-	-	89.9	97.3	-	-	92.2	96.3
Surrogate: Naphthalene d8		-	-	-	-	88.4	95.4	-	-	95.4	94.8
Surrogate: Phenanthrene d10		-	-	-	-	92.5	100.1	-	-	96.2	98.8