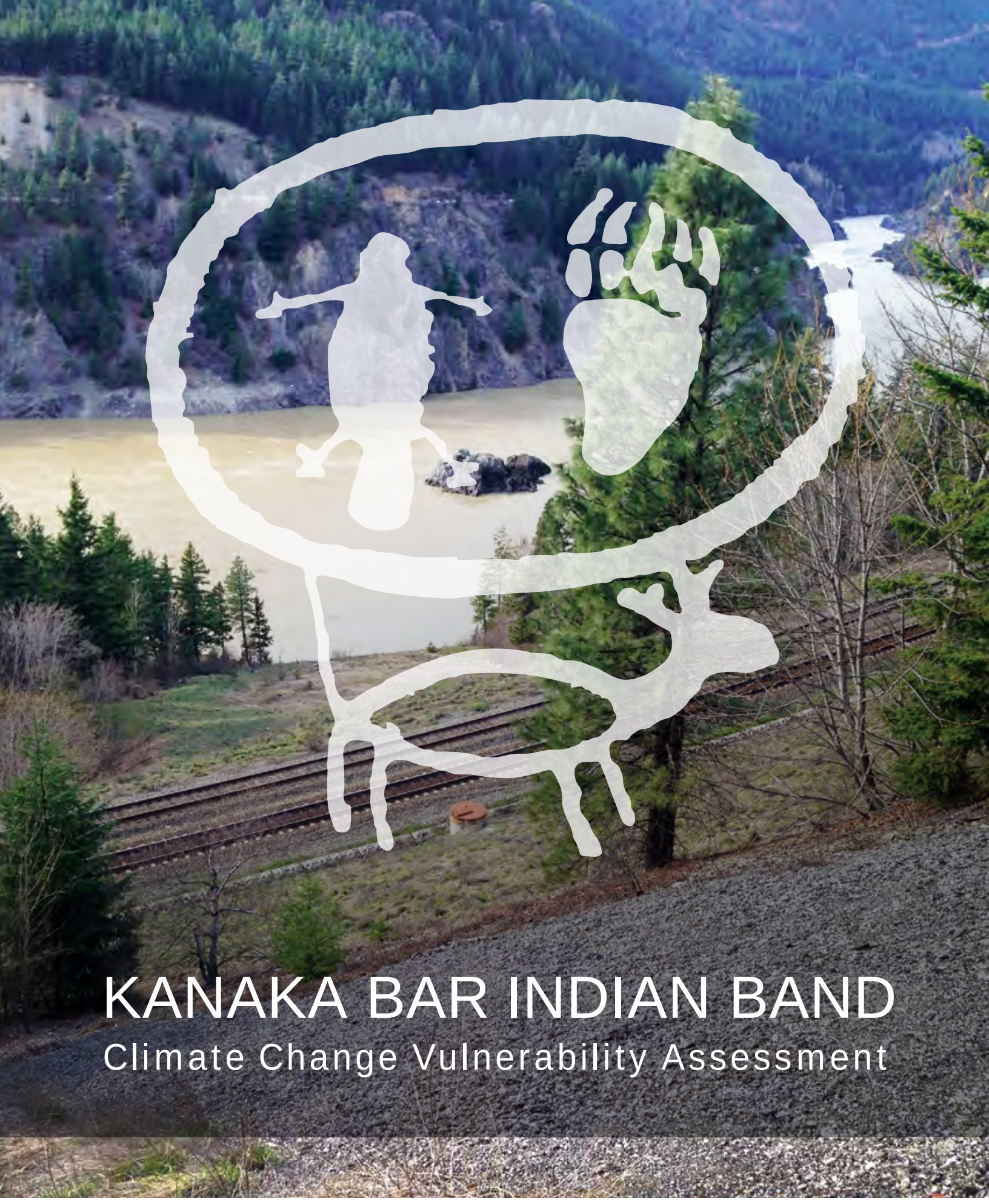

KANAKA BAR INDIAN BAND

Climate Change Vulnerability Assessment

Kanaka Bar Indian Band
2693 Siwash Road,
Kanaka Bar, BC V0K 1Z0

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The knowledge keepers of Kanaka Bar recognize that the air, land and water are now changing.

PRELUDE

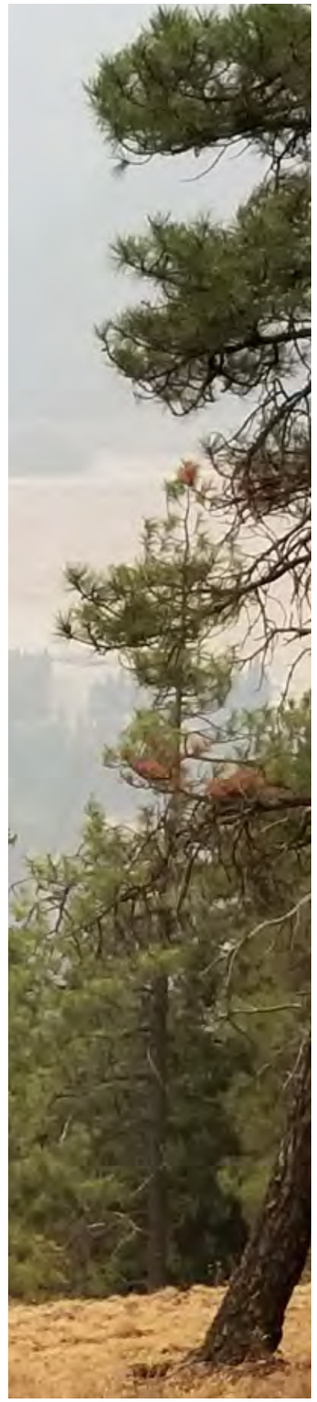
Located in the Fraser Canyon, Kanaka Bar is 1 of 15 communities that make up the Nlaka'pamux Nation today. For more than 7000 years, Kanaka Bar's Traditional Territory has sustained our people, and it has always been, and always will be Kanaka Bar's duty to manage, protect, and regulate the Traditional Territory.

In recent years, community knowledge keepers, and more generally, the residents of Kanaka Bar have become increasingly concerned about observed changes throughout the Traditional Territory. While change has always been constant in the Territory, it is widely recognized by Kanaka Bar that the pace, scale and type of change does not align with the typical historical evolutions of the landscape. In other words, the knowledge keepers of Kanaka Bar recognize that the air, land and water are now changing in ways that represent an imbalance to the ecological systems of the Territory. This is troubling, given the community's interdependency with the Territory.

Kanaka Bar has accepted that human caused climate change is real. Further, Kanaka Bar understands that many of the changes observed throughout the Territory are a direct consequence of climate change. Kanaka Bar has also acknowledged that the scientific community's assessment of global climate change represents significant environmental, social, and economic risks. We are now living in the "age of consequence."

While climate change has, and will likely continue to impact many communities throughout the world, Kanaka Bar continually seeks to better understand recent and potential climate changes and associated influences on the Territory. This will help the community proactively prepare itself for what climate change may bring. Through the advancement of the Kanaka Bar Climate Change Vulnerability Assessment, Kanaka Bar is working to understand its vulnerabilities, prepare for a community transition, and develop adaptation strategies for the environment and economies of tomorrow.

We are now living in the "age of consequence."



Kanaka Bar is committed to using its lands and resources to maintain a self-sufficient, sustainable and vibrant community.

1.0 INTRODUCTION

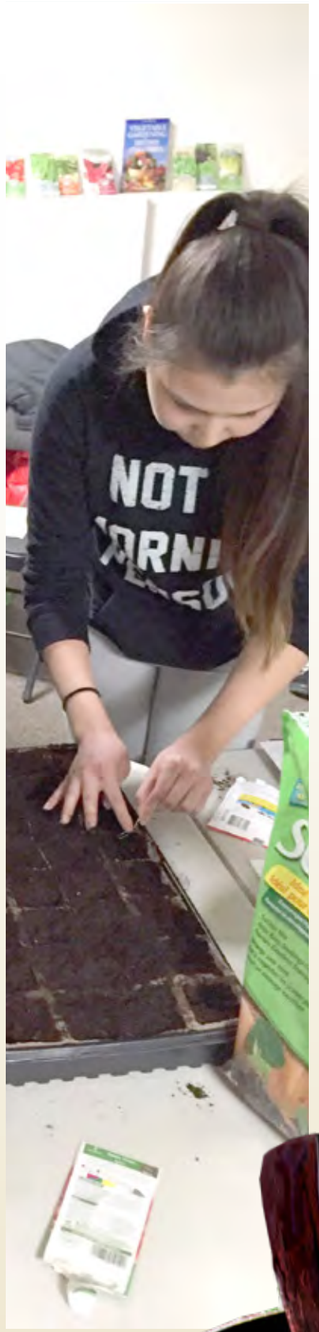
Kanaka Bar Indian Band (Kanaka Bar) is located 14 kilometers south of Lytton, British Columbia (BC) in the northern part of the Fraser Canyon, and is one of 15 indigenous communities that make up the Nlaka'pamux Nation. Kanaka Bar shares a similar language, culture, laws and spirituality (and colonization experience) with about 6,000 other Nlaka'pamux.

Originally known as T'eqt''aqtn (crossing place) and the residents T'eqt''aqtn'mux (the crossing place people), the community was renamed Kanaka Bar by colonial officials just after James Douglas declared the mainland colony in 1858. Today, the community and its residents choose to self-identify as Kanaka Bar, while never forgetting their Indigenous history, the connection to the land and the responsibility to care for it.

Kanaka Bar has an Indian Reserve (IR) land base of approximately 263 hectares within six individual IRs on the slopes and terraces lining the Fraser River. In addition to the IR lands, Kanaka Bar holds five fee simple properties throughout the Traditional Territory. The Traditional Territory of Kanaka Bar primarily encompasses the Kwoiek Creek watershed (on the west side of the Fraser River) and the Morneylun Creek, Nekliptum Creek, Niger Creek, and Siwash Creek watersheds (on the east side of the Fraser River.)

For over 7000 years, Kanaka Bar's ancestors have used the community's lands and resources to live sustainably. Kanaka Bar's present and future generations have the same right, responsibility and ability to achieve sustainable self-sufficiency through meaningful employment, a secure and healthy supply of food, accessible and healthy homes, a strong community governance model, and a diverse economy.

One challenge facing the future of Kanaka Bar and community self-sufficiency goals is climate change. Kanaka Bar membership and local area residents intuitively know something is happening within the natural systems. Observed changes in precipitation patterns, air temperature, and ecosystem shifts are occurring and is becoming disconcerting. Kanaka Bar's main concern related to climate change is the impact to the health and well being of community watersheds and the offered water resources.



Each of Kanaka Bar's watersheds throughout the Territory have contributed to the community's survival and will continue to contribute to the community's well-being going forward. These watersheds include:

- Kwoiek Creek
- Morneylun Creek
- Nekliptum Creek
- Niger Creek
- Siwash Creek
- North Fork (tributary of Kwoiek Creek)
- Four Barrel Creek

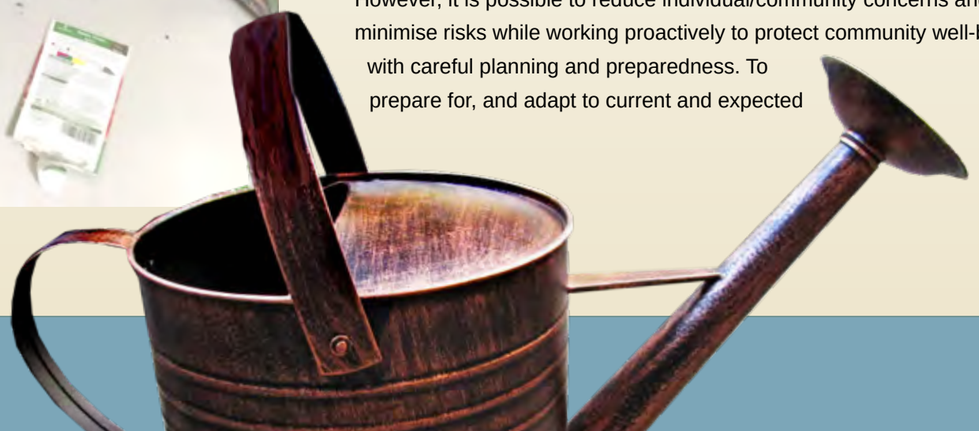
While each watershed represents a water source for Kanaka Bar, the focus of this project is on those water sources which provide immediate and proximal benefits to the community. The priority watersheds include Kwoiek Creek (main stem), Morneylun Creek, Nekliptum Creek, Niger Creek and Siwash Creek.

Figure 1.1 (page 6) and Figure 1.2 (page 8) provide maps of the watershed boundaries for Kwoiek Creek and the other four priority watersheds, respectively. The maps also include other key features such as the location of the community site, most commonly referred to as Upper Kanaka.

These five watersheds provide the day to day resources for the community, including drinking water, traditional food sources, and spiritual sites. Also, the watersheds represent the foundational resources for a Kanaka Bar economy of today and tomorrow, and their integrity is key to the community's sustainable self-sufficiency. Water availability and sustainability is a foundational resource to Kanaka Bar's goals and the community's overall wellness. Therefore, Kanaka Bar has always, and will continue to work, to understand any impacts to the watersheds brought on by climate change.

It is widely accepted that weather and climatic events will become greater in frequency, intensity, and duration and result in an increased variety of adverse impacts and losses. What is even more problematic is that these events are now becoming "unpredictable". This is creating an "inexplicable unease" in all demographics at Kanaka Bar.

However, it is possible to reduce individual/community concerns and minimise risks while working proactively to protect community well-being with careful planning and preparedness. To prepare for, and adapt to current and expected climate changes, the community has undertaken the Kanaka Bar Climate Change Vulnerability Assessment (herein the Vulnerability Assessment.) The Vulnerability Assessment represents the first important step to understand future climate scenarios, in particular, how these scenarios could influence water resources and the overall health and well-being of the community.



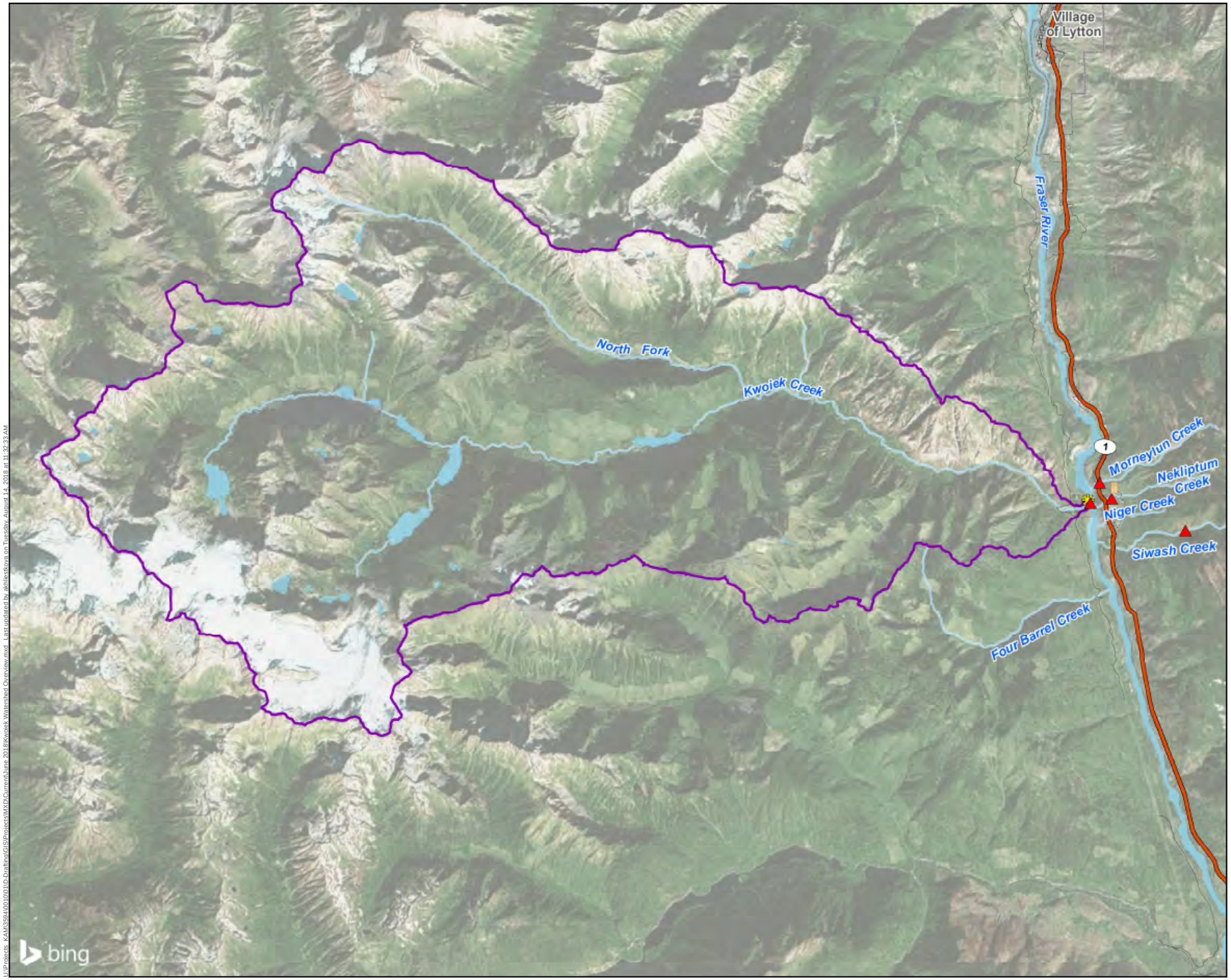
From this Vulnerability Assessment, Kanaka Bar can evolve into implementing a climate change adaptation plan which seeks to reduce adverse impacts and community risks by getting the community and infrastructure ready to embrace "transition" and "adapt" to the now known and foreseeable changes that are coming.

The goal of the community Vulnerability Assessment is to continually engage and work with all local area residents to create awareness, provide information about climate change, consider possible impacts to the community, and develop adaptation strategies to support a more resilient community.

By understanding community vulnerabilities, Kanaka Bar can:

- Prepare the community for the worst by making good decisions, living with success, and learning from failures;
- Achieve the vision of becoming self-sufficient, sustainable and vibrant by scaling up projects and programs that make site specific sense;
- Invest more in local capacity and infrastructure to tackle the impacts of climate change; and,
- Manage and maintain community assets in a better way.

Embrace "transition" and "adapt" to the now known and foreseeable changes that are coming.



Kanaka Bar Indian Band

Climate Change
Vulnerability Assessment

Kwoiek Watershed Overview

Draft Report

- Kwoiek Watershed
- Community Site
- Gauging Station
- Hydropower Facility

The accuracy & completeness of information shown on this drawing is not guaranteed. It will be the responsibility of the user of the information shown on this drawing to locate & establish the precise location of all existing information whether shown or not.

0 1 2 4 6
Kilometers

N

Coordinate System:
NAD 1983 UTM Zone 10N

Scale:
1:110,000

Data Sources:
-ClimateBC, DataBC, NRCAN, ESRI basemaps

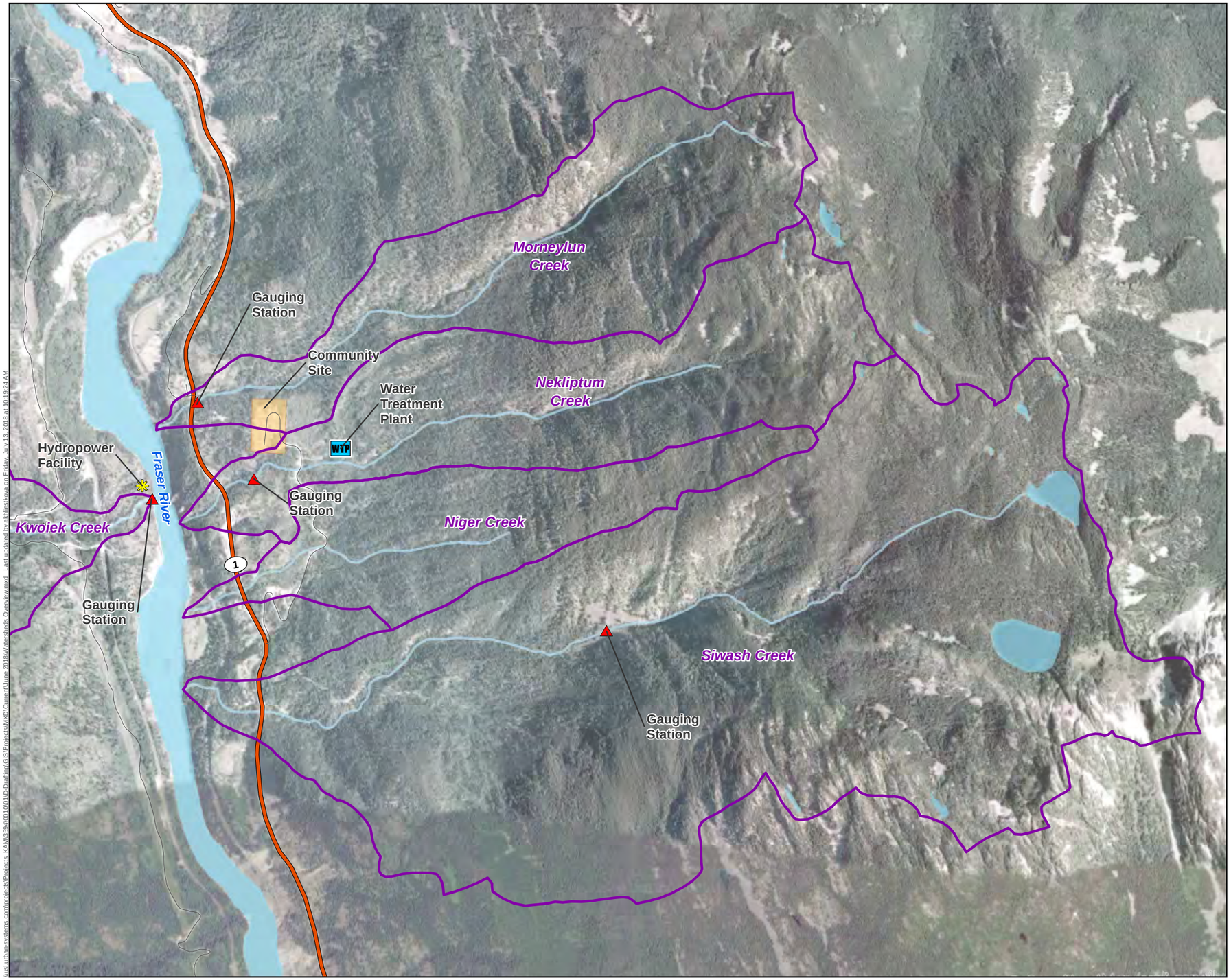
Project #:	3594.0010.01
Author:	AK
Checked:	
Status:	
Revision:	A
Date:	2018 / 8 / 14

URBAN systems

FIGURE 1.1

U:\Projects\3594\0010\01\D-Drafting\GIS\Projects\MXD\Current\June 2018\Kwoiek Watershed Overview.mxd - Last updated by akhilestova on Tuesday, August 14, 2018 at 11:32:33 AM

Figure 1.1: Kwoiek Watershed Overview



Kanaka Bar Indian Band

Climate Change
Vulnerability Assessment

Eastern Watersheds Overview

Draft Report

Watershed

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0 100 200 400 600
Meters

N

Coordinate System:
NAD 1983 UTM Zone 10N

Scale:
1:23,000

Data Sources:
-ClimateBC, DataBC, NRCAN, ESRI basemaps, Google Earth georeferenced imagery

Project #:	3594.0010.01
Author:	AK
Checked:	
Status:	
Revision:	A
Date:	2018 / 7 / 13

URBAN systems

FIGURE 1.2

Figure 1.2: Eastern Watersheds Overview

1.1 Climate Change Overview

It is well understood that global climate change is a pervasive and unprecedented phenomenon facing our world today. Since the 1950s, changes to the global climate system are unequivocal with documented warming of the atmosphere and ocean, diminishing amounts of snow and ice, and rises in sea level. A known contributing factor to the observed changes is anthropogenic greenhouse gas emissions, with concentrations of carbon dioxide, methane and nitrous oxide increasing since the pre-industrial era to levels that exceed those of at least the last 800,000 years[1]. Greenhouse gases trap energy from the sun contributing to warming at the Earth's surface.

Global Circulation Models (GCMs) indicate that continued emission of greenhouse gases will result in further changes in all components of the climate system, increasing the likelihood of severe and irreversible impacts affecting people and ecosystems. The degree of change projected by GCMs range based on future emission scenarios, which are commonly referred to as Representative Concentration Pathways (RCPs). The most stringent emissions mitigation scenario is referred to as RCP2.6 which is characterized by substantial net negative emissions. The highest greenhouse gas emission scenario is referred to as RCP8.5 or "business as usual."

A key indicator to help understand the potential impacts of climate change is air temperature. Air temperature is one of the main properties of climate, and a geographically consistent indicator of climate change as it is easily measured and directly observable. Changes in air temperature are correlated with greenhouse gas concentrations and influence other properties of climate such as precipitation. Figure 1.3 shows the observed and projected changes in global average surface temperature for RCP2.6 and RCP8.5.

1 There are many agencies assessing the relationship between human activities releasing greenhouse gas emissions and the climate system. These agencies have detailed their findings using peer-reviewed scientific best practices. See for example, http://nas-sites.org/americasclimatechoices/, https://science2017.globalchange.gov/chapter/front-matter-about/, https://climate.nasa.gov/, http://www.ipcc.ch/, https://nca2014.globalchange.gov/, https://www.wcrp-climate.org/, https://www.canada.ca/en/environment-climate-change/services/climate-change/centre-modelling-analysis.html, https://www.theccc.org.uk/tackling-climate-change/preparing-for-climate-change/uk-climate-change-risk-assessment-2017/, https://pacificclimate.org/about-pcic

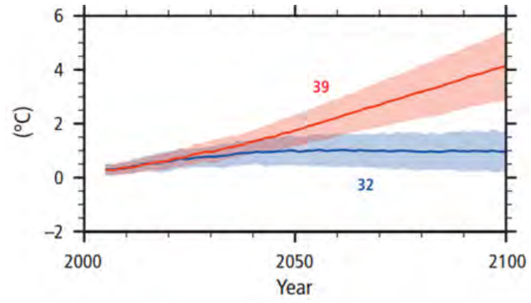


Figure 1.3: Global Average Air Temperature Projections

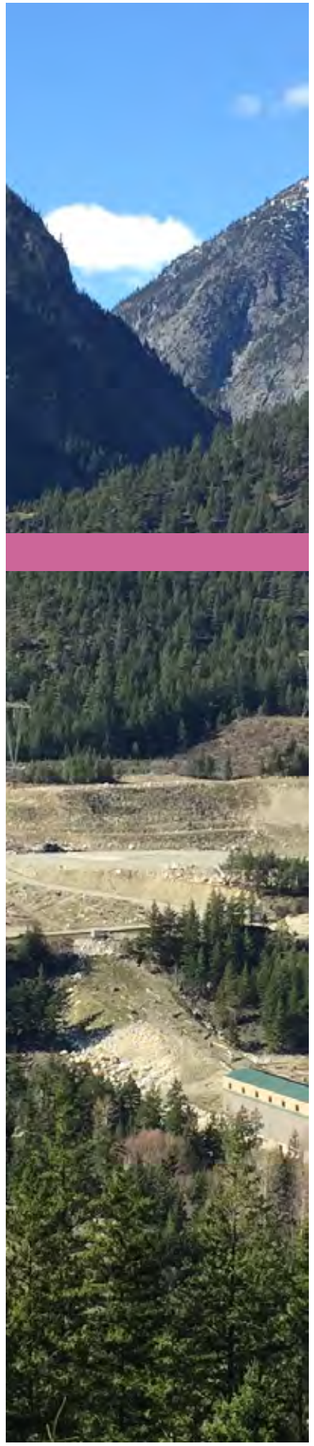
The mean of the projections (lines) and the measure of uncertainty (shading) are shown for RCP2.6 (blue) and RCP8.5 (red). The projections are based on an ensemble of climate models indicated by the number.

The RCP2.6 and RCP8.5 scenarios indicate an increase in global average air temperature of approximately 1°C and 4°C by the end of the century, respectively. Despite a growing number of climate change emissions mitigation policies and alternative energy initiatives, annual greenhouse gas emissions continue to increase. Even if emissions were considerably reduced in the near future, greenhouse gases already present in the atmosphere will persist for 100 years or more. Therefore, regardless of mitigation efforts taken going forward, we cannot avoid some level of warming. It is therefore prudent to plan for an RCP8.5 future until global mitigation actions are substantive enough to result in meaningful reductions in atmospheric greenhouse gas concentration.

Rising rates of air temperature increase the risk of detrimental impacts to natural and human systems. Key risks identified by the IPCC 5th Assessment[2] report include:

- Severe ill-health and disrupted livelihoods resulting from storm surges, sea level rise, coastal flooding, inland flooding, and periods of extreme heat;
- Extreme weather events leading to break-down of infrastructure networks and critical services;
- Food and water insecurity and loss of rural livelihoods and income; and,
- Loss of ecosystems, biodiversity and ecosystem goods, functions and services.

2 IPCC, 2014. 5th Assessment Report – Climate Change 2014 Synthesis Report



In urban areas, climate change is projected to increase risks for people, assets, economies and ecosystems. These risks include heat stress, storms and extreme precipitation, inland and coastal flooding, landslides, air pollution, drought, water scarcity, sea level rise, and storm surges. These risks will be amplified for those lacking essential infrastructure and services or living in exposed areas. In many ways, climate change is a “regressive tax” on those who are least able to adapt.

Rural areas are expected to experience major impacts on water availability and supply, food security, infrastructure and agricultural incomes, including shifts in the production areas of food and non-food crops around the world. These impacts will disproportionately affect the well-being of the poor in rural areas, such as those with limited access to land, modern agricultural inputs, infrastructure and education.

1.2 Climate Change in British Columbia

British Columbia (BC) has a diverse geography with landscapes that include rocky coastlines, sandy beaches, forests, lakes, mountains, inland deserts, and grassy plains. The climate in BC is influenced by the Pacific Ocean and mountain ranges, and varies from wet and mild coastal areas to dry, hot interior regions and cold northern regions.

Past trends in climate which have affected ecosystems across BC have been identified. The trends include the following[3]:

- Average annual temperature warmed by 1.4°C per century across the province.
- The northern regions of BC warmed more than the provincial average.
- Night-time temperatures increased across all of BC in all seasons.
- The night-time minimum average temperature in winter in BC increased by 3.1°C per century.
- Annual precipitation has been increasing across the province overall.
- Ice in lakes and rivers is depleted earlier in the spring.
- Average sea level has risen along most of the BC coast.
- Sea surface temperatures have increased along the BC coast.
- Water in the Fraser River is now warmer in the summer.
- More heat energy is available for plant and insect growth.
- The bulk of river flow is occurring earlier in the year.

3 British Columbia Ministry of Environment, 2016. Indicators of Climate Change for British Columbia 2016 Update.

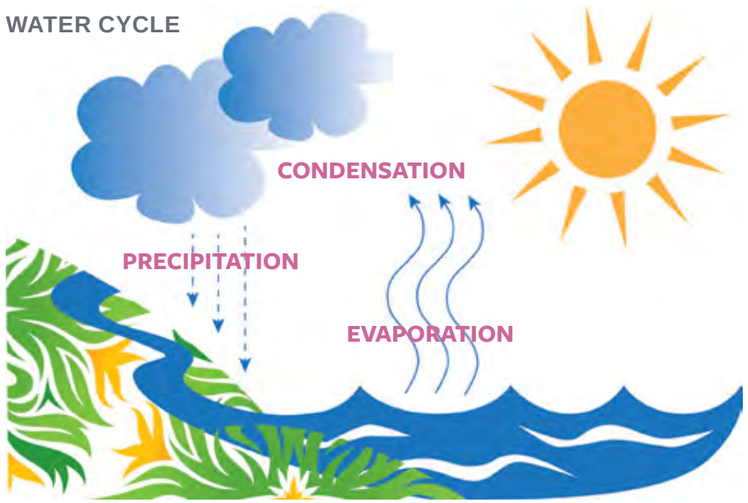
Climate projections for the remainder of the 21st century indicate that the climate will continue to change, and will have ongoing impacts to ecosystems and communities. These projections include[3]:

- Average annual temperature in BC may increase by 1.7°C to 4.5°C from 1961-1990 normals.
- Average annual precipitation may increase by 4 to 17 percent from 1961-1990 normals.
- Most small glaciers in southern BC will likely disappear.
- Some of the smaller rivers in southern BC may dry up during the summer and early fall.
- Salmon migration patterns and success in spawning are likely to change.

Due to the diversity of geography and climate in BC, trends in historical and projected future climate can vary significantly from region to region. Site-specific climate change projections for Kanaka Bar are detailed in Sections 3 and 4.

1.3 Climate Change Impacts to the Water Cycle

Of importance to many communities is the impact of climate change to the water cycle as it influences many factors related to everyday life. “Water is life” as we all depend on it for drinking and food production. However, it is also powerful and flooding and drought can put our communities at risk.



Changes in climate affect processes of the water cycle.

The water cycle describes the movement of water through the climate system in its various forms (vapour, liquid and solid). Life on land depends on movement of water in the climate system, and climate projections indicate that with rising surface temperature, there will be an increase in evaporation and water vapour in the air, impacting precipitation patterns. However, these impacts will not be uniform as changes in precipitation will vary among regions. For example, an increase in total precipitation and runoff are projected for high latitude land masses whereas mid-latitude and subtropical and semi-arid regions will likely experience less precipitation. Changes in precipitation could result in increased occurrences of flooding and drought causing damage to ecosystems and infrastructure, and creating water shortages.

Changes in climate can also affect other processes of the water cycle, including the duration of ice on rivers and lakes, the proportion of snow to total precipitation, the depth of snowpack, and the temperature in freshwater ecosystems. Warmer springs may promote earlier snowmelt and break up of lake and river ice resulting in changes to river hydrology, including the magnitude and timing of peak flows. Warmer summers may increase rates of evapotranspiration and contribute to declines in ground-water supplies and water quality. These trends are expected to lead to noticeable changes in watershed hydrology[4]. The magnitude and direction of changes to streamflow in watersheds will vary according to the dominant pattern of runoff. For instance, snowmelt and glacier-dominated watersheds are anticipated to see shifts in runoff patterns that more closely resemble rainfall-snowmelt patterns, where periods of snow accumulation are reduced, and peak flows start earlier in the year[5].

4 Nelitz et al. 2009. Evaluating the Vulnerability of Freshwater Fish Habitats to the Effects of Climate Change in the Cariboo-Chilcotin.

5 Pike et al. 2008. A Summary of Climate Effects on Watershed Hydrology

1.4 Approach to Vulnerability Assessment

The overall approach employed to complete the Kanaka Bar Climate Change Vulnerability Assessment uses an integrated methodology, informed by climate change and hydrologic analyses, traditional knowledge and scientific research. This was further complemented by community engagement sessions and secondary research. The approach contains elements from a variety of vulnerability and adaptation planning frameworks, including: the Canadian Council of Ministers of the Environment (CCME) Implementation Framework for Climate Change Adaptation Planning at a Watershed Scale, the Natural Resources Canada Climate Change Adaptation Planning Handbook for Small Canadian Communities, and the Center for Science in the Earth System (Climate Impacts Group) Preparing for Climate Change Guidebook for Local, Regional and State Governments. Although the approach draws on elements from established frameworks, it has been a “Made at Kanaka, by Kanaka” approach, which has been tailored to focus on the key values and concerns of the community.

Due to the importance of water resources to the community’s well being, vision and goals of self-sufficiency, the focus of the project and analyses has been on Kanaka Bar’s watersheds. This approach was taken to identify, and link community vulnerabilities associated with the impacts of climate change to the watersheds, and is useful for anticipating where impacts may be greatest. This also allows for Kanaka Bar to set priorities for adaptation strategies, outline future data collection efforts and for monitoring current and future climate change impacts. During the community engagements, other concerns unrelated to local water resources were brought forward, for example, the impact of climate change on salmon populations. These concerns were also considered and incorporated in the vulnerability assessment and adaptation strategies.

The approach to assessing the vulnerability of Kanaka Bar to climate change includes the following four main project phases:

PHASE 1
A baseline assessment and analysis of climate change projections on Kanaka Bar’s Traditional Territory and impacts to water resources within the Territory.

PHASE 2
Community engagement sessions and discussions with community leadership and staff to gather traditional knowledge, record climate observations, and identify key values and areas of concern to Kanaka Bar.

PHASE 3
A vulnerability assessment of community values and areas of concern, based on climate projections impacts to water resources and more broadly the Traditional Territory.

PHASE 4
The identification of initial adaptation strategies that can be advanced to reduce community vulnerability and enhance resiliency.

2.0 BASELINE CONDITIONS FOR KANAKA BAR'S WATERSHEDS

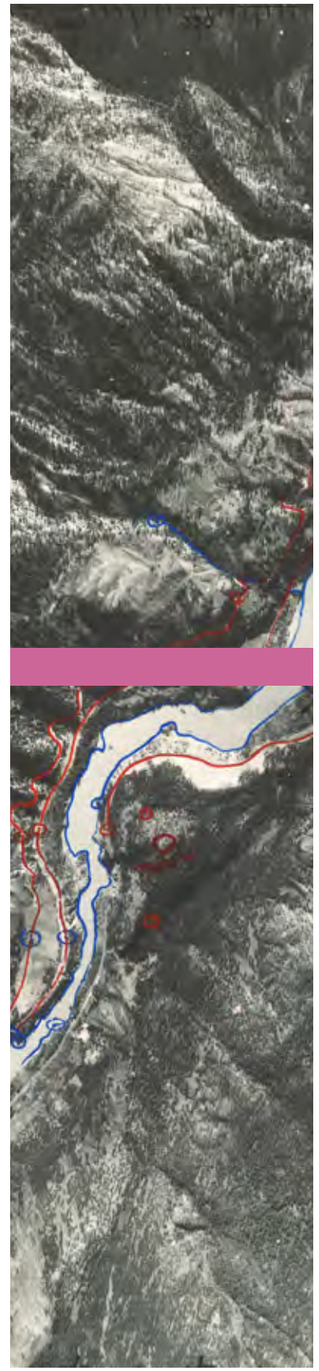
The first step towards understanding the potential impacts of climate change to Kanaka Bar's watersheds, and overall community vulnerability is to establish baseline conditions.

There are five main watersheds in Kanaka Bar's Traditional Territory; each of which provides key resources that support community well-being. To establish baseline conditions for the watersheds, the project team drew upon traditional knowledge, available empirical data and statistical estimations. This section of the Vulnerability Assessment provides an overview of the baseline conditions of each watershed. For further details on the baseline conditions, please see Appendix 1.

2.1 Traditional Knowledge of Baseline Conditions

Kanaka Bar's ancestors have lived within the Traditional Territory for over 7000 years and have always used and continue to use, the watersheds for drinking water, food gathering, and spiritual purposes. From a series of community engagement sessions, the membership has indicated the following facts about the land:

- Water always flows in all the creeks even during the driest of summers. For the four creeks on the east side of the Fraser River, Morneylun, Nekliptum, Niger, and Siwash, the baseflows are thought to originate from alpine lakes at the top of the watersheds, which helps contribute to the annual base flows of the creeks.
- There are microclimates in the Fraser Canyon with climate patterns differing considerably to the North and South of Kanaka Bar. For example, Kanaka Bar is known to be cooler and wetter than Lytton, just 14 kilometers to the North.
- Seasonal weather patterns have been predictable with cold, snowy winters and hot, dry summers.



- Until recently, regular thunderstorms were common in the summer season.
- Until recently, several feet of snow at the community site elevation (approximately 390 m above sea level) was common in the winter, with high elevation snowpack lasting year-round.
- Until recently, salmon cycles have been predictable with an abundance of salmon available for community consumption.
- The territories and seasonal movements of bears, ungulates and other animals have been predictable.
- Berries, mushrooms, roots, and other traditional plants have been harvested consistently at the same times of year, and in the same locations within the territory.

2.2 Baseline Climate Conditions

The climate varies within Kanaka Bar's Traditional Territory with considerable differences over the range of elevations between the Kwoiek Creek watershed on the west side of the Fraser River, and the other four watersheds on the east side of the Fraser River.

For the purposes of this study, all baseline climate data are reflective of conditions at the main community site, most commonly referred to as Upper Kanaka. Using spatially interpolated climate data from ClimateBC, historic normals were generated for the community site. Table 2.1 summarizes the climate normals for the 1970s, 1980s and 1990s.

Table 2.1: Kanaka Bar Community Site Climate Normals

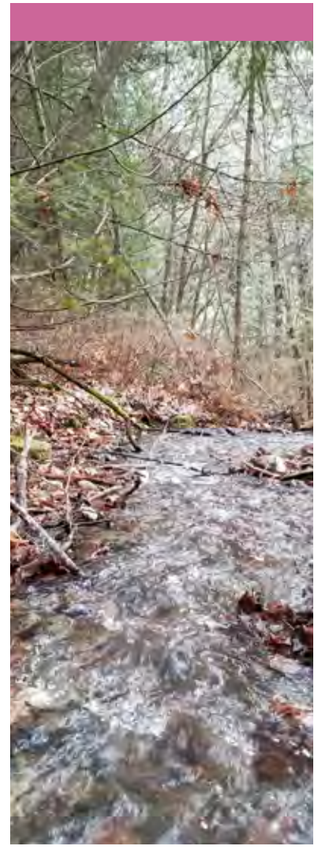
Normal Period	Annual Precipitation (mm)	Annual Snowfall (cm)	Average Temperature (°C)	Average Daytime Maximum Temperature (°C)	Average Nighttime Minimum Temperature (°C)
1970s	577	142	8.4	13.8	2.9
1980s	601	134	8.6	14.0	3.1
1990s	585	108	8.8	14.3	3.4

The historical normals indicate a trend of increasing total annual precipitation, increasing average/extreme temperatures, and decreasing total annual snowfall from the 1970s to the 1990s.

2.3 Baseline Flow Characteristics of Watersheds

As the watersheds are the focus of the vulnerability assessment, and water supply is a key focus of Kanaka Bar, baseline streamflow characteristics were established by gathering and interpreting traditional knowledge and other data sources. Ideally, flow characteristics are determined from 20 or more years of streamflow data, particularly for estimating the likelihood and magnitude of extreme flood and drought conditions. However, only two of the watersheds have historical flow data, Kwoiek Creek and Siwash Creek.

Kwoiek Creek had one gauging station installed from 2005 to 2013 and a second installed in 2013, which is currently collecting data. Siwash Creek has had a gauging station installed since 2011 and is currently collecting data. As part of this project, and a key step in adaptation planning, streamflow gauging stations were installed on Morneylun Creek and Nekliptum Creek in December 2017. For further details on the Morneylun Creek and Nekliptum Creek gauging stations, see Appendix 2. Due to the limited streamflow data available, regional hydrometric analyses were completed to estimate the streamflow characteristics for all five watersheds. However, where the regional analysis differed considerably from gauging station data, the gauging station data were used to reflect baseline conditions.



The following indicators were chosen to describe the streamflow characteristics of each watershed:

- **Average annual 7-day low flow** (reflective of typical low flow conditions)
- **Average annual flow** (reflective of typical average flow conditions)
- **Average annual peak flow** (reflective of typical high flow conditions)

The above indicators represent average flow conditions; however, it is often beneficial to estimate extreme flood and drought conditions as well as annual and seasonal yields. In the absence of sufficient flow data, the extreme values and yields were estimated using regional analysis and are included in Appendix 1.

Table 2.2 summarizes the size of the watersheds and the baseline flow characteristics.

Table 2.2 Watersheds and Baseline Flow

Watershed	Watershed Size (km^2)	Average Annual 7-day Low Flow (m^3/s)	Average Annual Flow (m^3/s)	Average Annual Peak Flow (m^3/s)
Kwoiek Creek[1]	281	1.5	10.7	54.6
Morneylun Creek[2]	3.2	0.003	0.076	0.716
Nekliptum Creek[2]	3.3	0.003	0.078	0.739
Niger Creek[2]	1.9	0.002	0.046	0.430
Siwash Creek[1]	11.3	0.022	0.210	1.730

1 Flow characteristics are based on gauging station data
2 Flow characteristics are based on regional analysis

Based on traditional knowledge, community observations, and recent measurements associated with the newly installed gauging stations, it is likely that the regional analysis is underestimating the average annual 7-day low flow and overestimating the average annual peak flow for Morneylun Creek, Nekliptum Creek and Niger Creek. For the average annual 7-day low flow, the regional analysis is likely not capturing the baseflows that are observed in the creek year-round as the majority of reference watersheds used in the regional analysis have a snow-dominated hydrology. The overestimated peak flows are likely a result of snowmelt and peak freshet flows integrated into the model. The uncertainty associated with the regional analysis highlights the importance of the newly installed gauging stations and the collection of site-specific data.

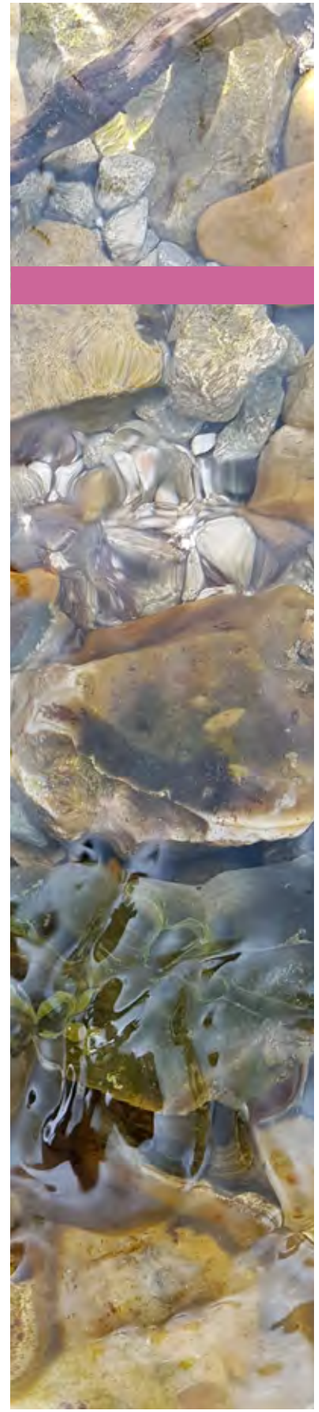
2.4 Kwoiek Creek

The Kwoiek Creek watershed is located on the west side of the Fraser River and is the largest of the five community watersheds featuring glaciers, Grizzly bears, ungulates and high alpine food sources. Prior to contact and implementation of the Indian Reserve system, the main community area was located around the mouth of Kwoiek Creek and the watershed supported the community with traditional food sources (salmon, berries and other traditional plants) and spiritual and cultural sites.

Currently, the watershed is home to the Kwoiek Creek Hydroelectric Project, a 50 MW run-of-river hydroelectric project, built and operated in partnership between Kanaka Bar (Kwoiek Creek Resources Inc.) and Innergex Inc. The run-of-river facility is a keystone project and economic driver for the community.

The Kwoiek Creek watershed area is approximately 281 km^2 and characterized by multiple biogeoclimatic ecosystem classification (BEC) zones with warm, moist Englemann Spruce/Subalpine Fir being the dominant classification. The climate within the Kwoiek Creek watershed varies significantly from west to east and with elevation. The west is generally cooler than the east due to higher elevations, but the watershed as a whole is cooler than the Fraser River valley. Precipitation in the watershed is influenced more by latitude and longitude than by elevation, although elevation is an influencing factor. In general, annual precipitation increases from east to west and from north to south.

The Kwoiek Creek watershed has a snow-dominated hydrology, which means that annual peak flows are generated by snow melt or rain-on-snow events. Freshet typically starts mid-April with peak flows occurring between late May and early July. The lowest flows typically occur during December through March.



2.5 Morneylun Creek

The Morneylun Creek watershed area is approximately 3.2 km² and is the most northern of the four watersheds on the east side of the Fraser River. It is located within the western edge of the Cascade Mountains, and the water generated by this watershed is currently unused by the community, however, food gathering, and other traditional practices are still prevalent throughout the watershed. Due to the proximity of the watershed to the community, it is considered a valuable water resource for supporting future housing and agricultural development opportunities.

The dominant BEC zones in the Morneylun Creek watershed are Interior Douglas Fir and Montane Spruce, which range from cold to hot and dry to very dry. The climate in the watershed varies with elevation from west to east, with hot, very dry conditions at low elevations near the Fraser River and cold, dry conditions at high elevations at the top of the watershed.

The Morneylun watershed has a rainfall-dominated hydrology, which means that annual peak flows are typically generated by extreme rainfall events. Freshet does occur, but peak flows are often less than those generated by high-intensity rain storms, especially if the events last for several hours. The lowest flows typically occur during December through March when snow accumulates. Traditional knowledge and technical observations suggest that the lakes on the ridge that forms the grade break between the west and east sides of the mountain where the watershed is located, contribute to the baseflow in the stream throughout the year.

2.6 Nekliptum Creek

The Nekliptum Creek watershed area is approximately 3.3 km² and is located just south of the Morneylun Creek watershed within the western edge of the Cascade Mountains, on the east side of the Fraser River. Nekliptum Creek is the primary community drinking water supply and is a critical community watershed for food gathering and other traditional practices. In addition, it is considered a valuable water resource for supporting future housing and economic development opportunities.

Similar to the Morneylun Creek watershed, the dominant BEC zones in the Nekliptum Creek watershed are Interior Douglas Fir and Montane Spruce which range from cold to hot and dry to very dry. The climate in the watershed varies with elevation from west to east, with hot, very dry conditions at low elevations near the Fraser River and cold, dry conditions at high elevations at the top of the watershed.

The Nekliptum watershed is a rainfall-dominated hydrology, which means that annual peak flows are typically generated by extreme rainfall events. Freshet does occur, but peak flows are often less than those generated by high-intensity rain storms, especially if they last for several hours. The lowest flows typically occur during December through March when snow accumulates. Traditional knowledge and technical observations suggest that the lakes on the ridge that forms the grade break between the west and east sides of the mountain where the watershed is located, contribute to the baseflow in the stream throughout the year.

2.7 Niger Creek

The Niger Creek watershed is the smallest of the four watersheds on the east side of the Fraser River with an approximate area of 1.9 km². It is located just south of the Nekliptum Creek watershed. Water from Niger Creek is not currently used by the community; however, it does supply drinking water and water for irrigation to one third party residence. For Kanaka Bar, it represents an important community watershed for food gathering and other traditional practices.

The dominant BEC zone in the Niger Creek watershed are Interior Douglas Fir with a temperature and precipitation range from cool to hot and dry to very dry, respectively. The climate in the watershed varies with elevation from west to east, with hot, very dry conditions at low elevations near the Fraser River and cool, dry conditions at high elevations at the top of the watershed.

Like Morneylun Creek watershed and Nekliptum Creek watershed, the Niger Creek watershed is a rainfall-dominated hydrology, which means that annual peak flows are typically generated by extreme rainfall events. Freshet does occur, but peak flows are often less than those generated by high-intensity rain storms, especially if they last for several hours. The lowest flows typically occur during December through March when snow accumulates. Traditional knowledge and technical observations suggest that the lakes on the ridge that forms the grade break between the west and east sides of the mountain where watershed is located, contribute to the baseflow in the stream throughout the year.

2.8 Siwash Creek

The Siwash Creek watershed is the largest of the four watersheds on the east side of the Fraser River with an approximate area of 11.3 km². It is located just south of the Niger Creek watershed. Currently, water from this creek is not used by the community other than for the residence on Lot 16. The community is actively considering the development of a run-of-river hydroelectric project in the watershed. It is also an important community watershed for food gathering and other traditional practices.

The Siwash Creek watershed area is characterized by multiple BEC zones with cool to cold, dry conditions, with Englemann Spruce/Subalpine Fir and Interior Douglas Fir being the dominant classifications. The climate in the watershed varies with elevation from west to east, with warm, dry conditions at low elevations near the Fraser River and cold, dry conditions at high elevations at the top of the watershed.

The Siwash Creek watershed is a mix of both snowmelt and rainfall-dominated hydrology, which means that annual peak flows can be generated by either the freshet or by extreme rainfall events. The lowest flows, however, typically occur during December through March when snow accumulates. Traditional knowledge and technical observations suggest that lakes on the ridge that forms the grade break between the west and east sides of the mountain where the watershed is located, contribute to the baseflow in the stream throughout the year.

3.0 CLIMATE AND STREAMFLOW PROJECTIONS

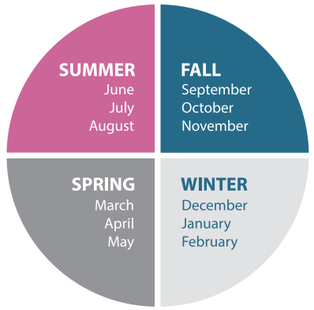
Understanding climate change projections for Kanaka Bar's Traditional Territory is a key step to assessing impacts to the watersheds and overall community vulnerability. To support this, data from the Pacific Climate Impacts Consortium (PCIC) and ClimateBC were used to produce regional and site-specific projections to understand how the climate in Kanaka Bar's Traditional Territory may change by the 2020s, 2050s and 2080s. All projections are based on an ensemble (or collective) of GCMs. This approach is considered a best practice for managing the uncertainty associated with individual models. All models were run using the 'business as usual' scenario for future greenhouse gas emissions which is considered the 'worst case' scenario. To date, global actions to reduce emissions continue to reflect 'business as usual' and therefore it is prudent to plan for the 'worst case scenario.'

The climate change projection analysis focused on temperature, precipitation, and streamflow and, when taken together, provides an indication of how climate and water resources are expected to change for future time periods.

Table 3.1, which follows, describes the projected changes in climate and streamflow and provides an indication of the magnitude of the projected changes. For more detailed information on climate and streamflow projections for the Kanaka Bar area, including seasonal variability and the range of projections from the GCM analyses, please see Appendix 3.

All references to seasons reflect the months indicated in this chart *(right)*:

Due to the data requirements for modelling stream flow, the future and reference time periods are different than those used for climate projections.



Months grouped by Season (for data purposes)

The future and reference periods are as follows:

- Historic reference period – 1955 to 2000
- Near future – 2001 to 2050
- Distant future – 2051 to 2098

The projected changes summarized in Table 3.1 reflect average conditions over 30-year periods (climate normals.) Seasonal and annual variations will continue to occur; therefore, the projected changes are not expected to be consistent on a year to year basis. However, for future time periods the projections indicate substantial changes, resulting in a very different climate for Kanaka Bar relative to present day.

Table 3.1: Description and Degree of Projected Changes for Climate and Streamflow

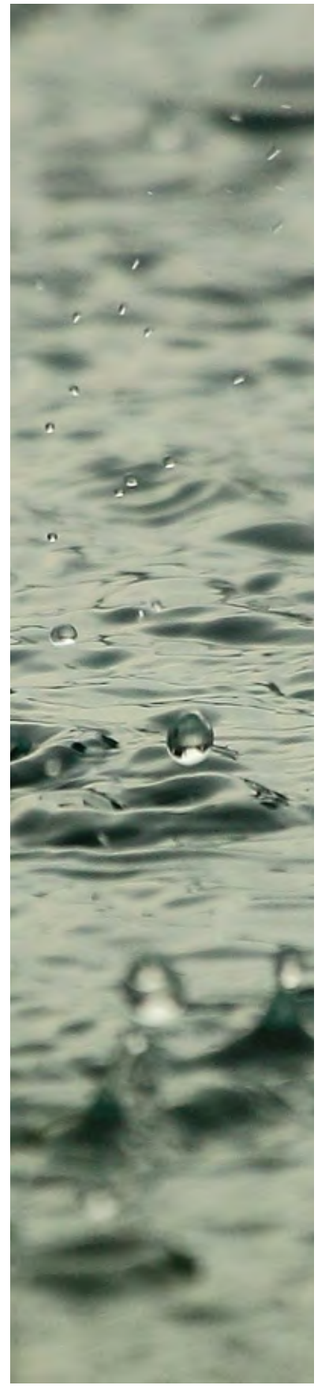
Description of Projected Change	Projected Magnitude of Change[6]
Climate Projections	
Warmer year-round temperatures	■ 3 to 4°C increase by the 2050s and 4 to 6°C by the 2080s
More precipitation in the spring, fall, and winter and less in the summer	■ 8% decrease in summer precipitation by the 2050s and 22% decrease by the 2080s ■ 3 to 8% increase in precipitation for each of spring, fall and winter by the 2050s and 11 to 17% increase by the 2080s
Less snow and more rain	■ 18% decrease in total annual snowfall by the 2050s and 35% decrease by the 2080s ■ 3% increase in annual precipitation by the 2050s and 7% increase by the 2080s
More frequent and intense storm events	■ 21 to 66% increase in storm intensity for future time periods depending on the duration and corresponding frequency
Streamflow Projections	
Less surface water flow during typical low flow and extreme drought conditions	■ 0 to 12% decrease in surface water flows during extreme drought conditions in the near future ■ 5 to 12% decrease in surface water flows during typical low flow and extreme drought conditions in the distant future
Less surface water flow during the summer months	■ 10 to 26% decrease in surface water flows during the summer months in the near future ■ 30 to 51% decrease in surface water flows during the summer months in the distant future
More annual surface water volume	■ 6% and 9% increase in total annual volume of surface water for the near and distant future, respectively
Earlier timing and lower magnitude of spring peak flows	■ Spring freshet is projected to occur 2-3 weeks earlier
More surface water flow during extreme flood events	■ 10% and 15% increase in surface water flow during extreme flood events for the near and distant future, respectively

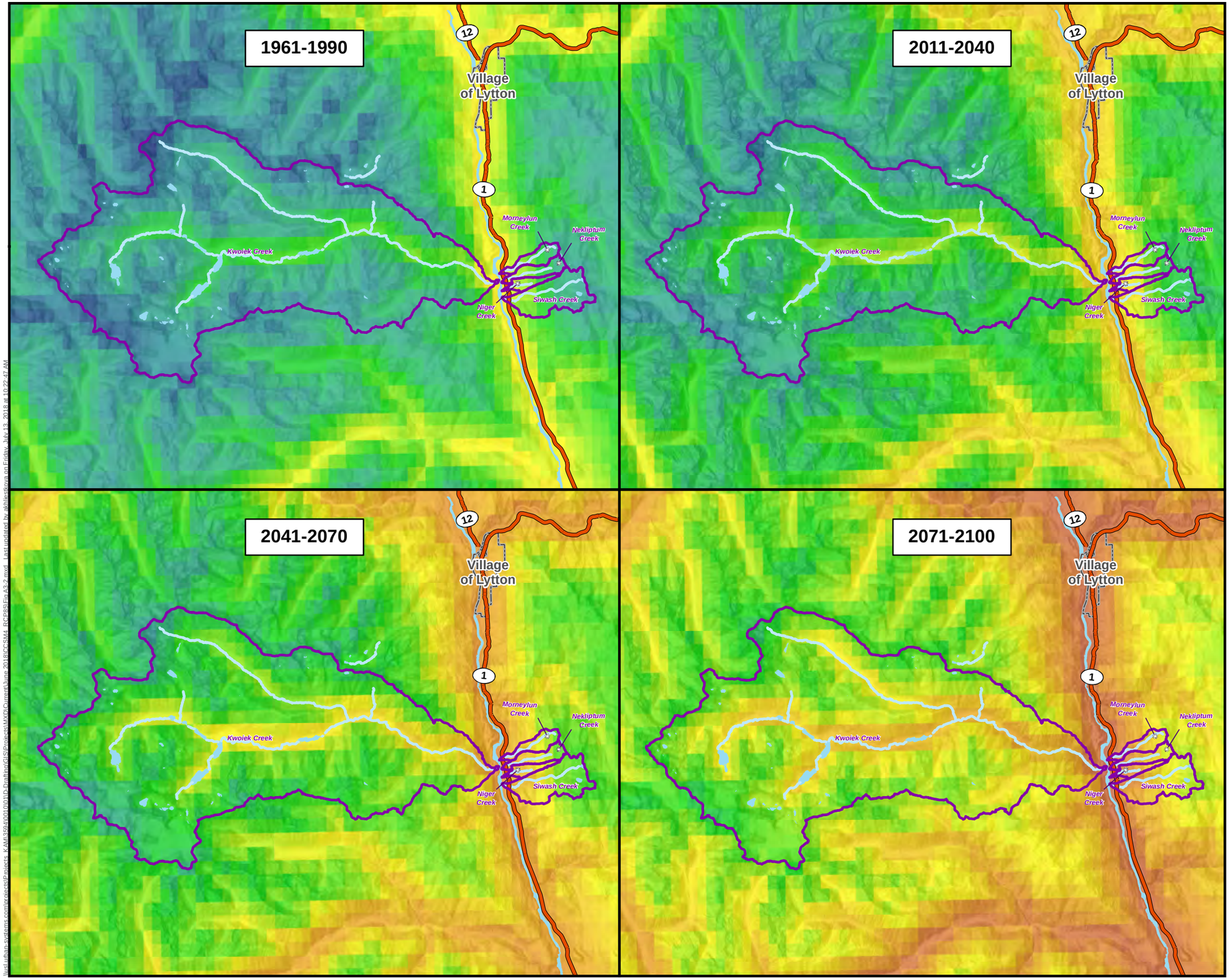
continued

6 Note that the degree of change presented in this table is meant to provide a general indication of the projected changes. More data, figures, maps and other details are provided in Appendix 3

For the climate projections, the changes in temperature and precipitation apply to the entire study area, with the exception of the changes in frequency and intensity of storm events which are specific to the Kanaka Bar community site. A series of maps were created to demonstrate the geographic variability and site-specific changes of the indicator variables throughout Kanaka Bar's Traditional Territory. Figure 3.1 shows the average annual temperature for the 1970s reference period and future time periods. Figure 3.2 shows the total summer precipitation for the 1970s reference period and future time periods. Figure 3.3 shows the total annual snowfall for the 1970s reference period and future time periods.

As a result of data limitations, the streamflow projections represent regional changes and are not site-specific to Kanaka Bar's watersheds. However, the regional projections for streamflow are discussed in the context of Kanaka Bar's watersheds in Section 4.





Kanaka Bar Indian Band

Climate Change Vulnerability Assessment

Mean Annual Temperature

Draft Report

Watershed

Mean Annual Temperature,

High : 18

Mean: 11

Low : -4

The accuracy & completeness of information shown on this drawing is not guaranteed. It will be the responsibility of the user of the information shown on this drawing to locate & establish the precise location of all existing information whether shown or not.

0 1 2 4 6

Kilometers

N

Coordinate System:
NAD 1983 UTM Zone 10N

Scale:
1:250,000

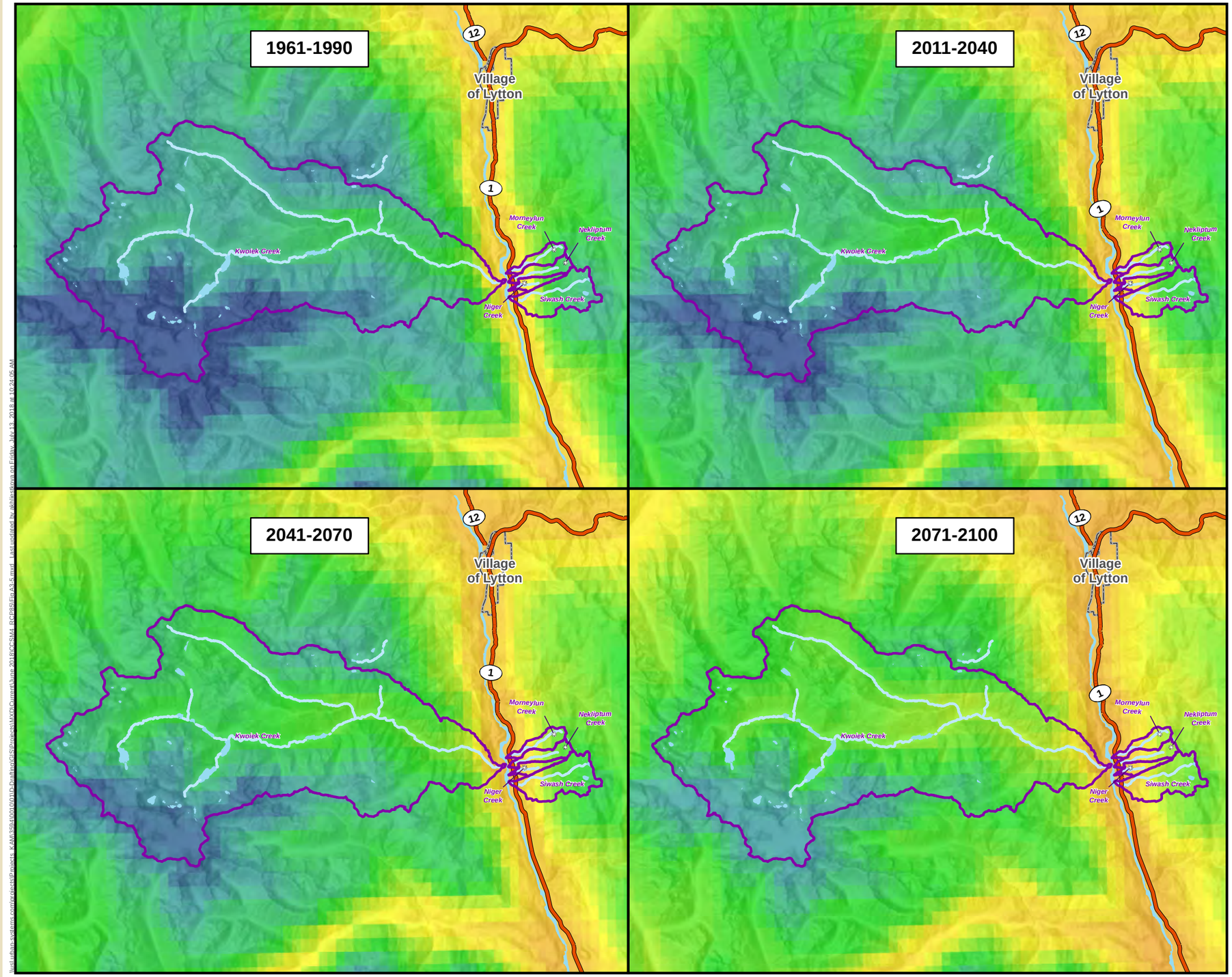
Data Sources:
-ClimateBC, DataBC, NRCAN, ESRI basemaps

Project #: 3594.0010.01
Author: AK
Checked:
Status:
Revision: A
Date: 2018 / 7 / 13

URBAN systems

FIGURE 3.1

Figure 3.1: Mean Annual Temperature



Kanaka Bar Indian Band

Climate Change
Vulnerability Assessment

Mean Summer Precipitation
Draft Report

Watershed

Mean Summer Precipitation
High : 175
Mean: 87.5
Low : 0

The accuracy & completeness of information shown on this drawing is not guaranteed. It will be the responsibility of the user of the information shown on this drawing to locate & establish the precise location of all existing information whether shown or not.

0 1 2 4 6
Kilometers

N

Coordinate System:
NAD 1983 UTM Zone 10N

Scale:
1:250,000

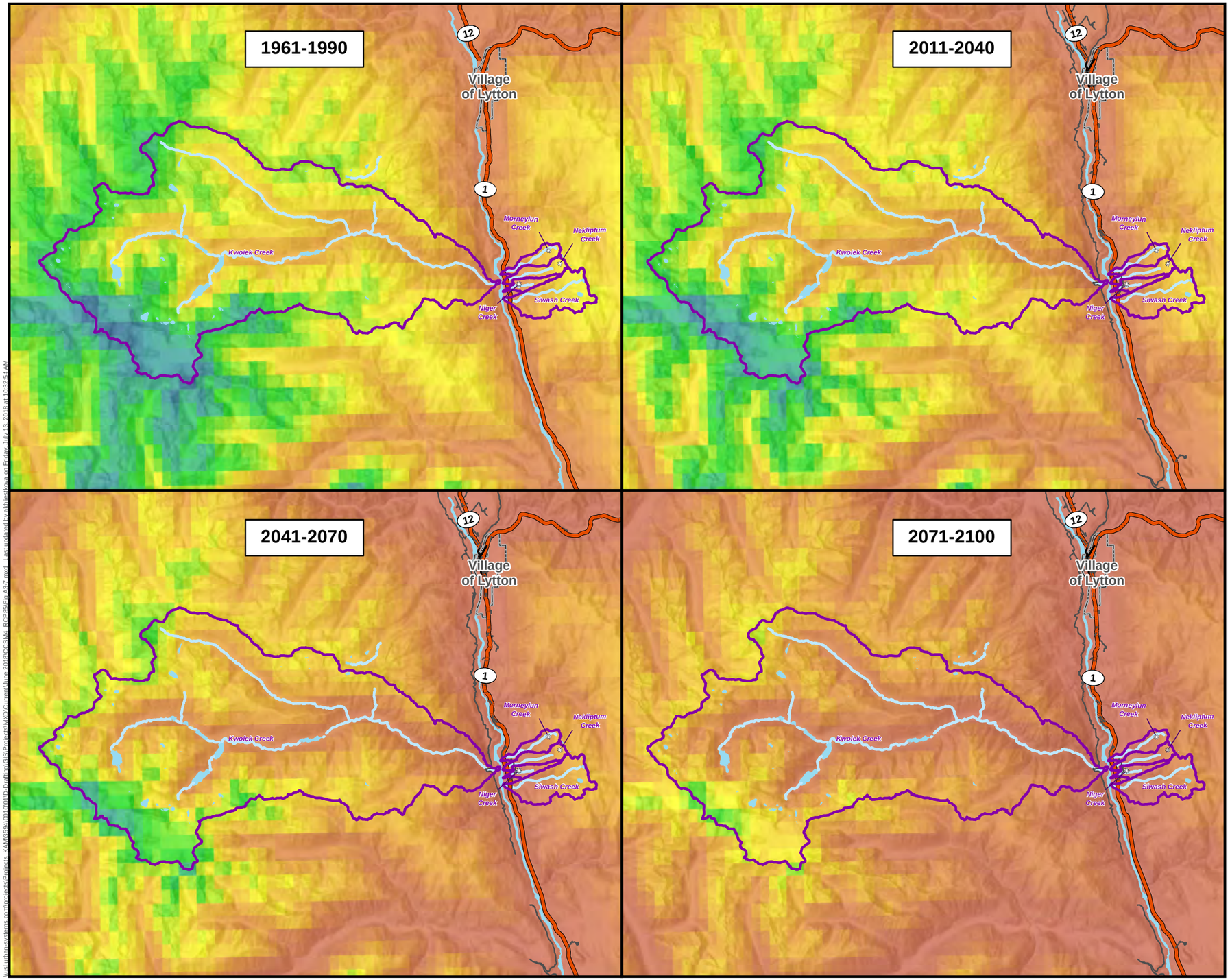
Data Sources:
-ClimateBC, DataBC, NRCAN, ESRI basemaps

Project #:	3594.0010.01
Author:	AK
Checked:	
Status:	
Revision:	A
Date:	2018 / 7 / 13

URBAN systems

FIGURE 3.2

Figure 3.2: Mean Summer Precipitation



Kanaka Bar Indian Band

Climate Change Vulnerability Assessment

Average Annual Precipitation as Snow

Draft Report

Watershed

Average Annual Precipitation as Snow, mm

High : 1300

Mean: 650

Low : 0

The accuracy & completeness of information shown on this drawing is not guaranteed. It will be the responsibility of the user of the information shown on this drawing to locate & establish the precise location of all existing information whether shown or not.

0 1 2 4 6

Kilometers

N

Coordinate System: NAD 1983 UTM Zone 10N

Scale: 1:250,000

Data Sources:

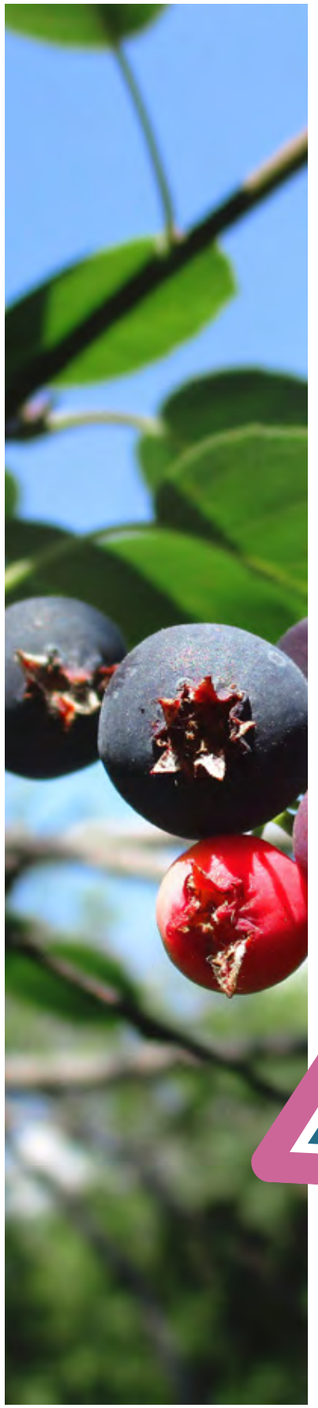
-ClimateBC, DataBC, NRCAN, ESRI basemaps

Project #:	3594.0010.01
Author:	AK
Checked:	
Status:	
Revision:	A
Date:	2018 / 7 / 13

URBAN systems

FIGURE 3.3

Figure 3.3: Average Annual Precipitation as Snow



4.0 PROJECTED CLIMATE CHANGE IMPACTS TO KANAKA BAR WATERSHEDS

This section provides a qualitative overview of how the regional climate change projections for Kanaka Bar's Traditional Territory are likely to impact the community watersheds. The primary impacts relate to stream flow, including extreme peaks and lows, average annual volume, and seasonal timing.

Table 4.1 summarises the expected impacts to Kanaka Bar's watersheds based on the regional streamflow projections. Although exact changes in streamflow are difficult to predict, with four of the five community watersheds now collecting streamflow data, over time, observed trends can be characterized which will provide site-specific information that can be used to refine the projected impacts.

In addition, there will likely be other elements of the watersheds and Traditional Territory that will be impacted, such as changes in vegetation and increased risk of forest fire, rock fall and landslides. Further discussion on the impacts to streamflow and other watershed elements in Kanaka Bar's Traditional Territory are provided in Appendix 3.

Table 4.1: Regional Streamflow Projections and Expected Impacts to Kanaka Bar's Watersheds

Description of Projected Change	Morneylun Creek, Nekliptum Creek, Niger Creek and Siwash Creek	Kwoiek Creek
Less surface water flow during typical low flow and extreme drought conditions	■ Near future impacts may not be as pronounced as those projected for the region due to the baseflow thought to be provided by the high-elevation lakes. ■ For the distant future, as the average temperature increases over time, the volume of water available in the high-alpine lakes may decrease as a result of increased evaporation. This may reduce the baseline flows available during low flow and drought conditions.	■ Near future impacts may not be as pronounced as those projected for the region due to glacier melt. ■ Contributions from the glacier are unlikely to change in the near future, but should the glacier eventually be completely melted in the distant future, which is likely due to the increasing temperatures, low flows in the watershed will likely decrease.
Less surface water flow during the summer months	■ Near and distant future impacts are likely to be less pronounced as those projected for the region as the high alpine lakes are likely to continue to provide baseflow in the summer. However, as temperatures increase over time, so will evaporation losses from the lakes which may result in a reduction in baseflow.	■ Near future impacts are likely to be less pronounced as those projected for the region as glacial melt in the Kwoiek watershed is likely to increase as temperatures increase, which will likely compensate for any streamflow reductions due to earlier freshet and reduced summer rainfall. ■ However, in the distant future, if the glaciers ultimately disappear, this additional summer streamflow would no longer be available, and therefore summer flows would likely be considerably less than the current baseline.

continued

Table 4.1: (continued)

Description of Projected Change	Morneylun Creek, Nekliptum Creek, Niger Creek and Siwash Creek	Kwoiek Creek
More annual surface water volume	■ Near and distant future increases are expected to be consistent with those projected for the region, as increases in total annual precipitation and the frequency and intensity of storm events will likely lead to higher runoff volumes.	■ Near and distant future increases are expected to be consistent or greater than those projected for the region as increases in total annual precipitation, the frequency and intensity of storm events and glacier melt will likely lead to higher runoff volumes.
Earlier timing and lower magnitude of spring peak flows	■ With the exception of Siwash Creek, the watersheds on the east side of the Fraser do not have a snow-dominated hydrology, and therefore, the changes in timing and magnitude of spring peak flows projected for the region will likely be less apparent. ■ Siwash Creek has a mixed snow/ rain-dominated hydrology and spring peak flows are expected to have a lower magnitude and occur several weeks earlier, as projected for the region.	■ Kwoiek Creek has a snow-dominated hydrology and spring peak flows are expected to have a lower magnitude and occur several weeks earlier, as projected for the region.
More surface water flow during extreme flood events	■ With the projected increases in annual precipitation, and in the intensity and frequency of storm events, it is likely that the regional projections of increased flow during extreme flood events will be reflective of future conditions in the watersheds.	■ For Kwoiek Creek, extreme flood events are likely to occur during the spring freshet and although average spring peak flows are projected to decrease in magnitude, extreme events will occur from time to time. With the projected increases in winter and spring precipitation, it is likely that the regional projections of increased flow during extreme flood events will be reflective of future conditions in the Kwoiek Creek watershed.

5.0 COMMUNITY VULNERABILITY ASSESSMENT

"Water is life" and the overall conditions of the watersheds are known to be a key priority, however, the project team recognized that there are likely other community vulnerabilities and future impacts associated with climate change. Therefore, a holistic approach was used to assess community vulnerabilities that may arise from climate change.

The method for assessing the vulnerability of Kanaka Bar involved a three-phase strategic planning process that relied on local input and traditional knowledge and a scientific assessment of climate change impacts. More specifically, the methodology uses a science and values-focused decision-making process:

Community engagement activities were structured to coincide with monthly community meetings to reach members living on reserve and other, off-reserve members, who are invested in the future of the community. The engagement sessions included presentations by the project team, group discussions and surveys.

5.1 Community Values and Areas of Concern

The second phase of the three-phase strategic planning process involved developing an inventory of community values and concerns. The climate and streamflow projections summarized in Section 3 were presented to the community at the February 15th, 2018 community meeting. Following the presentation, a group discussion was facilitated to identify changes in Kanaka Bar's Traditional Territory as observed by the community. From these discussions, community values ("what matters most") and areas of concern were identified.

The following is a summarized list of community member observations of the Traditional Territory gathered at the community engagement session:

- Decline in populations of sockeye and other salmon species in the Fraser river;
- Salmon are swimming deeper and are harder to catch;
- Lower quantity and quality of roots, berries, mushrooms, and other plants;
- Traditional berries are drying up before they ripen;
- Roots and berries are growing earlier and becoming less predictable;
- Douglas Fir trees are dying;
- Trees blooming 5 to 6 weeks ahead of pollinators;
- Ungulates are moving to higher elevations;
- Pine mushrooms are becoming less abundant;
- Migratory birds are staying year-round (e.g. robins present in December);
- Summer rain storms are becoming less frequent (none in 2017);
- Increased frequency of turbidity spikes in raw water supply, associated with more frequent storm events;
- Snowpack in the community is consistently lower than in the past;
- Mountaintops in the Territory no longer have snow year-round;
- Increased occurrence of dry summers and water restrictions;
- Increased occurrence of roads and basements flooding during spring months;
- Head ponds forming at culvert inlets when creek flows are high;
- Increased need to clean culverts of sediments;
- Culverts at highway 1 and CN rail are old and at risk;
- Extreme drought conditions leading to increased occurrences of forest fires in BC;
- Poor air quality associated with forest fires.

From the engagement session observations and discussions, the community components of highest value were categorized, and areas of concern were inventoried. In addition to the observations identified at the engagement session, the project team also included components related to the community's self-sufficiency goals. Table 5.1 summarizes the key community values and areas of concern.

Mountaintops in the Territory no longer have snow year-round.

Table 5.1: Community Values and Areas of Concern

Value	Areas of Concern
Water Resources	■ Morneylun Creek water supply ■ Nekliptum Creek water supply and quality ■ Niger Creek water supply ■ Siwash Creek water supply ■ Kwoiek Creek water supply
Traditional Foods	■ Salmon populations ■ Health of berries, mushrooms, and other traditional plants
Human Health	■ Forest fires ■ Air quality ■ Heat stress
Infrastructure	■ Buildings and homes ■ Access roads (Siwash Road and Highway #1) ■ Drinking water treatment plant ■ Community garden ■ Kwoiek Creek hydropower project
Future Development to Support Self-sufficiency Goals	■ Siwash Creek hydropower project ■ Agriculture ■ Must Stop Rest Stop

The values and areas of concern identified in this process were used to assess community vulnerability and create and prioritize adaptation actions that meet community needs.

5.2 Vulnerability Assessment

Taking the values and areas of concern identified by the community, a vulnerability assessment was completed to identify priority areas for adaptation planning. The vulnerability assessment involved two components:

- A qualitative assessment considering how climate influences each area of concern, the potential impacts of projected changes in climate and the community's capacity to adapt to the impacts.
- A second community engagement session to evaluate the severity of impacts to everyday life at Kanaka Bar and identify priority impacts based on the community's level of concern.

The qualitative assessment first considered which climate factors are known to influence each area of concern and how that influence is expressed (exposure). Secondly, the potential impacts to each area of concern were evaluated based on how the relevant climate factors are projected to change, and a sensitivity rank was assigned. In the next step, the adaptive capacity of each component and/or community to each impact was evaluated and assigned an adaptive capacity rank. Taken together, the sensitivity and adaptive capacity ranks provide an assessment of vulnerability. Opinions on impacts and assignment of ranks were based on the project team's professional judgement and knowledge of the community. The detailed results of this process are provided in Appendix 4.

The potential impacts generated during the qualitative assessment were presented to the community at the May 17th, 2018 community meeting. At the meeting, community members were given the opportunity to rank the severity of each potential impact by completing a survey. The members also identified their prioritized areas of concern through a voting process that involved placing stickers next to impacts that reflected their highest concerns.

Table 5.2 summarizes the results of the community vulnerability assessment.

Table 5.2: Community Vulnerability Assessment Results

Area of Concern	How Could Climate Change Influence this Area of Concern?		Current Capacity to Adapt	Vulnerability Rank	Community Severity and Priority Rank
WATER RESOURCES					
Morneylun Creek, Nekliptum Creek, Niger Creek, and Siwash Creek Water Supply	■ As described in Section 5, climate change could cause a reduction in baseflow, which would limit the water available for community use, particularly during the dry periods of the year.		■ Streamflow is currently being monitored for Morneylun Creek, Nekliptum Creek and Siwash Creek. ■ There are currently no strategies and limited management responses in place to prepare for water shortages.	**HIGH**	**HIGH**
Kwoiek Creek Water Supply	■ As described in Section 5, climate change is expected to impact the timing and magnitude of peak flows and with depletion of the glaciers eventually result in a reduction in flows during low flow periods. These changes may impact the power production profile of the Kwoiek Hydropower project.		■ Streamflow is currently being monitored for Kwoiek Creek. ■ Specific adaptation related to flows in Kwoiek Creek are not needed at this time to protect community interests and values.	**MEDIUM TO HIGH**	**LOW**
TRADITIONAL FOODS					
Salmon Populations	■ The impacts of climate change on salmon have been well documented with changes in water temperature impacting metabolism, growth, oxygen consumption, digestion, and distribution of movement during migration contributing to declines in populations (see Box 6.1 for more detail).		■ Salmon have biological limits associated with temperature and have little capacity to adapt to rapid rates of temperature change.	**HIGH**	**HIGH**
Health of berries, Mushrooms, and other Traditional Plants	■ Changes in temperature and precipitation patterns will likely continue to influence the health of berries, mushrooms, and other traditional plants leading to unpredictable growth patterns, and decreased viability as a sustainable food source.		■ Mushrooms, berries, and other traditional plants have biological limits associated with temperature and water. They have little capacity to adapt to rapid changes in temperature and precipitation. ■ However, certain species may migrate to higher elevations for favourable conditions that are typically cooler. They also have more precipitation to compensate for warmer, drier conditions expected in the summer.	**MEDIUM TO HIGH**	**HIGH**
HUMAN HEALTH					
Forest Fires	■ Warmer, drier summers are likely to increase the risk of forest fire in the Kanaka Bar Traditional Territory.		■ Kanaka Bar has implemented forest fire interface management to reduce the vulnerability of the community.	**MEDIUM TO HIGH**	**HIGH**
Air Quality	■ With increased risk of forest fire, it is likely that there will be more frequent air quality issues in the Kanaka Bar Traditional Territory.		■ Poor air quality conditions can be avoided by staying indoors, however, many buildings and homes in Kanaka Bar do not have air conditioning which further reduces exposure to poor air quality from forest fire smoke.	**HIGH**	**HIGH**
Heat Stress	■ Warmer summer temperatures will likely lead to increased frequency of heat waves that induce heat-related stress.		■ Individuals can cope with extreme heat through various practices (avoid the outdoors during peak daily temperature, dress appropriately, drink water, seek cool locations.) ■ However, despite these methods, vulnerable populations, such as the elderly and young, are less able to cope with heat-related stress.	**MEDIUM**	**MEDIUM**

continued

Table 5.2: continued

Area of Concern	How Could Climate Change Influence this Area of Concern?		Current Capacity to Adapt	Vulnerability Rank	Community Severity and Priority Rank
INFRASTRUCTURE					
Buildings and Homes	■ With the exception of potential damage from the increased frequency and intensity of storm events, no considerable impacts are expected.		■ In general, buildings and homes are designed to withstand the typical impacts of climate.	LOW	LOW
Access Roads	■ Increases in the frequency and intensity of storm events increase the risk of road washouts for Siwash Road and Highway #1.		■ Siwash Road is the only access road to the community. ■ Siwash Road and Highway #1 have culverts to manage stormwater flows. However, it is unknown whether the culverts are appropriately designed for future climate conditions.	MEDIUM TO HIGH	HIGH
Drinking Water Treatment Plant	■ Increases in the frequency and intensity of storm events will lead to more frequent raw water turbidity spikes which could impact the efficacy of water treatment and the need for increased maintenance.		■ The water treatment plant is designed to treat intermittent turbidity spikes in the raw water supply. ■ However, the additional stress to the system may reduce its effective lifetime.	LOW TO MEDIUM	MEDIUM
Community Garden	■ Warmer temperatures and changes in precipitation will impact growing conditions and irrigation demands for the community garden, which could influence the viability of certain plant species.		■ Plant selection and irrigation rates are controlled by the community and can be adjusted to changing climate conditions.	LOW TO MEDIUM	MEDIUM
Kwoiek Creek Hydropower Project	■ Changes in the magnitude and timing for flow patterns may impact the power production profile of the project (in a positive way) short-term, while the melting glaciers are providing increased flows. ■ Increases in the frequency and intensity of storm events may increase the risk of damage to access roads and the penstock protection infrastructure.		■ Kanaka Bar's partner for the Kwoiek Creek Hydropower project, Innergex, has indicated that the project is designed to accommodate the projected changes in the timing, and magnitude of flow patterns ■ Operation and maintenance of the of Kwoiek Creek Hydropower project infrastructure is the responsibility of Innergex.	LOW TO MEDIUM	LOW
FUTURE DEVELOPMENT TO SUPPORT SELF-SUFFICIENCY GOALS					
Siwash Creek Hydropower Project	■ Changes in the magnitude and timing for flow patterns and potential decreases in baseflow may impact the power production profile of the project. ■ Increases in the frequency and intensity of storm events may increase the risk of damage to access roads and the penstock protection infrastructure.		■ As the project is not yet under construction, the potential impacts of climate change can be considered in the design, and operations and maintenance of the facility.	LOW TO MEDIUM	LOW
Agriculture	■ Warmer temperatures and changes in precipitation will impact growing conditions and irrigation demands for agricultural development which could influence the viability of certain crops.		■ Larger agricultural developments are not yet underway, Kanaka Bar could consider the climate change projections for the area when considering crop selection and irrigation demands.	LOW TO MEDIUM	MEDIUM
Must Stop Rest Stop	■ Apart from potential damage from the increased frequency and intensity of storm events and potential issues with water supply if baseflow decreases, no considerable impacts are expected.		■ As the Must Stop Rest Stop is not yet constructed, the potential impacts of climate change can be considered in the design, and operations and maintenance of the facility.	LOW	LOW

Key community vulnerabilities were determined by considering the impact of climate change to each area of concern, and the severity and priority of the impacts as identified by the community. In general, the ranking from the vulnerability assessment and the community severity and priority assessment were well aligned.

The results indicate that the greatest vulnerabilities and highest community priorities relate to the following categories:

- **Water resources**
- **Forest fires**
- **Traditional foods**
- **Access roads**

These categories and the associated potential impacts to the community are the focus of the adaptation strategy discussed in Section 6.

7 British Columbia. Ministry of Environment. (2016). Indicators of climate change for British Columbia, 2016 update (Rev. June 2016. -- ed.). Victoria, B.C.: Ministry of Environment.

8 Cohen, B. I., & Commission of Inquiry into the Decline of Sockeye Salmon in the Fraser River (Canada). (2012). The uncertain future of Fraser river sockeye. Ottawa: Commission of Inquiry into the Decline of Sockeye Salmon in the Fraser River.

9 Grant, S. MacDonald, B. (2018). Fraser Sockeye Science Integration. Retrieved from http://www.frafs.ca/sites/default/files2/2018%20Fraser%20Sockeye%20Science%20Integration%20STATE%20OF%20SALMON%20FORUM.pdf

10 Nelitz, M., & Pacific Fisheries Resource Conservation Council. (2007). Helping pacific salmon survive the impact of climate change on freshwater habitats: Case studies: Perspectives from the Okanagan, Quesnel, Nicola, Cowichan, Nass, and Englishman river watersheds. (). Vancouver: Pacific Fisheries Resource Conservation Council.

Box 6.1: Impacts to Pacific Salmon

To the Nlaka'pamux people residing on the Fraser and Thompson River tributaries, salmon (particularly sockeye) has been the primary food source for generations. The Nlaka'pamux depend on salmon returns each year for food security to last the winter, and as means for bringing communities together to celebrate culture and promote vibrancy. Salmon are an important part of life in the Fraser Valley and the wellbeing of the salmon is critical for the prosperity of the people and other animal and marine species in the valley.

In recent years, the decline of wild pacific salmon has caused local, provincial, and federal governments to question the current sustainability of this keystone species. Fluctuation in salmon stock from year to year is common but it is the rapid decline of returning stocks of wild chinook, coho, sockeye, pink, and chum salmon over the past 20 years that is of concern. These varying, and sometimes unpredictable, numbers of return stock result in uncertainty. As well, measures imposed to mitigate below average returns have put the Nlaka'pamux on edge as indigenous food fishery openings have been limited to ensure sustainable fisheries and future salmon stock.

Although there are many factors contributing to the continual decrease of salmon populations, ongoing studies reveal that the effects of climate change on pacific salmon are of major concern. Climate change-related effects include rising water temperatures, severe weather patterns, floods, drought and ocean acidification. Each of these have a direct effect on pacific salmon, and as current trends show, the current shifts in marine ecosystems are not favourable for salmon and other marine life species *(British Columbia Ministry of Environment, 2016, p. 36.)*[7]

The primary effect of climate change on salmon populations is increasing water temperatures in both freshwater and ocean water bodies.

Increasing water temperatures are critical as salmon are a cold-blooded species. Rising water temperatures cause direct impacts on a salmon's metabolism, growth, oxygen consumption, digestion, and distribution of movement during migration.

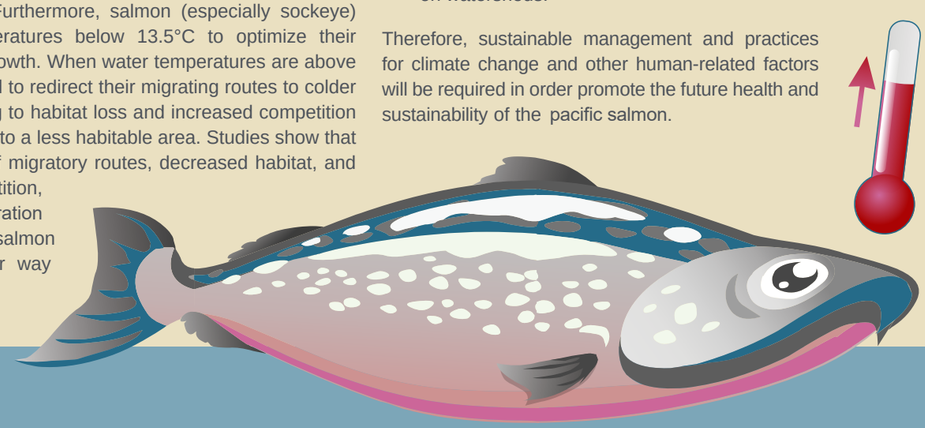
In warmer water temperatures, the metabolisms of salmon increase, leading to a larger food requirement to support adequate growth. Furthermore, salmon (especially sockeye) prefer water temperatures below 13.5°C to optimize their metabolisms and growth. When water temperatures are above 13.5°C, salmon tend to redirect their migrating routes to colder water areas, leading to habitat loss and increased competition among species due to a less habitable area. Studies show that this displacement of migratory routes, decreased habitat, and increased competition, is affecting the migration timing and size of salmon as they make their way into freshwater tributaries. Subsequently, later spawning times are developed which cause late hatching and increased juvenile mortality *(British Columbia Ministry of Environment, 2016, p. 36.)* Another concern for salmon is if they contain a parasite, salmon have higher mortality rates at temperatures of 13°C and above than at temperatures below 13°C *(Cohen, B. I, 2012. p.30.)*[8]

As current trends show, declining sockeye salmon populations from year to year in the Fraser River and its tributaries is predicted to continue *(Grant & MacDonald, 2018, p. 29.)* In years 2015 through 2017, record low returns of the past decade have been observed. Therefore, since the majority of salmon have a four-year lifespan, it can be predicted that future returns will also be low. Based on the four-year sockeye lifespan and typical migration patterns, the expected salmon run in 2018 is predicted to be the largest salmon run through the Fraser River system in regard to Kanaka Bar's location since 2014 *(Grant & MacDonald, 2018, p. 29.)*[9] The 2018 salmon run numbers of returning stock will be an indication of the current state of the pacific salmon population and what can be expected for future generations of Nlaka'pamux people in terms of this culturally significant food source.

Ultimately, salmon conservation to ensure future stocks is of primary concern for both indigenous and commercial fisheries. As the impacts of climate change on natural systems are difficult to mitigate, conservation efforts for salmon must focus on other factors affecting salmon populations. Case studies completed on the Fraser River and its feeding tributaries have shown that methods to help preserve salmon include *(Nelitz & Pacific Fisheries Resource Conservation Council, 2007, p.7)*[10]*:*

- Adjusting Fisheries Management Practices to ensure harvest rates are consistent with survival and escapement goals;
- Recognizing Aboriginal rights to water and salmon;
- Repairing riparian ecosystems to improve habitat quality and quantity;
- Ensuring protection of critical habitats;
- Improving fish passages; and,
- Implementing low impact forestry practices to limit impacts on watersheds.

Therefore, sustainable management and practices for climate change and other human-related factors will be required in order promote the future health and sustainability of the pacific salmon.



6.0 ADAPTATION STRATEGIES

Adaptation strategies were developed with a focus on Kanaka Bar's key vulnerabilities; water supply, forest fires, access to traditional foods and community access roads. While climate projections for the Kanaka Bar Territory and community vulnerabilities are now well understood, implementation of adaptation options requires careful planning. In some cases, additional information will be required to understand particular systems and determine the best course of action. This may require additional assessments, cost benefit analyses, and long-term planning efforts, whereas some actions can be implemented with relatively low cost and effort.

The following outlines a series of preliminary adaptation strategies for consideration, refinement with the entire community, and implementation to advance a more secure and resilient community. It is important to note that both "High Priority" and "Secondary Priority" adaptation measures have been inventoried. The purpose of doing so aims to support Kanaka Bar's efforts to allocate its resources (people, time and money) to the measures that are going to best support the community's resilience and overall vibrancy.

6.1 Water Resources

Kanaka Bar has five watersheds within the Traditional Territory, however, the following adaptation options apply to the four watersheds on the east side of the Fraser only as they are associated with community water supply and represent a key vulnerability within the community.

"Water is life" and Kanaka Bar is fortunate to have creeks near the community with year-round surface water supply. However, long-term changes in temperature and precipitation are predicted to impact baseflow in the creeks, and limit water supply during dry periods of the year. Therefore, the following proactive actions are outlined to manage and protect Kanaka Bar's water resources while supporting a viable water supply for future generations.

High Priority

- Continue to manage gauging stations and collect flow data at Morneylun, Nekliptum and Siwash Creek. The gauging stations provide valuable data for tracking long-term trends to determine if there is more, less or the same amount of water over time, and further draw correlations to climate change. The data from these stations will also be a valuable resource and assist with decision making regarding future development and community water supply and demand.

- Issue a moratorium on unsustainable resource extraction activities in the community watersheds. The community's traditional knowledge indicates that the baseflow in the creeks have provided consistent surface water supply for thousands of years, and maintaining the quality and quantity of this resource is of critical importance. Protecting the natural state of the watershed will limit potential cumulative effects associated with climate change on water supply and other ecological and traditional values within the watersheds. Considering the value of the water resources provided by the community watersheds and the sensitivity of watershed hydrologic processes, it is suggested that unsustainable resource extraction activities such as intensive mining, clear cut logging, and other intensive activities which could threaten Kanaka Bar's water resources, be limited within the watersheds. The governance to advance such a management strategy is outlined in Kanaka Bar's *Traditional Territory Land and Resources Strategy.*[11]

- Assess current and future water demand and develop a water management strategy. The gauging stations will provide detailed information on water supply; however, it is critical to better understand the current and future demand on Kanaka Bar's water resources. There are several current uses of water in the community including drinking water, irrigation and dust control. Data collection and/or estimations of volumes and timing of use are required to better understand current demand. Several developments within the community are planned that will see water demand increase in the future, and in particular the Must Stop Rest Stop and restaurant lands on Highway 1, and housing and agriculture on Lot 4. Initial water demand estimates are being advanced as part of the Highway 1 Redevelopment Strategy. Estimating future water demand for these developments, in greater detail once they are further advanced, and others —while considering anticipated climate change impacts to the community's water resources— will assist in determining the need to explore the development of additional water resources and/or water storage facilities.

- Implement additional monitoring for the drinking water treatment plant. The projected increase in the frequency and intensity of storm events could impact the capacity of the drinking water treatment plant to provide effective treatment. It is recommended that a monitoring program be implemented to track the frequency and duration of filter backwash to assess trends and potential stresses on the system. In addition, a raw water monitoring program is recommended to monitor trends in turbidity.

- Install weather monitoring stations in the community. The nearest Environment Canada weather station to the community is located in Lytton, which is known to be hotter and drier than Kanaka Bar. Considering the microclimates that exist in the Fraser Canyon, it would be prudent for Kanaka Bar to collect their own long-term weather data to track site-specific trends within the community. The data from one or more weather stations can also be correlated with the streamflow data collected within the watersheds to gain better understanding of the influence of climate conditions on streamflow in real-time. A weather station will also add important empirical data to support community observations and decision making.

Secondary Priority

- Assess and monitor the hydrology of the upper watershed lakes. The upper watershed lakes influence the baseflow in the community watersheds, however, the hydrologic processes of this influence are not well understood. A detailed assessment of the lakes will provide a better understanding of their connection to the community watersheds and importance in terms of maintaining the natural surface water flows. In addition, a water level monitoring program for the lakes is recommended to track long-term trends and evaluate potential correlations with baseflow in the creeks. Ultimately, this information will help determine whether the lakes should be considered as targets for adaptation strategies that could support a more resilient water supply to Kanaka Bar.

- Develop a conceptual design for siting and sizing of a raw water reservoir. Based on the results of the current and future water demand assessment(s) and water management strategy, raw water storage may be needed for maintaining water supply during low flow periods. As a first step, a conceptual design is recommended to evaluate what size reservoir would be needed and determine suitable locations within Kanaka Bar's territory.

- Share this report with Innergex and remind them of Kanaka Bar's concerns related to climate change. Although the projected short-term changes in streamflow may prove beneficial to the power production of Kwoiek Creek Hydropower project, other impacts, such as extreme storm events and forest fires may cause infrastructure damage and increase maintenance and operation costs. It is recommended that Kanaka Bar work to ensure the community's knowledge, the ground observations and concerns are regularly shared Innergex.

11 Available at: http://www.kanakabarband.ca/downloads/territorial-land-and-resources-strategy.pdf

6.2 Forest Fires

Kanaka Bar is located within a dry forest ecosystem where the risk of forest fires is already high. With hotter, drier summers projected, there will likely be an increased risk of forest fires in the area. Forest fires can impact the community in variety of ways including loss of infrastructure, evacuation, extended periods of poor air quality and even loss of life. The following proactive actions are recommended to mitigate the potential impacts of forest fires.

High Priority

- Continue and expand forest fire interface and fuel management practices. Kanaka Bar has already and proactively initiated forest fire interface and fuel management work in areas surrounding the community. This is the first line of defense for protecting the community from the spread of wildfire. It is recommended that this work continue in the priority radius and be extended to secondary priority areas.

- Implement FireSmart strategies for buildings and homes. If a forest fire were to reach the community, the risk of fire damage to buildings and homes can be reduced by applying FireSmart standards[12]. It is recommended that a home and site hazard assessment be completed for all buildings and homes in the community. From the assessments, site-specific FireSmart standards can be implemented. In addition, establish a FireSmart standard for all newly constructed buildings and homes.

- Host public education sessions on FireSmart and fire prevention. Approximately 48% of forest fires in British Columbia are caused by human activity. The best protection against loss, damage, and injury due to forest fire is prevention. It is recommended that public education sessions be held annually for Kanaka Bar and other surrounding communities to learn about best practices for fire prevention and FireSmart strategies to protect buildings and homes.

- Review and update the community Emergency Response Plan. Considering the increased risks to the community associated with forest fires, heat stress, and drought, it is recommended that the community Emergency Response Plan be reviewed bi-annually and updated as needed to reflect current best practices and changing circumstances at Kanaka Bar.

Secondary Priority

- Install air quality monitoring instruments. Forest fires in the Kanaka Bar area or elsewhere in British Columbia can impact air quality in the community. Monitoring air quality will allow the community to identify conditions that pose a risk to human health. This information can be used to warn community members when it is unsafe to spend extended periods of time outside.

- Install air conditioning systems for buildings and homes or purchase portable air filters. Smoke exposure from forest fires can be reduced by keeping the windows closed and running an air conditioner on the recirculation setting. Air conditioners also provide cooling which will reduce the likelihood of heat stress during summer heat waves. In the absence of air conditioning, portable air filters can be used indoors to reduce smoke exposure.

12 http://www.bcwildfire.ca/Prevention/docs/homeowner-firesmart.pdf

6.3 Traditional Foods

Salmon, mushrooms, berries, and other plants have been traditional food sources for the people of Kanaka Bar for thousands of years. Some traditional food sources have already been disrupted by changes in climate conditions and other impacts (in particular salmon.) With projected increases in temperature, and changes to precipitation patterns, increased stress is expected for traditional food sources. The following proactive actions are outlined to monitor traditional foods and promote food self-sufficiency, particularly if traditional food sources become less abundant.

High Priority

- Continue and expand food production initiatives in the community. Kanaka Bar currently has a permaculture community garden, chicken coop and honey bee hive with intentions to continually advance food self sufficiency efforts. It is suggested that the community build from these successes by developing residential backyard gardens, greenhouses, a larger scale community food garden on Lot 4, additional livestock (e.g. pigs, goats) and additional fruit trees. In addition to supporting Kanaka Bar's goal of food self-sufficiency, gardens and greenhouses could be used to cultivate traditional plants that are experiencing stress in the natural environment.

- Implement Kanaka-based knowledge sharing and documentation of traditional food sources. Several members of the community monitor and harvest traditional food sources annually. Documenting observations of year to year variability will assist with evaluating trends in the timing, locations, yield and health of traditional food sources. Establishing a community group, or family-based initiatives that share knowledge and engage with youth will promote long-term monitoring and use of traditional foods. Developing a seasonal harvesting calendar and map will assist with documenting observations and trends in traditional food sources gathered from the watersheds.

Secondary Priority

- Develop and implement an agriculture plan for Lot 4. Lot 4 has been identified as a site for future agricultural development. It is understood that Kanaka Bar has developed an initial agricultural plan for Lot 4 that considers soil capability, crop type options, irrigation demands, equipment, and labour needs. Efforts to advance this plan are already underway with the development of a raw water line and other community-based initiatives. While efforts are underway, much work remains, and the opportunity leverage this land for community food self-sufficiency is key. It will be important for Kanaka Bar to continually explore innovative food production opportunities, such as land-based fish production, engage interested members in agricultural activities, and continually refine its plan for Lot 4 to support a safe, secure and sustainable food source for the community today and into the future.

- Support and contribute to all salmon protection initiatives. With observed declines in the pacific salmon populations, there are multiple ongoing efforts to protect and restore the fishery. Examples of groups supporting the pacific salmon fishery include several indigenous based organizations, Pacific Fisheries Resource Conservation Council, the Pacific Salmon Foundation and the Department of Fisheries and Oceans Canada. As the decline of the pacific salmon populations is a main concern for the Kanaka Bar community, where possible, provide support to salmon protection initiatives.

6.4 Access Roads

There is only one access road, Siwash Road, from Highway 1 to the Kanaka Bar community. In the case of a medical emergency or evacuation order (e.g. during a forest fire), Siwash Road is the only exit from the community and therefore represents a key vulnerability. Highway 1 itself is also a vulnerability to the community as it represents the only exit from the area. Climate change will add to the existing vulnerabilities of being a rural community with limited road access options. This increased vulnerability will stem from the increase forest fire risk and precipitation events which are projected to be more frequent and intense increasing the risk of damage to the roads.

High Priority

- Continue and expand culvert inspection and cleaning program. Culverts represent areas of potential road washout. Currently, Kanaka Bar staff inspect the culverts after storm events and remove debris built up at the inlets. This represents important maintenance. To further reduce the risk of road washout, it is recommended that debris be removed in and around the streams and upstream of the culverts. This will help prevent debris build up at the culvert inlets.

- Complete a culvert assessment and compare sizing with updated IDF curves. As climate change is projecting an increase in the frequency and intensity of storm events, an assessment of the Siwash Road culverts is needed to determine if they are sized appropriately. Other parameters to include in the assessment include upstream and downstream pipe condition, evidence of damage or reduction in hydraulic capacity, evidence of corrosion or perforation, channel conditions both upstream and downstream of culverts, evidence of accumulation of silt and sediment affecting pipe capacity, and the embankment conditions at the culvert crossings.

- Develop a conceptual design for a secondary access route. A secondary access road into and out of the community will provide a considerable reduction in vulnerability. As an initial step, it is recommended that a conceptual design be developed to determine a suitable route.

Secondary Priority

- Initiate discussions with the Ministry of Transportation and Infrastructure (MOTI) regarding culvert management of Highway 1. Highway 1 is also vulnerable to road washouts. However, the management of Highway 1 is the responsibility of the MOTI. As the Highway 1 culverts associated with the Kanaka Bar's community watersheds are relatively old, it is recommended that Kanaka Bar initiate discussions with MOTI, and through written memorandums, express concerns related to road washouts and community vulnerability.

6.5 Supporting Self-Sufficiency

Kanaka Bar's vision of self-sufficiency is in itself an adaptation strategy. Global climate change can have considerable impacts on systems that the community currently depends on, such as global food trade and third-party energy services. Achieving self-sufficiency will remove Kanaka Bar's dependency on these systems, further improving community resilience. Measures to support food self-sufficiency are discussed above, however, energy self-sufficiency is also a key priority. In addition, asset management is an important step towards infrastructure planning for the future. Integrating climate change resilience with asset management represents a proactive action that supports long-term sustainability and self-sufficiency.

High Priority

- Complete an asset management plan, integrating knowledge of climate change. An asset management plan represents an opportunity to inventory the community's natural and built (infrastructure) assets to assist moving toward service, asset and financial sustainability. This includes an assessment of location, age, condition and capacity. With the knowledge of climate change projections for Kanaka Bar, this information can be integrated into the assessment and planning processes in the asset management framework, adding an additional level of resilience to the project outcomes.

Secondary Priority

- Continue and expand strategies to achieve energy self-sufficiency. Kanaka Bar can reduce their dependence on third-party power by continuing to explore clean energy production opportunities. Opportunities include the Siwash Creek Hydropower project, currently in the pre-feasibility phase, wind power projects and additional solar power projects. These opportunities can be complemented with continued effort on demand-side management.

6.6 Youth and Community Engagement and Education

One main vulnerability within the Kanaka Bar community is creating and maintaining a multi-generational understanding of climate change vulnerabilities and ongoing implementation of adaptation strategies. The most severe changes in climate at Kanaka Bar are projected for 30 to 60 years from now. Therefore, it is essential that Kanaka Bar's members, in particular the youth of the community, are educated about potential climate change impacts to the community and engaged in adaptation strategies. Ultimately, today's youth will be responsible for the long-term sustainability of the community.

High Priority

- Host an annual youth workshop on climate change and adaptation at Kanaka Bar. This represents a key first step and ongoing process for keeping the youth in Kanaka Bar and other surrounding communities informed about climate impacts in the community, and current strategies to address vulnerabilities.

Secondary Priority

- Engage youth to assist with implementation of adaptation strategies and monitoring programs. Where possible, provide hands-on opportunities for youth to get involved in adaptation implementation and monitoring programs.

6.7 Summary

Table 6.1 (page 54) summarizes the priority adaptation options to reduce the vulnerability of Kanaka Bar to climate change. Next steps will involve developing an implementation plan that involves prioritization, cost-benefit analyses and integration into other planning initiatives.

Table 6.1: Summary of Priority Adaptation Options

Adaptation Theme	High Priority	Secondary Priority
Water Resources	■ Continue to manage gauging stations and collect flow data at Morneylun, Nekliptum and Siwash Creek ■ Issue a moratorium on unsustainable resource extraction activities in the community watersheds. ■ Assess current and future water demand and develop a water management strategy ■ Implement additional monitoring for the drinking water treatment plant ■ Install weather monitoring stations in the community	■ Assess and monitor the hydrology of the upper watershed lakes ■ Develop a conceptual design for siting and sizing of a raw water reservoir. ■ Share this report with Innergex and remind them of Kanaka Bar's concerns related to climate change.
Forest Fires	■ Continue and expand forest fire interface and fuel management practices ■ Implement FireSmart strategies for buildings and homes ■ Host public education sessions on FireSmart and fire prevention ■ Review and update the community Emergency Response Plan	■ Install air quality monitoring instruments ■ Install air conditioning systems for buildings and homes or purchase portable air filters
Traditional Foods	■ Continue and expand food production initiatives in the community ■ Implement knowledge sharing and documentation of traditional food sources	■ Develop and implement an agriculture plan for Lot 4 ■ Support and contribute to all salmon protection initiatives
Access Roads	■ Continue and expand culvert inspection and cleaning program ■ Complete a culvert assessment and compare sizing with updated IDF curves ■ Develop a conceptual design for a secondary access route	■ Initiate discussions with the Ministry of Transportation and Infrastructure (MOTI) regarding culvert management of Highway 1
Supporting Self-Sufficiency	■ Complete an asset management plan, integrating knowledge of climate change	■ Continue and expand strategies to achieve energy self-sufficiency
Youth & Community Engagement and Education	■ Host an annual workshop on climate change and adaptation at Kanaka Bar	■ Engage youth to assist with implementation of adaptation strategies and monitoring programs

7.0 CLOSURE

Kanaka Bar accepts that we are now living in the age of consequence and that we must take proactive measures to prepare our community for the environment and economy of tomorrow.

With support from the First Nations Adapt Program, we now understand climate change in our local context and our community's key vulnerabilities. The adaptation strategy we have developed provides actions that we can take to improve our resiliency to the known and foreseeable changes in our Traditional Territory. With this knowledge and plan of action, our community is in a better position to realize our vision of self-sufficiency.

The adaptation strategy we have developed provides actions that we can take to improve our resiliency to the known and foreseeable changes in our Traditional Territory.

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