Yukon River Inter-Tribal Watershed Council Tribal Climate Resilience Program: Creating a Climate Change Adaptation & Action Plan for the Yukon River Watershed

One People ~ One River

Yukon River Inter-Tribal Watershed Council

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2024

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ACKNOWLEDGEMENTS

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For more information about this report, please find contact information at www.yritwc.org.

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EXECUTIVE SUMMARY

ANTs are facing many water quality and quantity variabilities and uncertainties associated with climate induced environmental changes, drinking water infrastructure needs, and anthropogenic impacts. Yet, water resilience has significance, purpose, and implications in context of the water systems and governance that is rarely discussed by Alaska Native Tribes (ANTs).

The Yukon River Inter-Tribal Watershed Council (YRITWC) through the funding support of the Bureau of Indian Affair has successfully hosted four two-day regional Water Resilience Workshops in the Yupik, Athabascan, Koyukon, and Gwich'in traditional territories. A total of 32 ANT leaders, planners, Tribal Environmental Professionals (TEPs), youth and Elders attended the workshops in Fairbanks on February 21st to 23rd, in Nenana on March 28th to 30th, in Galena on May 2nd to 4th, and in Anchorage on May 9th to 11th. Additionally, we hosted a discussion session with 12 participants at the YRITWC Biennial Summit held in Nenana on July 26th.

Prior to the workshop the YRITWC staff conducted a watershed wide phone and email survey to identify regional water related concerns and vulnerabilities, as well as generated a visual illustration of the survey responses. Furthermore, the YRITWC staff conducted a comprehensive literature review on Traditional Ecological Knowledge (TEK) of regional environmental observations; generated regional climate projections from data available through the University of Alaska Scenarios Network for Alaska and Arctic Planning (SNAP); and completed spatial and temporal water quality trend analysis using the Indigenous Observation Network data records. The focus of the workshops was to share information that was generated in advance to initiate focus discussions on generational environmental observations associated with climate driven landscape and water resource changes, and concerns from anthropogenic contamination on water resources. Participatory mapping exercises complemented focus group discussions by documenting participants' own environmental observations and perceived water resource of concerns on a map.

Creating the space for discussions and participatory mapping exercises was essential for assessing local and regional vulnerabilities to climate driven environmental or anthropogenic impacts to water resources. The goal of the workshops was to: a) identify regional and watershed wide themes of threats; b) set priorities to respond to water resource threats; c) discuss capacity needs to achieve sustainable water resources; and d) identify water governance strategies to guide future work. The resulting "Water Adaptation and Action Plan" provides a summary of identified common themes of priorities and strategies to support mitigation, preservation or conservation efforts as needed to promote water resilience.

INTRODUCTION

Water is Life

From an Indigenous point of view, water is sacred and uplifts tradition, culture, and the traditional way of life. Climate change and other anthropogenic impacts produce a spectrum of consequences and unique threats to water sources that must be mitigated to ensure environmental health for people and the wildlife they depend upon, especially fish.

Yukon River Inter-Tribal Watershed Council

The Yukon River Inter-Tribal Watershed Council (YRITWC) is a treaty organization, created in 1997 by Indigenous leaders from the Yukon River basin in Alaska and the Yukon Territory, Canada. The Indigenous grassroots organization, consisting of 74 First Nations and Tribes, dedicated to the protection and preservation of the Yukon River Watershed. The council is guided by its mission statement:

"*We the Indigenous Peoples from the headwaters to the mouth of the Yukon River, including its tributaries, having been placed here by our Creator, do hereby agree to initiate and continue the cleanup and preservation of the watershed, for the protection of our own and future generations of our Indigenous Peoples and for the continuation of our traditional way of life".*

In August 2001, the Indigenous People of the Yukon Watershed came together in Teslin, YT to formalize their connective vision in an Inter-Tribal Accord. The accord states that the participating Indigenous People agree to cooperate and work together to clean-up and preserve the Yukon Watershed. The following quotes were shared by Indigenous leaders during the Summit.

"Keep our water clean so it will be safe to drink for all of our grandchildren."
Marge Smith.

"I would like to see our Rivers clean again not just for us but for fish and birds and all animals to be healthy again. We can do this together!
Martha A. Wright

"I am concerned about the river and its inhabitants. I am only 14 but since I started fishing with my dad, I have noticed a great decrease in the number of fish. I would like to see a change".
Francis Lee Captain

"I love the river and want to keep it clean for the kids of Carmacks and the Yukon".
Cindy Charlie

To achieve the Council's mission, the YRITWC is providing First Nations in Yukon and northern British Columbia in Canada and Tribes in Alaska with technical assistance, facilitate the development exchange of information, coordinate efforts between First Nations and Tribes, undertake research, and provide training, education, and awareness programs to promote the health of the Watershed and its Indigenous peoples.

At the Watershed Council's Summit in Ruby, Alaska, in August 2011, the YRITWC leadership decided it was time for the First Nations and Tribes of the Watershed Council to be more assertive in bringing all this capacity and knowledge and action together into a collective inter-tribal plan for the Yukon River. The watershed plan would be written to match the vision of the Watershed Council founders of a river clean enough to drink from and to sustain the coming generations of the Yukon basin.

In August 2013, representatives from the First Nations and Tribes of the Council approved the Yukon River Watershed Plan at the Watershed Council's Summit in Mayo, Yukon. The objectives of the approved Watershed Plan are to protect and improve the water quality in the Yukon River and its tributaries and to assure that the Yukon River will continue to sustain the coming generations of all the people, fish, wildlife and plants of the Yukon. This plan combined modern science and policy with the Traditional Knowledge of the Indigenous governments and people of the Yukon River.

After the Watershed Council representatives approved the Watershed Plan, the YRITWC developed draft water quality legislation for First Nations. The draft considered their legislative power to further the protection of water quality by approving specific water quality objectives and standards derived from the Watershed Plan. For Alaskan Tribes, government strategies were proposed to assert inherent rights and to participate in a meaningful way in the river's governance.

The YRITWC struggled with implementing the Watershed Plan as approval of the drafted legislation and government strategies to endorse the Watershed Plan by individual Tribes and First Nations has been limited. The YRITWC is a collective association of the Tribal and First Nations governments, but not a sovereign government itself. Therefore, endorsement by individual Tribal and First Nations governments is required for the YRITWC to implement the Watershed Plan. Every Tribal government has a distinct approach to legislation – its own understanding of its authority to legislate and its own legislative form and procedure, hence the YRITWC needs to explore new approaches and implementation strategies for each government to fit its own legislative forms and authorities.

The Water Resilience Adaptation project aimed to identify watershed wide priorities and concerns to clean water as it aligns with the Watershed Plan objectives, and to develop action strategies for Alaska Native Tribes (ANT). The workshops provided the opportunity for 57 federally-recognized ANT communities to discuss local, regional and watershed-wide hydrosocial issues associated with sustainable water resources.

BACKGROUND

Yukon River Basin

The Yukon River basin (YRB) is the fourth largest drainage basin in North America. Spanning 855,000 km^2 it is twice the size of the state of California, and discharges 6,457 m^3/s of freshwater into the Bering Sea (Brabets et. al., 2000; Brabets and Walvoord 2009).

Figure 1: Yukon River Watershed

The Yukon River originates in British Columbia, Canada and flows northwest through the Yukon Territory across the interior of Alaska to the Bering Sea, a length of 1,980 miles. The overall basin flows from east to west through 20 different ecosystems, each with unique surficial and bedrock geology. Bradets et.al., 2000, identified five distinct physiographic zones in the YRB: (1) rolling topography and gentle slopes, (2) low mountains-generally rolling (3) plains and lowlands, (4) moderately high rugged mountains, (5) and extremely high rugged mountains underlined by discontinuous and sporadic permafrost (Figure 2). The YRB water quality characteristics of surface and groundwater is strongly influenced by its complex geology and diverse landscape (Brabets et. al., 2000; Brabets and Walvoord 2009). The diverse landscape includes glaciers, mountains, wetlands and tundra. For example, 30% of the YRB consists of wetlands (Figure 3).

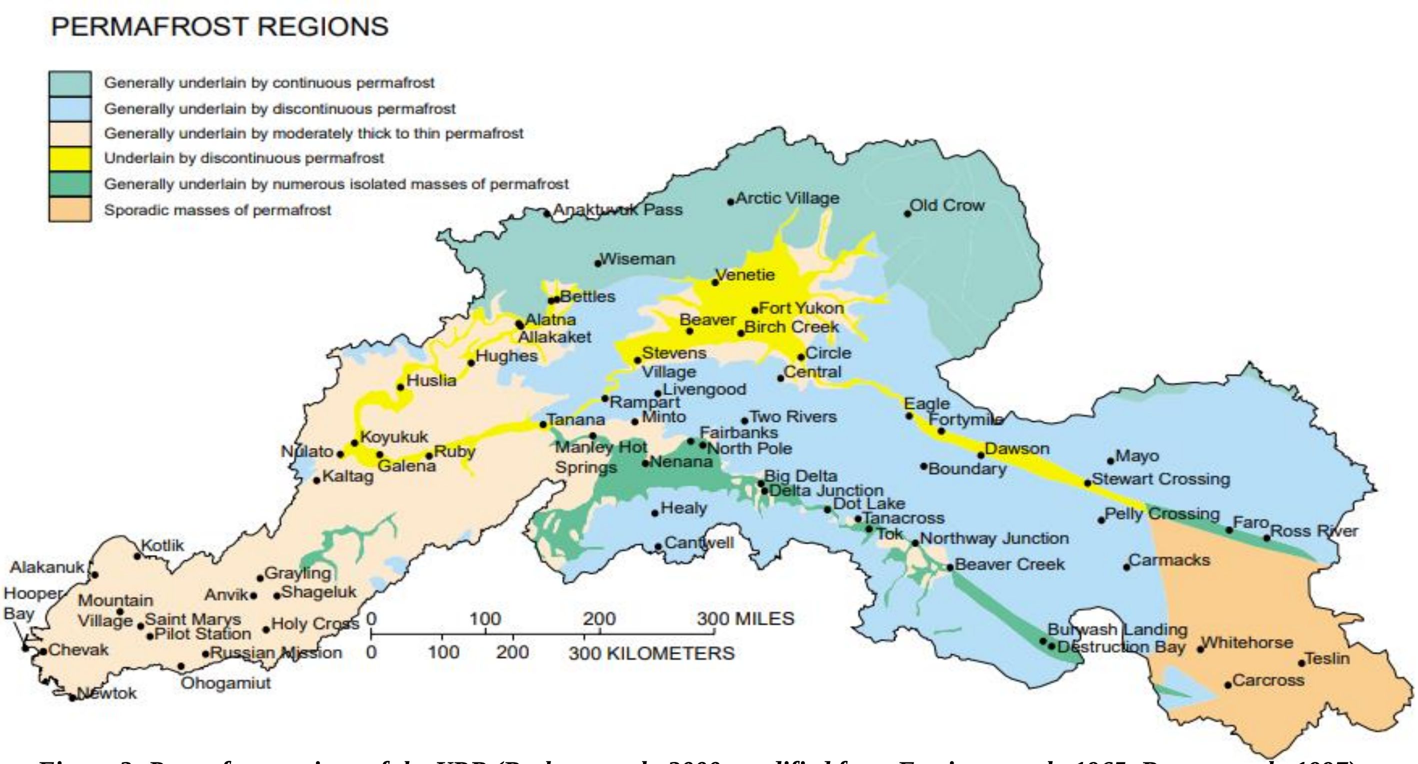

Figure 2: Permafrost regions of the YRB (Brabets et. al., 2000, modified from Ferrians et. al., 1965, Brown et. al., 1997).

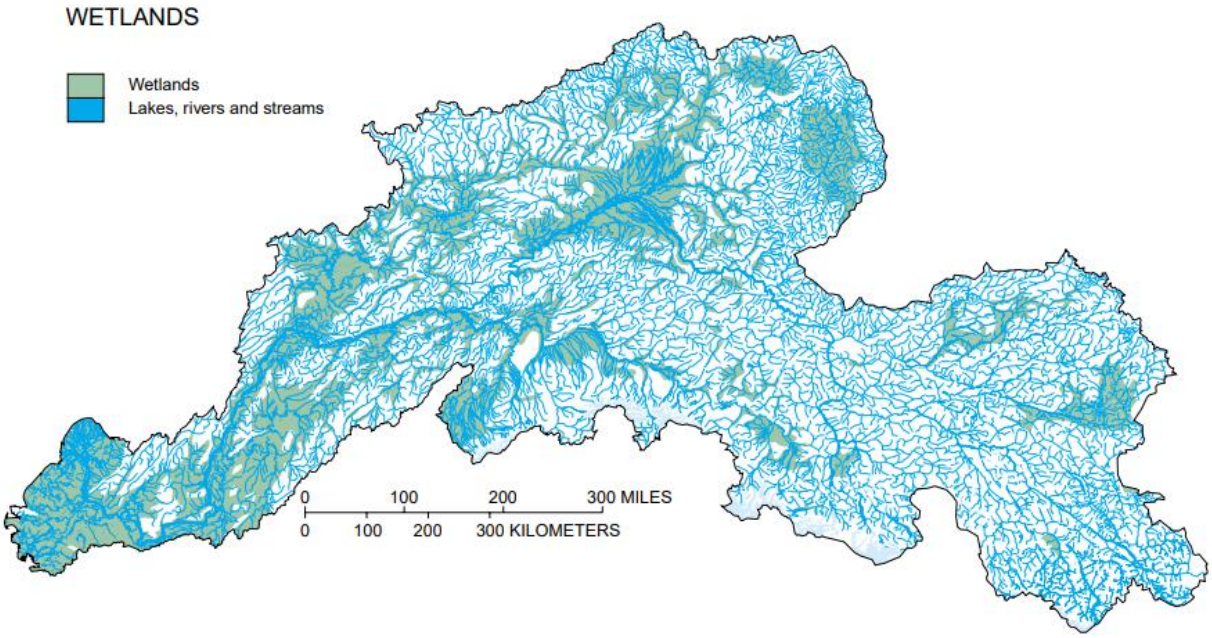

Figure 3: Wetland areas of the YRB (Bradets et. al., 2000 modified from Fretwell and others, 1996)

Hydrologic Characteristics of the YRB

The YRB is composed of many streams and rivers. Utilizing the Alaska Hydrologic Unit Classification system (U.S. Geological Survey, 1987) and a similar classification system for Canada, the YRB can be divided into 13 major basins. Figure 4 illustrates the major sub-watersheds in the YRB: Yukon Headwaters (13,000 sq. Miles) drains wide-ranging glacial fed lake system; Teslin River (13,100 sq. Miles), Pelly River (18,600 sq Miles), Stewart River (19,800 sq Miles), White River (18,100 sq Miles), Upper Yukon (28,200 sq Miles), Porcupine River (45,000 sq Miles), Chandalar River (13,700 sq Miles, East Central Yukon (27,300 sq Miles, Tanana River (44,300 sq Miles), Koyukuk River (34,000 sq Miles), West Central Yukon (20,900 sq Miles), and Lower Yukon (24,500 sq Miles) (Brabets et. al., 2000; Brabets and Walvoord 2009).

Most Yukon River discharge occurs during the ice-free months from snowmelt, rainfall and glacial melt. For example, the Tanana and White River drainages are glacially fed systems and provide about 29% of the total water flow of the discharge at the mouth (Brabets et al., 2000; Brabets and Walvoord 2009). Stream discharge quantity and variability can have considerable effects on the quality of surface waters, as streamflow influences a river's ability to support aquatic communities, dilute waste discharges, and carry suspended sediment and geochemical weathering products. The Yukon River transports about 60 million tons of suspended sediment annually with about 20 million tons deposited on the floodplains of the braided stretches (Brabets et al., 2000; Brabets and Walvoord 2009). Whereas, the seasonal variability of streamflow can cause temporal variability of water quality (see section Indigenous Observation Knowledge).

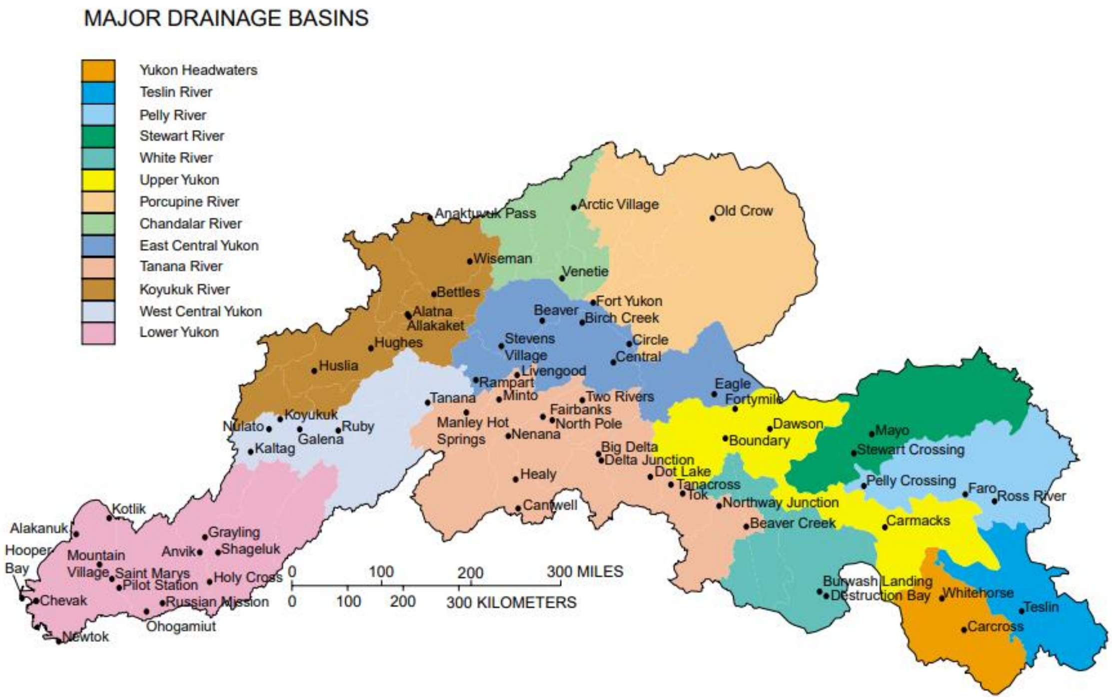

Figure 4: Major draining basins in the YRB (Brabets et.al., 2000).

Yukon River Basin and Land Use

Many of these sub-watersheds cross political and jurisdictional boundaries. The YRB includes parts of two Canadian National Parks, Vuntut and Kluane, in addition to several Habitat Protection Areas. Atlin Provincial Park is located near the headwaters of the Yukon River. These lands compose about 9% of the land area of the Canadian YRB. In Alaska about 68% of the YRB land is owned by the Federal government including four National Parks that cover 10% of the area, 8 Wildlife Refuges that cover 32% of the area, and Bureau of Land Management (BLM) with 22% land ownership. The U.S. military and Native corporations each own approximately 1 percent of the land (USGS, 2000).

Yukon River Basin & Climate

Climate introduced environmental change and its impacts occurring across the YRB are being observed by scientists and communities alike (ACIA 2005; Hinzman 2005; IPCC 2007; Brabets and Walvoord 2009; Herman-Mercer et al. 2011 and 2016). Theses observed landscape and hydrological changes include early ice break-up, later freeze-up, changes in precipitation, increasing forest fires, glacial retreat, flooding, erosion, permafrost degradation, and hydrological changes (IPCC, 2007; Bieniek et al., 2011; 2014; Bates et al. 2008; Brabets and Walvoord 2009; Walvoord and Striegl 2007; Herman-Mercer et al 2011; Wilson 2014; Frey and McClelland, 2009; Toohey et. al., 2016; Cozzetto et.al., 2013; Zolkos et. al., 2020; and Tank et. al., 2023). Considering the ANT traditional way of life, these environmental changes have profound societal, economic, and cultural impacts (Berk-Mercer et al., 2011; Houser et al., 2001).

Freshwater & Water Security

For many ANTs climate change poses a direct threat to water security as communities of the YRB utilize the Yukon River and its tributaries for drinking water and household use. Local and regional effects from river and coastal erosion and permafrost thaw have altered freshwater or groundwater systems impacting water quality and quantity, which presents a human, fish and wildlife health concern. Cozzetto 2013 described increasing temperatures of surface waters are driving many of the challenges to water quality that ANTs are facing such as contamination of drinking water by microbial pathogens, increase of organic material and sediment, and increased algae blooms. Furthermore, the GAO report published in 2009 stated that 31 Alaska Native villages have been identified as facing imminent flooding and erosion, threatens; a third of these villages are located on the Yukon River. Seasonal flooding can move through sewage lagoons, outhouses, and landfills which can overflow and run-off to contaminate drinking water sources (Pandey et. al. 2014, Mutter et. al. 2016). Greater levels of precipitation and permafrost thawing can also contribute to increase the mobilization of pollutants to water resources and subsistence harvesting areas located near landfills and sewage lagoons (Mutter 2014; Duffy et. al., 1998, Egeland et al., 1998).

The YRITWC's signatory communities have long been concerned with the impacts of climate change and contamination of water resources. These concerns and their implications for human health among ANT and Yukon First Nations were specifically identified as a priority during the open floor discussions and individual conversations at the Biennial Summit 2011).

WORKSHOP PREPARATION

Survey

A watershed wide phone and email survey was conducted to achieve a better understanding on current ANTs water resources concerns and vulnerabilities. The survey responses also helped with the workshop preparation in guiding discussion themes for the water resilience and adaptation framework. We received 28 phone and 3 email responses. A total of 31 communities out of 57 YRITWC signatory ANTs, have taken the survey to share freshwater and drinking water quality and quantity concerns as well as the level of water governance knowledge across the regions. Figure 5 illustrates the survey regional responses.

Survey Responses

The survey responses on water concerns and concerns discussed by communities shared by Tribal or City staff members have been analyzed and grouped into these following common themes:

- ***Landscape Changes*** resulting from permafrost thaw, erosion, and lakes or ponds drying out.
- ***River and Stream Changes*** associated with water level, channel or water quality changes.
- ***Weather Pattern Changes*** resulting from increasing cloud formation, precipitation changes, and increase of air temperature as well as sun intensity.
- ***Flora & Fauna Changes*** on subsistence food resources, animal health and abundance.

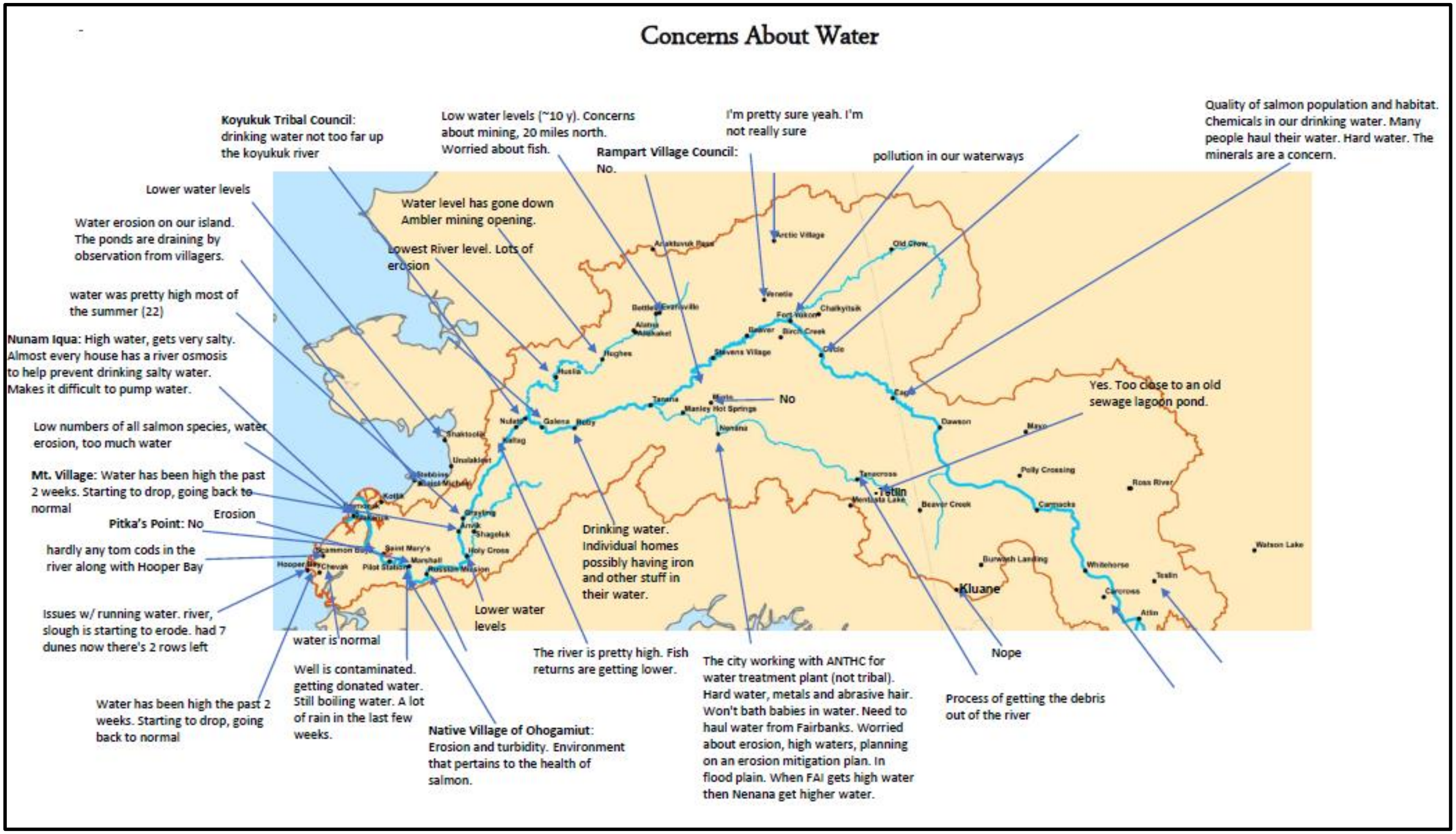

Figure 5: Survey Responses across the Yukon River Basin.

- ***Pollution Sources*** impacts to freshwater or drinking water resources identified are landfills, litter and littering.
- ***Drinking Water System*** issues with water treatment process, pipe distribution system and water quality.

Survey responses on *Concerns about Water* revealed that water quality and quantity impacts are closely associated with landscape and river/stream changes. Water quality and quantity concerns expressed are linked to human health, and the health of subsistence food resources i.e. wildlife, and fish health as well as abundance (Figure 6).

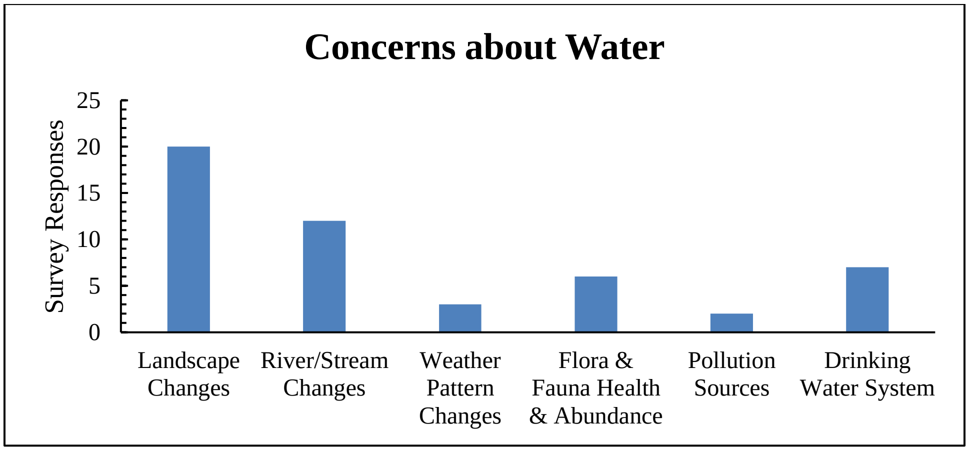

Figure 6: Survey Responses on Concerns about water.

In contrast, the survey responses on water concerns discussed in community or Tribal government meetings are mostly connected to clean drinking water accessibility such as community drinking water treatment system, and distribution piping and home system failures (Figure 7).

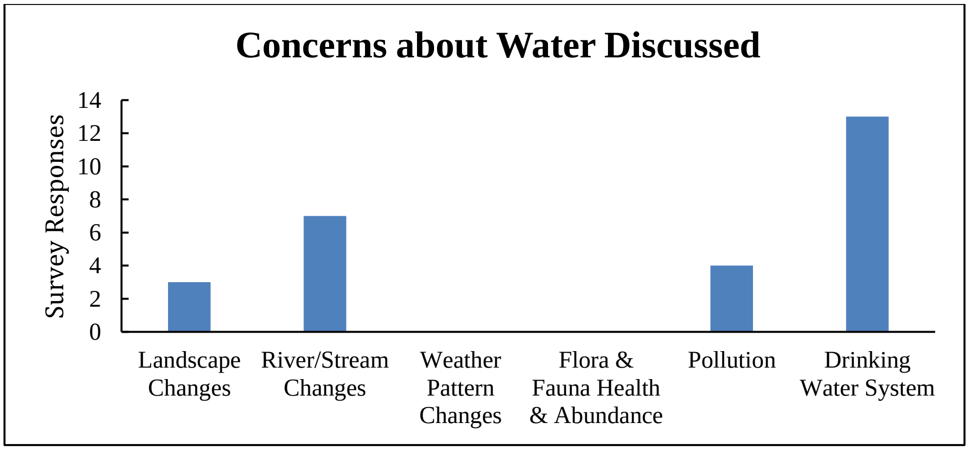

Figure 7: Survey Responses on water concerns discussed at community or Tribal government meetings.

Out of 28 survey responses, four ANTs have previously discussed water rights and one Tribal Government has taken action to pursue water rights or protection. The majority of ANTs would like to receive more information on water regulation and water rights in order to make informed decisions (Figure 8).

Figure 8: Survey Responses on Water Regulation and Water Rights.

Informational Booklets

In preparing the Resilience Workshops, we collected secondary data from available sources such as research publication, literature, satellite imagery, and physical science data relevant to hydrology and water quality. The generated information and materials served a) to develop the resilience and adaptation framework; b) to gain a comprehensive understanding on regional water stressors and threats; and c) to guide the workshop presentations and discussions. Water Resilience Booklets for the Yupik, Athabascan, Koyukon and Gwich'in regional with summarized content of local and regional Traditional Ecological Knowledge, water quality and quantity, climate predictions, satellite imagery and maps, as well as water governance, policies, and regulations were provided to each participant at the workshop. The booklets are also available on the YRITWC website[1].

WORKSHOP STRUCTURE

To bring minds together in problem-solving efforts, a series of two-day Water Resilience Workshops were hosted for the Yupik and Cupik, Koyukon, Athabascan, and Gwich'in regions of the YRB in 2023. The Gwich'in region workshop was held in Fairbanks and attended by participants from Fort Yukon, Arctic Village, Venetie, Evansville and Beaver Village. The Athabascan region workshop was held in Nenana and was attended by Tribal members from the Native Villages of Tanana, Tetlin, Tanacross, Nenana, and Circle sent representatives to the workshops. The Koyukuk region workshop was held in Galena, representatives from the Native Villages of Galena, Nulato, and Koyukuk attended the workshop. Lastly, the Cupik and Yupik region workshop was held in Anchorage with Tribal representatives included the Native Villages of St. Mary's, Emmonak, Russian Mission, Kotlik, and Anvik. Additionally, we hosted a discussion session at the YRITWC Biennial Summit held in Nenana. The discussion session was attended by Tribal representatives from the Native Village of Alakanuk, Mountain Village, Huslia, Marshall, Hooper Bay, Fort Yukon, and Russian Mission.

[1] YRITWC website at https://www.yritwc.org/science

Overall, 2 YRITWC signatory ANT representatives such as Tribal environmental staff members, city employees, youths, and elders participated in the workshops. Figure 9 illustrates the 4 regional workshop regions in Alaska as well as pictures of participants attending the workshops.

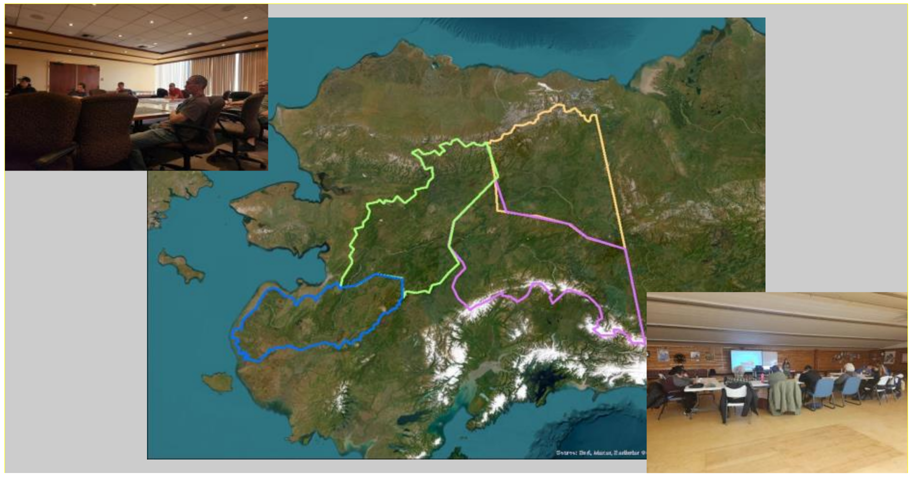

Figure 9 illustrates the 4 workshop regions and participants attending the workshops.

The workshop objectives were to: a) identify regional themes of water resources vulnerability and threats; b) set priorities to respond to sustainable water resources threats; c) discuss capacity needs; and d) identify water governance strategies to guide future YRITWC and ANTs actions to protect and preserve clean water for the upcoming generations. Creating the space for discussions was essential to encourage participants to document their own environmental observations, identify and assess local and regional vulnerabilities and risks to water resources in their region. Figure 10 illustrates the Resilience and Adaptation framework steps addressed by the workshops.

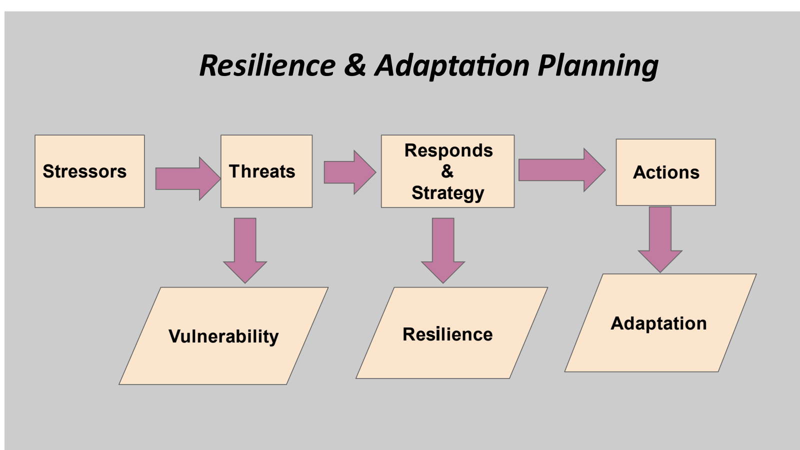

Figure 10: Water Resilience and Adaptation Workshop Framework.

Water Resources Vulnerability

The structured breakout sessions were aimed to understand Alaska Tribes' concerns about climate change, water, and human and environmental health. During these sessions TEK on historical and current environmental observations, historical climate trends and future predictions, satellite imagery to observe landscape and water resources change, water quality and quantity data, and water regulation and governance were presented to guide discussions related to concerns, needs, risk/vulnerabilities, and actions among ANTs participants. Appendix provides deeper details on the presented information.

WORKSHOP FINDINGS

Environmental Observations

Four categories were created to organize the wide-scope of environmental observations shared by workshop and summit session participants that were perceived to impact water freshwater or drinking water resources' quality or quantity as well as flora and fauna. The categories are: 1) Climate Driven Landscape Changes 2) Climate Driven Hydrological Changes; 3) Climate Driven Weather and Seasonal Changes; and 4) Natural Events and Disasters. The environmental observations responses that were perceived to impact water sources and percentage of valid responses are:

Landscape (30%): Tundra ponds are drying out, loss of permafrost, more severe and increased river and coastal erosion as well as sediment deposition.

Hydrology (27%): Changes in river or stream flow and level, in addition to river channel changes – shallower and wider. For example, in the lower Yukon Kuskokwim Delta (YKD) region, rivers are widening significantly and sandbars are appearing where channels were previously surrounded by shallow waters. Melting coastal sea ice and sea level rise are also observed resulting in saltwater intrusion impacting freshwater resources within the YKD communities.

Weather (25%): Increase in cloud coverage, precipitation and temperature, higher sun intensity, stronger winds, and seasonal change of freeze-up and snowmelt. Freeze-up in 2016 occurred on October 4th and on October 23rd in 2022.

Natural Events/Disasters (7%): Increase in storm surges, flooding and wildfire.

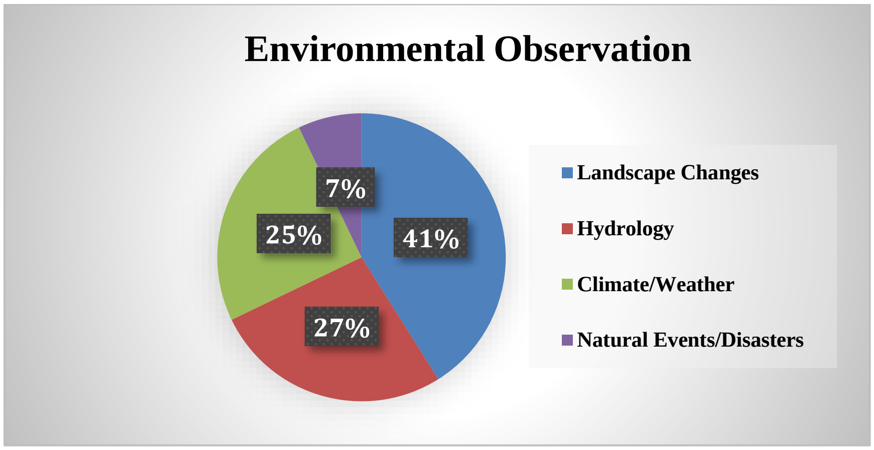

Figure 11: A graphical representation of the environmental observations categories and their frequency shared responses by workshop participants.

Water Vulnerability

The threats or risks that workshop and summit session participants linked to outcomes in water vulnerabilities were categorized into four overarching groups. These categories are also used as the priority areas for the action and strategy discussions at the workshops. The threats identified to pose the highest risk to water sources identified by participants are: 1) Pollution related to point sources; 2) Environmental Stressors associated to climate driven landscape and hydrology changes; 3) Drinking and Wastewater Infrastructure improvement needs; and 4) Capacity and Resources limitations to address threats to water sources. The water vulnerabilities categories and percentage of valid responses are:

Pollution – Point Sources (35%): Historical and current resource development (i.e. Mining, Oil and Gas), land or building contamination (i.e. Brownfield sites, historical military debris, sewage lagoons, and landfills) and littering.

Environmental Stressors (24%): Precipitation and hydrologic patterns, air temperature, frequency of extreme events, permafrost thaw, erosion, and sea level rise.

Drinking & Wastewater Infrastructure (22%): Drinking water treatment system, water pressure, drinking and wastewater piping distribution system, and drinking and wastewater home connection system.

Capacity & Resources (13%): Limitation of enforcement, funding to address infrastructure challenges, clean-ups or backhaul opportunities, lack of heavy equipment.

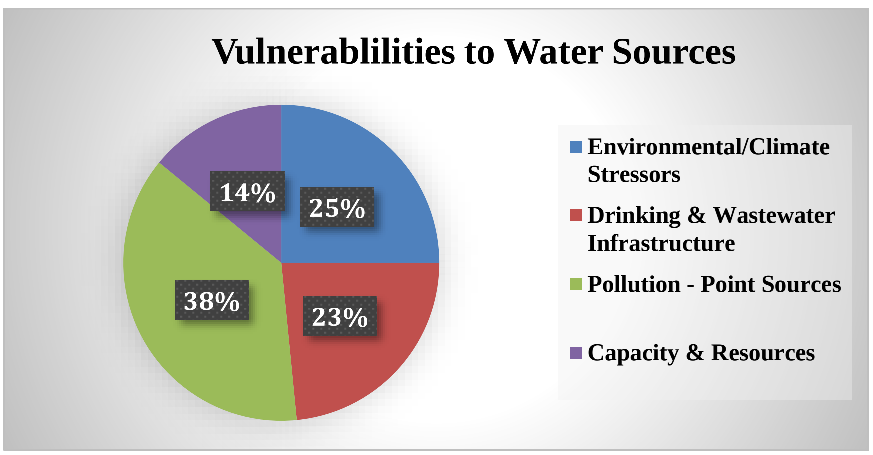

Figure 12: A graphical representation of the water resources threat and risks categories identified by workshop participants.

Response and Strategy to Water Resilience

For each water resource vulnerability group, we asked the workshop participants to come up with responses to mitigate and adapt to water sources stressors or threats and to identify strategies on how resilient water resources can be achieved for future generations. Additionally, we asked the participants to differentiate between the implementation strategies based on community-level by Tribal governments or through the YRITWC or secondary support. The strategies were then organized into three priority action categories in which they were related such as Environmental Monitoring, Pollution Mitigation & Clean-up, and Capacity & Resources (Figure 18). Lastly, it should be noted that the strategies and action items presented in Table 2 and 3 do not represent the perspectives of all YRITWC signatory ANTs.

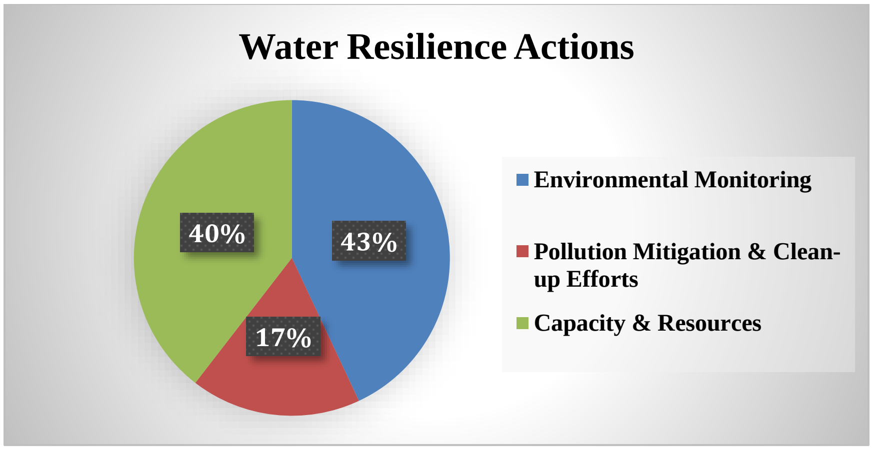

Figure 18: A graphical representation of the water resilience actions identified.

The following Tables 1 to 3 are outlining the water vulnerabilities and associated strategies and recommended action items for Tribal Governances identified by workshop and YRITWC summit participants.

Tabel 1: Tribal Government Water Sources Resilience Action Recommendations to Address Environmental Stressors

Strategy	Action	Needs & Resources Required	Key Performance Indicators
Environmental Monitoring	***Air Quality Program*** Air Quality Monitoring Program Road Dust Prevention	***Funding for Tribal Environmental Workforce*** - Indoor & Outdoor Air Quality Monitoring Training & Equipment	***Tribal Environmental Workforce*** - Monitoring & Enforcement Plan - EPA Approved Quality Assurance Project Plan (QAPP) - Indoor Air Quality Improvement
	Water Stewardship Surface & Groundwater Quality & Quantity Monitoring Program	- Water Quality Monitoring Training & Equipment. - Funding for Water Quality Analysis - Data Analysis & Management Training - Geographic Information System (GIS) Training - Learn more about Water Rights - Protection of River, Lakes - Scenic River Nomination - Review Federal Environmental Impact Statement Plans - Identify Traditional Water Sources with Cultural Significance - Document Traditional Place Names (Land & Water)	- Tribal Council's Partnering with YRITWC ION Program to Enhance Surface & Groundwater Monitoring - Adapt ION Umbrella EPA Approved QAPP - Tribal Council's Passing Resolution to Support YRITWC Water Stewardship Efforts - Resolution for Clean- Water - Identified & Mapped Traditional Source & Cultural Significant Waterways
	Stream & River Survey Fish & Wildlife Habitat Survey	- Stream & River Survey Training - Invasive Species Training - Tribal Council collaborate with YRITWC & other Scientists to Identify and Map Significant Fish Habitat Areas - Develop a Monitoring Plan - Establish Traditional & Nature Based River/Stream Restoration Program	- Fish & River/Stream Monitoring Plan. - Fish Habitat Assessment - Invasive Species Inventory - Establishing Tribal Conservation Districts to Build Relationships with Landowners & Agencies. - Explore Opportunities on Land Ownership to gain more Lands to Protect Subsistence Area & Ecosystem.

Hazard Mitigation Program	Wildfire Mitigation Program	- Forestry Training - Identify & Document Community Fire Hazard - Tribal Meetings on Wildfire Fuel Reduction & Defensible Space	- Hazard Mitigation Plan - Community Fire Mitigation Plan
	River Safety & Rescue Transportation Program	- Drone & GIS Mapping Training - Map Local River Channels & Flood Zones	- Safety Transportation Maps - Awareness System
	Erosion & Permafrost Mitigation	- Tribal Meeting on Erosion and Permafrost Mitigation - Erosion & Permafrost Monitoring Training and Equipment	- Partner with YRITWC & other Researchers to Mitigate Erosion - Enhance Tribal Efforts for Nature-Based Erosion & Permafrost Mitigation - Government-Government Consultation with the Department of National Security
Environmental Education	Tribal Environmental Community Outreach Youth Environmental Education	- Funding for Community Wellness Coordinator - Council Engagement with Government Agencies to Lobby for Educational Opportunities for Tribes (i.e. Culture Camps).	- Cultural Revitalization & Community Wellness Education Program - Environmental Tribal Stewardship Advocacy Program via Social Media. - Culturally Relevant Curricula

Tabel 2: Tribal Government Water Sources Resilience Action Recommendations to Address Capacity and Resources

Strategy	Action	Needs & Resources Required	Key Performance Indicators
Local Economic Development	Tribal Meeting to Discuss Local Economy Opportunities	- Funding to Enhance Tribal Grant Writing Capacity - Prepare Grant Applications for Local Economic Development	- Update or Develop an Economic Development Plan - Tribal Grant Writer Position - Submitted Grant Applications
	Eco-Tourism	- Training Opportunities for Eco-Tourism and Business Administration	- Tribal Eco-Tourisms Strategic Plan
	Community Garden	- Host Community Gardening Trainings & Workshops - Workshops on Traditional Plants & Medicine - Grant Applications – USDA Uban Agriculture Program	- Community Garden Program
Drinking Water & Wastewater System Improvement	Develop Locations for New Housing to Address Water Pressure Issues Repair or Replace Drinking Water Treatment & Piping Distribution System	- Monitor Drinking Water Quality - Monitor Traditional Water Quality - Drinking Water Treatment Operator Training - Explore new Drinking Water Filtration and Disinfection System to address Climate Driven Water Quality Issues	- Develop Source Water Protection Plan - Resolution for Clean- Water (Source Water Protection) - Partnership with Alaska Native Tribal Health Consortium (ANTHC)
Infrastructure Improvement	Infrastructure & Housing Improvement	- Housing & Infrastructure Stabilization or Relocation to higher ground - Explore Funding Opportunities with FEMA and DCRA (Emergency Preparedness & Response) - Emergency Preparedness Training	- Update or Develop a Housing and Infrastructure Plan - Submitted Funding Applications

Tabel 3: Tribal Government Water Sources Resilience Action Recommendations to Address Pollution Mitigation & Clean-up

Strategy	Action	Needs & Resources Required	Key Performance Indicators
Tribal Backhaul & Cleanup Response Workforce Development	Identify Contaminated Land & Infrastructure Environmental Assessments & Clean-up Support Community Clean-up & Recycling Efforts Establish Local or Regional Backhaul & Recycle Program	- Qualified Environmental Samplers Training - Fluids Removal Training - HAZWOPER Training - Backhaul Training i.e. Heavy Equipment Operator & Shipping & Packaging Requirements - Funding for Infrastructure to Store & Safely Manage Hazardous Material - Develop or Update Solid Waste Management Plan (including management of the scrap and fluids facility)	- Pass Resolution on Sustainable Materials Managements (SMM) - Pass Resolution to Establish Regional Backhaul Hub - Tribal Resolutions vs. Directives for YRITWC Clean-up Efforts - Tribal Enforcement on Littering - Solid Waste Management Plan
Pollution Mitigation & Cleanup	Leachate Mitigation (Landfill, Sewage & Backhaul Sites) Oil Spill Response Team	- Landfill & Sewage Lagoon Assessment - Apply for Funding to Increase Capacity to Relocate Landfills and/or Sewage Lagoons - Oil Spill Response Training - Oil Spill Equipment & Supplies	- Landfill & Sewage Lagoon Assessment Report - Funding Applicants to Address Landfills and Sewage Lagoons Needs - Regional Tribal Lead Oil Spill Response Team

The YRITWC is an Indigenous grassroots organization that provides technical assistance, such as facilitating the development and exchange of information, coordinating efforts between First Nations and Tribes, undertaking research, and providing training, education and awareness programs to promote the health of the YRB and its peoples. The Tables 4 to 6 delineating the action items identified by workshop and summit discussion participants for YRITWC. The draft action items are aimed to assist and support Tribal Governments with their efforts to address local and regional water vulnerabilities to achieve resilience of water resources.

Tabel 4: YRITWC Water Sources Resilience Action Recommendations to Address Environmental Stressors

Strategy	Action	Needs & Resources Required	Key Performance Indicators
Environmental Monitoring	***YRITWC IGAP*** Air Quality Monitoring Program	- Establish Indoor & Outdoor Air Quality Monitoring Program - Develop Umbrella EPA approved QAPP	- Monitoring Plans - Umbrella EPA approved QAPP
	YRITWC Mining Program Expand YRITWC Mining Program Promote Responsible Development Water Quality & Quantity Monitoring for Baseline & Assessment GIS Mapping of Mining Impacts	- Funding for a Full-Time Position - Update Online YRB Mining Map - Mapping of Historical, Current & Future Resource Development Pollution Concerns - Assess Data of Potential Impacts to Human and Fish Health - Clean-Up of Mine related Waste & Equipment - Apply for Stream/River Restoration Funding - Update YRITWC Mining QAPP - Summarize & Review EIS for Tribal Process - Support Tribes with drafting Comments for Consultations	- Online YRB Mining Map - Surface Water Quality Monitoring Program - YRITWC Mining QAPP

	Indigenous Observation Network (ION)
	Surface and Groundwater Quality
	Surface Water Quantity/Discharge
		- Expand the ION to Incorporate Groundwater Monitoring
		- Update ION Umbrella Water Monitoring QAPP for EPA Approval
		- Provide Water Quality Monitoring Training
		- Create Watersheds Vulnerability Index
		  - Local & Regional Hydrological Modeling
		  - Local & Regional Aquatic-Ecological Modeling
			- Approved ION Umbrella Water Monitoring QAPP
			- Water Stewardship Plan – Holistic – Scientific & Traditional Approach (Land & Water Placement)
			- ION Community Reports
			- University of Colorado - Arctic Rivers Project Collaboration

		- Analyze & Interpret ION, Federal & State Water Quality & Quantity Data for Spatial & Temporal Trends - Provide Platform for ION Data & Information Access - Provide Tribal Support with their Climate Change Adaptation Planning Efforts	- University of Colorado & Yukon College Partnership - FieldScope, USGS ScienceBase, NSF Arctic Data Center, Circumpolar Active Layer Monitoring & Data Stream
Environmental Monitoring	Stream/River Survey	- Establish Classification of YRB Natural Streams/Rivers	- River/Stream Classification Maps
	Fish & Wildlife Habitat Survey	- Support Tribal Invasive Species Inventories	- YRB Invasive Species Inventory
Hazard Mitigation Program	Erosion & Permafrost Monitoring	- Monitoring Efforts to Support Tribal Hazard Mitigation Planning - Provide Erosion & Permafrost Monitoring Training - Achieve a Better Understanding about Boat Traffic and Impacts to River Bank Erosion - Investigate Drivers of Mudslides - Investigate Mudslides Risks & Vulnerabilities to Communities	- Erosion & Permafrost Monitoring Data - Communities Erosion & Permafrost Maps - Mudslides, Soil Properties & Slope Data
	River System Mapping	- Support Tribal Efforts with Watershed Wide River Channel Safey Mapping	- Watershed River Channel Maps - Watershed Awareness System

Tabel 5: YRITWC Water Sources Resilience Action Recommendations to Address Tribal Capacity and Resources Needs

Strategy	Action	Needs & Resources Required	Key Performance Indicators
Grant Writing	***YRITWC Grant Writing Assistance***	- Funding for YRITWC Grant Writer Position - Develop & Support Grant Applications with Tribal Entities - Generate Grant Writing Informational Material - Provide Grant Writing & Management Trainings	- Submitted Grant Applications - Grant Writing & Management Trainings - Grant Writing Information Material

Water Stewardship	***YRITWC Science Program***
	Watershed Protection "Road Map"
		- Generate YRITWC Stewardship Library:
		  - Water Regulation/Policies
		  - Clean Water Act
		  - Water Protection – Scenic Rivers Act
		  - Water Rights
		  - Endangered Species Act
		  - Salmon-Focused Investments in Sustainable Habitats (FISH)
		  - Whitefish Habitat Mapping
		  - Wetland Habitat Protection Areas (HPA)
		- Facilitate Discussion with Tribal Councils on Sustainable Water & Water Rights
			- YRITWC Water Stewardship Library
			- Drafted Watershed Protection Strategies
			- Drafted Tribal Watershed Protection Resolutions
			- Adaptive Watershed Protection Plan ("Road Map")

Drinking Water & Wastewater System Improvement	***YRITWC Drinking Water Assistant Program*** Sustainable and Clean Drinking Water	- Provide Training for Drinking Water Operators - Support Tribal Source Water Protection Planning - Identify Drinking Water Risks & Impacts - Support Tribal Planning Efforts Towards Sustainable & Clean Drinking Water - Generate Information on Water Treatment Options	- Training Opportunities for Local Water Plan Operators - Source Water Protection Plans

Environmental Education	***YRITWC IGAP*** Community & Youth Environmental Education	- Generate Youth Education Material (i.e. Traditional Environmental Practices, Indigenous Natural & First Laws, Water & Watershed Science, Pollution & Littering) - Participate in School Educational Programs or Tribal Cultural Camps - Provide Environmental Education & Training Opportunities to Signatory Tribes	- Community Programs for Environmental Awareness & Protection - Youth Environmental Education Program

Tabel 6: YRITWC Water Sources Resilience Action Recommendations to Address Pollution Mitigation & Clean-up

Strategy	Action	Needs & Resources Required	Key Performance Indicators
Pollution Control & Cleanup	***YRITWC Brownfields Program*** Environmental Assessments & Clean-Ups	- Identify Contaminated Land & Infrastructure - Coordinate Environmental Assessments & Clean-up - Provide Qualified Environmental Samplers Training - Provide HAZWOPER Training - Provide Oil Spill Response Training - Provide Heavy Equipment Operator Training Opportunities	- Local Assessment & Response Capacity - Completed Environmental Assessments - Completed Contaminated Land Cleanups
	YRITWC IGAP Program	- Provide Assistance with Tribal Backhaul of Reusable Material - Support Community Clean-up & Recycling Efforts	- Sustainable Tribal Governance Backhaul Activities
	YRITWC IGAP & Science Program Pollution Mitigation	- Provide Assistance with Landfill & Sewage Lagoon Environmental Assessments - Assess Landfill & Sewage Lagoon Environmental Impacts - Provide Grant Writing Expertise to Tribal Governance for Landfill & Sewage Lagoons Improvements or Relocation Efforts	- Completed Landfill & Sewage Lagoons Environmental Assessments & Reports

CONCLUSION

The Climate Change Adaptation & Action Plan for the YRB achieved the overall objectives of this project: 1) to foster collaborative partnerships between ANTs; 2) to facilitate workshop discussions; 3) to identify and prioritize vulnerabilities to local and regional water sources; and 4) to draft a Water Adaptation and Action Plan to address local and regional water vulnerabilities. This report is intended to support ANTs with developing water resilience strategies by identifying Tribal priorities and action areas, and feasible steps toward their implementation. It should be noted that the draft Water Adaptation and Action Plan is not completed and the YRITWC is encouraging ANTs to develop a more completed Tribal action plan that aims to foster water resilience and reduce health risks, with the support of this document.

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APPENDIX: *Water Resources Vulnerability*

Traditional Ecological Knowledge

In order to achieve a deeper understanding about environmental changes, a comprehensive literature review on Traditional Ecological Knowledge (TEK) was conducted and a summary was presented to the workshop participants. For our research we defined TEK as a collection of knowledge, beliefs, and practice of living beings (wild nature) passed down in continually learning from Indigenous generations to generations (Berkes et.al., 2018). The TEK provides great insights about historical environmental changes across the landscape of the YRB such as telling the weather by the looks of the horizon and sky or changes or shifts in season (i.e. early spring and river break-up or an earlier berry picking season). We have reviewed TEK environmental observations documented back to the 1980's across the YRB regions. The literature review included materials from the Alaska Native Knowledge Network from the University of Alaska Fairbanks[1], Western Tundra[2], The Creation Legend of the Yup'ik People[3], and the National Science Foundation Social Science Resources[4]. Below are some examples of our findings:

The book titled "Western Tundra talks about open country between Beaver and Arctic Village" published in the 1920, described the Gwich'in and Athabascan landscape as an open country or a bare tundra desert between Beaver and Arctic Village in the 20th century. ***Allen Tritt of Arctic Village stated "Most of the tundra was ice, so we didn't have forest fires. You also could see a steamboat on the Yukon from Venetie***".

In the Gwitch'in Climate Report, Matt Gilbert gives deep insights by ANT members, who are the first to witness and experience climate change. The Gwitch'in Climate Report includes a regional 2005 climate impact report from the Gwich'in Athabascans of Fort Yukon, Venetie, and Arctic Village, a 2013 Gwich'in Elder and Youth Climate Solution Statement to the World from Arctic Village, and 2020 updated Climate Interviews. These regional reports included environmental observations related to unpredictable weather patterns, permafrost thawing, changes in hydrology as well as in vegetation patterns in 2005. The following quotes were documented in the report:

"No rain in 2004 and not much the last 10 years before that and freeze-up came too early in Mid-September 2004. The snow is late some years too (which extends freeze-up)",
Allen Tritt of Arctic Village.

"*Snow just evaporates now in a week, one week no snow, 2nd week ice, and 3rd week water",*
William Flitt of Fort Yukon.

"*Freeze-up happens quickly when there's low water. We've had low water (regularly)*",
Richard Carrol of Fort Yukon.

[1] University of Alaska Fairbanks at http://www.ankn.uaf.edu/
[2] Western Tundra at http://alaskool.org/
[3] The Creation Legend of the Yup'ik People at https://theearthstoriescollection.org/en/the-creation-legend-of-the-yupik-people/
[4] National Science Foundation Social Science Resources4 (https://arcticdata.io/social-sciences/)

"Now 50 below only lasts 3-4 days in the winter and ice is not thick, because it's too warm",
Stanley Jonas of Fort Yukon.

"In September it rains and the river rises and you can go hunting but it hasn't rained in the last couple of years. I can't go up Black River 2-3 years now",
Harry Thomas of Fort Yukon.

"Permafrost degradation causing mudslides and run offs from hills and mountains",
Bobby Tritt of Venetie.

There are numerous common themes of environmental observations identified in the Yupik and Cupik, Koyukon, Athabascan, and Gwich'in regions:

- Flora & Fauna: Changes in vegetation and increase of invasive species; changes in wildlife and fish health and abundance.
- Weather Patterns: Unpredictable weather patterns including increase in storm surges, stronger winds, increase in sun intensity/hotter summers, change in precipitation and snow coverage amounts. Seasonal changes including later Freeze-up and earlier snow/ice break-up.
- Permafrost Degradation: Loss of permafrost impacting infrastructure, increase of coastal and riverbank erosion, mudslides and road washouts. Changes on the land with increase of vegetation and drying out of waterways.
- Hydrology: Changes in water systems and waterways as compared to the past including water level and flow changes and river ice thickness. For example, wetlands including lakes and streams are drying out but there is also increase in flooding due to increase of precipitation. Change in water quality with increase of turbidity.

Climate Predictions

With numerous common themes and unique local circumstances, climate change in Alaska is affecting each community differently. In order to identify climate stressors and threats to water resources we presented workshop participants with historical regional and local climate projections available from the University of Alaska Fairbanks Scenario Network for Adaptation Program (SNAP)[1]. Climate change projections are important for predicting future landscape and freshwater change. We have to understand climate systems in order to advance water resilience, which requires looking at past air temperature and precipitation trends, and incorporating aspects of fundamental processes that drive climate and weather.

Global climate models use the laws of physics to build mathematical representations of the climate systems that calculate climate variables such as air temperature, rainfall wind speed, relative humidity, solar radiation, sea surface temperature etc., to predict changes to ice, land, atmosphere or ocean. It is important to know that global climate change models are limited due to large scale resolution and therefore will only provide regional predictions.

The Intergovernmental Panel on Climate Change (IPCC), a scientific organization that reviews and assesses socio-economic, and scientific climate change information. The IPCC concluded that the global mean surface temperature has increased since the mid-20th century. The increase is driven by the influx of greenhouse gas emissions. As we do not know what lies ahead of us, the IPCC has used climate models to establish projections around a range of possible emission scenarios called the Representative Concentration Pathways (RCPs). The range of RCPs are based on the uncertainties because we do not know about future population changes or what global/country actions will be taken with regards to economic development and technology advancement. The different RCPs for climate predictions are:

- RCP 4.5: the best-case scenario were global carbon emissions to reach net zero by 2050, resulting in peak concentration by 2075 and then plateau.
- RCP 6.0: considered the most likely scenario with the assumption of reaching net zero emission before 2075, leading to reduced concentrations after 2100.
- RCP 8.0: the worst-case scenario with no significant actions taken to reduce greenhouse gas emissions.

For ANTs climate change projections, historical climate data were projected for RCP 6.0 scenario. Figure 12 illustrates Alaska's average annual air temperature and precipitation projection in the 2030s under RCP 6.0. Based upon the projection the Southeast region of Alaska would experience the highest increase of temperature and precipitation in the 2030s. Meanwhile Interior Alaska experiences an average annual temperature of 29 degrees Fahrenheit compared to the historical average of 20 degrees Fahrenheit and an average annual total precipitation of 234 mm compared to the historical average of 206 mm.

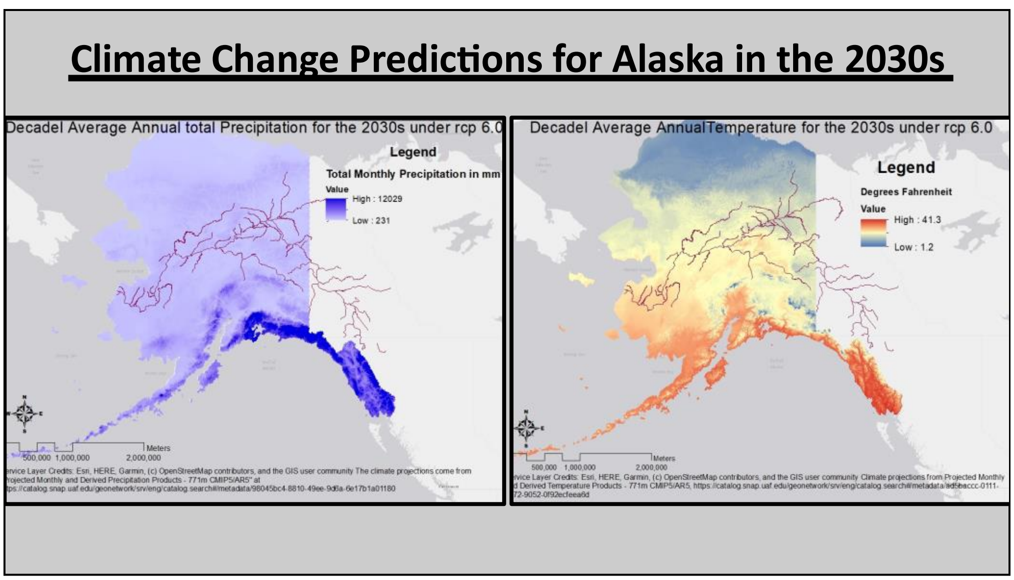

Figure 12: Climate Change Air Temperature and Precipitation Predictions in the 2030s.

[1] University of Alaska Fairbanks Scenario Network for Adaptation Program (SNAP)[1] at https://catalog.snap.uaf.edu/geonetwork/srv/eng/catalog.search#/metadata/b3b9581e-cccc-440f-bb2f-0fd6754d8d41.

Water Quality Data

Indigenous Observation Network (ION) is a collaborative effort between the ANTs and First Nations, the YRITWC, and the United States Geological Survey (USGS) established in 2006. The community-based environmental program combines Indigenous Knowledge and modern science to address concerns regarding past and current changes to the landscape, water quality and hydrology.

Leveraging historical data from the USGS and ION over the past decade has contributed to a better understanding of changes in surface water geochemistry and active layer dynamics throughout the YRB. Since the early 1980s, hydrological trend analysis of this database indicates an increase in annual fluxes of weathering ions and an increase in groundwater contributions to surface waters due to permafrost thawing in the YRB (Toohey et. al., 2016). Since 2010, we have observed increases in active layer thickness throughout the entire watershed with some of the largest increases within the Yukon River delta. The efforts of ION are critical to address challenges to drinking water resources caused by landscape and hydrological changes as a result of a changing climate. Examples of surface water geochemistry and active layer dynamics data provided are illustrated in Figures 13 & 14.

Climate Driven Water Quality Trends

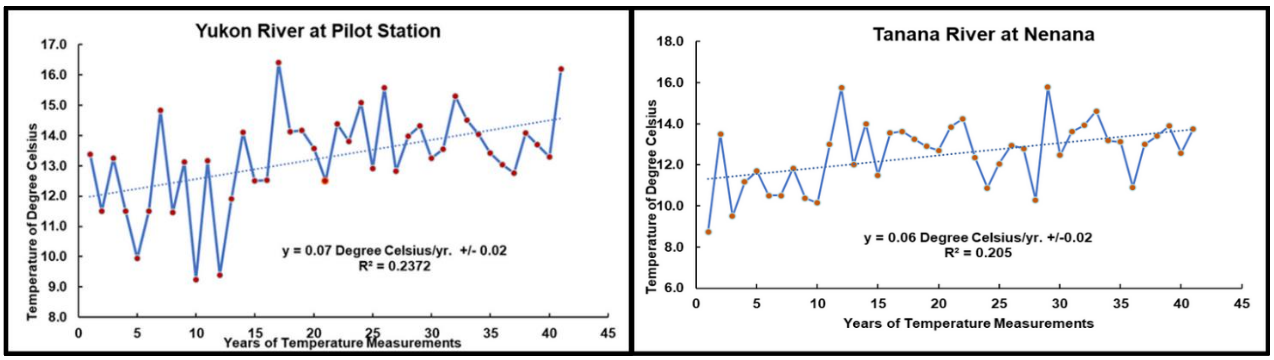

Figure 13: Water temperature analysis from the Tanana River at Nenana and the Yukon River at Pilot Station.

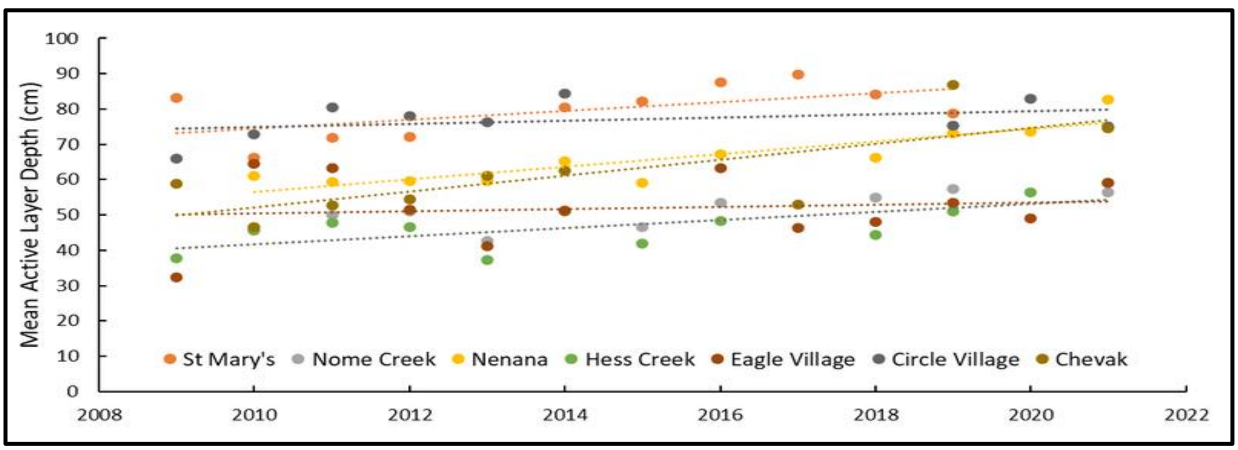

Figure 14: Average active layer depth measurements at sites across the YRB.

Satellite Imagery

Historical and recent satellite imagery was generated to achieve a better understanding of ANTs water resources and landscape changes over time. The imagery also included layers of communities drinking water protection zones and existing anthropogenic sites such as landfills or oil spills available by the State of Alaska online portals. The satellite imagery was used for the participatory mapping exercise so participants could mark places and water bodies of concerns relevant to their community's food security and their traditional way of life. The mapping exercise also gave room to share experience and knowledge of these places and to discuss action priorities to preserve or mitigate environmental impacts such as pollution, community infrastructure, and resource development. The generated maps will be used as representation of spatial data for future Tribal Council's discussions on the implementation of action items. Figure 15 shows the participatory maps and participants' engagement.


Figure 15: Pictures of the participatory mapping session and an example of a map created by participants.

Water Governance and Justice

The ANTs are federally recognized tribes and as such they have the authority to protect the well-being of their tribal citizens under the United Nations Declaration on the Rights of Indigenous Peoples. Protecting well-being includes protecting and preserving clean water necessary for life. For the workshop water strategy planning informational material was gathered including concepts and principles of water resilience, water governance, water rights, water policies and laws were generated for ANTs conceptual understanding on how water is managed and regulated. The following concepts of water governance have been summarized and presented to ANTs to provide a deeper conceptual understand of the context such as:

- ***Water resilience*** is a key concept for water management that implies an ability to prepare, adapt, and recover from water-related challenges and crises. Sharon B. Megdal, 2021, stated *"Water Resilience is not only about supply. It is about how the natural and human-connected systems live with the water. Perhaps a term to think about is co-existence: how we as humans coexist with our natural water systems. Our ability to be resilient requires us to think about this co-existence in everything we do, including how we build and design our communities and their structures."* As Nikki Tulley, a member of the Navajo Nation explained, *"Preparing for future generations is a way of resilience within Indigenous communities."*

- The ***Clean Water Act (CWA)*** was passed by Congress in 1972. The CWA objective is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." The federal CWA Antidegradation policy requires that our water quality standards protect existing designated uses by establishing the maximum level of pollutants we can allow in surface water (US Department of Justice, 2024). The “Tiered” water classification system (Tier 1 to 3) is part of the Antidegradation section of the Environmental Protection Agency’s CWA such as Tier 1 refers to waters that have been degraded beyond the minimum water quality standard and Tier 3 waters with exceptional quality. When a local waterway is designated as a Tier 3 Water, it means that the waterway is so exceptional, so central to the economy and lifestyle, and so culturally and spiritually significant that everything possible should be done to protect it for all those who depend on it, now and in the future. There are currently two Tier 3 waterways nominations (Teedriinjik River and Draanjik River) submitted by ANTs to the Alaska Department of Environmental Conservation (ADEC) in the YRB.

- ***National Wild and Scenic Rivers*** systems by the Alaska National Interest Lands Conservation Act in 1980 provided for twenty-five wild and scenic rivers designations. In order to be eligible for a Wild and Scenic River designation, a river must be free-flowing and possess one or more outstandingly remarkable values. Outstandingly remarkable values are river-dependent natural, cultural, or recreational resources that are unique, rare, or exemplary at a regional or national scale (National and Scenic Rivers Program, 2021). The National Wild and Scenic Rivers located in the YRB are:
    - Alatna River
    - Beaver Creek
    - Charley River
    - Fortymile River
    - Koyukuk River (North Fork)
    - Tinayguk River
    - Sheenjek River
    - Wind River
    - Andreafsky River
    - Birch Creek
    - Delta River
    - John River
    - Nowitna River
    - Sheenjek River
    - Unalaklett River

- ***Water Rights:*** Alaska constitution defines water as a public resource, but no one has automatic rights to use water (Constitution of the State of Alaska, Article VIII, Section 3; Alaska Statutes 46.15.030). There are two kinds of Water Rights approaches a) the Right to use water and b) the Right to reserve water. ***The Right to access water*** means taking it from a particular water source (i.e. streams, lakes, or groundwater). ***The Right to reserve water*** means keeping the water in place or protecting a specific flow of river/stream water (instream flow) or in lakes (lake water levels) (Lowe et.al. 2017). There are multiple categories available such as fish and wildlife habitat, parks and recreation, navigation, or water quality and sanitation.

- ***Water Governance*** is the set of formal, public institutions and regulations, informal networks and social norms, as well as private sector mechanisms such as markets that modify and regulate the way stakeholders interact with water and water-related ecosystems and derive and distribute benefits from them (Regan et al. 2016). Water Co-Governance is when two or more self-governance jurisdictions agree to share authority or jurisdiction to make an enforceable decision (Kotaska, 2013; Simms, 2014; Wilson, 2014b).

- ***Indigenous Water Governance*** refers to the unique systems, practices, and principles that Indigenous communities use to manage and steward water resources within their territories (Wilson, 2014; Wilson and Inkster, 2018. It is deeply rooted in Indigenous knowledge, traditions, cultural values, and spirituality, often reflecting a holistic worldview that recognizes the interconnectedness of humans and the natural environment (Tsatsaros et., al.2018). Indigenous water governance has been established around the world to protect water resources for example:
    - **Maori** tribes retain rights to manage and protect their water resources under the Treaty of Waitangi. The establishment of co-governance arrangements, such as the Waikato River Authority, enables collaboration between Maori and government agencies in managing water quality and allocation.
    - The **Okanagan Nation Alliance in British Columbia** manages water resources collaboratively with federal and provincial agencies to address water quality, fisheries management, and ecosystem restoration.
    - The **Indigenous Maya communities in Guatemala** have developed sophisticated water management systems, including stone terraces, reservoirs, and underground canals, to capture and store rainwater for agricultural purposes. These traditional water management techniques support food security and resilience against droughts in the region.

- **Rights of Nature** is a legal and philosophical concept that recognizes the inherent rights of ecosystems, natural communities, and non-human entities to exist, thrive, and evolve while it acknowledges that ecosystems, rivers, forest, mountains, and other natural entities have intrinsic value and inherent rights (GARN 2024; CEDF 2024; and IJC 2019). The Rights of Nature branches into many different possible paths such as granting rights to a particular species, like salmon, or granting rights to a river, stream, mountain, lake, or granting rights to all nature, all lands and all waters. The rights declared can also vary, as they can be broad or they can be a specific set of rights. Additionally, there are different ways to grant such rights, from constitutional amendments, codifying rights of nature into Tribal law, or even something like a town council or community declaration. The Rights of Nature movement is growing internationally, and it has been used to protect nature in countries all over the world. It's also gaining traction in the United States, and is often lead by Indigenous communities or groups for example:
    - In 2008, Ecuador was the first country to recognize "*Rights of Nature"* by its constitution to give broad rights to all nature (IJC 2019).
    - In 2010, Bolivia passed the *"Law of the Rights of Mother Earth"*. The Law of the Rights of Mother Earth gives aspects of legal personhood to the natural environment (IJC 2019).
    - In 2017, the Whanganui River was granted legal status as an ecosystem after the New Zealand parliament finalized the "*Te Awa Tupua Act*" (IJC 2019).
    - In 2018, the White Earth Band of Ojibwe people in Minnesota declared *"Rights of Manoomin"* (local wild rice species) in Tribal law (IJC 2019).

- In 2019, the Yurok Tribal Council approved the resolution to establish the legal “Rights of Personhood” for the Klamath River in Tribal law. The Kamath River, an important Salmon spawning river, now has legal rights to exist, flourish, and naturally evolve (Smith 2019).