COPPER RIVER CLIMATE CHANGE ADAPTATION PLAN

Copper River Native Association

Model Forest Policy Program

Ahtna Regional Tribes

Updated 2024

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COPPER RIVER
NATIVE ASSOCIATION

Copper River Valley
Alaska Native Villages

Ahtna Intertribal Resource Commission

ALASKA NATIVE
TRIBAL HEALTH
CONSORTIUM

Model Forest
POLICY PROGRAM

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

International Arctic
Research Center

UAF
UNIVERSITY OF
ALASKA
FAIRBANKS

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Acronyms

Ahtna Intertribal Resource Commission (AITRC)
Alaska (AK)
Alaska Climate Adaptation Science Center (AK CASC)
Alaska Division of Natural Resources (AK DNR)
Alaska Native Tribal Health Consortium (ANTHC)
Bureau of Indian Affairs (BIA)
Copper River Native Association (CRNA)
Copper River Watershed Project (CRWP)
Environmental Protection Agency (EPA)
Federal Emergency Management Agency (FEMA)
Hazard Mitigation Plan (HMP)
Indian Environmental General Assistance Program (IGAP)
Local Emergency Planning Committee (LEPC)
Model Forest Policy Program (MFPP)
Multi-Jurisdictional (MJ)
National Oceanic and Atmospheric Administration (NOAA)
Small Community Emergency Response Plan (SCERP)
Traditional Ecological Knowledge (TEK)
United States Geological Survey (USGS)
University of Alaska Fairbanks International Arctic Research Center (UAF IARC)
University of Alaska Fairbanks Scenarios Network for Alaska +Arctic Planning (UAF SNAP)
Quality Assurance Project Plan (QAPP)

EXECUTIVE SUMMARY

Copper River Native Association (CRNA), with support from various partners, prepared this climate change adaptation plan to outline current trends in the Copper River Valley and determine goals and action items that CRNA can take to support the adaptation of the Ahtna tribal and Copper Valley communities it serves.

The planning process was a lengthy one centered around webinars that outlined potential risks to communities associated with climate change and explored options to address those risks. The communities that specifically participated in these webinars were Mentasta, Tazlina, Kluti-Kaah, Gakona, and Gulkana. Community representatives (the environmental coordinators for each tribe) talked with their tribal members and received input and information to complete the questionnaires regarding climate change impacts and strategies for addressing them.

The plan focuses on some of the main trends associated with warming temperatures, including flooding and erosion, permafrost thaw, shifts in wildlife patterns and vegetation, and the increasing incidence and severity of wildfires. All of these changes have significantly impacted the traditional harvest practices ("subsistence") of the Ahtna people—practices that are key to their cultural and nutritional survival. The plan also considers a few non-climate related stressors that may exacerbate climate change impacts. Where relevant, these additional factors are also included in action planning.

The plan outlines several goals that CRNA can take with partners, including education on climate change risks; adaptation strategies; health and subsistence; assisting tribes implement their own plans; and improving monitoring.

The following outlines the three priority CRNA goals for regional climate adaptation:

- Goal 1: Raise awareness and educate the CRNA staff, tribal leaders, and community members on climate change risks and resilience solutions to protect human health, subsistence resources, food security, infrastructure, and natural systems.
- Goal 2: Assist the tribes in implementing their priority climate solutions, such as resilient infrastructure, energy independence, food security, and emergency response.
- Goal 3: Improve the accuracy, consistency, and availability of regional environmental sampling/testing and data collection by coordinating region wide testing protocols (Quality Assurance Project Plan (QAPPs) with regional Tribes and agencies.

The plan identifies Short-Term (6-12 months) and Medium-Term (2-5 years) action items to address these three goals and their related objectives outlined below.

The Short-Term Action Items focus on meeting the most urgent needs and taking advantage of current funding and partnership opportunities. The short-term work plan includes the following action items priorities:

- Provide targeted education and outreach to communities on climate risks and adaptation strategies to raise awareness and generate support for taking action (IGAP support)
- Coordinate and support development or updating of Small Community Emergency Plans (SCERPs) and Hazard Mitigation Plans (HMPs) for each local village (State of AK support)
- Host quarterly regional climate change meetings to coordinate actions, amplify regional adaptation, and monitor implementation steps and resilience outcomes (IGAP support)
- Provide training on subsistence protection and food security opportunities for village residents (EPA and State of AK support)

The Medium-Term Action-Items focus on deepening the understanding and support for climate adaptation, raising the necessary funds, and undertaking planning and on-the-ground adaptation projects to reduce risks and increase resilience to extreme events The medium-term work plan includes the following action items:

- Develop a Multi-Jurisdictional Hazard Mitigation Plan (MJ-HMP) for all participating villages to identify mitigation needs and qualify for disaster assistance funding, if needed (FEMA &/or BIA funding)
- Provide targeted education and technical action support for prioritized topics from local villages and integrate education into the MJ-HMP process. (BIA Funding)
- Develop and deploy collaborative regional Quality Assurance Project Plans (QAPPs) to monitor and evaluate implementation of climate adaptation strategies from regional and village specific climate action plans (EPA Support)
- Provide targeted education on climate change and human health to CRNA staff, health professionals, tribal leaders, and village residents. (BIA support)
- Improve and increase Ahtna cultural revitalization and resilience throughout the Copper River Valley (BIA support)

Below in the plan are details and specifics outlining key partners to completing these action items and funding sources for carrying them out.

1. BACKGROUND

1.1. The Copper Valley Region and People

The Copper River Valley is located in the eastern portion of southcentral Alaska, and has an area of more than 24 thousand square miles. The basin is interspersed with four ranges of rugged mountains, many large glaciers, and broad river valleys. The lower elevations feature a boreal forest environment dominated by spruce, aspen, cottonwood and birch trees, while higher elevations are predominated by alpine tundra, rock, and ice. The region features a continental climate, characterized by short, warm summers and long, cold winters.

The Ahtna people are organized into eight different tribes, each of which has its own tribal government: Cantwell, Mentasta, Cheesh'na, Gakona, Gulkana, Tazlina, Kluti-Kaah, and Chitina. There are also several communities throughout the Copper Valley: Slana, Chistochina, Glennallen, Tolsona, Copper Center, Kenny Lake, Tonsina, and McCarthy.

The plan's focal region specifically covers the area from Mentasta down to Chitina, encompassing seven native villages and four communities: Mentasta Traditional Council, Cheesh-Na Tribe, Native Village of Gakona, Gulkana Village Council, Native Village of Tazlina, Native Village of Kluti-Kaah, the Native Village of Chitina, the town of Chistochina, the town of Copper Center, the town of Glennallen, and the town of Chitina. The estimated square miles, based on the map shown in **Figure 1**, are 6,621.51 mi ^{2}. The total approximate population is 2,242. The communities that specifically participated in this plan were Mentasta, Gakona, Gulkana, Tazlina, and Kluti-Kaah. The average population of the tribes and communities ranges from 80 to 500.

Copper River Native Association (CRNA) is one of the tribal consortiums in the Copper River Valley, and takes responsibility for supporting and providing assistance to regional villages and communities on environmental issues and healthcare.

Figure 1: Map of Project Area

Source: Google Earth

1.2. Climate Change Impacts and Risks

Native villages and community members in the Copper River Valley have been experiencing climate changes for the past several decades. Although the Copper River Valley stretches across a vast area that includes different environmental concerns, there are several similar issues that extend across the whole valley: increasing invasive plant species, river temperatures rising and affecting salmon populations, increasing erosion, thawing permafrost, and increasing wildland fire danger.

In addition to these stressors, a number of non-climate stressors (e.g., constrained hunting laws, homelessness) discussed in **Appendix I** (**Climate Change Impacts, Risks, and Projections**) have complicated the physical and cultural survival of the Ahtna people.

The following **Table 1** shows the key climate change impacts addressed by this plan. Additional information is in **Appendix I**.

The listed "Indicators" and "Effects" in **Table 1** represent a combination of first-hand observations, shared traditional ecological knowledge (TEK), and potential negative effects given future climate projections. This table summarizes the local knowledge specific to the Copper River Valley region gathered directly from village residents including indicators and effects that were observed and described as first-hand experiences by community members, and are not the full extent of all climate changes and effects.

The planning process included an informal approach to gathering local knowledge, observations, and shared traditional knowledge. The scope is limited to the Copper River region and the information was drawn from virtual discussion sessions with village Environmental Coordinators, other village leaders, guest presentations by village elders, and three virtual public forums to invite public review and input. A formal TEK protocol was not used as it was beyond the scope of this project. There may be instances where local knowledge is not yet supported by publications of reports or local data. In those cases, further research is needed to investigate the on-the-ground observations and local knowledge gathered during this planning process.

Table 1: Key Climate Change Impacts from Local Observations and Shared Traditional Ecological Knowledge

Trend	Indicators	Effects (Observed or Potential)
Warmer temperatures	• Hotter summers • Warmer waters	• Fewer salmon as waters warm • Increased parasites in salmon • Cascading effects increase risks associated with other trends in this chart • Increased wildland fires
Changes to water bodies	• Later freeze up • Rivers don't freeze over completely • Spring breakup earlier • Glaciers melting • Small ponds and streams drying up	• Risk of falling through ice • Lack of ice impedes travel to subsistence areas • Dangerous road conditions • Higher and faster rivers impede travel • Loss of traditional fish camps
Precipitation changes	• Later snow • Freezing rain • More rain but not soaking into ground-increased transpiration	• Freezing rain making it difficult for caribou to get to their winterfeed • Berries and vegetation not getting water to grow

Changes to wildlife	● Wildlife migrate to higher elevations ● Caribou migrate in different places ● Bears are out later ● Invasive plant species ● Berry patches are being overgrown by non-native plant species ● More parasites and disease in animals	● Animals needed for hunting and fishing are less available
Thawing permafrost	● Subsidence ● Methane showing up in shallow ponds ● Muskeg ponds disappearing	● Infrastructure less stable ● Waste leaching threatens health of people and animals
More intense and frequent wildfires	● Ecosystem alteration (loss of old vegetation)	● Air quality issues such as breathing issues and asthma ● loss of homes, possessions, important buildings, transportation and emergency routes ● wildlife habitat destruction and migration due to loss of habitat ● loss of historical and cultural sites
Flooding and Erosion	● River banks are falling into the water ● More rapid water, changes to flow	● Community members lose fish wheels and land that was used for fishing ● Roads close to waterways are threatened ● Degraded salmon habitat

Based on community observations and knowledge, and scientific data, five regional risks were identified and prioritized by the Planning Team for the Copper River Valley:

- Wildland Fires
- Earthquakes
- Subsistence Resources Lost
- Erosion
- Flooding

The process for identifying and prioritizing these risks are located in **Appendix G** (**Planning Process**).

1.3. Plan Purpose and Vision

The purpose of this plan is to understand regional climate change impacts and identify concrete actions that address climate change to help ensure public health, environmental protection, and community well-being in the Copper Valley Region. This plan will guide CRNA's adaptation actions over the next few years, including a strategy for CRNA to obtain funding and carry out said actions in cooperation with local villages.

Parallel to this CRNA plan, the Planning Team worked with each of the participating villages on their own village adaptation action plans. CRNA will work with the villages to help them secure funding and implement these plans.

The vision is that communities in the Copper River Valley achieve the following adaptation objectives:

- **Wildfire Safety**: Have active forest fuel management programs, effective fire wise programs, fire response teams in each community and an air quality system for public health risks; and wildfire preparedness takes place at every level of government.
- **Infrastructure Resilience:** Increase earthquake and permafrost resilience to current and new infrastructure; conduct outreach on fuel tank maintenance and preparedness to community members; communities and businesses will improve building codes and ordinances; and communities will develop emergency plans to prepare and respond to earthquakes.
- **Subsistence Resources Access:** Have continued access and conservation of subsistence resources through adaptation strategies for tribal and community members; Native Villages, as sovereign governments, will be an integral part of Alaska and Federal Fish & Game regulations and public policy-making decisions; through participation in the regulatory process, Native Villages will play a role in supporting access and conservation of subsistence resources for the Ahtna people; Public education on food sovereignty and security will enable villages to effectively participate in subsistence policy making.
- **Emergency Preparedness:** Possess the ability to adapt quickly and efficiently to flooding and erosion concerns and to increase community awareness and education about the Copper River watershed and flooding and erosion occurrences.

These desired conditions are visions and goals that community members want for their community and environment. The adaptation goals and objectives outlined below will provide a pathway to achieve the climate resilience visions and goals.

Fall Subsistence Gathering.
Photo Credit: Colleen Merrick. (2022)

2. ADAPTATION GOALS AND OBJECTIVES

- **GOAL 1:** Raise awareness and educate the CRNA staff, tribal leaders, and community members on climate change risks and resilience solutions to protect human health, subsistence resources, food security, infrastructure, and natural systems.
  - **Objective 1.1:** Host quarterly regional climate change meetings to build relationships, share information, and facilitate fundraising and collaboration for climate adaptation and mitigation actions.
  - **Objective 1.2:** Provide targeted education, outreach, and community engagement activities to learn and take action on the top priority risks and opportunities identified by the regional climate change plan.
  - **Objective 1.3:** Educate health professionals and the public about the links between human health and climate change, including the deep connection of mental health, how to avoid health hazards from floods, wildfire, disease vectors, and more.
  - **Objective 1.4:** Educate and provide on the ground training on food security and adaptation strategies to protect subsistence resources and to enhance local food production.
  - **Objective 1.5:** Support international climate change mitigation and adaptation strategies by attending international meetings and webinars, and sharing information and resources.

- **GOAL 2:** Assist the tribes in implementing their priority climate solutions, such as resilient infrastructure, energy independence, food security, hazard mitigation, and emergency response.
  - **Objective 2.1:** Support regional education and development with resilient infrastructure practices.
  - **Objective 2.2:** Support development and integration of climate resilience into new or existing community plans such as wildfire protection plans, community emergency response plans and Hazard Mitigation Plans.
  - **Objective 2.3:** Research, facilitate and support regional coordination for funding, grants, and project resources.
  - **Objective 2.4:** Collaborate with regional partners on climate change related projects (Tribes, CRWP, AITRC, LEPC, ANTHC, DNR, etc.).
  - **Objective 2.5:** Develop a Copper River Valley regional data collection program for climate change information.

- **GOAL 3:** Improve the accuracy, consistency, and availability of regional environmental sampling/testing and data collection by coordinating region wide testing protocols (QAPPs) with regional Tribes and agencies.
  - **Objective 3.1:** Include the following types of environmental monitoring:
    - Water quality monitoring
    - Waste stream assessment
    - Air quality sampling
    - Erosion assessment

3. ADAPTATION ACTION ITEMS

This section outlines a mitigation and adaptation strategy for reducing the impacts of risks identified above, and carrying out the goals and objectives. The Planning Team identified adaptation activities to address the risks and implement the goals and objectives, assessed and prioritized the activities, and developed a strategy for implementing the activities in a regional short-term workplan.

3.1. Identification and prioritization of adaptation action items

Adaptation activities reflect the actions communities want to take based on their goals and objectives. Additional information on the process of identifying, assessing, and prioritizing these action items are in **Appendix G** (**Planning Process**). The following action items were identified, assessed, and prioritized:

Action Items

- Provide targeted education and outreach to communities about climate change risks and solutions, emergency preparedness, flooding and erosion control, wildland fires, restoration and flood mitigation, gardens and greenhouses, climate resilience, and more.
- Develop or Update Small Community Emergency Response Plans
- Host quarterly regional climate change meetings to coordinate climate actions
- Develop Multi-Jurisdictional Hazard Mitigation Plans
- Develop Wildfire Protection Plans
- Educate public about climate change and health effects
- Food security training and resources
- Develop QAPPs
    - Water quality monitoring
    - Waste stream assessment
    - Air quality sampling
    - Erosion assessment
- Technical assistance
    - Fire lines/brush clearing
    - Resilient infrastructure
    - Community greenhouses/gardens
    - Erosion
    - Flooding
- Develop Copper Valley regional data collection system/software

3.2. Details on priority action items

This section provides detailed descriptions about each priority action item. These action items are listed in order of priority, from first priority to last priority. The top five priority items will be included in the regional short-term workplan, and when those are completed, work will continue on to the next priority item until all of them are completed. The priority action item list will be evaluated periodically and can be changed or updated at any time.

- **Provide targeted education and outreach**

CRNA will work with regional Tribes, organizations, and communities to develop a plan for education and training programs to address top priority risks and initiate actions to build resilience (wildfires, earthquakes, changes in subsistence resources, flooding, and erosion) in the Copper Valley region. Outreach will include on-the-ground practices for subsistence food security and education on participation in the public policy-making process for subsistence hunting and fishing state and federal regulations and policies. CRNA will use social media and networking channels, host trainings, and post flyers and brochures to raise community awareness and education.

- **Develop SCERPs**

CRNA will work with the regional Tribes and communities to develop and update Small Community Emergency Response Plans (SCERPs) for each community so they are prepared for a sudden emergency or disaster.

- **Host quarterly regional climate change meetings**

CRNA will host quarterly regional climate change meetings to bring together communities, agencies, organizations, and more to build relationships to increase climate resilience and collaborate on climate adaptation and mitigation projects and programs.

- **Develop Hazard Mitigation Plans (HMPs)**

CRNA will work with regional Tribes and communities to develop multi-jurisdictional Hazard Mitigation Plans for communities in the Copper Valley region. With these plans, each community will be prepared and can work together in the event of an emergency or natural disaster to assist communities and community members. FEMA approved HMPs will also qualify the participating communities for FEMA post disaster funding to support recovery, if needed.

- **Develop Wildfire Protection Plans**

Wildfire Protection Plans are important as wildfire continues to be an increasing threat to the Copper Valley area. This action item was listed as a high priority and will be included as part of the Hazard Mitigation Plans for participating villages. Wildfire plans may also be developed as their own local action item in the village short-term workplans.

- **Educate the public about climate change and health effects**

CRNA Environmental Department will work with the CRNA Health Department, Cross Roads Health Ministries, and other community health clinics to educate and raise awareness with health providers and health staff about the effect of climate change on human health. The Climate Change Coordinator will host informational sessions and provide information about other trainings available for health staff. Regional Health staff will then be responsible for informing and educating the public on climate change and health effects, and consider climate change effects when treating community members mental and physical health.

- **Food security training and resources**

CRNA will work with regional Tribes, communities, organizations, and more to host trainings focused on food sovereignty and raise public awareness and education about the importance of food security. CRNA will work with partners to develop and implement projects and activities focused on improving food security throughout the Copper Valley region. CRNA will assist with and improve public awareness and knowledge of subsistence rules and regulations, and how to comment on laws and regulations that affect subsistence resources.

- **Develop Quality Assurance Project Plans (QAPPs)**

CRNA will work with regional communities, organizations, and agencies to conduct environmental sampling for water quality, waste, air quality, and erosion. These sampling projects will gather environmental data to quantify effects in the environment so communities can plan mitigation activities to improve human and environmental health. Use of regional QAPPs will also allow collaborative monitoring of the implementation of the adaptation plan and help inform adjustments to the plan according to results over time.

- **Technical assistance**
    - <u>Firelines/brush clearing</u>

      CRNA will work with regional Tribes and communities to plan and establish fire lines around communities, and clear brush around buildings and important sites in communities to protect against wildfire. CRNA will conduct public outreach to raise awareness and education about firewise actions, current burn regulations, air quality, and other wildfire related information.

    - <u>Resilient infrastructure</u>

      CRNA will work with partners to research information about resilient infrastructure and housing and raise public awareness and education about how homes, buildings, and other infrastructure can be more resilient. CRNA will work with businesses and organizations to improve infrastructure resilience design and construction throughout the Copper Valley area. Upgrading infrastructure can also help protect habitat and ecosystems. For example, the Copper River Watershed Project is working to enlarge and upgrade the design of river culverts to allow higher flow volumes and stream simulation. This will help reduce flood damage and improve habitat for salmon and other freshwater fish.

- Erosion
  CRNA will work with Tribes, communities, and partners to assess the erosion throughout the Copper Valley area. CRNA will work with partners to plan, develop, and implement activities to reduce erosion and mitigate current erosion effects. River bank analysis can help to identify banks with a stable rock base for better placement of fish camps and fish wheels and help avoid putting structures on more erodible river bank soils.

- Flooding
  CRNA will work with Tribes, communities, and partners to assess flooding risk to communities throughout the Copper Valley area. CRNA will then work with Tribes, communities, and partners to address, prevent, and plan for flooding risks and events.

- **Regional data collection system**

CRNA has collected a lot of climate change observations, data, and information from community members, agencies, scientific documents, organizations, and more. Currently there is no place to store all this data and have it accessible to many different partners. CRNA will work with communities and organizations to plan, develop, and implement a regional climate change data collection system so all climate change data is in a central place that can be accessed by multiple partners. Then the data can be used by multiple organizations, agencies, or communities for climate change related projects, grants, funding, and more. The quarterly climate adaptation meetings can provide excellent technical consultation on the development of this regional data collection system.

3.3. Regional Short-term Action Workplan

Table 2 below is the regional short-term work plan. The top five priority action items are outlined in this workplan. Once those activities are complete, work will be done on the other action items, working down the priority list.

Table 2: Regional Short-term Action Workplan (6-12 months)

Action Item	Action	Leader	Timeframe	Funding Source
1. Provide targeted education and outreach	Develop and prioritize outreach topic list	CRNA Climate Change Coordinator, and Tribal Environmental Coordinators	By January 2023	General staff time; IGAP grant; BIA or other climate change grant if needed
	Collaborate with tribes and other partners to develop outreach plan	CRNA Climate Change Coordinator, and Tribal Environmental Coordinators	By May 2023	General staff time; IGAP grant; BIA or other climate change grant if needed

	Create, publish, and deliver outreach resources and activities	CRNA Climate Change Coordinator, and Tribal Environmental Coordinators	May 2023 - September 2023	General staff time; IGAP grant; BIA or other climate change grant if needed
2. Develop Small Community Emergency Response Plans (SCERPs)	Determine if each community has a current SCERP in place	CRNA Climate Change Coordinator, and Tribal Environmental Coordinators	By December 2022	General staff time; IGAP grant
	Plan and hold community meetings to develop or update SCERPs	CRNA Climate Change Coordinator, and Tribal Environmental Coordinators; State assistance	January 2023 - April 2023	General staff time; IGAP grant; other grants if needed
	Have Council or community leaders approve final SCERP	Tribal Environmental Coordinators; Councils/Boards	April / May 2023	General staff time; IGAP grant
	Submit SCERPs to State of AK	CRNA Climate Change Coordinator, and Tribal Environmental Coordinators	May / June 2023	General staff time; IGAP grant
3. Host quarterly regional climate change meetings	Draft concept paper describing purpose, process, and benefits of meetings	CRNA Climate Change Coordinator	By November 2022	General staff time; IGAP grant; BIA or other climate change grant if needed
	Identify and invite participating people, stakeholders, community members, agencies, local organizations and businesses	CRNA Climate Change Coordinator	By December 2022	General staff time; IGAP grant; BIA or other climate change grant if needed
	Schedule and host first meeting	CRNA Climate Change Coordinator	By January 2023	General staff time; IGAP grant; BIA or other climate change grant if needed
4. Develop Hazard Mitigation Plans (HMPs)	Determine the status of each community's Hazard Mitigation Plan	CRNA Climate Change Coordinator, and Tribal Environmental Coordinators	By December 2022	General staff time; IGAP grant; BIA or other climate change grant if needed

	Contact State of AK or Contractor to assist with updating or developing Plan	CRNA Climate Change Coordinator, and Tribal Environmental Coordinators	By March 2023	General staff time; IGAP grant
	Research and apply for funding if hiring contractor	CRNA Climate Change Coordinator, and Tribal Environmental Coordinators	January 2023 - June 2023	General staff time; IGAP grant
	Host community meetings to develop or update HMP	CRNA Climate Change Coordinator, and Tribal Environmental Coordinators; State of AK staff	June 2023 - June 2024	General staff time; IGAP grant; other grant if needed
5. Educate the public about climate change and health effects	Set up meeting with Health departments and organizations in Copper Valley to determine current knowledge of climate change among staff	CRNA Climate Change Coordinator; CRNA Health Dept; Cross Roads staff; Tribal health staff; other health organizations staff	By January 2023	General staff time; IGAP Grant
	Plan trainings with Health organizations to improve knowledge and awareness about climate change and health effects	CRNA Climate Change Coordinator; CRNA Health Dept; Cross Roads staff; Tribal health staff; other health organizations staff	January 2023 - May 2023	General staff time; IGAP grant; other grants if needed
	Host trainings and provide information to health organizations about climate change and health effects	CRNA Climate Change Coordinator; CRNA Health Dept; Cross Roads staff; Tribal health staff; other health organizations staff	May 2023 - October 2023	General staff time; IGAP grant; other grants if needed

CRNA will collaborate with tribes to help them implement their own climate related projects. ANTHC, Zender Environmental, EPA, and other organizations and agencies will be sourced for technical assistance to assist with funding opportunities, capacity building, and project implementation.

4. FUNDING MECHANISMS AND RESOURCES

The CRNA adaptation project includes a review and summary of potential funding sources compiled by Model Forest Policy Program. A list is provided of funding sources that are most likely to address the five priority regional risks plus a number of specific local village risks. The primary funding sources for the action items identified are the BIA Tribal Resilience Grants, the FEMA grants, and EPA or IGAP related funding. However, information on a number of other funding sources and financial mechanisms will be provided to broaden the potential for larger scale or longer-term projects. As new grant opportunities become available, relevant proposals will be developed and submitted that address priority action items

Fall Fireweed in the Copper River Basin. *Photo Credit: Colleen Merrick. (August 2019)*

5. IMPLEMENTATION AND OUTCOMES

Implementation of the climate resilience action strategies recommended in this plan is vital to building climate resilience in the Copper River Basin. There are short-term action items to tackle in the next 6-12 months because they are urgently needed or there are ready opportunities with time and resources available now. Implementation will also extend into the future with a medium (2-5 years) and long term (5-10 years) investments in time, energy, and resources according to priority needs.

To keep track of progress toward climate resilience for the Copper River Basin, it's important to have a clear guide that establishes short- and medium-term action items and identifies the long-range priorities of the future. This regional plan clearly identifies the priority regional goals that all villages share. And the action plans need to be reviewed on a regular basis to be sure progress is being made and to update the workplan as items are completed or priorities evolve.

The action steps necessary to achieve the plan's objectives are outlined in detail with a short-term action workplan (6-12 months) and a medium-term action workplan (2-5 years). Both provide an outline of the action steps, responsible parties, timeline, and potential funding sources. The workplans provide clear communications between CRNA and participating village leaders. They also facilitate tracking of progress and regular updates.

Effective action steps will lead to significant positive outcomes in both the near-term and medium-term timeframes. Taking action right away with the short-term action plan will enable this plan to avoid becoming just another plan on a shelf. The short-term strategies will also help to engage village and agency partners and build momentum toward further actions. The following resilience building outcomes are expected from the short-term action strategies:

1) The targeted educational programs for specific audiences will build the awareness and support of village residents and leadership, leading to steady financial support for a variety of adaptation projects
2) The CRNA Environmental Department capacity will be expanded by adding a Climate Coordinator position to the staff. This position will provide a focus on climate change issues and leadership for implementation of priority action items.
3) Rapid development or updating of the local village SCERPs provide a vital tool to improve the effectiveness of local emergency response teams, helping to protect people and infrastructure in the face of extreme weather events.
4) CRNA's hosting of quarterly regional meetings will be particularly important to keep up the collaboration between the village leaders with CRNA and other organizations. Those quarterly meetings will foster information sharing, promote project partnerships, yield potential for larger grants, and bring motivation and accountability for taking implementation steps. The collaboration will be particularly helpful to creating regional QAPPs and monitoring protocols that lead to better tracking of impacts and adaptive management of the plan itself.

5) The development of a multi-jurisdictional HMP for the region will be a particularly powerful process. It will enhance the educational outreach on a regional scale, identify regional partnership opportunities to solve problems on a regional scale, and greatly increase the eligibility for disaster mitigation funds in the region. Villages will become safer during extreme events and increase their ability to recover. Hazard mitigation projects called for in the HMP will serve to reduce the risks of drought and wildfire, and floods and erosion.
6) Education focused on the health effects of climate change will be an especially important element for both CRNA and ANTHC. Both are health care providers who need to recognize climate-related illness and support preventive public health measures, such as air quality mitigation steps for wildfires and preventing toxic exposure to harmful algal blooms in warming water bodies.

It's also important to map out medium-term action strategies over the next 2 to 5 years that require more time and resources to accomplish. The medium-term action items are primarily focused on enhancing the actions started in the short-term action plan. They help to ensure that those early activities are kept current into future years where needed, such as long-term monitoring protocols and ongoing targeted education programs.

Long term goals are also needed to track long term progress and keep the communities working together toward their shared long-range goals for protection of Copper River people, infrastructure, and subsistence resources.

Some action steps are already being done by organizations and local villages, such as climate education programs by IGAP Coordinators; community gardens and greenhouses built by villages to increase food security; improved waste disposal and recycling programs; erosion monitoring along the Copper River; water quality monitoring in our major rivers and streams; and increased safety and emergency preparedness with local Small Community Emergency Response Plans (SCERPs) and Hazard Mitigation Plans (HMPs). These actions are important to educate residents and build momentum toward large climate adaptation strategies and projects.

To ensure the regional and local village plans are being implemented, CRNA will organize regional climate meetings on a quarterly basis. Putting these meetings quickly into action will help sustain the momentum for plan implementation. The meetings will help to track progress, coordinate funding proposals, provide technical assistance, and share both success stories and lessons learned. They will also enable projects aimed at large-scale issues such as flood mitigation, stream bank stabilization, infrastructure upgrades, and regional environmental monitoring for air and water quality.

With the leadership of CRNA and the ongoing collaboration with the four participating villages, they will serve as a positive model for the region. Over time additional villages can join into the regional collaborative efforts and continue to increase regional resilience into future years.

The following table highlights the positive outcomes expected from priority adaptation actions.

Table 3: Highlights of Taking Action and Outcomes

Highlights of Taking Action & Outcomes

Actions	Outcomes
Education on climate change hazards & solutions	• Leaders and public support climate projects • Health professionals help protect residents
CRNA leadership for quarterly regional meetings	• Collaborate for projects and funding • Effective regional QAPPS & monitoring protocols • Track progress; more successful projects
Emergency planning: SCERPs and HMPs	• Villages are safer from climate hazards • Eligible for hazard mitigation and recovery funds • More capacity to prepare, prevent damage, and recover from impacts
Food security projects	• Nutritious and affordable alternative foods • Protection for traditional food sources
Hazard mitigation projects	• Reduced risks from drought and wildfire • Reduced losses from floods and erosion • Reduced damage from thawing permafrost

6. APPENDICES

A. Mentasta Traditional Council Climate Action Plan
B. Native Village of Gakona Climate Action Plan
C. Native Village of Tazlina Climate Action Plan
D. Native Village of Kluti-Kaah Climate Action Plan
E. Regional Medium-Term Action Workplan
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G. Planning Process
H. The Ahtna People: History and Culture
I. Climate Change Impacts, Risks, and Projections
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    - I.3. Permafrost Thaw
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        - I.8.1. Earthquakes
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        - I.8.3. Poverty
        - I.8.4. Environmental Damage
        - I.8.5. Changes in Subsistence Patterns

A. Mentasta Traditional Council Climate Action Plan

This page is a placeholder for the Mentasta Traditional Council Climate Change Adaptation Plan. When their plan is complete, the Mentasta Executive Summary will be added to this Regional Climate Change Adaptation Plan as an Appendix, along with a link to the complete Mentasta Climate Action Plan.

B. Native Village of Gakona Climate Action Plan

This page is a placeholder for the Native Village of Gakona Climate Change Adaptation Plan. When their plan is complete, the Gakona Executive Summary will be added to this Regional Climate Change Adaptation Plan as an Appendix, along with a link to the complete Gakona Climate Action Plan.

C. Native Village of Tazlina Climate Action Plan

This page is a placeholder for the Native Village of Tazlina Climate Change Adaptation Plan. When their plan is complete, the Tazlina Executive Summary will be added to this Regional Climate Change Adaptation Plan as an Appendix, along with a link to the complete Tazlina Climate Action Plan.

D. Native Village of Kluti-Kaah Climate Action Plan

This page is a placeholder for the Native Village of Kluti-Kaah Climate Change Adaptation Plan. When their plan is complete, the Kluti-Kaah Executive Summary will be added to this Regional Climate Change Adaptation Plan as an Appendix, along with a link to the complete Kluti-Kaah Climate Action Plan.

E. Regional Medium-Term Action Workplan

Table 4: Regional Medium-Term Action Workplan (2-5 years)

Action Item	Action	Leader	Timeframe	Funding Source
1. Facilitate development of Multi-Jurisdictional HMP with Communities of Copper River Valley.	Coordinate MJ collaboration activities for HMP process - planning, technical assistance, and community engagement	CRNA Environmental Coordinator; Consultant	Planning 2024-2025	BIA or FEMA
	Conduct and complete MJ HMP development process; FEMA approval	CRNA Environmental Coordinator; Consultant	2026	BIA or FEMA
	Coordinate collaborative fundraising to begin to implement resilience strategies in multiple villages	CRNA and Tribal Environmental Coordinators; Consultants; Contractors	2027 and beyond	BIA or FEMA
2. Provide targeted education and action support for prioritized topics of local villages (integrate into HMP process).	Create a 3-5 year plan for training programs to address top priority risks and initiate actions to build resilience	CRNA and Tribal Environmental Coordinators	By March 2023	General staff time; IGAP grant; BIA grant
	Secure funding for education, outreach, and community engagement	CRNA Environmental Coordinator	Fall 2023	BIA; FEMA; other education grants
	Develop and implement regional training programs for top priority topics (such as food security, emergency response, wildfire mitigation, flood mitigation, etc.). (One per year - 3-5 years)	CRNA and Tribal Environmental Coordinators; Village leaders for local actions; expert trainers	Begin by spring 2024 Implement one training topic per year, including on-the-ground village work	General staff time; IGAP grant; BIA grant; FEMA; other climate change grant if needed

3. Develop and Deploy a collaborative regional QAPP to monitor and evaluate the implementation of climate adaptation strategies from regional and village action plans.	Organize a multi-village and agency regional monitoring team to guide the development of a series of regional climate adaptation QAPPs	CRNA and Tribal Environmental Coordinators; Zender; Village leaders	By spring 2023	Staff time
	Draft a scope of work and secure funding to begin QAPP development and initiate a monitoring network	CRNA and Tribal Environmental Coordinators; EPA; Zender; Village leaders	Spring 2024	Staff time; EPA; FEMA
	Select one or two top priority adaptation strategies, develop the related QAPP protocols and launch monitoring network	CRNA and Tribal Environmental Coordinators; EPA; Zender; Village leaders	Spring 2025	Staff time; EPA; BIA; FEMA
4. Provide targeted education on climate change and human health to CRNA staff, health professionals, tribal leaders, and community residents.	Organize a collaboration with related climate and health organizations and agencies for a regional educational approach	CRNA; ANTHC; AK Public Health	By summer 2023	Staff time
	Secure funding for two-year educational campaign	CRNA	By spring 2024	Staff time
	Develop and deliver multi-targeted educational program on human health and climate change with a focus on Alaska specific conditions to CRNA, ANTHC, health professionals, and tribal leaders	CRNA; ANTHC	2025-2026	BIA; CDC; EPA
	Provide public outreach materials, events, and training for health professionals to share with patients and residents	CRNA; health professionals; Village leaders	2026 and beyond	BIA; CDC; EPA

5. Improve and increase Ahtna cultural revitalization and resilience throughout the Copper River Valley.	Retain and teach the Ahtna language through an Ahtna language emersion school.	CRNA Education Administrator	Planning 2024-2025; implementation 2025-2026	BIA TCR; Alaska Native Education Program
	Pass on traditional ecological knowledge through culture camps, after school programs, workshops, and intergenerational knowledge exchanges.	CRNA Education Administrator	2025-2026 and beyond	BIA TCR; Alaska Native Education Program
	Develop partnerships to leverage resources and knowledge at regional, state, and federal levels.	CRNA Education Administrator	2024-2026 and beyond	BIA TCR; Alaska Native Education Program

F. Existing Village Plans and Initiatives

There is currently no regional climate change plan for the Copper River Valley, and only a few individual communities or villages have a local climate change plan developed.

There are a number of other plans that need to be integrated with this Climate Plan and with village plans, as shown in **Table 5**.

Table 5: Village Plans

Community	Community/Comp	HMP	Other
Tazlina	No	Glennallen/Tazlina Multi-Jurisdictional Hazard Mitigation Plan 2019	Tribal Environmental
Kluti-Kaah/Copper Center	No	2015 (expired)	Solid waste (developing), SCERP (updating), Wildfire protection (developing)
Mentasta	2006 (outdated)	No	Tribal Environmental; Wildfire protection (outdated)
Gakona	No	No (developing)	Tribal Environmental, solid waste, SCERP (updating)

Gulkana	No	2013 (expired)	No
Cheesh'na/Chistochina	2006 (outdated)	draft 2019	No
Chitina	2009 (outdated)	2015 (expired)	No

G. Planning Process

This project started with CRNA receiving a BIA Tribal Resilience Program Grant on June 1, 2020 to develop a regional Climate Change Adaptation Plan. This project was designed to have CRNA work with the tribes and communities of the Copper River Valley to create an overarching Climate Change Adaptation Plan for the Copper River Valley, and to help each village create their own plan.

Sarah Sherwood, the Environmental Coordinator at CRNA, was the Project Coordinator. CRNA contracted with the Model Forest Policy Program, MFPP, to help guide and facilitate the planning process. Together, CRNA and MFPP developed a project workplan, identified project partners, and developed the project schedule.

CRNA and MFPP worked together to identify potential stakeholders and project partners for this project. Project partners include:

- Copper River Native Association (CRNA)
- Copper River Native Villages
- US Environmental Protection Agency (EPA)
- Model Forest Policy Program (MFPP)
- Ahtna Intertribal Resource Commission (AITRC)
- University of Alaska Fairbanks Scenarios Network for Alaska + Arctic Planning (UAF SNAP)
- UAF International Arctic Research Center (UAF IARC)
- Alaska Native Tribal Health Consortium (ANTHC)

CRNA and MFPP hosted monthly climate change meetings with project partners to gather community knowledge and information, distribute climate change information, work together to develop the climate change plan, talk about next steps for each partner, and other discussions related to the project. These sessions also allowed the communities and partners to share ideas and knowledge with each other, and guest speakers were invited to talk on specific climate change topics.

CRNA and MFPP created and distributed four questionnaires to the villages to help gather community knowledge and information. Questionnaire #1 was to get an introduction to the Village IGAP Coordinators, village representative for the project, and climate resilience background information on the villages. Questionnaire #2 was to understand village awareness of climate change, gather data on climate concerns, current conditions, and existing plans. Questionnaire #3 was a Risk Assessment to identify the current impacts and projected future risks of the villages. Questionnaire #4 was to identify adaptation strategies at the regional and local village scale. IGAP Coordinators were responsible for engaging local tribal members to share information, gather local information and input, and answering the questionnaires with assistance and input from their community members.

CRNA gathered climate change data for the Copper River Valley from scientific sources such as: UAF, SNAP, IARC, USGS, AK Fish & Game, NOAA, and more.
CRNA worked with MFPP, the native villages, and other project partners to gather Traditional Ecological Knowledge on climate change data from community members. The TEK gathering was an informal process, based mainly on first-hand observations and descriptions of climate change experienced by local village residents. It also included guest presentations by village elders and opportunities for interviews and shared traditional knowledge. CRNA, MFPP, and ANTHC hosted a series of three virtual Public Forums for informal local information gathering. The First Public Forum in March 2021 was to gather input and knowledge from the Copper River community on climate change observations, issues, and concerns.

Both TEK, community knowledge, and scientific data were used to identify climate changes, concerns, risks, and help determine adaptation strategies.

Next, CRNA worked with project partners to determine the top five regional risks and regional assets for the Copper River Valley. CRNA and MFPP created a Risk Matrix to assist with identifying risks. Project Partners worked through the Risk Matrix together to identify the regional risks. Villages used the Risk Matrix to determine risks for their individual village areas.

The Planning Team made the decision to focus on wildland fire, earthquakes, subsistence resources changes, flooding, and erosion in this plan, although others are discussed. The Planning Team developed the risk matrix shown in **Table 6** to evaluate the significance of climate risks.

Figure 2: Community Risk Chart

Copper River Basin - Village Climate Risks Cross Reference — Most Recent Update May 18, 2021

Climate Risks	NV Glennallen	NV Tazlina	NV Kluti-Kaah	Mentasta TC	Mt. Sanford TC	NV Gakona	NV Gulkana	Cheesh'na TC
Flood	X	X	X			X		
Erosion	X		X	X		X		
Wildland Fire	X	X	X	X		X		
Thawing Permafrost	X		X					
Heat - receding ice, rain on snow						X		
Severe weather - hot, drought								
Severe weather - cold, storms	X		X					
Forest decline	X	X	X	X		X		
Water supply at-risk		X						
Subsistence - animal			X					
Subsistence - fish			X	X		X		
Subsistence- plants			X					
Insects								
Invasive species			X	X		X		
Roads, bridges								
Health impacts						X		
Other?								
Non-Climate Stressors								
Earth quake		X	X	X				
Volcano ash	X	X				X		
Ground failure	X		X	X				
Roads & bridges						X		
Other?								

There were several monthly meetings and a community forum where climate change observations and risks were discussed. Village representatives talked about risks to their villages, and prioritized those risks for their area. CRNA and MFPP then created a table to document all the risks mentioned and their priority for each community. The five regional risks were chosen based on this table.

CRNA hosted a Second Public Forum on July 14, 2021 where special expert guest speakers discussed the top five regional risks in detail, and community members were invited to brainstorm adaptation strategy ideas specific to the Copper River Valley.

A Risk & Solutions Matrix model was developed to prioritize risks, assess risk impacts, and develop potential adaptation ideas and strategies. CRNA hosted several working sessions to complete the Risk & Solutions Matrix for each of the top five regional risks. Working with the Regional Villages and project partners, regional impacts, assessment of risk level, desired future conditions, and potential adaptation strategies were identified and listed for each regional risk. Each matrix category is described in this document.

Table 6: Risk Matrix

Regional Risk Matrix-Copper River Basin								
The purpose of this Risk Matrix is to identify, analyze, and prioritize climate risks for the Copper River Valley Region								
Climate-Related Risks and Assets at Risk			**Specific Regional Impacts or Consequences**		**Assessment Level of Risk**			
Category of weather or climate risks	Local climate stressors	Known assets at risk	Impacts to people, natural resources	Potential consequences	Probability to occur	Severity of consequences	Adaptive capacity	Overall risk level
Wildland fire	Heat and spruce beetle forest die-off increasing	All village infrastructure	Air quality, homes, offices, roads, etc.	important sites damaged, loss of identify, loss of tradition	High	High	Low	High
Earthquakes	Increase seismic activity anticipated	Roads, infrastructure	Loss of homes, injury, infrastructure, buildings, access to subsistence resources	Road and bridge damage, no transportation, no emergency response	High	High	Low/ Medium	High
Subsistence Resources lost	Hotter air and water temperatures, permafrost loss, erosion	Wildlife, salmon, food security	Not harvesting enough food resources, mental health impacts, policy limitations, loss of cultural traditions	Loss of culture and sense of identity, hotter temperatures, loss food security, health issues, increased flooding and erosion	High	High	Medium	High
Flooding and Erosion	Melting glaciers, rapid spring runoff, increased flooding, increased erosion, thawing permafrost	Homes, roads and bridges, fish camps, land	Loss of land, injury, loss of cultural sites, homes/buildings, water quality impacts, fish affected	Loss of traditional and cultural sites and harvest areas, loss of culture and identity with place, increased erosion	High	High	Medium	High

CRNA worked with project partners to develop the regional goals and objectives for the plan. These regional goals and objectives will guide the short- and long-term regional work plans and implementation strategies.

MFPP created a short-term action workplan template that was sent out to the Villages for them to develop their village specific action workplans. This workplan template was used to develop a regional short-term action workplan covering 6 months to 1 year to plan for climate change projects and activities.

The Planning Team had multiple sessions from May to July 2022 to identify, assess, and prioritize adaptation action items based on the regional risks and goals developed.

The Planning Team identified potential action items and prioritized them to develop the short-term action workplan. Criteria for evaluation was developed to apply to each action item. There were two categories, “Most Important” and “Most Realistic to Implement”, and each action item was assigned a number, or score, for each category by the Planning Team, with the highest number being most significant. The two scores were then tallied together for a total number count.

Table 7, below, shows the evaluation and score for each action item.

CRNA and MFPP developed the regional short-term workplan based on the prioritized action items, then presented it to other project partners and Villages for feedback and comment.

CRNA worked with MFPP to research and discover funding sources and opportunities to help implement adaptation projects. Several of the monthly meetings focused on funding opportunities, sources, and upcoming grants. Discussions were held at several monthly meetings to review regional and village implementation ideas and adaptation strategies.

A Third Public Forum in October 2022 introduced the Copper River Climate Change Adaptation Plan to the Copper Valley communities and invited public review, comment and feedback on the draft plan. The feedback received was considered and addressed in the final draft of the plan.

Table 7: Prioritized Action Items

Action Item	Most Important	Most Realistic to Implement	Total Count
Host quarterly regional climate change meetings	10	13	**23**
Provide targeted education and outreach	14	14	**28**
Develop Hazard Mitigation Plans	13	10	**23**
Develop regional environmental QAPPs	8	11	**19**
Assist tribes through technical assistance	---	---	**---**
Firelines / brush clearing	11	7	**18**
Resilient infrastructure	11	6	**17**
Community greenhouses / gardens	7	5	**12**
Flooding	5	3	**8**
Erosion	6	4	**10**
Educate public about climate change and health effects	9	12	**21**
Food security training and resources	12	8	**20**
Develop SCERPs	14	14	**28**
Develop Wildfire Protection Plans	12	9	**21**
Develop Copper Valley regional data collection system	4	2	**6**

H. The Ahtna People: History and Culture

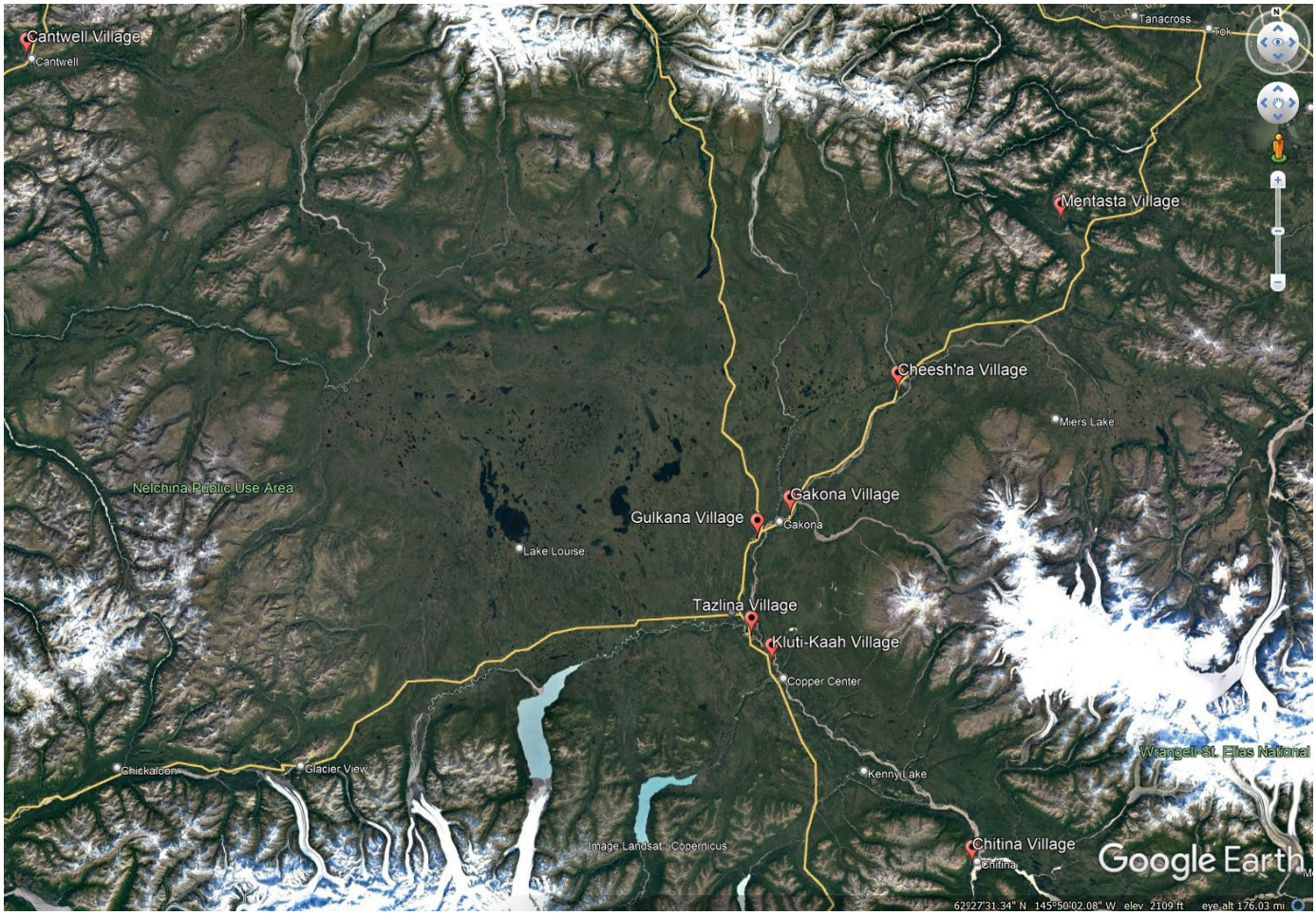
With an area more than 24 thousand square miles in size, the Copper River basin encompasses vast swaths of Southcentral Alaska. The basin is interspersed with four ranges of rugged mountains, many large glaciers and broad river valleys. The lower elevations feature a boreal forest environment dominated by spruce, aspen, cottonwood and birch trees, while higher elevations are predominated by alpine tundra, rock and ice. The region features a continental climate, characterized by short, warm summers and long, cold winters. From its headwaters at Copper Lake, in the northern foothills of the Wrangell Mountains, the Copper River flows 290 miles before reaching the Gulf of Alaska near the town of Cordova. Four of the five Pacific salmon species inhabit the Copper River drainage, spending the early stages of their lives in its tributaries, and returning at the end of their lives to reproduce. There are also a wide variety of other fish populations within the drainage, including whitefish species, arctic grayling, northern pike, rainbow trout and lake trout. Additionally, the surrounding lands in the Copper Basin are the home of moose, caribou, Dall's sheep, mountain goat, brown bear, black bear, wolf, coyote, red fox, wolverine, mink, lynx, and many smaller animals.

Since time immemorial, the basin has been inhabited by the Ahtna, a group of Northern Dene Athabaskans. For millennia, Ahtna culture evolved through adaptations to the land's harsh environment, developing patterns of seasonal movement that enabled them to harvest seasonal resources during short periods of time each year. Historically, the Ahtna people were semi-nomadic and extensive travelers, living in small groups of 20 to 40 people. They moved from place-to-place multiple times throughout each year based on where food sources were located. Annual summer fish camps for the entire family and winter villages served as their primary camps. Most groups of Ahtna also had fall hunting camps in the upland areas. Although Ahtna no longer follow these seasonal nomadic patterns, historical traditions and ways of life, especially the practice of a subsistence lifestyle, continue to this day. All aspects of traditional Ahtna culture are reflected in this close relationship to the land.

The Ahtna people have a history of adaptation and resiliency throughout their culture and generations. They have adapted to the changing seasons, changing climate, wildlife changes, and more. The rapid pace of the current era of climate change, combined with other stressors associated with colonization, pollution, and rapid social change, presented new challenges. Their nomadic culture was their main way of life until Russian and American influence and occupation forced them to settle down into village areas. While this drastically limited their traditional movement and cultural ability to adapt, the ability and preparedness to adapt is still in their history and a part of their identity and culture. Alaska Natives are at the forefront of planning and preparing for climate changes and adaptation actions and projects.

Today, Ahtna are organized into eight different tribes, each of which has its own tribal government: Cantwell, Mentasta, Cheesh'na (Chistochina), Gakona, Gulkana, Tazlina, Kluti-Kaah (Copper Center), and Chitina (see **Figure 3**).

Figure 3: Map of Copper River Ahtna Villages



Source: Google Earth

I. Climate Change Impacts, Risks, and Projections

This appendix is based on both so-called Western science and indigenous knowledges, including observations from local peoples. The gathering of local perspectives on climate change information was an informal, voluntary process of sharing local observations, concerns, and impacts of changing climate conditions within the Copper River region. The TEK information sources included village project leaders, village elders, guest presentations, interviews, and public forum comments. This informal information gathering was based on volunteer participation with no attempt at statistical analysis or random distribution. The purpose of TEK information sharing was to identify the primary concerns and impacts experienced by the local populations in the region for the purpose of identifying and prioritizing adaptation strategies to increase local and regional climate resilience. No research protocols were used and no publication of traditional knowledges was made beyond the adaptation planning documents written by CRNA and the local village leaders. The Western Science information was based on input from experts from project partners, including UAF, IATRC, ANTHC, plus relevant publications and websites, such as the National Climate Assessment and online data from UAF-SNAP and the NOAA Climate Resilience Toolkit.

I.1. Warmer Temperatures and Changes to Precipitation and Water Bodies

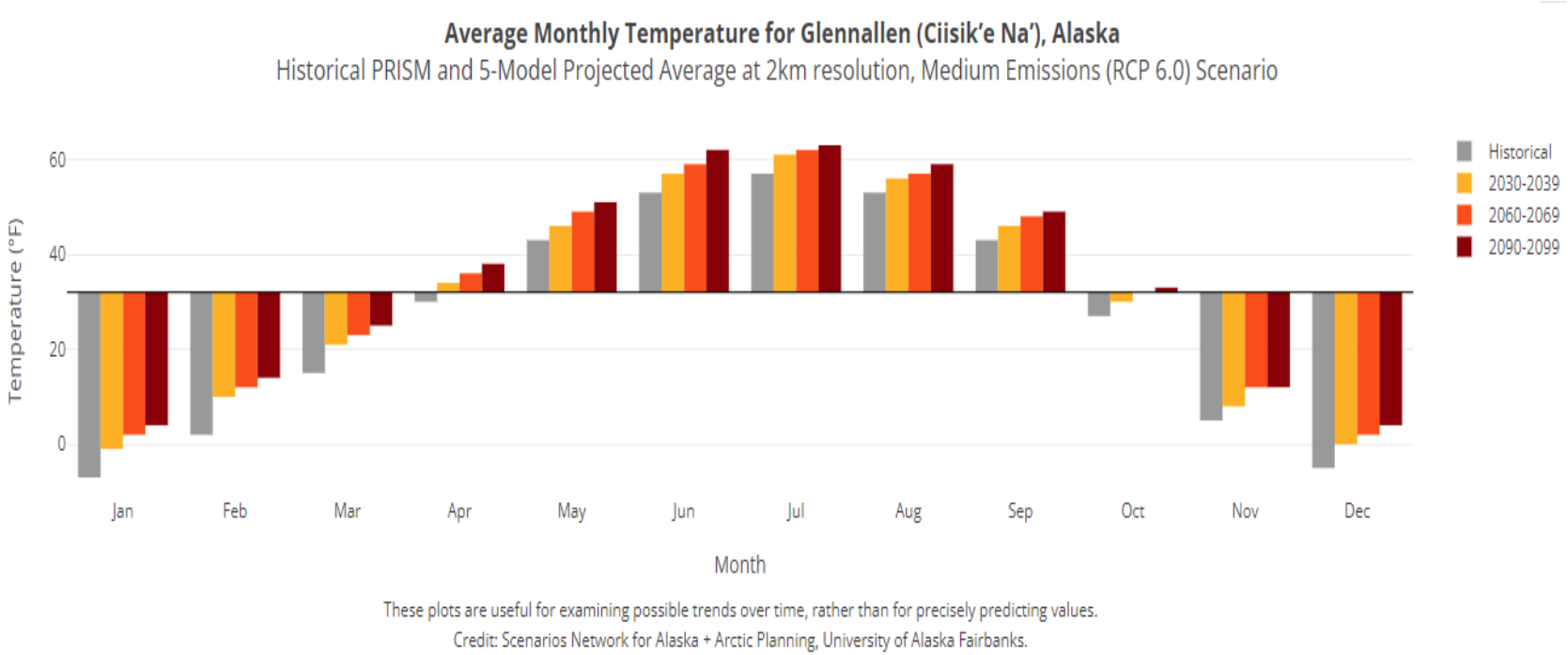
In the past 60 years, temperatures in Alaska have warmed an average of 3°F. (Fitzpatrick, 2008)

Past historical data is important because it shows what the environment and region were like before the major effects of climate change. That information can be compared with current data to see the climate and environmental changes, and how the environment and region have been affected. UAF SNAP and other tools were used to gather historical and current climate data for the Copper River Valley.

Temperature

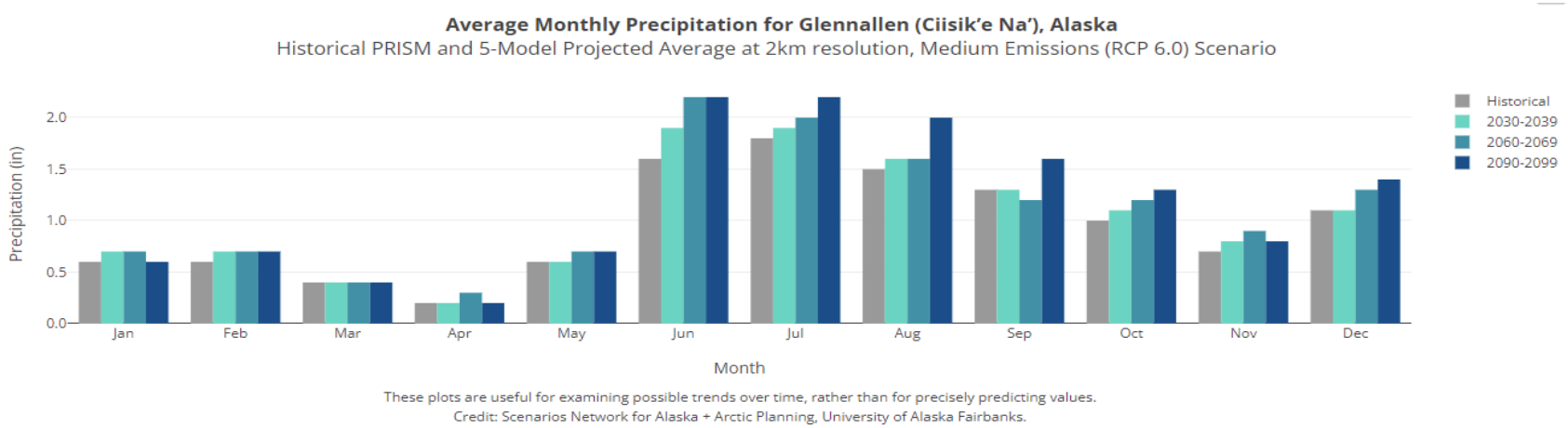
The graphs below show the historical, recent, and future projected temperature and precipitation data for Glennallen, AK. These graphs show a steady rise in temperature along with a rise in precipitation during summer and fall months. These rises are predicted to increase in the coming years, with the Copper Valley having increasingly hotter summers and more precipitation.

Figure 4: Average Monthly Glennallen Temperature (Historical and Projected to 2099)



Source: Scenarios Network for Alaska + Arctic Planning, University of Alaska Fairbanks: Community Climate Charts

Figure 5: Average Monthly Glennallen Precipitation (Historical and Projected to 2099)



Source: Scenarios Network for Alaska + Arctic Planning, University of Alaska Fairbanks: Community Climate Charts

Table 8: Temperature and Precipitation Data

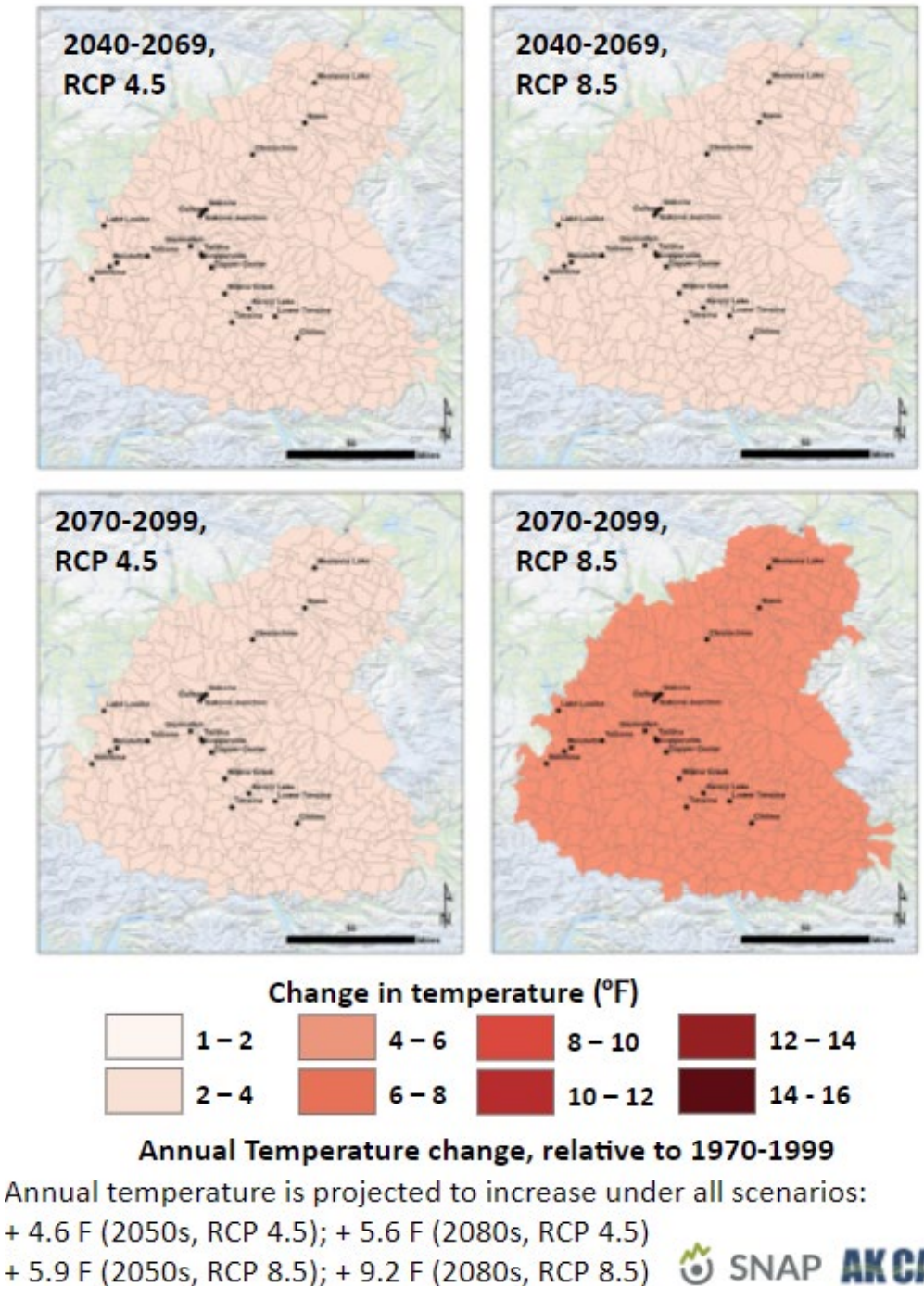
Glennallen SNAP Data difference between Baseline data and 2010-2019 data		
Month	**Mean Temperature difference (degree F)**	**Mean Precipitation difference (inches)**
January	+2.1	+10
February	+3.8	+13
March	+2.8	+10
April	+0.1	+10
May	+1.4	+7
June	+1.6	+12
July	+1.5	+13
August	+1.5	+16
September	+1.8	+32
October	+1.6	+20
November	+2.6	+16
December	+2.9	+9

Source: Scenarios Network for Alaska + Arctic Planning, University of Alaska Fairbanks: Community Climate Charts

Copper Valley residents have observed rising temperatures in the Copper Valley area and the effects of those changes. In 2019, NOAA reported all heat records broken for Alaska, and in the local Copper Country Journal June 2022 also had record setting hot days (NOAA, 2020; Copper Country Journal, 2022). Warmer air temperatures have led to warmer winters and hotter summers. The warmer winter has caused bears to be out later, rivers not to freeze over completely, and more freezing rain which causes treacherous road conditions. Spring breakup is happening earlier in the year and winter snows are happening later. Warmer summers have resulted in more intense and frequent wildland fires, increased glacier melting, higher and faster rivers, wildlife to migrate to higher elevations, and small ponds and streams drying up (Fitzpatrick, 2008).

Copper Valley residents have also observed the following changes in precipitation. There is more rain in the winter than snow, and there is increased and erratic precipitation in the summer, which affects berry growth for harvesting.

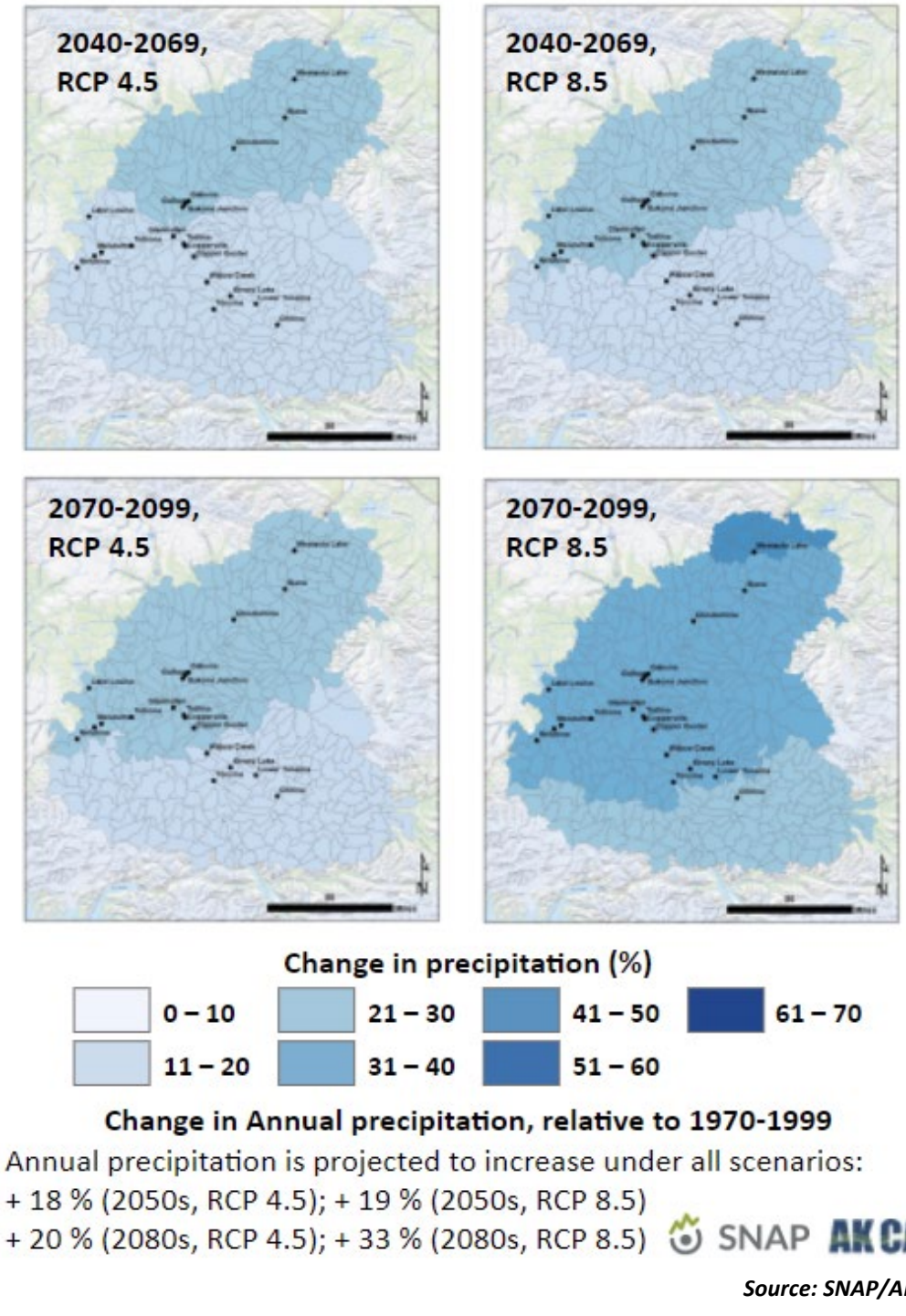
Figure 6: Predicted Changes in Average Temperature



Source: SNAP/AK CASC

The figure above shows temperature change prediction for the project area. These predictions reflect the current changes in temperature that have been happening over the past years. These potential changes can greatly affect our environment and communities.

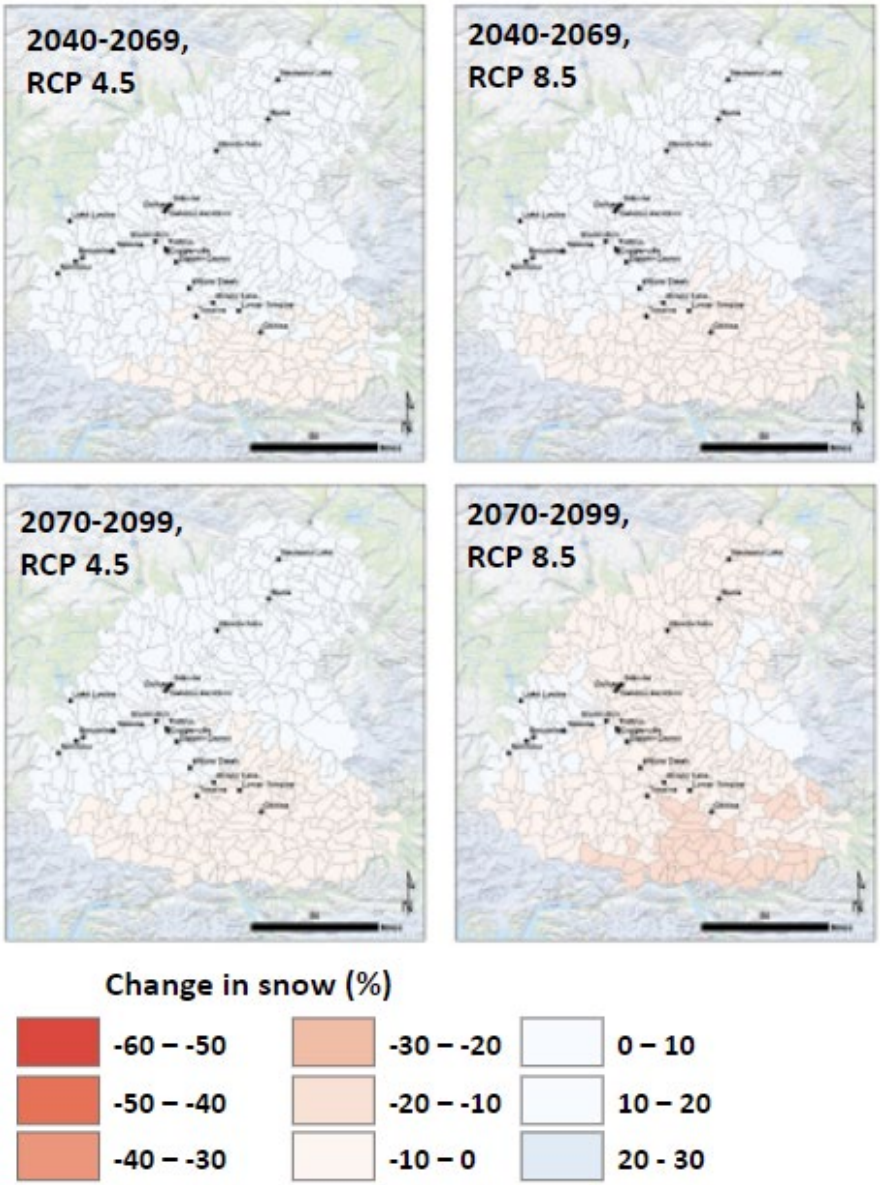
Figure 7: Predicted Changes in Precipitation



Source: SNAP/AK CASC

The figure above shows the predicted changes in precipitation for the project area. These predictions show increased precipitation, which could lead to increased flooding, erosion, and affect vegetation growth and spread.

Figure 8: Predicted Changes in Snowfall



Change in October to March snowfall water equivalent (snowfall), relative to 1970-1999. This is the change in the amount of snow that falls.

+5 % (2050s, RCP 4.5); +3 % (2050s, RCP 8.5)
+2 % (2080s, RCP 4.5); -8 % (2080s, RCP 8.5)

SNAP AK CASC

Source: SNAP/AK CASC

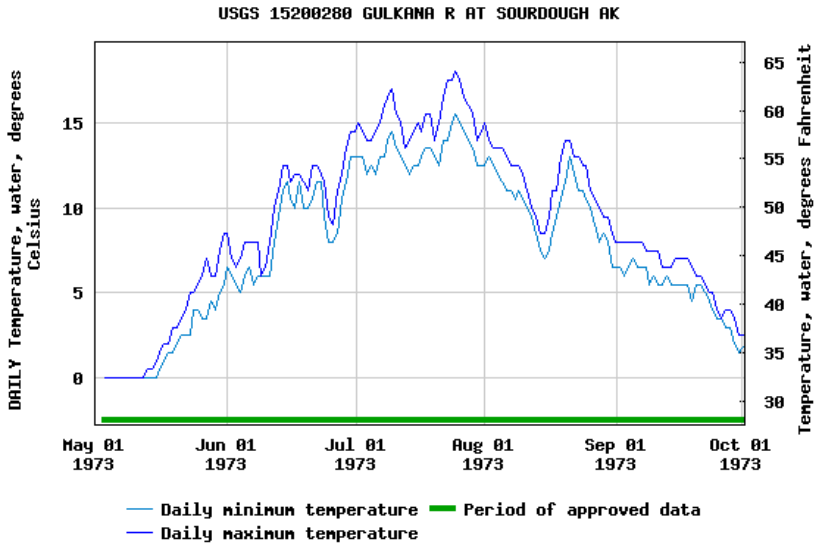
The figure above shows predicted changes in snowfall during the winter for the project area. Snowfall is predicted to decrease and change to rain over the coming years as air temperatures rise and both summer and winter get warmer.

Water Temperature

Water temperatures are warming along with the air temperature. The rivers and streams in the Copper Valley are getting warmer, which affect the fish species and subsistence resources people rely on. Salmon is an important subsistence resource to the Copper Valley community. Warmer water temperatures can affect the size of salmon, salmon run times throughout the year, and can create a better environment for parasites and diseases. Several studies and consistent surveys done through the Prince William Sound Science Center also support ecological knowledge pointing to changes in salmon runs (Barmore, 2019).

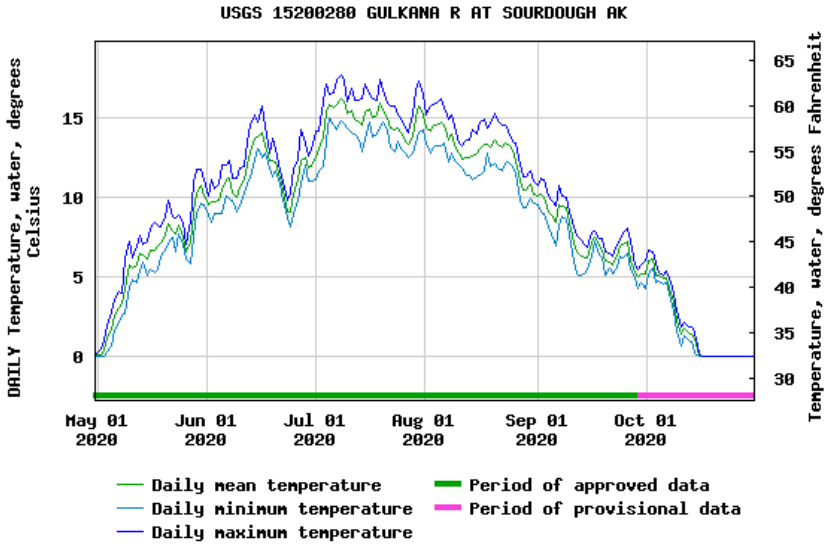
The graphs below show water temperature at specific sampling sites over the course of many decades.

Figure 9: Gulkana River Water Temperature 1973



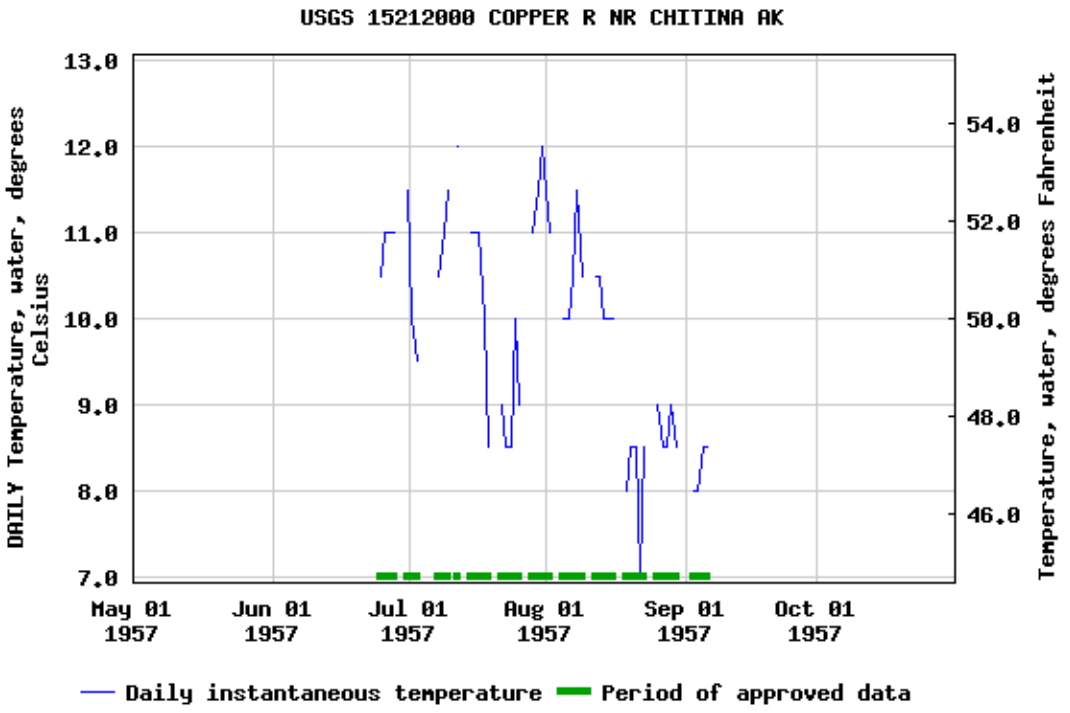
Source: Water temperature for Gulkana River at Sourdough, AK; May - Oct 1973

Figure 10: Gulkana River Water Temperature 2020



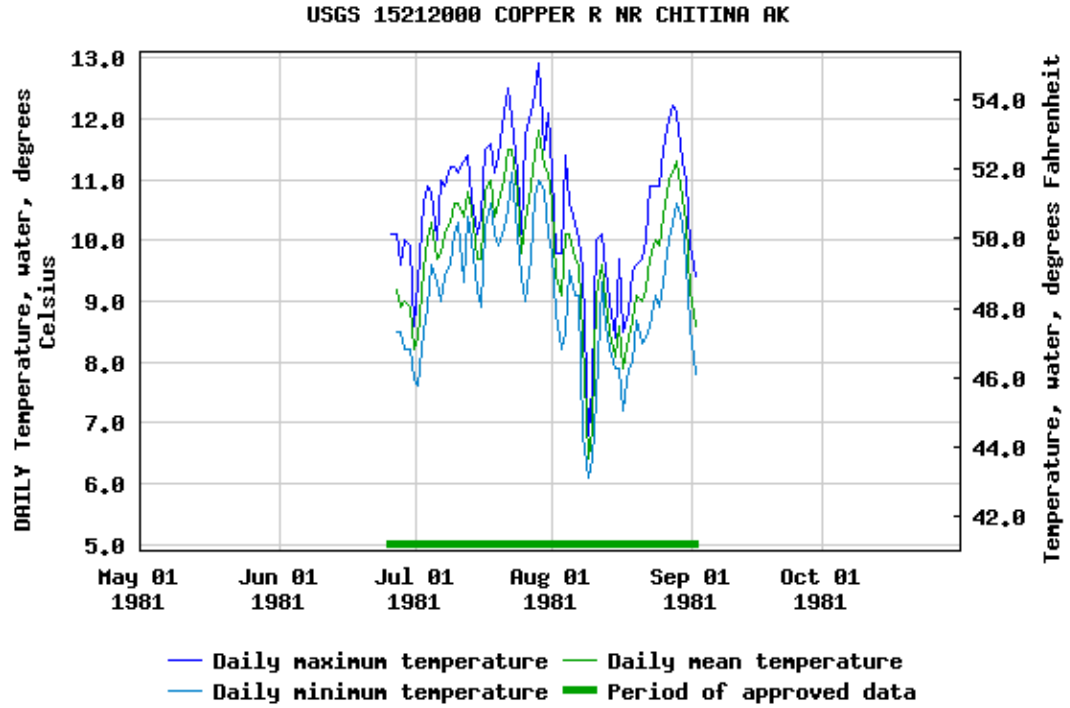
Source: Water temperature for Gulkana River at Sourdough, AK; May - Oct 2020

Figure 11: Copper River Water Temperature 1957



Source: Water temperature for Copper River at Chitina, AK; May - Oct 1957

Figure 12: Copper River Water Temperature 1981



Source: Water temperature for Copper River at Chitina, AK; May - Oct 1981

I.2. Extreme Weather

In recent years, extreme weather events are breaking records and impacting people, communities, wildlife, and natural systems across Alaska, including the Copper River Basin region. Records are being broken for heat waves, heavy snowfall, high and low rainfall amounts, and secondary impacts of air and water pollution (Thomas, 2019).

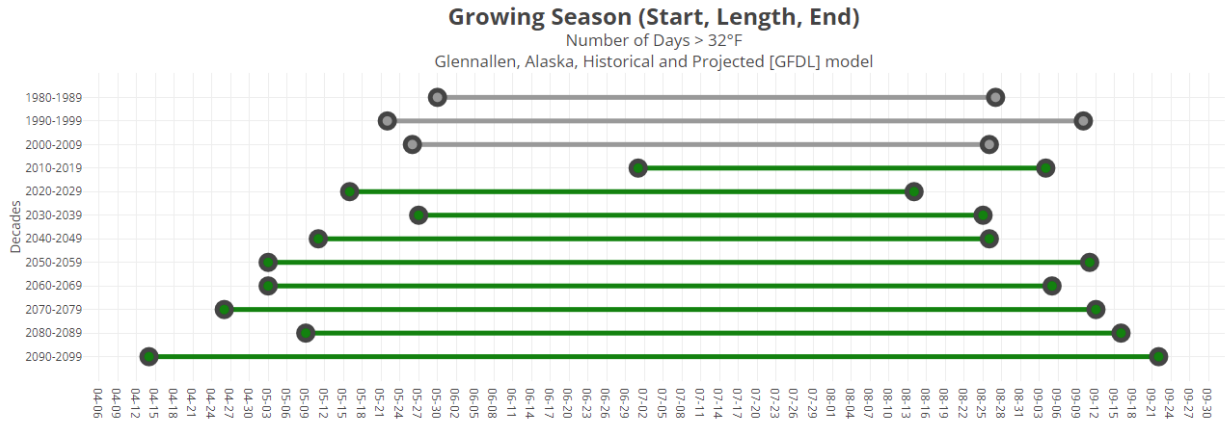
I.3. Permafrost Thaw

With rising temperatures, permafrost is thawing faster than before (Fitzpatrick, 2008). With the thawing of permafrost, community members are observing more methane bubbles in ponds and lakes. Muskegs ponds are soaking into the ground and disappearing as the permafrost, which used to be a barrier between the surface and the water table, is thawing (Klein, 2005). Permafrost thaw is also exposing unlined dumps to the soil and water table, and letting waste leach into the water and soil. This will have a huge impact on the health and safety of wildlife and fish and the people who harvest them.

Infrastructure and building is becoming unstable and variable as the ground shifts due to thawing permafrost, and this will only get worse as the temperatures rise (Instanes, 2005). Community members have experienced houses and buildings shifting and becoming unstable and uneven. These are changes that need to be addressed through major repairs or rebuilds, which most homeowners in the area can't afford.

The graphs below illustrate predicted permafrost and related information.

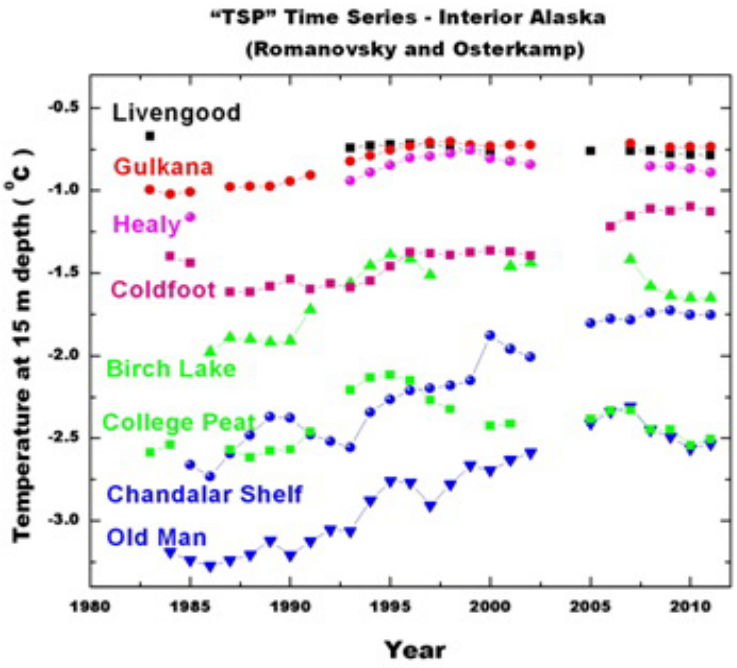
Figure 13: Growing Season for Glennallen, AK 1980-2099



Source: Scenarios Network for Alaska + Arctic Planning, University of Alaska Fairbanks: Alaska Garden Helper

The figure above shows the current and predicted growing season for Glennallen, AK. With warmer weather and increased precipitation, the growing season is predicted to increase in the coming years (Meehl, 2007). This can be good for food security, but negatively impact subsistence foods and lifestyles that depend on winter and colder weather.

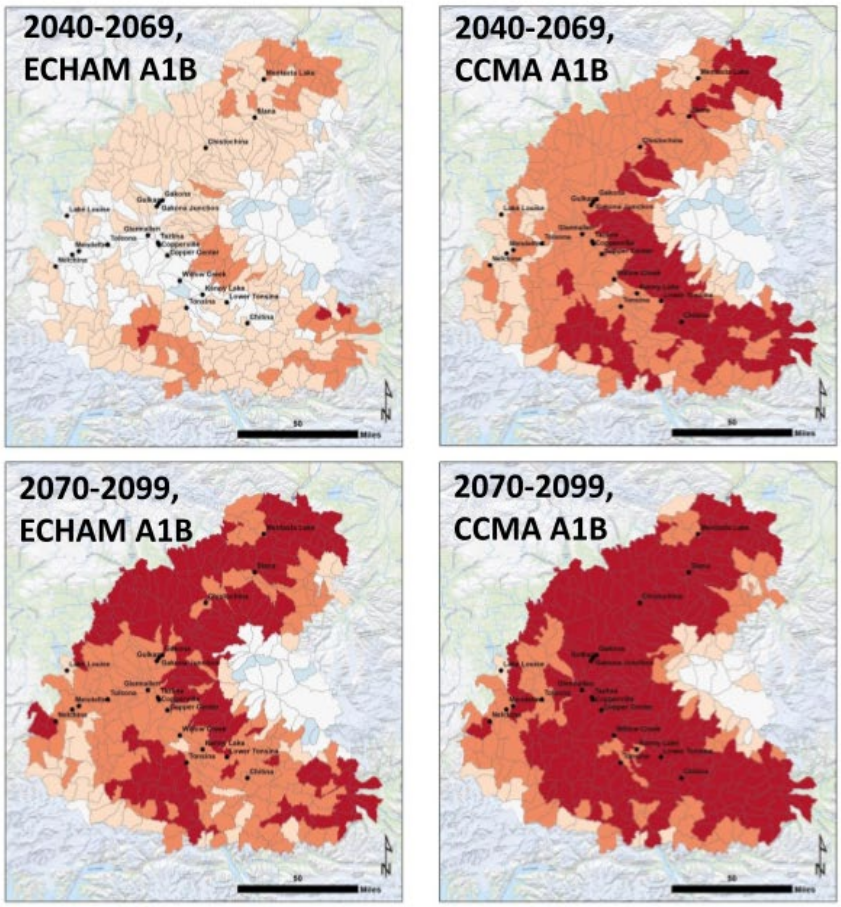
Figure 14: Ground Temperature Data



Source: Arctic Report Card, 2013

The figure above shows the ground temperature at 15 meters deep in the ground. This is generally where permafrost is located. This figure shows the changes in ground temperature over the past 30 years.

Figure 15: Predicted Ground Temperature Data



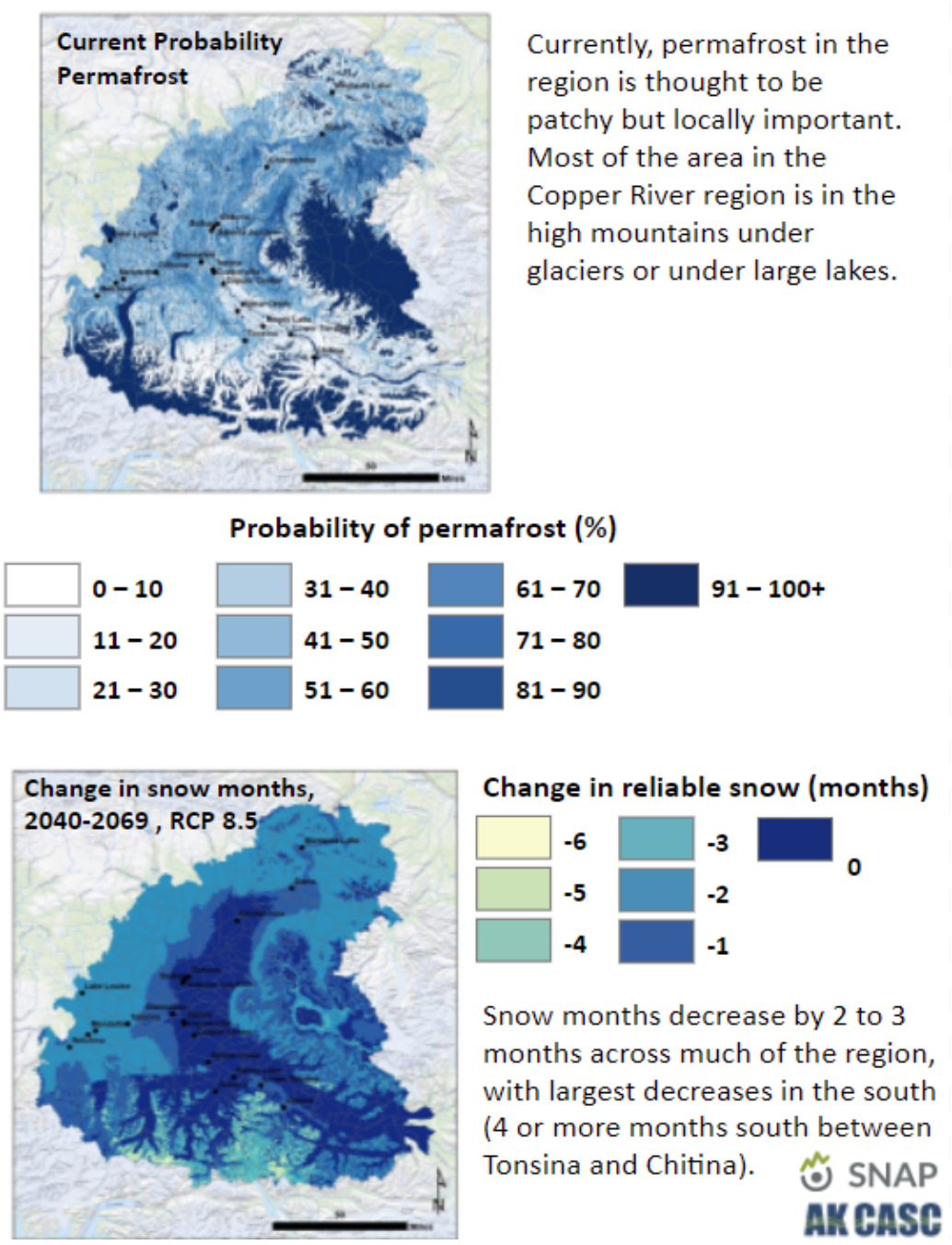
Annual average ground temperature 1m (3.3 ft) deep This is an index of how likely permafrost is to remain under climate change. Once annual average temperatures rise above freezing (0°C) permafrost thaw likely increases. Some areas of permafrost might persist until the 2050s under the ECHAM model, but decrease under all others.

0.5°C (2050s, ECHAM A1B); 1.9°C (2050s, CCMA A1B);
2.2°C (2080s, ECHAM A1B); 2.8°C (2080s, CCMA A1B)

SNAP
AK CASC

Source: SNAP/AK CASC

Figure 16: Predicted Permafrost Changes



Source: SNAP/AK CASC

The figures above show the changes in ground temperatures and permafrost percentage for the project area. With warmer temperatures, ground temperature will continue to warm, and permafrost will continue to thaw. This will affect the stability of all infrastructure in the Copper Valley area.

I.4. Flooding and Erosion

Flooding and erosion of coastal and river areas affect 87% of Alaska Native communities (GAO 2009). Climate change has accelerated the normal process of erosion along Alaska's rivers and coasts. Heavier rains produce more floods, and swollen rivers wash away the soil. In both coastal and river communities, various types of infrastructure and cultural resources are being threatened.

Flooding and erosion risks were assessed together in this plan because they complement each other and can be connected in climate activities. Flooding and erosion impacts can include loss of land, fish camps, graveyards, other cultural areas, homes, and personal items. Flooding and erosion also impact subsistence resources: salmon spawning sites can be eroded, salmon become more quickly fatigued by fast river runs, water quality impacts, and changing river flow patterns. Around 300 ft of land has been lost along the Copper River in the Copperville neighborhood in the past 4 years due to erosion. The bluff by Simpson Hill is eroding quickly and severely, such that the Richardson Highway, a critical evacuation route, will soon need to be rerouted.

Flooding and high river flows are washing away fish wheels, where they are being destroyed by the river, or being deposited downstream where they are unable to be salvaged. Flooding and erosion are washing away accessible fishing areas and private camps along the Copper River, and people are having trouble finding other available spots to fish. In some areas, residents have had to move their fish-camps due to erosion. The loss of important sites and cultural resources can impact mental health and increase the loss of identity in community members. Flooding and erosion can also cause damage or loss of bridges, roads, buildings, and transportation routes, which would impact emergency response teams' access and services to community areas.

Warmer temperatures are leading to melting glaciers, which cause immense flooding and erosion during spring break up (Fitzpatrick, 2008). This affects salmon runs and traditional calm spawning areas.

I.5. Wildlife and Vegetation Patterns

In Northern Alaska, there are reports of warmer temperatures that may be driving big game, such as moose, to higher, colder elevations. Though the Alaska Dept. of Fish & Game has not yet reported this in the Copper River region, several community members described their experiences of increasing difficulty in finding moose and other large game during their annual hunt. Their belief was a possible shift in the migration pattern along with an overall increase in tourism-based recreational hunters impacting their subsistence resource game populations.

Anecdotal reports are also made of Northern Alaska caribou herds with migration patterns that are changing the route and time of year that they migrate due to warmer weather and human activities (Joly, 2021). Freezing rain in winter can create a layer of frozen crust over the tundra, covering lichen, moss, and other food that caribou usually consume in the winter (Rosen, 2019). In summer months, the increase in tundra wildland fires can destroy the lichen, which takes 50-100 years to recover. This may

also further reduce access to food for caribou and push them to higher elevation habitat in the region. This restriction of food for caribou has the potential to cause starvation and vulnerability to disease. There have been anecdotal reports from people who have noticed more parasites and disease in moose and hares.

Salmon, an important subsistence resource for the Copper River Valley, are being affected by increasing water temperature. Community members are seeing smaller salmon, smaller salmon runs, runs at different times throughout the spring and summer than usual, more parasites in the salmon, and that erosion along the river banks are changing traditional salmon spawning grounds. Low returns of sockeye and Chinook salmon during the late 2010s and early 2020s prompted closures in some fisheries by the Alaska Department of Fish & Game.

Berry bushes have been affected by increased and erratic precipitation: while there is more rain, the hotter temperatures cause the rain to evaporate faster, so the vegetation doesn't get access to that water (Meehl, 2007). Therefore, berry patches have been receding and not producing as much.

Residents have noticed the mosquito population has plummeted, and bat and bird populations along with them. The local newspaper Copper River Country Journal has even reported this finding since as early as 2017. While we may not know the cause of these population shifts, there does seem to be a correlation to climate warming (Copper River Country Journal, 2021). Furthermore, swans have been seen leaving later in the spring, and returning earlier in the fall. It has long been known that swans and other migratory birds have used the Copper River as access to summer feeding grounds. Northwestern Naturalist published a four-year study on migratory behavior and timing that began in 1987, that also supports what local observers are reporting (King, 1998).

Invasive species have increased in the Copper Valley area. Community members have observed white sweetclover and other invasive plants growing more in the area. White sweetclover has taken over a majority of the areas along the road ways and gravel pits. It is outgrowing native species in the area that humans and wildlife harvest and consume, such as berry bushes and other traditional foliage. Other invasive plants are spreading throughout the Copper Valley area, and have been spreading and growing more over the past recent years. Spruce bark beetles have been in the area for decades, but more are surviving through the winter with the warmer temperatures, so their devastation to the forests is intensifying (Fleming, 1995). Animal species that aren't usually seen in the Copper Valley before are now being spotted in the area. Community members have reported seeing mountain lions in Mentasta and Copper Center as early as 2017. Mule deer are migrating to Alaska, where they have never lived before (Woodford, 2019).

Table 9: Non-native Plants in the Copper River Valley

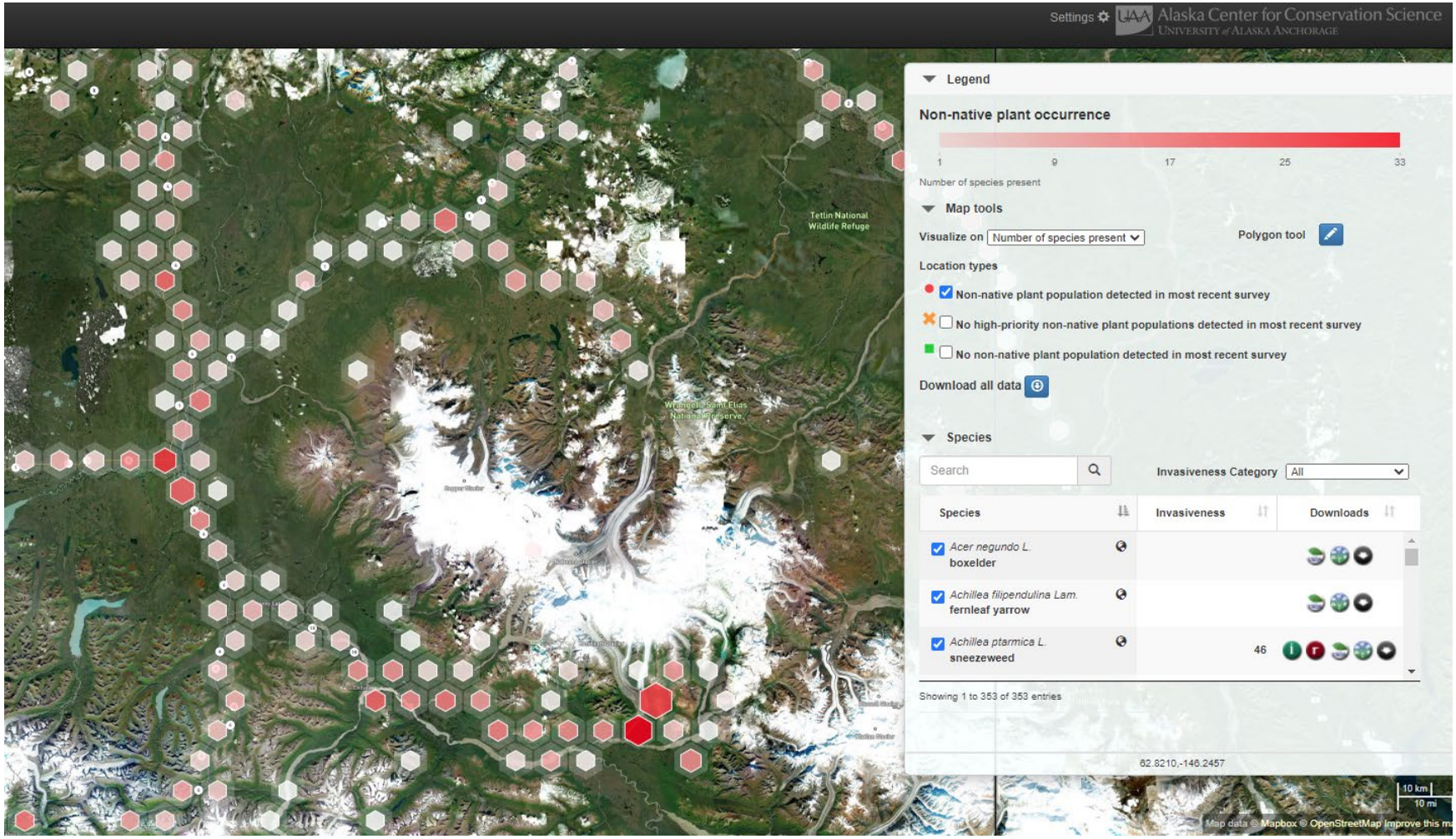
white clover 	white sweetclover 	golden dock 	alsike clover  Infestation of *Trifolium hybridum* L. Photo by R. Old.	annual bluegrass  Cite as: Shawn Wright, University of Kentucky, Bugwood.org
common plantain 	quackgrass  Elizabeth Bella, USDA	field pennycress  *Thlaspi arvense* L. Photo by M.E. Harte.	european stickseed  *Lappula squarrosa* (Retz) Dumort. Photo by M. Harte.	butter and eggs 
prostrate knotweed 	yellow sweetclover 	shepherd's purse  *Capsella bursa-pastoris* (L.) Medik. L.	smooth brome  *Bromus inermis* ssp. *inermis* Leyss. Photo by J. Randall.	orchardgrass  Catherine Herms, The Ohio State University

common chickweed  USDA Forest Service	foxtail barley  	pineappleweed  	kentucky bluegrass 	common tansy  Flower heads of *Tanacetum vulgare* L. Photo by C. Slemmons.
lambsquarters 	common pepperweed  Fruits of *Lepidium densiflorum* Schrad. Photo by M. Harte.	herb sophia  Paul Slichter	narrowleaf hawksbeard 	common dandelion  NPS/ Santa Monica Mountains National Recreation Area
bird vetch  Flowers grow in a one-sided spike *Photo: M. Rasy, University of Alaska, bugwood.org.*	reed canarygrass  Glen Mittelhauser	sanddune wallflower  Mary Ellen Harte	red clover  Infestation of *Trifolium hybridum* L. Photo by R. Old.	black medick  *Medicago lupulina* L. Photo by K. Kohout.

yellow alfalfa 	big chickweed  Ian Cruickshank	thymeleaf speedwell  Flowers and foliage of *Veronica serpyllifolia* L. ssp. *serpyllifolia*. Photo by R. Old.	common eyebright  *Euphrasia nemorosa* L. Photo by V. Hume	scentless false mayweed  K. George Beck and James Sebastian
common velvetgrass  Purple-tinged panicles of *Holcus lanatus* L. Photo by J. DiTomaso.	splitlip hempnettle  Gary Nielsen	perennial cornflower  Dow Gardens	corn poppy  Jan Samanek	oxeye daisy  *Photo: Andrea Altherr*

Source: Alaska Exotic Plants Information Clearinghouse

Figure 17: Invasive Species Map

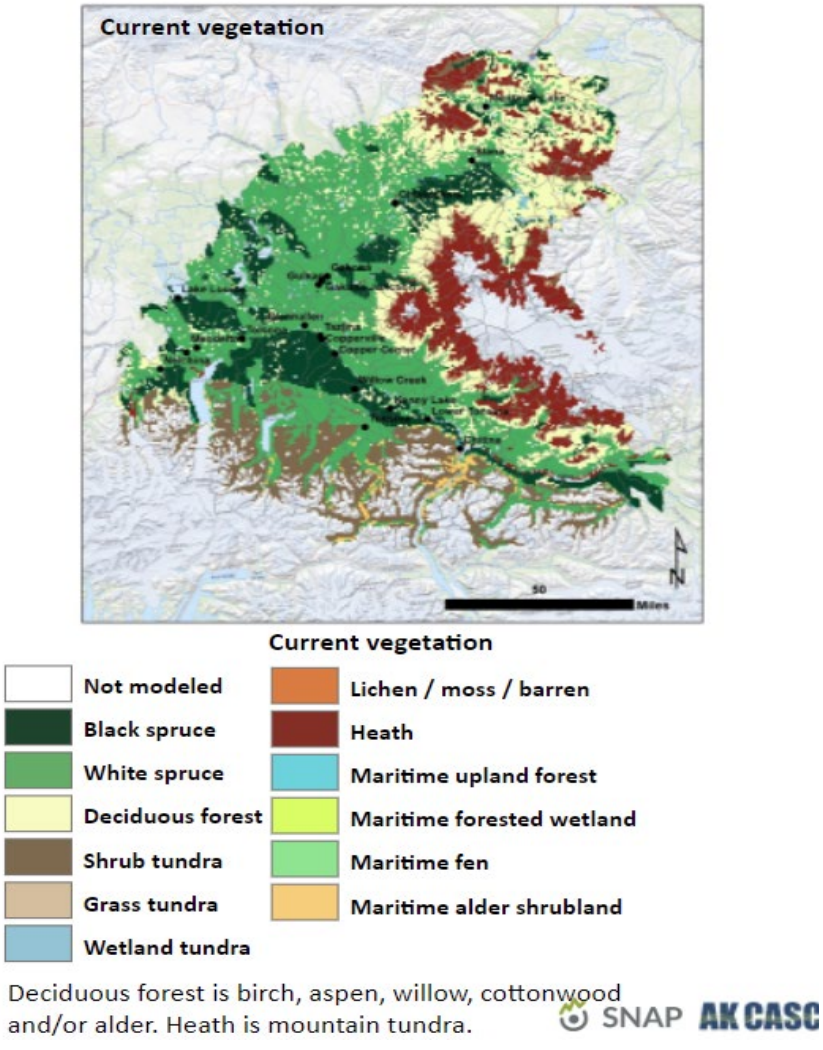


Source: Alaska Exotic Plants Information Clearinghouse

Residents of the Copper Valley have noticed changes in the vegetation throughout the valley. People are noticing flowers blooming earlier in the spring and later in the fall. Numerous residents reported that vegetation growth has increased tremendously in the past 10 years. More vegetation is growing around lakes and ponds, and extending into higher elevations (ACIA, 2004). People state that moose are no longer eating the vegetation around lower lakes and ponds because they are staying at higher, colder, elevations. So that vegetation is growing incessantly, and is overtaking small ponds and lakes. Trees and brush are growing and overtaking areas that used to be open tundra areas. Forests are severely stressed for a number of reasons: spruce bark beetles are staying alive longer and more frequently due to warmer winter, the permafrost that black spruce rely on for water and nutrients is thawing, removing that source of sustenance, and trees are more vulnerable to disease due to the warmer weather (Juday, 2005).

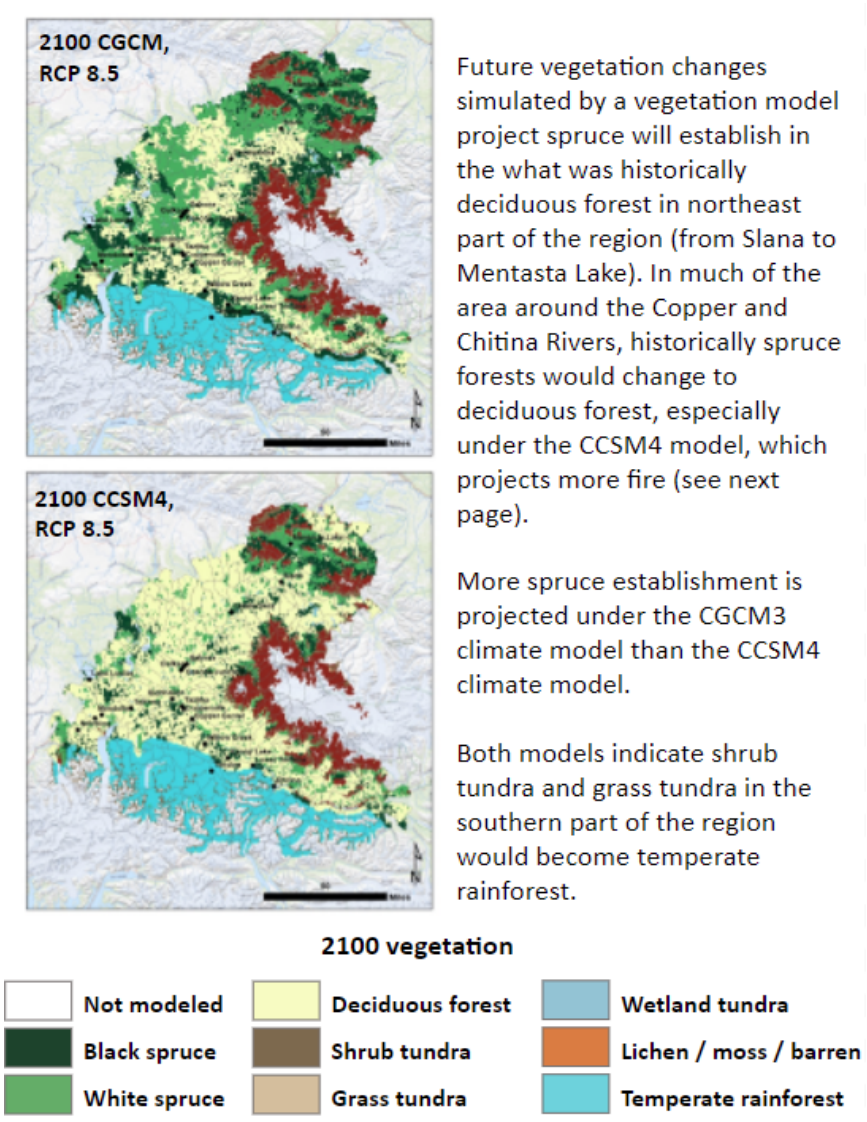
The figures below show current and predicted vegetation, and describe the predicted vegetation changes.

Figure 18: Current Vegetation Map



Source: SNAP/AK CASC

Figure 19: Predicted Vegetation Changes



Source: SNAP/AK CASC

I.6. Subsistence

Subsistence hunting, fishing, and gathering have been part of Alaska Native's tradition and culture since time immemorial. It is critical to the nutritional and cultural survival of the Ahtna people. Salmon have become the most important resource and have the highest harvest rate by local residents. Large mammals, such as moose and caribou, have the second highest harvest rate and are an important food source for Copper Valley residents (Holen, 2015).

Many factors affect subsistence, but it is included as a stand-alone section in this plan given the importance of understanding the specific phenomena that affect traditional harvests. Climate impacts to lands, waters, food, and other plant and animal species threaten cultural heritage sites and practices that

sustain intra- and intergenerational relationships built on sharing traditional knowledge, goods, and ceremonial or cultural objects (Chan, 2006).

Subsistence resources changes and impacts are varying and numerous. Residents of the Copper Valley have trouble harvesting moose and other large animals due to policy regulations, an increase in hunters from other areas, changes in wildlife movement, and environmental changes from warming weather. Food security is being threatened in multiple subsistence resources due to migration changes, plant growth changes, and invasive species. Vegetation change and an increase in invasive species is changing people's access and ability to harvest plants and berries in their traditional manner (Brown, 2021). Fish camps and fish wheels are being lost due to increased flooding and erosion. Fishers are crowded into smaller access areas to fish.

These changes are impacting how much salmon people can harvest and store for winter food. These limitations of harvesting traditional resources increase food insecurity for people of the Copper Valley (ICC-Alaska, 2015). With less traditional food sources, people have to turn to grocery stores and processed food. This is leading to increased mental health issues due to lack of cultural and traditional activities, and increased health problems throughout the community (GAO, 2009). Native people are losing access to their traditional and cultural resources, and therefore losing their traditional lifestyles and traditions.

The loss of traditional resources is increasing and predicted to escalate. Loss of traditional resources leads to loss of cultural harvesting and traditions. This can lead to a loss of self and identity, and increased mental health impacts on tribal and community members. It's important to prepare for these escalating impacts to public health and mental well-being in years to come.

I.7. Wildfires

Wildfires are an increasing threat with warmer air temperatures and dryer summers. Forest die-off from drought and invasive insects are also increasing the severity of wildfires (Juday, 2005). They alter ecosystems and environments. They can also be very harmful to communities and infrastructure. Due to climate changes, wildfires are expected to become more frequent and intense in the future.

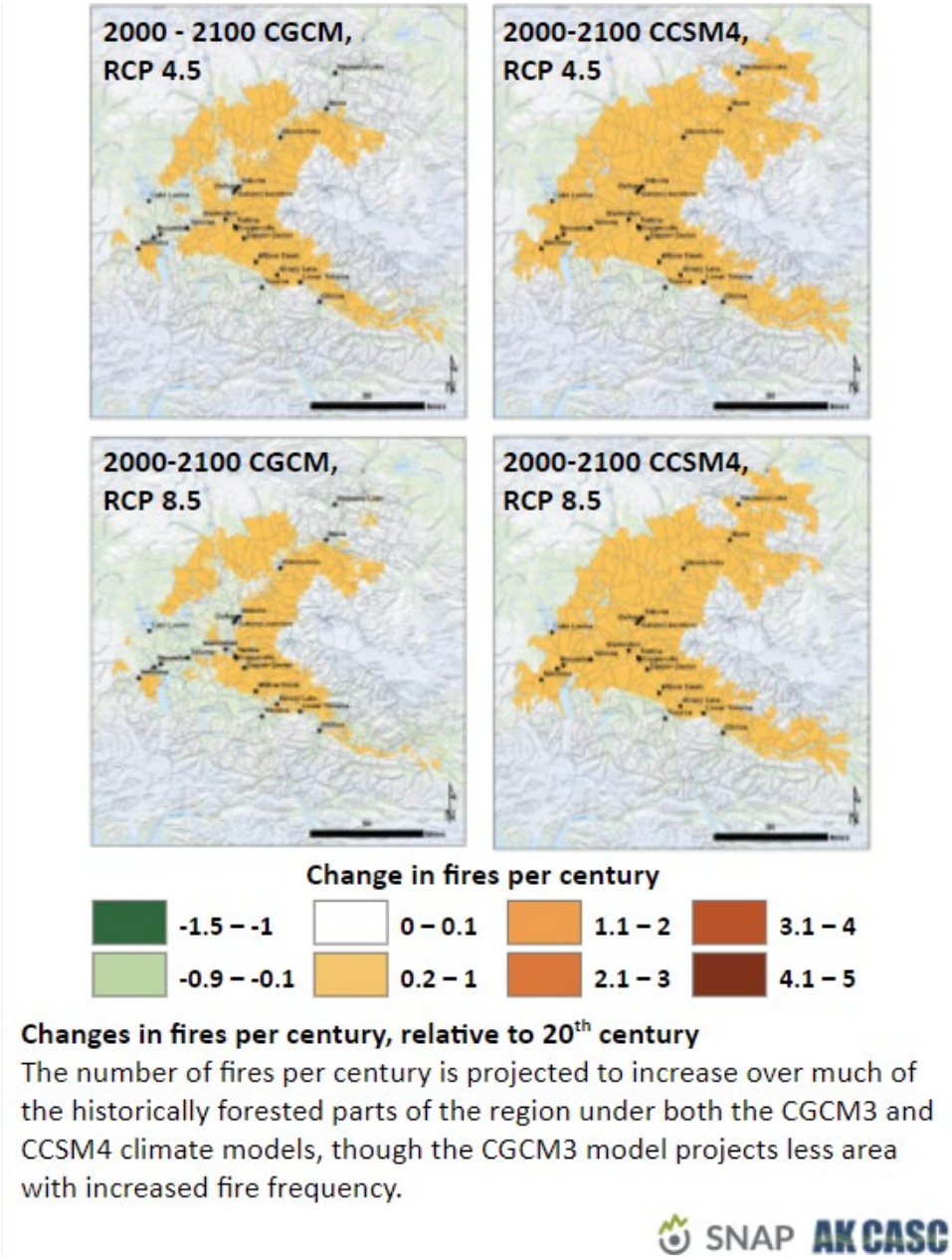
While wildfires can damage the environment and be a threat to communities, they can also benefit the ecology of an area. Wildfires can help regenerate trees and vegetation, and can change the habitat of an area to benefit different wildlife species.

Three of Alaska's top five wildfire seasons have occurred since 2004 (Mooney, 2015). Community members of the Copper River Valley have observed an increase in number and size of wildfires over the past few years. The summer of 2019 was the worst wildland fire season Alaska had seen in many years. Several houses in the Copper Valley burned down and the whole valley was inundated with smoke from other fires across the state.

Wildland fire impacts in the Copper River Valley include an increase in air quality issues such as breathing issues and asthma; loss of homes, possessions, important buildings, transportation and emergency

routes; wildlife habitat destruction; wildlife migration due to loss of habitat; and loss of historical and cultural sites. Most historical and cultural sites cannot be reconstructed, and if they are lost, that knowledge and history are lost as well.

Figure 20: Predicted Wildfire Changes



Source: SNAP/AK CASC

The figure above shows predicted changes in wildland fire in the project area. Due to warmer and dryer weather, wildfires are expected to become more frequent and intense in the future.

I.8. Non-Climate Stressors

Non-climate stressors are considered in this section because they can synergize with the impacts of climate change and affect the landscape as well as food security and cultural survival.

I.8.1. Earthquakes

All communities in the Copper River basin are vulnerable to earthquakes, which can cause extensive damage to buildings, roads and other infrastructure, as well as injury and death. Although earthquakes are not climate-related, climate-induced stressors can exacerbate communities' vulnerability to them. For example, a powerful earthquake is more likely to cause more damage to buildings if they have already suffered damage due to thawing permafrost.

While there have not been many earthquakes in the Copper Valley, the few that have happened have caused major issues and impacts. Homes, buildings, tribal offices, businesses, and more are damaged by earthquakes. Important infrastructure such as transportation routes and evacuation routes have been wrecked by earthquakes, trapping people and preventing necessary freight from arriving. An earthquake in 2002 damaged the Denali Highway and Richardson Highway so much that the road was undrivable, and Mentasa community members were trapped in Mentasta without access to necessary facilities and services. Earthquakes can limit access to subsistence resources, create unstable infrastructure and indirectly cause wildfires from fallen power lines, and increase flooding and erosion issues.

Earthquake impacts include loss of homes and livelihoods; injury; access to homes, building, transportation routes, and bridges damaged; down power lines that could cause fires; winter earthquakes that could increase flooding and erosion; access to subsistence resources obstructed; and more.

I.8.2. Poor Condition of Aging Infrastructure

Inadequate infrastructure can increase the risk of impacts related to climate change impacts; while some types of infrastructure (e.g., solar panels) can increase adaptive capacity. Infrastructure that is older or in poor repair is more vulnerable to climate-change impacts than is newer infrastructure that has been engineered to account for anticipated climate impacts. Many villages have aging infrastructure that is vulnerable to climate-related disruption, including water and sewer lines, roads, electrical systems, housing and public buildings.

The Trans-Alaska Pipeline System is a major piece of older infrastructure that passes through the Copper River basin. The pipeline was designed and built in the 1960s and 1970s, before climate change was a major factor in Alaska. It was originally expected to be in service for only about 30 years (Fowler, 2008). Today, the pipeline is nearly 50 years old, and is vulnerable to a variety of climate-related factors including permafrost thaw, wildfire and erosion, as well as non-climate factors such as earthquakes. A leak or rupture along the pipeline could cause extensive damage to the entire ecosystem, specifically fish populations in the Copper River, or to other natural resources in the region.

I.8.3. Poverty

Another significant non-climate stressor in the Copper basin is poverty. While the Copper Valley is on the road system, it is in a rural part of Alaska. Because of that, food and other items are expensive. The cost of living is high throughout the Valley, and there are not many local job opportunities. Many residents of villages in the Copper River region live below poverty level (Dept of Commerce, 2022). Although this is not climate related in and of itself, it is much more difficult for people who live in poverty to adapt to changing conditions or disruptions brought about by climate change. For example, changing access to subsistence resources may make it more expensive to harvest them, causing lower-income households to be unable to participate in these activities.

I.8.4. Environmental Damage

There have been a lot of ecological and environmental changes due to human development: fish spawning grounds have been altered, wetlands have been transformed, natural habitat and grounds have been built upon, and more. Since the 1970's, there has been a huge boom in economical and human development in the Copper Valley. The Alyeska Pipeline was built, housing accommodations, stores, gas stations, and more were built to accommodate the growing population. This development displaced wildlife, destroyed habitats, and changed the ecosystem of the area.

I.8.5. Changes in Subsistence Patterns

For a variety of reasons (economic, legal, and social, including colonization), people are shopping rather than hunting, resulting in poorer health outcomes, because store-bought foods are not as healthy as subsistence foods. As well, respondents noted that more people are allergic to fish now than in the past. Harvest laws can contribute to changes in subsistence patterns, as they reduce people's ability to adapt to climate change by hunting in different seasons and limit take and access. Alaska Natives have had limited control over subsistence laws that deeply affect them (Ristroph, 2021).

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