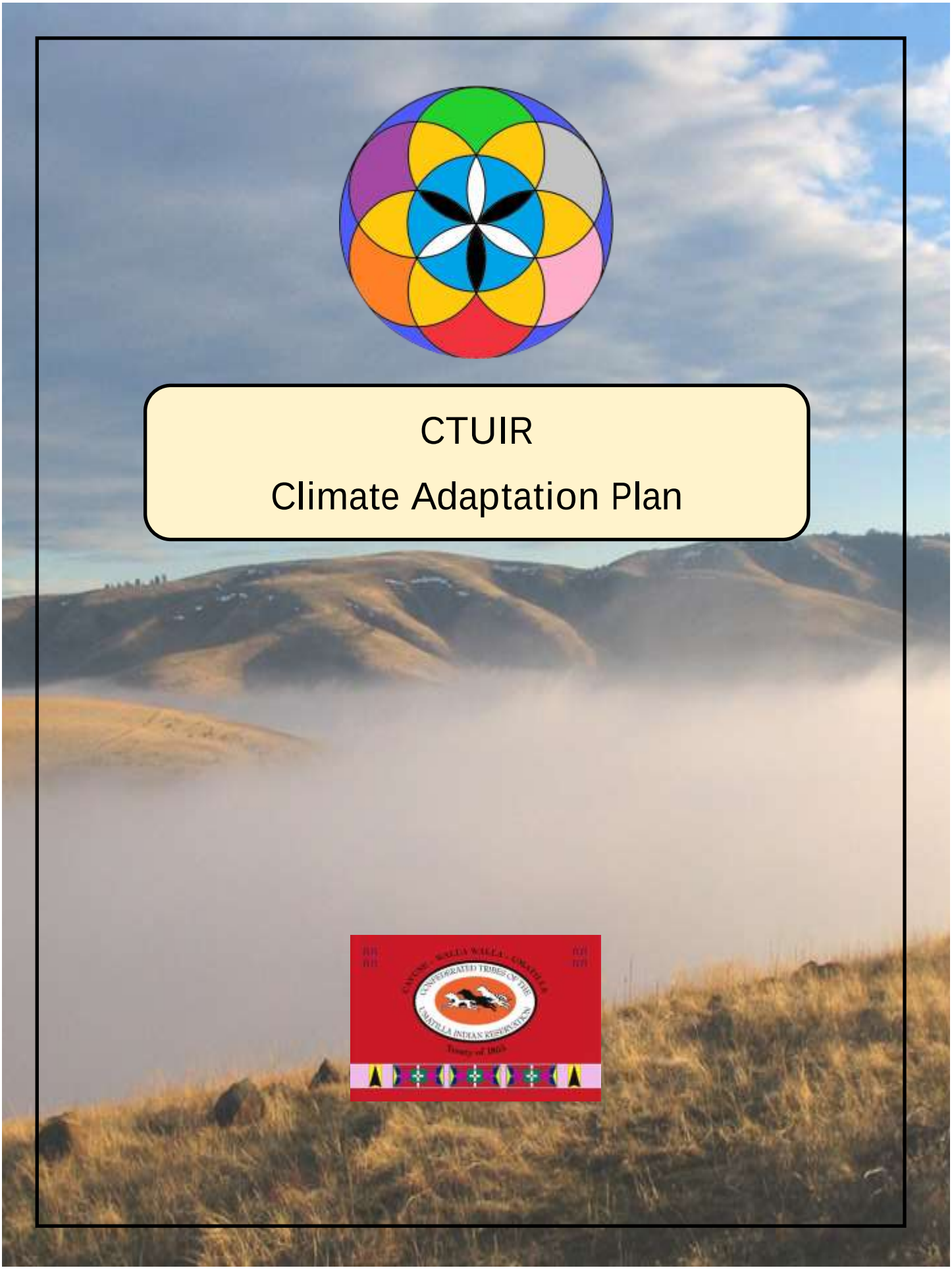

CTUIR

Climate Adaptation Plan

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Ṫúx̱ṫux̱it ku hulí ku x̱ʷáamičan án, awkú ṫłáawx̱maamɨnna átawišamataš. ~ (FH)

Ṫúx̱ṫuxʷit hulíʔin ku x̱ʷáamičan án, awkú ṫłáawx̱ imaamɨnay átawitma. ~ (TMO)

"In rain, and wind, and sun above, but most of all for those we love."

- Umatilla Traditional Prayer

Thank you so much to our presenters and panelists in the CTUIR Climate Adaptation Webinar Series!

Wenix Red Elk (CTUIR DNR CRPP), Althea Huesties-Wolf (CTUIR DNR FFPP and Health Commission); Kate Ely (CTUIR DNR WRP), John Barkley (CTUIR TWC); Scott O'Daniel (CTUIR OIT GIS); Mary Wister (NOAA/NWS); Gary James, Aaron Jackson, Jerimiah Bonifer, Donna Nez (CTUIR DNR Fisheries); Scott Peckham, Carl Scheeler, Lindsay Chiono (CTUIR DNR Wildlife); Ken Hall, Bud Herrera, Jeremy Wolf, Corrine Sams (CTUIR FWC); Cheryl Shippentower, Andrew Addessi (CTUIR DNR RAF), Jeff Casey (BIA Fire Management Ops); Bobby Fossek, Brosnan Spencer, Meadow Fossek-Spencer (Naknuwithlama Tiichamna); JD Tovey, Holly Anderson, Dani Schulte, Samantha Matlock, (CTUIR TPO), Frank Anderson (CTUIR Public Works Dept); Tanner Michael, Kimberly Hughes (CTUIR Housing Dept); Sydelle Harrison (OSU School of Public Health); Caleb Minthorn, Patrick Mills, Mason Murphy (CTUIR DNR EESP); Caryn Appler, Jeni Hall, Dave Moldal, and Donald Williams (Energy Trust of Oregon); Antone Minthorn (CTUIR ECDC); Leona Enright, Kaeleen McGuire, and Bruce Zimmerman, Ashley Picard (CTUIR DECD); Skya Ducheneaux (Akiptan CDFI); Dave Tovey (CTUIR NCFS); Julie Taylor and CTUIR Tribal Youth Council (CTUIR DCFS); Matthew Johnson (CTUIR Communications); Judge Abby Abinanti (NCTCC); Judge William Johnson (CTUIR Tribal Court); Katrina Miller, Fred Hill, (CTUIR Education); Naomi Stacy (CTUIR OLC); and Colleen Sanders (CTUIR DNR FFPP)

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With Generous Guidance

Thank you to everyone who spent time dreaming and planning for a brighter future—this is for those who follow in our footsteps, and for the First Foods who promised themselves, and whose promise we keep.

Iwá naamí miyanašmíyay ana kúma čáw áx̣ʷay pawá čná. -
It is for our children and those that aren't here yet.

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Edited by Colleen Sanders, Climate Adaptation Planner, First Foods Policy Program CTUIR DNR

THE CTUIR COMPREHENSIVE PLAN VISION

This vision was developed in support of the Tribal community vision was formulated through a series of community meetings and a visioning rally, Vision Quest 2020. Mission statement adopted by Board of Trustees Resolution No. 10-008 on February 1, 2010.

"THE CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVATION GOVERNMENT SERVES OUR COMMUNITY THROUGH RESPONSIBLE LEADERSHIP AND ACCOUNTABILITY. WE RESPECT OURSELVES, CITIZENS, NEIGHBORS, ENVIRONMENT, CULTURE, RELIGION AND A HEALTHY LIFESTYLE. WE WILL UPHOLD AND EXERCISE OUR SOVEREIGNTY AND TREATY. WE STRIVE TO, ONCE AGAIN, BE A SUSTAINABLE, EMPOWERED AND PROSPEROUS NATION."

CTUIR COMMUNITY VISION

Respect The Environment

Umatilla, Walla Walla, Cayuse community will protect and strengthen our natural environments of water, air, land. Each one of these resources is an essential link to the preservation of our Tribal natural & culturally sustainable practices as a healthy nation in survival from the past, to the present and into the future.

Respect For Our Tribal People

We support and protect the personal health and viability of all our members with a holistic, physical and spiritual approach. We will have respect and consideration of lifestyles, quality of life and community & cultural values including the unique needs and rights of our Tribal Elders and Youth

Connect With The CTUIR Tribal People

Fair and open communication, with focus on improved sharing & interpretation of information through all venues (computers, CUJ, radio and city newspaper) enhancing community connection for all members living on, around or off the CTUIR reservation

Be Sustainable With Community Focus on Growth and Prosperity

A sustainable community that focuses on the priorities and goals for jobs, economics and housing, with investment that can meet the needs of our people short and long-term, to create economic vitality to sustain our community labor force to develop and strengthen our Tribal tourism. Continue growth as the largest employer to be able to sustain and support our people. "Managing their own affairs" including a way to help our people help each other—e.g. creation of jobs, organizing volunteer pools, Tribal food bank and resources to enhance our elders health care and livability. A strong vision for our future business and cultural growth with the unique creation and thought for the young people to be trained, educated & self reliant in both business and Tribal leadership for continued Tribal sustainability into the future.

This Climate Adaptation Plan upholds the vision set forth in the CTUIR Comprehensive Plan visioning session, and projects this vision out into an uncertain future. This document is not intended to replace or substitute specific resource plans or other policy documents, but rather to provide guidance for community and decision makers to help ensure current and future natural, built, and social resource management activities are aligned with, and account for, the protection and enhancement of the CTUIR's First Foods into the future.

This vision document can be used to guide management plans and help inform policy, and future implementation strategies should be directed by departments and programs affected, and by the CTUIR community.

Revisions and updates to this document should be revisited every 5 years to provide for the most recent and relevant information, or more frequently as it is necessary, and as capacity allows.

How to Use This Plan

Visioning into an Uncertain Future

This Climate Adaptation Plan is a document that is intended to be used as a guide for CTUIR to achieve an orderly, harmonious, environmentally and economically stable community, with the knowledge that historical conditions are no longer a reliable predictor of future conditions.

This Plan will also attempt to build opportunities to safeguard CTUIR Tribal Treaty Rights, land preservation and unique needs to preserve cultural and Tribal traditions are also protected as defined by Tribal community members, even as seasonal conditions deviate from historic ones.

This document is also a partner plan to the CTUIR Comprehensive Plan, and should be used to inform forthcoming updates to that and other relevant plans, with climate impacts as a consideration for the development and implementation of planning benchmarks.

The monitoring process also includes periodic progress reports to and from the Tribal community to improve communication between the Tribal government operations, community and the governing body, the CTUIR Board of Trustees (BOT).

Downstream Projections of Modeling Efforts

Chapter 3 of this plan contains detailed analysis of projected climate impacts to CTUIR resources, as well as community-identified adaptation goals to mitigate for those impacts. These goals are directly connected to the progress benchmarks found in the CTUIR Comprehensive Plan Chapter 5: Plan Elements, and connects with the fundamental goals and objectives important to the CTUIR in achieving the organizational and community visions.

Projections and Proxy Estimates – Climate modeling and downscaled projections can provide a rough overview of atmospheric changes that are to be anticipated, including one which was conducted for CTUIR in the Climate Change Vulnerability Assessment (2015) (see Chapter 2), but does not provide for analysis of how these atmospheric impacts translate into effects on First Foods. This Plan provides estimates for how atmospheric changes will impact Tribal resources in specific detail, utilizing data and modeling from sources as relevant as possible. Prioritization of modeling placed 1) Umatilla Indian Reservation (UIR)/Blue Mountain/Columbia River estimates , 2) Pacific Northwest regional/state impacts, 3) national estimates, and 4) global projections as available when sourcing data for this Plan.

Due to gaps in data and modeling for many of these impacts, a number of these estimates are "proxy estimates," meaning that similar—but not exact—data may serve as a stand in for modeling climate impacts of certain resources. The best example of this is where agricultural or non-native species estimates are used to approximate specific impacts to First Foods where data and modeling for these native species does not currently exist. Filling in gaps First Foods-specific data collection and monitoring should be a priority for future updates to this Plan.

Community Identified Adaptations – Adaptation goals found in Chapter 3 have been identified by the CTUIR community through various channels, including direct communications, participation in outreach activities, guidance from CTUIR committees and commissions, and through Climate Adaptation Webinar Series (Nov 2020 – June 2021) engagement. A full inventory of the community engagement that informs this Plan is found in Appendix 2.

Celebrating CTUIR Sovereignty and Resilience

This Plan also represents an opportunity to strengthening Tribal sovereignty by further formalizing reciprocal systems of responsibility between CTUIR and First Foods, through identifying direct connections between Indigenous knowledge and climate resilience. Indigenous people are uniquely qualified to lead climate adaptation response; future and existing plans developed by the CTUIR and its Departments, as well as decisions made by the Tribal governing bodies, should be compliant and consistent with the goals and

objectives as identified within this Plan and as it connects to the CTUIR Comprehensive Plan Chapter 5.

Creating a Model to Guide the Way – Indigenous knowledge is beginning to be recognized as the guiding force behind climate adaptation efforts, but Indigenous knowledge cannot be applied without the participation of Indigenous people. This Plan represents a framework for understanding the integral role of Indigenous knowledge in climate adaptation, as it can be accessed and replicated by non-Indigenous agencies and organizations.

Climate Adaptation Plan Goals

We prepare to be efficient, and to create a cohesive response at a scale that is manageable, in the face of global change.

It is the goal of this
Climate Adaptation Plan to:

1. Center Indigenous knowledge and Environmental Justice in climate crisis planning.

Tribes and Indigenous people have an essential role in implementing climate adaptations because of reciprocal responsibilities to lands and First Foods carried forward for thousands of years. By expanding traditional management and Tribal sovereignty, Tribes are the people who are best to develop strategies based on deep cultural knowledge, as the original people of these lands.

2. Identify, develop, and support interdisciplinary strategies to mitigate impacts from: 1) short term variability and 2) long term climatic shifts.

The climate crisis will affect everyone and all sectors of modern life, and it is essential to have all voices participate in the planning and adaptation process. Collaborative strategies that address multiple impacts will be most efficient.

For many aspects of CTUIR Tribal governance, resilience is built into traditional ways of life and working with people and places. Departments and programs within CTUIR can work together to boost one another's projects to create adaptability and flexibility in governance and community operations, and together support the whole Tribal Nation's readiness for uncertainty.

3. Celebrate existing CTUIR adaptation strategies.

Indigenous people have always adapted to natural climatic changes since time immemorial. This Plan is not inventing anything new, but is a chance to identify and celebrate many of the strategies that will be necessary.

CTUIR is a leader in holistic resource management, and Tribal governance is rooted in Tamanwit, and a knowledge that we are all connected.

Indigenous Communities vs. Climate Change —Tribal Youth Reflection

By Ermia Butler, First Foods Policy Program Climate Youth Intern

Droughts that are more frequent and extreme, storms, heat waves, rising sea levels, melting glaciers, and warmer seas may directly injure animals, ruin their habitats, and disrupt people's lives and societies. Indigenous cultures, in particular, place a high value on first foods and natural resources.

Commonly harvested first foods are huckleberries, roots, salmon, elk, and deer, which are in demand. Many local people have to travel farther away to gather huckleberries, like going to Washington or Idaho. Salmon and steelhead are facing a challenging summer, as extreme temperatures and record-low snowfall have reduced most rivers' flows to a quarter of their normal levels.

Wildfires pose a threat to tribal lands where tribal people hunt and gather. Fire burns hot enough to sear the tribes' roots and berries and interrupt the migration patterns of elk, deer, and other large animals. Reservations have been targeted as sites for industrial waste disposal and uranium and coal mining, resulting in contaminated rivers, lakes, and tribal grounds throughout the nation. Some tribes have resorted to trash storage or mining to generate cash.

We used less nonrenewable energy sources to solve disputes that have prompted anxiety about what the future could bring. However, we are still striving to find solutions.

As our environment continues to change rapidly, environmentalists are attempting to find solutions by looking at information from the past and attempting to anticipate the future. However, the issue is that there needs to be more data about the future or the past because this hasn't happened previously.

However, a theory is a learning theory. The information from the past to see where everything began can help determine environmental patterns. With more young adults wanting to make a difference, more individuals are attending school to acquire education on such issues in indigenous communities to preserve the culture and beliefs based on natural resources and the connection to first foods.

Photo on opposite page: Ermia Butler (left) and First Foods Policy Program (FFPP) AmeriCorps RARE intern Eleanor Williams (right) at the McKay Creek fish salvage (2020).

Photos from top left clockwise:

Manager of the CTUIR Tribal Native Nursery, Gail Redberg (left) gives Ermia a tour of one of the greenhouses of native plants (2020).

DNR Water Resources (WRP) Hydrologist Kate Ely holds water sample container for Ermia on the Umatilla South Fork (2022).

DNR FFPP Climate Planner Colleen Sanders holds a sampling container for Ermia to fill with water sample (2022).

Fisheries Tech Andrew Wildbill (left) helps Ermia while Jerimiah Bonifer (center) shows RARE intern Eleanor Williams to use the backpack electro-shocker during a McKay Creek fish salvage (2020).

Chapter 1

Na k̓ʷałanáwštaymaša

Celebrating CTUIR

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1.7 CTUIR DNR First Foods Mission
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1.8 CTUIR Climate Engagement
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1.9 Summary of Adaptation Recommendations

Pamawanica Tkwatatma Cna Tiichampa

The Foods Named Themselves in this Land

Iwíšayča čná tanán, ku kúuk pamáwaniča tkʷátatma: “Áwnaš ín wáta wiyáwaṫwita.” Ku itútiya latítlatit, “Ínaš wáta wáṫi.” Ku itútiya x̣áwš, “Ínaš átwanata naamína pátna.” Ku itútiya pyax̣í, ku kʷná itútiya tmíš, ku pátwanana tmíšna wíwnuwin.

Ku kúušx̣i itútiya núsux, “Ínaš wiyáwaṫwita, kuš patwánata inmíma isx̣ípma.” Ku itútiya kʷná yáamaš, ku kʷaaná pátwanana wawúkyayin.

Kúuš pamáwaniča tkʷátatma, ku ƛ̓áax̣ʷ ana tún ittáwax̣inx̣a x̣nít, ku ana tún iwá tkʷátat naamí. Kúma k̓ʷáy pamáwaniča mítaat. Mítaat pamáwaniča tkʷátat, ana pmáy pawá, ana kʷaaná pawalptáykinx̣a, “Mítaat tkʷátat iwiyánikniksa.” K̓ʷáy iwá núsux ku nikʷít ku x̣nít k̓ʷáy ana kúma úyit patútiya.

Áwtaš wáta náma naknuwiłá, ana pmáy pawáta čná tanán waníči, kutaš wáta tkʷátat paamíin, ku kúuš aw kú pawíšayčinx̣a ana kú iwawax̣míwix̣a ku pattáwax̣inx̣a pát twánani ana tún áwtni tkʷátat. Čáwnam ł̓q̓íwita tkʷátatna!

Ana kúuš patútiya, pmáy pamáwaniča čná tiičámpa. K̓ʷáyš kʷíł ínčˀa šúkʷaša, ana kú pasínwix̣ana nčˀínčˀima, “Áwtni iwá tkʷátat ƛ̓áax̣ʷ, ana pín ittáwax̣ša čná tiičámpa, ana tún iwá tkʷátat.

K̓ʷáy iwá áwtni. Čáwnam áqałq̓iwita kʷaaná.

Kúuš pasínwix̣ana nčˀínčˀima. ƛ̓áax̣ʷna áwawtta tkʷátatna, ana mún iwíšayčta úyit, kuna kʷaaná ák̓ʷałata ásapalwitana. Kúuš pasínwix̣ana nčˀínčˀima, kuš áykinx̣ana. Kúuš pasínwiša, ku ana pmáy patáwinpataxa tkʷátatna, kupam níix̣ki timnáki kupam áwinpatata.

Kúuš paˀínx̣ana tkʷaynpłáma: Níix̣kipam timnáki tkʷáynpta!

Kúušx̣i x̣niłáma: Níix̣kipam timnáki áwštaymata naamína pátna, ana k̓ʷapín pináwaniča čná tiičámpa.

Kʷíłnaš áw k̓ʷáy ínčˀa šúkʷaša.

The people came to be here, and then the foods named themselves: “Now I shall take the lead.” And the celery stood up, “I shall be first.” And the cous stood up, “I shall follow our older sister.” And the bitterroot stood up, and there the chokecherry stood up, and the chokecherry was followed by the huckleberry.

And in the same way the salmon stood up, “I shall take the lead, and my younger brothers will follow me.” And the deer stood up there, and the elk followed that one.

Thusly the foods nominated themselves, and all whatever roots grew, and all whatever are our foods. Those three nominated themselves that. Those three nominated themselves, they who are, that which they sing, “Three foods are going around.” That is the salmon and the meat and the roots that stood up first.

Now we shall be the keepers, they who will be the designated people here, and we will be their food, and thusly then they become when it turns to spring and the elder sister grows followed [by] whichever tabooed food. You should not play with the foods!

As they stood up, they named themselves in this land. That much I too know, when the elders used to speak, “All the food is tabooed, she who is growing in this land, anything that is the food.”

That is tabooed. You should not play with that.

Thusly the elders used to say. We all will taboo the food, whenever it will become first, and for that we are glad, we will feast. Thusly the elders used to say, and we used to hear them. Thusly they are saying, and they who go get the food, and with a good heart then you will go get it.

Thusly the hunters used to say: With a good heart you shall go hunting!

In the same way the root diggers: With a good heart you shall meet our older sister, she who nominated herself in this land.

That much now I also know.

Excerpt from the Umatilla Language Dictionary, CTUIR Language Program and Dr. Noel Rude (2016)

Chapter 1 : Na k̓ʷałanáwštaymaša ~ Celebrating CTUIR

Text in this chapter is largely excerpted from existing CTUIR publications; these publications are cited, and readers are invited to explore these cited documents for more information.

1.1 CTUIR Geography

It is from these first peoples that we, the modern-day cultures of the southern Columbia Plateau, race our emergence. Today, we are variously known as Imatalamłáma (Umatilla), Nuumiipuu (Nez Perce), Peluutspuu (Palouse), Walúulapam (Walla Walla), Wanapam (River People), Weyíitletpuu (Cayuse), or simply ‘Ichishkiin (Columbia River Sahaptin) speaking peoples. We are culturally, historically, and linguistically diverse. Our ancestral lands are distributed across the interior regions of the southern Columbia Plateau, extending along the middle Columbia and Snake Rivers and their tributaries in what is now Oregon, Washington, and Idaho.[1]

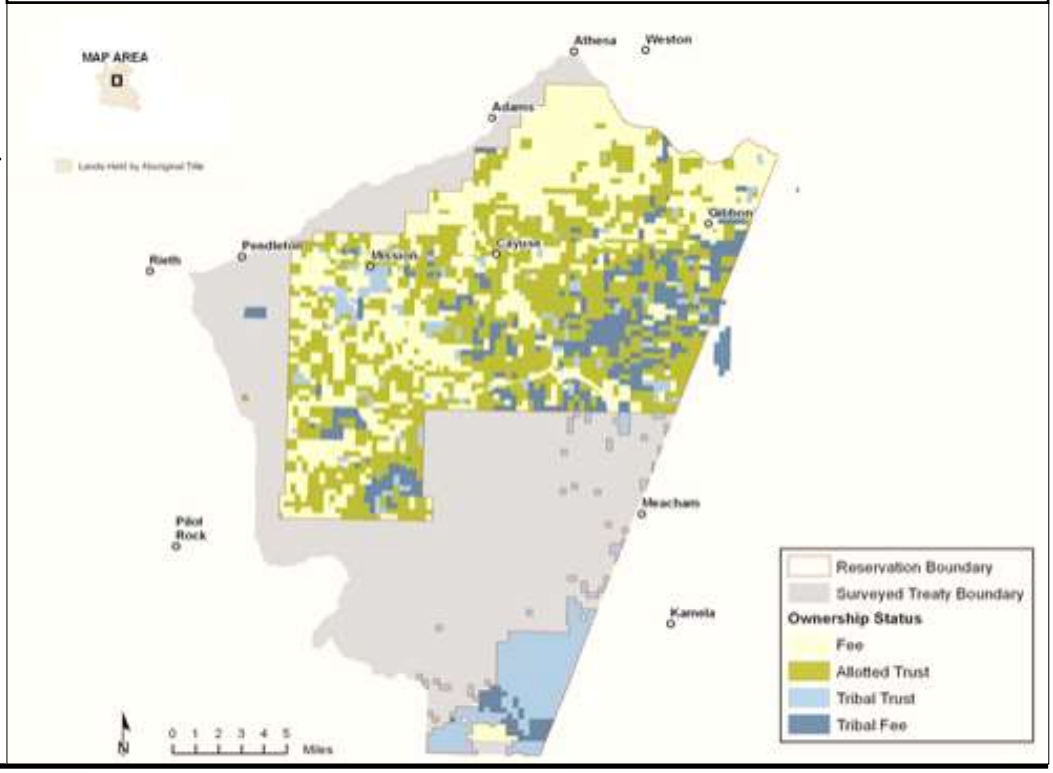
The expansive Columbia River Plateau extends from the eastern slope of the Cascade Range to the western slope of the Rocky Mountains, and from the northern reach of the Columbia River to the Blue Mountains and Salmon River. The homeland of the people now known as Cayuse, Umatilla, and Walla Walla included islands in and areas on both sides of the mid-Columbia River; both sides of the lower Snake River; Horse Heaven Hills; the John Day, Malheur, Powder, Burnt, Umatilla, Walla Walla, Touchet, Tucannon, and Grande Ronde Rivers; and Willow, Birch, Butter, McKay, Johnson, and Mill Creeks, among many others. This land base provided for numerous and prosperous well-populated villages that depended on river as well as mountain and forest yields. Winter villages ranged in size from 50 persons to 700. Population estimates of Cayuse, Umatilla, and Walla Walla prior to contact ranged from 1,100 to 8,000, depending on the geographical area included.[1]

The geographic reach of our sovereignty includes the area within the borders of the Reservation which the Tribes reserved in the Treaty of 1855.

The Reservation is located on the northwest side of the Blue Mountains in Eastern Oregon and includes the Umatilla River, Isqúulktpe Creek, Meacham Creek, Wildhorse Creek, McKay Creek, Johnson Creek and other tributaries. Water is the giver of life, food and the spirit. The Reservation is also an area of sacred foods, salmon, deer, roots, berries, elk, and other plants, fish and game. [2]

Figure 1.1 shows the map of the Umatilla Indian Reservation (UIR) in both its current diminished ‘checkerboard’ and original (prior to theft by survey and legislation) expanse; landowner status also shown.

Figure 1.1 Umatilla Indian Reservation (UIR) Original and Diminished Boundaries



1.2 CTUIR Sovereignty and Jurisdiction

The Walla Walla and Umatilla are river peoples, among many who shared the Big River. Both Tribes were part of the larger culture of Shahaptian speaking river people of southeastern Washington, northeastern Oregon, and western Idaho. The Cayuse lived along the tributary river valleys of the Blue Mountains. Their original language was known as Waiilatpuan. The area from Wallula to the mouth of the Yakima River, where many members of the Tribes lived, could be considered the cross roads of the Columbia River system. This area was shared by many related bands and was a central hub of Tribal life on the Columbia Plateau. The geographic setting placed the Umatilla, Walla Walla, and Cayuse in prime situation of being the middlemen of trade. Tribal Members relied on traded goods from the plains, such as buffalo meat and hides, obsidian from the south, as well as abundant seafood, plants, and medicines from the Pacific Northwest coast. Trade and barter were significant aspects of Indian life on the Plateau and essential for the survival of Indian people. Indians relied on other Indians to provide goods they themselves were not able to obtain, were not available during their seasonal round, or not available in their country. Often groups from a single village community would travel different directions as part of their seasonal round.[4]

There were specific spiritual and practical preparations that had to be adhered, and which ensured prosperity and subsistence. It required a diverse cultural system, with rules and a specialized division of labor to ensure survival. Without strict adherence to many of those cultural traditions, survival would not have been possible. A long time ago the Indian people promised to protect the land and had the responsibility to care for her. In return, the land provided the tools and resources to support Tribal life since time immemorial.[4]

Figure 1.2 shows a map of CTUIR's Ceded lands, over which the Tribe still exercises considerable direct jurisdiction within Northeast Oregon and South East Washington. These lands encompass much of the Blue Mountains, parts of the Hanford Nuclear Reservation, and the Columbia and Snake Rivers.

Figure 1.2: CTUIR's Ceded Lands in Oregon and Washington

Euro-American settlement in the 1800s, culminating in the CTUIR's Treaty of June 9, 1855 (creating the Umatilla Indian Reservation; henceforth referred to as the Treaty of 1855), introduced an alternative paradigm of land ownership and resource use into the Umatilla Basin. In the Treaty of 1855, the United States government acquired 6.4 million acres

of Tribal lands, which were divided into parcels and distributed as property to mostly Euro-American settlers. Unlike the Tribal system of common use of the land, the new proprietary system of land ownership created landowner rights to privately own, control, and exclusively determine use of property. Associated with this private ownership is an emphasis on resource extraction for the exclusive benefit of the owner, rather than the sustainable utilization of natural resources by and for the benefit of community members.[2]

Tribal Knowledge keepers, youth, and community participate in a tamayct (earth oven) at the Tamastslikt Cultural Institute as part of cultural and First Foods learning.

Land management is complicated by non-Tribal interests that infringe onto the Reservation and across the traditional use area. The Railroad came through the Reservation without meeting any of the Tribes concerns. They already had their plans and railroad designs and were paid in subsidy from the United States to construct their projects. The Tribes had asked the railroad company to tie its new rail line into the grade that went up Wildhorse Creek instead of coming out of Meacham Creek and heading down the Umatilla River. The Tribes were concerned about child safety, livestock, land, water, and root fields. The railroad was the biggest business of the time, and was only concerned with its own progress. The Umatilla River and Meacham Creek were irreparably damaged by the railroad construction efforts.[2] CTUIR has an ongoing and working relationship with Union Pacific Railroad, whose infrastructure bisects the reservation and covers the Tribe's traditional use lands.

The Tribes will always exercise our national sovereignty and preserve our traditional cultural ways in harmonious existence with our homeland. We will always provide for the well-being of our people in the future. We will live in balance with the land and use our natural resources only when traditional and cultural teachings dictate use. We will respect all persons; acknowledge the wisdom of our elders and religious leaders; sustain the hopes of our people; and accept responsibility for our actions realizing that we are accountable to the Creator. The Creator's spirit lives in our homeland and our national sovereignty protects the spirit with the land, waters, people, culture, religion and language.[2]

The general characteristic of the UIR for land use could be described as rural. Most of the lands on the UIR are used for agriculture on lower elevation lands with forestry and grazing in the upland, mountainous area. The most urban and developed area is located near the Reservation's western boundary, bordering the city of Pendleton. This area is identified as the Mission Community Planning Area, the most urban area of the Reservation. This Mission Community Area contains residential, commercial and light industrial development. The Mission Community Area contains most of the Reservation's housing, schools, and Tribal and Bureau of Indian Affairs (BIA) administrative office buildings. This area also contains the Yellowhawk Tribal Health Clinic, CTUIR Government complex, and CTUIR Fire and Emergency Services, considered to be critical facilities. A number of public facilities can be found in Mission such as community wells that serve the CTUIR's public water system, two steel water reservoirs located on hills above the community, and an electrical substation. The Mission Market and grain silos are also located in this area. Portions of the Mission Community area were developed prior to flood studies and portions of the developed area are located within the 500-year floodplain. The CTUIR operates and maintains a community sewer system within the Mission Community Planning Area which is connected with the system that serves and is operated by the City of Pendleton. [6]

1.3 CTUIR Economy, Traditional Use Area, and Treaty Rights

Economy

A strong economy provides freedom for the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and its members to focus efforts on maintaining a strong Tribal identity and empowering members to achieve economic self-sufficiency. [7] Four decades ago (in the 1970's) the CTUIR's economic goals centered on building a strong Native agricultural enterprise. The fact that the CTUIR farms some 12,000 acres of land today is a testament to the efficacy of those early planning efforts. But today's CTUIR economy also includes a highly successful casino resort, a technology company with national and international clientele, large industrial properties both on and off the reservation, and a variety of other economic interests spread across the greater Columbia Plateau region.[7]

CTUIR has established commercial and industrial shovel-ready development sites that have been partially developed (Coyote Industrial Park South and Coyote Business Park North and East). This new development is located in the vicinity of the Interstate 84 and State Highway 331 interchange near the Wildhorse Casino and Resort and the Arrowhead Travel Plaza within the Mission Community Plan area.[7]

CTUIR Economic and Community Development staff take a photo at the Wanapa Industrial Site Inauguration.

The Wanaket and Wanapa Tribal trust properties are located along the Columbia River in northwestern Umatilla County. Wanaket is a dedicated wildlife management area of approximately 2,768 acres. This property is undeveloped, containing many wetland areas and several ponds, with the exception of a 165-foot Bonneville Power Association transmission line easement, which crosses Wanaket in an east-west direction parallel to and south of Oregon State Highway 730. The Wanapa property is north of the Wanaket Wildlife Area and contains approximately 195 acres. Although currently undeveloped, the Wanapa property land use designation is industrial and will most likely be developed in the near future.[6]

The Nixyáawii Governance Center and Public Safety buildings were completed in 2009 and 2007, respectively, north of the commercial and industrial areas.[6] By 2011, the CTUIR completed expansion of the Wildhorse Resort and Casino (WRC), the Resort Hotel (added 10-story with 200-rooms) Cineplex and Arrowhead Travel Plaza. New development in the Coyote Business Park North included the US Forest Service building and a three-business retail center added to the existing Cayuse Technologies and Davita Dialysis Center. [6]

The Wildhorse Resort and Casino complex is the largest employer within the UIR and the second largest employer in Umatilla County. Obviously, it is very important to the UIR economy and has helped in improving the median household income of those living on the reservation. In total, there are more than 1600 people employed by the CTUIR and its enterprises. [6]

The CTUIR and its enterprises are major employers in the area. The CTUIR operates a fixed bus route regional public transit system (Kayak Public Transit) throughout the northeastern Oregon and southeast Washington region, and a subsidized taxi voucher program. Although a high percentage of workers drive alone to work, ridership has continued to increase each year as gasoline prices rise and population in the region increases. [6]

Economy plays a vital role in community sustainability. The CTUIR governmental structure is unique in its relationship to the Tribal community. Municipal and county governments rely on public taxation and grant programs to sustain their functions. The CTUIR government is sustained by grant programs and profits from Tribal enterprises which are also funneled back into the community in the form of dividends and social services.[2]

Traditional Use Area and Treaty Rights

The CTUIR also retains certain reserved Treaty Rights regarding hunting, fishing and gathering within a large area of aboriginal title lands surrounding the UIR. The CTUIR does not have land use jurisdiction on those aboriginal title lands that it does not own but does coordinate with surrounding jurisdictions regarding impacts to these reserved Treaty Rights. This coordination also includes natural hazards.[6] Traditional Tribal economic activities involved moving from one geographical area to another with the seasons to obtain and barter food, clothing, shelter and other necessities. In the traditional economy, clean water and natural landscapes are the foundation of wealth.[2]

Non-Tribal land management across the ceded lands and traditional use area complicate and restrict access to First Foods harvest opportunities. A significant reduction in the amount of land area where Tribal Members can exercise Treaty Rights, and — in many areas still accessible — ecological conditions are outside their historic range of variability. At some sites, degradation has resulted in the local loss of First Food resources. Although the CTUIR manages First Food resources inside of the reservation boundaries, the reservation is not large enough, and does not contain the variety of ecosystems required to provide all First Food resources. Outside of the reservation boundaries, but within their Ceded lands, the CTUIR DNR is not the primary land manager and there are limited mechanisms by which the CTUIR is able to inform the decision-making process regarding land management issues that affect First Foods, a central component of the CTUIR culture and wellbeing.[8]

Figure 1.3 provides a density use map of where CTUIR has historically traveled, participated in landscape management, and has documented Treaty Rights across the U.S. intermountain West. Tribal Members actively exercising their Treaty Rights throughout this traditional use area strengthens CTUIR claims to harvest rights in these areas, and perpetuates these rights into an uncertain future.

Figure 1.3: Documented CTUIR Management and Treaty Harvest Presence "From Bison to Sea Lions" across the Pacific Northwest

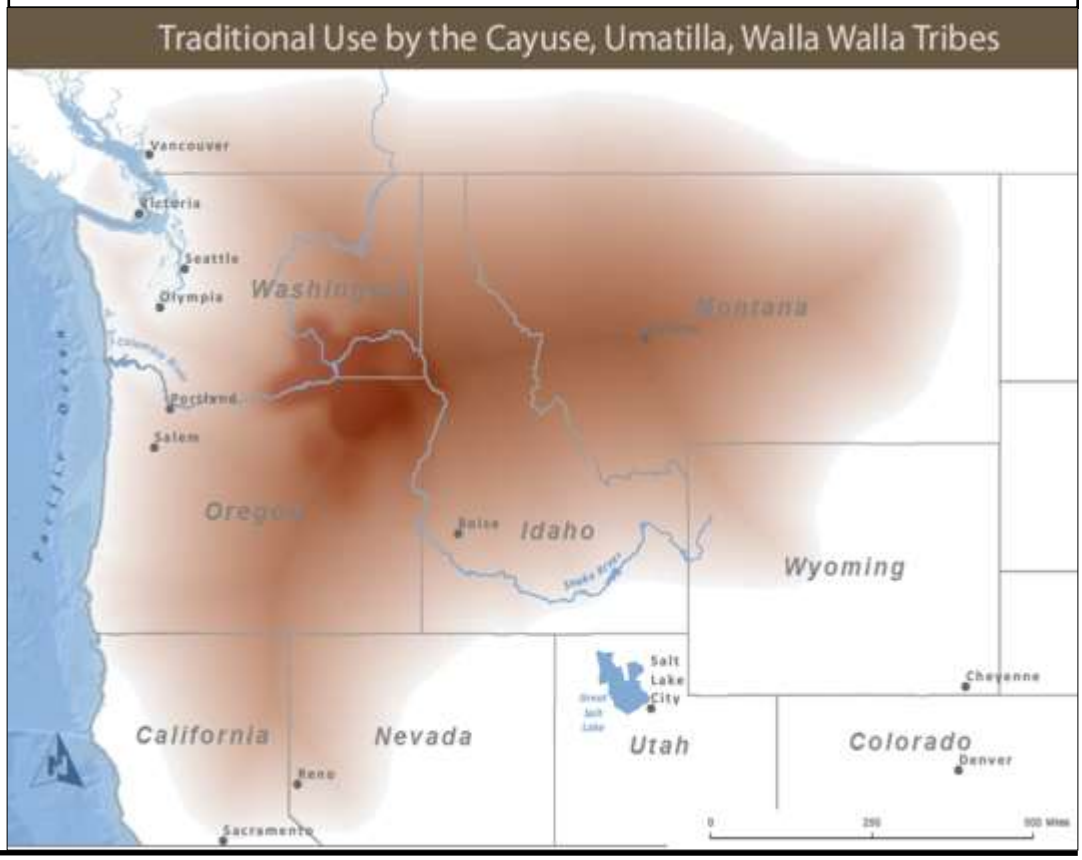


Figure 1.4: CTUIR Organizational Chart (2022)

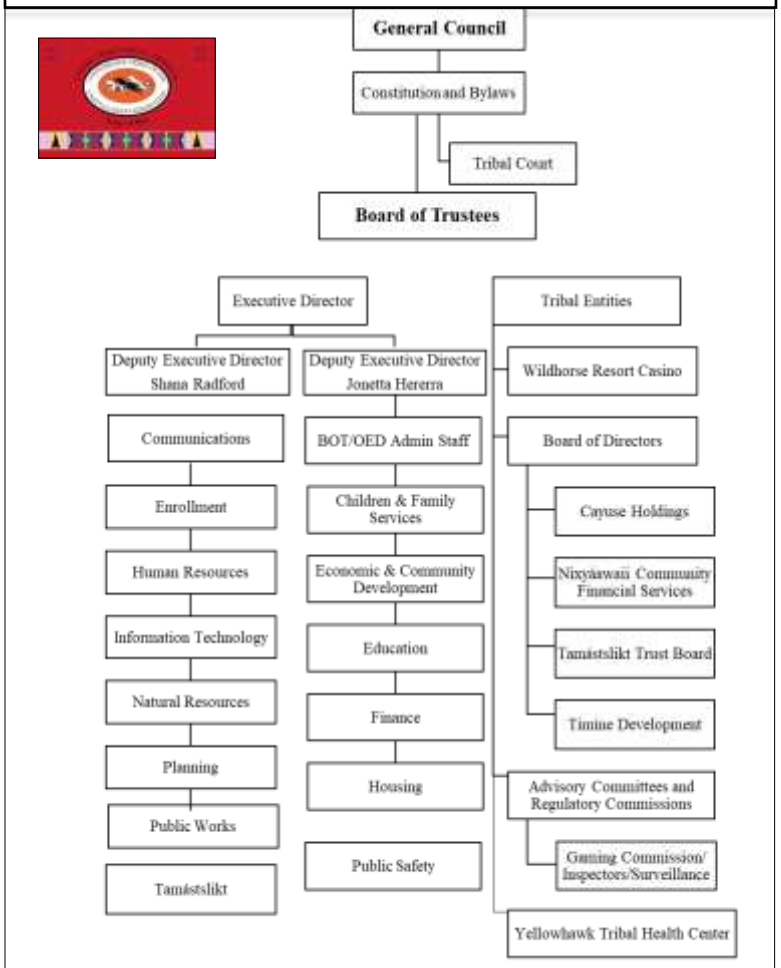
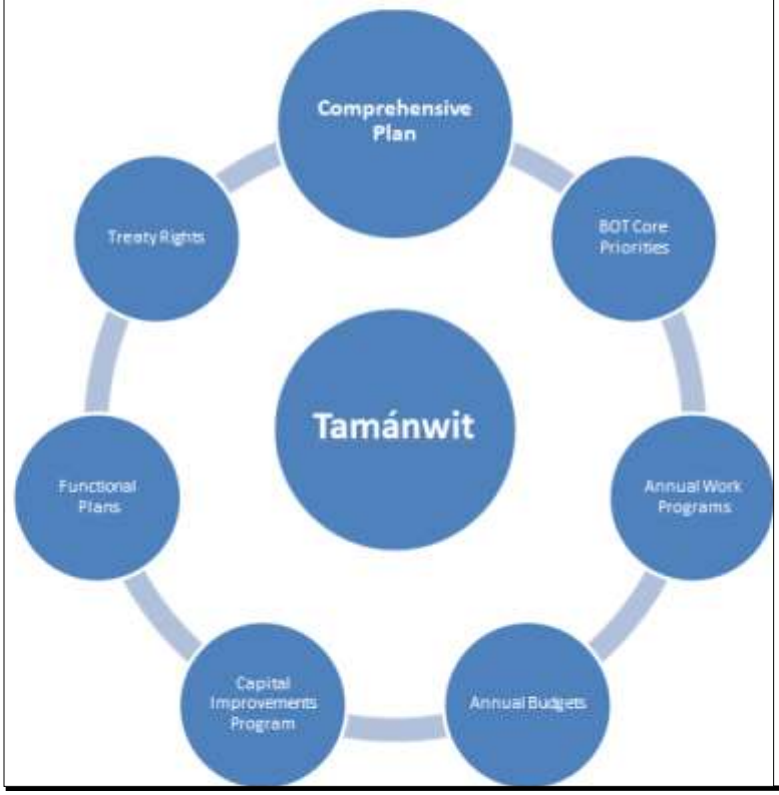


Figure 1.5: CTUIR Government Integration Chart (2010)



1.4 CTUIR Governance Structure

CTUIR's Comprehensive Plan provides detailed information on the structure, function, departments and services of the Tribal government, as well as major historical events and governmental accomplishments. **Figure 1.4** provides an organizational chart for the CTUIR Tribal Government; this chart was updated in 2022 to incorporate two additional Deputy Director positions.

Our Board of Trustees (BOT) and General Council (GC) are the focus of power under our Constitution and By-Laws. The Constitution and By-Laws mention neither a judicial branch nor an executive department. The BOT/GC has the exclusive authority to maintain executive, regulatory, judiciary, fire control, and police powers in our system of government. Those within the penumbra of these powers – including the Tribal attorney, the BIA superintendent, the Indian Health Service director, and the executive director – have in the past implicitly exercised the powers of government and greatly influenced the way the Tribes choose to go with their policies and laws.[1]

CTUIR has a number of commissions and committees that act in an advisory capacity to the Board of Trustees to assist in conducting governmental affairs. These Commission and Committee members are enrolled CTUIR Tribal members appointed by the Board of Trustees and are governed by adopted Bylaws or the CTUIR Advisory Committee Code. The Law and Order Committee, advisory to the Public Safety Department and Board of Trustees, provided the formal review and recommendations to the Board.[6]

Figure 1.5 provides an illustration (originally found in the CTUIR Comprehensive Plan, page 15) of CTUIR planning and implementation of priorities (2010).

Please see the CTUIR Comprehensive Plan for more information:

- CTUIR Comprehensive Plan 1.1 Summary of Accomplishments (pages 9-12)
- CTUIR Comprehensive Plan 1.2 Integration with Other Tribal Plans (pages 14-15)

1.5 Columbia River Regional Habitat Types, Plants, and Animals

The Ceded land of the CTUIR are a vast, heterogeneous landscape spanning a wide range of temperature, precipitation and soil gradients. This results in a diverse array of upland ecosystems, ranging from low elevation sagebrush-steppe to subalpine forest and grasslands. First Foods and other culturally important resources are found throughout this complex landscape, and their abundance and distribution is determined by the individual species' ecology and life history strategy, as well as current and historic land use patterns, management and distribution regimes. In the most general terms, the First Food serving order follows an elevation gradient, from lower elevation river, wetland and riparian systems (Water, Salmon), to higher elevation grasslands (Roots) and forest (Berries), highlighting the importance of the entire landscape to support and produce the full array of First Foods.[8]

This climate supports shrub-steppe plant communities in the undisturbed areas. The topography of the UIR is gently rolling hills and valleys with elevations ranging from 1120 feet above sea level at the western boundary, to 4000 at the eastern boundary in the Blue Mountains. Precipitation in the geographical area is seasonal. Approximately 10% of the annual precipitation comes in the months of July–September. Most precipitation comes from intense Pacific storms occurring from October through April.[6]

Low Elevation Shrub-Steppe

Shrub-steppe covers a large portion of the CTUIR Ceded lands across the Columbia Plateau, Blue Mountains, and Snake River Plains ecoregions. Climatically, shrub-steppe occupies arid to semi-arid areas, with hot, dry summers, and cold winters. Shrub-steppe communities span a large elevation range and vary from shrub-dominated (e.g. sagebrush species, rabbitbrush) to bunchbrass-dominated (e.g. Idaho fescue, bluebunch wheatgrass, Sandberg's bluegrass), with a diverse native forb component (e.g. biscuitroot, bitterroot, mule's ears).[8] Shrub-steppe is the most important vegetation zone for the production of Roots across the landscape. Cous (*L. cous*), bitterroot (*L.rediviva*), wild onions (Allium spp.), wild hyacinth (*T. grandiflora*), camas (*C. quamash*), celery (*Lomatium* spp.) and many other First Foods are found throughout this zone.[8]

Cultural landmarks along the Columbia River illustrate the shrub-steppe ecosystems of CTUIR's low elevation lands.

Mid-Elevation Forests

At higher elevations dominated by ponderosa pine and mixed-conifer forests, large scale fire-suppression of both wildfires and Native American burning regimes across the landscape resulted in large changes in ecosystem structure, composition, and health.[8] Dry conifer forest ecosystems are dominated by ponderosa pine and associated conifer species, and generally occupy low to mid-elevations that are moisture limited with frequent fire events. Dry forest landscapes often include and are inter-mixed with grasslands (e.g. meadows, scab-flats, Pacific Northwest bunchgrasses).[8] Berries are not as abundant in dry conifer forests as in higher elevation moist conifer forests, but a number of species are common in dry conifer understories. Commonly encountered species include serviceberry (*Amalanchier alnifolia*), black hawthorn (*Crataegus douglasii*), chokeberry (*Prunus virginiana*), and currants (*Ribes* spp.). Huckleberry (*Vaccinium membranaceum*), while

largely associated with higher elevation moist conifer forests, can also be found in some dry forests, generally in low abundances with limited fruit production. In general, abundances of these species are lower in ponderosa-pine dominated stands that are associated with drier sites, while abundances increases in Douglas-fir, grand-fir, and dry mixed conifer stands on sites with greater water availability (e.g. areas with deeper soils, greater precipitation, and/or more northernly aspects).[8]

Mid- and high-elevation conifer forests support upland First Foods like Deer and Elk, as well as their forest and grassland habitats.

High Elevation Forests

Moist forests occupy higher elevation areas within CTUIR Ceded lands. These forests are associated with cooler temperatures and greater precipitation than other upland ecosystems in the region. Moist forests are generally bound by dry forests at lower elevation and, if elevations are sufficiently high, subalpine grasslands above. These forests are dominated by grand fir, Douglas-fir, and subalpine fir, but also include lodgepole pine, western larch, ponderosa pine, and other species. [8] Fire, in particular, was a key tool in natural resource stewardship utilized by the Tribes of the CTUIR and across western North America; the exclusion of Native peoples and their extensive knowledge on the use of fire in natural resource stewardship of western landscapes, and the strong push to suppress fire across the landscape resulted in major changes to the structure, composition, and function of many ecosystems. [8]

Moist conifer forests are some of the most productive and important areas for berry harvest. Many berries, most notably, big huckleberry (V. *membranaceum*), grouse huckleberry (*V. scoparium*), and serviceberry (*A. alnifolia*) can occur in high abundances. In particular, huckleberry dominates the understory of several moist conifer forest types and is one of the most abundant understory shrubs throughout all grand fir and subalpine fir plant associations in the Blue and Wallowa Mountains.[8]

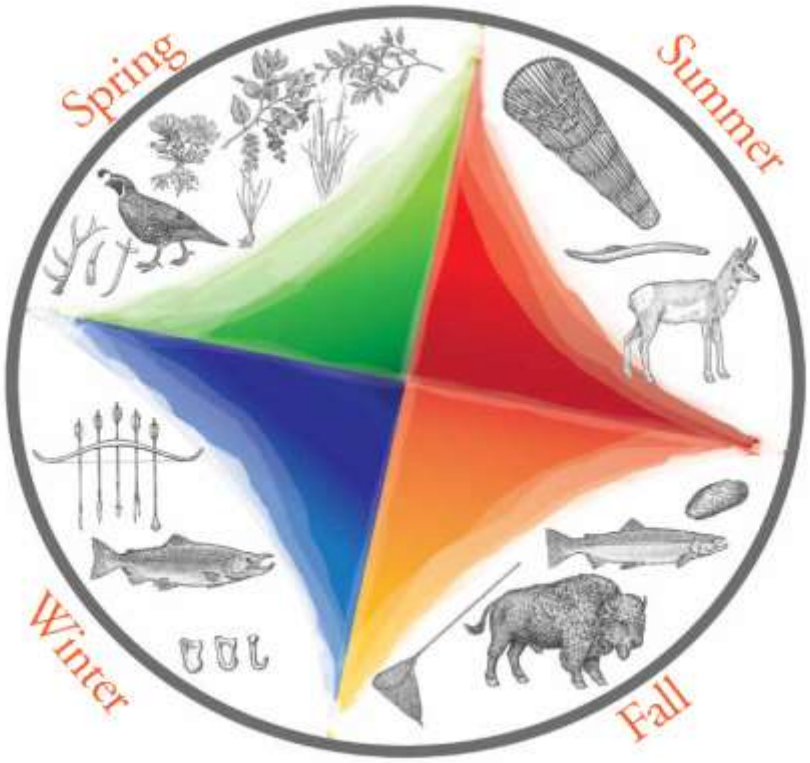
Not only is big huckleberry a key First Food for the CTUIR, fruit are an important part of the diet of many wildlife species.[8] Livestock grazing is common in many moist conifer forests and high densities of livestock and wild ungulates may reduce forage availability and… may increase pressure on riparian ecosystems, whose health and functioning are important to other First Foods (Water, Salmon). Other considerations to management of Big Game includes the importance of appropriate security cover (e.g. thickets, coarse woody debris), and connectivity to promote movement across the landscape.[8] Increased stand density and overstory canopy reduces understory vegetation, forage quantity and quality, and fire suppression
hinders the abundance of fire-dependent First Foods, such as huckleberry, which responds positively to fire disturbances. Factors that affect biotic integrity of shrub-steppe and dry conifer forests, such as non-native plant invasions, are currently not as relevant to moist conifer forests.[8]

1.6 First Foods of the Columbia Plateau Tribes

For thousands of years the Columbia River provided the Tribes with abundant and diverse natural resources. Salmon, lamprey, steelhead, sturgeon, and river mussels seemed infinite. They were the staple of all life on the Columbia Plateau. Eagles, bears, coyotes, and Indians were amongst those who relied on the salmon, elk, deer and antelope that were abundant. The rivers and streams abounded with beaver and otters. Seals and sea lions were known to venture up the Columbia River to the great fisheries at Celilo. Grouse, quail, multitudes of geese and ducks, hawks, owls, badgers, rabbits, and other wildlife shared the diverse wetland, steppe, desert, and upland areas. Roots, nuts, berries, mushrooms, medicine, and fiber plants were available and changed with the season. The hillsides were covered with lush bunch grasses. The timbered mountains were healthy. The river vegetation was lush. The water was cool and clean. The entry of spring on the Columbia Plateau with the arrival of fresh plants and the dramatic return of the Salmon were affirmed annually, year after year. First Food feasts gathered the Tribes to celebrate this renewal of life cycles together with their community.[4]

First Foods are critical to cultural perpetuation. Without First Foods and access to them, many of the "food-associated" cultural activities – preparation for First Foods harvest, food harvest, preservation, sharing, consuming, celebrating, and the teaching and learning that occur between and among generations – would not be possible. There are direct links between the First Foods and rights protected in the CTUIR's Treaty of 1855, and subsequent legal decisions, including the right to fish, right to hunt, right to gather, and water rights for in-stream flows and other Tribal community consumptive uses. The First Foods is a Tribal way of relating to the natural world. Because First Foods relate to Tribal creation belief, wherein the First Foods promised to take care of the Indian people, and Indian people have a reciprocal responsibility to take care of First Foods. Religion, culture, and natural resources are therefore inherently linked. We don't expect others to share the Tribes' creation belief, but we hope others will understand these inherent links exist, and this is why First Foods ("natural resources") are valuable to the CTUIR.[4]

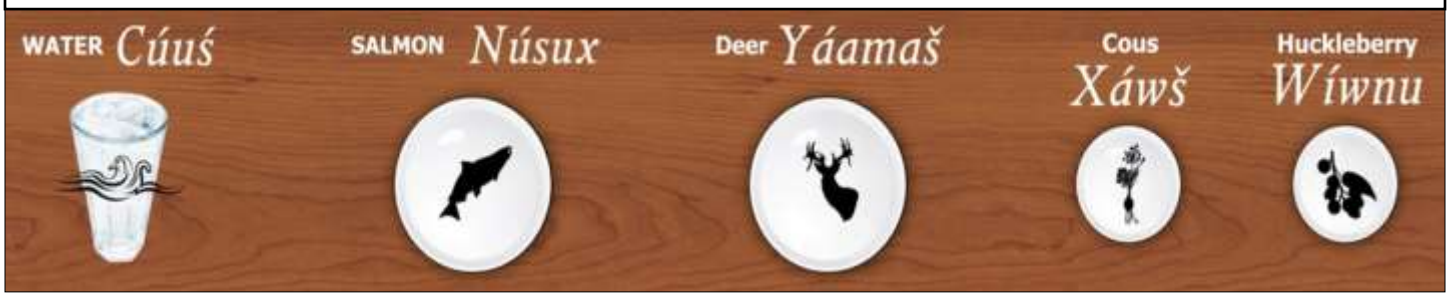
Figure 1.6: Harvest Seasonal Round of the CTUIR First Foods (2015)



Designed by Donna Nez & Stephanie Kaping

Figure 1.6 shows the seasonal harvesting round for the CTUIR tribes, as originally published in "Saxu|Siwaala|Seewi'cs: River Mussels Through Time (2015)" book, designed by Donna Nez and Stephanie Kaping. [4]

Figure 1.7: First Foods Serving Order on the Longhouse Table Informs DNR's First Foods Mission



1.7 CTUIR DNR First Foods Mission

CTUIR Department of Natural Resources has been using the framework of the First Foods to guide the work that department does; the First Foods mission is to "protect, restore, and enhance the First Foods – for the perpetual cultural, economic, and sovereign benefit of the CTUIR through population and habitat management goals & actions; and natural resource policies and regulatory mechanisms.[9]" The First Foods Mission was adopted by the CTUIR Board of Trustees in 2006, and was made an integral part of the mission and governance of the Tribal departments through its inclusion in the Comprehensive Plan (2010), and each of the departments speak to the First Foods Mission in different ways.

In applying this approach, the DNR emphasizes the reciprocal relationships between natural resources and humans. This is a deeply held and widely shared belief within the Tribal community that means humans are responsible for taking care of the foods that provide sustenance to humans. This relationship is expressed in the concept of "reciprocity" between the community and the environment. Furthermore, the First Foods management approach provides the Tribal community with a means to "monitor" the performance of its government as the diversity, quality, and regularity of First Foods that can be harvested, served, and safely consumed are direct and meaningful indicators of the DNR's management effort and progress.[9]

Figure 1.7 illustrates the serving order of First Foods on the CTUIR Longhouse table; this Indigenous knowledge framework is used to direct the efforts of DNR, and correspond to Tribal rights to hunt, fish, gather, and graze Ceded and traditional use lands. This framework for natural resource management seeks to reflect the unique Tribal values associated with natural resources and to emphasize ecological processes and services that are undervalued by westernized Euro-American natural resource strategies. The First Foods framework prioritizes efforts to renaturalize processes that sustain First Foods and provides a direct and culturally appropriate means for monitoring and reporting restoration progress to the Tribal community.[9]" The First Food serving ritual in the Longhouse is based on this order, and reminds people of the promise the foods made, and the people's reciprocal responsibility to respectfully use and take care of the foods. The longevity and constancy of these foods and serving rituals across many generations and their recognition through First Food ceremonies demonstrate the cultural and nutritional value of First Foods to the CTUIR community. Even though the means to pursue, acquire, process, and prepare First Foods have changed dramatically following Euro - American settlement, the First Foods and their serving order have remained constant. First Foods have not been replaced in the serving ritual despite the availability of new, introduced foods. For instance, bass and wheat have not replaced salmon and cous. When new foods are served at Tribal meals, they are not recognized in the serving ritual; instead, they are served after First Foods and with no formal order or sequence.[8]

The First Foods Mission is also well-documented through technical guides and scholarly articles published by DNR. These include: Forest Management Plan (2010); Umatilla River Vision (2011); Ecology and Society paper, "Aligning environmental management with ecosystem resilience" (2018); First Foods Upland Vision (2019); and Climate Adaptation Plan (2022).

1.8 CTUIR Climate Change Engagement

CTUIR has been addressing the climate crisis for millennia through culture, restoration, advocacy, and sovereignty work the Tribal government and community engages in. Increasingly, academic institutions are beginning to acknowledge the role of global colonization in driving factors that create the climate crisis, and has been noted as such in recent Intergovernmental Panel on Climate Change (IPCC)'s Climate Assessments (2021).

Close connections to First Foods empower Tribal people to be observers of change and stewards of natural resources.

Food Systems and Climate Change

A predominant source of carbon emissions caused by global colonization is food production, processing, transportation, and waste. Food systems contribute between 10-30% of annual greenhouse gas emissions.[10]

These carbon emissions can from sources like:

- Land conversion into farmland and soil carbon loss from tillage;
- Energy intensive synthetic fertilizer production and application;
- Noxious gas emissions from food processing plants and operations;
- Transportation miles and refrigeration costs in shipping food;
- Methane emissions from food waste decomposing in landfills.

First Foods and Climate Resilience

Unlike agricultural plant and animal species that require supplementary nutrition and irrigation, First Foods are "place-based" and innately suited to their natural climate, representing "pre-fossil fuel foods" that fed robust and vibrant Indigenous societies for millennia before carbon was emitted from fossil fuel sources. These species don't require much of the energy and carbon intense needs of agricultural species, and have demonstrated their inherent climate resilience through many landscape altering events.

Past Engagement

This Climate Adaptation Plan is not anything new, but the most recent step in a long line of preparing for extreme natural disaster events and long term climatic shifts, and serves as a place to collect and celebrate the work that has come before us.

- 2008 - ATNI Climate Change and Adaptive Government Workshop and two-day event
- 2012 - "Facing Climate Change: Plateau Tribes" outreach video production
- 2013 - BIA Tribal Resilience Grant $250,000 to then-Dept of Science and Engineering (DOSE) for a dedicated planning/research position
- 2015 - CTUIR Climate Change Vulnerability Assessment for the CTUIR reservation
- 2016 - Climate Change Online Data Viewer from OIT GIS Program
- 2016 - Hazard Mitigation Plan chapter on climate change included in document update
- 2017 - Climate Adaptation Planner position hired to develop an adaptation plan
- 2018 —Youth and Climate Change Video Project from Education and Child & Family Departments
- 2019 - Women's Foods Data Monitoring Project from BIA Tribal Resilience grant
- 2019 - Preparing for Fire Project for air quality and traditional burning from Meyer Memorial Trust grant
- 2018 & 2019 - Participation with regional, ATNI, and national climate change forums for Tribes
- 2015—2020 - Participation with Carbon Taxing Legislation in Washington & Oregon
- Nov 2020– June 2021 - Climate Adaptation Webinar Series hosted by CTUIR
- Dec 19 2022—Climate Adaptation Plan adopted

1.9 Summary of Adaptation Recommendations

The following Chapter 2 provides a brief overview of climate modeling and projection efforts that have been conducted for the Pacific Northwest and for CTUIR specifically. Chapter 3 "Šapátunx̣wit Adaptation Goals" reviews specific climate projections for impacts that will affect First Foods and the CTUIR community. These impacts are divided into seven areas of focus: A) Water, B) First Foods Availability and Access, C) Infrastructure and Built Systems, D) Human Health and Happiness, E) Energy Production and Use, F) Economics and Community, and G) Tribal Sovereignty and Treaty Rights. This chapter also contains extensive adaptation goals that have been community-identified through the Climate Adaptation webinar series, conducted from November 2020 to June 2021, as virtual outreach and engagement. Though these adaptation goals are specific to each area of focus, broad themes emerge, and inform how the Tribal community plans to build resilience to changing conditions and needs.

Sustaining First Foods and cultural knowledge will be essential for building climate resilience.

1. First Foods Knowledge, Access, Processing, and Safe Harvest

Reciprocal systems of responsibility to First Foods are central to CTUIR culture and ways of life. These relationships have sustained Tribal people through other cataclysmic events, and are robust to climate changes when land management practices are placed in Indigenous stewardship. Securing and expanding Tribal Member and community ability to uphold these reciprocal relationships is a core adaptation priority.

2. Information Collection, Sharing, and Networks for Tribal Sovereignty

Tribes (especially those with federal recognition and a reservation land base like CTUIR) have the unique right to self-determination of their Nations, which includes the ability to set and enforce certain regulations. Information collection and analysis that centers Indigenous knowledge is essential to the maintenance of this ability. Working with other partners and Tribes can also support and expand this ability for the benefit of the CTUIR community and surrounding region.

3. Training, Education, and Opportunity for Tribal Community

Knowledge of climate impacts and opportunities to mitigate for possible harm will be a large part of adapting to changing conditions. Opportunities for education and training exist in all areas of focus, for all ages and occupations, and are especially important for:

- Tribal Youth and Students – who are future leaders and most impacted by future changes;
- Tribal Harvesters and Entrepreneurs – who spend much of their time outdoors and will experience disproportionate mental and physical health impacts.

4. Flexibility/Adaptability in Governance, Economy, Community, and Self

Though less dramatic than extreme weather events, uncertainty and seasonal variability are also part of climate impacts Tribes will experience. Historic conditions are no longer a reliable measure of climatic conditions, and governments and communities must be able to anticipate variability by implementing flexible and adaptive strategies for all services, events, and within family units and self.

5. Building Capacity to Implement Adaptation

Tribes have always adapted to natural changes in climate, and these resilience strategies are threaded throughout cultural and First Foods learnings. Tribal governments and communities often have vast knowledge and enthusiasm to tackle emerging problems, but capacity to fund, administer, and implement these strategies on a broad scale are a limiting factor. Securing programmatic funding for adaptation strategies, expanding Tribal community capacity to implement adaptations, and prioritizing solutions with an interdisciplinary approach will be essential for the success of these strategies.

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CTUIR Energy Policy (2009)
CTUIR First Foods and Food Systems Assessment (2020)

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- Chapter One Cover photo “DNR Fisheries on the Columbia” CTUIR DNR Fisheries
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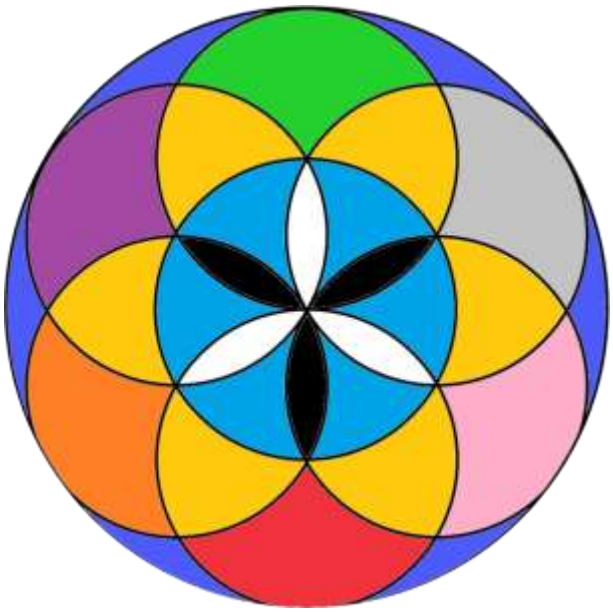
- Figure 1.2 “CTUIR Ceded Boundaries Map”, CTUIR OIT GIS
- Inset photo, “Tamayct at TCI” CTUIR DNR CRPP
- Inset photo, “Economic and Community Development staff at Wanapa” CTUIR DECD
- Figure 1.3 “CTUIR Traditional Use Area Density Map”, CTUIR OIT GIS
- Figure 1.4 “CTUIR Revised Organizational Chart”, original from Comprehensive Plan 2010, revision BOT approved in 2022.
- Figure 1.5 “CTUIR Government Integration Chart,” Comprehensive Plan 2010.
- Inset photo, “Cultural landmarks on Columbia River,” CTUIR DNR CRPP.
- Inset photo, “Elk in Snowy Conifer forests,” CTUIR DNR CRPP
- Figure 1.6 “CTUIR First Foods Seasonal Round,” Saxu|Siwaala|Seewi’cs: River Mussels Through Time; Donna Nez and Stephanie Kaping 2015.
- Figure 1.7 “First Foods Mission Serving Order,” CTUIR DNR Eric Quaempts.
- Inset photo, “CTUIR Tribal Members dig roots during excursion,” CTUIR DNR CRPP.
- In-set photo, “CTUIR Tribal Member Manaia holds up Xaws (Roots)” Althea Huesties-Wolf.
- Reference panel photo; “RAF forest stocking density project tour,” CTUIR DNR FFPP
- Reference panel photo; “ Camas fields at Indian Lake,” CTUIR DNR CRPP
- Credit Inset photo, “Longhouse Gathering,” Wenix Red Elk, CTUIR DNR CRPP.

CTUIR Adaptation Wheel



"That which is connected cannot be separated."
- Atway Louie Dick, Tribal Knowledge Keeper

Indigenous knowledge is reciprocally interconnected. To parse out climate impacts into separate efforts detracts from this vision of a connected world. Our plan focuses on intersections of climate impacts for a holistic adaptation approach that does not sever natural connections.

The following sections examine the effects climate change will have on each of these areas of Tribal resources, as well as provide adaptation goals and strategies to achieve them.

Water (Surface- & Groundwater)

Water is the first and last of the First Foods, and will be profoundly affected by climate changes. Both surface and groundwaters will be impacted, and the effect of this ripples out into all other areas of life.

First Foods Availability & Access

Protecting and enhancing cultural and sustaining connections to traditional First Foods through their natural availability, health, and abundance, as well as Tribal member ability to access these foods, is essential.

Infrastructure & Built Systems

Buildings, roads, bridges, and communication networks are some of the ways Tribal Members access sovereignty and Treaty Rights. These will face impacts from extreme weather and chronic stress.

Human Health & Happiness

For Tribal people health is more than just medical. Cultural and spiritual connections to land and First Foods affect physical and emotional wellbeing, and chronic and acute impacts must be mitigated to protect these connections.

Energy Production & Use

Alternatives to fossil fuel energy come in different forms, and all have some environmental cost. Improving energy efficiency, reliability, and diversity of sources at a local level will build resilience.

Economics & Community

Global and local extreme weather events threaten economic and community safety and stability. Availability of goods and services will be challenged by long and short term climatic changes.

Sovereignty & Treaty Rights

Tribal self-determination and reciprocal systems of responsibility to First Foods are opportunities for Tribes to be climate leaders, and Tribes have specific tools to enact standards and practices that impact the entire region.

Chapter 2

Connecting Climate & First Foods

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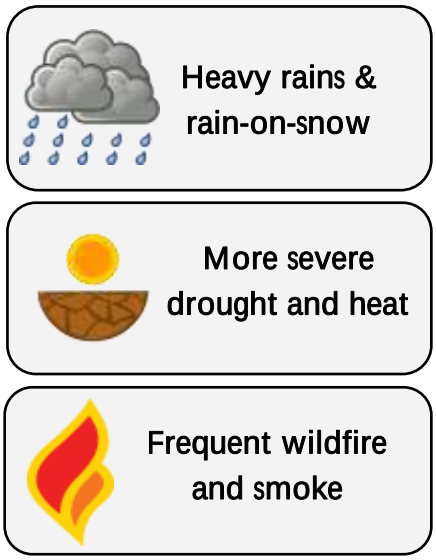
2.1 CLIMATE IMPACTS TO THE PACIFIC NORTHWEST REGION



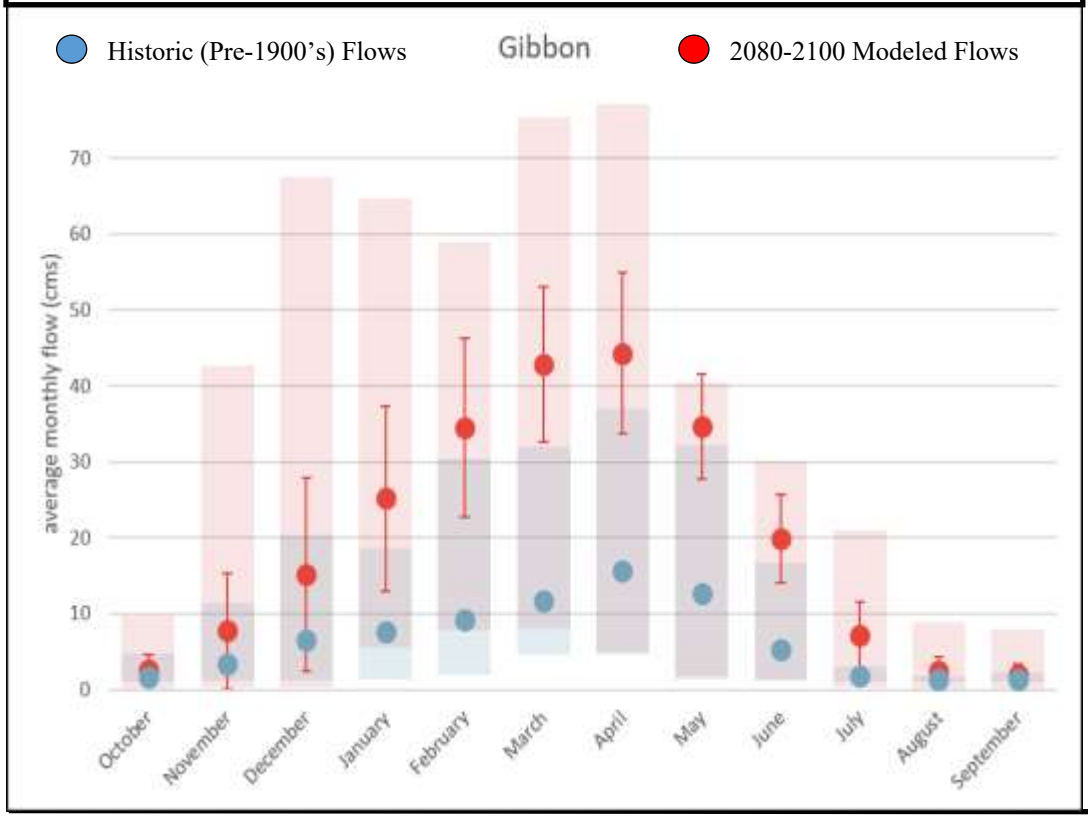
Global heating will impact each ecoregion differently. In the Pacific Northwest (PNW), climate change projections show the primary impact will be warmer winters, affecting seasonal precipitation and regional hydrology. These impacts can be organized under three main categories:

- Winter precipitation is more likely to fall as rain instead of snow, or as rain-on-snow events that shift river seasonal cycles;
- Increased frequency and severity of summer drought situations that place co-management of water in conditions of conflict;
- Increased risk of unintentional and catastrophic wildfire, both from fires close to home and far away, as smoke impacts large regions.

A shift in the way precipitation falls on the landscape has profound effects on the life that depend on that water. **Figure 2.1** shows modeling projections of the Umatilla River's hydrology shift under future conditions, conducted by CTUIR OIT GIS specialists Scott O'Daniel and Bethy Rogers-Pachico (2019).

- Historic weather pattern data was input into statistical modeling programs, and was projected to the end-of-century (2100) using several global climate change action scenarios, called RCP's. Measurements of water conditions were taken at the Gibbon water gage on the Umatilla Indian Reservation (UIR) Eastern Boundary.
- The points in blue show the historic hydrology of the river, with the expected peak flows occurring March to May, as snow in the mountains slowly melts and filters into streams and tributaries. The points in red show the statistical modeling of basin flows for the years 2080-2100.
- These future flows are seen to be increased in intensity, with an extremely wide margin of variability. There is a shift of peak flows into the winter to December instead of from March and April historically.
- Error bars demonstrate the confidence intervals of each data point, and red and blue shading illustrates the variability that exists at each point. As we see, not only do future projections of the river

Fig 2.1: CTUIR OIT "Future Flows of the Umatilla River Basin" Model



increase in winter flows, but there is also a large scale of variability in these estimates, showing that flows in the river could differ dramatically from one year to the next.

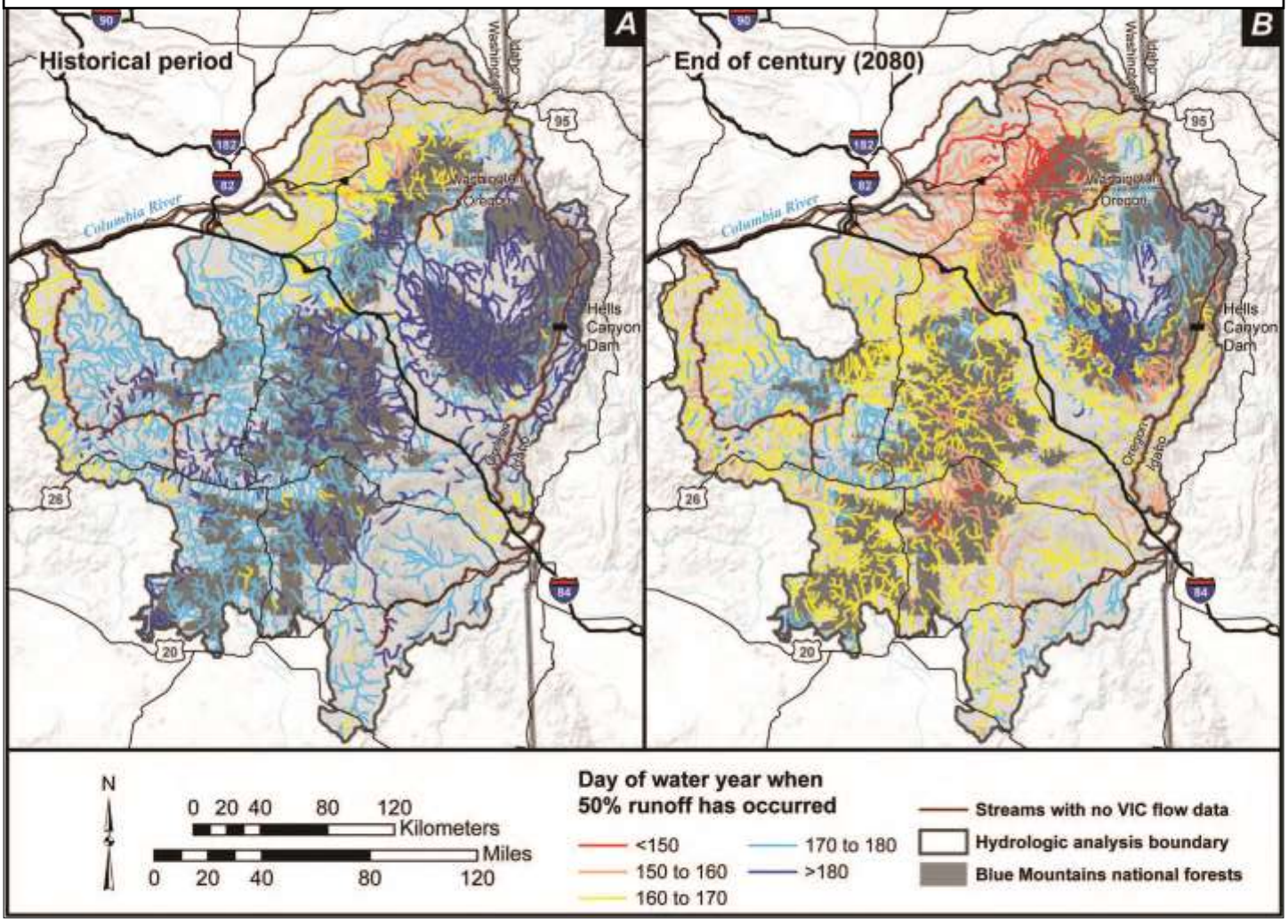
This shift has implications for First Foods and reciprocal responsibility that Tribal people have upheld since time immemorial.

2.2 WINTER PRECIPITATION

The PNW has a combination of different hydrologic systems, including:

- Rain-dominated systems where high precipitation falls as rain for most of the year (typically coastal locations with warmer winters);
- Snow-dominated systems in high elevation areas that accumulated winter snow pack, which melts slowly as the summer progresses;
- "Mixed rain and snow" systems that have a combination of winter snow and spring/autumn rain. As winters warm, there will be less intense overall effects on rain-dominated river systems, but large changes in hydrology that depends on snow for summer base flows. The Blue Mountain and Columbia Plateau ecoregions are mid-elevation landscapes dominated by a mixed snow/rain hydrology, where much of the annual precipitation falls as snow in the mountains, and rain at lower elevations, with most rainfall during spring and fall months. **Figure 2.2** shows a number of watersheds within the CTUIR Ceded lands, bordered by the Umatilla, Wallowa-Whitman, and Malheur National Forests as they will be affected by changing seasonal precipitation (Clifton et al 2018). This map measures "days of the water year when 50% runoff has occurred" within historical period on the left side,

Figure 2.2: Blue Mountains Comparison of Historic and Projected End-of-Century Measure of Snow Pack Melt



and in a modeled future of 3˚C (5.4) of warming by 2080 on the right. If the "water year" begins in October, then the stream colors indicate how long into this time period it is when half of the stored water has been released.

- Red indicates less than 150 days into the year (before February),
- Orange indicates 150-160 days (early to mid-February);
- Yellow indicates 160-170 days (early March);
- Light blue indicates 170-180 days (mid-March);
- Dark blue lines indicate greater than 180 days (late March and beyond).

On the left in the historical period, much of the Blue Mountain watersheds retained their snow pack into the spring, with the majority of streams showing 50% runoff in 170 to 180 days or greater, into the March month. On the right in the 2080 projection, this is reversed; many of the watersheds are predicted to lose half their runoff in under 170 days, some as early as before February in the northern Walla Walla River basin (Clifton et al, 2018). This illustrates the magnitude of change warming winters will have on snow pack accumulation and stream flow.

2.3 SUMMER DROUGHT

Under historic conditions, precipitation falls in winter months as snow in the higher elevations, and remains until warming weather in spring caused the snow to melt slowly over the season. This slow melt would infiltrate into the soil, and travel through pores and aquifers to ultimately reach the rivers and streams as "base flow."

Figure 2.3 illustrates how rainfall at higher elevations ends up in river systems in three ways (ThePhysicalEnvironment.com):

- Direct channel precipitation: water is added as rain falls directly on rivers and streams;
- Overland flow: water is added as "runoff" moving across the top of the soil;
- Interflow: water percolates into the shallow water table or deeper groundwater flow, and moves through soil pores out into river channels.

Rainfall (as opposed to snowfall) is more likely to be added as overland flow, and creates greater potential for associated soil erosion due to heavy rainfall events. This also reduces opportunity for water to be added as interflow, reducing the amount of water that is passively released into rivers during dry months. Lower quantities of this river base flow means this water becomes hotter, especially in combination with extreme heat events during these same months. This creates concerns about harmful algal growth, reduced dissolved oxygen, and lethal temperature limits for aquatic species.

Figure 2.3: Precipitation Becomes River Base Flow in Three Ways

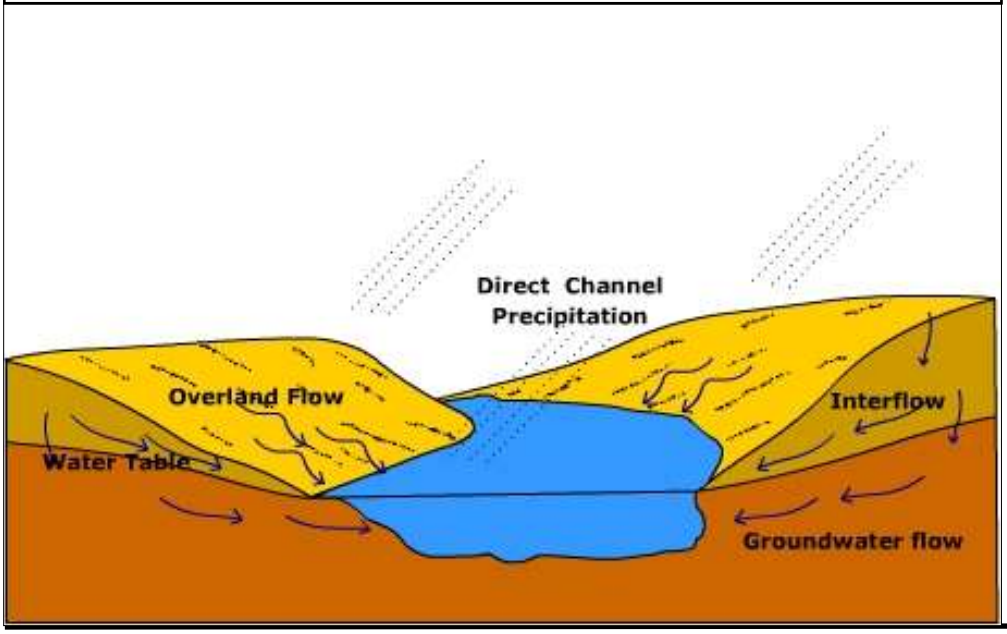
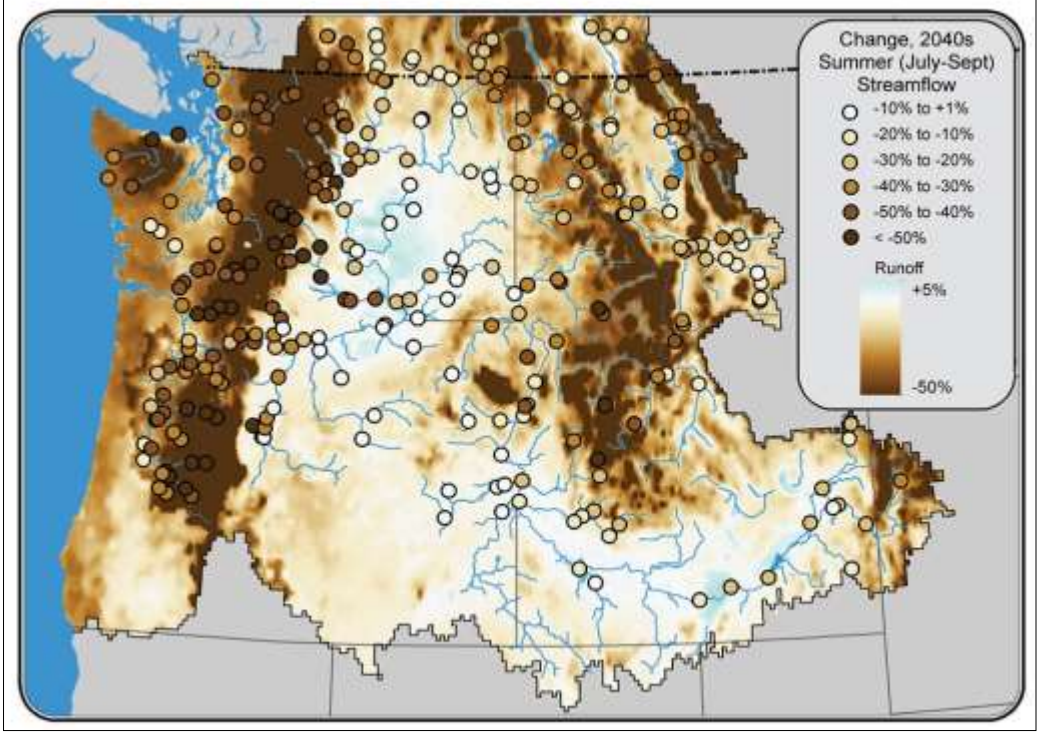


Figure 2.4 illustrates the severity of these two impacts on Pacific Northwest watersheds (USGCRP 2014). Colored dots indicate the degree of change in summer (July to September) stream flow projected by mid-century (2040). Additionally, color gradients display the reduction in snow pack runoff

that will result. This ranges from light brown at an increase of 5%, to dark brown indicating a reduction of 50%. In this map, CTUIR Ceded lands are likely to experience moderate decreases in snow pack runoff, estimated at 10-20% reduction, though more severe loss of snow pack is projected for much of CTUIR's traditional use areas (USGCRP 2014).

Figure 2.4: Projected Reduction in Summer Streamflow and Snow Pack Runoff



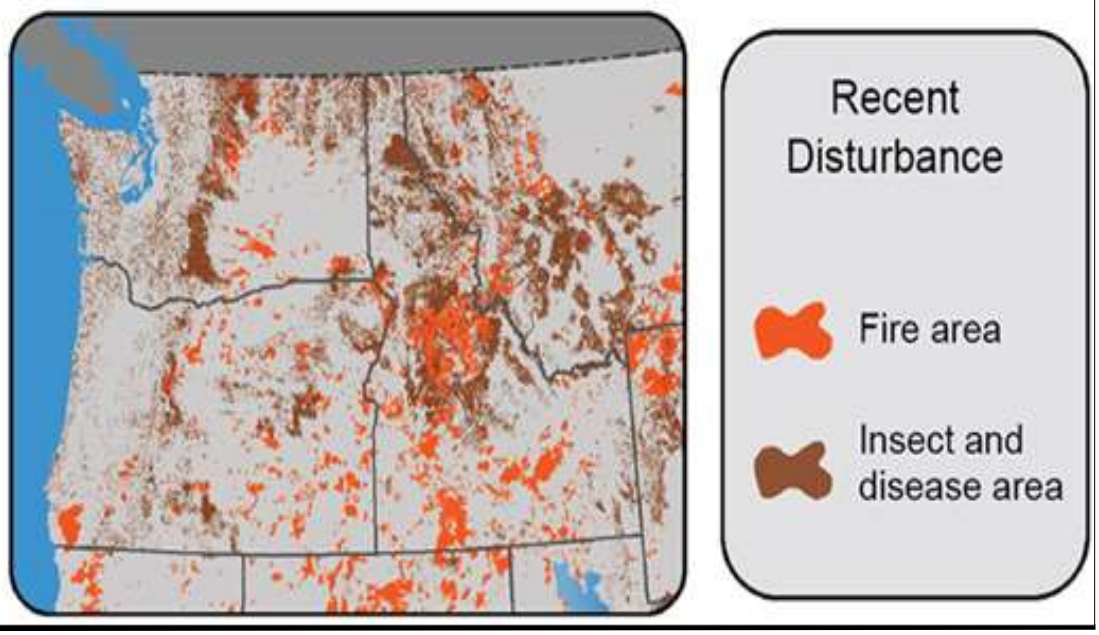
2.4 WILDFIRE & SMOKE RISK

While the Columbia River Plateau ecoregion is adapted to periodic fire, and requires low intensity fires to keep habitats healthy, climate change will increase the frequency and intensity of fires beyond what is beneficial. Warm winters have the potential to benefit the growth and spread of invasive grasses with high fire fuels capability. Grasses take advantage of wet conditions in spring to put on biomass before becoming dormant ahead of summer heat, creating a heavy vegetation load for potential wildfire ignition. Summer drought also creates water stress for trees and large shrubs that require soil moisture throughout the season. Stressed trees are also more susceptible to insect and disease infection.

Frequent wildfire and smoke

Figure 2.5 illustrates areas burned between 1984 and 2008 (24-year period) in orange, and areas affected by insects or disease between 1997 and 2008 (11-year period) in brown. Often these two forest impacts compound each other to worse the severity of each event. Insect and disease outbreaks often follow wildfires where trees are weakened, resulting in tree mortality, and creating increased fire

Figure 2.5: Fire Disturbance and Associated Insect and Disease Pressure on PNW Forests



risk (USGCRP 2014).

Combined with federal fire suppression policy and criminalization of Indigenous cultural burning over the last century, the vegetation fuel load in many Pacific Northwest forests creates a higher risk of facilitating the spread of catastrophic wildfire.

Figure 2.6: Projected Increases in Areas Burned in the PNW with 1.8˚F (1˚C) of Warming

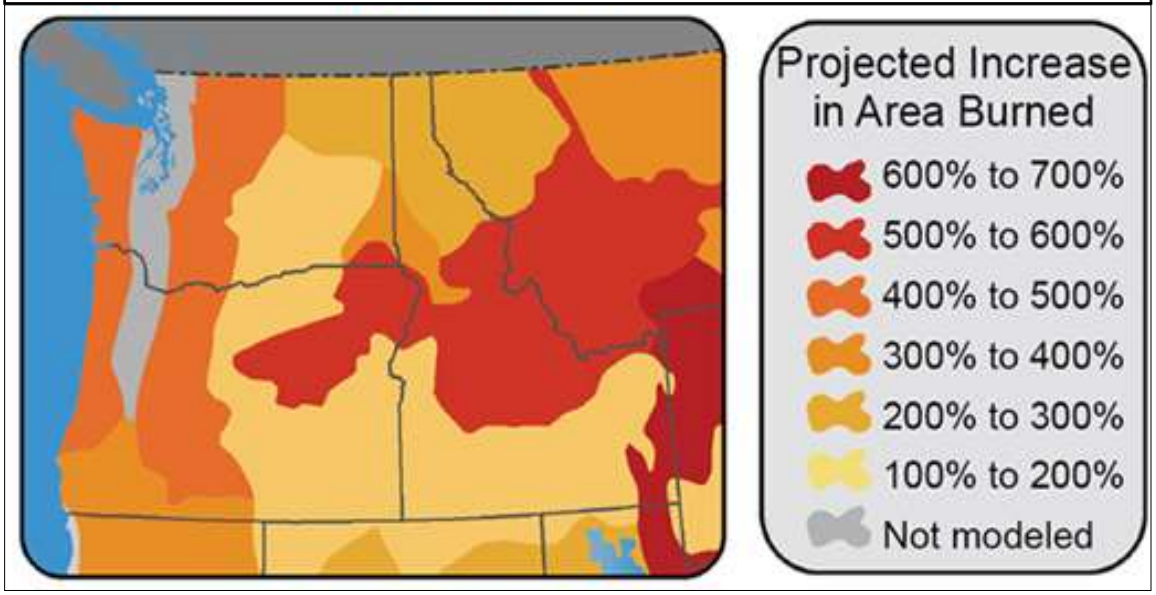
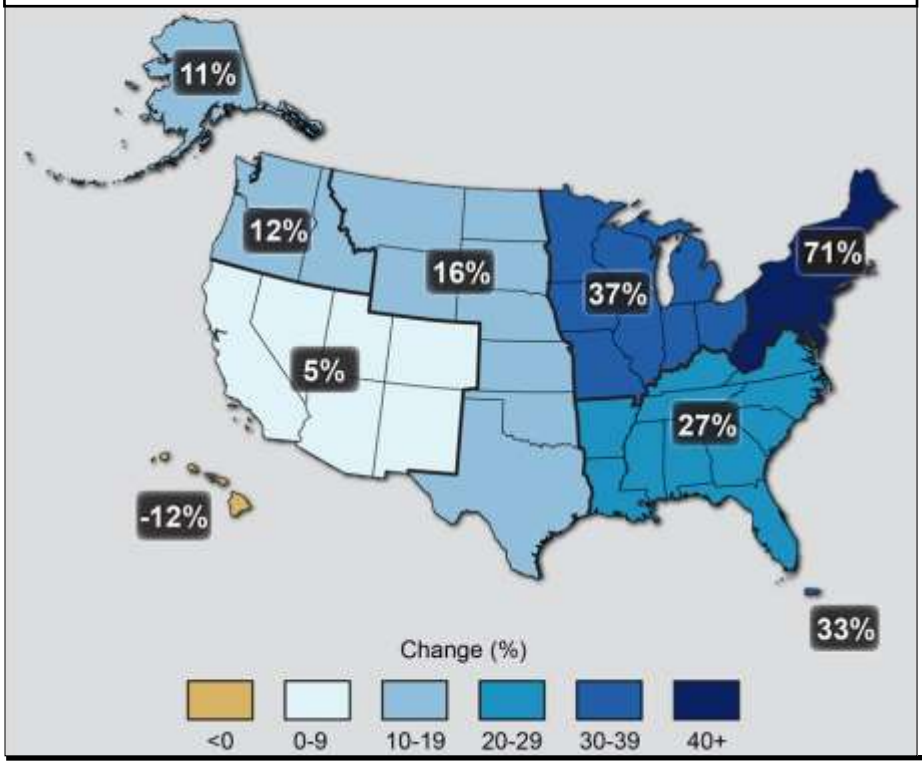


Figure 2.6 maps projections for fire risk in a 1.8˚F (1˚C) warmer future. Much of CTUIR's Ceded and traditional use areas are expected to experience 400-700% risk increase within forested lands, and a 100-200% increase within grassland habitats (USGCRP 2014). Wildfire poses serious risk to infrastructure, public safety, wildlife and plants, and to air quality through the smoke generated. Forest stocking density rates of trees can be managed to reduce the spread of predatory insects, with selective thinning to remove weak and crowded trees can increase the distance between individuals to prevent rapid transmission. Indigenous cultural burning is also being utilized on public and reservation lands, as CTUIR Range, Agriculture, and Forestry (RAF) Program works with various agencies to conduct prescribed burns.

2.5 COMPOUNDING FACTORS

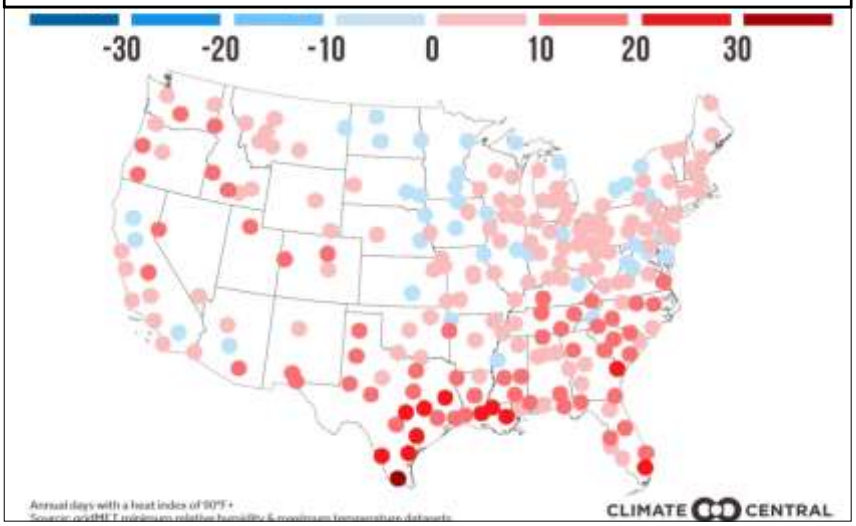
Figure 2.7: Observed Change in Very Heavy Precipitation in U.S.



Warm air holds more water, thus seasonal storms will carry more force, and move more slowly. Heavy precipitation is categorized as 1 inch or more of rain or snow in 24 hours. While the Pacific Northwest is likely to experience less intense increases in heavy precipitation (both in the form of rain and snow) than other parts of the United States, higher rainfall during humid seasons creates problems of flooding, landslide, and soil erosion into sensitive and unprotected waterways. **Figure 2.7** provides an overview of how regions across the United States are expected to experience changes in heavy precipitation (NCA USGCRP 2014). An increase of 12% in heavy precipitation events is small compared to Southern, Midwestern, and

Northeastern increases, but still has the potential for devastating impacts to the region's resources, economies, and communities.

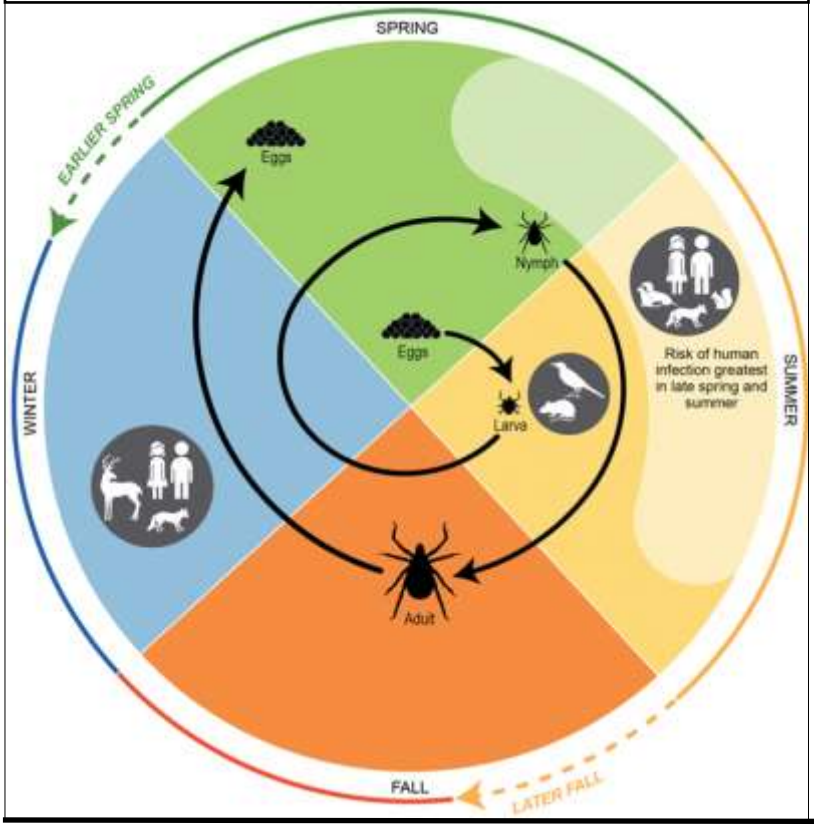
Figure 2.8: Changes in Number of Days of Extreme Heat



Extreme heat is categorized as temperatures over 90˚ F for one or more days. The frequency, intensity, and duration of these events is highly likely to increase under climate change. Heat is a concern for many reasons, and can be deadly for a number of demographics of people who are particularly vulnerable. Heat can cause additional complications for those with pre-existing medical conditions like diabetes and cardiac illness. Prolonged exposure can also be dangerous for those who lack areas of refuge or access to cooling, such as outdoor workers, and those without housing. Heat can also stress animals, trees, and large shrub species, especially when coupled with long periods of drought, and has even melted some kinds of infrastructure.

Figure 2.8 illustrates the change in frequency of extreme heat events across the United States since 1979 (Climate Central, 2019). Dots in the blue gradient represent areas that have experienced a decrease in frequency of hot days; dots in the red gradient are areas that have experienced increases in frequency of hot days. The Pacific Northwest has experienced 10-30% increase in frequency of extreme heat, with the burden of adaptation falling disproportionately on those without existing adequate access to cooling.

Figure 2.9: Lifecycle Expansion of Predatory Insects



Predatory insects also benefit from warming winters. Both native and non-native populations are very likely to increase, as fewer will be culled by freezing temperatures over sustained periods of time in the winter. Warm winters, wet springs, and hot summers benefit the growth and reproduction cycles of many predatory insects like ticks, pine beetles, and mosquitos.

Figure 2.9 is a stylized illustration of the lifecycle of a blacklegged tick (*Ixodes scapularis*) (Beard et al 2016). Warming conditions are likely to prolong seasons of reproduction, resulting in higher densities of these insects. These insects create hazardous safety concerns for trees and wildlife, as well as a quality of life and health issue for humans and pets; also many are vectors for serious disease. Proliferation of these insects can restrict access to First Foods harvest opportunities, as well as negatively impact the health and abundance of First Foods themselves.

2.6 OCEAN ACIDIFICATION

While CTUIR is not a Tribe that relies directly on coastal resources, many First Foods and their habitats do depend on anadromous fish migration that bring marine nutrients inland to riverine ecosystems that rear them. Salmon and Pacific Lamprey are the best examples of this interconnection between river and coastal ecosystems, as these species spend their juvenile years in inland freshwater streams, and migrate to the ocean to grow big in nutrient-rich marine waters. When these fish return home to freshwater streams, their bodies decompose and return these accumulated nutrients to river systems. **Figure 2.10** provides a map of the ways in which salmon enrich inland ecosystems through their yearly decomposition on these landscapes (National Park Service). Because of this integral connection to coastal resources, CTUIR does have justification for concern over climate impacts to ocean acidification. Oceans have currently absorbed much of the carbon dioxide that has been released, but this changes the ocean water's chemistry as a result.

Figure 2.10: Marine Nutrients Return to Inland Ecosystems

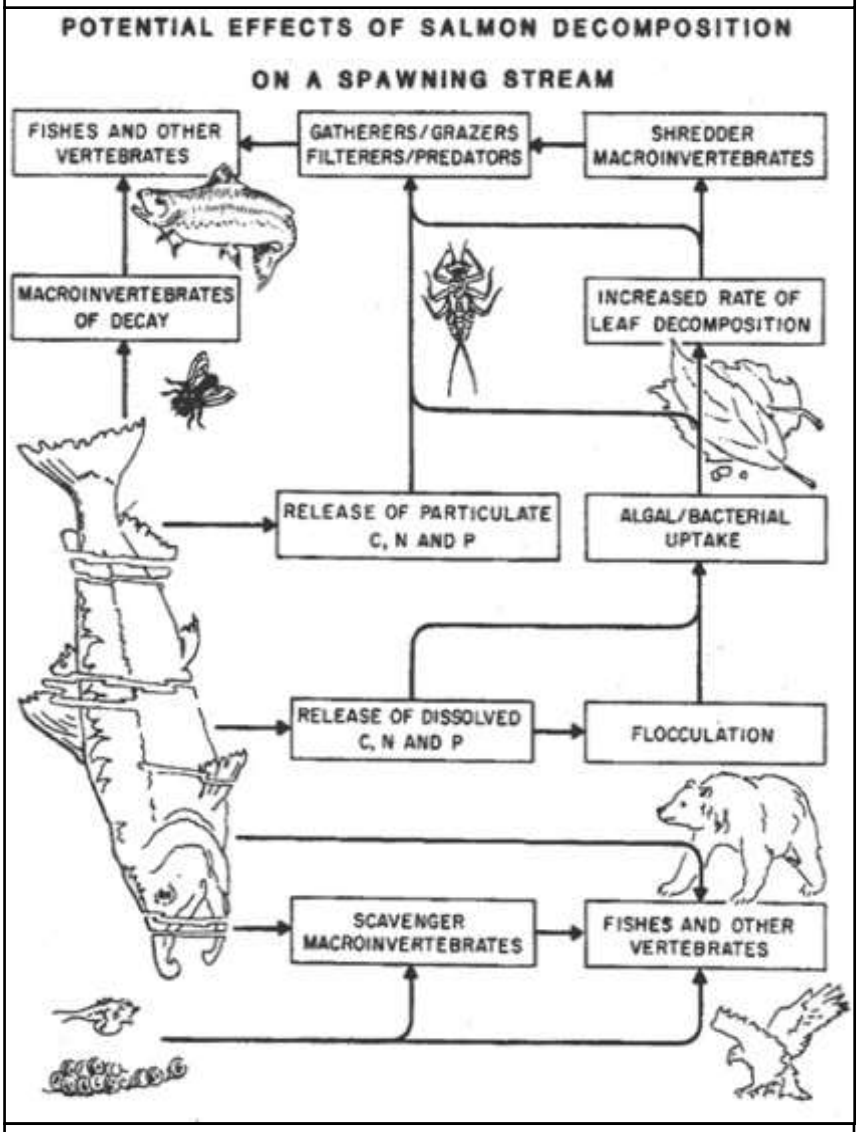


Figure 2.11 provides evidence of this changing chemistry monitored at an ocean research site in Hawaii (HOT 2021). Since 1980, the Pacific Ocean has experienced a 0.1 decrease in pH (becoming more acidic). While this might not sound like a large change, in a 40-year period of time, the Pacific Ocean experienced a 30% increase in acidity (NOAA 2021).

Acidification is a harm to marine ecosystems by threatening the availability of carbonate ($HO\text{-}_3^{2-}$) that comprises the protective shells of many organisms, including phyto– and zooplankton which are foundational in coastal food webs.

Figure 2.11: Changing pH (Vertical Axis) of Pacific Ocean Waters

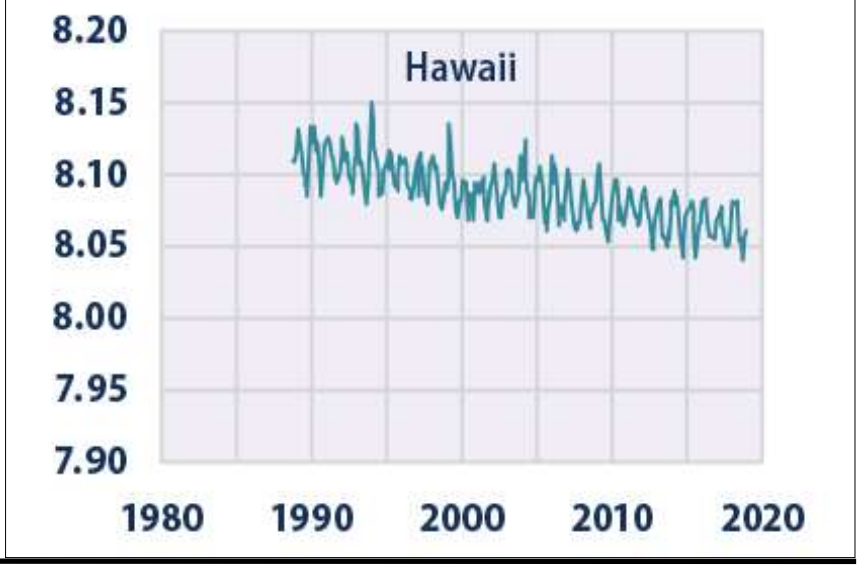


Figure 2.12 illustrates the impact of ocean acidification on marine ecosystems; this diagram was sourced from "Into the Salish Sea" (https://intothesalishsea.org/the-most-insidious-threat-to-our-ocean/) (2021). Because Salmon connect river and ocean environments together, inland Pacific Northwest Tribes like CTUIR have a responsibility to be engaged with coastal management policy to protect and preserve these connections.

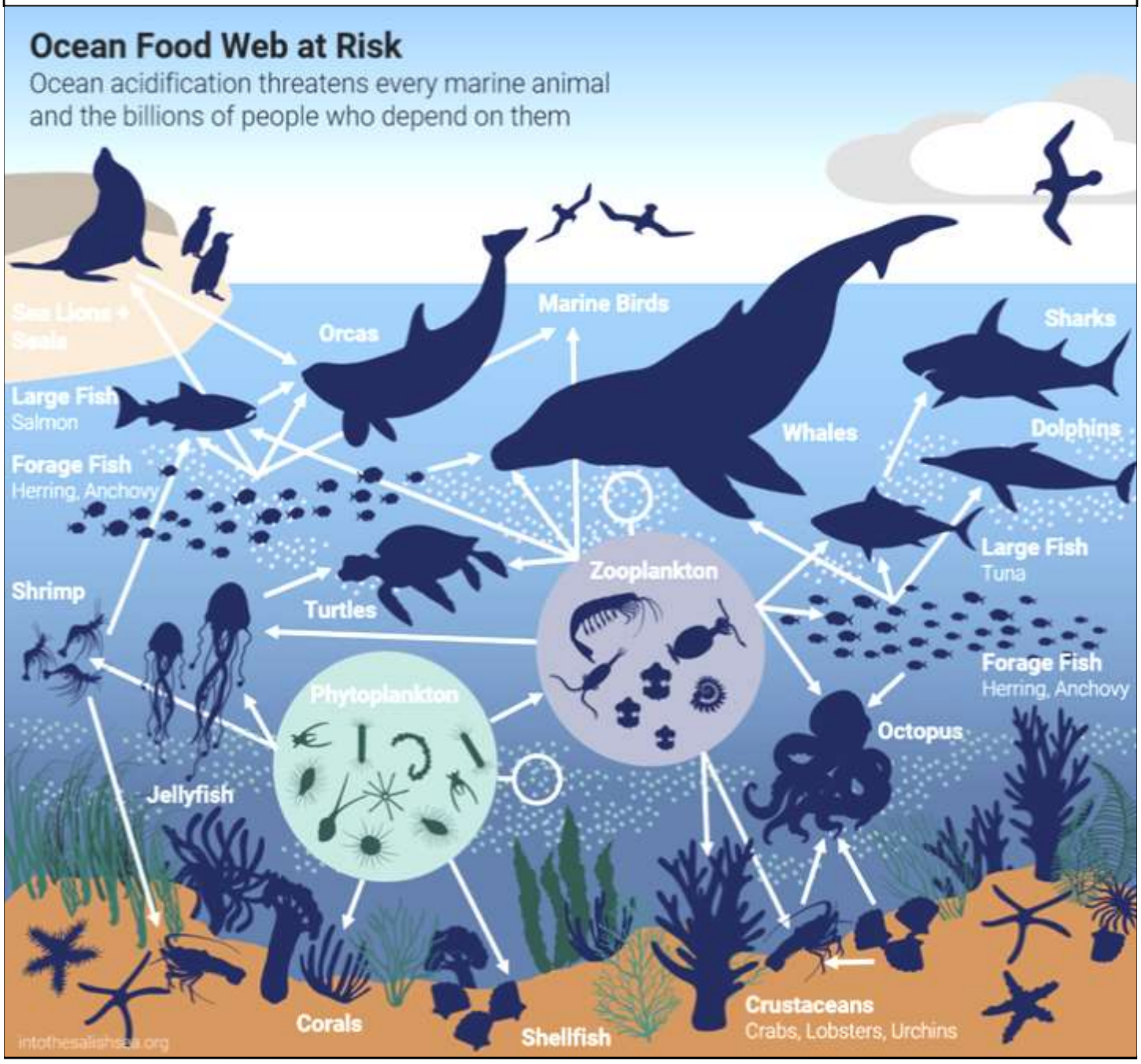
2.7 UNKNOWNS AND FEEDBACK LOOPS

There are a number of elements in predictive modeling whose effects are so-far unknown; some of these have the potential for disastrous consequences for climate adaptation.

Breakdown of Atmospheric Circulation Patterns

Atmospheric circulation patterns like the jet stream, Pacific Decadal Oscillation, and El Nino/La Nina occur in response to air temperature and moisture content, and are responsible for driving established

Figure 2.12: Ocean Acidification Threatens Marine Ecosystems (from Into the Salish Sea)



seasonal patterns. As air warms globally, the predictability of these patterns is disrupted, and result in unexpected weather events.

Extreme cold events, known as "polar vortexes," are the result of decay in established atmospheric circulation patterns that keep polar air closely circulated above the Arctic. As polar vortexes become more likely to occur, cold air is pushed further south into Canada and the United States, making it more likely that some places will see more extreme cold than they have historically experienced. A recent example occurred in Texas, February 2021, as record low cold temperatures and snow fell on unprepared residents in the southern U.S. Electrical grid failures left over 10 million people without electricity for days (Busby et al 2021).

Alternatively, the unpredicted heat event that occurred across the Pacific Northwest in June and July 2021, as a "heat dome" that reached 116°F (47°C) in Portland, OR, enveloped the region for over a week, and killed more than 1,000 people in the Pacific Northwest (Neal et al 2022). This event was estimated to be a 1-in-1,000 year event (Neal et al 2022) though disruption of atmospheric circulation patterns may bring additional surprises.

Changing Glacial Albedo

Albedo is defined as the reflectivity of an object; light colors have greater reflectivity than dark colors. This has implications for global heating: loss of glacial ice decreases reflectivity and increases absorption. As polar ice melts due to warming, white glacial ice that historically reflects solar radiation is converted into open ocean or dark terrain, which absorbs light and heat. As more glacial ice is lost around the world, the faster the rate of heating will pick up in a harmful feedback loop (Rutherford et al 2017).

Oceanic Methane Hydrates and Melting Permafrost

Beneath the Arctic Ocean, frozen methane hydrates make up a significant amount of total mobile carbon sources on Earth, and are only stable under a narrow temperature range (Ruppel and Kessler 2017). These gas hydrates are also present in marine soils and permafrost areas in terrestrial regions around the Arctic. As these northern regions warm, hydrates dissociate from their frozen state and become mobile in waters and atmosphere. Methane is an incredibly potent greenhouse gas, with 84 times the heating potential of carbon dioxide over a 20-year period (Abdel-Shafy and Mansour 2018). Thus methane hydrate dissociation presents another feedback loop: more carbon is released as these soils warm (Knoblauch et al 2018). Many factors including depth and strength of the gas hydrate storage and the permeability of soils, and modeling is ongoing.

Earth's Shifted Axis

Even astronomical factors can affect rates of warming and effects of change. Recent studies have reported that Earth's axis has shifted as a result of a number of factors, predominantly melting glacier ice caps and pumping of groundwater causing redistribution of water on Earth. Climate changes heighten demand for consumptive water and places pressure on groundwater resources to meet needs of global communities (Deng et al 2021). This shift in Earth's axis is likely to have some effect on how life functions, though there is much that is still unknown.

2.8 CTUIR CLIMATE CHANGE VULNERABILITY ASSESSMENT

Assessing priorities is a typical approach to climate planning, and ideally engages affected communities in facilitating informed conversations around impacts and planning. As part of a 2013 BIA Tribal Resilience grant awarded to CTUIR, a Vulnerability Assessment was conducted in 2015 to assess Tribal community priorities and perform downscaled climate modeling for the Umatilla Indian Reservation.

Climate Projection Modeling

Climate projections are generated from statistical modeling that examines historic data and performs thousands of iterative likelihood scenarios that account for increasing carbon dioxide levels. These resulting models demonstrate likely scenarios for changings in climate, tracing different predictive outcomes based on optimistic or pessimistic visualizations of our

human activities. There are standard recognized climate modeling scenarios, and many have short hand names to easily compare across disciplines.

- **Representative Concentrated Pathway (RCP)**: RCP 4.5 demonstrates a future where societies have worked to radically reduce current carbon emissions, whereas RCP 8.5 demonstrates what is likely to happen if societies continue to carry on with "business as usual," making little or no attempt to curb our carbon emissions.

- **IPCC Scenario Families**: International modeling scenarios illustrate different future approaches to energy and development. Many projections use the A1B scenario, which assumes a future where rapid economic growth, and global population peaks in mid-century and declines thereafter, with the rapid introduction of new and more efficient technologies that are balanced between fossil fuel and renewable energy sources.

- **Degrees of Warming (˚C/F)**: These projection scenarios are based on overall global temperature increases. 1˚C (1.8˚F) is a level of warming that is almost sure to occur, with current efforts aimed at curbing a 1.5˚C (2.7˚F) and 2˚C (3.6˚F) global temperature rise, while 3˚C (5.4˚F) increase or more is not outside the realm of possibility.

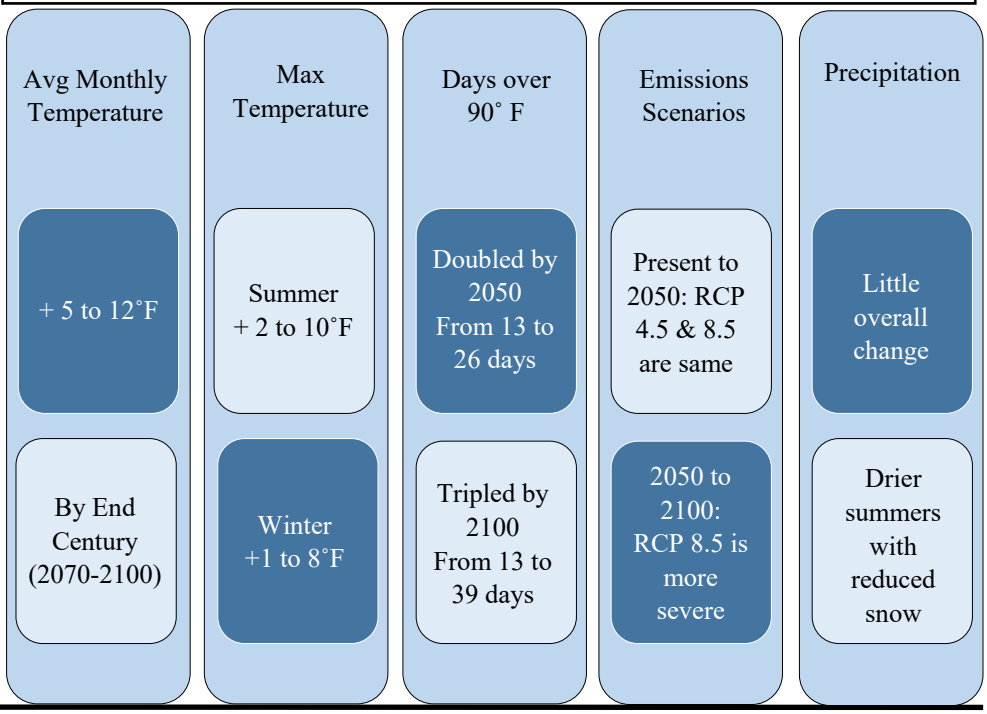
Figure 2.13 provides a quick overview of the modeling that was done by the Oregon Climate Change Research Institute (OCCRI) for the CTUIR ceded lands as part of the CTUIR Climate Change Vulnerability Assessment (2015). Downscaled monthly Coupled Model Intercomparison Project V5 (CMIP5) was used to compare historical and climate modeled seasonal patterns. Overall, warming temperatures, increased days of extreme heat, and changes to precipitation were predicted. This information was then used to conduct a vulnerability assessment workshop, where participants ranked the sensitivity and adaptive capacity of key items of concern.

Key Items of Concern, Sensitivity, and Adaptive Capacity

As part of the Vulnerability Assessment, a working group was convened periodically over the course of 6 months to discuss potential climate change impacts to the region, and how that might affect Tribal resources. These were distilled into Key Items of Concern (KICs). These were used to frame the group discussions at the one-day workshop in which community and staff were asked to participate. In small groups and individually, workshop participants were asked to assign sensitivity and adaptive capacity of KICs.

- **Adaptive capacity**: a score of AC1 means that a KIC has very low ability to change its conditions (example: resident freshwater mussels), compared to a score of AC5 (example: elk are able to migrate readily).

Figure 2.13: CTUIR Vulnerability Assessment Summary of MACA Modeling



- **Sensitivity**: a score of S4 would indicate a very sensitive KIC (example: Salmon are impacted by waters temperatures of 68˚ F).

Figure 2.15 above shows the ranking of various KICs as they were scored according to their sensitivity and adaptive capacity (CCVA 2015).

- Chinook Salmon are colored in red in the top right corner of the matrix, indicating that they are very sensitive to changes in water quality and quantity, and very limited in their ability to migrate from one stream to another.

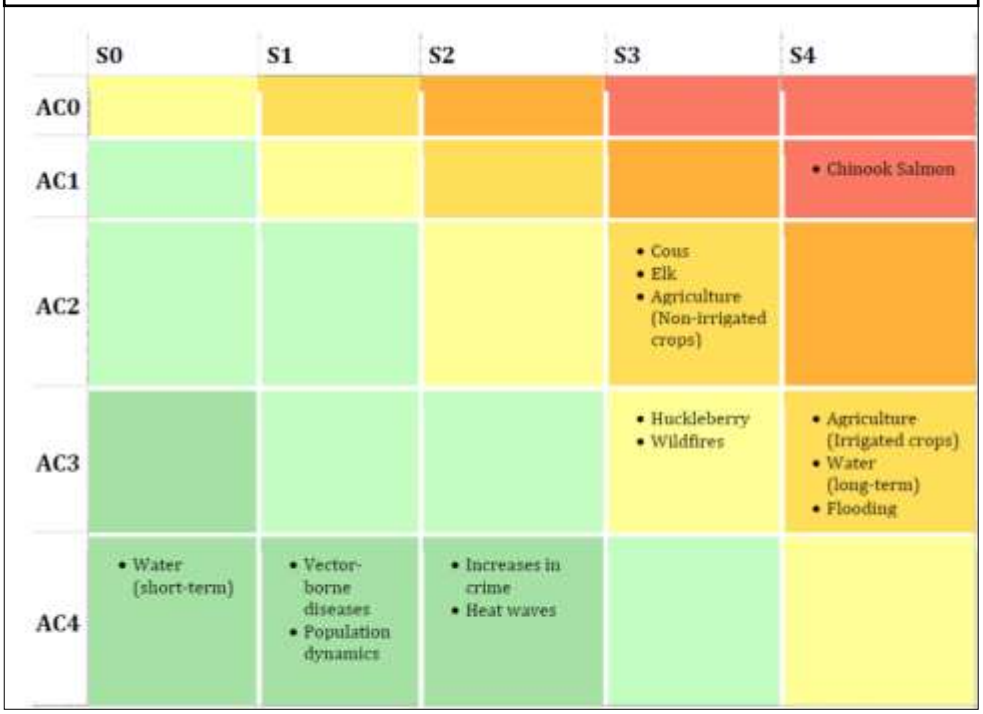
- Cous, Elk, and Huckleberries were ranked as sensitive to changes, but slightly more able to adapt;

- Non-First Foods KICs like Agriculture, Flooding, and Long Term Water Use were thought to be sensitive, but could be adapted to suit a changing climate.

- Other KICs like Vectorborne Illness, Population dynamics, and Short Term Water Use were not sensitive and could be easily adapted to the projected climate impacts.

This provides a Tribal staff and community-based snapshot of the perception of climate risk and where adaptation will need to occur. To inform the Climate Adaptation Plan, follow-up interviews were conducted with a number of event participants, to identify report strengths and opportunities to improve these approaches. Hindsight considerations centered around relative scale that participants placed on ranked adaptive capacity as compared to number values assigned. Some expressed resistance to the idea of prioritizing one First Food species or KIC over another, contradicting the inherently integrated idea of Tamanwit.

Figure 2.14: Vulnerability Assessment Key Items of Concern (KICs) for CTUIR



For more detailed information on this report and it's findings, please read the CTUIR Climate Change Vulnerability Assessment (2015); https://ctuir.org/departments/natural-resources/climate-adaptation/climate-projection-resources/ctuir-climate-change-vulnerability-assessment-2015/

2.9 IMPLICATIONS FOR REGIONAL POLICY DECISIONS

Because of this regional interconnectedness, any policy decisions must consider implications of climate adaptation actions not just to immediate environments, but also the needs of those that are connected to them by a longer chain. This also has implications for international policy, since migratory fish spend much of their lives in internationally regulated oceans, and different nations have varied responses to climate change, invasive species management, and overharvesting issues.

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- Chapter 2 Cover Photo, "Snowy Sunset on Indian Lake Tipi." CTUIR DNR WRP Craig Kvern.
- Icon images source from Google, and are not original productions nor are they property of CTUIR.
- References Inset Photo, "CTUIR Tribal Fire Crew on Break at Yakama Fire," BIA Umatilla Agency Fire Operations, 2021.

CTUIR Tribal fire crews on break while working on the Yakama Nation Wildfire in 2021

Chapter 3

Šapátunx̣wit

Impacts and Adaptation Goals

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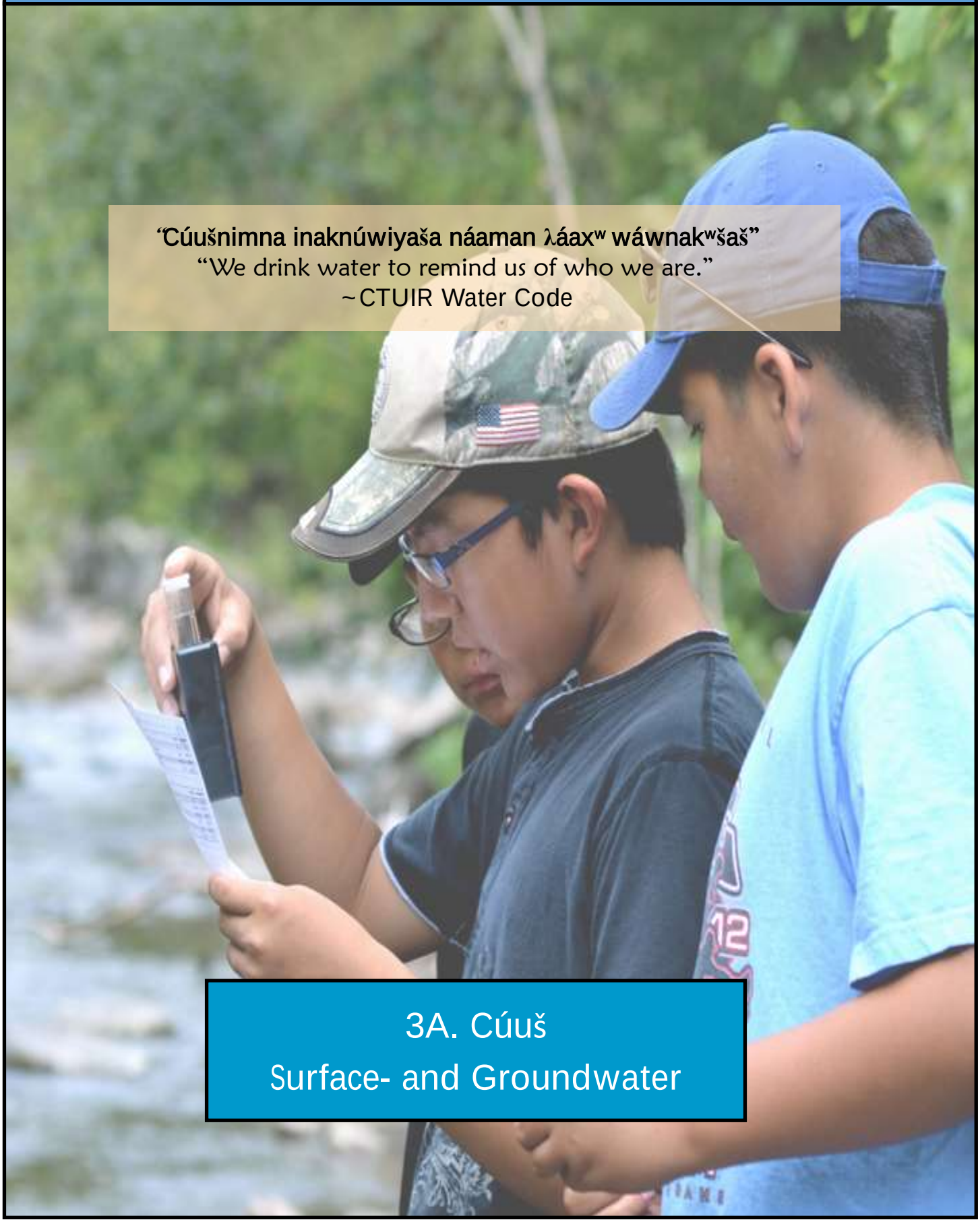


“Cúušnimna inaknúwiyaša náaman λáaxʷ wáwnakʷšaš”
“We drink water to remind us of who we are.”
~CTUIR Water Code

3A. Cúuš
Surface- and Groundwater

Climate Impacts for **Surface Waters**

"Like the First Foods table settings, a functional Umatilla River would be dynamic throughout the annual cycle, yet consistent and reliable across decades. During winter, snowmelt water fills the main channel, causing the river to fill dry channels, inundate the floodplain, scour fine sediments from the streambed, and cut new channels with its high-energy flows.

During summer, flows recede and the river abandons some old channels for new channels. These seasonal patterns vary between wet and dry years. The native riverine and riparian communities are adapted to and depend upon these dynamic physical conditions for their growth and survival.

Thus, maintaining a functional Umatilla River for First Foods requires managing for the range of dynamic river conditions (and not simply static levels) throughout the year (Umatilla River Vision, 2011)." This section examines those impacts to waters that flow over lands.

"Water is the alpha, and it is the omega, the first and the last, beginning and end."
~Thomas Morning Owl, Umatilla Language Master Speaker

1. Unpredictable Snowfall

Warming winters will reduce the reliability of snowfall, and increase the percent of precipitation that falls as rain and as rain-on-snow events.

75-100% reduction in SWE into the 2080s over much of Ceded lands (Clifton et al, 2018) as seen in Figure 3A.1 (page 45).

2. Faster Melt of Winter Water

Unlike snow, warm winter rain increases runoff into rivers and streams immediately, resulting in winter flooding.

Increasing frequency of heavy precipitation events, measured as estimated 12% increase in the maximum daily precipitation into 2050 (Salathe et al, 2014) as seen in Figure 3A.2 (page 46).

3. Shifted Seasonal Hydrology

Peak flows of rivers and streams will shift from late spring to mid-winter, and increase chances of winter flooding. This can create a disconnection with aquatic ecosystem seasonal cycles.

15-30 day peak flow shift by 2050, 40-50 day peak flow shift by 2100 (Dalton, 2020) as seen in Figure 3A.3 (page 47).

4. Lower Summer Base Flows

Reduced opportunity for water infiltration reduces summer base flow in river and streams, creating ecological drought and higher water temperatures in summer months.

Small decreases of less than 10% for perennial streams , but some more sensitive regions are likely to experience a decrease of up to 30% by 2080 (Clifton et al, 2018) with **most severe impacts to Lostine, Minam, Imnaha, John Day, Grand Ronde, and Wenaha Rivers,** as seen in in Figure 3A.4 (page 48).

1. Unpredictable Snowfall

As climate change warms our winters in the Blue Mountains, the ability to accrue snow pack will be reduced, with the biggest impact predicted to affect mid-elevation mountain slopes. Grassy slopes that support the production of Root species and Big Game grazing, as well as within mid-elevation conifer forests will see the largest shifts.

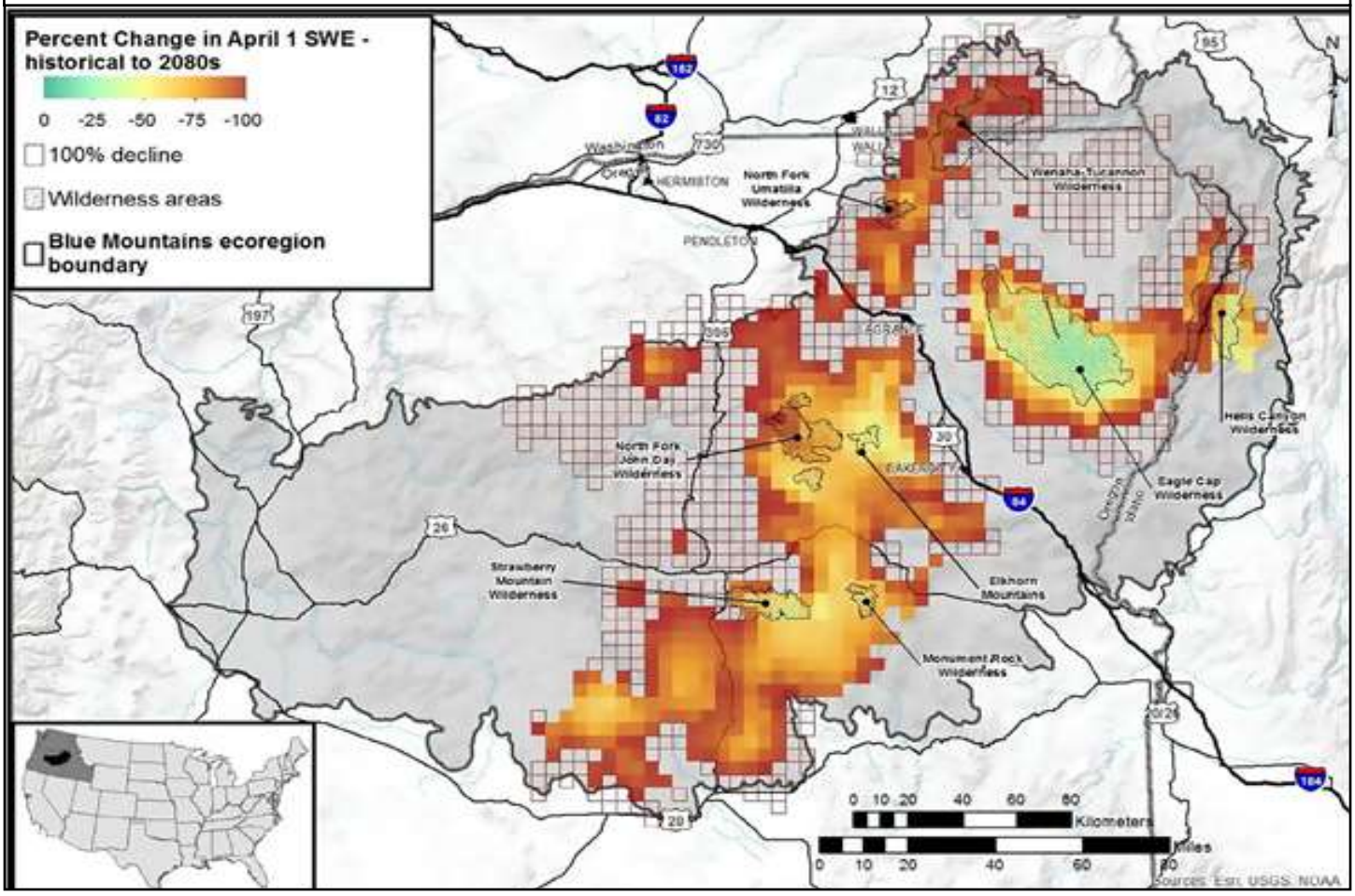
To measure of how much water is likely to be available for the coming water year, Snow Water Equivalent (SWE) is used to estimate the amount of water a current snow pack will be able to deliver.

Figure 3A.1 shows SWE for the Blue Mountain National Forests projected into 2080, under a 3˚C (5.4°F) of warming scenario. The color gradient shows the impact of changing SWE:

- Green indicates a 30% decrease in the potential to accumulate snow pack in those regions.
- Orange indicates a 50-70% decrease, and red indicating a 75-100% reduction.
- This projection anticipates locations which will experience the most sensitivity include the Strawberry Mountain, Monument Rock, Wenaha-Tucannon, and Hells Canyon Wildernesses, and at mid-elevations in the North Fork John Day, with **reductions estimated to be 75-100% in those management areas**.
- The Eagle Cap Wilderness is projected to experience the least impact, with roughly a 20% reduction being expected for that high elevation mountain range.

It seems that much of the Blue Mountains will lose its ability to store water predominantly as seasonal snow accumulation, thus land managers will need to consider how changing precipitation may create potential for runoff, soil destabilization, degradation to habitat, vegetation management strategies, and seasonal water availability.
(Credit: Clifton et al., 2018)

Figure 3A.1: Projected Change in SWE in Blue Mountain Forests



Gaps in Knowledge/Data/Policy:

- Effect of snow depth, soil moisture, and other atmospheric conditions and First Foods plant success;
- Magnitude and speed of shifts in precipitation patterns, and effects of intra– and inter-seasonal variability.

2. Faster Melt of Winter Water

River waters cycle seasonally: spring rain and snow melt contribute to high levels of water moving at a time when anadromous fish migrate back to their spawning grounds. As less winter snow falls, replaced instead by rain, this peak flow will become shifted earlier into the winter, and could cause a disconnect with fish migration and peak flow timing. Rain-on-snow (ROS) events are unique in this concern, because they compound multiple hazards:

- Rain is warmer than the snow that fell preceding, and melts the snow as it drains into river basins, increasing the magnitude of flooding effects.
- The snow also creates an impermeable barrier which prevents rain from infiltrating into the soil as it would on bare ground, resulting in additional water runoff potential.

Research conducted on soil types and snow covers typical of the Western U.S. estimate that a single ROS event increases the volume of flow in a river basin by 12% per event (Eiriksson, 2012). This means that a rain-on-snow event will cause rivers to flood by 12% more than if the rain fallen on bare soil. This greatly contributes to the magnitudes of flooding events during the winter season (Eiriksson, 2012).

Figure 3A.2 shows the modeling of frequency of heavy precipitation events for the Pacific Northwest measured over a 30 year average by the middle of the century under an A1B climate scenario (Salathe et al, 2014):

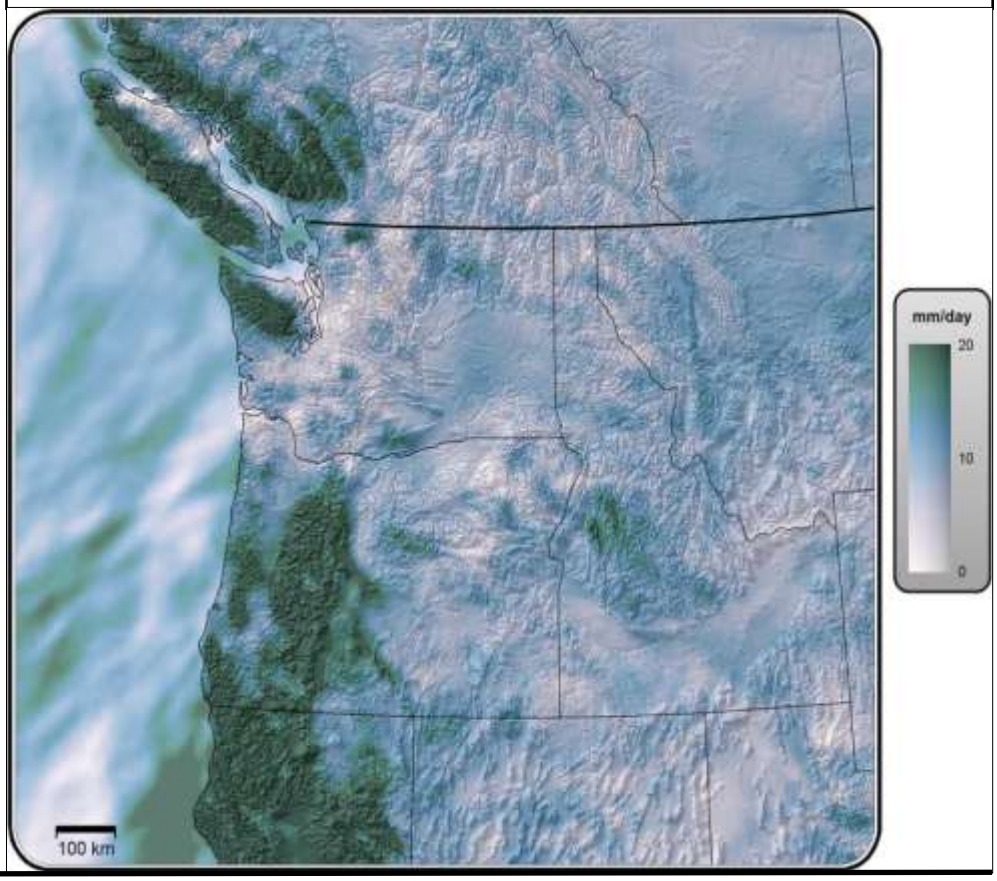
- An estimated **12% increase in the maximum daily precipitation into 2050 is anticipated across much of the Blue Mountains**, meaning that heavy precipitation events will become more frequent.

Through very elementary math, we can do some simple calculations about what this information means when considered together:

- If 30% of those heavy precipitation events are ROS events, then a 43% increase in river flow during winter can be expected.
- If 50% of heavy precipitation falls as ROS, then a 72% increase in winter river flow is projected.
- While extremely unlikely, if 100% of these events result in rain falling on snow, then a 144% increase in the magnitude of river flow is anticipated as a direct result of the type of precipitation falling, and the material that it is falling upon.

Increasingly frequent heavy precipitation events, as well as ROS events, will create a faster melt of snow pack that does manage to accumulate. Water managers should plan for flashier rainfall during all seasons but especially for flood events, with the potential for greater intra– and inter-seasonal variability.

Figure 3A.2: Projected Increase in Heavy Precipitation by 2050

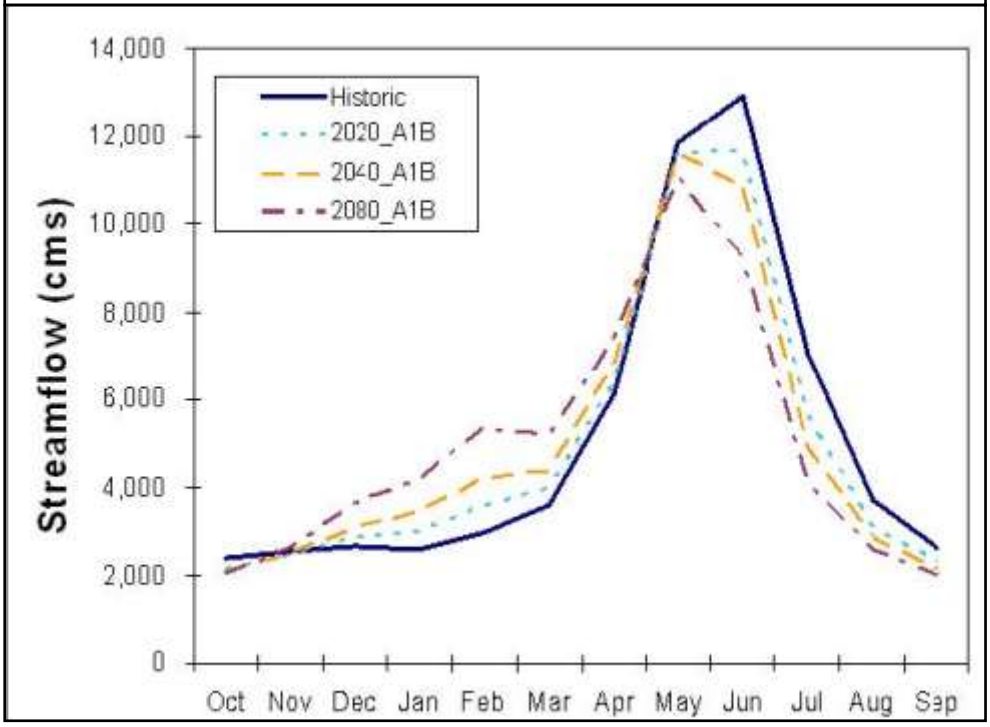


(Credit: Salathe et al, 2014)

Gaps in Knowledge/Data/Policy:

- Effect of land use on ROS erosion; how do different land use and management strategies affect topsoil erosion and overland flow into waterways.
- Effect of atmospheric rivers on precipitation patterns and seasonal variability.

Figure 3A.3: Streamflow Shifts for Mid and Late 21st Century



3. Shifted Seasonal Hydrology

"Hydrologic aspects of water quality within the Umatilla River Basin center on the flow regime (pattern of water discharge) in the river, which follows a distinctive seasonal pattern. Substantial flood pulses occur in late winter and early spring following rain-on-snow and warm "Chinook" winter wind events. Low flows occur in the summer when groundwater inputs and occasional rain events in the Blue Mountains maintain river base flows. Minimum flows observed in the dry months represent the approximate lower limit of discharge ranges necessary to sustain aquatic and riparian communities (Umatilla River Vision, 2011)." With warmer winters, flood pulses and peak flow will shift earlier into the winter, and could cause disconnection with seasonal fish migration timings.

Figure 3A.3 shows the projected change in peak flow measured at The Dalles Dam, OR, along the Columbia River, under climate scenario A1B (Hamlet et al 2010).

- Historic river conditions are shown in the solid black line, with peak flows typically during spring months (March to May).
- Light blue hashed line shows projections for 2020 are already displaying a shift in current conditions.
- Yellow hashed lines project 2040 conditions, where a second peak of flow is forming in winter.
- Red hashed line projects out to 2080, showing a definite second peak occurring February to March.
- This is an estimated shift of roughly 30 days earlier (from mid-June to mid-May), as well as a smaller peak from mid-January through February by 2080 (Hamlet et al 2010).
- Most recent modeling from the Climate Toolbox predicts a shift of roughly **30 days by 2040**, **40-50 day shift by 2070** under both high and low emissions scenarios, and **45-50 days under both by 2100 (**US Climate Toolbox, 2021) .
- Also anticipated is a reduction of peak magnitude of about 21,000 cfs for the high emissions scenario, all measured that The Dalles, Oregon.
- Other projections for McNary Dam on the Columbia River also project a 30-day shift earlier by 2070 (Dalton et al 2020) and a similar 30-day earlier shift for the Umatilla River measured at Pendleton, with peak flow moving from April to March (Dalton et al 2020).

With peak flows shifting over a month earlier into the spring, there are questions of whether aquatic animal species will be able to adapt their own lifecycles to accommodate for this shift, or if they will struggle to succeed. Resource managers will need to prepare for earlier high flows and wet ground conditions.

(Credit: Hamlet et al., 2010)

Gaps in Knowledge/Data/Policy:

- How First Foods migration patterns might be altered or impacted by these shifts;
- Changing energy generation and irrigation needs.

4. Lower Summer Base Flow

"Low flows occur in the summer when groundwater inputs and occasional rain events in the Blue Mountains maintain river base flows. Minimum flows observed in the dry months represent the approximate lower limit of discharge ranges necessary to sustain aquatic and riparian communities (Umatilla River Vision, 2011)."

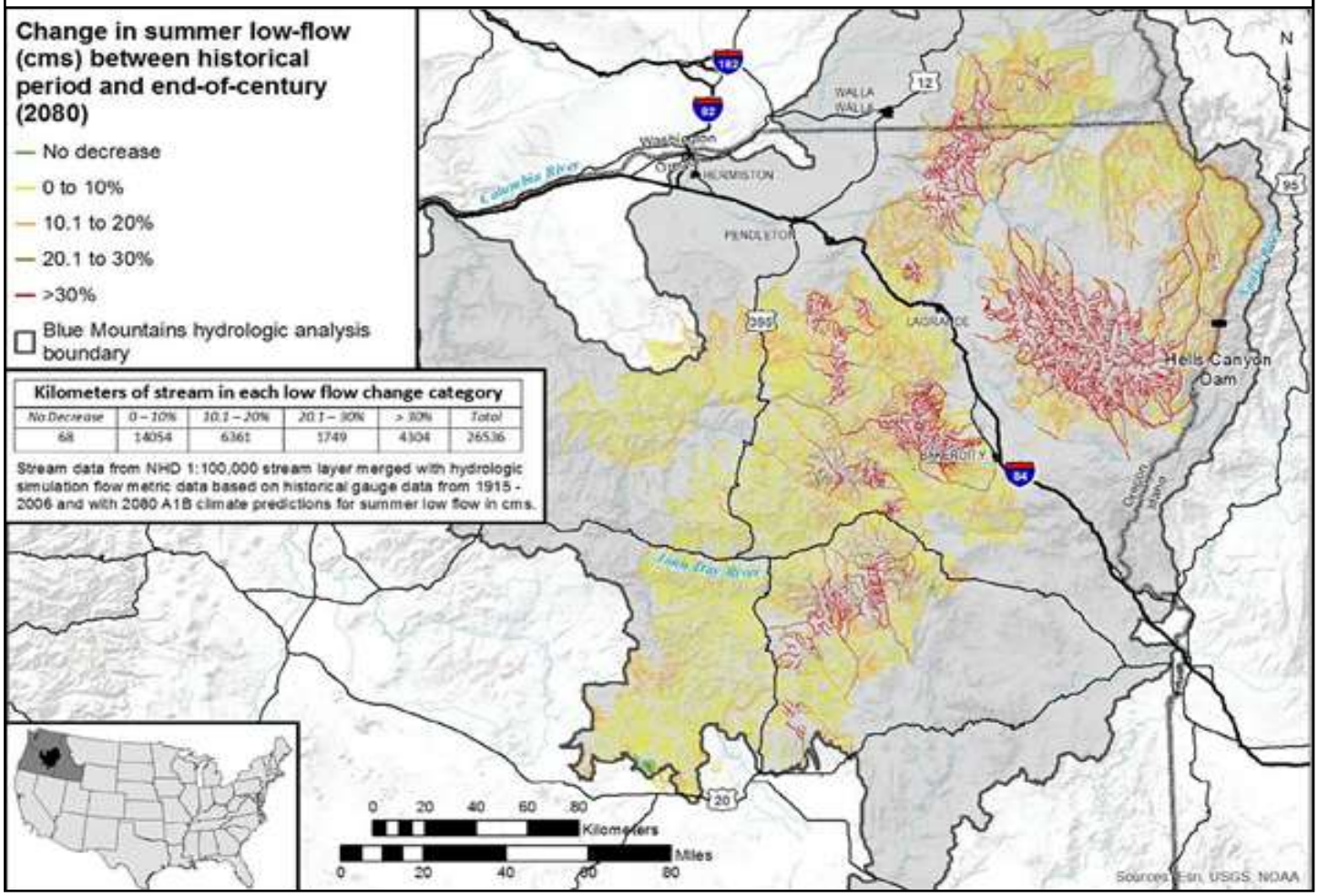
As peak hydrology shifts earlier into the winter, rivers that rely heavily on melting spring snow for summer flows will see a reduction in water storage capacity. This is likely to result in more intense periods of summer drought, and will increase the temperatures of the waters that do flow, secondarily concentrating sediments and pollution.

This will negatively impact the aquatic life that require consistent flows of cold, clear water, such as migratory salmon and lamprey, residential trout and sedentary freshwater mussels that are unable to rapidly migrate to better conditions.

Figure 3A.4 provides a projection of summer flow decreases to 2080 in the Blue Mountain National Forests under a 3˚C (5.4°F) of warming scenario:

- Streams marked in green will experience no decrease in summer flow; orange and yellow colors will likely see a 10-30% summer decrease.
- Streams in red will experience flow reductions of greater than 30% as compared to a historical average.
- In the Blue Mountains, we see that **roughly half of river basins in this region will see small**

Figure 3A.4: Reduction in Summer Stream Flow in Blue Mountains by 2080



decreases of less than 10% for perennial streams; this includes an estimated 14,054 miles of stream (Clifton et al 2018).

- Some more sensitive regions such as the Wallowa Mountains, Elkhorn Mountains, Wenaha-Tucannon Wilderness are likely to experience a **decrease of up to 30% by 2080; this includes an estimated 4,104 miles of stream** (Clifton et al 2014).

It is likely that much of the Blue Mountain foothills will escape the most severe impacts since they are already predominantly rain-fed. The most severe impacts to summer flows for higher elevation river systems such as the **Lostine, Minam, and Imnaha Rivers, the North Fork John Day River system, and the Grande Ronde and Wenaha Rivers**.

These areas could be good locations to expand efforts to improve floodplain connection, for natural water storage in soils. Engineered options for water storage could also be explored: engineered wetlands and aquifer recharge storage projects could increase regional capacity to store plentiful water in winter months for release during summer months. Policy improvements could also be made to support the recognition of in-stream water needs and rights, and a reduction in consumptive water use throughout these heavily impacted and agricultural basins.
(Credit: Clifton et al, 2018)

Gaps in Knowledge/Data/Policy:

- Drought early warning system protocols and data collection; what are the ecological, health, and industrial trigger points of drought, and monitoring for these routinely.

Adaptation Goals for Surface Waters

A. Conservation of Water in River Systems

i. Natural Storage

"High-flow events provide temporary surface water connections between main channel and off-channel aquatic habitats, build and rearrange important channel and gravel-bar features across the floodplain thereby maintaining habitat diversity, enhance water movement… facilitating hyporheic water flux, and recharge the alluvial aquifer with water. A functional river, then, is dependent on the sufficient magnitude and frequency of flood events to maintain dynamic channel patterns and adequate water exchange rates between the channel and floodplain sediments (Umatilla River Vison, 2011)."

Short Term:

- **Quantify water storage and releases** as cold summer flows resulting from restoring floodplain connection and revegetation efforts.

- **Survey existing and potential restoration efforts to explore other potential locations on the UIR and across the basin** to create effective water storage with minimal continuing input.

CTUIR Water Resources staff routinely conduct stream surveys for surface water quality and quantity (pictured).

Long Term:

- **Prioritize healthy functioning river systems** for storing abundant winter flows which require minimal energetic input to operate, unlike engineered solutions.

- **Continue to implement Umatilla River Vision touchstone rehabilitation efforts** where opportunities arise.

- **Plan and actively facilitate the restoration of native beaver** (*Castor Canadensis*) within watershed restoration as appropriate per location and project phase.

ii. Engineered Storage

Engineered water storage systems already exist within the Umatilla River basin, and can be used as pilot examples for calculated winter water withdrawal and storage.

Short Term:

- **Explore research and monitoring of issues of chlorinated byproducts** like trihalo methane associated with deep aquifer storage water permeability in clay soils.

Long Term:

- **Invest in infrastructure designed to help artificially store water** during winter high flows for agricultural and municipal need. These could include (but are not limited to): water injection systems, infiltration pits, swales, rain water catchments, and permeable pavement, among others.
- **Develop and implement engineered wetlands and beaver dams** along tributaries that would be appropriate across the Umatilla Basin and other watersheds in CTUIR Ceded lands.

iii. Water Conservation Plan and Re-Use Initiatives

Reducing water demand overall will leave more in streams for fish and other First Foods needs. Water conservation initiatives can be enacted at a Tribal government, community, or family scale.

Short Term:

- **Develop a community-focused Water Conservation Plan** with specific strategies, goals, and monitoring procedures to quantifiably reduce water demand at an individual, family, government, and community scale.
- **Organize education and awareness campaigns for water conservation strategies** aimed at individuals and families, including knowledge sharing events, art and other creative engagement activities, youth projects, social media posts, and Confederated Umatilla Journal (CUJ) outreach efforts.
- **Investigate capacity to provide financial incentives or access to credit** to improve home and municipal buildings to reducing the consumptive demand of water resources to support water conservation.

Long Term:

- **Pursue investments in infrastructure to reduce water use**, or designs to recapture water; many buildings will require capital to implement upgrades or new facilities constructed to make more efficient use of water.
- **Expand use of native plants in landscaping** and reduce the acreage in turf grasses, like lawns, to reduce irrigation demand.

B. Expand Umatilla River Vision

i. Redirect Development Out of Current and Expanded Floodplain

"Managing the Umatilla River and floodplain to allow lateral inundation contributes to maintaining habitats for native riverine communities. Constraining high flows concentrates stream power (and energy to move sediments) within the main channel, resulting in an incised channel with faster flows (Umatilla River Vision, 2011)."

Relocating and decommissioning infrastructure in floodplains allows for greater reconnection opportunities.

Short Term:

- **Conduct climate-adjusted flooding magnitude visioning and mapping exercises**, with support from Federal Emergency

Management Agency (FEMA) and CTUIR Office of Information Technology (OIT) Geospatial Information Systems (GIS) program.

Long Term:

- **Develop urban and rural planning frameworks to prioritize removing, relocating, or restricting development in the floodplain zones.** This might mean creating policies that explicitly prohibit certain residential and industrial development in the floodplain. Tribal Planning Office (TPO) currently imposes some floodplain building restrictions, and would be involved in this process.

- **Advocate for restoration of river floodplains and implementation of the Umatilla River Vision across the CTUIR Ceded lands** to build non-Tribal understanding of the need for reconnection to preserve water quality and quantity.

Debris located in the river's expanding floodplain like vehicles (pictured) could be washed into the channel during high water events. (Feb 2020)

ii. Prioritize Riparian Property for Acquisition

"The spatial distribution of surface water across the floodplain drives the active and continuous exchange of water between the river channel and river gravels, as well as subsurface movement of river water through river gravels (Umatilla River Vision, 2011)." Land ownership on the UIR is a checkerboard and there are many private home sites and industrial operations located in the CTUIR watershed floodplains that could be acquired.

Short Term:

- **Develop a plan to acquire properties along riparian corridors** as properties come available for ownership transfer; see Ch 3F pages 234-235 for additional detail.

- **Advocate for expansion of state and federal resources dedicated to assisting Tribes with purchasing at-risk properties** within existing and expanded floodplains. FEMA operates these programs in many states, and opportunities could be expanded in Oregon and Washington.

- **Examine previous historic flooding events to anticipate where future problems with property developments are likely to occur**. These include the extraordinarily high flows of February and May 2020 and those from the past 60 years, including 2019, 1995, 1996, 1975, and 1965.

Long Term:

- **Support and expand riparian land acquisition priorities within CTUIR committees, commissions, plans and codes** to increase the resiliency of water systems through Tribal governance.

- **Develop or expand purchasing options for flood-damaged property acquisition**; 8-10 of these properties damaged in Feb 2020 were purchased by a joint CTUIR and Federal Emergency Management Agency (FEMA) program as a result of this flood.

C. Collaborate for Floodplain Reconnection & Restoration

i. Expand Restoration Scope and Develop Mutually Beneficial Evaluation Criteria

CTUIR is already engaged in restoration activities both on the UIR and in the traditional use area. Current efforts are concentrated on tributaries within reservation boundaries, but it is likely that supporting restoration efforts on the main channel of the Umatilla River will be necessary.

Short Term

- **Identify various watershed stakeholder groups**

whose interests align, and who recognize the need for action with mutually beneficial solutions around water conservation.

- **Collaborate with other regional land managers to form drought early warning and response systems, and water conservation plans** for agricultural and ecological drought conditions.

- **Develop additional technical guidance documents for First Foods land management support**, like the Umatilla River Vision, and the First Foods Upland Vision. These could be guidance support for agricultural, forestry, range, and other land management practices and training.

Long Term:

- **Advocate for prioritization of Indigenous knowledge for water management and conservation with municipalities and counties** in CTUIR Ceded and traditional use lands.

- **Support Indigenous and nature-based rights at state, national and international levels.**

D. Water Quality & Quantity Monitoring and Data Collection

"In addition to using conventional physio-chemical measures, evaluation of water quality in the Umatilla Basin must also include appropriate measure of biotic communities and hydrologic processes associated with high ecological health. To be successful, then, the First Foods paradigm must integrate the methods and means of water resource management into the concept of 'water quality.' Regardless of water physio-chemistry, water quality is low anywhere water is managed in ways that are incompatible with the ecological integrity (or "health") of the river (Umatilla River Vision, 2011)."

i. Support Existing Data Collection and Management Efforts

Many different agencies and entities, including CTUIR, contribute to water quality and quantity data collection throughout the Umatilla Basin and across the Ceded and traditional use areas.

Short Term:

- **Develop predictive models** that utilize CTUIR and other water data for use in tracking flow trends as they change over time.

- **Develop approaches to incorporate climate-shifted hydrologic modeling into existing CTUIR policy documents,** such as (but not limited to) the CTUIR Water Code, annual land leasing for irrigation, groundwater pumping and well permitting, and "total maximum daily load" (TMDL) water quality standards.

Long Term:

- **Continue to support Oregon and Washington water gauging stations** that contribute to CTUIR data collection, especially those located in the Umatilla and Walla Walla River basins.

ii. Pursue Additional Funding for Expanded Monitoring & Analysis

Actively pursuing additional grant and agency funding for data collection and analysis efforts will assist in planning.

Short Term:

- **Identify areas where gaps in data**

collection and relevant water and atmospheric condition information exist, and implement projects to address these gaps.

Long Term

- **Pursue opportunities for additional data collection stations at mid-elevation ranges in the Blue Mountains** to facilitate early warning of heavy precipitation and high flow/flooding events.

- **Develop, fund, and implement establishment of flooding and drought early warning protocols**, along with action trigger threshold values, and community response guidelines, and have these included future revisions of the CTUIR Emergency Operations Plan (EOP).

River-adjacent infrastructure, such as the Union Pacific Railroad line along Meacham Creek (pictured left), is threatened by flooding and also impedes floodplain reconnection.

- **Pursue additional support funding for data continuation and analysis** to improve understanding of surface and groundwaters connectivity, and how readily sources respond to water conservation and storage measures.

E. Water Administration, Modeling, and Management Strategies

"Privatized and extractive use of natural resources has environmental consequences for the Umatilla Basin, including the degradation of ecosystem processes that once supported the natural production and harvesting of First Foods for consumption by Tribal Members. Additionally, private land ownership and extractive resource use have created challenges to basin-wide management of resources necessary to sustain First Foods ("Saxu|Siwaala|Seewi'cs: River Mussels Through Time," 2015)."

How water is metered and used must be adaptive enough to respond to changing conditions. Water use on the UIR is regulated by the Tribal Water Commission (TWC) and by the Water Code policy.

i. Support Adaptable and Responsive Water Governance

Variability in seasonal conditions is a large part of the challenge climate change will bring. Building flexibility and responsiveness into systems governance will allow CTUIR to have appropriate contingency plans to address flooding and drought.

Short Term:

- **Support Tribal Water Commission (TWC) operation** in their ability to regulate water use on the UIR, and to provide a liaison capacity between stakeholders, Tribal Members and community, and the Tribal government.

- **Update CTUIR Water Code and other related water policy** to anticipate for changing seasonal conditions, and specify areas where adaptation are necessary.

- **Identify various water curtailment and conservation strategies** with the Tribal community, and develop a plan to implement and expand these efforts, and skills associated with implementation.

Long Term:

- **Develop and implement storm and overland water runoff capture strategies** to reduce water loss during heavy precipitation events.

- **Consider developing and implementing a progressive water use metering and pricing framework** rooted in earned income to reduce burden on lower income families.

ii. Build Capacity for Regional Water Governance

CTUIR is a leader in the Pacific Northwest region, and policies set by the tribe have a far-reaching effect. Improving the range of CTUIR decision-making power for water governance could improve water conservation efforts for the region.

Short Term:

- **Collaborate with DNR Energy and Environmental Sciences Program (EESP) to implement deep groundwater monitoring** and data collection in coordination with geothermal power generation fact-finding efforts, such as borehole drilling, among others.

- **Organize and facilitate a Tribal community conversation about the potential to develop a McKay Conveyance system** for consumptive use purposes to relieve stress on in-stream water needs.

- **Organize and facilitate updates to previous CTUIR water audits**, to collect water use information from Tribal facilities, and from volunteer usage reporting from UIR residents, and for water conservation planning efforts.

- **Expand and support "Place Based Planning" efforts to proactively plan for water needs**, and engage with additional stakeholders and outreach opportunities; Grande Ronde River Basin planning with DNR and Oregon Water Resources Department (OWRD) is a regional example of this work.

Long Term:

- **Develop legally defensible accounting methods for quantifying water conservation savings** in a protocol, as part of water conservation strategies to fortify in-stream water rights claims.

- **Develop a strategy for gray water treatment and landscape irrigation use**; Buffalo Peak Golf Course in La Grande, OR, is an example of how such waste water can be recaptured for use.

- **Support and expand regional and Tribal community outreach around water conservation**, to help families feel empowered to address reducing and changing water needs.

Community and youth education about watershed science and data collection strategies will improve the capacity of Tribal nations to monitor changing stream conditions. In turn, this will expand CTUIR's ability to maintain regulatory status and implement adaptations as necessary, in line with Tribal Water Commission guidance.

How Do We Measure the Success of These Adaptations?

"Cúuš is tamánwit and we must teach and live tamánwit. We must share water with all living things. If we do not share, our greed will harm us. We must not look upon waqíšwit (life) as the šiyápu. We must take care of the water. Seven generations in the past we had good water. Seven generations in the future we must give back the same that was lent to us by Aniłá (the Creator); cold, clean water. So we think of fourteen generations of cold, clean, plentiful water. As we did seven generations back, so should we be able to do seven generations in the future, go to any stream or river and get cold clean water to drink (CTUIR Water Code, 2005)."

- **Connectivity via Umatilla River Vision Touchstones** (hydrology, geomorphology, connectivity, native riparian vegetation, and native aquatic biota).
- **Comprehensive Plan Objective 5.6.3:** To Protect, enhance, and restore functional floodplain, channel, and watershed processes to provide sustainable and healthy habitat for aquatic species of the First Food order (Comp Plan page 81 for benchmarks).
- **CTUIR Water Code Section 1.05. Statement of Policy B. Goals of Water Management:** The primary goals of water management are to conserve the quantity and maintain or improve the quality of water resources; protect and restore cold clean pure water consistent with the Tribal Water Quality Standards; maximize the beneficial use of water resources; promote diversity and protection of beneficial uses; promote the orderly economic development of the Reservation; and coordinate water use with land use and other planning on the Reservation (page 5);
- **CTUIR Water Code Section 1.05. Statement of Policy D. Use of Water without Waste**: In developing and utilizing water resources, water users shall appropriate water for beneficial purposes without waste. Regulations shall be developed and implemented to discourage the misuse or waste of water, and penalties shall be imposed on persons who misuse water or fail to cease practices that waste water (page 5);
- **CTUIR Water Code Section 1.05. Statement of Policy E. Water Conservation Required:** All official actions that allow persons to divert and use water resources shall be promulgated under the principle that the water user appropriates the minimum quantity of water required to accomplish the purpose of the diversion. To this end, standards and regulations shall be promulgated which require conservation in the allocation, use, and development of water resources and shall provide incentives for water users to practice water conservation (page 5);
- **CTUIR Water Code Section 3.07:** Water Quality Management Planning Goals and Objectives (page 42).
- **CTUIR Hazard Mitigation Plan (2021) Section 3: Hazard Identification and Risk Assessment**—Drought (page 74-78)
- **CTUIR Hazard Mitigation Plan (2021) Section 3: Hazard Identification and Risk Assessment**—Flooding (page 95-107)
- **CTUIR Hazard Mitigation Plan (2021) Section 4: Hazard Mitigation Strategy** (pg 192-208)
- Umatilla Basin Water Rights Settlement negotiations (ongoing).
- Tribal Water Commission (TWC) Annual Reports.
- WRP Annual Work Plans and Activities.

What Gaps in Knowledge, Policy, Capacity, or Education Exist?

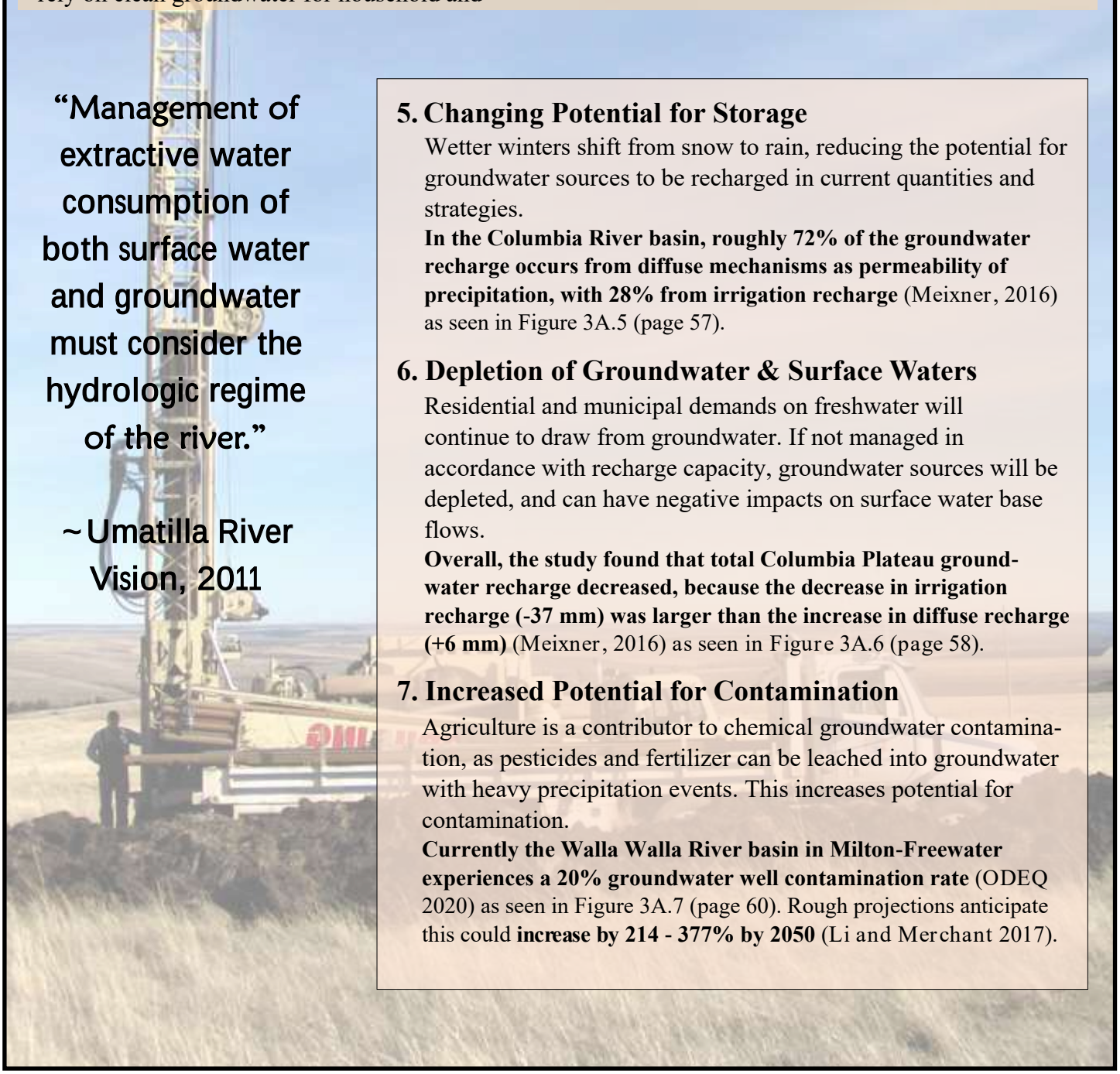
- Changing supply of surface water in light of irrigation diversion like the Umatilla Basin Project;
- Sustained drought effects on water availability and surface water flow;
- Quantification of water conservation measures to be incorporated into water rights calculations;
- Responding to communities and stakeholder around water policy, use, and conservation.

Climate Impacts for **Groundwaters**

"Levels of groundwater and surface water are intricately linked as reductions in surface water levels may diminish groundwater levels (and vice versa)… Thus, management of extractive water consumption of both surface water and groundwater must consider the hydrologic regime of the river (Umatilla River Vision, 2011)."

Water stored in shallow aquifers is critical for summer base flow in streams, and many people rely on clean groundwater for household and drinking water needs.

Roughly 60% of surface waters in the Blue Mountains and 100% of UIR residential water supplies are fed by groundwater sources. Impacts to these vital contributions to future regional hydrology must be considered. In modern times, CTUIR has been able to maintain its groundwater supply, but more information is necessary to know how changes in climate will affect the recharge of these unique and essential systems.



"Management of extractive water consumption of both surface water and groundwater must consider the hydrologic regime of the river."

~Umatilla River Vision, 2011

5. Changing Potential for Storage

Wetter winters shift from snow to rain, reducing the potential for groundwater sources to be recharged in current quantities and strategies.

In the Columbia River basin, roughly 72% of the groundwater recharge occurs from diffuse mechanisms as permeability of precipitation, with 28% from irrigation recharge (Meixner, 2016) as seen in Figure 3A.5 (page 57).

6. Depletion of Groundwater & Surface Waters

Residential and municipal demands on freshwater will continue to draw from groundwater. If not managed in accordance with recharge capacity, groundwater sources will be depleted, and can have negative impacts on surface water base flows.

Overall, the study found that total Columbia Plateau groundwater recharge decreased, because the decrease in irrigation recharge (-37 mm) was larger than the increase in diffuse recharge (+6 mm) (Meixner, 2016) as seen in Figure 3A.6 (page 58).

7. Increased Potential for Contamination

Agriculture is a contributor to chemical groundwater contamination, as pesticides and fertilizer can be leached into groundwater with heavy precipitation events. This increases potential for contamination.

Currently the Walla Walla River basin in Milton-Freewater experiences a 20% groundwater well contamination rate (ODEQ 2020) as seen in Figure 3A.7 (page 60). Rough projections anticipate this could **increase by 214 - 377% by 2050** (Li and Merchant 2017).

5. Changing Potential for Storage

Changing precipitation will alter the ways in which groundwater is recharged, especially in mixed rain/snow hydrologic systems like the Blue Mountains.

At higher elevations in the Blue Mountains, such as the Elkhorn or Eagle Cap Wildernesses, groundwater recharge is more likely to be driven by accumulation of snow pack in winter months. Lower elevations are more likely to rely on winter and spring precipitation in the form of rain absorbed into soil moisture.

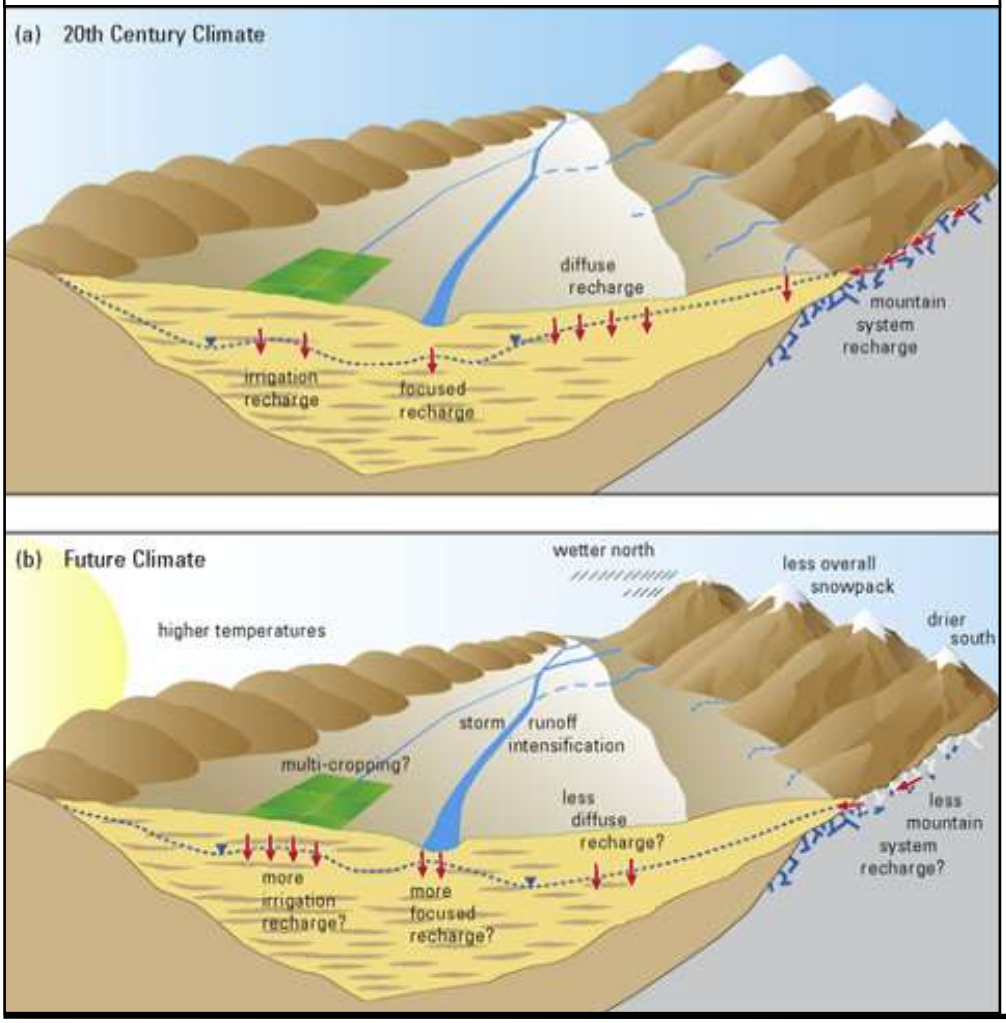
Figure 3A.5 illustrates the four major ways groundwater has historically been recharged, and how climate change is likely to alter those connections.

- In the **Columbia River Plateau basin, roughly 72% of the groundwater recharge occurs from diffuse mechanisms** (precipitation) as direct infiltration and percolation into the water table.
- The second largest contributor is from irrigation recharge, which is excess irrigation water as it percolates downward and enters shallow aquifers.
- Other forms of recharge include mountain systems recharge (MSR) at high elevations (usually headwaters), and focused recharge that occurs at ephemeral streams and other points such as hyporheic zones.
- Compared to the Columbia River, the **Spokane River Valley has a more diverse set of recharge mechanisms, with 57% coming from focused recharge at ephemeral streams and other hyporheic zones, 24% from mountain systems, and 16% from diffuse recharge;** the remaining 3% is from irrigation recharge.

For CTUIR Ceded lands, it can be approximated to include a combination of these two groundwater systems, though more detailed data collection is necessary:

- Columbia River Plateau groundwater systems, like the Umatilla and Walla River basins; and
- Mid-elevation mountain ranges like Laliik (Rattlesnake Mountain), North Fork Umatilla River, John Day and Wenaha-Tucannon Wildernesses, and the Wallowa-Whitman, Malheur and Umatilla National Forests should be looking to maximize rainfall infiltration into upland soils for diffuse recharge mechanisms.
- Higher elevation locations like the Elkhorn, Eagle Cap, and Hells Canyon Wildernesses are assumed to share groundwater system attributes similar to the Spokane River Valley system, could also benefit from diffuse recharge strategies. But greater potential comes from improving focused recharge along river-ways, such as engineering wetlands and increasing stream

Figure 3A.5: Groundwater Impacts from Climate Change



meander and channel complexity.
Resource managers should develop research into specifying which recharge mechanisms exist for different watersheds across the CTUIR Ceded lands. (Credit: Meixner, 2016)

Gaps in Knowledge/Data/Policy:

- Fine detail knowledge of Columbia basalt hydrology and specific response to climate impacts.

6. Depletion of Ground and Surface Waters

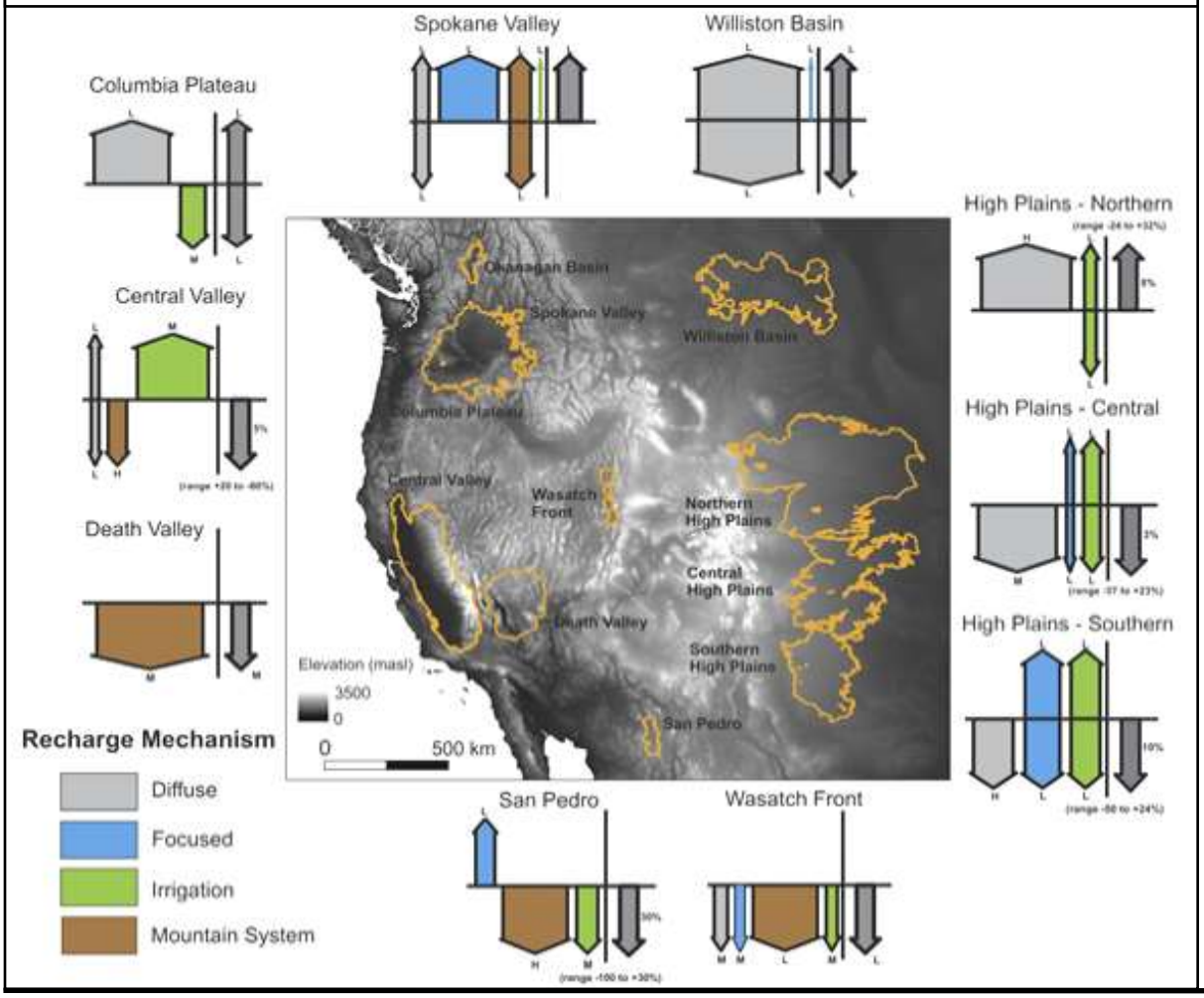
As reliability with natural groundwater recharge shifts, basins across the West will have different potentials for recharge due to their inherent geology. The geology and topography of the CTUIR ceded and traditional use lands is very diverse, and there is a lot of potential for different kinds of groundwater recharge mechanisms to be supported and enhanced.

While studies for the Blue Mountains groundwater have not been modeled, low elevations can be assume to be approximated by the Columbia River Plateau groundwater system, while higher elevations share groundwater system attributes similar to the Spokane River Valley system for the purposes of this plan.

Figure 3A.6 outlines the potential for each major river basin within CTUIR traditional use area for recharge with each of the different pathways to groundwater.

- Projections for different recharge mechanisms are estimated for different watersheds around the U.S. West. The size of the arrow indicates the magnitude of the change, while the direction (up/down) illustrates the direction this change is headed (increasing/decreasing). Diffuse recharge is shown as a gray arrow, focused recharge is shown as a blue arrow, irrigation recharge as green arrows, and mountain systems recharge as brown arrows.
- In the Pacific Northwest, simulated future diffuse recharge is projected to increase, as winter precipitation will be greater than needs of regional plants in cool months. This surplus of water as soil moisture can contribute to storage in permeable soils.
- However, in agricultural areas, irrigation recharge is likely to decrease, as crop plants will need much more water during growing seasons with increasing extreme heat (Meixner, 2016).

Figure 3A.6: Projected Shifts in Groundwater Recharge Capacity for Mid-Century



- For the Columbia Plateau system, the study found that **total groundwater recharge decreased, because the decrease in irrigation recharge (-37 mm) was larger than the increase in diffuse recharge (+6 mm)** (Meixner, 2016).

This study shows that even modest future increases in diffuse recharge could lead to an increase in total recharge across the whole Columbia River Plateau.

Within the Spokane Valley, focused Mountain System Recharge from upland tributary basins, and focused recharge from seasonal floodplain inundation and hyporheic exchange are the primary modes of groundwater recharge. In a climate shifted future, overall changes in recharge will hinge on whether the effects of warming — such as higher energetic needs from plants and animals— will outweigh the effects of increased precipitation.

- Focused recharge directly from rivers and associated reservoirs is expected to increase slightly given the close link between precipitation, river flows, seepage loss, and expected precipitation increases from warming temperatures.
- Knowledge of the properties of a basin's geology will help in adaptation planning to preserve the integrity and availability of groundwater resources.

Within the CTUIR's Ceded and traditional use lands, there are opportunities for diffuse groundwater recharge at low elevations including:

- Planting deep-rooting native or perennial grasses that facilitate soil moisture infiltration;
- Advocating for no-till agricultural dryland systems and long-term stable grassland ecosystems;
- Diverse crop rotations that retain soil health, water holding capacity, and increase soil carbon organic matter;
- Expanding flood zones to prioritize floodplain reconnection to facilitate greater opportunities for diffuse and focused recharge.

Within higher elevation systems, strategies that emphasize retaining soil moisture, increasing stream channel meander and decreasing water velocity strengthen focused recharge. First Foods habitat restoration, and strategically engineered wetlands can buffer ephemeral high flows would facilitate greater recharge in these high elevation mountain streams. Resource managers should proactively plan for greater ephemeral and runoff potential.
(Credit: Meixner, 2016)

100% of Umatilla Indian Reservation (UIR) residents rely on groundwater wells for home use. Drilling wells (pictured) is costly, and many well levels are dropping.

Gaps in Knowledge/Data/Policy:

- Specific infiltration potential for Columbia basalts, and effects of non-irrigated agriculture on storage potential

7. Increased Potential for Chemical Contamination

Nitrate and pesticide leaching into groundwater contaminates watersheds that sustain First Foods, especially in heavily agricultural areas. Agricultural crops require inputs like nitrogen fertilizers, irrigation, pesticides and herbicides, and farming creates situations for the potential over application of chemicals in response to changing seasonal conditions.

These inputs directly contribute to the generation of greenhouse gases, and chemical inputs like pesticides and nitrate fertilizers can leach into surface and

groundwater through irrigation excess and heavy precipitation events. Farmland makes up over 80% of land use in Umatilla County, which is representative of much of the CTUIR Ceded lands.

Figure 3A.7 shows the locations of high pesticide concentrations in the Milton Freewater area of the Walla Walla River basin, sampled and reported in 2020.

- The Environmental Protection Agency (EPA) has set the maximum contaminant level for nitrate at 10 mg/L for nitrate levels.
- Wells were sampled for the presence of various pesticide contaminants (labeled "parent" in the map legend) and their chemical byproducts. On the map these wells are indicated by the color and geometry of detected contamination. Low levels of contamination are indicated in light blue, moderate contamination in orange, and significant contamination in green.
- Within the Milton-Freewater area of the Walla Walla River, **20% of wells had nitrate concentrations above what are considered natural level (higher than 3 mg/L), and 1% was above the maximum contaminant level (10mg/L).**
- The lower Umatilla River basin has already reached nitrate contamination levels high to be classified as a "groundwater management area" and is referenced as the Lower Umatilla Basin Groundwater Management Area, or "LUBGWMA" in Oregon State.

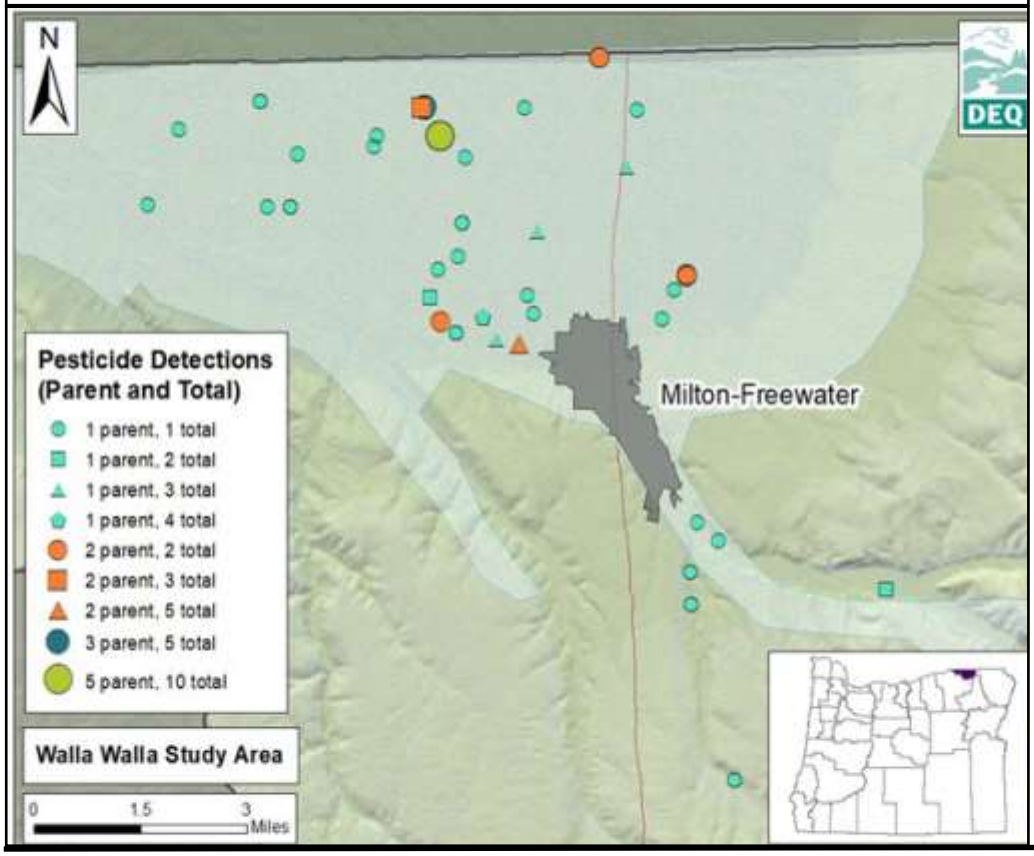
Because of significant gaps in data collection, understanding how groundwater contamination will change requires a proxy estimate. Contamination modeling studies conduction in North Dakota agricultural watersheds may offer some insight on how changing precipitation affects groundwater quality.

- From **2000 to 2020, this study predicted a 1,885-1,072% increase in "vulnerable" watersheds, and a 645-2,143% increase from 2020 to 2050 under different emissions scenarios** (Li and Merchant. 2017).
- While North Dakota will see different climate challenges than CTUIR, this can serve as an extreme prediction for the potential of groundwater contamination under climate change projections.
- Using the findings of this study, quick back-of-the-envelope calculations indicate residential wells within CTUIR ceded lands could **increase 214 - 377% in contamination by 2050,** though there are many variables and assumptions in this prediction.

Additional monitoring, data collection and sampling, and predictive modeling for the Columbia River basin would help in understanding how contamination risks are changing.

(Credit: Oregon Dept of Environmental Quality, 2020)

Figure 3A.7: Areas of High Pesticide Detection in Walla Walla Wells (2020)



<u>Gaps in Knowledge/Data/ Policy:</u>

- Monitoring and modeling of changing contamination risks and rates for CTUIR Ceded lands;
- Routine data collection for groundwater contaminants related to emission sources.

F. Create Opportunities for Infiltration

i. Restored Infiltration

"The spatial distribution of surface water across the floodplain drives the active and continuous exchange of water between the river channel and river gravels, as well as subsurface movement of river water through river gravels." (Umatilla River Vision, 2011)

Short Term:

- **Conduct community mapping exercises to identify opportunities to improve water infiltration** on the Umatilla Indian Reservation (UIR) and CTUIR Ceded lands; these could include natural, engineered, and behavioral strategies.

- **Support and advocate for education on benefits of wetlands and healthy river ecosystem function to diverse audiences**. Outreach to audiences should include (but not be limited to) Tribal families, youth and students, affiliation and partner organizations, and other regional non-Tribal private and public stakeholders.

Long Term:

- **Support and expand locations where wetlands and ephemeral streams exist to store excess water** and sequester it for the benefit of flood control, First Foods habitat, and water quality improvement. Opportunities could be located in areas affected by seasonal flooding or groundwater upwellings, such as along the Mission Creek Mission area.

ii. Engineered Infiltration

"When years with higher precipitation levels occur during the winter months resulting in a thicker snow pack at the higher elevation, sudden warming events have the potential to cause rapid melting of the snow pack and flooding in lower elevations. (CTUIR Hazard Mitigation Plan, 2016, 2021) Several municipalities and organizations within CTUIR's Ceded lands are building capacity for artificial storage, though these have a range of strategy and efficacy.

Short Term:

- **Examine regional water storage projects for community preference and feasibility**. Many locally are designed to serve primarily consumptive demands, and can have contamination and accumulation issues that need to be addressed. Examples include aquifer storage and recovery (ASR) with the City of Pendleton, and in Milton Freewater with the Walla Walla Basin Watershed Council.

- **Identify and inventory opportunities to improve groundwater infiltration for municipal/urban homes and communities locally**. These could include permeable pavement technology for sidewalks and roads, Rain gardens, bioswales, and compost operations, among others. Examples include aquifer storage and recovery (ASR) with the City of Pendleton, and in Milton Freewater with the Walla Walla Basin Watershed Council.

- **Identify and inventory opportunities to improve groundwater infiltration for municipal/urban homes and communities locally**. These could include permeable pavement technology for sidewalks and roads, rain gardens, bioswales, and compost operations, among others.

Long Term:

- **Upon completion, explore and research**

resiliency options related to the Umatilla Basin Water Rights Settlement, including potential for conveyance from McKay Reservoir, and other opportunities to convey stored water to the CTUIR homeland as appropriate.

G. Expand Groundwater Data Collection & Modeling

i. Support Existing Data Collection Efforts

Groundwater networks are highly complex, with some that interact across large distances, and others that are confined to their own geography. Knowing how groundwater sources are connected will allow for a more knowledgeable withdrawal and use planning, as well as locations where the most efficient areas of infiltration and exchange are for prioritizing restoration or artificial storage strategies.

Short Term:

- **Expand DNR Water Resources Program (WRP) pilot groundwater dating studies to examine recharge periods for select deep groundwater storage locations,** as an initial step towards determining the length of time it takes groundwater sources to recharge.

- **Continue and expand coordination between Tribal Planning Office (TPO) Environmental Health and Safety Specialist and WRP** to administer a broad set of codes that dictate the levels of contamination required to trigger advisories, and the protocols that are involved.

Long Term:

- **Support and expand CTUIR Dept of Natural Resources (DNR) WRP groundwater monitoring and data collection initiatives**, especially for the health and longevity of residential and industrial groundwater wells.

- **Identify gaps in water monitoring and management systems,** and where they could overlap and expand to improve CTUIR response to groundwater knowledge, modeling and monitoring.

CTUIR WRP staff monitor groundwater levels within the UIR. Well monitoring for water quantity and quality is done alongside Tribal Planning Office.

ii. Pursue Additional Funding for Expanded Monitoring & Analysis

Use of this water quality data for predictive planning could be expanded, and engagement with data from other basins in the traditional use area could be of guidance to adaptation planning efforts.

Short Term:

- **Actively pursue additional grant and agency funding for these data collection and analysis efforts,** especially as it could assist in the identification of climate-driven trends.

Long Term:

- **Expand capacity of water quality testing possible through the DNR Energy and Environmental Science Program (EESP)**, to include biological and chemical elements in its laboratory testing capability.

iii. Participate with Groundwater Contamination Efforts and Studies

Chemical contaminants are already a concern for the Umatilla River Basin as concentrations of nitrates from agricultural use throughout the watershed collect in the lower basin.

Short Term:

- **Participate with joint agency management efforts in the Lower Umatilla Basin Ground Water Management Area (LUBGWMA)** on groundwater contamination issues.

Long Term:

- **Expand and fund monitoring studies to provide information on how groundwater contamination rates are shifting** in response to land use and climate changes.

H. Opportunities for Regional Collaboration and Engagement

i. Outreach, Engagement, and Education

Watershed connection requires restoration and monitoring work to be done both on and off the UIR. Engagement of other entities as opportunities arise will expand the reach of the Umatilla River Vision.

Short Term:

- **Engage other public ate and private watershed stakeholders as project collaborators** where restoration and conservation goals align. Areas of contamination such as the LUBGWMA provide audiences and outreach opportunities for collaboration.

- **Support and expand Tribal participation with water education opportunities for all ages**. K-12 opportunities like Watershed Field Days, homeowner education about well, sewer, and septic services, and regional water conferences are examples of the kinds of educational opportunities available to pursue for water education.

Long Term:

- **Develop strategies within projects and work plans that empower communities around implementation of water conservation** and adaptation approaches. These might include community listening and visioning sessions, community science components to water monitoring initiatives, and providing incentives/financing assistance with infrastructure upgrades, among others.

- **Develop community-identified water use valuing systems to guide future decisions about water management**. These kinds of quantifiable valuing approaches could assist in communication of water conservation priorities across sectors.

ii. Leadership and Management

Communities and families have a role in preparing for changing water conditions. Providing education, access to services, and equipment necessary to be prepared is essential.

Short Term:

- **Continue, support, and expand CTUIR ability to apply "Treatment as a State" (TAS) status that promotes CTUIR as a leader in watershed quality and management;** this includes existing projects like the WRP TMDL water quality standards, the Umatilla Basin Project for irrigation supply and management, and consensus building innovations like the OWRD Place Based Planning project in the Grande Ronde Basin. See Ch 3G pages 273-274 for additional detail.

- **Incorporate CAP strategies** into CTUIR Annual Work Plans (AWPs), Board of Trustees (BOT) priorities, and other relevant Tribal governing documents, as well as developing measures of success relevant to each department and program.

Long Term:

- **Reduce groundwater pumping to levels supported by monitoring and demand.** Demand on groundwater supplies should be balanced with recharge potentials that vary in UIR locations.

- **Engage leaders at all levels in discussions of**

water management. Watersheds and floodwaters transcend human boundaries, and management requires leaders at different levels of jurisdiction to work cooperatively to address issues and find solutions.

Measuring Success and Gaps in Groundwater Adaptation

How Do We Measure the Success of These Adaptations?

" 'Cúušnimna inaknúwiyaša náaman λáaxw wáwnakwšaš' Water keeps all our bodies for us. Čúuš is a part of everything. It is within Natítayt, it is within Tiičám, and it is within Núsux (the salmon). It is essential for the survival of all life. Cold, clean, healthy water is the life blood of the land. We drink water to remind us of who we are. Cúuš cleanses and heals our bodies, "Płíx iwá čúuš" (CTUIR Water Code, 2005)"

- **Comprehensive Plan Objective 5.6.1**: To ensure that ground and surface waters are available to satisfy CTUIR Treaty Rights, the needs of CTUIR members, and the citizens of the Umatilla Indian Reservation (Comp Plan page 81 for benchmarks);
- **Comprehensive Plan Objective 5.8.2**: Quantify and adjudicate the CTUIR reserved rights to consumptive use of waters on the Umatilla Indian Reservation, to stream flows in the Umatilla River Basin, the Walla Walla River Basin, the Grande Ronde River Basin, the John Day River Basin, the Tucannon River Basin and to other areas with reserved water rights (see Comp Plan page 95 for benchmarks).
- **CTUIR Water Code Section 1.05 Statement of Policy F Groundwater Conservation**: Groundwater supplies are vitally important to the health and welfare of the citizens of the Reservation and to the progressive development of the Reservation economy. Development of water resources shall be controlled and regulated to prevent the depletion of aquifers and the overdraft of groundwater. Management of water resources shall protect and improve the quality of the groundwater resources (page 5);
- **CTUIR Water Code Section 1.05 Statement of Policy G Competition for Water:** Well Interference: Development of water resources shall be controlled and regulated to reduce or prevent well interference and competition for water between users (page 5);
- **CTUIR Water Code Section 3.07:** Water Quality Management Planning Goals and Objectives (page 42).
- **CTUIR Hazard Mitigation Plan (2021) Section 3: Hazard Identification and Risk Assessment**—Drought (page 74-78)
- **CTUIR Hazard Mitigation Plan (2021) Section 3: Hazard Identification and Risk Assessment**—Flooding (page 95-107)
- **CTUIR Hazard Mitigation Plan (2021) Section 4: Hazard Mitigation Strategy** (pg 192-208)
- Tribal Water Commission (TWC) annual reports.
- Water Resources Program Plan of Operations (1993), annual work plans, and completed activities.
- Umatilla Basin Water Rights Settlement negotiations (ongoing).
- Reduce groundwater pumping in vulnerable locations.
- Permit and allow new groundwater pumping only in places where recharge is proven.

What Gaps in Knowledge, Policy, Capacity, or Education Exist?

- Clear and detailed understanding of how long certain groundwater networks take to be recharged;
- Knowledge of how irrigation demand and management will change with changing climate conditions;
- Metering of consumptive water use for UIR residents and industries to establish conservation baseline measures;
- Coordinated water conservation outreach and voluntary management/monitoring participation;
- Impacts of engineered groundwater capture systems like ASR have on artisanal wells and sources.
- Tribal Member and community participation in monitoring and planning.

Water Adaptation Summary

Surface Water Adaptations

A. Conservation of Water in River Systems

B. Expand Umatilla River Vision

C. Collaborate for Floodplain Reconnection & Restoration

D. Water Quality & Quantity Monitoring and Data Collection

E. Water Administration, Modeling, and Management Strategies

Creating conditions for water conservation and storage buffer for water temperature and low flow impacts, and provide habitat for floodplain connection. Addressing opportunities for water recapture and understanding of unique hydrology will help develop adaptations that provide cold and clean water for all needs.

Measures of Success:

- Umatilla River Vision Touchstones (2011)
- CTUIR Comprehensive Plan (2010) Objective 5.6.3
- CTUIR Water Code (2005) Section 1.05 B, D, and E; and Section 3.07 for benchmarks.
- CTUIR Hazard Mitigation Plan (2021) Section 3: Drought (page 74-78), Flooding (page 95-107)
- Tribal Water Commission annual reports
- WRP Annual Work Plans and activities.
- Umatilla Basin Water Rights Settlement

Groundwater Adaptations

F. Create Opportunities for Infiltration

G. Expand Groundwater Data Collection & Modeling

H. Opportunities for Regional Collaboration and Engagement

Groundwater and surface waters are connected, and must be monitored and managed as such. Columbia basalts are unique in their groundwater behavior, and diverse locations have different recharge capacities. Understanding how these groundwater sources are affected at a local level is essential, and infiltration of high flows into shallow aquifers buffer for flood and drought.

Measures of Success:

- CTUIR Comprehensive Plan (2010) Objectives 5.6.1, and 5.8.2
- CTUIR Water Code Section 1.05 Statement of Policy F, and G; and Section 3.07 for benchmarks
- CTUIR Hazard Mitigation Plan (2021) Section 3: Drought (page 74-78), Flooding (page 95-107)
- Tribal Water Commission annual reports
- Reduce groundwater pumping in vulnerable locations
- Permit and allow new groundwater pumping only in places where recharge is proven

Chapter 3A References and Credits

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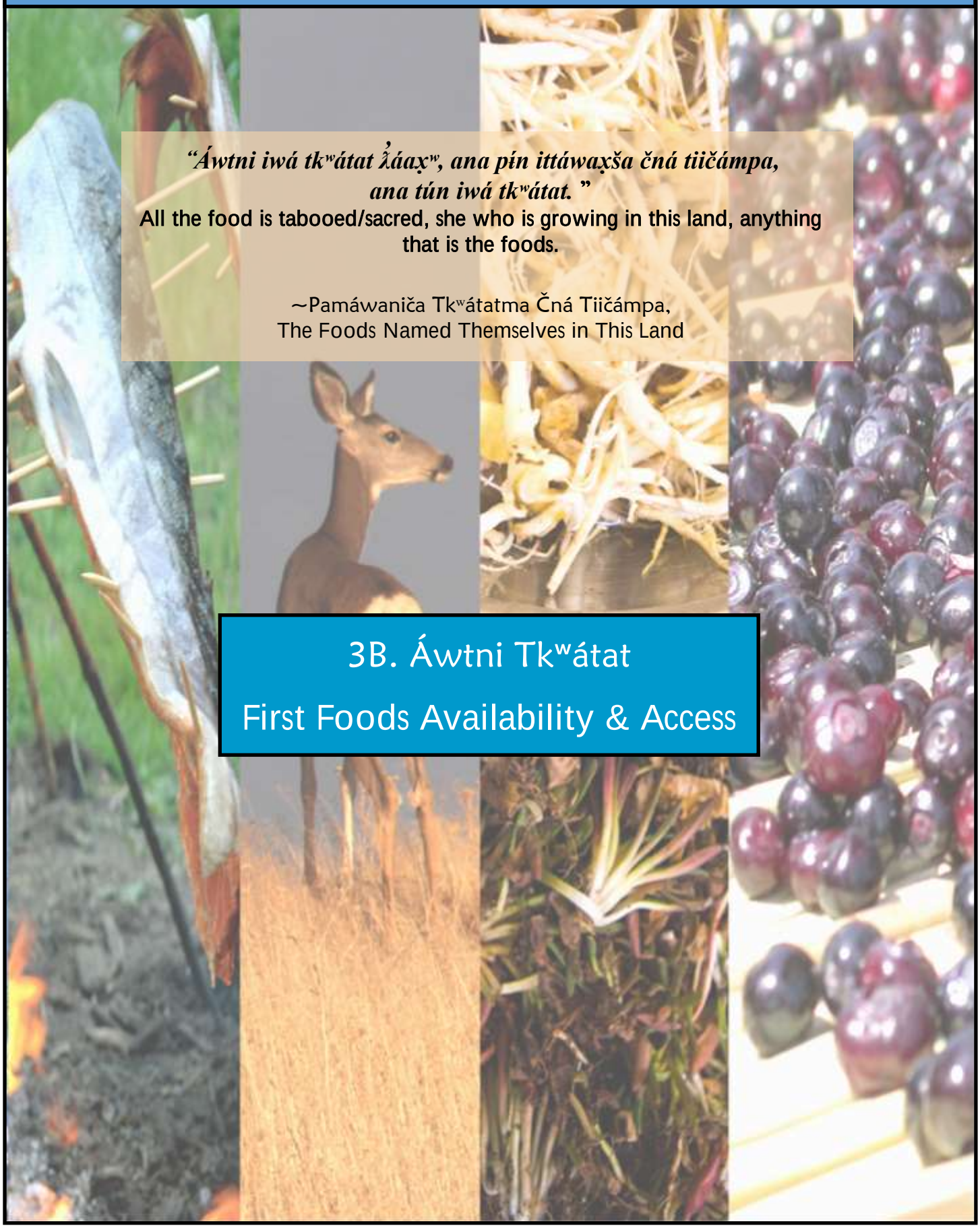
- Panel photo, "North Fork Umatilla River" CTUIR DNR FFPP 2022
- Inset photo, "WRP Craig Kvern conducting well testing outreach" CTUIR DNR WRP
- Summary Inset photo, "Lake Hiyuumtipin (Indian Lake) in Winter," CTUIR DNR WRP Craig Kvern 2017
- Panel Photo, "Rushing Feb 2020 Flood Waters," DNR WRP 2020



"Áwtni iwá tkʷátat ƛ̓áax̣ʷ, ana pín ittáwax̣ša čná tiičámpa, ana tún iwá tkʷátat. "

All the food is tabooed/sacred, she who is growing in this land, anything that is the foods.

~Pamáwaniča Tkʷátatma Čná Tiičámpa,
The Foods Named Themselves in This Land

3B. Áwtni Tkʷátat

First Foods Availability & Access

Climate Impacts for First Foods Availability

"The availability and long-term production of First Foods in the uplands throughout the Ceded lands requires healthy, functional ecosystems. Healthy ecosystems maintain their full array of ecosystem services, which are the benefits supplied to society by natural ecosystems."

(First Foods Upland Vision, 2019)

First Foods availability is challenged by climate change as a multiplier of existing threats to the success of these crucial species. There are many social, political, and economic barriers that threaten the health and abundance of First Foods. These complications interact with climate change impacts in ways that often make conditions worse for First Foods and for Tribal people who depend on them.

1. **Warming Surface Water Temperatures**

Peak winter stream flows will shift earlier into the year, and cause a reduction in water available in the summer season. Warmer air temperatures will also contribute to warming river systems, impacting aquatic species directly through potentially lethal temperatures and lower oxygen content, and terrestrial species through an increase in algal contamination.

17-20% increase in August stream temperatures at lower elevations and a 14-17% increase in higher mountain levels by the end of the century in 2100 (Clifton USFS 2018) in Figure 3B.1 (page 70).

2. Plant Habitat Suitability Migration

Habitat suitability depends on many factors such as stream temperature, vegetation type, topsoil erosion, and connection with environmental reciprocal relationships, such as with pollinators and host fish. As seasonal precipitation and temperatures change, suitable habitat for First Food species will shift as a result.

10—40% reduction in habitat suitability for huckleberries across much of CTUIR Ceded and traditional use lands, with some modest 15-30% increases in the Eagle Cap Wilderness, as in Figure 3B.2 (page 71). Timing of harvests may shift **1–2 months earlier** (Prevey et al 2019).

3. Impacts to Pollinators and Other Insects

Pollinators have complex plant-insect interactions that will be challenged by change, and First Foods ecosystems depend on native insects for heath and abundance. **Reduction in suitable habitat of 30% for Black-Notched Bumblebee (*Bombus bifarius*) and of 6% for the Fuzzy Horned Bumblebee (*Bombus mixtus*)** by mid-century as in Figure 3B.3 (Koch et al 2019) (page 73). Other pollinators to prioritize include **Narrow-Legged Miner Bee (*Andrena angustitarsata*), Blue-and-Black Miner Bee (*Andrena nigrocaerulea*), Small Green Miner Bee (*Andrena microchlora*),** and **Sweat Bees (*Lasioglossum*)** (Gardner 2019 and 2020).

4. Increased Invasive Species Pressure

Within aquatic systems, invasive mussel and predatory fish species thrive in hotter water temperatures which stress native fish. In terrestrial landscapes, invasive grasses are better suited to summer drought than native shrubs and trees. Additional atmospheric stress could increase invasive species competitive advantage over desired native First Foods and habitat species.

Aquatic Invertebrates (+59%) and Plants (+12%), and Terrestrial insects (+18%) will experience the largest Increase (Bellard et al 2013) in Figure 3B.3 (page 75). Specific weeds

"From this land in which the people lived and its incumbent seasons came the diet, the languages, and the customs that are distinctly appropriate and associated with the homeland. The traditional diet of fishes, meats, roots, greens, and fruits defined when and where the people traveled to harvest and process foods."

~ Wiyaxayxt| Wiyaakaa'awn: As Days Go By
(Conner and Lang, 2006)

5. Increased Riparian and Topsoil Erosion

Topsoil erosion is more likely to occur with climate change as a risk multiplier. As the seasonal hydrology shifts, opportunity for water infiltration into the soil will decrease, creating more potential for sediment to enter waterways. While conservation farming practices mitigate some impacts, erosion potential still increases.

Future erosion under conventional tillage experience 192% increase in soil loss, and roughly 115% increase under conservation tillage/no-till, for 4˚F (2.2˚C) scenario (Farrell et al, 2015) as seen in Figure 3B.5 (page77).

6. Disconnect Between Vegetation Growth and Big Game Nutritional Needs

Native plant forage will be impacted by changing precipitation patterns; this is likely to result in a disconnection in the seasonal window big game reproductive females have to produce calves and milk they will need. This could reduce fitness in some herds and could alter the frequency of seasonal calving.

Large data gaps exist; rough estimates anticipate peak forage growth will shift earlier in the year, affecting fat accumulation and milk production in female elk, and is likely to negatively impact elk calf success and frequency of birth (Wisdom et al, 2017) as seen in Figure 3B.6 (page 79).

7. Changes in Plant and Animal Pathogen Potential

Animals and plants are susceptible to disease and pathogens, which are likely to have an altered distribution and virulence under warmer conditions. New strains or changed relationships with existing illnesses are likely to cause impacts to First Foods success.

Many data gaps exist. **5°C (9°F) winter temperature increase results in a 15% increase in infection of one-year old conifer needles, and a 30% increase in infection for two-year old needles** (Stone et al 2008) as seen in Figure 3B.7 (page 80). Other diseases of note include: Big Game illnesses like **M. ovi**, and **Epizootic Hemorrhagic Disease (EHD)**; fish illnesses like **Ich and Furunculosis**; and conifer pests like **Western Pine Beetle, Mountain Pine Beetle, and Pine Engraver.**

1. Warming Surface Water Temperatures

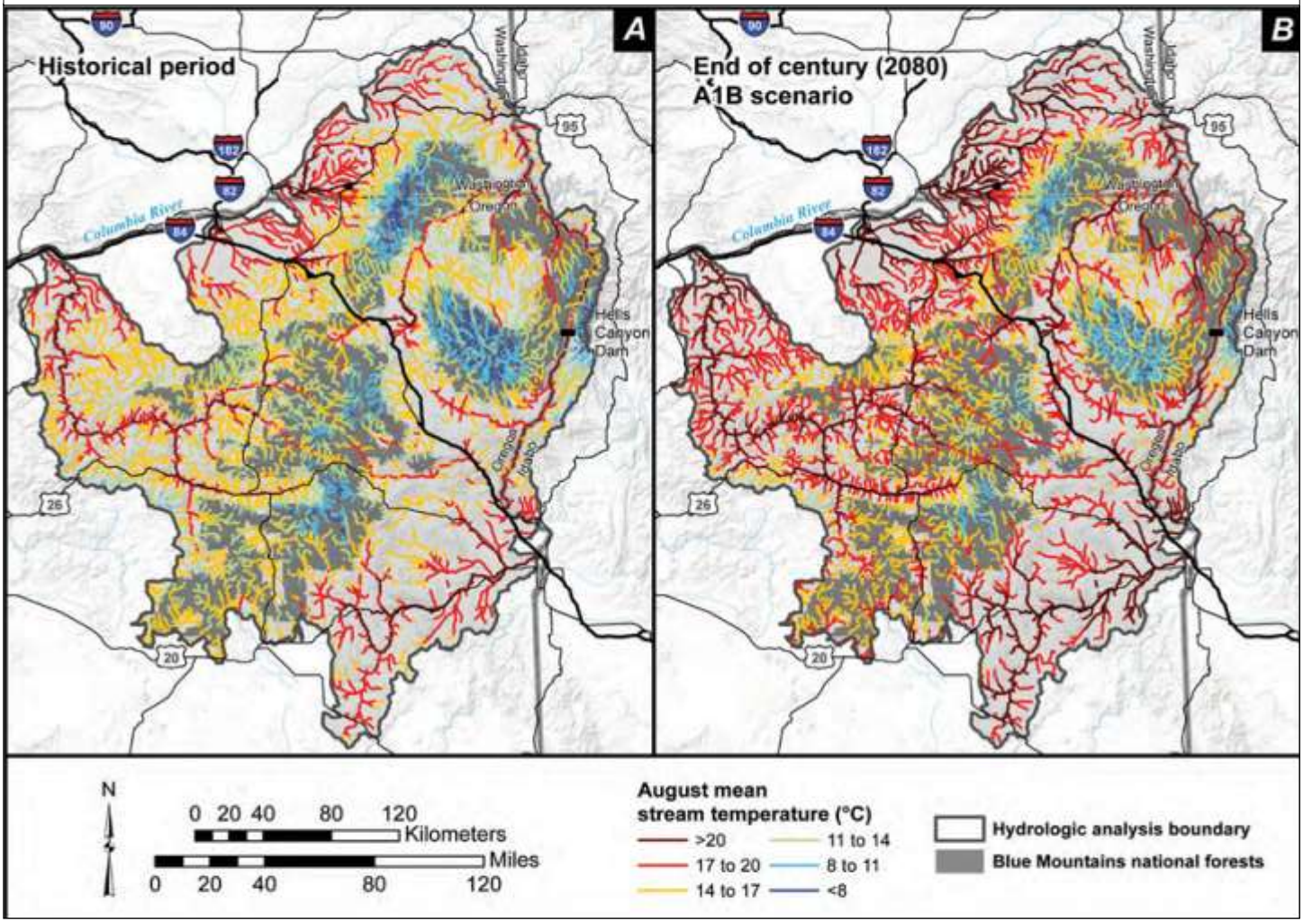
"Changes to surface water flows affect a variety of river functions, including connections between habitats for aquatic biota and patterns of floodplain water movement (Umatilla River Vision, 2011)."

As snow pack decreases and air temperature rises, stream temperatures will increase because of low flows and extreme heat. These temperatures might reach levels lethal to anadromous native fish and species of freshwater mussel in many places.

Figure 3B.1 illustrates projected historic and future stream temperatures on a map of the national forests within CTUIR's Ceded lands in the Blue Mountains (Halofsky and Petersen 2017). Color range of the riparian sections indicate the average stream temperatures in the month of August for observed historic conditions (1980's) (left, A) compared to projected future conditions by 2080 under Scenario A1B (right, B).

- In projected future, miles of **extremely cold waters (< 8˚ C, dark blue lines) is reduced by 70% from 1980 to 2040, and by 90% by 2080**;
- Conversely, the miles of **extremely hot waters (> 20˚ C, purple lines) increases by 98% from 1980 to 2040, and by 218% in 2080** (Halofsky and Pedersen).
- **17-20% increase in summer stream temperature at lower elevations**, and a **14-17% increase in higher mountain levels** by the end of the century in 2080.
- Least affected were **mid-elevation streams**, likely because they receive rain most years, even under historical conditions.

Figure 3B.1: Projected Change in Stream Temperature Historically (Left) and by 2080 (Right)



- Most impacted by increasing stream temperatures are low elevation tributaries including the **Wanakut Wildlife area, mouth of the Umatilla River at Columbia River confluence**, northern reaches of the Wenaha-Tucannon Wilderness, and southeastern slopes of the Strawberry Mountain and Monument Rock Wilderness areas.

In these areas, it would be beneficial to expand restoration of First Food aquatic species that are able to withstand warmer waters, such as Pacific lamprey (*Entosphenus tridentatus*), and floater (*Anodonta spp*.) freshwater mussel species.

- Least impacted areas are projected to be **Eagle Cap Wilderness, Grande Ronde River and Johnson Creek watersheds, and parts of the Elkhorn Mountains**.

In these areas, restoration of cold water fish species such as Chinook salmon (*Oncorhynchus tshawytscha*), Pacific steelhead (*Oncorhynchus mykiss*), bull trout (*Salvelinus confluentus*), Western Pearlshell (*Margaritifera falcate*) and Western Ridged Mussel (*Gonidea angulate*) could continue to be prioritized and expanded.

Suitable cold water habitat is likely to be limited to higher elevations and northern latitudes. This map shows lower reaches of the Umatilla Basin are at risk of being lost as potential habitat for cold water species under this change scenario, as streams experience temperature and hypoxia passage barriers for cold water migratory fish.

(Credit: Halofsky and Pederson USFS, 2017)

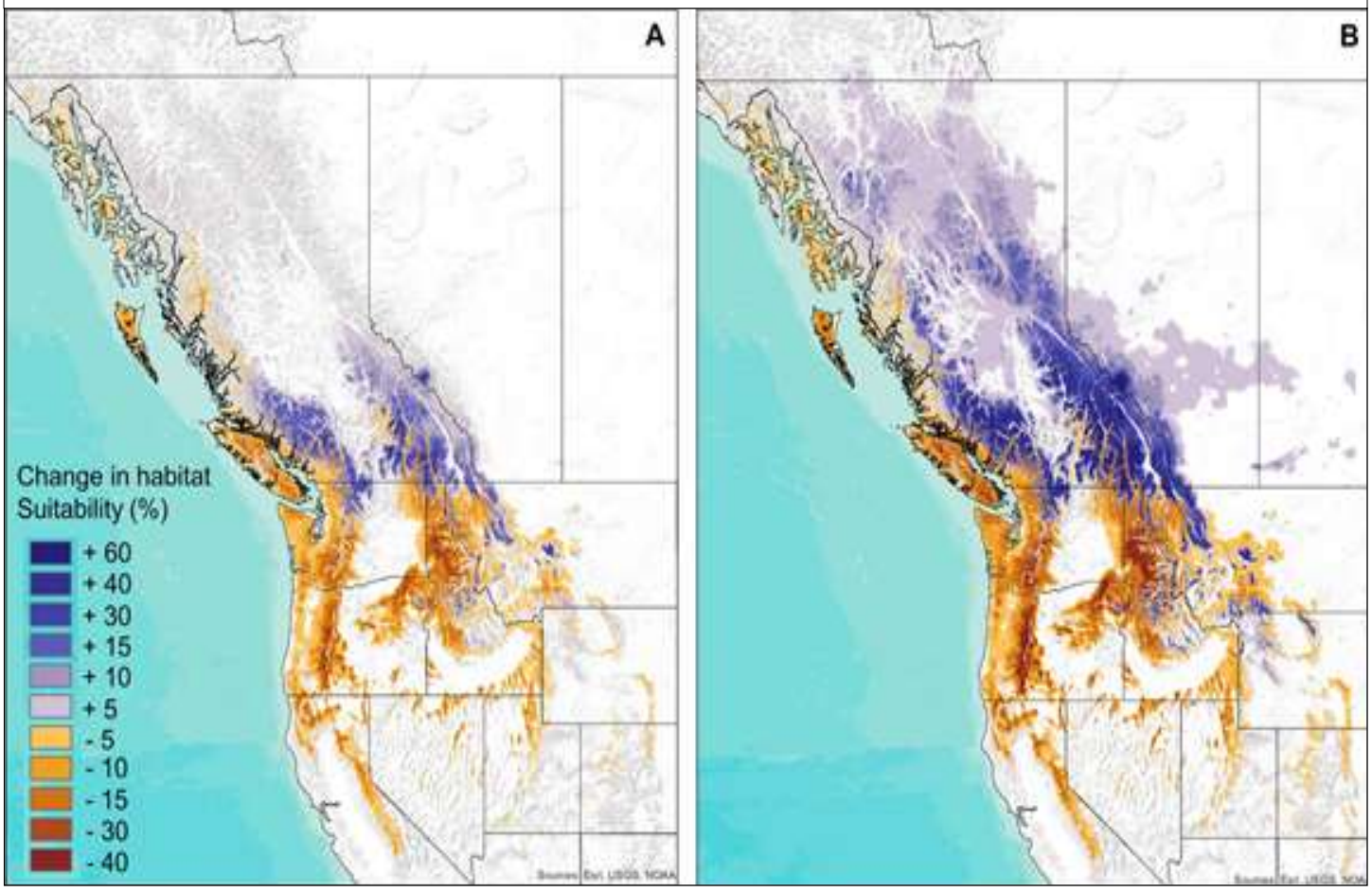
Gaps in Knowledge/Data/Policy:

- Magnitude of cold water release from floodplain restoration, and how this might buffer temperatures.

2. Plant Habitat Suitability Migration

"The availability and long-term production of First Foods in the uplands throughout the Ceded lands requires healthy, functional ecosystems. Healthy ecosystems maintain their full array of ecosystem services, which are the benefits supplied to society by

Figure 3B.2: Change in Huckleberry Habitat Suitability by 2100 Under Low (A) and High (B) Emissions Scenarios



natural ecosystems (First Foods Uplands Vision, 2019)."

Native plants in the Blue Mountains and Columbia Plateau have an internal set of environmental criteria that dictate where these species will thrive, and often have close symbiotic relationships with other animals and insects. Population and habitat monitoring of Men's Foods (fish and animal species) is part of Tribal management of riparian areas, while Women's Foods (root and berry species) have been largely unmonitored in grassland and forest slopes.

Large information gaps exist about climate impacts to many First Food species. Tribes are often at the forefront of collecting data and monitoring these important native species, like the Xáwš roots (pictured).

Plant First Foods like the big huckleberry (*Vaccinium membranaceum*) are likely to experience negative impacts from climate change, and are a useful indicator species due to its highly sensitive habitat requirements.

Figure 3B.2 shows the predicted change in habitat suitability for huckleberry species by the end of the 21st century (2100) for RCP4.5 on the left, and for scenario RCP8.5 on the right.

- Under both emissions scenarios, models anticipate **moderate degradation of 5—15 % in suitability of habitat** across much of the CTUIR Ceded lands and traditional use area.
- **Severe degradation of 30-40% at lower altitudes** (likely the lower limits in habitat range) is expected, with greatest decreases in the **Wenaha-Tucannon and North Fork Umatilla Wildernesses, and northern Elkhorn Mountains.**
- **Modest 15-30% gains in higher altitude locations** (expanding into previously unsuitable habitat) in the **Eagle Cap Wilderness Mountains**, as well as locations in central Idaho (Prevey et al 2019).
- Uplands habitat restoration at lower elevations and at the downslope range of current Root and Berry species should favor plants that are able to adapt to drier and warmer conditions. Plant species that require cold and wet conditions should be prioritized in higher elevation restoration locations than previously established.
- Temporal shifts also exist: timing of traditional harvests of culturally-important species may need to shift an estimated **1–2 months earlier** in the year (Prevey et al 2019). Huckleberry is an extremely sensitive species, and so can be used as a potential indicator of how other Women's Foods might migrate in response to warming temperatures. This study model also does not reflect other environmental factors for plant phenology, like snow depth and timing, day length, and chilling effects that are likely to influence species-specific adaptation capacity. More detailed research is necessary.

Land management strategies that allow for adaptive approaches will be essential for plant First Foods species health. CTUIR has robust forest management strategies and goals under the established Forest Management Plan (2010), and is in the process of creating similar standards and guidelines for range and grassland management, located within the forthcoming Rangeland Management Plan.

(Credit: Prevey et al USFS, 2019)

<u>Gaps in Knowledge/Data/Policy:</u>

- Animal species are also likely to be impacted by changing habitat suitability, and will need to migrate along with their symbiotic plant species. More information is needed about these specific interactions.
- First Food plant and medicine species are very diverse, and further information is needed to know more precise information about shifts in habitat for these species.
- Data collection of different phenological events on the same individuals and species to account for changes to seasonal cues.

3. Impacts to Pollinators and Other Insects

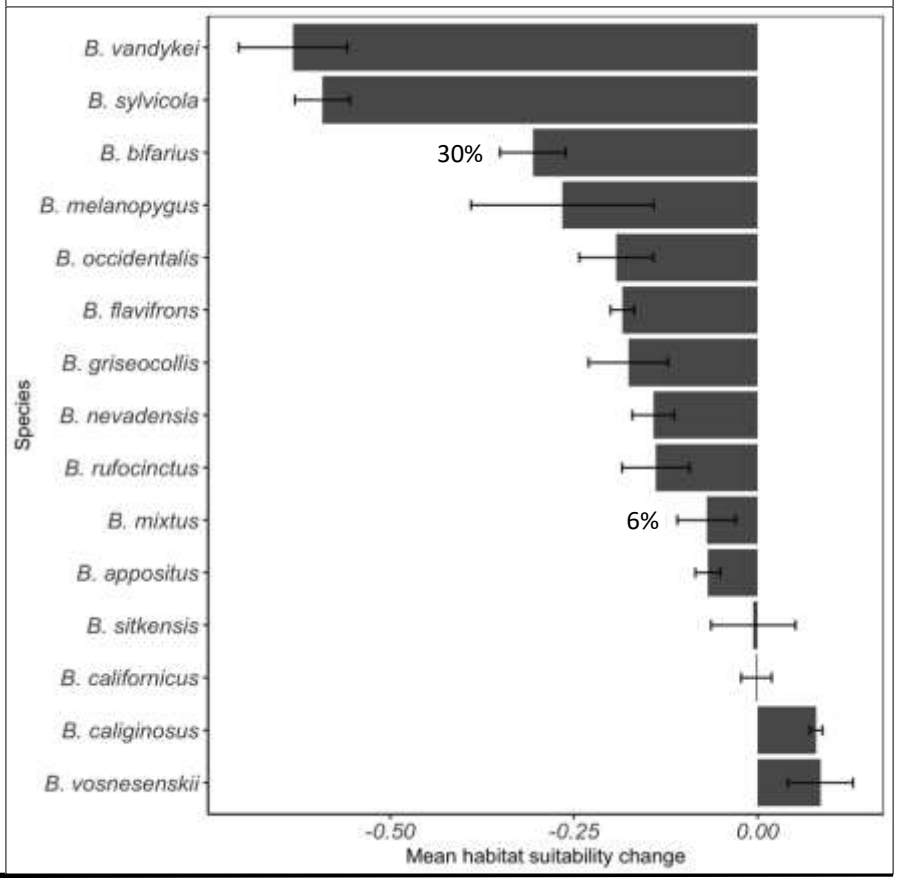
Land conversion and habitat suitability shift also affect insect communities that are closely related to First Foods and other important plants within ecosystems. Pollinators are a classification of insect that is essential to the health and abundance of food, both agriculturally and for First Foods. Native bee species particularly are important for native plant pollination.

Within these diverse species of native bees, the Bumblebee (*Bombus*) Family has been the most researched and has a large role in First Foods pollination. Much of this research focuses on Western Oregon and Washington sites, but can also provide insight into anticipated changes in habitat suitability range for these species in Eastern PNW habitats. In general, bumblebee diversity increases in higher elevation and mountain habitats (Koch et al 2019), while many of the study sites are found at sea level. More refined data is needed.

Figure 3B.3 shows the average change in habitat suitability for 15 bumblebee species found in the Pacific Northwest, and how climate change is projected to affect the availability of habitat in the future (Koch et al 2019).

- Data was from 23 field sites in seven US National Parks: Olympic National Park, Mount Rainier National Park, North Cascades National Park, Ebey's Landing National Historical Reserve, Lewis and Clark National Historical Park, Fort Vancouver National Historic Site, and San Juan Islands National Historical Park, all at sea level.
- Climate projections were modeling using three general circulation models (GCMs) with 4.5 and 8.5 representative concentration pathways (RCPs) for the year 2050 and 2070.
- Overall, 80% of bumble bees in the PNW may experience habitat loss in the next 50 years. Bumble bee species found predominantly in high alpine environments are at greatest risk of losing suitable habitat (Koch et al 2019).
- Most vulnerable species to least: Van Dyke's Bumblebee (*B. vandykei*) (1); Forest Bumblebee (*B. sylvicola*) (2); **Black-Notched Bumblebee (*B. bifarius*)** (3); Black Tail Bumblebee (*B. melanopygus*) (4); Western Bumblebee (*B. occidentalis*) (5); Yellow-headed Bumblebee (*B. flavifrons*) (6); Brown-Belted Bumblebee (*B. griseocollis*) (7); Nevada Bumblebee (*B. nevadensis*) (8); Red-Belted Bumblebee (*B. rufocinctus*) (9); **Fuzzy Horned Bumblebee (*B. mixtus*)** (10); and White-Shouldered Bumblebee (*B. appositus*) (11);
- Sitka Bumblebee (*B. sitkensis*), California Bumblebee (*B. californicus*), Obscure Bumblebee (*B. caliginosus*), Western Bumblebee (*B. occidentalis*), and the Yellowfaced Bumblebee (*Bombus vosnesenskii*) are least vulnerable and may experience an expansion in suitable habitat (Koch et al 2019).
- Species primarily found in high altitude environments are projected to incur a mean habitat suitability loss, with *B. vandykei* (63%), *B. sylvicola* (59%), and ***B. bifarius* (30%)** as largest losses. **Other species of note is *B. mixtus*, which will experience a reduction of 6%.**

Figure 3B.3: Changes in Habitat Suitability for Bumblebee Species under Combined RCP 4.5 and 8.5 Scenarios.



- As lower altitude bees are pushed to higher elevations where greater bee diversity and richness exist, species will compete for floral, nest, and hibernacula resources in an environment that is also spatially limited in comparison.

CTUIR is conducting its own inventory of important pollinators for First Foods. Data collection and reporting for these studies began in 2017, and a number of First Foods and other culturally important plants have been surveyed for the types and frequency of pollinators that visit their blooms.

Bumblebee species were identified as common pollinators for First Foods like Xmáaš (pictured); courtesy of Beecology (2020)

- Xáwš (*Lomatium cous*): largest percentage of pollinators seen to be native bees. The most abundant were multiple species in the genus Andrena (a ground nesting bee that emerges in the early spring), which comprised 60% of total insect abundance. Of these, the **Narrow-Legged Miner Bee (*Andrena angustitarsata)* was most abundant, composing 32.8%** (Gardner 2018).
- Wiwinu (*Vaccinium membranaceum*): most frequent pollinator was native bees. The most abundant were multiple species in the genus Bombus, representing 61.5% of the total insects collected (Gardener 2018), with **Fuzzy Horned Bumblebee (*Bombus mixtus*)** and **Black-Notched Bumblebee (*Bombus bifarius*)** were the most abundant pollinators. B. bifarius is projected to incur a loss of 30% in habitat suitability by mid-century (Koch et al 2019).
- Xmáaš (*Camassia quamash*): the most abundant were bumble bees at 24.4% of total insect abundance, with ***Bombus mixtus and Bombus bifarius*** as 63% of bumble bees species, and **Blue-and-Black Miner Bee (*Andrena nigrocaerulea*)** accounting for 17% of insects collected (Gardner 2020).
- Latítlatit (*Lomatium grayi*): largest percentage of pollinators found to be native bees (90.1%), with most abundant in genus Andrena (50%) (Gardner 2019). The most abundant species was **Small Green Miner Bee (*Andrena microchlora*)**, comprising 19.7%. The second most common were **Sweat Bees (*Lasioglossum)***, making up 24% of total insect abundance (Gardner 2020).

Many of these pollinators are generalist foragers, with known host associations on multiple species of First Foods and culturally significant plants. Additionally, many are ground nesting insects and require compact bare soils for nesting sites. Conservation of these pollinators would maintain diverse foraging resources, both temporally and spatially over the season, as well as providing nesting habitats. Ideas to maintain bumblebees could include keeping understory foraging materials available, and opening forest canopies to encourage flowering plant density (Gardner 2020).

Land management and agricultural activity has a large role in ability to protect pollinator species. There are many connections to wildfire and cultural burning in forested and grassland ecosystems, pesticide use, habitat degradation/land conversion, and pathogens like *Nosema bombi* and *Crithidia* spp. Local examples of management and opportunities for research include CTUIR's existing pollinator research, partnerships with U.S. Forest Service, and the Nature Conservancy with the Zumwalt Prairie restored grassland in Wallowa County, OR. There are also opportunities to participate in research efforts and community/citizen science with initiatives like the Oregon Bee Project and the Pacific Northwest Bumblebee Atlas.

(Credit: Koch et al 2019)

<u>Gaps in Knowledge/Data/Policy:</u>

- Attribution of population loss to pathogens and land-use change;
- How population genetic data may inform the potential for habitat corridors as a mitigation strategy to ensure that vulnerable bumble bee species do not become isolated from adjacent populations;
- Species plasticity and ability to physically change to accommodate shifting floral resource availability.

4. Increased Invasive Species Pressure

"The introduction and spread of non-native plant species, particularly annual grass species exacerbated the effects of overgrazing by quickly colonizing disturbed areas. Invasion of shrub-steppe by non-native grasses such as annual bromes (*Bromus tectorum, B. arvensis, B. hordeaceus*, etc), ventenata (*Ventenata dubia*), and medusa-head (*Taeniatherum caputmedusae*) altered fire frequency and intensity, particularly in low-elevation areas (First Foods Upland Vision, 2019)."

As conditions change rapidly, naturally resilient native species may be constrained by factors that reduce their ability to adapt unassisted. Terrestrial invasive plants create additional challenges for native species, as they are often unpalatable to Big Game, out compete desired native vegetation, and increase the risk of catastrophic wildfire. Invasive aquatic species will also increase in potential distribution, as warming waters reduce cold water conditions that are favorable for native fish.

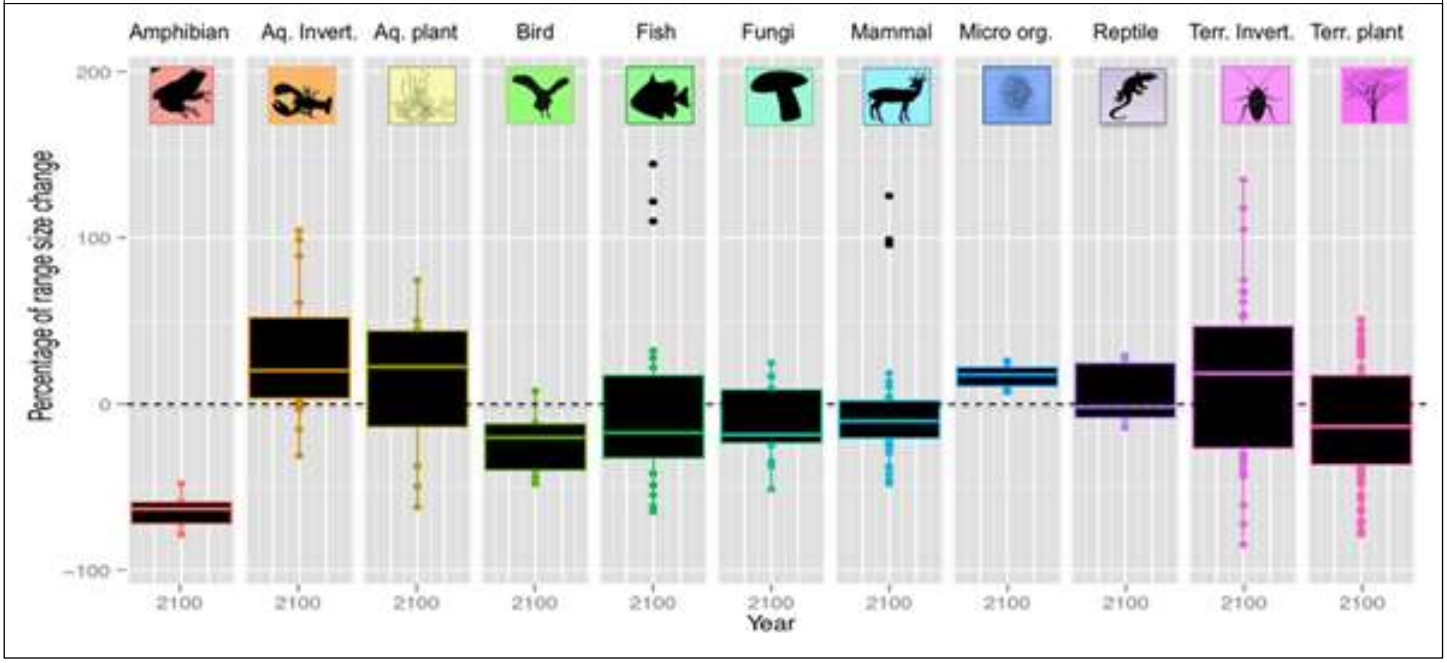
Figure 3B.4 displays a box plot graph which projects the anticipated global expansion and contraction of categories of invasive species. While these are global estimates, these trends can be used as proxy estimates to anticipate changes in the Pacific Northwest until refined data is available.

- Boxes show projected changes for different invasive species groups: those above the dashed line will expand their global range, and those below the dashed line will experience a constricting of range. The volume of the box shows the variation within each of these predictions.
- **Largest range expansions occur for aquatic invertebrates (+59%), terrestrial plants (+12%), and terrestrial insects (+18%)** (Bellard et al, 2013).
- Relatively little effect on Mammals, Reptiles, Fungi, and Microorganisms; loss of range for Amphibian and Bird species.

Feral pigs (*Sus scrofa*) have expanded throughout the PNW as winters in northern states have become milder, and established in Washington, Oregon, and Idaho by 2012. Feral cats (*Felis catus*) are also anticipated to increase (Gervais et al 2020). In the Pacific Northwest, few studies have been done for invasive species spread, but of those conducted:

- **Aquatic species predicted to increase**: Asian clam (*Corbicula fluminea*), Channeled apple snail (*Pomacea canaliculata*), Brazilian waterweed (*Egeria densa*), Water hyacinth (*Eichhornia crassipes*), Dioecious hydrilla (*Hydrilla veticillata*), Large-flower primrose (*Primula vulgaris*), Parrot feather (*Myriophyllum aquaticum*), and a slight expansion in Nutria (*Myocastor coypus*) range (Gervais et al 2020).

Figure 3B.4: Modeled Shift in Invasive Species Globally by Organism Classification



- **Plant species predicted to increase** include: Velvetleaf *Abutilon theophrasti*), Ragweed (*Ambrosia artemisiifolia*), **Cheatgrass (*Bromus tectorum*)**, Butterfly bush (*Buddleja davidii*), **Yellow starthistle (*Centaurea solstitialis*)**, Johnsongrass (*Sorghum halapense*), and **Saltcedar (*Tamarix* spp),** particularly in Eastern Oregon and Washington (Gervais et al 2020).
- **Insect species predicted to increase** include: Swede midge (*Contarinia nasturtii*), Brown marmorated stink bug (*Halymorpha halys*), Gypsy moth (*Lymantria dispar*), Potato tuber moth (*Phthorimaea operculella*), Apple maggot (*Rhagoletis pomonella*), and Wheat blossom midge (*Sitodiplosis mosellana*) (Gervais et al 2020).
- For CTUIR's reservation and Ceded lands, grasshoppers (*Orthoptera* spp.) and Mormon crickets (*Anabrus simplex*) have been identified as a large economic impact to agricultural resources in the region (Adams ODA 2021).
- Unmanaged horses (*Equus caballus*) can have a big impact on availability of forage for Big Game First Foods.
- **Species identified in CTUIR Invasive Weed Management Plan** include: Sweet Briar and Multiflora Rose (*Rosa multiflora* and *Rosa eglanteria*), Himalayan blackberry (*Rubus armeniacus*), Giant/Japanese/Bohemian knotweeds (*Fallopia sachalinensis, Reynoutria japonica,* and *Fallopia × bohemica)*, garlic mustard (*Alliaria petiolate*), leafy spurge (*Euphorbia esula*), sulfur cinquefoil (*Potentilla recta*), Russian olive (*Elaeagnus angustifolia*), rush skeletonweed (*Chondrilla juncea*), common crupina (*Crupina vulgaris*), bulbous bluegrass (*Poa bulbosa*), Russian thistle (*Salsola* spp.), Medusahead Rye (*Taeniatherum caput-medusa*), Ventenata (*Ventenata dubia*), and kochia (*Bassia scoparia*).
- Invasive species high concern watchlist includes saltcedar, Scotch broom (*Cytisus scoparius*), and purple starthistle (*Centaurea calcitrapa*) are species of priority concern for encroachment.

CTUIR RAF seasonal staff assist with invasive species monitoring and management, like GPS locating of priority noxious plants. This builds understanding of how these species are changing each year, and assists with management methods.

Columbia River Plateau and Blue Mountains ecosystems are very unique and few studies have been conducted for invasive species in the region. Aggressive management and monitoring protocols to control their spread could be effective in reducing their impact on First Foods. CTUIR's Agricultural Management Plan (2015) and Invasive Weed Management Plan details strategic approaches to terrestrial invasive species management; further details can be found in these integrated plans.

(Credit: C. Bellard, et al, 2013)

<u>Gaps in Knowledge/Data/Policy:</u>

- Knowledge to evaluate which invasive species may pose greatest regional threats due to feedback loops, symbiotic relationships, and other environmental and species dynamics;
- Disease organisms or their vectors, and how these might affect changing native and invasive species dynamics;
- How human impacts such as fish stocking, feral animal abandonment, and ballast water release impact these species distribution and spread;
- Out of date or absent list of priority species to control for states and other regional jurisdictions;
- Coordinated and integrated research and monitoring approaches, use existing data and improve data collection, access, analysis, and reporting.

5. Increased Riparian and Topsoil Erosion

"Water infiltration rates into soil are directly linked to management practices and disturbances (grazing systems, fire, shrub management, invasive species) that alter soil structure and vegetation cover (e.g. compaction, loss of biological soil crusts, type of vegetation). Water that does not infiltrate into the soil leaves a site via overland flow, not only reducing the water availability for vegetation uptake or groundwater recharge, but also contributes to soil erosion, further affecting soil stability, health, and productivity, and ultimately First Foods production (First Foods Upland Vision, 2019)."

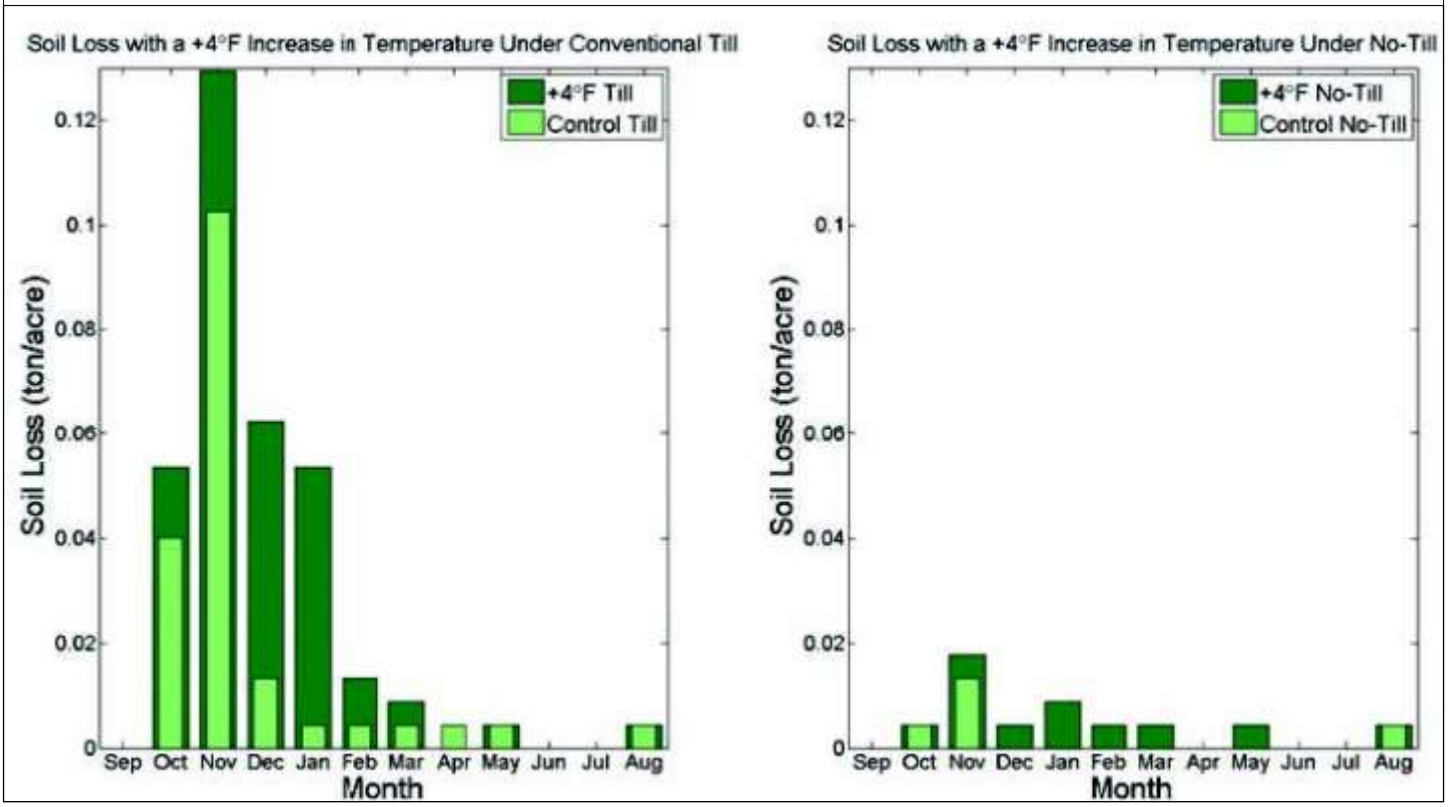
Soil erosion is a negative impact from land use practices, and will be made worse by climate change. Increasing runoff will create more soil erosion, which can flow into waterways and cause sedimentation, and challenges for aquatic organisms. CTUIR Ceded lands are heavily agricultural, including dryland grains (which typically undergo fallow periods of bare soil), and diversified irrigated farming. Both incorporate regular tillage practices, which increase potential for erosion to occur.

Figure **3B.5** provides a projection of changing weather conditions and the effect of increasing air temperature on soil erosion.

- Soil loss (in tons/acre) is shown for two different agricultural tillage intensities. Conventional tillage (left) is disruptive of soil connections, and No-Till (right) largely preserves soil connections through direct seeding. These two methods are compared under historic conditions (light green "Control" bars on the graph), and under an annual temperature increase of 4˚F (2.2˚C) (dark green bars) on a moderately flat slope over a 30 year study period.
- **Under conventional tillage, average changes in erosion could result in a 192% increase in soil loss** seasonally over time. Increases of soil loss of about 30% during the late fall under conventional tillage practices, and an estimated 75% increase in winter months (Farrell et al, 2015).
- **Under No-till direct seeding, average changing in soil loss is projected to still increase roughly 115%**, even with this the conservation tillage no-till strategy, with the largest increase, estimated 60%, in the winter months (Farrell et al, 2015).

These soil erosion estimates are conducted solely for monoculture planted in dryland agricultural grains, and is estimated for the Palouse region of Washington and Idaho, representing much of CTUIR's Ceded and traditional use lands. While conservation agriculture

Figure 3B.5: Projected Increases in Soil Erosion from Agriculture at 4˚F (2.2 C) Warming



Soil "slumps" (pictured left) result from erosion due to shallow rooting grasses like spring wheat under heavy precipitation. Unmanaged horses (pictured right) browse forage necessary for deer and elk species on grasslands.

practices reduce the potential for soil erosion under this climate shifted future, there is still an increase in the amount of soil that will potentially end up in nearby streams as runoff.

First Foods species like Pacific lamprey and *Anodanta* freshwater mussels provide filtration capacity to their habitat, and help to remove sedimentation from these waters. One mussel can filter 10 gallons of water in 30 minutes (CTUIR/Oregon Public Broadcasting, 2021), and 175,200 gallons of water per year; CTUIR is working to restore these populations through partnership with the Walla Walla Community College Water and Environmental Center (WEC) Pacific Lamprey and Freshwater Mussel Labs.

Given that many of these agricultural lands are likely to also experience additional water quality and quantity challenges, prioritizing these species —which are also able to tolerate warming waters —should be considered.

(Credit: Farrell et al REACCH Y4, 2015)

Gaps in Knowledge/Data/Policy:

- How land use and management strategies for agriculture in the region will change in response to climate.

6. Disconnect Between Vegetation Growth and Big Game Nutritional Needs

"Alterations to touchstone attributes that affect forage, cover, and movement across the landscape should be primary considerations with respect to dry forest use, management and restoration activities. Attributes of biotic integrity, namely, vegetation composition and structure, influence forage abundance and availability.

The diet of these species includes a wide range of grass, forb, and shrub species, and their relative importance changes throughout the year; grass and forb species dominate the diet from spring through summer, while shrubs become an important component of diets from late summer through winter as grass and forb species senesce (First Foods Upland Vision, 2019)."

First Foods Yaamas (mule deer, *Odocoileus hemionus*) and Wawukya (elk, *Cervus canadensis*) depend on native grasses and forbs for forage, and large quantities of forage are necessary to prepare deer and elk for the energetic expense of birthing and rearing calves. Historically, forage has been available to supply these needs, though this is not likely to remain the same in a changing climate.

Figure 3B.6: Modeled Changes in Factors that Affect Elk Success in a Warmer Future

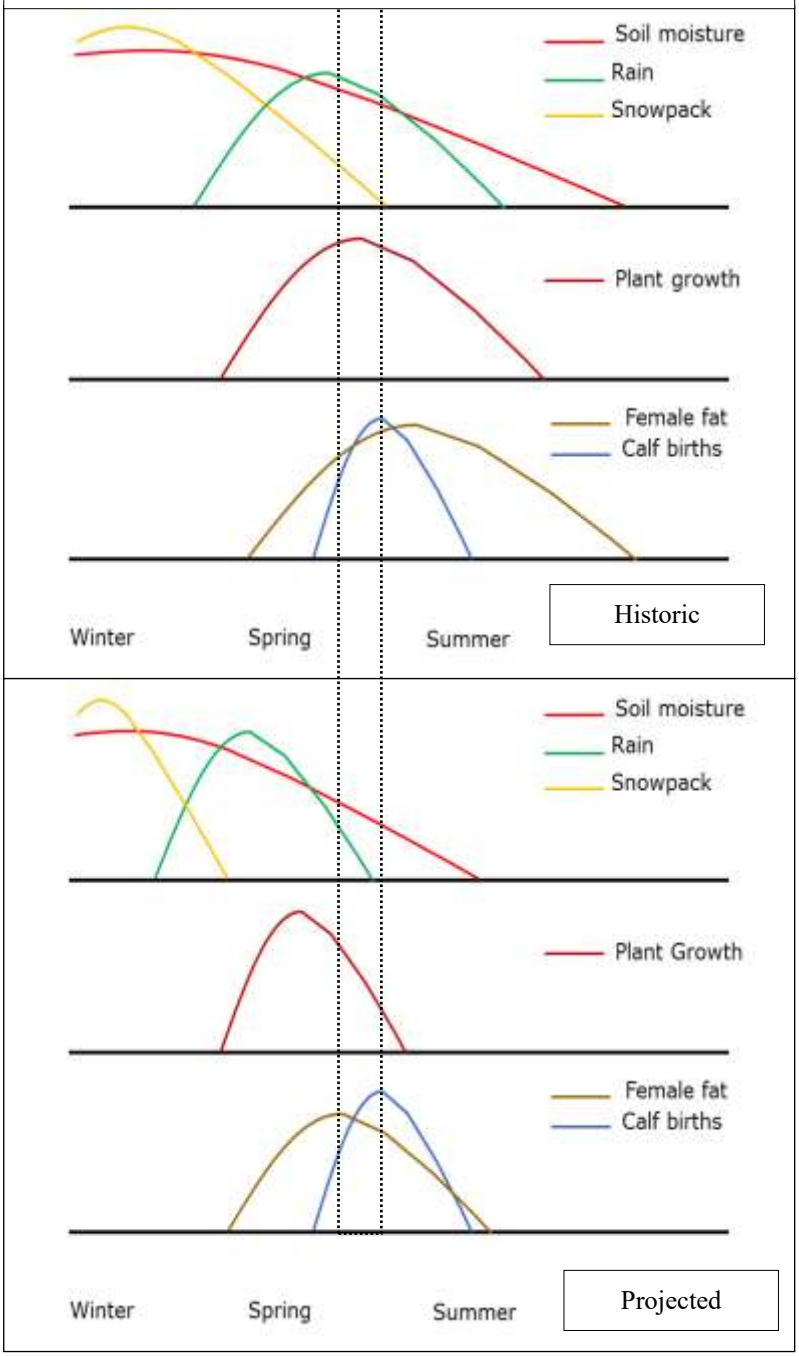


Figure 3B.6 shows very rough estimates of how climatic changes are likely to affect Big Game species based on forage and nutrition needs for calving, and modeled for the Starkey Experimental National Forest in the Blue Mountains.

- These graphs compare historic (top charts) and the projected changes (bottom charts) under a warmer future, and the way this alters the relationship between plant biomass development and elk seasonal grazing needs (Wisdom et al 2017).
- Colored lines show ambiguous availability of different elements: yellow line shows snow pack accumulation, green line shows precipitation as rain during the growing season, and the red line shows the soil moisture change as a result of these precipitation patterns.
- Seasonal plant growth shown in dark red lines, female elk fat availability in brown lines, and timing of calf births are shown in the blue lines. Hashed vertical lines have been added for comparison.
- Low resolution modeling anticipates that **plant growth is expected to shorten in its window of availability, and the peak biomass production will no longer coincide with the timing of elk calf births.**

Wildlife researchers predict a decline in the birth and survival rate of elk, but there are very few studies available to quantify this impact. This could cause local elk populations to modify their migration patterns to stay longer in places with better forage, potentially lingering on private agricultural lands outside of range of hunters.

This could also result in staggering of calving by female elk, potentially resulting in carrying calves every other year, or periodically to conserve body fat resources. This has an effect on the potential to supply elk to subsistence and Longhouse tables. Much more information is needed on how vegetation and migration pattern changes are affecting success and survival of Big Game, especially along the Columbia Plateau and Blue Mountain regions.

(Credit: M Wisdom, USFS et al, 2017)

<u>Gaps in Data/Knowledge/Policy:</u>

- Native forage vegetation biomass availability changes at a regional resolution;
- Deer and elk sensitivity to changes in forage and invasion from nonnative plants;
- Magnitude of range shifts are anticipated for primary forage plant species;
- Shifts in hunting windows and regulations in response to Big Game population and habit changes.

7. Changes in Plant and Animal Pathogen Potential

"Many ecological processes operate at scales beyond any particular site (e.g. wildfires, seasonal migration of elk, invasive species). Therefore, understanding and incorporating landscape context and connections between and among areas may be critical to successful stewardships at a local site (First Foods Upland Vision, 2019)."

Intensity and distribution of plant and animal diseases are affected by changing climate conditions. There is little information currently available on how pests and disease associated with First Foods species will also change. Much of the knowledge of disease shift comes from agricultural industries that to monitor issues within monoculture crop environments. While not perfectly accurate for estimating First Foods impacts, these can offer some insight into how this might occur in naturally functioning habitats.

Figure 3B.7: Swiss Needle Cast Disease and Temperature

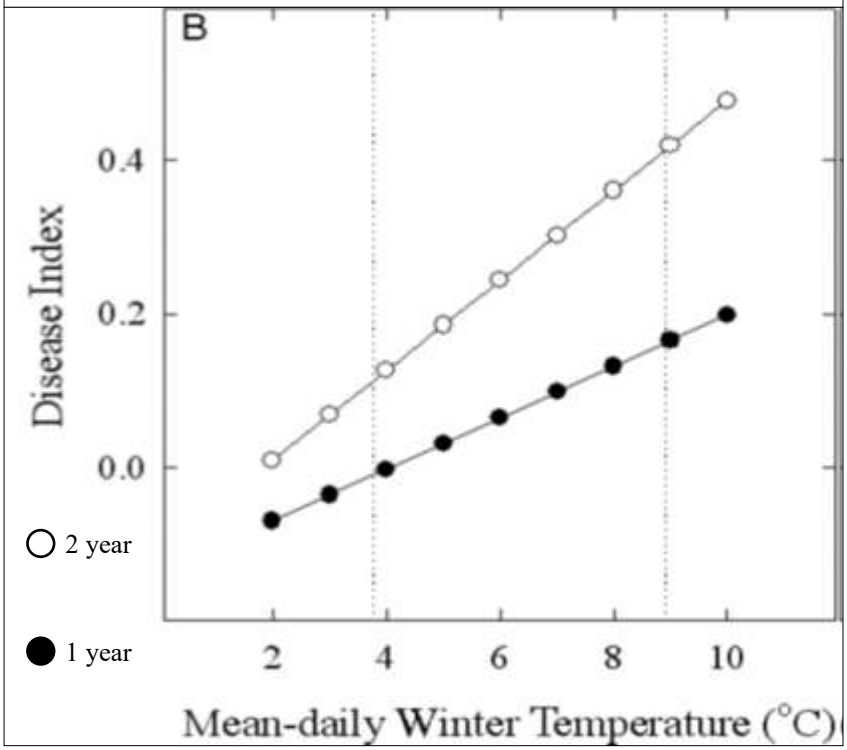


Figure **3B.7** shows projections of Douglas fir-affecting Swiss Needle Cast Disease (*Phaeocryptopus gaeumannii*), an infection that affects western Oregon and Washington conifer forests, but is of lower concern for Eastern Columbia Plateau forests. Modeling of this pathogen provides a proxy estimate that helps anticipate how Ponderosa (*Ponderosa pinus*) and other fire-adapted conifers might be affected by warming winters. In this figure, frequency of infections of Swiss Needle Cast are shown for warming winter conditions.

- Infection was modeled for one year old Douglas fir needles (closed circles), and for two year old needles (open circles) as winter temperatures rise.
- This model shows that the rate of needle infection increases for both vulnerable years for Douglas Fir as winter temperatures rise. Rough estimates from the graph show that in forests where the disease is already present, a 5˚C (9°F) temperature increase (shown by hatched lines of graph) results in a **15% increase in infection of one-year old needles, and a 30% increase in infection for two-year old needles** (Stone et al 2008).
- Currently winter temperatures are measured on average as 3 to -6 ˚C (37.4—21.2°F) for Ontario, Oregon, and 5.6 to -2 ˚C (42—28.4°F) for Pendleton, Oregon (Western Regional Climate Center, 2010). Recent climate projections estimate midcentury temperature increases 2.4 to 3.1˚C (4.3 - 5.6 ˚F) for Umatilla County (Dalton, 2020).
- Pendleton, Oregon with a current winter temperature average of -2 – 5.6 ˚C. With a projected increase of 2.4-3.1˚C, winter temperatures for Pendleton could reach almost 9˚C (16 ˚F)by 2050 and beyond. This corresponds to a 15-30% infection in conifer needle disease under these warmer conditions.

Swiss Needle Cast Disease can be used as a proxy for estimating increases in forest predation, but there are other species that are more relevant for inland Pacific Northwest forests:

- Western Pine Beetle (*Dendroctonus brevicomis LeConte*), Mountain Pine Beetle (*Dendroctonus ponderosae*), and Pine Engraver (*Ips pini*) have done extensive damage, affecting 30-50% of CTUIR standing pine volume in drier areas over

generally endemic to CTUIR forests like root fungal diseases (mostly caused by fungal infections), mistletoe (*Santalales* spp.), and episodic insect outbreaks like tussock moth (*Orgyia pseudotsugata*) or Western Spruce Budworm (*Choristoneura freemani*). However these are likely to shift or increase due to changing climate.

- Any agent, invasive or endemic, that chronically weakens a tree is likely to push it to mortality under drought conditions.

CTUIR forests are at risk from a number of climate impacts, including drought, pest insects, disease, and wildfire.

Men's animal and fish First Foods are also at risk from increased pathogenicity.

- Big Game and wildlife diseases that affect CTUIR Ceded and traditional use lands include:
  - ◊ M. ovi (*Mycoplasma ovipneumoniae*), a respiratory disease caused by a bacterial infection of the lungs in Bighorn Sheep (*Ovis Canadensis*). It is spread when Bighorn Sheep herds come in contact with domestic sheep (*O. aries*) and goats (*Capra hircus*). M Ovi was responsible for a die-off event in 2015-16 of the Bighorn Sheep herd in the Lower Owhyee River Canyon, Southern Oregon (Epps OSU 2017). More research is needed to know how land management and climate change will affect future distributions of this disease.
  - ◊ Chronic Wasting Disease (CWD) is a prion disease that poses risks to Big Game species like deer (mule deer, *Odocoileus hemionus*; black-tailed deer, *O.h. columbianus*; white-tailed deer, *O. virginianus*), elk (*Cervus canadensis*), and moose (*Alces alces*). Washington Department of Fish and Wildlife (WDFW) has developed a CWD Management Plan (2021) with a citizen science monitoring protocol, and Oregon Department of Fish and Wildlife (ODFW) also has information on the disease. As of summer 2022, CWD has not been detected in Washington State (WDFW 2022), and no known cases in Oregon State (ODFW 2021).
  - ◊ Epizootic Hemorrhagic Disease (EHD) is a hemorrhagic disease known as Bluetongue, caused by an infection of a virus transmitted by biting midges to white-tailed deer. Mule deer do not appear to be affected. This virus was responsible for the die-off event in 2020 of an estimated 2,000 white-tailed deer in eastern Oregon across the western face of the Blue Mountains from Milton-Freewater to the Pilot Rock area (DeVivo et al 2020). As drought conditions increase, deer are likely to be concentrated at fewer water access points, and will likely increase incidences of this disease.
  - ◊ Covid-19 (Sars-Cov-2) has also been detected in white-tailed (and suspected in mule) deer studied in 4 states: Illinois, Michigan, New York, and Pennsylvania. 33% of samples collected from January 2020 through 2021 tested positive, though no deer is known to have shown clinical signs of the disease (APHIS 2021). This highlights the potential for disease "spillover" between humans and wildlife, especially as climate change increases conditions for disease spread, and human/wildlife interactions in the Wildland-Urban Interface (WUI).

- Fish diseases are driven by high water temperatures and low flows, which are projected to increase as climate changes. Highly relevant diseases for salmonids include:
  - ◊ Furunculosis (*Aeromonas salmonicida*), a water-borne bacterium contracted through scratches, lesions or the digestive system. This bacteria becomes toxic and eventually kills the fish. Outbreaks are driven by water temperatures over 60˚ F.

- ◊ Hexamita, a parasitic intestinal disease that predominantly affects salmonids. This illness doesn't cause high mortality but weakens the fish and reduces its ability to grow.
- ◊ Ich (*Ichthyophthirius multifiliis*), a fish parasite that proliferates in water exceeding 60-65˚ F. This parasite can cause high mortality if present at enough density in the environment. In 2021, CTUIR experienced issues with Ich: temperatures associated with the May-June heat dome exposed Spring Chinook hatchery broodstock to river temperatures exceeding 65˚F. Overall, the parasite caused 13% loss (an 8.5% increase over the typical 4.5% loss) of CTUIR hatchery brood.
- ◊ Ceratonova (*Ceratomyxa shasta*), a myxozoan parasite that infects fish intestines, and was widespread in salmonids throughout the Columbia River Basin in 2021.
- ◊ Columnaris disease (*Flavobacterium columnare*), a bacteria which thrives in high water temperature and low flow conditions that stress fish and occurred in 2021.

- Less relevant diseases affecting salmonids include Infectious Salmon Anemia Virus (ISAV) and Infectious hematopoietic necrosis virus (IHNV), which is highly contagious, highly fatal, and not treatable. Screening of hatchery fish in the Columbia River Basin indicates very low prevalence of IHNV in recent years.
- For Pacific Lamprey (*Entosphenus tridentatus*), Furunculosis (*Aeromonas salmonicida*) is a widespread pathogenic bacteria throughout the Columbia River basin. It causes organ damage and sepsis in fish, and is associated with hot water temperatures, poor water quality, and crowding. Salmon Kidney Disease (*Renibacterium salmoninarum*) is another infectious bacteria detected in the basin, though to a much lesser extent.

Combined threats of climate change and land use are likely to shift distributions and virulence of existing pathogens, and increases potential for new pathogens to be introduced. Impacts to vegetation and water temperature also become relevant, as forage and water quality play a large role in animal health.

<u>Gaps in Knowledge/Data/Policy:</u>

- How wild and domestic species interactions are likely to be altered; which wild/domestic spillovers exist at high concerns;
- Human influence on environmental change and how it impacts disease dynamics. This includes distribution of domestic and invasive species;
- How animal immunity and plant defenses respond at different time and distribution scales;
- How natural and restored ecosystem disturbance like low intensity fire may affect these pathogen and host relationships.

Fish species, particularly those raised in artificial conditions such as CTUIR hatchery population supplementation programs, are at risk from pathogens that thrive in warm water conditions.

A. Anticipate Habitat Shift and Migration

i. Map and Model Potential New Habitat Ranges

"Many ecological processes operate at scales beyond any particular site (e.g. wildfires, seasonal migration of elk, invasive species). Therefore, understanding and incorporating landscape context and connections between and among areas may be critical to successful stewardships at a local site. Engaging and when possible developing a shared vision for ecosystem and landscape attributes that support First Foods production should increase management and restoration success (First Foods Upland Vision, 2019)."

Predictive modeling efforts to anticipate First Foods habitat shifts and the effect of fragmentation will require data to develop.

Short Term

- **Identify information gaps and develop additional data sets** and monitoring protocols to fill these information gaps. This can provide data to inform GIS models that aim to track changes in species distribution.

- **Develop climate projection models for plant and wildlife First Foods migration** to predict where new harvest and habitat locations they shift. These can inform the building and strengthening of partnerships in locations where First Foods are likely to find suitable habitat and provide harvest opportunities. USFS maybe have some initial research information, and be good partners in future activities.

- **Coordinate engagement with citizen and Tribal community scientist opportunities,** both within CTUIR and with external partners and networks. Many community-led research initiatives exist for various plant and animal species. Examples include:
  - ◊ Species-specific initiatives like Oregon Bee Project (https://www.oregonbeeproject.org/); Pacific Northwest Bumblebee Atlas (https://www.pnwbumblebeeatlas.org/), and others.
  - ◊ Observation Reporting initiatives on social media and other platforms, like the Local Environmental Observer (LEO) Network (https://www.leonetwork.org/) and others.

Rotary fish traps like this one on the Umatilla River temporarily trap fish to be counted before being released, as part of CTUIR project monitoring and effectiveness evaluation. This kind of data collection also informs harvest regulation and management actions.

Long Term

- **Cultivate legally defensible data and modeling for First Foods migration** that can be used to inform long term management strategies, provide justification for capital investment and securing funds, and is admissible as evidence for regulatory and legal actions.

ii. Strengthen or Build Partnerships in Potential New Habitat Ranges

Since land use and climate change impacts are inseparable, working with new and existing partners in land management will be necessary to promote the stewardship of First Foods.

Short Term

- **Actively cultivate new partnerships with an expansion of land managers and conservation/restoration opportunities** to maintain First Food harvest migration to new suitable habitat

Ranges. Existing partnerships include organizations like Blue Mountain Land Trust; federal land managers within USFS; private land and home owners with an interest in native plant restoration; corporate entities such as Amazon Inc. that are responsible for providing project mitigation funds; and others.

Long Term

- **Proactively cultivate relationships** that facilitate continued and expanded opportunities for the exercise of Treaty Rights. These include agreements, easements, and cooperative partnerships with land cooperatives and trusts, federal land managers within USFS, BLM, BOR and others, private land and home owners within the WUI, and with commercial and industrial interests that manage affected lands.

B. Invasive & Displaced Species Management and Monitoring

i. Of Aquatic Invasive & Displaced Species

"Likewise, the native riparian vegetation community is adapted to patterns of floodplain inundation (Rood et al. 2005). Inundation events scour floodplain soils, influence the germination of seedlings, and carry large wood into the river channel. Prevention of such events, then, may favor introduced or even nonriparian species over native riparian species. (Umatilla River Vision, 2011)."

Cold, clear water throughout the seasons is essential for native aquatic species to thrive. When stream temperatures become hotter, conditions benefit aquatic invasive plants, invertebrates, and animals that encroach and threaten First Foods in various ways.

Short Term:

- **Coordinate with other water and conservation management agencies** involved with plant and invertebrate invasive species. Regional coordination of monitoring and management support of species sighting and eradication efforts. Tribal fishermen should be at the forefront of this work, and is likely to include the mosquito control districts, county watershed councils, state and federal agencies like Fish and Wildlife services, and community interest groups such as water recreationalists, anglers and fishermen, bird appreciation societies, and boaters, among others.

- **Expand and support public engagement and reporting** of aquatic invasive species through improved awareness, identification and sighting knowledge, and interactive reporting tools to improve mapping and knowledge. DNR Fisheries and organizations like Columbia River InterTribal Fish Commission (CRITFC) already conduct outreach to Tribal fishermen, and would be excellent partners with which to coordinate.

- **Pursue funding to support DNR Fisheries staff capacity in reporting aquatic invasive species**. Tribal staff routinely manage specific locations year after year, and many of these sites are visited daily. Protocols for sighting invasive species should be developed, as well as support with staff and AWP objectives, and in equipment like GPS to conduct mapping to determine trends.

Long Term:

- **Maintain cool, clean water** as much as possible (see "Umatilla River Vision" for details on Touchstones and strategies).

- **Determine appropriate management actions for other displaced native and non-invasive species that impact salmonid survival**, like pelicans (*Pelecanus erythrorhynchos*), terns (*Hydroprogne caspia*), gulls (*Larus spp.),* and sea lions (*Eumetopias jubatus*). DNR Fisheries staff are currently working on a proposal

for an avian predation study in the Umatilla River Basin for 2023. Sea lions and avian predators have both been concerns for management for some time, and are likely to continue to have an impact.

- **Species of Concern** include (but are not limited to): plant species like riparian tuber grasses (Yellow Flag Iris, Water hyacinth), and invertebrates like Asian Clams (*Corbicula fluminea*) and Zebra Mussels (*Dreissena polymorpha*). Although not classified as invasive, non-native species such smallmouth bass, largemouth bass, and walleye are piscivorous species that have impacts on salmonids, and large populations of American shad introduced the Columbia River system as well.

Invasive species like Himalayan Blackberry (pictured top left) grow in riparian and upland places. Many species can exacerbate drought effects and create access barriers to reach harvest locations.

ii. Of Terrestrial Invasive & Displaced Species

"Forage production can also be impacted by the invasion of dry forest understories by non-native species, the majority of which are unpalatable and/or have less nutritive quality than native species. Annual bromes (cheatgrass), medusahead, and ventenata all readily invade dry conifer forest reducing forage quality and quantity (First Foods Upland Vision, 2019)."

Terrestrial invasive species are closely linked to agricultural, forestry, and recreational alterations of the land. Disturbance of soils and functioning ecosystems allows invasive species to take hold. Changes to hotter climatic conditions tend to benefit these invasives over native species.

Short Term:

- **Coordinate with other land and conservation management agencies** involved with plant and invertebrate invasive species. Regional coordination of monitoring and management in support of species sighting and eradication efforts is likely to include weed control boards, county conservation districts, state and federal agencies like Natural Resources Conservation Services, and community interest groups like recreational trail restoration and native plant appreciation societies.

- **Expand and support public engagement and reporting** of invasive species through improved awareness, identification and sighting knowledge, and with interactive reporting tools to improve mapping and knowledge. DNR Range, Agriculture, and Forestry (RAF) Program currently provides outreach to communities about noxious weeds of concern, and would be excellent partners with which to coordinate future initiatives.

- **Consider supporting and cultivating so-called "Invasi-vore" gathering and foraging groups** to be aware and active within CTUIR traditional use lands. Community gathering groups that focus on harvesting invasive species can help non-Tribal recreators reconnect with the land in ways that preserves Tribal Member access to First Foods and culturally significant species. Examples of people trailblazing this approach include social media platforms like:

  ◊ Tribal ethnobotanist Linda Black Elk (https://www.instagram.com/linda.black.elk/);
  ◊ Invasive species fermenter Pascal Baudar (https://www.instagram.com/pascalbaudar/);
  ◊ Urban and wildcraft forager Alexis Nikole (https://www.instagram.com/blackforager/).

Long Term:

- **Maintain soil stability and structure** that supports First Foods (see "First Foods Uplands Vision" for touchstones and strategies).

- **Develop a methodology to inventory risk vectors for relevant invasive species**. This methodology could be used to assess disturbances on changing distributions of invasive species. Data collected could help determine effectiveness of management actions on specific species of concern, (ex: which species respond positively or negatively to controlled burning, etc) and future decision-making.

- **Species of note** include plants listed in the CTUIR Invasive Weed Management Plan:
  - ◊ Annual forbs like Giant/Japanese/ Bohemian knotweeds, garlic mustard, leafy spurge, sulfur cinquefoil, Scotch broom, and purple starthistle.
  - ◊ Grasses and grassland species like rush skeletonweed, common crupina, bulbous bluegrass, Russian thistle, Medusahead Rye, Ventenata, kochia, and bromes like Cheatgrass.
  - ◊ Understory shrubs like Sweet Briar and Multiflora Rose, Himalayan blackberry, Russian olive, and saltcedar.
  - ◊ Insects like grasshoppers and Mormon crickets, Western Pine Beetle, Mountain Pine Beetle, Pine Engraver, Tussock Moth, and Western Spruce Budworm.

- **Continue to implement the CTUIR Forest Management Plan (2010) and the forthcoming Range Management Plan (expected 2022)** on relevant CTUIR lands, and provide these documents to other land management entities for collaboration as appropriate.

C. Proactively Address Wildfire Risk

i. Support and Expand Prescribed and Cultural Burning

"Fire suppression, which began in the early 1900's resulted in increased stand density, fuel loads, and the abundance of fire intolerant species (e.g. grand fir) within forest stands. As a result, fire regimes have changed from predominantly small, frequent, low-severity fires, to large, infrequent, high severity fires. This alters soil attributes as increased fire severity reduces nutrients (especially nitrogen), organic matter, and soil microorganisms. Increased severity also increases injury and mortality rates of plants, whose roots help stabilize soil and prevent erosion (First Foods Uplands Vision, 2019)."

Benefits of returning these low intensity burns to conifer forests in the CTUIR Ceded and traditional use lands will reduce wildfire risk through vegetation fuels management, and increase the success and harvest opportunities of First Foods.

Short Term:

- **Continue to coordinate with other grassland and forest management agencies** on opportunities to conduct prescribed and cultural burning implementation as appropriate; these include: Bureau of Indian Affairs (BIA) Fire Operations, Oregon Department of Forestry (ODF) and US Forest Service (USFS), as well as CTUIR's DNR Range, Agriculture, and Forestry (RAF) Program.

- **Support and expand Tribal-led capacity to implement intentional burn pre-treatment management activities** like selective thinning for CTUIR forest management areas (see Forest Management Plan for detail). This may include grant and program

funding for CTUIR DNR and BIA Umatilla Agency, as well as support for Tribal entrepreneurs and volunteer community members to access and participate in trainings and opportunities. See Ch 3F pages 227-229 for additional detail.

- **Inventory opportunities and implementation needs for intentional burning on the UIR and CTUIR Ceded lands**, including across different land ownerships. An inventory could also include an assessment of barriers that operators and land managers face in meeting requirements to implement intentional burning treatments.

- **Consider organizing and hosting a Prescribed Fire Training Exchange (TREX)** and continue to participate with these trainings as they are held in other locations. TREX programs emphasize interagency collaboration and have been held with host Tribes in the Pacific Northwest in recent years (http://waprescribedfire.org/trex).

Prescribed burn crews with the Umatilla Agency Fire Operations conduct a helicopter ignition of a prescribed burn at Stage Gulch on the Umatilla Indian Reservation (UIR).

Long Term:

- **Advocate for cultural and prescribed burn strategies** in state, national, and international land management policy. This could include assessing communities for barriers that have slowed implementation, and opportunities for collaboration.

- **Support program and capacity need for data collection and information gathering equipment** that can support safety and organizational decision making for intentional burn activities. First Foods Policy Program (FFPP) and RAF Program collaborated to provide a Remote Automated Weather Station (RAWS) to the BIA Umatilla Agency Fire Operations program to improve "go/no go" decision-making for prescribed burns, as part of a Meyer Memorial Trust grant.

- **Connect with other Indigenous communities in this work,** especially those with functional partnerships with land management government agencies and organizations. Tribes like Yurok, Karuk, Hoopa, and Klamath River Tribes in Northern California and Southern Oregon have been working with US Forest Service to conduct intentional burn research and implementation led by Indigenous knowledge, as well as the Cultural Fire Management Council (https://www.culturalfire.org/) and others.

ii. Develop Education and Engagement Preparedness for Homes and Families

"Fire and other disturbances (e.g. bark beetle outbreaks) are also fundamental components of healthy, properly functioning moist conifer forests. Therefore, in order to support First Foods production, the goal is not to eliminate disturbance events but rather to ensure that disturbance events and regimes remain within the natural range of variation, and that ecological systems are capable of recovering touchstone attributes following disturbance (First Foods Uplands Vision, 2019)."

Proactive and intentional fire is necessary to reduce wildfire risk, and education about the beneficial role of fire may be necessary for collective acceptance.

Short Term:

- **Support and expand education and preparedness initiatives** for landowners and families in the Wildland/Urban Interface (WUI) to encourage understanding and acceptance of utilization of prescribed fire. BIA Umatilla Agency currently provides some community education, and would be excellent partners with which to collaborate with on future initiatives.

Long Term:

- **Identify barriers that exist for popular implementation of intentional burns**. This could include policy barriers such as liability insurance, as well as physical barriers like electrical and communications infrastructure. Oregon State University (OSU) and University of Oregon have previously conducted mapping research on intentional burning potential and could be good partners in future research.

D. Species Migration Information and Practices

i. Conduct Community Planning and Listening Sessions around Facilitated Species Migration

"This responsibility is part of the reciprocal relationship that the CTUIR has with their traditional foods and an acknowledgement that the First Foods are not only important for health, but also for cultural identity. Gathering traditional plant foods is an activity that is inextricably linked with the ceremonial and ritual life of the CTUIR and is essential for continued cultural identity and sovereignty (First Foods Upland Vision, 2019)."

Tribal communities are not a monolith, and issues of First Foods migration can be very sensitive, especially around cultural and traditional knowledge.

Short Term:

- **Organize and host community listening sessions** on attitudes around intentional and facilitated migration of First Foods and other culturally significant species. Such events would attempt to synthesize and document the spectrum of feelings and perspectives within the CTUIR community around intentional and assisted species migration.

- **Develop site- or species-specific coordinated plans and protocols for First Foods** and culturally significant species, and/or associated habitat species, that will need to migrate. This is likely to involve mapping of existing habitat ranges, future projections using downscaled climate modeling, and ground-truthing of models to determine significant habitat and topographic characteristics. This effort is also likely to include species-specific research on micro-population differences that exist. DNR Cultural Resource Protection Program (CRPP) and the Tribal Native Plant Nursery (TNPN) would be excellent partners in these efforts.

Long Term:

- **Build and support stakeholder engagement in planning** to maximize opportunities to collaborate on facilitated migration. These could include agreements and easements with private landowners individually, and with collective organizations like Blue Mountain and Wallowa Land Trusts, as well as with government agencies and public land managers.

- **Identify data and information gaps that exist,** and develop data collection initiatives to respond to these gaps to provide additional relevant information. These initiatives should examine gaps and opportunities for both plant and wildlife First Foods species, as well as other

culturally relevant species and ecosystem connections.

ii. Develop and Implement Facilitated Migration Opportunities

"The ultimate goal of this First Foods-focused management approach is to ensure the sustainable stewardship of natural ecosystems within CTUIR Ceded lands. Using the long-term production and harvest of the full First Foods order as a benchmark for success helps ensure natural resource management and restoration priorities, plans, and actions support the continuity of Tribal cultural traditions, First Foods and the ecosystems in which they are found (First Foods Upland Vision, 2019)."

CTUIR Fisheries staff regularly undertake fish salvage activities using backpack electroshockers to stun fish to be relocated.

Protecting and preserving First Foods into an uncertain future means looking at new potential habitat locations as climatic suitability changes.

Short Term:

- **Conduct an assessment and inventory mapping project to identify new potential locations** appropriate for specific First Foods. This project would involve using accurate and updated climate projections for CTUIR's traditional use area to determine migration opportunities as they are expected to change through the century. One example is the potential for steelhead reintroduction to colder waters of McKay Creek above the McKay Dam and Reservoir.

- **Collaborate with community partners who are actively engaged with facilitated migration of First Foods**. There are many community members and groups that are taking this work on already; an example is the Indigenous stewardship nonprofit, Naknuwithlama Tiichamna (Caretakers of the Land), in Cove, Oregon, and would be excellent to collaborate with on these efforts.

Long Term:

- **Conduct research and protocol development** into site-specific First Foods species bio-plasticity (ability of species to change life cycling timing in response to environmental conditions) to determine if some species sub-populations are more resilient to change. This research is likely to involve many government and university partnerships to conduct.

- **Develop genetic materials sourcing capacity with DNR Fisheries Population Supplementation Program and the Tribal Native Plant Nursery**. Understanding genetically distinct micropopulations that exist within CTUIR's First Foods could help identify trends that might emerge as subpopulations of these species adapt (or fail to adapt) to changing conditions. Developing a program/project that – as much as is possible for recalcitrant (seeds unable to be dried for storage and require living genetic materials sources), and orthodox (seeds can be dried for storage without a living source) plant species with the TNPN, would be an excellent complement to existing DNR Fisheries genetic materials collection and propagation efforts.

E. Research and Regulatory Understanding for First Foods Harvest

"The First Foods-focused mission provides resource managers in the basin with a framework for involving Tribal Members in management dialogues. Within such a framework, monitoring and restoration efforts can concentrate on improving the ecological functionality of the Umatilla River, which ultimately sustains First Foods (Umatilla River Vision, 2011)."

While maintaining Tribal Member ability to exercise Treaty Rights, it is also important to have generations of Tribal community members understand their responsibility to these First Foods, practice sustainable harvesting techniques, and have respect for the land and water that support these relationships.

Short Term:

- **Expand awareness, appreciation, and knowledge of species like Pacific lamprey and Freshwater Mussels.** These species are incredibly resilient and will be essential in climate adaptation, though are currently underappreciated as important members of functioning ecosystems, as well as the cultural and ecosystems services they provide.

- **Organize and facilitate opportunities for the Tribal community to learn about Indigenous knowledge, sustainable First Foods harvesting practices** that don't harm long-term prosperity, identification of signs of illness or injury on plant and animal species, and other teachings from Indigenous knowledge keepers. Learning experiences are likely to prioritize CTUIR Tribal Members and community, but could also be accessible for non-Tribal audiences in appropriate.

Long Term:

- **Continue and support needs that allow for First Foods regulatory capacity and adaptive harvest monitoring**, particularly for species that experience other challenges like commercial harvest and pollution pressures. Coordination with other regulatory and monitoring organizations like the Columbia River Inter-Tribal Fish Commission (CRITFC) and the Inter-Tribal Bison Management group is likely to be necessary for setting and enforcing regional First Food harvesting limits, and for understanding how these species are adapting.

Wetland restoration and Wapato planting with Naknuwithlama Tiichamna (Caretakers of the Land) volunteers in Cove, Oregon (Feb 2021). These First Foods are being returned to these lands through Indigenous-led volunteer initiatives like this one, and have had varying success across the region.

Measuring Success and Gaps in First Foods Availability Adaptation

How Do We Measure the Success of These Adaptations?

"Our vision of sovereignty is much the same as it was before the coming of the Europeans – we want to preserve and protect our families, hunt and fish as we always have, and live in an environment that is relatively safe for all. We independently and collectively for the community to preserve our ways in the future. The key is that we want to do it ourselves (Johnson, 2006)."

- **First Foods Upland Vision Touchstones** (soil stability, hydrologic function, landscape pattern, and biotic integrity) and how it impacts First Foods availability.
- **Comprehensive Plan Objective 5.6.2:** To develop sustainable fish harvest opportunities throughout the usual and accustomed fishing stations (see Comp Plan page 81 for benchmarks);
- **Comprehensive Plan Objective 5.6.4:** To provide sustainable harvest opportunities for Big Game species of the First Food order by protecting, conserving, and restoring Big Game populations and their habitats (see Comp Plan page 81 for benchmarks);
- **Comprehensive Plan Objective 5.8.1:** Develop and implement policies and strategic plans to restore, protect and provide for the exercise of each 1855 Treaty-reserved Right – fishing, hunting, gathering, livestock pasturing and associated water rights (see Comp Plan page 81 for benchmarks);
- **Comprehensive Plan Objective 5.14.7:** Ensure all commercial and institutional properties on the reservation comply with the international fire code through the annual inspection process (see Comp Plan page 124 for benchmarks);
- **CTUIR Mission Community Plan (1993) Part D**: Tribal Services Element 2.1 Ensure effective fire prevention and suppression for high value and high hazard structures in the Mission Community.
- **CTUIR Water Code (2005) Section 1.05. Statement of Policy K:** Provide Water For Fish And Wildlife Resources. The fish and wildlife populations and traditional plants of the Reservation are important subsistence, cultural, and recreational resources, and as such, in managing water resources, the Confederated Tribes shall allocate water and provide sufficient water quality for the protection and conservation of these resources;
- **CTUIR Water Code (2005) Section 1.05. Statement of Policy L:** Provide Water for Wetland Resources. Wetlands provide critical habitat for fish and wildlife populations, traditional plants, and other natural resources of the Reservation;
- **CTUIR Water Code (2005) Section 1.05. Statement of Policy M:** Protection of Stream Flows. Streams are an integral and vital element of the culture of the Confederated Tribes.
- **CTUIR Hazard Mitigation Plan (2021) Section 3**: Hazard Identification and Risk Assessment Results (page 68-190).
- **CTUIR Hazard Mitigation Plan (2021) Section 4:** Hazard Mitigation Strategy (page 192-212)
- DNR Annual work plans and activities.
- CTUIR Fish and Wildlife Commission annual reports
- Anticipate flood, drought, and air quality impacts on First Foods.

What Gaps in Knowledge, Policy, Capacity, or Education Exist?

- Detailed understanding and projections of Big Game forage and vegetation changes;
- Disease and pathogen changes for important plant, animal, and habitat species;
- Sufficient understanding of migration patterns of wildlife of high priority;
- Compounding effects of heat and drought on water quality and quantity for aquatic species.

Climate Impacts for First Foods Access

"Privatization of land and agricultural development beyond reservation boundaries have also further reduced the CTUIR's ability to access its traditional foods. Today, just 24% of the Ceded territory are public lands where Tribal Members can exercise their Treaty Rights.

While the CTUIR's Treaty guarantees the Right of access, there is no guarantee that the Tribe's First Foods and other culturally important resources will be present for them to harvest. Moreover, because the goals of state and federal land management agencies do not explicitly include management or stewardship for First Foods, it is the responsibility of the CTUIR to speak on behalf of the First Foods and engage public lands managers (First Foods Upland Vision, 2019)."

Many effects of climate change will threaten not only the abundance of First Foods, but also how readily they can be accessed. Access barriers can be tangible impacts, such as flooding that damages roadways necessary to access public lands, as well as intangible, like heavy smoke inundation events that create poor air quality conditions over large areas. These impacts reduce how easily Tribal Members and families are able to reach known and new locations for First Foods harvest.

"To Tribes all over the land, the earth was their Mother, wise and loving in her care for her children. Our love, therefore, is a kind of mystical devotion, for this wise Mother has cradled our race since the beginning of time.

~ Maudie C. Antoine, CTUIR BOT Chair (1955)

8. Seasonal Flooding Magnitude

Precipitation will become unpredictable, and heavy rainfall causes flooding that can devastate roadways necessary to access First Foods.

Higher elevations are likely to experience an increase of 20-30%; greatest impact will be to the Eagle Cap Wilderness and Hells Canyon area, which will see 30% and greater increase (Clifton USFS, 2018) as seen in Figure 3B.8 (page 93).

9. Increased Frequency & Severity of Wildfire Risk

Land management and climate impacts increase the possibility of experiencing a catastrophic wildfire.

2-3 times increase in risk along the Columbia River, with the Blue Mountains likely to experience 6 times greater risk of fire for a 1˚C (1.8˚F) increase (USFS, 2017) as shown in Figure 3B.9 (page 94).

10. Poor Air Quality over Large Areas

With conditions for wildfire increasing, smoke from near and distant fires will create poor air quality conditions that restrict the ability for Tribal Members to safely exercise Treaty Rights.

7.6% per day increase in exposure to particle pollution during smoke events if outdoors without respiratory protection (Henderson et al 2005)**.** This can be calculated to be **15-45% increase in smoke exposure potential during future fire seasons,** as seen in Figure 3B.10 (page 95).

8. Seasonal Flooding Magnitude

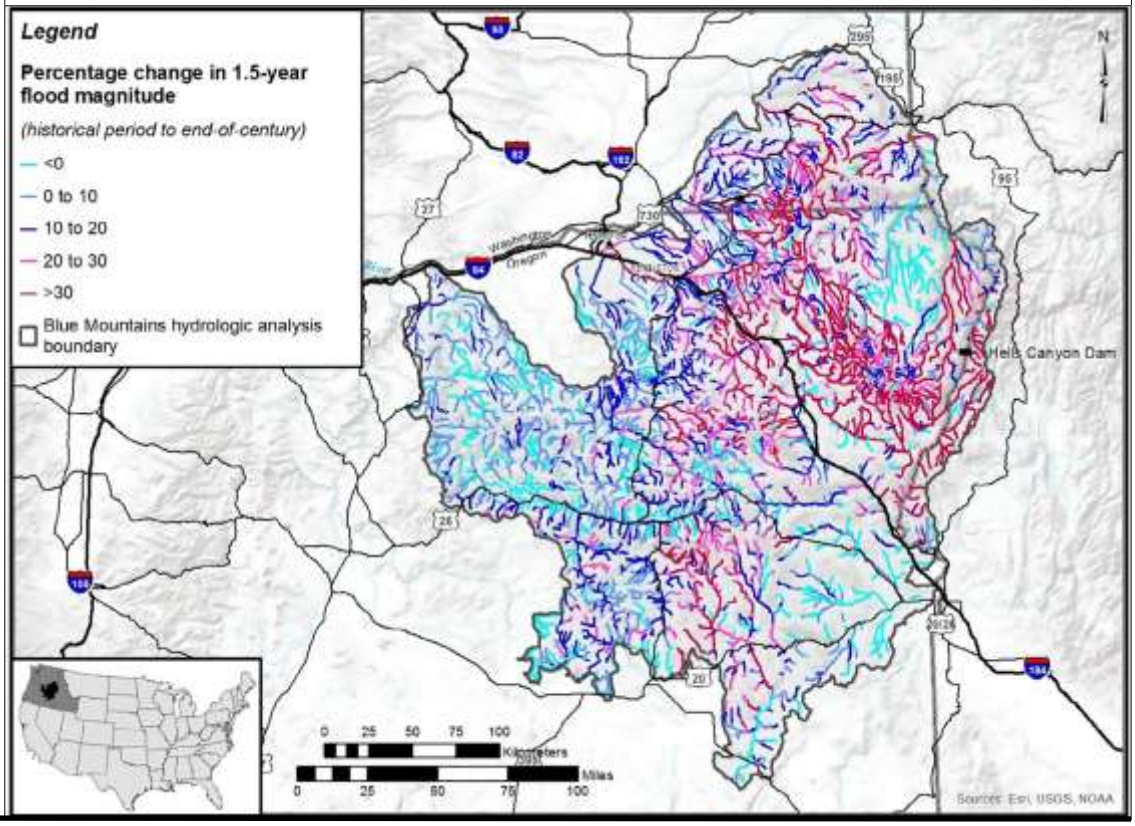
"Streams that pass through moist conifer forests are often important for Salmonids (spawning and rearing), lamprey and associated species, and land management and disturbance events can remove vegetation and group cover, exposing soil and increasing soil erosion, overland flow, and subsequent sedimentation of streams and rivers beyond natural ranges. This can affect stream habitat and water quality, so management should include considerations to ensure the maintenance and functioning of soil stability, hydrologic function, and other touchstones (First Foods Upland Vision, 2019)." As hydrologic regimes shift to rain-dominant systems, winter season flooding issues are likely to increase.

Figure 3B.8 is a visual representation of the changes in seasonal flooding likely to occur for the Blue Mountain region by the end-of-century. Colored lines show various streams with in this region, and the magnitude of predicted changes in flooding.

- Pale blue lines indicate streams that will see changes of 10% or less, while dark blue lines show an increase of 10-20%. Pale purple lines show streams that will see a 20-30% increase, and dark purple indicates watersheds that will experience greater than 30% increase in flooding (Clifton et al, 2018).
- **Moderate change of 10-20% increase is expected at low elevation watersheds** like the confluence of the Umatilla River and Butter and Sand Hollow Creeks in Morrow County, at the southwestern foot of the Blue Mountains. This is likely because these streams systems have historically been rain-fed and will continue to be so in the future.
- **Higher elevations are likely to experience a much larger change of 20-30% increase**, as locations like the **Wenaha-Tucannon Wilderness, and the Elkhorn Mountain range** will experience greater melting of snow pack from warming winters.
- **Greatest impact will be to the Eagle Cap Wilderness and Hells Canyon area, which will see over 30% change in flooding.**

Floods can destroy roads and create emergency conditions that threaten Tribal family safety, ability to exercise Treaty Rights, and has the potential to reduce First Foods access. But flooding is also an essential event in healthy functioning ecosystems, and creates opportunities for water infiltration into aquifers. Built infrastructure in the floodplain is threatened by flooding, and reactive strategies for flood management often make the problem worse by channelizing rivers and reducing infiltration opportunities through dikes and levees.

Figure 3B.8: Percentage Change in Flooding Magnitude by 2080



Expanding natural stream meander, including woody debris and vegetation, improving channel connectivity, and reconnecting floodplains to their rivers is an effective way to mitigate for flooding upstream of immovable build infrastructure such as towns and dams, and mitigate for reduction in access to First Foods harvest caused by flooding. Utilizing touchstones found in the Umatilla River Vision can help water and resource managers reconnect floodplains for adaptation.

(Credit: Clifton et al, 2018)

Figure 3B.9: Projections of Increase in Wildfire Due to 1˚C Temperature Increase

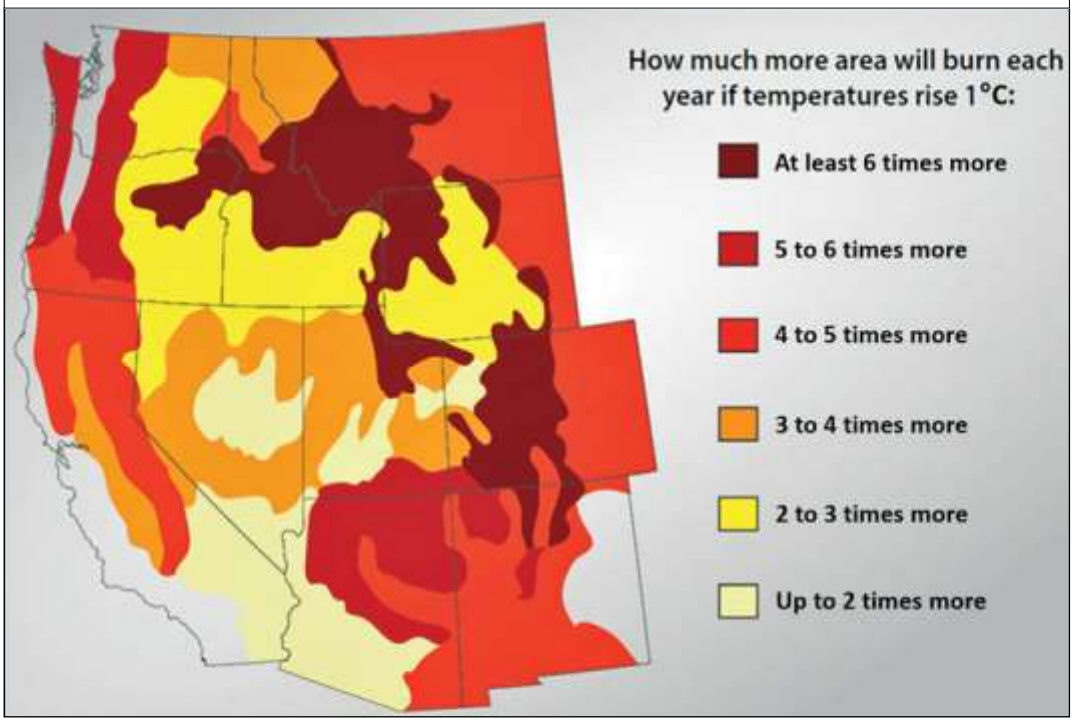


Figure 3B.9 is a projection of increases in wildfire risk in the Western United States for 1˚C (1.8 ˚F) of heating in global temperatures.

- Colored regions demonstrate severity of wildfire risk increase: yellows and oranges indicate 2-4 times increase in area burned; red colors show 4-6 times increase; and darkest red indicates where lands are at least 6 times more likely to be at risk of fire.
- While the scale of this map makes it difficult to estimate for specific CTUIR Ceded and traditional use lands, projections anticipate **2-3 times increase in fire risk along the Columbia River, with the Blue Mountains likely to experience 6 times greater risk of fire.**

Gaps in Knowledge/Data/Policy:

- How floodplains are projected to expand in specific watersheds due to flood magnitude;
- Capacity of Federal assistance programs that fund acquisition of riparian properties impacted by flooding.

9. Increased Frequency and Severity of Wildfire Risk

"Prior to Euro-American settlement, it is thought the historic fire regime primarily consisted of small, high intensity fires at an interval of 30-80 years, which created a heterogeneous landscape with patches of shrub-steppe dominated by different species and in various stages of recovery. As fire return intervals have shortened and the size of fires increased, structural and species complexity of shrub-step has been simplified and large areas are dominated by non-native invasive grass and forb species affecting biotic integrity of the system (First Foods Upland Vision, 2019)."

Several feedback mechanisms interact with a naturally fire-prone landscape to increase the risk of catastrophic wildfire occurrence as a result of climate change.

Tribal people in the West have carried out traditional burning to reduce vegetation fuels on forest floors, release nutrients back into the soil, and cull small "sucker" trees that crowd healthier ones and reduce soil moisture. Returning cultural burns to the landscape could help reduce the risk of wildfire, though there are complicating factors like human development in the Wildland/Urban Interface (WUI) that adds complexity to this issue. Smoke also reduces visibility for traveling, and creates dangerous conditions on roads and rivers when vehicles and vessels aren't able to see clearly.

(Credit: Halofsky 2017, Ojima et al. 2014)

Gaps in Knowledge/Data/Policy:

- Fine detail knowledge on how fire conditions are likely to change in eastern Oregon and Washington;
- How insect and pathogen activity will affect tree establishment and survival, and thus fire activity;
- How landscapes and ecosystems may be altered due to changing habitat suitability and species migration.

10. Poor Air Quality over Large Areas

Harvesting and perpetuating First Foods is a deep and essential connection for Tribal people, and many who are dedicated to exercising Treaty Rights are willing to do so in all kinds of inclement conditions. As conditions for wildfire increase, frequency of heavy smoke from fires burning throughout the western U.S. is likely to inundate CTUIR traditional use lands from fires near and far.

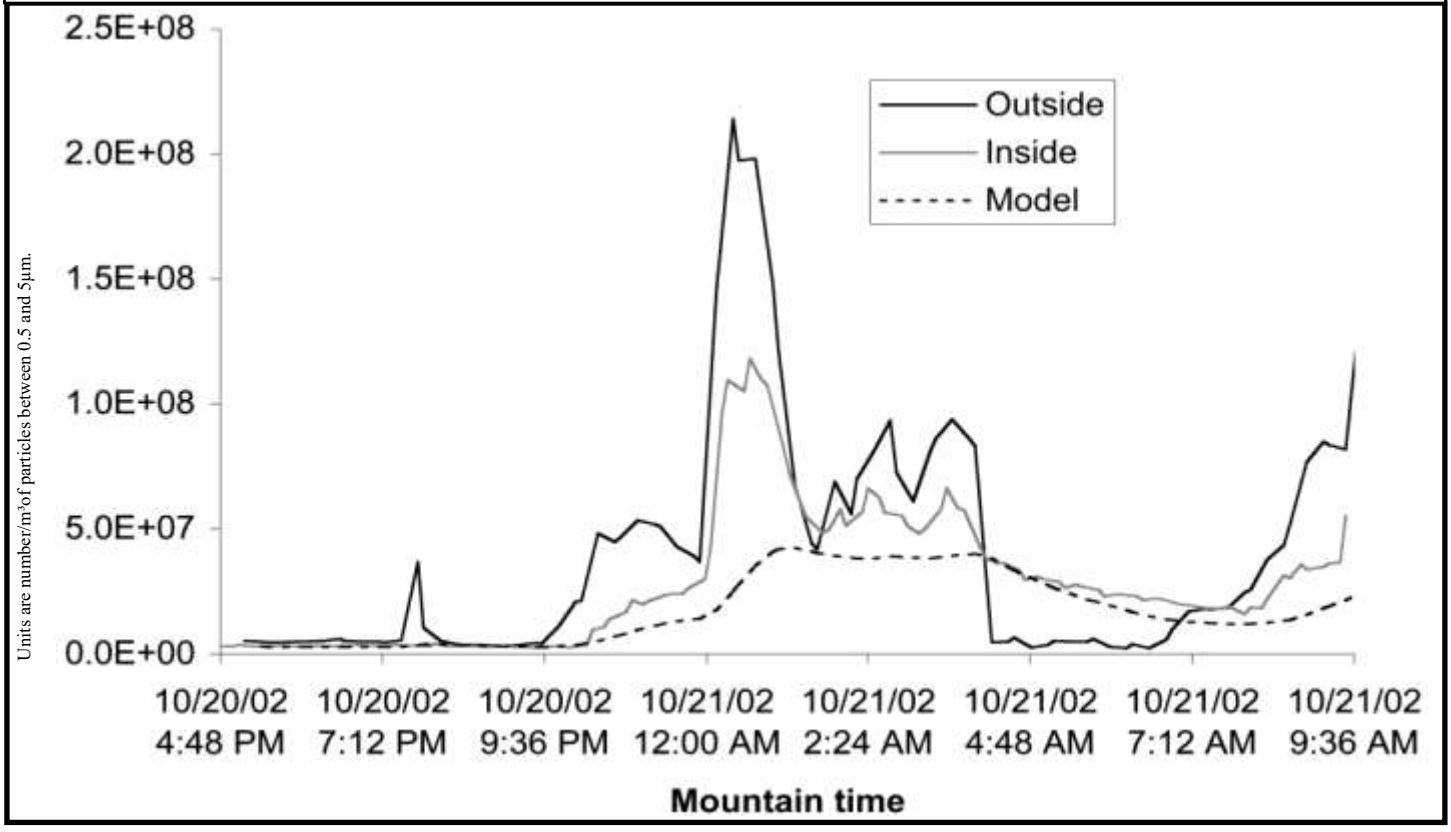
Exposure to chronic smoke can cause respiratory issues in healthy people, and worsen existing respiratory issues like asthma and chronic pulmonary obstructive disorder (COPD).

Smoke can also increase complications from existing medical conditions such as cardiac illness, high blood pressure, and diabetes. Because of this, wildfire smoke creates a barrier for Tribal Members to access Treaty Rights and First Foods harvest opportunities. Particulate Matter of 2.5 μm (PM2.5) is a particle size that makes up most wildfire smoke, and is able to pass the blood barrier in the lungs in humans and other organisms and can affect the ease of which blood is moved by the circulatory system around the body.

Figure 3B.10 is a real-time measure of smoke pollution from a large wildfire in Colorado, charting the levels of PM 2.5 μm present in the air during a controlled burn. Particle pollution from wildfire is measured in outside conditions (solid line), at specific indoor location near the burn (gray line), and compared to an atmospheric model of indoor air quality for the scenario (hashed line).

- Over the course of a 12-hour period, smoke inundation changes for all three were measured as wind speed, precipitation, and air temperature affect the density of these harmful particles.
- Most dense inundation of smoke occurred at night

Figure 3B.10: Filtered and Unfiltered Conditions of Particle Pollution from Wildfire Smoke



Umatilla Agency BIA Fire Operations control helicopter patrols an aerial ignition prescribed burn over Stage Gulch in October 2021

(10 PM to 4 AM in this instance) for all measures. This peak is higher for outdoor conditions, though there is also a corresponding increase in indoor air pollution during this time as well. As shown, sheltering indoors reduces the levels of particle pollution exposure at times, but there were periods where outdoor air is measured as cleaner than indoor air (between 4 and 7 AM).

- Within this house **without** air cleaning equipment operating, PM2.5 was 6.4 times higher during the prescribed burn compared with a non-burn event, and was much higher than was predicted by indoor air quality model for smoke events estimated. This shows that **being outside during smoke events expose a person to an estimated 15 µg/m³ of particle pollution in a 12-hour period**, for a home that does not operate air cleaners during these events. This corresponds to a 30 µg/m³ exposure on average over the course of a 24 hour day.
- This represents **a 7.6% increase per day in exposure to particle pollution during smoke events when Tribal Members are out exercising Treaty Rights without respiratory protection** (Henderson et al, 2005). As risk of wildfire increases 2-6 times by 2100 (USFS, 2017), this exposes Tribal Members exercising Treaty Rights to **15-45% increase in smoke exposure potential** during future fire seasons.

While this study compared smoke from a controlled burn rather than a wildfire, this proxy estimate gives us a conservative estimate for the particle pollution exposure for people outside during smoke inundation events. As smoke events become the new seasonal normal, it will be impossible for Tribal Members to continue their exercise of Treaty Rights and connection to First Foods without encountering some level of smoke exposure.

Non-Tribal public health entities often issue "shelter-in-place" orders during these events, but with the frequency of large wildfires increasing, these events are likely to coincide with First Foods harvest opportunities, forcing Tribal Members to make choices to prioritize either health or cultural connection. Adaptation measures that focus on reducing poor air quality burdens for Tribal Members both inside and outside, and increasing awareness of the importance of air quality will hopefully mitigate harm from smoke pollution.

Priority should be given to strategies that facilitate safety during Treaty Rights exercise — like respirator give-aways, that preserve connection to First Foods — with additional strategies aimed at improving decision-making around air quality, and improving home indoor air.

(Credit: Henderson et al 2005)

<u>Gaps in Knowledge/Data/Policy:</u>

- Atmospheric seasonal patterns are increasingly variable, and are likely to be a source of uncertain for fire and smoke impacts;
- Seasonal variability is likely to create big differences in severity of fire season year after year, though smoky conditions should be expected at any point during summer and fall seasons.

F. Anticipate Health Impacts for Tribal Harvesters

"Some hazards can almost be expected to occur. In eastern Oregon, cold winters and hot, dry summer months are normal conditions. Because these conditions exist every year, the possibility of a winter storm, a thunder storm or fog occurring is much greater than an earthquake or a volcano. These types of hazards are "chronic" hazards as they occur with some regularity and can sometimes be predicted through historic evidence and scientific methods. (CTUIR Hazard Mitigation Plan 2016)."

Exercise of Treaty Rights for Tribal Members is essential, and is a climate adaptation itself. Reducing impacts that challenge those opportunities are priority for mitigating threats to health while maintaining cultural connection.

i. Plan for Poor Air Quality Events During Harvest Seasons

Shelter-in-place orders for poor air quality events are highly likely to be a frequent seasonal occurrence. It is unrealistic and unjust to expect Tribal Members to forego Treaty Rights opportunities during these times, thus adaptation measures need to be in place to preserve capability for First Foods harvest as much as possible. For more information see Chapter 3D: Human Health and Happiness, page 157-158 for additional detail.

Short Term:

- **Fund and implement opportunities to provide personal protective equipment to Tribal community, staff, and others** to reduce impacts to health while out on the lands. This could include (but is not limited to): access to P100 respirators, N95 masks, and other equipment that preserve mobility and filters particulate matter. Emphasis should be placed on those with pre-existing health issues, Tribal harvesters, and those who work and/or live outdoors.

- **Fund and implement opportunities to improve indoor air quality of homes and facilities on the UIR through expanded use of air purifiers**, including (but not limited to): pre-manufactured models, and do-it-yourself fan and filter constructions, as well as other technologies as they become available.

- **Fund and develop Tribal government capacity for a dedicated Air Resource Advisor position,** either within CTUIR or BIA Fire Operations employment structures. This position would support expanded analysis of air quality impacts to wildfire controlled and prescribed burning implementation, and would work with DNR's Air Quality program to provide relevant outreach and information sharing with the Tribal community.

Long Term:

- **Expand access to personal protective and air filtration equipment** for community members through grants and advocacy. Many funding sources provide for planning exercises, but few include equipment in allowable costs. Advocating for funding and other frameworks to include bulk equipment purchases will expand capacity.

- **Improve understanding and decision-making** around air quality for the Tribal community through education and outreach. Understanding atmospheric science basics like ventilation and patterns of air movement, as well as the effect of varying exposures to air pollution can help families make decisions that protect health, cultural and community

connection, and empower families to plan to mitigate for quality of life impacts from smoke.

- **Prioritize vulnerable groups and invite them to be a the forefront of strategies and implementation.** Elders and children are at risk due to their health and activity levels, and young mothers who are pregnant or nursing are also susceptible due to infant development. Those who lack access to reliable and safe shelter are also at greater risk of exposure. Engaging these groups in planning for seasonal exposure will help protect those who are most at risk. See Ch 3D pages 157-159 for additional detail.

ii. Plan for Extreme Heat, Harmful Algal Blooms, and Additional Insect Vectors

Extreme heat, water-borne illness, and insect threats like mosquitos and ticks are impacts that reduce safe access and create health challenges for the exercise of Treaty Rights. See Ch 3D: Human Health and Happiness pages 157-158 for additional information.

Short Term:

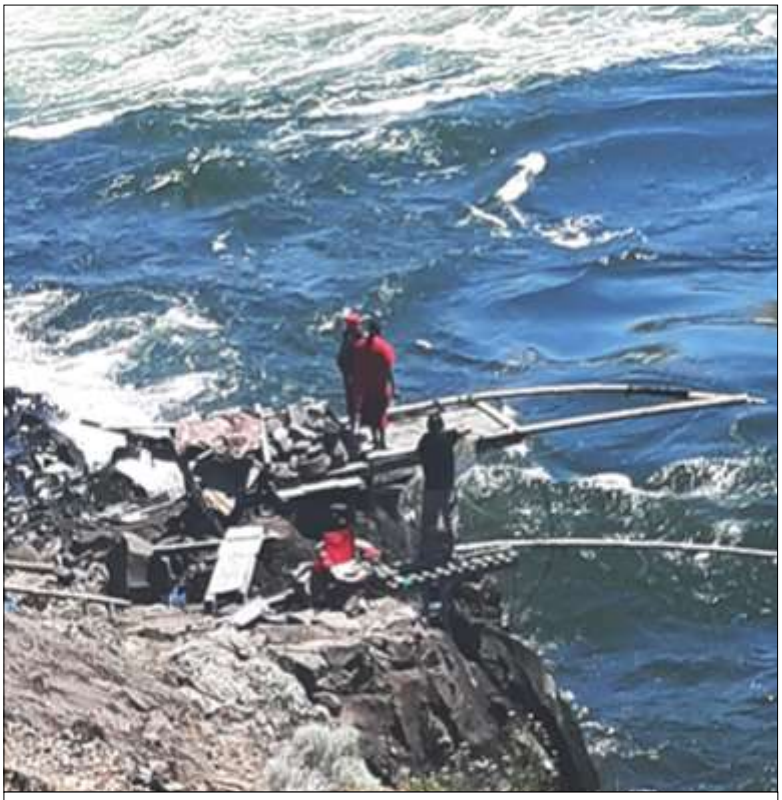
- **Support and expand health education and first aid skills** necessary to identify and treat heat-related illnesses. Informational outreach on heat related illness and how to respond accordingly has been conducted as short media posts and as part of other first responder training, but opportunities that involve scenario and response practice that is broadly accessible could help reduce incidences of heat exposure and illness.

- **Support and expand health education and first aid skills** necessary to identify and treat insect vectored illnesses. This includes outreach about mitigating for exposure to mosquitoes and ticks, awareness of signs and symptoms of insect-vectored illness documented or suspected in the region like Lyme Disease, West Nile, and Zika Viruses, and knowledge of how and where to have diagnostic tests and treatments performed.

- **Support and expand health education and first aid skills** necessary to identify and treat toxin exposure from harmful algal blooms (HABs). This should include awareness of health issues associated with HABs for humans and animals, knowledge of how to identify when algal blooms may be toxic, understanding of land and resource management issues that drive the formation of unusual algae growth, and steps to respond to and mitigate for illness and injury caused by contact with HABs.

Long Term:

- **Develop and expand disease identification and monitoring tools regionally**, and collaborate with other public health agencies on data collection/sharing and response. Building capacity to test and treat locally for affected diseases, as well as providing community outreach and support for awareness and decision-making, will improve community response to existing and emerging climate-driven illnesses.



Tribal fishermen on the Columbia River are an example of Tribal Members who experience impacts from seasonal smoke, extreme heat, and harmful algal bloom exposures.

G. Engage in Policy and Agency Land Management Discussions

"Upland ecosystems within CTUIR Ceded lands are owned and managed by a diverse mix of individuals, communities, government and Tribal agencies. Many critical ecological processes necessary for the sustained production of First Foods cross ownership and management boundaries, and some managers may be unaware of the importance of First Foods to CTUIR culture or their goals do not explicitly include stewardship of First Foods. Therefore, achieving the goal of sustained production of First Foods by natural ecosystems and the ability of Tribal members to harvest requires communication and close collaboration across land ownership and management boundaries (First Foods Upland Vision, 2019)." Tribes are often not in direct control of the lands that support First Foods, and so coordinating with other management agencies is required to promote Tribal stewardship approaches.

i. Advocate for Proactive Wildfire Management within State/Federal Agencies

Many land management agencies are still operating on wildfire suppression policies, and while the acceptance of prescribed fire as a proactive risk reduction tool is gaining popularity, it still lags behind what is required. Implementation of prescribed fire in many places is driven not by Treaty Rights and Indigenous knowledge, but by commodification of this process.

Short Term:

- **Continue to participate in co-management opportunities for forested lands in Ceded and traditional use areas**. CTUIR has existing coordination with other forest management agencies, particularly between the DNR Range, Agriculture, and Forestry (RAF) Program, BIA Umatilla Agency Fire Operations staff, and partners with the US Forest Service (USFS) and Oregon Department of Forestry (ODF) through co-management and Good Neighbor Authority agreements.

Long Term:

- **Expand Tribal businesses, enterprises and community groups to organize opportunities to implement prescribed and cultural burning** in a way that re-connects Tribal Members with the land, and benefits them economically. Yurok Tribe in Northern California provides a good example of Tribes working with a range of entities to return cultural burning to public lands. Support from non-governmental fire users could have a role in expanding and implementing intentional burns. See Ch 3F pages 227-229 and 249 for additional detail.

- **Advocate for capacity to implement prescribed and cultural burning** in legislative action at state and national levels. This may include advocating for funding to Tribes to compact fire services within Tribal government structures, supporting opportunities to provide training for intentional burning, expanding mechanisms that facilitate Tribal management of public lands, and improving insurance mechanisms that protect landowners who want to work with Tribes to conduct intentional burns.

ii. Expand Opportunities for Treaty Rights Exercise and Understanding

Cultural connection should be at the forefront of climate adaptation, and wildfire risk management is an opportunity for expanding culturally-significant land management practices.

Short Term:

- **Develop CTUIR community-led plans for identifying new First Foods harvest locations**, for facilitated migration of important species, and for mutual aid support in times of crisis. Actively and continuously engaging the Tribal community in planning and discussion will improve the quality of these efforts, as well as expand capacity for observation and monitoring through community science frameworks, and will increase accountability of Tribal government services to the CTUIR people being served.

- **Continue to educate non-Native people and agencies about Tribal Rights** to fish, hunt, gather, graze, and administer water in the region. Many incorrectly believe that Tribal people exist in the past, while Tribal people have always persisted and will always persist on these homelands. Education about the ongoing contributions of Tribal people and practices to sustainable and resilient landscapes demonstrates the essential need for continued presence of Tribal people practicing culture, religion, and connection with First Foods for the prosperity of all.

Long Term:

- **Prioritize adaptation strategies that maintain cultural connection and First Foods harvest**, especially when extended "shelter-in-place" alternatives are proposed. First Foods harvest windows are responsive to environmental conditions and annual variability is likely to be huge. Prioritizing adaptation strategies that allow for mobility and engagement with natural resources will preserve First Foods connections.

- **Advocate for use of a variety of vegetation management and rights advocacy approaches** for wildfire control and invasive species risk. This is likely to include (but is not limited to): herbicide application, seasonal grazing, intentional burning, mowing and manual removal. Many options can be used concurrently, and an emphasis on Tribal Rights within these strategies could strengthen sovereignty and Indigenous land stewardship. Examples include developing frameworks to prioritize Tribal grazing rights on public lands above the needs of commercial livestock producers, and efforts to quantify grazing "rights" held by deer, elk, and other Big Game First Foods as they are connected to Treaty Rights to harvest and Tribal 5th Amendment rights.

Pacific Lamprey (left) and Fresh Water Mussels (right) are aquatic First Foods that will have an important role in adapting to the climate crisis. Lamprey can live in warmer waters than salmon, and fresh water mussels filter sediment from streams to reduce debris that harm fish. Expanding opportunities to supplement and monitor these species is essential in climate adaptation.

Measuring Success and Gaps in First Foods Access Adaptation

How Do We Measure the Success of These Adaptations?

"The Treaty of 1855 illustrates the vision and foresight our peoples had for future generations. The flame of sovereignty continues to burn through oral traditions given to us throughout time. This is our true law – our language, tradition, and custom. (Johnson, 2006)"

- **Comprehensive Plan Objective 5.6.5:** To assess the distribution and security of cultural foods plants (roots, berries) and protect and enhance them for CTUIR member use (see Comp Plan page 81 for benchmarks);
- **Comprehensive Plan Objective 5.6.6:** To protect, preserve, and perpetuate the CTUIR's culturally significant places and resources for the benefit of current and future generations (see Comp Plan page 81 for benchmarks);
- **Comprehensive Plan Objective 5.7.9:** Improve the accuracy of external perceptions of the Tribes' cultures by creating opportunities for others to experience our world, our work, and our challenges through the eyes of Tribal people (see Comp Plan page 86 for benchmarks);
- **Comprehensive Plan Objective 5.14.8:** Ensure appropriate levels of fire equipment, fire flows and prevention programs consistent with the level of commercial and residential construction on the reservation (see Comp Plan page 124 for benchmarks).
- **CTUIR Water Code (2005) Section 1.05. Statement of Policy N:** Protection of Stream Zones. Protection of stream zones of the Umatilla Indian Reservation is vital to the preservation of Tribal traditional values and religion, and the Confederated Tribes' hunting, fishing, and gathering rights and the way of life that depends on them as provided by the Treaty of 1855;
- **CTUIR Water Code (2005) Section 1.05. Statement of Policy O:** Watershed Protection. Watershed practices which serve to capture water or reduce its rate of flow from the Reservation shall be promoted;

CTUIR DNR Fisheries Lamprey Restoration Project is introducing juvenile Pacific lamprey to the river to restore this First Food species

- **CTUIR Water Code (2005) Section 1.05. Statement of Policy Q:** Anti-degradation Policy. The protection of existing instream uses and the level of water quality and quantity necessary to provide full support to those uses must be maintained and protected.
- **CTUIR Hazard Mitigation Plan (2021) Section 5:** Mitigation Strategy Implementation and Integration (page 214-225)
- Harvest restrictions or prohibitions set by FWC, DNR Fisheries, CRITFC and other regulating entities.
- Adaptive Big Game hunting seasonal windows, locations, and regulations responsive to conditions over static annual dates.
- Community observation of First Foods illnesses and injury, Tribal Member safety during harvesting activities, and noxious weed spread.

What Gaps in Knowledge, Policy, Capacity, or Education Exist?

- Insurance liability and access to knowledge/ equipment is a barrier for prescribed fire implementation;
- Carbon pricing approaches and how these might reduce/impact opportunities for First Foods harvest and cultural practices;
- Current and future energy project development impacts on First Foods access corridors.

First Foods Adaptation Summary

First Foods Availability Adaptation

A. Anticipate Habitat Shift and Migration

B. Invasive & Displaced Species Management and Monitoring

C. Proactively Address Wildfire Risk

D. Species Migration Information and Practices

E. Research and Regulatory Understanding for First Foods Harvest

Details of how conditions will change are currently lacking, and would facilitate First Foods adaptation. Changes in vegetation, pest, pathogen, and drought stress are likely to impact habitat suitability and availability of First Foods. Community-led facilitated migration and regulation could ease these impacts.

Measures of Success:

- First Foods Upland Vision touchstones provide technical metrics that can be measured.
- CTUIR Comprehensive Plan Objectives 5.6.2, 5.6.4, 5.8.1, and 5.14.7, and their associated benchmarks.
- CTUIR Water Code (2005) Section 1.05. Statement of Policy K, L, and M.
- CTUIR Hazard Mitigation Plan (2021) Section 3 and 4
- Fish and Wildlife Commission (FWC) Annual Reports
- DNR annual work plans and activities

First Foods Access Adaptation

F. Anticipate Health Impacts for Tribal Harvesters

G. Engage in Policy and Agency Land Management Discussions

Tribes often do not have direct control over lands that sustain First Foods, and land use and management is inextricably linked with climate impacts. Working with private, public, and industry collaborators on returning Indigenous knowledge and stewardship to CTUIR Ceded and traditional use lands is essential.

Measures of Success:

- CTUIR Comprehensive Plan Objectives 5.6.5, 5.6.6, 5.7.9, and 5.14.8 and their associated benchmarks.
- CTUIR Water Code (2005) Section 1.05. Statement of Policy N, O, and Q.
- Harvest restrictions or prohibitions set by FWC, DNR Fisheries, CRITFC and other regulating entities.
- CTUIR Hazard Mitigation Plan (2021) Section 5
- Adaptive Big Game hunting seasonal windows, locations, and regulations responsive to conditions over static annual dates.
- Community observation of First Foods illnesses and injury, Tribal Member safety during harvesting activities, and noxious weed spread.

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- Panel Photo; “Prescribed Burn on Stage Gulch,” BIA Umatilla Agency, Oct 2021
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- Background Photo; “Cultural Huckleberry Smoking,” CTUIR DNR CRPP
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- Inset Photo; “Tribal Fishermen Fish from Scaffold on the Columbia,” CTUIR DNR CRPP Wenix Red Elk
- Panel Photo; “Hazy Sunrise on Prescribed Burn,” BIA Umatilla Agency, Oct 2021
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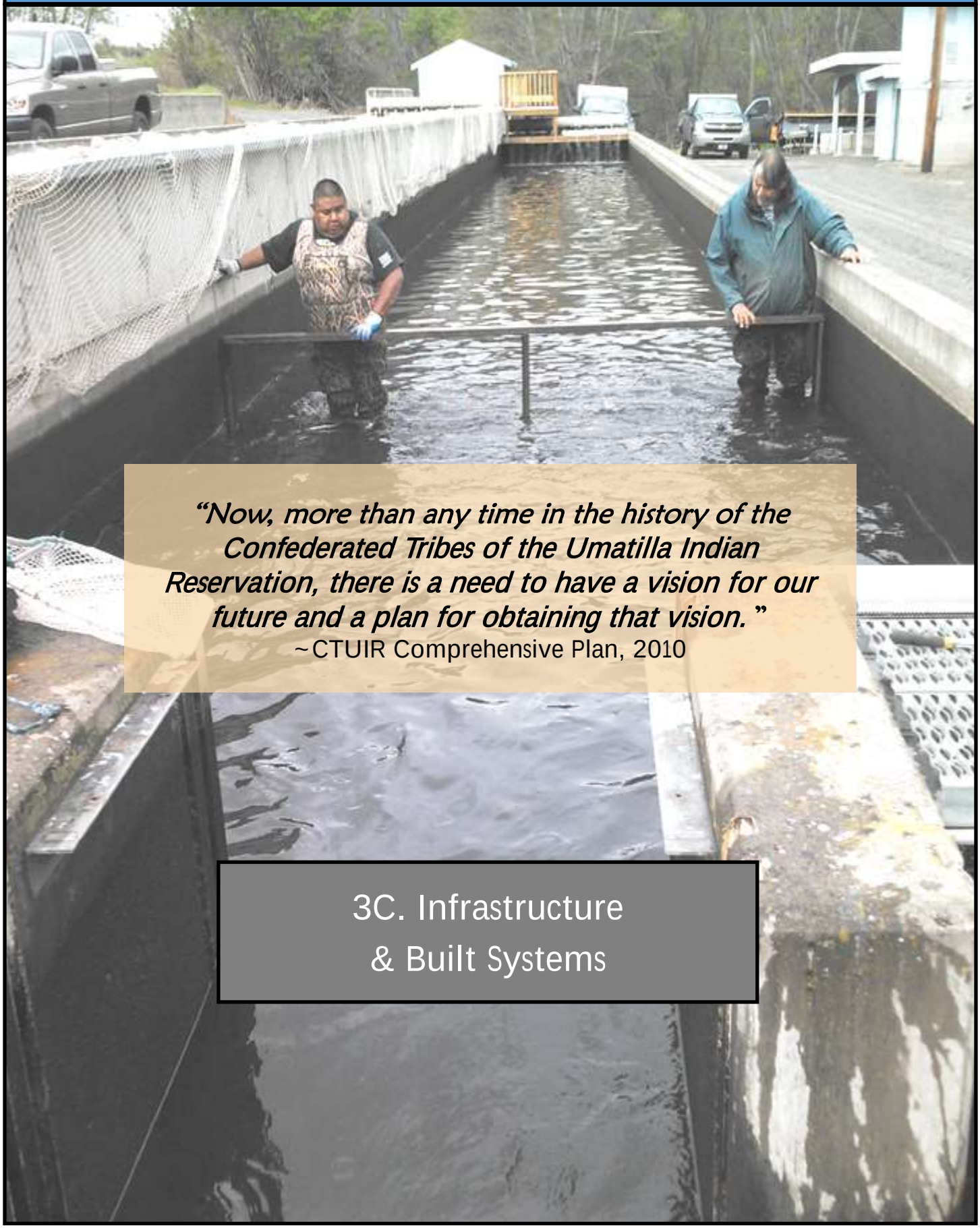
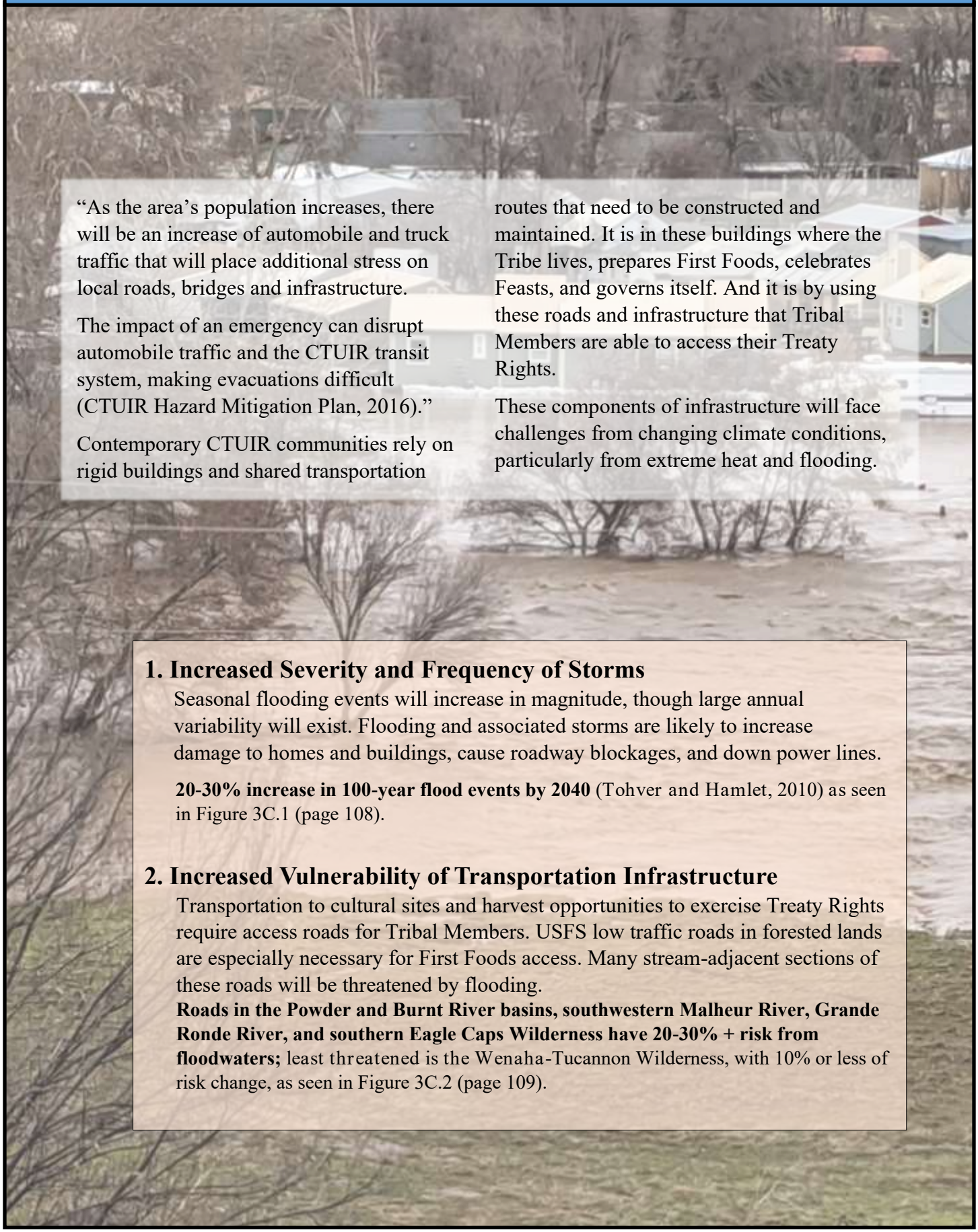
- Inset Photo Right; “Freshwater Mussel at Home in Streambed,” CTUIR DNR
- Inset Photo; “Fisheries Staff Prepare for Juvenile Lamprey Release,” CTUIR DNR
- Summary Inset Photo; “Tribal Fishermen Harvest Lamprey at Willamette Falls,” Althea Husties-Wolf
- Panel Photo; “First Foods on the N’chi’wana,” FWC Bud Herrera 2020



"Now, more than any time in the history of the Confederated Tribes of the Umatilla Indian Reservation, there is a need to have a vision for our future and a plan for obtaining that vision."
~CTUIR Comprehensive Plan, 2010

3C. Infrastructure & Built Systems

Climate Impacts for **Physical Infrastructure**



"As the area's population increases, there will be an increase of automobile and truck traffic that will place additional stress on local roads, bridges and infrastructure.

The impact of an emergency can disrupt automobile traffic and the CTUIR transit system, making evacuations difficult (CTUIR Hazard Mitigation Plan, 2016)."

Contemporary CTUIR communities rely on rigid buildings and shared transportation routes that need to be constructed and maintained. It is in these buildings where the Tribe lives, prepares First Foods, celebrates Feasts, and governs itself. And it is by using these roads and infrastructure that Tribal Members are able to access their Treaty Rights.

These components of infrastructure will face challenges from changing climate conditions, particularly from extreme heat and flooding.

1. Increased Severity and Frequency of Storms

Seasonal flooding events will increase in magnitude, though large annual variability will exist. Flooding and associated storms are likely to increase damage to homes and buildings, cause roadway blockages, and down power lines.

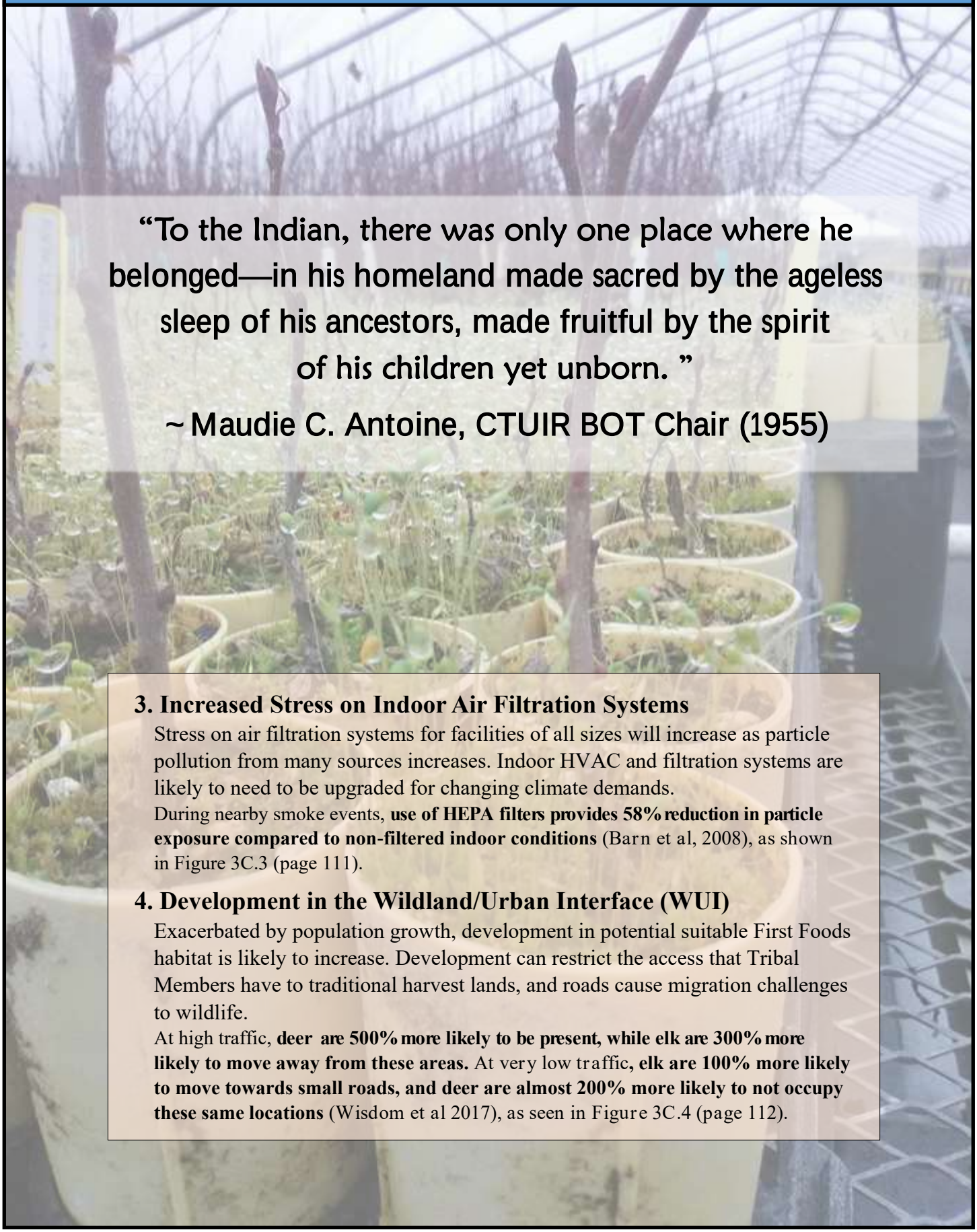
20-30% increase in 100-year flood events by 2040 (Tohver and Hamlet, 2010) as seen in Figure 3C.1 (page 108).

2. Increased Vulnerability of Transportation Infrastructure

Transportation to cultural sites and harvest opportunities to exercise Treaty Rights require access roads for Tribal Members. USFS low traffic roads in forested lands are especially necessary for First Foods access. Many stream-adjacent sections of these roads will be threatened by flooding.

Roads in the Powder and Burnt River basins, southwestern Malheur River, Grande Ronde River, and southern Eagle Caps Wilderness have 20-30% + risk from floodwaters; least threatened is the Wenaha-Tucannon Wilderness, with 10% or less of risk change, as seen in Figure 3C.2 (page 109).

Climate Impacts for **Physical Infrastructure** (cont.)



"To the Indian, there was only one place where he belonged—in his homeland made sacred by the ageless sleep of his ancestors, made fruitful by the spirit of his children yet unborn. "

~ Maudie C. Antoine, CTUIR BOT Chair (1955)

3. Increased Stress on Indoor Air Filtration Systems

Stress on air filtration systems for facilities of all sizes will increase as particle pollution from many sources increases. Indoor HVAC and filtration systems are likely to need to be upgraded for changing climate demands.

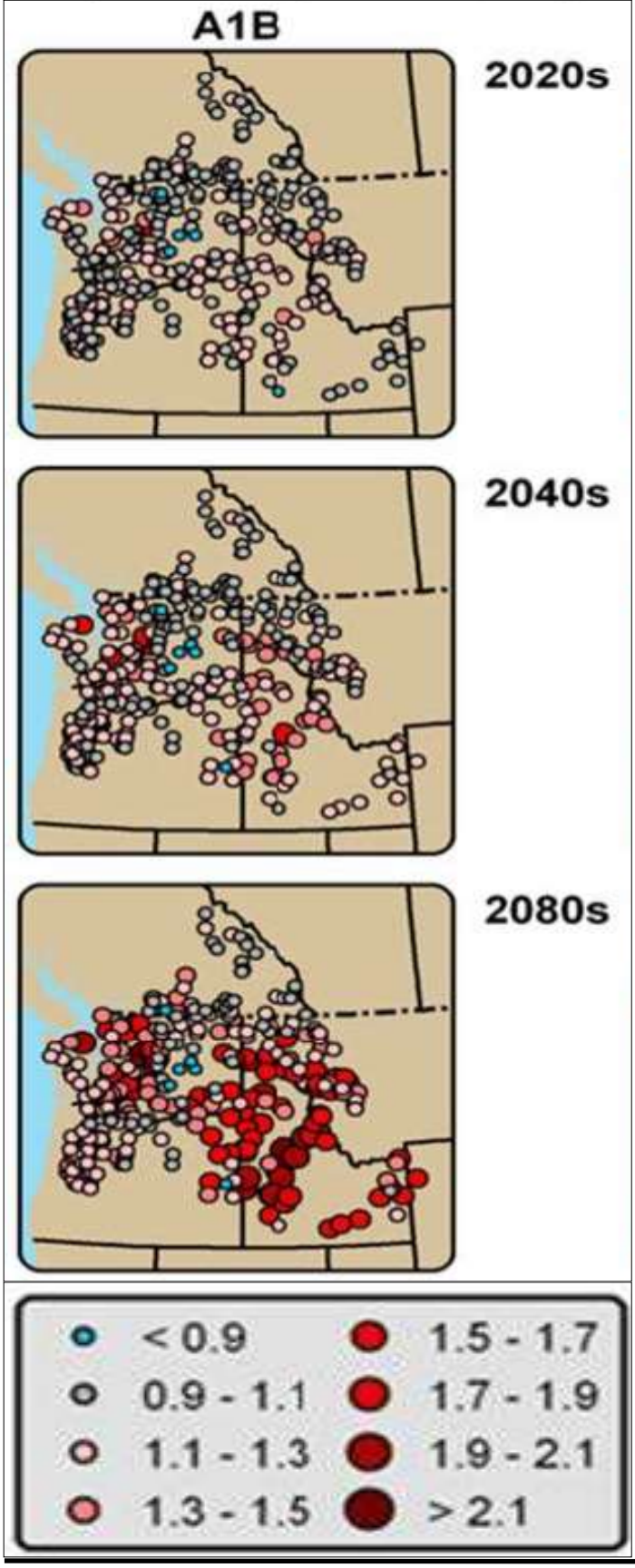
During nearby smoke events, **use of HEPA filters provides 58% reduction in particle exposure compared to non-filtered indoor conditions** (Barn et al, 2008), as shown in Figure 3C.3 (page 111).

4. Development in the Wildland/Urban Interface (WUI)

Exacerbated by population growth, development in potential suitable First Foods habitat is likely to increase. Development can restrict the access that Tribal Members have to traditional harvest lands, and roads cause migration challenges to wildlife.

At high traffic, **deer are 500% more likely to be present, while elk are 300% more likely to move away from these areas.** At very low traffic**, elk are 100% more likely to move towards small roads, and deer are almost 200% more likely to not occupy these same locations** (Wisdom et al 2017), as seen in Figure 3C.4 (page 112).

Figure 3C.1: Ratio of 100-Year Flood Statistics into the Future



1. Increased Frequency and Severity of Seasonal Storms

"Constraining [river] high flows concentrates stream power (and energy to move sediments) within the main channel, resulting in an incised channel with faster flows. Such altered hydrologic and geomorphic conditions reduce the range of habitats with depth and flow conditions suitable to native riverine species and promote channel incision, further diminishing habitat connectivity (Umatilla River Vision, 2011)."

Essential infrastructure located in floodplains restricts the natural function of the waterway, as well as putting this infrastructure at risk from increased magnitudes of flooding.

Figure 3C.1 provides an illustration of how these waterways are projected to change in flooding magnitude as a percentage of historic 100-year flood levels, into the 21st century under Scenario A1B.

- Colored dots of various sizes mark the expected change in flooding at three different points: by 2020, 2040, and 2080. These dots show small changes as blue dots, and larger changes as increasingly dark red hues.
- These changes are calculated as the percent of a 100-year flood event; for example, blue dots indicate 90% of a 100-year flood event, which is actually a reduction in flooding. Conversely, 1.7-1.9 (midsize red dots) correspond to 170-190% of a 100-year flood event, making this a 41-47% increase in flood magnitude.
- Much of the CTUIR Ceded lands are projected to **experience 20-30% increases in flooding by 2040, and 33% and greater increase by 2080**. Parts of Idaho that are likely to become suitable First Foods habitat are projected to experience 47% and higher increases in seasonal floodwaters (Tohver and Hamlet, 2010).

Overall, it can be expected that when flooding occurs, the magnitude of the volume of water will exceed previously anticipated levels, and can threaten the structural integrity of existing infrastructure. These expected increases in flood volume must be incorporated into planning and construction of new projects.

CTUIR's community experienced an example of this impact in February 2020, when flooding inundated numerous homes, swept vehicles and debris into rivers, and destroyed Thornhollow Bridge, as well as a number of other river-adjacent roads and railways, which reduced transportation accessibility and emergency evacuation options. These kinds of events will be increasingly more frequent in the future, and watershed floodplains will expand as a result of increasing flood magnitudes. Vulnerable and essential infrastructure planning needs to include climate change projections in planning for new and existing infrastructure.

(Credit: Tohver and Hamlet, 2010)

Gaps in Knowledge/Data/Policy:

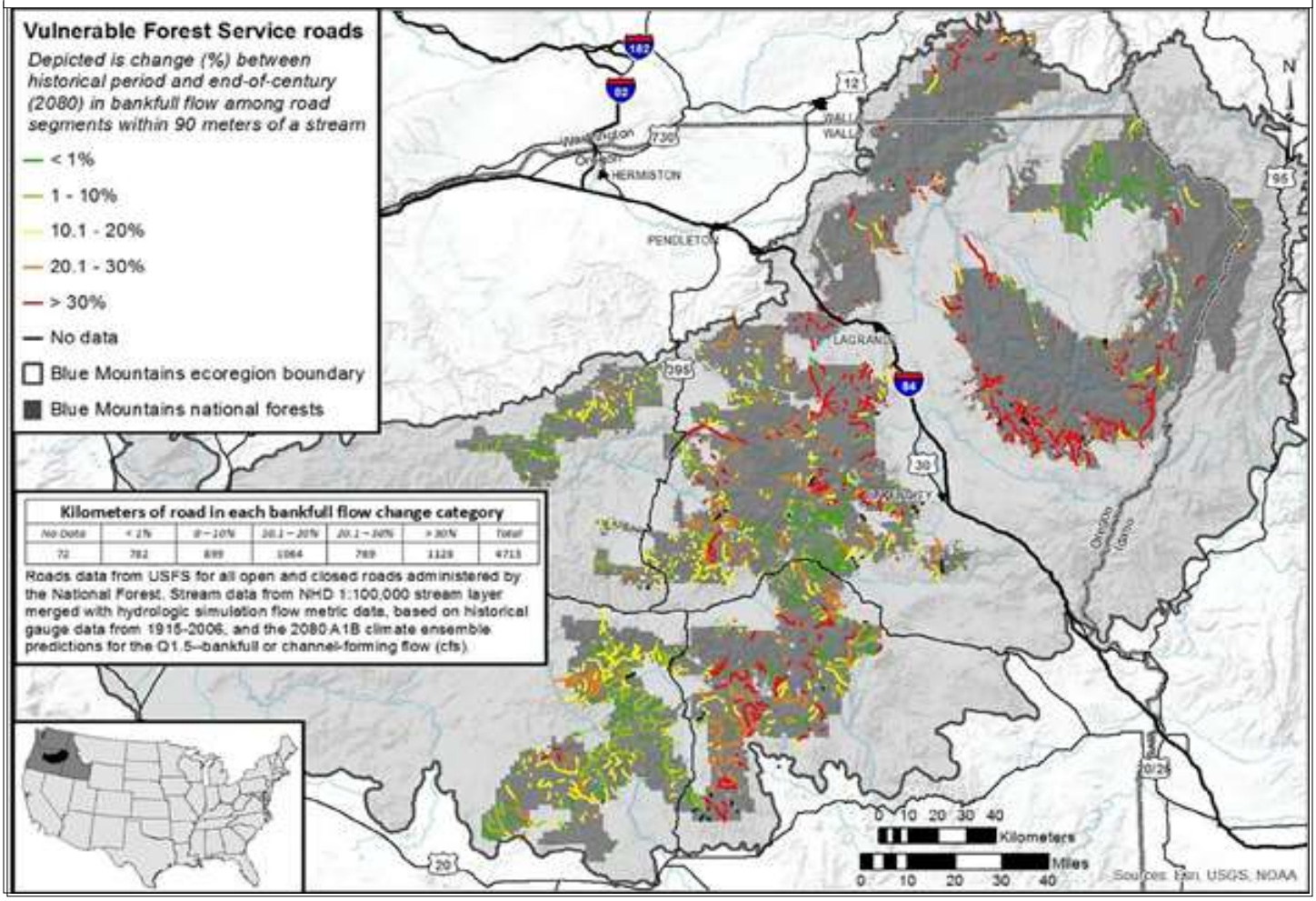
- Data on expansion of floodplains in response to increasing magnitude and coordination with Federal Emergency Management Agency (FEMA);
- Changes in wind activity, intensity, and direction as it is part of storm intensity.

2. Increased Vulnerability of Transportation Infrastructure

"The UIR and Umatilla County rely primarily on automobiles and trucks as the main sources of transportation. Maintaining the highway and road system and to the reservation and within the reservation is essential to the area economy and general welfare of the residents of the UIR… Other transportation modes that exist on the UIR are Union Pacific Railroad lines, pipelines used for transporting natural gas, and high voltage electrical lines used by the Bonneville Power Administration to transport electricity (CTUIR Hazard Mitigation Plan, 2016). "

First Foods exist frequently in locations where Tribal Members must travel to in order to reach harvest opportunities. Tribal Members travel on roads and cross bridges to reach these locations, and this transportation infrastructure is often located over and adjacent to waterways. Forest Service roads are often gravel, and thus can be at high risk of eroding when high

Figure 3C.2: Percent Change in Bankflow by 2080 Compared to Historic



water events inundate them seasonally.

Figure 3C.2 is a map of three National Forests within CTUIR Ceded lands, and shows U.S. Forest Service roads that are close to waterways and vulnerable to flooding.

- Within this map, green roads are found to be least impacted (10% or less of change), while yellow and orange roads are moderately impacted (10.1-30% threatened), and dark red roads are severely impacted at 30% and greater increase in risk to infrastructure.
- In this map, many of the roads in lower elevations are likely to see small to moderate increases in risk, such as in the **John Day basin, Middle Fork John Day River, Silvies River, and western Umatilla National Forest near Heppner were estimated at 1-20% increased risk (Clifton et al 2018)**.
- Other regions will experience higher rising risk as seasonal snow melts more quickly, including regions like **Powder and Burnt River basins, southwestern end of the Malheur National Forest and Malheur River, Grande Ronde River, and southern Eagle Caps Wilderness with 20-30% and above risk (Clifton et al 2018);**
- Lowest increase is expected in the **Wenaha-Tucannon Wilderness with 10% or less** of change.

Roads are used by Tribal Members to access First Foods harvest opportunities, and U.S. Forest Service roads especially assist hunters and gatherers to reach remote locations where First Foods thrive. The existence of many of these roads next to rivers and streams also creates barriers to implementing Umatilla River Vision strategies, but are necessary to reach historic and existing locations for many First Foods.

Tribal community prioritization of roads under risk of being destroyed by flooding should be conducted to understand which roads are at risk and which are worth being reinforced and updated where possible. (Credit: Clifton et at 2018)

Thornhollow Bridge on the Umatilla Indian Reservation was damaged by the February 2020 flooding. Note the buckled concrete in the bridge center.

Gaps in Knowledge/Data/Policy:

- How Tribal community members value specific roadways and access points, and where there are roads that create problems or hazards;
- Landslide potential and how wildfire and prescribed burning may factor into sediment movement after disturbance, and with heavy precipitation.

3. Increased Demand on Facility Indoor Air Filtration Systems

Facilities, homes, and service infrastructure are an integral part of modern Tribal life, and CTUIR has planning in place to maintain and improve these in its Comprehensive Plan. However, much of previous planning has been done using historic estimates of weather patterns and extreme events. Climate crisis impacts will change seasonal conditions and increase regular maintenance burdens, as well as increase risk of extreme events that require emergency response.

Most Tribal facilities are likely to need upgrades in air filtration as a result of increasing wildfire smoke, dust from drought conditions, expanding pollen potency and season, and ozone created by extreme heat events.

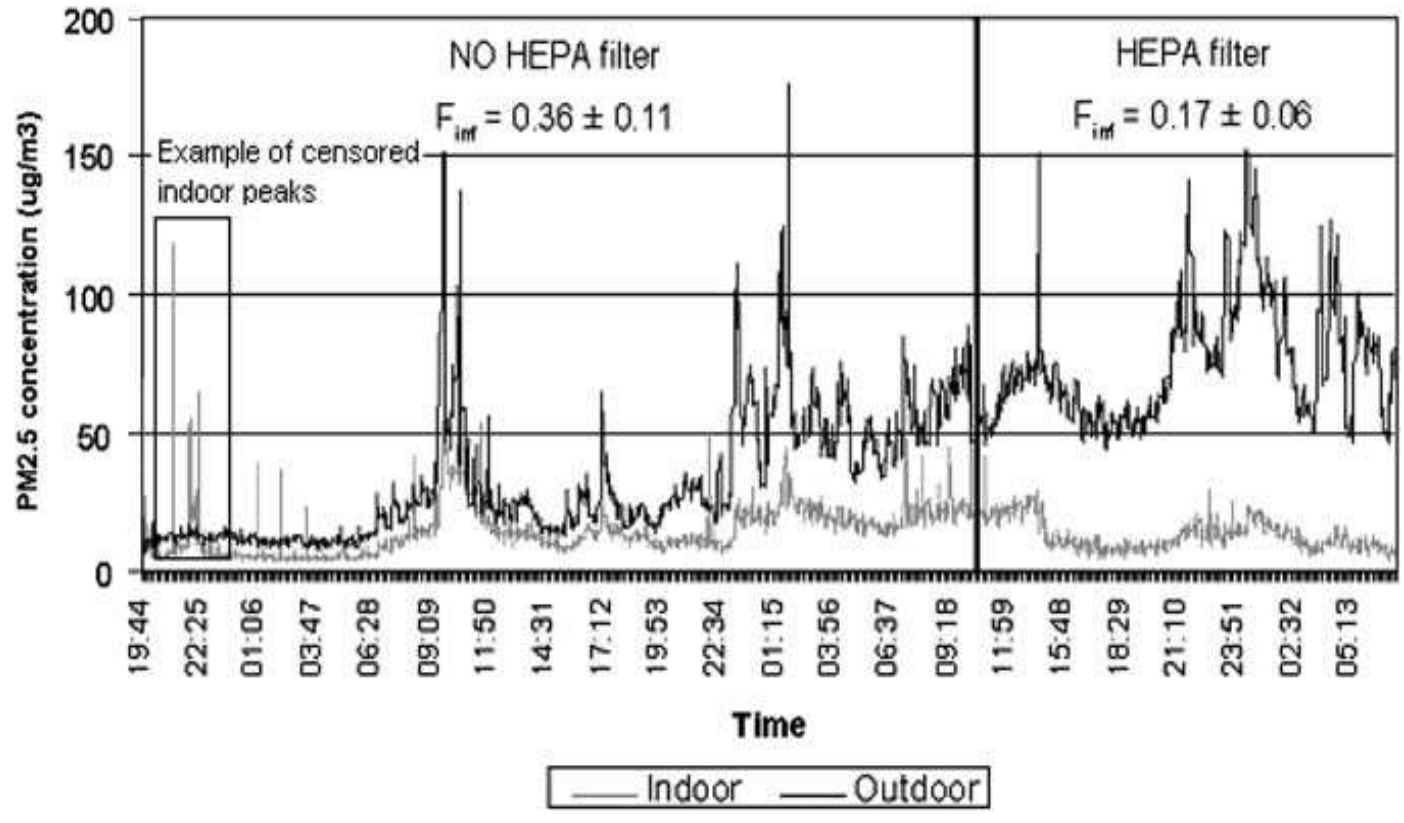
Figure 3C.3 shows the change in air quality between filtered and unfiltered conditions during wildfire smoke inundation events.

- This time chart shows a 2-day period of indoor air quality in a residential house during a summer 2004 wildfire event in British Columbia, measured as Particulate Matter (PM) 2.5 present over time. The light gray line represents air quality sampling within the home, while the dark line shows air particulate matter outdoors.
- The left side of this diagram shows particle pollution indoors before filtration equipment was implemented, and can be considered an accurate example of homes and buildings that lack robust air filtration capacity. On the right is the impact that HEPA-grade air filtration has on wildfire particle pollution.
- This illustrates intrusion of smoke into housing without HEPA filtration can be 70-100% of outdoor air quality (Barn et al 2008). This means that indoor air is close to, or the same as, conditions outdoors.
- Use of the HEPA filter **improved indoor air quality 58% over outside air** during the wildfire, showing the difference a filtration system can make in the air quality and health of people over time.

These findings call into question common public health recommendations to "shelter in place" (remain inside buildings) during poor air quality events, as this recommendation inaccurately assumes that most facilities have adequate filtration capacity. Future conditions will create increasingly frequent poor air quality events, and many homes are not adequately equipped with air filtration to protect residents.

Upgrading and maintaining facilities is a costly undertaking, but planning for improvements and upgrades now could help alleviate some of the funding burden in future years. Increasing awareness poor air quality effects, improving understanding of current smoke intrusion into facilities, and empowering communities around air quality decision making can improve agency in adapting to this climate impact.

Figure 3C.3: Indoor Air Quality Improvements from HEPA During Wildfire Event



(Credit: Barn et al, 2008).

Gaps in Knowledge/Data/Policy:

- Infiltration rate of smoke into CTUIR facilities and housing;
- Rates of ozone pollution that exist around Tribal communities and population centers.

4. Development in the Wildland/Urban Interface (WUI)

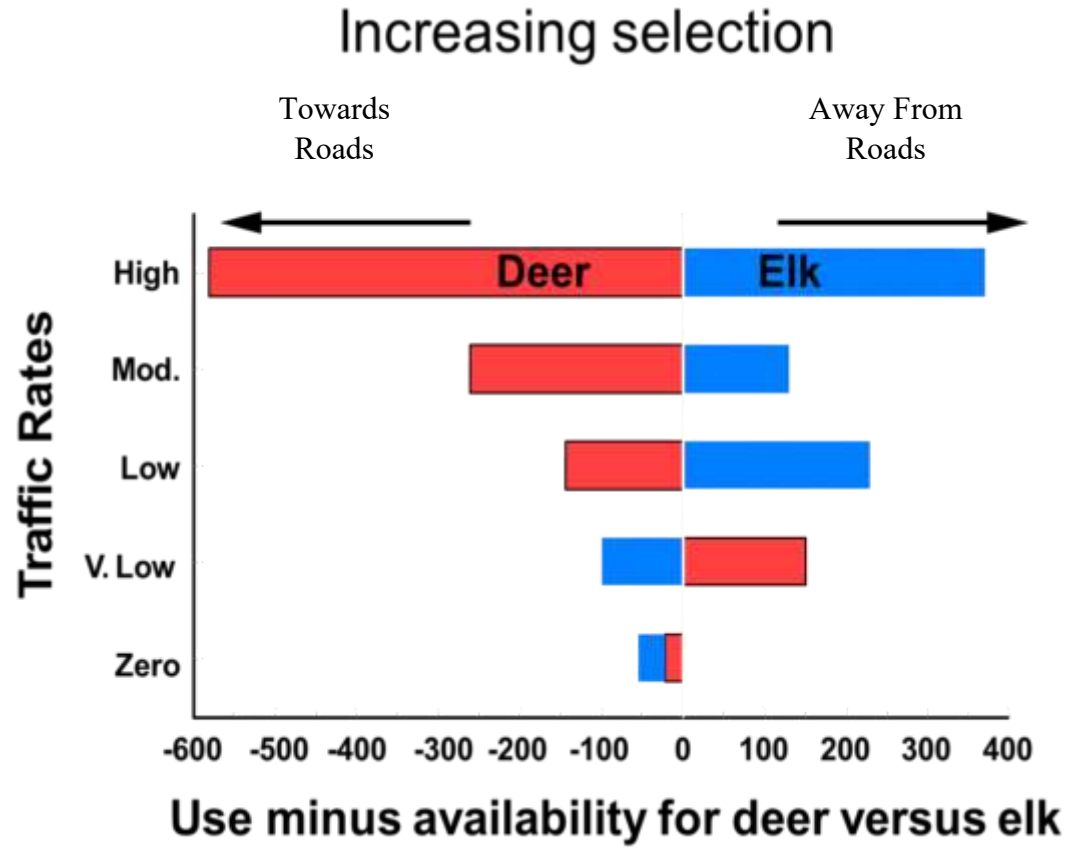
"Roads are well known barriers to the movement of elk and deer. Roads are thought to be a driving factor in determining elk distribution across seasons and landscapes. Elk avoid roads resulting in distribution shifts of populations away from roads and concerns about increased flight responses and associated energetic costs, reduced foraging time and reducing the total amount of effective habitat. Roads also facilitate other human activities such as recreation, which can affect habitat use and behavior of Big Game (First Foods Upland Vision, 2019)."

Infrastructure often creates access issues for success and harvest of First Foods, and the climate crisis will find those conflicts intensifying. Development in the WUI creates many challenges that will be made worse by changing conditions: highways are migration barriers to many plants and animals, electrical transmission lines are strung through forests that are experiencing more intense pest and wildfire pressure, and houses decrease agency capacity to use prescribed fire as a management tool while creating additional structures that need to be defended by wildland firefighters.

Figure 3C.4 shows the results of an experiment the Starkey Experimental National Forest, located within the CTUIR Ceded lands. Its goal was to monitor the movement patterns of elk and deer as compared to the traffic rates of roads in their migration territory.

- This chart examines the relationship between elk and mule deer dynamics in the presence of variable road traffic and each other. Bars show the magnitude of migration (animal "use" of space subtracted by the availability of habitat) towards or away from roads of different sizes, for elk and deer respectively.
- Blue bars represent elk migration, while red bars show movements of deer, both in response to the presence of roads. Migration towards roads is demonstrated by negative values, while away from roads is designated by positive values.
- In high traffic situations, such as large highways through forested lands, **deer are 500% more likely to utilize habitat near roads, while elk are over 300% likely to move away** from these same roads. This pattern of distribution is similar with moderate traffic (such as paved non-highway surface streets),

Figure 3C.4: Elk and Deer Migratory Response to Presence of Roads



where deer are roughly 300% more likely to occur near these roads, and elk 150% more likely to move away from these kinds of roads. At low density traffic, such as along graveled Forest Service roads, the pattern still remains, with deer 150% more likely to use those spaces, and elk much more likely at 250% to move away from those roads (Wisdom et al 2017).

- At **very low traffic volumes**, such as un-graveled Forest Service roads, and ATV, horse-, and hiking trails, the pattern is reversed, finding **elk 100% more likely to move towards those small roads, and deer almost 200% likely to not** occupy those same spaces. No roads was measured to affect the availability of both deer and elk, with elk 50% more likely to move towards these spaces, and deer only 25% more likely (Wisdom et al 2017).
- This study shows that **elk are prone to move away large roads with high traffic, while deer are more likely to move away from areas where elk exist at high densities**.

Roadways facilitate Tribal Member access to First Foods harvest while also presenting a migration barrier to these species. Pictured is a Big Game caution sign at Hanford Nuclear Reservation, installed after numerous vehicle strikes of elk and deer that are populous at the site.

While traffic presence is not strictly a climate impact, human development in the WUI affects species habitat health, connectivity, and the ability to migrate. Such knowledge about Big Game response to traffic intensity is helpful when planning for new and existing infrastructure in the light of the climatic changes.

Population growth projections used in the CTUIR's Hazard Mitigation Plan (2016) predict 7.5% growth rate for both CTUIR and Umatilla County (CTUIR Hazard Mitigation Plan, 2016). This estimate is without any kind of anticipation of regional climate migration, as magnitudes of which are difficult to predict. As populations grow over time and with climate-induced migration, more pressure will be placed on developing in the WUI.

Prioritizing either elk or deer success in certain locations can be assisted by the placement of roads and trails that support access to these First Foods, and infrastructure planning should consider these kinds of First Foods migration and habitat requirements in the siting and maintenance of structures.

<u>Gaps in Knowledge/Data/Policy:</u>

- Migration pathways and population habits that could assist infrastructure adaptation planning.

A. Identify Ongoing and Emerging Hazards and Opportunities on the UIR and CTUIR Ceded Lands.

i. Coordinated Mapping of Biological and Physical Hazards

"An essential component of the Umatilla Indian Reservation's Hazard Mitigation Plan is the identification of natural and man-made hazards that present potential risks to lives, property and the natural and cultural resources of the Reservation. The purpose of this section is to identify hazards that have the potential to cause injury or damage and evaluate whether or not they present a realistic threat to the residents of the Umatilla Indian Reservation (UIR). Each of these hazards is analyzed to determine the level of risk that each hazard presents (CTUIR Hazard Mitigation Plan, 2016)."

Flooding and wildfire cause many different emergencies for the natural, built, and social environments.

Short Term:

- **Perform an inventory of existing and emerging disaster needs**. This may include natural threats like landslides and slumps, threats to the built environment such as septic tank seepage from flooding, or threats to social systems such as "shelter in place" support for elders and others isolated by extreme heat or smoke events. This exercise could be done for just the UIR, or in collaboration with other entities across the CTUIR Ceded lands and beyond, and should build on existing documents like the Hazard Mitigation and Emergency Operations Plans.

- **Fund and staff dedicated hazard mitigation planning positions** to build capacity for proactive and reactive emergency services. As a potential position within Tribal Planning Office (TPO), such a position could work closely with Public Safety, Dept of Child and Family Services (DCFS), and other programs that respond to community need before, during, and after a disaster event. This could include working with community members proactively to put safety and preparedness precautions in place.

Previous flooding events like the one on the Umatilla River in Feb 2020 have revealed where regional infrastructure is vulnerable to future disaster events.

- **Inventory and map current and emerging areas of concern for transportation infrastructure** on UIR and for Tribal community members who live off reservation. These might include areas of pooling water, roads and bridges threated by flooding, or transit stops that are at risk of heat and smoke exposure.

- **Inventory and map current and emerging areas of concern for communication networks** on the UIR and for Tribal community members who live off reservation. These might include points of vulnerability due to shared services infrastructure (powerlines, water mains, etc). This could include an assessment of insufficient services like internet access for those at dispersed living sites like Gibbon and Thornhollow, as well as an chance to highlight opportunities for connection like the Cay-Uma-Wa Camp Crier online communication application; see Ch 3F pages 241-244 for additional detail.

Long Term:

- **Update existing plans and codes using climate projections** and data modeling to anticipate climate changes to flooding and other climate-intensified disasters. This is already beginning with the FEMA remapping of the Umatilla River floodplain in 2022. Some of these changes will need to involve federal agency participation, and potential acts of legislation to be implemented.

- **Continue to update CTUIR Hazard Mitigation Plan** with community engagement on emergency response needs as these change. Currently this plan undergoes revision on a 5-year interval with a new version expected in 2022. Each new version of this plan has incorporated elements of climate impacts within its scope, though had yet to incorporate specific climate projections and data.

- **Update transportation and communications planning to incorporate changing climate conditions** and Tribal community needs; this process is going to be starting with the 2022 Transportation Plan update. A new version of this plan could incorporate climate impact projections to better align strategic planning and benchmarks with anticipated future conditions.

ii. Community Capacity for Built Systems Management

"Planning itself is an ongoing attempt to guide future development or redevelopment, solve problems, address future needs, and create opportunities to enhance community life, the local economy, and environmental quality (CTUIR Comprehensive Plan, 2010)." Planning invites the community to share perspectives and skills, as well as express unmet needs and visions for the future.

Short Term:

- **Facilitate community identification of traits of a flexible transportation system**, for Kayak and other services, such ability to recognize external changes and threat (responsiveness), and take the appropriate action (competency and organic organizational structure). These community-identified priorities and strategies could assist in long-term transportation planning that accurately anticipates the current and future needs and gaps in service for riders and operators.

- **Expand education and skill-building around residential emergency response**; this is likely to include residential well testing and treatment protocol, septic tank inventory and installation of risers, implementing home fire breaks and fire resistant building materials and landscaping, performing assessments of built infrastructure regularly, and preparing relevant insurance and ownership documents in the event of an emergency. Additional planning could assist in proactively migrating vulnerable homes and infrastructure out of the floodplain and assistance in filing necessary claims on damage and loss financing.

Long Term:

- **Develop community response mapping tools** where Tribal community members can inventory and identify locations where problems exist, and where there are new issues emerging. Facilitating an online reporting tool as well as hosting periodic discussion groups could empower community members and provide valuable information sharing on issues as they arise.

- **Facilitate improved community aid capacity** to assist with property disaster risk assessment, disaster volunteer responder coordination, documentation of damage post-event, and with meeting

insurance claims and requirements. Government staff capacity can only go so far, and empowering the Tribal community to be proactive, reactive, and supportive of emergency coordination will improve CTUIR's overall ability to respond quickly and effectively to disasters as they occur. Additional guidance and community coordination can be included in future versions of the Emergency Operations Plan (EOP, 2016); see EOP 3.3.3 page 67 for additional detail.

B. Anticipate Changing Community and Climate Demand on Facilities for Investment Planning

i. Upgrade CTUIR Facility and Residential Air Filtration Capacities

In recent summers, all CTUIR facilities have struggled accommodate the sharp increase in smoke pollution from wildfires, particularly ones burning in the Willamette Valley and Columbia River Gorge. These fires will be a regular part of summer in the future, as well as the increasing prevalence of other climate-related air pollution sources like dust, pollen, and ozone. While upgrading facilities can be expensive, it is cost effective long term to begin those upgrades as soon as possible.

Short Term:

- **Implement community initiatives to improve residential exhaust fans** use and understanding, to mitigate smoke, mold and mildew. CTUIR Housing has worked with residents of Tribal housing to understand the importance of utilizing exhaust fans to remove particle pollution and moisture from inside homes to prevent illness, as well as other strategies to improve air circulation and quality.

- **Migrate Heating, Ventilation, and Air Conditioning (HVAC) and central heating/ cooling infrastructure** from foundations or subbasements if affected by flooding, especially in Tribal housing. CTUIR Housing Department has been at the forefront of this work; Mission area housing has long been seasonally affected by groundwater seepage that inundates housing foundation and causes maintenance problems. In response, Housing has implemented a project to migrate essential ventilation system equipment from housing foundations to attics, in an effort to reduce maintenance issues caused by flooding.

Mission area housing has experienced inundation from rising groundwaters, also known as a spring, which is located in the floodplain of nearby Mission Creek.

Long Term:

- **Upgrade Tribal facility HVAC systems** to use Minimum Efficiency Reporting Values (MERV) 13 grade filtration at least. This will likely require a systems revision that could be lengthy and costly. Anticipating this need early can assist in planning for this large cost burden and there are many interim steps that can be taken, such as installing independent air ventilation systems in buildings. This was done during the height of the Covid-19 pandemic for the Head Start and Afterschool Programs within the CTUIR Department of Education.

- **Identify barriers to indoor air quality health** that the community experiences, and develop strategies to overcome these barriers. These might be

cost barriers around equipment or energy use, infrastructure barriers like home or apartment upgrades and eligibility of assistance programs due to property ownership status, among others.

- **Assess the needs of extremely vulnerable community members specifically**, including elders, outdoor workers, and unsheltered community members; these needs are likely to be different than other age groups, occupations, and lifestyles. Prioritizing these groups in adaptation response guarantees that all peoples' needs are being considered.

ii. Water Reclamation and Management Infrastructure

"The First Foods-focused mission highlights direct linkages between the ecological health of the Umatilla River and the health and well-being of Umatilla Tribal Members. Degradation of the river, water quality, and associated ecological processes results in the loss of traditional Tribal foods. This loss of food resources is linked to increasing occurrences of health issues (Umatilla River Vision, 2011)."

Waste- and stormwater are underutilized opportunities for water conservation. Sewage and storm water reclamation could provide additional non-potable water supplies for appropriate to non-consumptive uses in order to reduce future demands on finite freshwater sources.

Short Term:

- **Improve assessment and treatment of residential septic and well systems** to provide skill building to families, and prevent leaching or other contamination of groundwater. As incidences of flooding increase, residents with isolated well and septic systems need to understand and be aware of hazards and mitigation strategies that will minimize harm to human health.

- **Support community reporting and guidance on planning** through an interactive mapping and comment collection. An example is the 2021 Capital Improvements Plan update; this visioning exercise is being conducted by the Tribal Planning Office (TPO) to engage the community in planning for the future of this space. An ArcGIS webmap tool has been used to gather 'real time' feedback from community members, though access to this portal is not equitable for those who lack internet access or access to web navigation services. https://ctuir.org/news/input-on-capital-improvement-projects/

Long Term:

- **Continue to fund, implement, and plan the proposed CTUIR wastewater treatment plant**, and expand on TPO and Public Works feasibility studies about membrane-bioreactor (MBR) treatment technology. This is a multi-million dollar proposed facility which will require time to secure capital, and permit plans to build. There are intermediate steps such as feasibility studies and water use information/voluntary metering initiatives that can implemented in the shorter term.

- **Develop and implement water recovery and graywater use strategies**, including graywater capture approaches that sequester water for landscape and irrigation purposes; reclaimed water is often not safe for human consumption, but could be used for non-food irrigated landscapes like the Wildhorse Resort and Casino Golf Course, CTUIR governance facilities

campus greenspaces, and for spaces of gathering like the July Grounds, among others. More research on potential impacts to health would be needed.

iii. Intentional Water Infiltration and Conservation Strategies

Water is precious, and conserving cold, clean water will be essential. Strategies to sequester winter precipitation and high flow can be natural, behavioral, and engineered, and these strategies can be combined for effective conservation.

Greenspaces and other permeable surfaces like the engineered wetlands outside the Yellowhawk Tribal Health Center (pictured) help stormwater be infiltrated rather than pooling.

Short Term:

- **Inventory and map locations of seasonal water inundation** from groundwater and surface water sources across UIR and in the Mission community. Some of this assessment has already been done as part of the CTUIR Hazard Mitigation Plan (2016), but a dedicated mapping effort could yield updated and additional information, as well as empower and engage the Tribal community in planning.

- **Support and implement Native and drought-tolerant plants** in landscaping, at home, within Tribal government and community development, and across the UIR. Much of the CTUIR Nixyaawii/Yellowhawk Campus, Coyote Business Park campuses, and Wildhorse Hotel and Casino complex are landscaped with native vegetation that requires minimal seasonal irrigation. Expanding the use native plants for landscaping with CTUIR entities, across the UIR, and around the region, and partnering with the DNR Tribal Native Plant Nursery would reduce summer irrigation demand from nonfood sources.

- **Implement engineered storage options like bioswales and other strategic landscape management practices**, especially where it preserves built systems integrity. Many of these practices are rooted in Indigenous knowledge and are often labeled "permaculture" or "restoration agriculture," taking advantage of natural ecosystem function to capture heavy precipitation and facilitate its infiltration into the soil.

Long Term:

- **Continue to relocate critical and new infrastructure out of climate-forecasted floodplains**. Past migrations include: Nixyaawii Governance Center (NGC), Yellowhawk Health Center, Nixyaawii Community School (NCS), and the new Nixyaawii Community Neighborhood development. Other new developments are planned for the future. Infrastructure that comprises the Mission area and Mission Market are still located in the Umatilla River floodplain and would require capital investments to relocate.

- **Install permeable pavement in new and revitalized development** (where possible) to reduce the likelihood of roadway flooding and increase soil water storage. 'Permeable pavement' is constructed to provide structural paved surfaces that can rapidly percolate water through its surface and distributed into the substrate below. Engineering paved surfaces that can redistribute stormwater to adjacent greenspaces would assist in capturing winter water; see Chapter 3A pages 60-61 for additional detail.

- **Develop natural storage options like wetlands** where feasible, and determined by the Tribal community. Wetlands and ephemeral streams are natural deposition areas for seasonal flood waters, and the inundation of these storage ecosystems provides water filtration and cooling outcomes for water through wetland soils. These ecosystems also provide excellent habitat for First Foods species, especially those that have been impacted by the regional draining and destruction of historical wetlands.

C. Develop Sustainable Housing and Walkable Communities

i. Implement Land Development that Facilitates Non-Carbonized Living

"The Reservation Boundaries were under attack even before it was surveyed. Public meetings were held in La Grande, Pendleton, and Walla Walla in the late 1860's to remove the Indians from the Umatilla Reservation. The settlers had discovered that Indian lands were capable of producing wheat and the mountains were good for livestock grazing. Roads and trails were utilized by the whites who were constantly encroaching on reservation lands (CTUIR Comprehensive Plan 2010)."

Living in disconnection with land, water, and foods has been a large driver of the climate crisis. Roads and vehicular transportation that burns fossil fuels have been instrumental in this disruption. Reviving and revising ways of living that create greater connection with natural resources and community will be essential in reducing carbon footprints.

Short Term:

- **Incentivize personal choices that reduce carbon demands**. Examples include reduced mandatory minimum off-street parking, robust public transit services like Kayak Public Transit, and street tree and landscaping policies that prioritize native and drought-tolerant vegetation. This may require securing funding and Tribal government staff capacity to organize and implement such incentive projects, though many could be paired with surveys to the Tribal community on how best to engage around issues and barriers experienced by communities.

- **Update relevant services plans to assess emerging community needs**. An example the forthcoming update to the Transportation Systems plan, which will engage the tribal community how transportation needs are changing. Development of Tribal long-term plans typically involve some level of engagement with CTUIR official committees and commissions, though outreach to the broader Tribal community depends on the individuals and programs administering this process. Expanding and explicitly planning for broad CTUIR community engagement in planning could strengthen planning efforts.

- **Design and implement communal living spaces, greenspaces, and gardens** that allow for Tribal community members to create abundance collectively. Consciously including areas for people to gather and share knowledge, tools, supplies, produce, services and aid, and many other things, will create opportunities for building resilience through connection.

Long Term:

- **Prioritize compact and multi-use zoning for new Tribal development** (where possible). An example is the

new Nixyaawii Community Neighborhood (also known as Bowman South) subdivision development, zoned in a way as to reduce the need for vehicular travel by placing residences close to current and future employment and services. This should facilitate the development of a diversified walkable community where people are able to live near work and commercial opportunities.

Recent Tribal housing developments like Huckleberry Court (pictured) have been built to include energy efficiency measures that can reduce energy demands and improve standard of living.

- **Develop, fund, and implement non-motorized transportation opportunities** like walking, biking, and horse trails, particularly to areas of employment, business, and services, like the 2022 Walk Routes to School grant from ODOT to implement a walking path from the Mission area/July Grounds to Nixyaawii Community School to assist students getting to school in a safe and healthy manner. As more community infrastructure is re-located out of the Mission Creek floodplain, there are additional opportunities to ensure these new developments are navigable through non-carbonized means.

- **Continue to fund, expand, and improve CTUIR Kayak Public Transit** vehicles, staff, systems, outreach, incentives and costs assistance, among other needs, for the award-winning rural public transit system.

ii. Expand Localized Economy and Opportunity

Hazardous conditions do not necessarily become disasters, however climate change will act as a "threat multiplier" that will increase the likelihood of overlapping hazards becoming emergency situations. Some hazards are man-made: lack of evacuation routes, barriers to accessing aid, and unavailability of necessary items and equipment are components that can turn hazards into disasters. Supply chain issues are likely to continue and worsen into the future due to globalization, and increasing frequency of natural disasters. Diversifying and localizing materials and services sourcing will fortify Tribal and regional communities against disruption.

Short Term:

- **Conduct community kitchen feasibility assessment to assess infrastructure and capacity needs** in constructing and operating a certified commercial kitchen with access for the Tribal community. Such a facility could greatly expand the capacity of the CTUIR community to provide local food, safe processing options, diversified economic initiatives, and opportunities to share knowledge and skills in a way that builds resilience. See Ch 3F page 232 for additional detail.

- **Identify essential manufacturing or production processes likely to be disrupted** by future global instability, and incorporate plans to mitigate for these impacts. Recent years have demonstrated that supply chains that source globally are guaranteed to experience disruptions as extreme weather events become frequent. Improving local and regional sourcing could mitigate for these impacts, and identifying essential goods, components, components, and services that have been affected by recent supply chain disruptions would provide a roadmap for where needs and supplies are vulnerable. See Ch 3F 227-228 for additional detail.

Long Term:

Prioritize or strengthen materials sourcing from local/regional locations (as is conditionally appropriate) for construction or services demands, and identify potential alternatives if able. An existing example is local procurement of gravel and construction materials for Tribal development projects from American Rock asphalt manufactuers on the Umatilla Indian Reservation (UIR). While an extractive industry like construction materials mining creates harms to environmental conditions, sourcing such materials regionally allows for CTUIR to have a role in regulating activities, as well as mitigating for global instability.

- **Continue to build transportation networks and partnerships across the larger region** to improve access and connectivity, and to alleviate barriers identified. Kayak Transit already extends across the CTUIR Ceded lands and provides free transit to riders within this area. Municipalities often have their own smaller transit services that operate much smaller routes, and greater collaboration between these systems could improve public transit conditions for all.

Tribal Planning Office (TPO) has been planning for changes to the July Grounds area of the Mission Community, and has used outreach and online mapping to engage the CTUIR community in what this will look like; pictured is one possible plan proposed by TPO .

CTUIR TPO regularly engages the Tribal community in visioning for the future. Pictured is from the Mission Community Master Plan that plans for future developments of the CTUIR Tribal community.

Measuring Success and Gaps in Physical Infrastructure Adaptation

How Do We Measure the Success of These Adaptations?

- **CTUIR Land Development Code** (revised 2021): many regulations, permitting, and zoning requirements and restrictions are outlined.
- **Comprehensive Plan Objective 5.5.1:** Reserve adequate capacity in Tribal sewer and water systems for future Tribal use and development (see Comp Plan page 76 for benchmarks);
- **Comprehensive Plan Objective 5.5.2:** Develop land use policies and Land Development Code regulations that assure the UIR is a sustainable community (see Comp Plan page 76 for benchmarks);
- **Comprehensive Plan Objective 5.9.7:** Seek to achieve carbon neutrality in all new housing construction by incorporating energy efficient design and construction in Tribally funded housing and by extending technical assistance and incentives where possible to individual Tribal Member home construction. (see Comp Plan page 97 for benchmarks);
- **Comprehensive Plan Objective 5.13.5:** Provide transportation opportunities for Tribal citizens and other Reservation residents that do not drive. (see Comp Plan page 117 for benchmarks);
- **Comprehensive Plan Objective 5.13.6:** Provide transportation facilities for non-motorized transportation, including pedestrians, bicycles, and horses (see Comp Plan page 117 for benchmarks);
- **Comprehensive Plan Objective 5.13.5**: Provide transportation opportunities for Tribal citizens and other Reservation residents that do not drive. (see Comp Plan page 117 for benchmarks);
- **Comprehensive Plan Objective 5.13.10:** Provide transportation opportunities that conserve energy and money, and reduce carbon emissions. (see Comp Plan page 117 for benchmarks).
- **CTUIR Hazard Mitigation Plan (2021) Section 3**: Hazard Identification and Risk Assessment Results (page 68-190);
- **CTUIR Hazard Mitigation Plan (2021) Section 4:** Hazard Mitigation Strategy (page 192-212).
- Adequate housing availability and suitability for tribal members and community;
- Upgrading Tribal housing and facilities to respond to smoke and flood concerns;
- Rapid response to infrastructure threats, and protocols in place for safety.

Flooding like the February 2020 event illustrates the vulnerability of infrastructure, like the Walla Walla River running through municipalities such as the City of Walla Walla pictured here.

What Gaps in Knowledge, Policy, Capacity, or Education Exist?

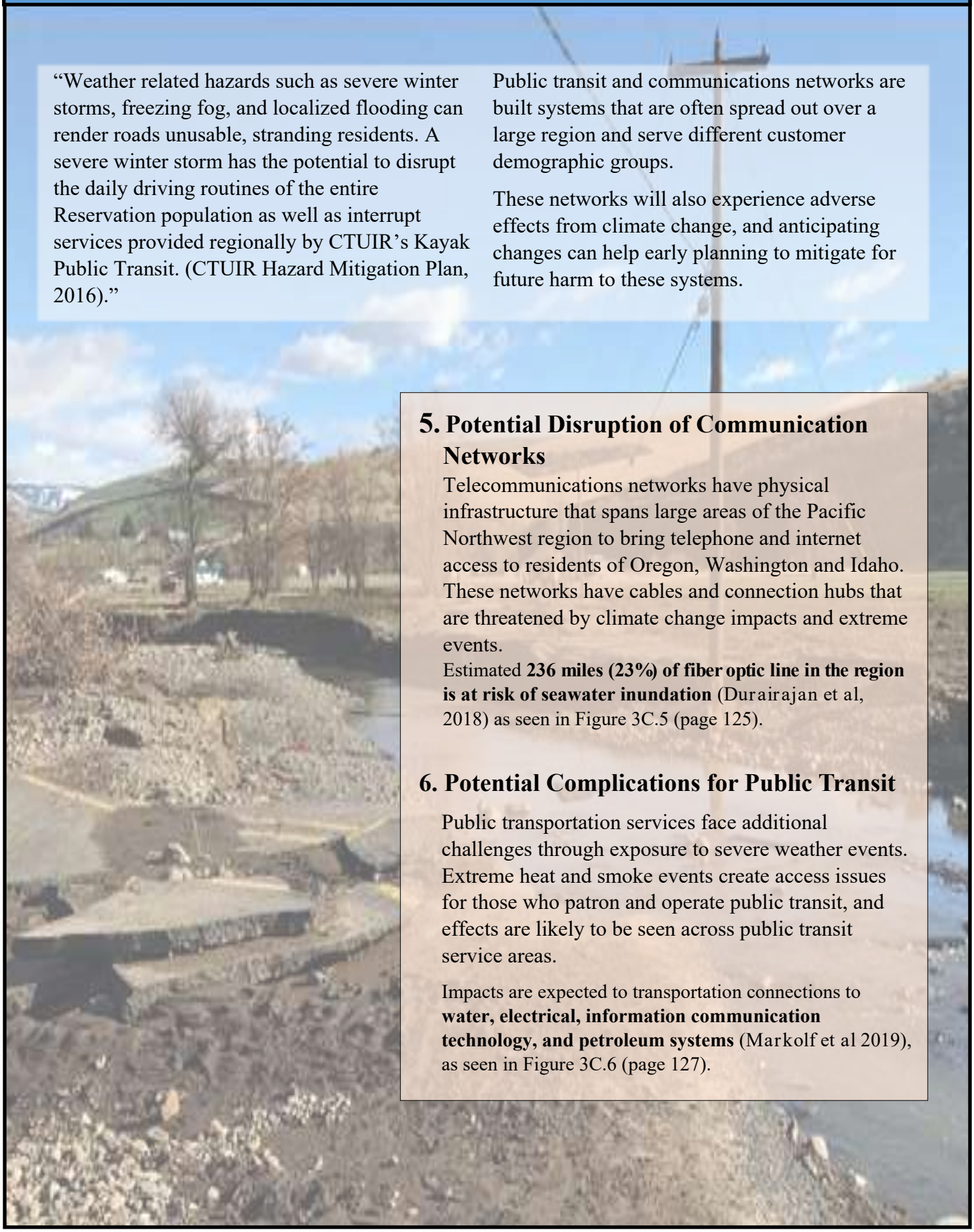
- Logistics, connections, and agreements with adjacent municipalities, such as the City of Pendleton;
- Funding and capacity to implement UIR wastewater treatment facility and network;
- Comprehensive understanding of water use and availability by tribal community, and needs across UIR;
- Outreach and understanding around existing infrastructure safety, such as around the UIR pipeline and other critical infrastructure;
- Skill building and services available to assist with septic and sewage issues;
- FEMA-adjusted expanded floodplain mapping, and how this will change insurance and property availability;
- Community kitchen feasibility study, development and funding assessment.

Climate Impacts for **Built Systems**

"Weather related hazards such as severe winter storms, freezing fog, and localized flooding can render roads unusable, stranding residents. A severe winter storm has the potential to disrupt the daily driving routines of the entire Reservation population as well as interrupt services provided regionally by CTUIR's Kayak Public Transit. (CTUIR Hazard Mitigation Plan, 2016)."

Public transit and communications networks are built systems that are often spread out over a large region and serve different customer demographic groups.

These networks will also experience adverse effects from climate change, and anticipating changes can help early planning to mitigate for future harm to these systems.



5. Potential Disruption of Communication Networks

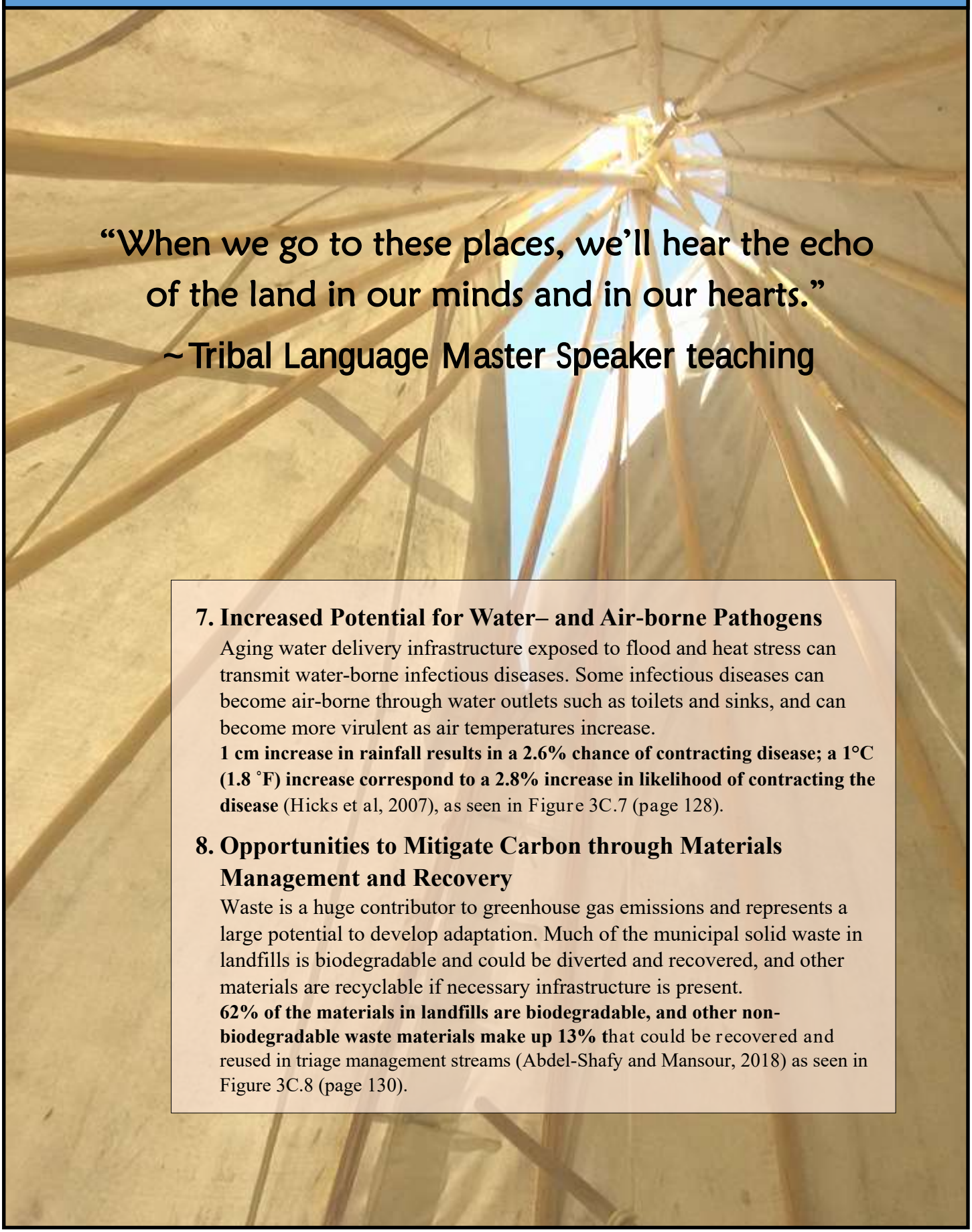
Telecommunications networks have physical infrastructure that spans large areas of the Pacific Northwest region to bring telephone and internet access to residents of Oregon, Washington and Idaho. These networks have cables and connection hubs that are threatened by climate change impacts and extreme events.

Estimated **236 miles (23%) of fiber optic line in the region is at risk of seawater inundation** (Durairajan et al, 2018) as seen in Figure 3C.5 (page 125).

6. Potential Complications for Public Transit

Public transportation services face additional challenges through exposure to severe weather events. Extreme heat and smoke events create access issues for those who patron and operate public transit, and effects are likely to be seen across public transit service areas.

Impacts are expected to transportation connections to **water, electrical, information communication technology, and petroleum systems** (Markolf et al 2019), as seen in Figure 3C.6 (page 127).



"When we go to these places, we'll hear the echo of the land in our minds and in our hearts."

~Tribal Language Master Speaker teaching

7. Increased Potential for Water– and Air-borne Pathogens

Aging water delivery infrastructure exposed to flood and heat stress can transmit water-borne infectious diseases. Some infectious diseases can become air-borne through water outlets such as toilets and sinks, and can become more virulent as air temperatures increase.

1 cm increase in rainfall results in a 2.6% chance of contracting disease; a 1°C (1.8 ˚F) increase correspond to a 2.8% increase in likelihood of contracting the disease (Hicks et al, 2007), as seen in Figure 3C.7 (page 128).

8. Opportunities to Mitigate Carbon through Materials Management and Recovery

Waste is a huge contributor to greenhouse gas emissions and represents a large potential to develop adaptation. Much of the municipal solid waste in landfills is biodegradable and could be diverted and recovered, and other materials are recyclable if necessary infrastructure is present.

62% of the materials in landfills are biodegradable, and other non-biodegradable waste materials make up 13% that could be recovered and reused in triage management streams (Abdel-Shafy and Mansour, 2018) as seen in Figure 3C.8 (page 130).

5. Potential Disruption of Communications Networks

"Electrical power and electronic devices have become essential to our society; economics, banking, emergency services and day-to-day living providing lifeline utility systems. Interference with the functioning of these devices, circuits and systems has the potential of severely impacting the citizens of the UIR (CTUIR Hazard Mitigation Plan, 2016)."

Sharing of stories and information is an essential way of creating networks that support climate adaptation and natural disaster response. Fiber optic communication lines and other transmission infrastructure could be adversely affected by increased storms and by sea level rise, affecting communication for both coastal and inland communities.

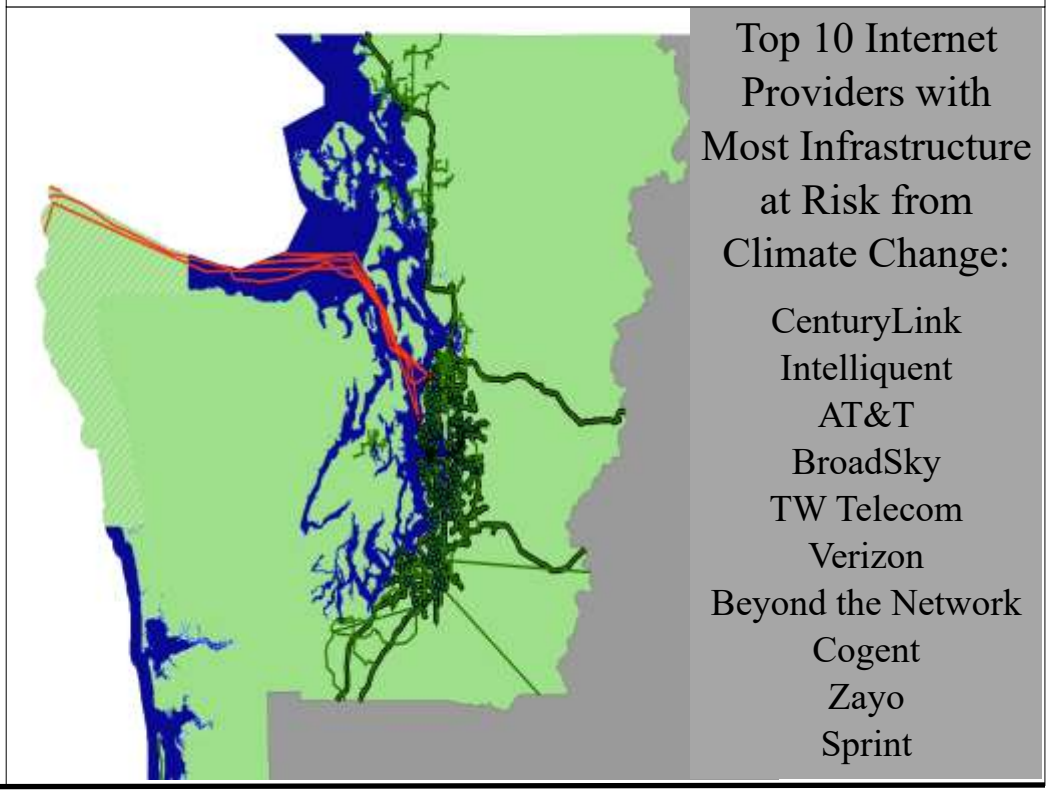
Figure 3C.5 shows one regional analysis of vulnerable telecommunications infrastructure threatened by sea level rise in Washington State.

- On the map, blue areas demonstrate where a 1-foot sea level rise will cause coastal inundation with corrosive salt water.
- Telecommunications infrastructure like submarine fiber optic cables are shown in red, metro cables are shown in green, and green dots represent termination points that supply end users with telecommunication services.
- Seattle metropolitan area is more vulnerable to internet disruption due to sea level rise than many other coastal cities.
- Projections for the Seattle area estimate **236 miles (23%) of fiber optic line are at risk** of seawater inundation within this century (Durairajan et al, 2018).
- Nationally, an estimated 4,067 miles of fiber conduit and over 1,000 termination points will be buried underwater by 2030 (Durairajan et al, 2018).
- The list to the right of the figure ranks ten of the most vulnerable internet providers nationally based on the number of fiber miles and nodes that are threatened.

While this study specifically examines the threat of sea level rise in a coastal city as a proxy estimate , these results are still applicable to climate planning for inland CTUIR. Critical infrastructure are typically located together, and fiber-optic cables, water pipes, and electric transmission lines may all be buried underneath a road or along a road right-of-way.

River flooding, wildfire, and land movement are potential direct threats to buried and above-head communications infrastructure. Indirect risk factors include cyber interconnectedness, which occurs when one infrastructure system depends on data/information from another infrastructure system that is threatened or damaged. One example is traffic signaling (Rinaldi et al., 2001).

Figure 3C.5: Telecommunications Infrastructure Threatened by Sea Level Rise



Broadband Internet cable is installed across much of the Mission and Tutuilla areas of the UIR, and is usually laid concurrently along established roads.

Underground components may be susceptible to flooding and/or land shifting/subsidence from drought or rising water tables. High humidity and extreme temperatures can also increase risk of short-circuiting and component failure (Fu et al., 2016).

Overall, threats to interconnected systems could result in disruptions in traffic management systems, roadside communication systems, real-time traffic monitoring/information systems, real-time public transit tracking systems, GPS and route mapping service, ridesharing services like Uber, and autonomous vehicle systems.
(Credit: Durairajan et al, 2018)

Gaps in Knowledge/Data/Policy:

- Inland specific analysis of climate impacts to vulnerable critical communications infrastructure;
- UIR-specific inventory of co-located critical infrastructure currently or potentially threatened by flooding, wildfire, and land movement.

6. Potential Complications for Public Transportation

"As Elders are driven past places they remember on the landscape, stories and memories of the ancestral homelands may be generously shared. Their grandchildren and other fortunate passengers bear witness to these oral accountings. Embedded in these many stories are place names, meanings, and traditional uses, as well as Coyote stories, which get passed on. While technology used to move across the land may have changed, Tribal people's ties to the landscape have not (Karson Engum and Conner, 2015)."

Transportation systems keep Tribal families and communities connected and able to access cultural places and First Foods harvests. These systems are also a large contributor to greenhouse gas emissions, thus there is an opportunity where reductions would have a large benefit. Mass transportation like the CTUIR Kayak Public Transit System are necessary for reducing emissions of transportation systems, but public transit also may face challenges.

Likely, health of transportation system users and operators will be jeopardized by climate and extreme weather events, as heat, flooding, and storm intensity create threats, especially for rural systems. Hypothetical examples include (Markolf et al 2015):

- Public transit riders exposed to unsafe heat conditions while walking to/from a transit stop, and/or waiting at the stop for their bus/train;
- Extreme heat exposing workers to heat exhaustion is increasingly possible and may warrant the shift of construction hours and/or season;
- Transportation systems performing worse during weather events like heavy snow or rain;
- Transit users and operators exposed to chronic/heavy wildfire smoke during summer operations. Extreme weather can shift commuter choice from active modes (walking, biking etc) to transit and automobiles - potentially putting additional stress on transit systems/roadways.

Transportation systems are necessary to support the function of CTUIR's region, as First Foods harvest opportunities are rural and remote, and 10% of Umatilla Indian Reservation (UIR) residents lack access to a vehicle (US Census, 2019). Socioeconomically marginalized groups rely on public transit, and

disruptions in services disproportionately impact vulnerable community members (Markolf et al 2019).

Transportation systems also exist within a complex network of additional services infrastructure, and disruptions can have compounding effects.

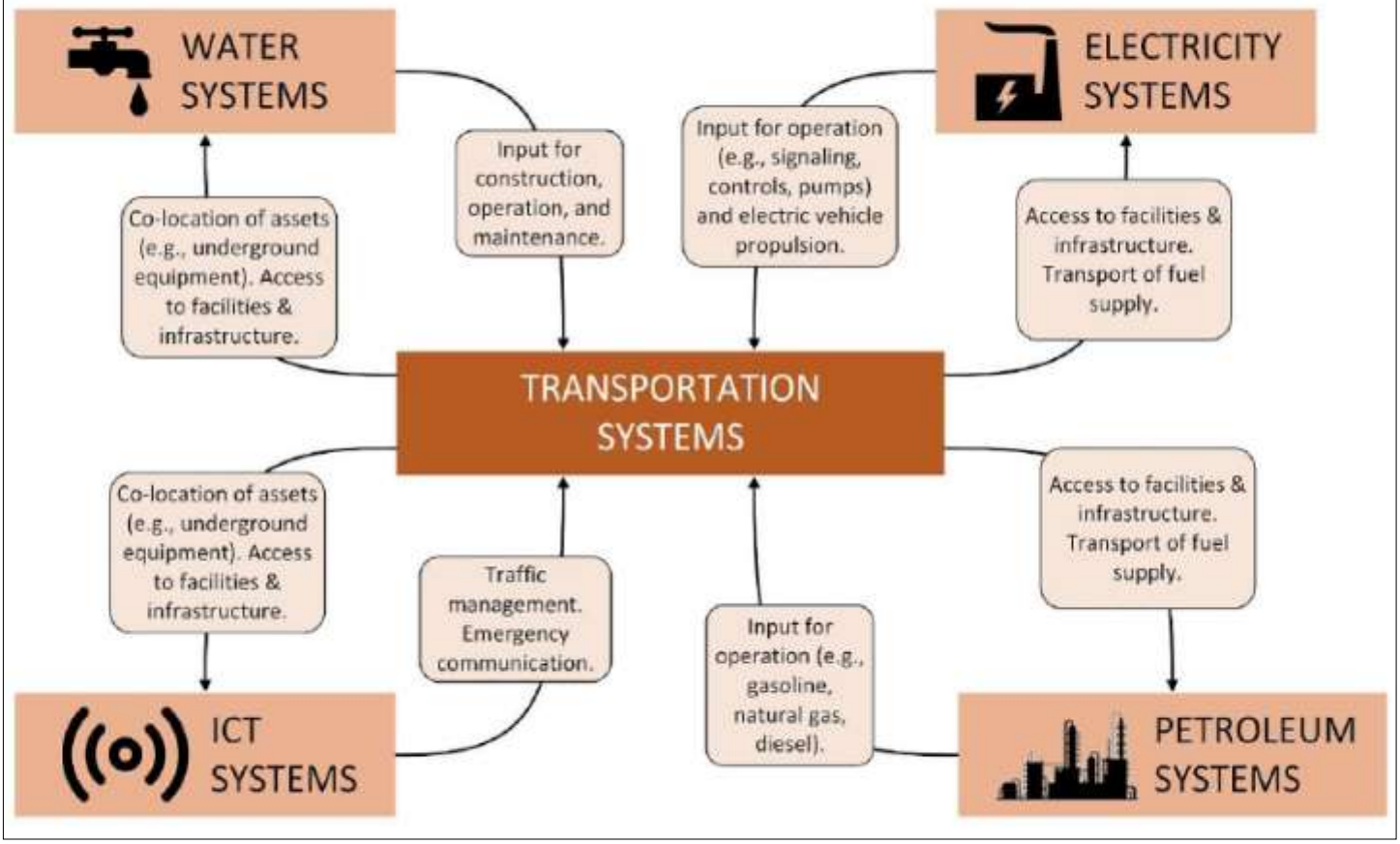
Figure 3C.6 is a visualization of the way transportation systems are connected to other essential services, and demonstrates network locations that could be potentially disrupted by climate impacts.

- **Water systems** create input for construction, operation, and maintenance of transportation systems. In turn, transportation systems have a co-location of assets (e.g. underground equipment), and access to facilities and infrastructure of water systems.
- **Electrical systems** provide input for operation (e.g. signaling, controls, pumps) and electric vehicle propulsion to transportation systems. In turn, transportation systems provide access to facilities and infrastructure, and the transportation of fuel supply to electrical systems.
- **Information Communication Technology (ICT) Systems** provide traffic management and emergency communication to transportation systems. In turn, transport systems provide the co-location of assets (e.g. underground equipment), and access to facilities and infrastructure to ICT systems.
- **Petroleum systems** provide input for operation (e.g. gasoline, natural gas, diesel) to transportation systems. In turn, transportation systems provide access to facilities and transportation of fuel supply to petroleum systems.

Detaching the connection between transportation and petroleum systems is where much of climate adaptation work can be accomplished. In a food systems assessment (FSA) conducted by Yellowhawk Tribal Health Center in 2020, 96% of survey respondents identified private vehicle as their primary way of accessing grocery options, while only 3.8% of participants used Kayak Public Transit services, and 11% commuted with friends or family (CTUIR FSA, 2020).

Expanding reliable public transit is necessary to build climate resilience, and systems development

Figure 3C.6: Transportation Systems are Interconnected with Other Essential Service Networks



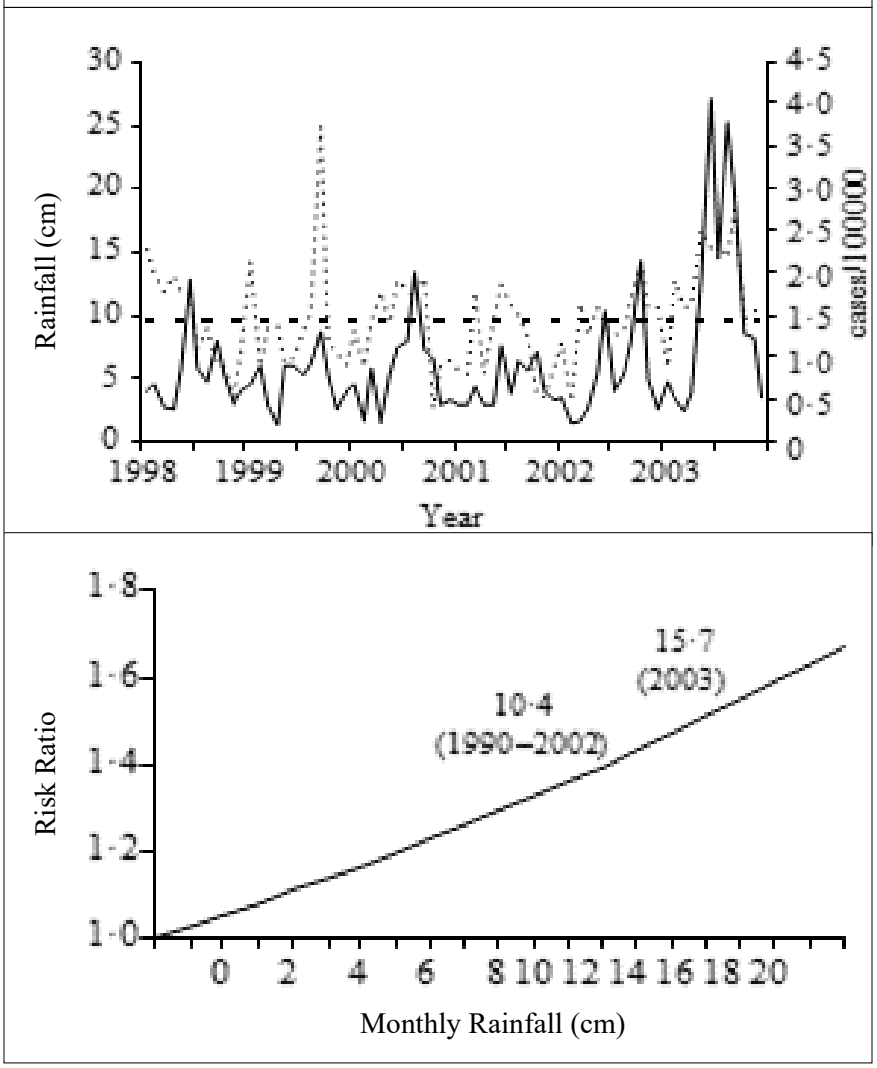
which includes climate adaptations reduces future burdens. These interconnections and potential disruptions are essential to consider to support and expand public transportation into an uncertain future.

(Credit: Markolf et al, 2019)

Gaps in Knowledge/Data/Policy:

- Updated Kayak Transportation Plan, anticipated in 2022, and changing rider needs;
- Impact of coordinated ride share programs, as well as private application companies on transportation needs and carbon reduction opportunities.

Figure 3C.7: Precipitation and Incidences of Legionnaires Disease Over Time (Top) and in Relation to Rainfall (Bottom)



7. Increased Potential for Water– and Air-borne Pathogens

"Restricted access and degradation of the Umatilla River Basin can reduce the availability (and potentially nutritional quality) of First Foods, impacting the health of the Tribal community… Degradation results in reduced water quality, requiring additional purification of river water for drinking to remove pathogens, nutrients, and contaminants (Umatilla River Vision, 2011)"

Water contamination from different sources will become an increasingly frequent concern due to climate impacts. Water and warm temperatures are an excellent source of infectious organisms like bacteria, mold, fungi, and viruses. There are a number of different pathways for climate shifts to increase potential to cause water contamination, including (but not limited to):

- Increasing precipitation over heavily agricultural lands increase potential for nitrate pollution to leach into groundwater;
- Heavy flooding events overtop residential well caps, and flood buried septic tanks that can leach sewage into aquifers;
- Harmful algal blooms in drought and heat conditions create toxicity issues for still or slow-moving water bodies;
- Stress on water delivery infrastructure increasing due to flooding and drought cycles that shift land and threaten stability of buried lines;
- Fungal filaments found in disturbed soils can become airborne and create respiratory infections that could require treatment and/or hospitalization.

Figure 3C.7 illustrates just one of these contamination pathways, showing how heavy precipitation events and flooding can increase incidents of bacteria *Legionella spp*, which can cause Legionnaires' disease in humans.

- In the top panel chart, precipitation is presented as a checked line, while compared to a plot of incidences of Legionnaires' disease as the solid line, in New England in the early 2000's. As observed, sharp increases in the disease follow heavy precipitation events;
- In the bottom panel graph is the direct correlation between the amount of monthly rainfall and the

risk of contracting Legionnaires' disease during this period in time.

- As precipitation goes up, there is a linear increase in prevalence of this water-borne illness, estimated a **1 centimeter increase in rainfall resulted in a 2.6% chance of contracting the disease**.
- Over this one year period, **a 5.3 cm increase in rainfall resulted in a 14.6% increase in the chances of contracting this illness**.
- The same study also linked the increasing risk of Legionella with increasing temperatures, identifying a **1°C (1.8°F) increase correspond to a 2.8% increase in likelihood of contracting the disease** (Hicks et al, 2007).

Legionnaires Disease is carried by water traveling through pipes contaminated with the bacteria, and becomes aerosolized at some termination source (ex: toilet flushing, high pressure sink faucet etc). This bacteria, when inhaled, can result in pneumonia-like symptoms of a bacterial lung infection. While Legionella is just one example, water transfer infrastructure faces a number of these potential incidents of water-borne illness from contaminated points in a vast delivery network.

Valley Fever, a respiratory infection caused by the fungus *Coccidioidomycosis*, is another concern as an air-borne pathogen set to expand in a climate shifted future. Valley Fever is contracted by breathing in fungal filaments attached to airborne dust particles from infected agricultural soils, kicked up during activities like tillage (Gorris et al 2019). While Valley Fever is currently endemic to the U.S. Southwest, warm wet season followed by a duration of extreme heat create conditions that benefit the growth and spread of this fungus further northward in the future. Additional information on Valley Fever can be found in Chapter 3D.4 on page 147.

(Credit: Hicks et al. 2007)

Seasonal flooding can create conditions for pathogens to thrive in piped infrastructure, and is made worse when followed by periods of drought and prolonged heat.

Gaps in Knowledge/Data/Policy:

- Contamination sources of highest concern: assessment and mapping needed to identify areas of current and emerging regional contamination issues;
- Coordination and reporting of health issues related to biological contamination among overlapping health and public service entities.
- How airborne pathogens that impact communities, including those like *Coccidioidomycosis*, or "Valley Fever" may be affected by conditions and land use policy.

8. Opportunities to Mitigate Carbon Release through Materials Management and Recovery

"An important success the CTUIR has had in establishing self-sufficiency has been the contracting of a number of important economic, environmental, social and community programs that were once provided by the BIA or by other local, state and Federal agencies (CTUIR Comprehensive Plan, 2010)." One example of this has been in the realm of waste management.

Landfills are a large contributor to carbon emissions, but expanding capacity to address opportunities in waste management present an efficient approach to mitigate carbon release and improve services to Tribal communities. CTUIR's Tribal Environmental Recovery Facility (TERF) is a great example of Tribal sovereignty strengthening approaches to climate adaptation by improving Tribal self-sufficiency and providing community services.

Biological materials like food scraps, lawn clippings, and other once-living debris can end up in landfills, where it breaks down without oxygen to create methane. Methane is a very strong greenhouse gas that has 24-34 times the heat-trapping power of carbon dioxide in the short term,

which grows to 84-86 times that of carbon dioxide over a 20-year period (UNECE 2022). Landfills account for roughly 17% of U.S. methane emissions annually (US EPA, 2013).

Figure 3C.8: Analysis of Waste Components within the United States

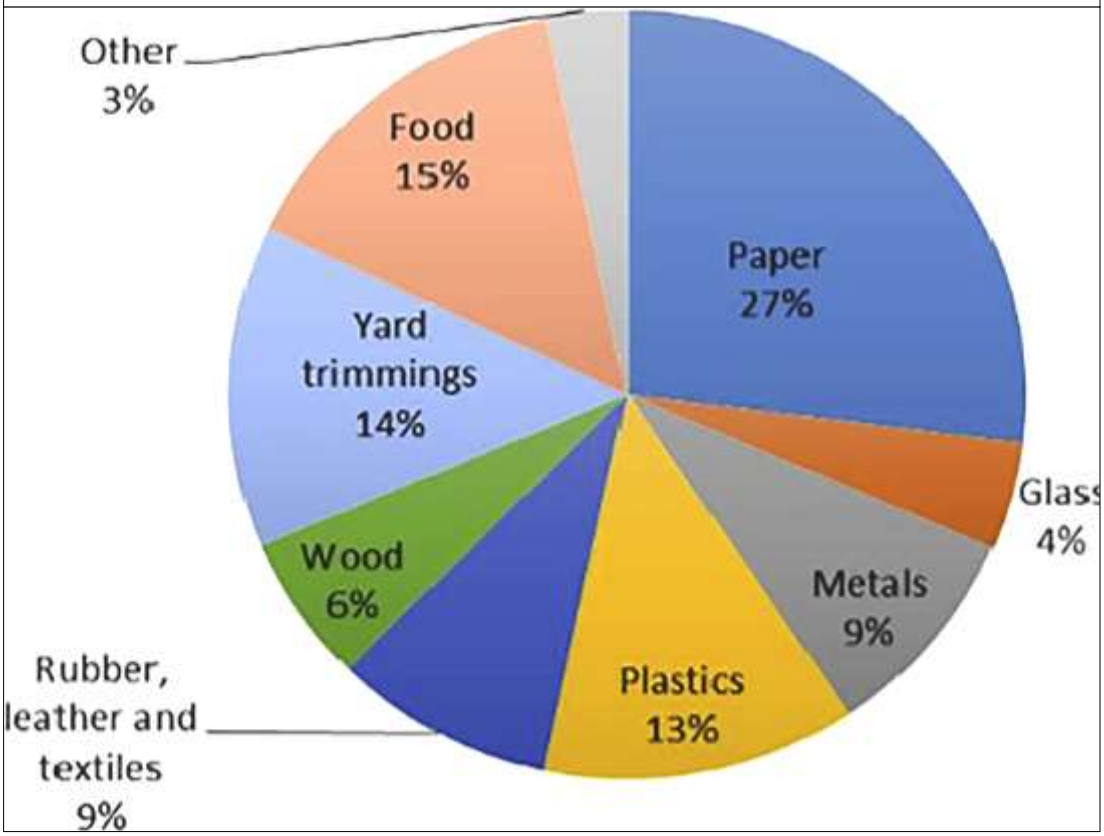


Figure 3C.8 is a pie chart overview of different materials that entered landfills in the United States (2013).

- Total amount entering landfills was 254 million tons of waste;
- **Reclaimable biodegradable waste including paper, food, yard trimmings, and wood, accounts for 62% of the materials** that end up in landfills (Abdel-Shafy and Mansour, 2018).
- **Other non-biodegradable waste materials include glass and metals make up 13% that could be recovered** and reused in triage management streams (Abdel-Shafy and Mansour, 2018).

Using proactive materials management to divert especially biological waste from landfills presents a tremendous opportunity to reduce carbon release regionally. Activities like food waste capture and composting could also keep important nutrients and resources in communities in a way that is useful, and has the potential to create employment and Tribal enterprise opportunities. Some places within the Tribe's Ceded lands and on the UIR do not have adequate access to materials disposal (barriers may include funds and time available) and will often resort to open burning of garbage, which creates air pollution, or burying garbage unpermitted.

Research has shown that decreasing distance to the recycling bins for households increases compliance with collecting and sorting solid waste. Strategies for local governments can take must encourage markets for recycled materials, increase professional capacity in the waste management operations, and provide financial support for implementing recycling projects (Abdel-Shafy and Mansour, 2018). CTUIR community members have expressed interest in curbside recycling options (CTUIR CAP W6, 2021), as current operations require recyclers to visit the TERF station to dispose of materials, which can be a barrier. Much of this material can be recovered with composting and bio fuels processing, but facilities need to plan to recover these materials, and investments in technology and infrastructure must be present to utilize these kinds of opportunities.

(Credit: Abdel-Shafy, M.S.M. Mansour, 2018)

Gaps in Knowledge/Data/Policy:

- Detailed estimates of types of waste collected and processed by TERF on the UIR;
- Additional capacity and funding needs to implement identified waste recovery projects;
- Assessment of CTUIR's volume of food, yard, and paper waste that could be recovered.

D. Resident and Community Preparedness, Response, and Services

"The land hears our songs, warms to our footsteps, responds to our prayerful manners, and is alive with its own stories. Each generation inherits responsibility for the land and all that live on it, and it is our duty to keep the names and the stories alive (Morning Owl et al 2015)."

Communications and transportation infrastructure are typically interconnected across large distances, and will experience direct and indirect impacts from climatic changes. These services are often necessary for emergency response as well as daily operations, and planning ahead to anticipate impacts could save money and lives.

i. Improve Knowledge of and Response to Water-borne Illness

Flooding and drought will cause increased potential for water contamination, especially within watersheds and infrastructure where water pools and sits still.

Umatilla Indian Reservation (UIR) residents and flood responders chat casually as floodwaters pour across the adjacent pasture. Note the inundated and stranded white pick up truck behind them in the photo.

Short Term:

- **Assess and inventory potential water contamination sources**, including from residential septic leaching, agricultural chemical run off, and from biological sources like bacteria; mapping of these sources could inform future mitigation actions to prevent serious illness.

- **Support community skills and knowledge around water-borne illness**, common signs and symptoms of diseases and disorders of concern, diagnostic procedures and requirements, and possible treatment/mitigation options. Improving community understanding of response increases capacity to address emergency issues in a standardized but decentralized manner.

Long Term:

- **Expand water contamination and illness testing to be most accessible**, including sampling and tracking protocol for biological contaminants, information about necessary testing (blood, water, stool sampling etc) for each contaminant of concern, locations and contact information for testing sites, and connect with community on actions that can be taken to improve reporting.

- **Continue engaging with surface and groundwater contamination tracking and coordination efforts**, such as the Lower Umatilla Basin Groundwater Management Area (LUBGWMA) and in other basins like the Walla Walla and Columbia Rivers.

ii. Improve Knowledge of and Response to Airborne Illness

Many sources of air pollution are likely to increase due to the climate crisis. Many of these sources of air pollution either cause illness themselves (such as ozone's impact on asthma), or are associated with biological contagions that cause illness, like fungi and bacteria that can infect respiratory tract or other systems in the body.

Short Term:

- **Coordinate with DNR's Air Quality program to inventory existing air quality contamination sources**, including from industrial, agricultural, residential, and natural sources, and begin to assess how these are likely to change with climate.

- **Identify land and resource management practices that increase the potential for contamination** (such as aggressive soil tillage, riparian-adjacent livestock grazing, and excess nitrogen fertilizer applications), and recommend mitigation strategies.

- **Support community skills and knowledge around air-borne illness and contamination**, common signs and symptoms of diseases of concern, diagnostic procedures and requirements, and possible treatment/mitigation options.

Long Term:

- **Improve or develop diagnostic testing for emerging diseases of concern** due to a changing climate, such as the potential for Valley Fever and Radon poisoning, and for other infectious diseases that are problematic in contaminated or poorly ventilated spaces. This could involve working with external partners to secure capacity, or investing in new testing equipment and staffing with the Yellowhawk Tribal Health Center Laboratory. See Ch 3D pages 156-160 for additional details.

- **Encourage community agency around respiratory safety and decision-making**, which includes awareness of possible biological contamination and the potential to become air-borne in given situations. Providing baseline education and equipment that is required for informed decision making can expand community capacity to act in inclement situations, while still preserving cultural connection and autonomy. See Ch 3B pages 97-98 for additional detail.

Road sign for the CTUIR Tribal Environmental Recovery Facility (TERF) that serves residents on the UIR.

E. Strengthen Opportunities to Divert Materials from Landfills

"This is our mother this country, as if we drew our living from her (*Ictixec*, 1855 Treaty Council)."

Developing and expanding alternative pathways for waste that reduce materials deposited in landfills can improve not only adaptation and resilience, but quality of life.

i. Expand Biological Materials Recapture

Organic material is well-suited to be returned to natural processes through composting and other methods of disposal. Expanding this biological materials disposal is likely to require expansions in capacity, infrastructure, and education.

Short Term:

- **Develop and support biological materials composting as a part of TERF services**, which includes securing land, equipment, and staffing capacity requirements. This is likely to include an increase of at least 1 position dedicated to building this capacity, as well as some infrastructure and equipment investments.

- **Repair wood chipping equipment donated from DNR to TERF** to provide woody debris rendering services to community, which can be used for woody resource for gardens, trails, compost operations, and other projects. This chipper is currently non-operational but only needs to have certain parts replaced to be operation, and could provide wood chipping capacity to the community to divert wood waste from landfills and slash piles.

Long Term:

- **Provide capital investment to TERF to expand facilitates and services**, as well as support additional staffing capacity. Large funds investment is likely to be required to expand TERF's capacity to collect, process, and distribute compostable materials. At minimum will likely require concrete slabbing, equipment purchase, and other potential infrastructure investments. See Ch 3F pages 228-229 for additional detail.

ii. Expand Knowledge of and Access to Materials Recycling

Misinformation and changing capacity of global recycling systems create confusion around what materials are and aren't recyclable, and many lack easy access to points of materials recapture.

Short Term:

- **Facilitate education campaigns to build community skills for addressing recycling issues**, such as Portland's Master Recycler Programs (www.masterrecycler.org), and the ReBuilding Center classes (www.rebuildingcenter.org) can build community knowledge and reduce contamination in recycling streams. Such programs could be organized alongside existing outreach efforts and with partners that can facilitate additional education initiatives.
- **Conduct a waste management assessment for CTUIR operations** to identify where/what kind of waste is generated, potential opportunities to divert select materials from landfills, and barriers to implementing strategies. Such an assessment could provide a complete mapping of common materials use, and could be paired with a goods and services, and biological materials recapture inventory. See Ch 3F pages 228-229 for additional detail.

Long Term:

- **Conduct a community inventory of materials recovery opportunities and barriers**, which would gauge knowledge and engagement of existing services, gaps that exist in recovery opportunities, and identify barriers to accessing garbage and recycling utilization. See Ch 3F pages 228-229 for additional detail.

- **Develop capacity to provide curbside/clustered and expanded access to recycling** for the CTUIR community. Travel to waste disposal centers and hours of operation are likely large barriers for the Tribal community to fully utilize recycling options offered through TERF, and many community members have expressed the need for easier access to expand their ability to recycle.

TERF operates on the UIR and serves residents of the reservation. This waste management facility offers waste disposal and recycling services to the CTUIR community, and is operated by the Dept. of Economic and Community Development (DECD). Expanded services identified by the CTUIR community include curbside recycling and composting.

Measuring Success and Gaps in Built Systems Adaptation

Long term planning for the CTUIR Mission community has been conducted with input from the community's visions for the area, with one such engagement event hosted in the Board of Trustees Chambers in the NGC as pictured.

How Do We Measure the Success of These Adaptations?

- **CTUIR Transportation Systems Plan** (updated 2022) measures and benchmarks.
- **Comprehensive Plan Objective 5.12.1:** Assure that community facilities are designed and sized to meet the long term needs of the CTUIR (see Comp Plan page 112 for benchmarks);
- **Comprehensive Plan Objective 5.13.4:** Develop transportation systems necessary for all forms of transportation in order to provide for economic development, employment, senior and disabled, health care, education, shopping, visiting family and friends, fitness and legal access (see Comp Plan page 117 for benchmarks);
- **Comprehensive Plan Objective 5.13.7:** Develop, maintain, and improve transportation systems to minimize or reverse environmental degradation from transportation systems (see Comp Plan page 117 for benchmarks);
- **Comprehensive Plan Objective 5.13.9:** Design, build, and maintain transportation systems with the future in mind (see Comp Plan page 117 for benchmarks);
- **Comprehensive Plan Objective 5.13.2:** Ensure that Tribal citizens have access to traditional, gathering, and other traditional activities (see Comp Plan page 117 for benchmarks).
- **CTUIR Hazard Mitigation Plan (2021) Section 5**: Mitigation Strategy Implementation and Integration (page 214-225).
- Tonnage of materials diverted from landfill annually; adequacy of waste management services over customer base
- Contamination levels of recycled materials to TERF as a measure of awareness.
- Communications reliability, both in time and reach to community members.
- Biological and chemical contamination monitoring and reporting.
- Level of service and quality of Kayak Public Transit, and ability to service the region.
- Community engagement around long term planning.

What Gaps in Knowledge, Policy, Capacity, or Education Exist?

- Population changes anticipated as a result of climate migration, or pandemic;
- Global and regional changes in recycling and waste management potential;
- Composting operations needs include available land, additional staffing, and equipment;
- Current locations of contamination sources and severity of potential for future issues;
- Mapping of reoccurring problem areas to anticipate changing community needs;
- Anticipated impacts to Kayak riders and operators.

Infrastructure and Built Systems Summary

Physical Infrastructure Adaptation

A. Identify Ongoing and Emerging Hazards and Opportunities on the UIR and CTUIR Ceded Lands.

B. Anticipate Changing Community and Climate Demand on Facilities for Investment Planning

C. Develop Sustainable Housing and Walkable Communities

Extreme weather events and long term chronic stress from multiple sources will challenge effectiveness and longevity of facilities and systems. Infrastructure that supports Tribal Rights, ecosystem restoration, and First Foods access should be prioritized.

Measures of Success:

- Land Development Codes maintained and updated by TPO to provide guidance.
- CTUIR Comprehensive Plan Objectives 5.5.1, 5.5.2, 5.9.7, 5.13.5, 5.13.6, and 5.13.10 and their associated benchmarks.
- CTUIR Hazard Mitigation Plan (2021) Section 3 and 4
- Appropriate and energy efficient housing availability.
- Multi-use development zoning for carbon-free commutable neighborhoods

Built Systems Adaptation

D. Resident and Community Preparedness, Response, and Services

E. Strengthen Opportunities to Divert Materials from Landfills

Systems that support transportation and communication are vulnerable to short and long term climate impacts that have transit and public safety implications.

Measures of Success:

- CTUIR Special Transportation Plan and update provides specific guidance and benchmarks;
- CTUIR Comprehensive Plan Objectives 5.12.1, 5.13.4, 5.13.7, 5.13.9, and 5.13.2 and their associated benchmarks.
- CTUIR Hazard Mitigation Plan (2021) Section 5
- Improve utilization of TERF materials recapture services, including waste disposal and recycling.
- Implement TERF composting capacity.
- Maintain and expand Kayak Public Transit services.
- Invest in broadband and community-scale communication networks.

Chapter 3C References and Credits

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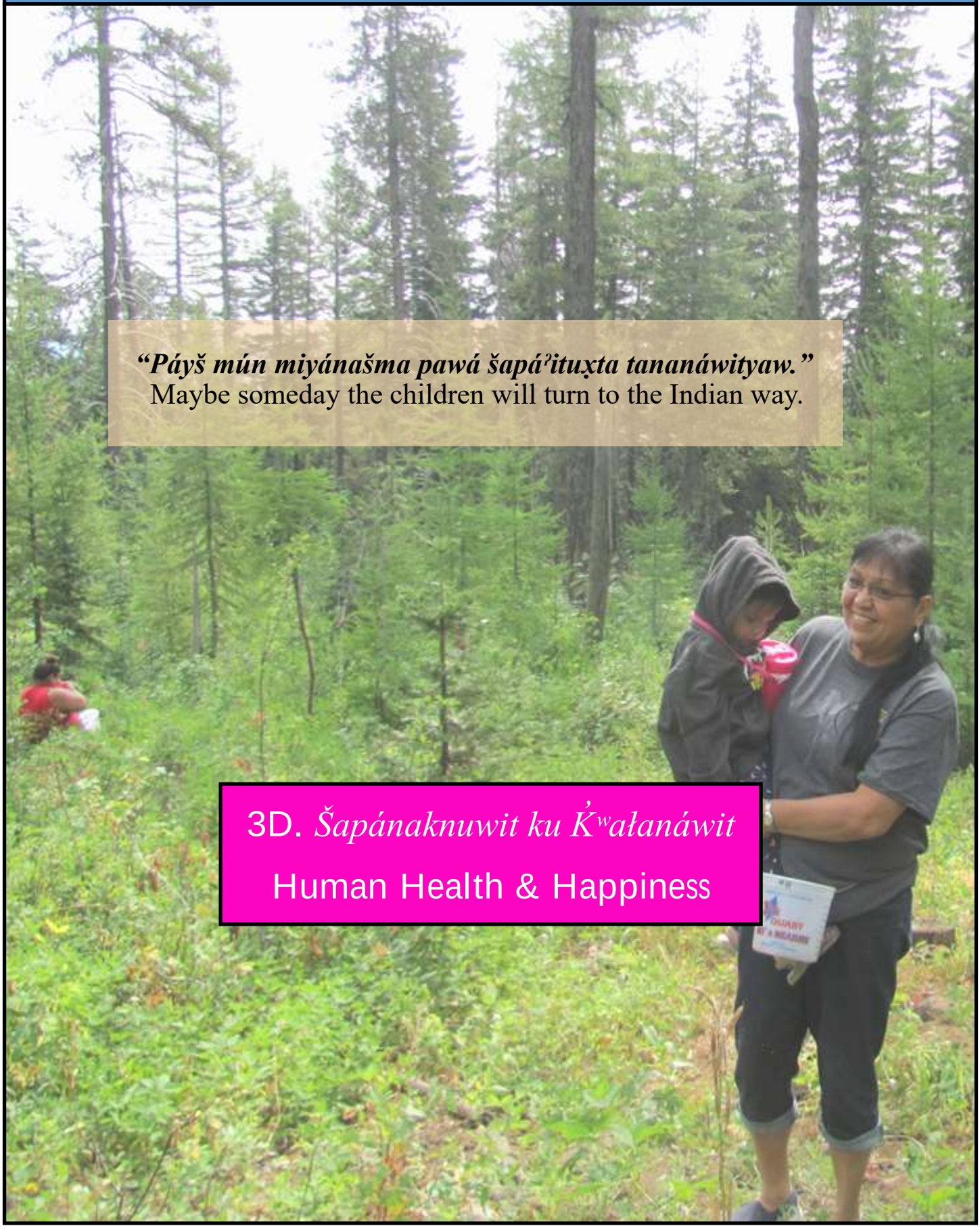
Photo Credits

- Part C Cover Photo, "DNR Fisheries staff move juvenile salmon to hatchery gate," CTUIR DNR Fisheries
- Background Photo, "Historical marker for Feb 2020 flooding," Althea Huesties-Wolf, 2020
- Background Photo, "Young Chokecherries at CTUIR Native Plant Nursery," DNR FFPP 2019
- Inset photo, "Thornhollow Bridge damage from Feb 2020 flood event," CTUIR DNR 2020

- Inset Photo, “Wildlife Presence Warning Sign at HNR,” CTUIR FFPP 2022
- Inset Photo, “Reith Road and bridge flooded by Umatilla River,” CTUIR DNR CRPP Jennifer Karson-Engum 2020
- Panel Photo, “Red sun visible mid-day over NGC parking lot through thick wildfire smoke,” CTUIR DNR FFPP 2020
- Inset Photo, “CTUIR Housing unit inundated with groundwater around foundation,” CTUIR Housing
- Panel Photo, “Dark clouds over the Umatilla River basin,” CTUIR DNR 2020
- Inset Photo, “Greenspace with cattails and tuli reeds outside Yellowhawk,” CTUIR DNR FFPP 2022
- Panel Photo, “Thick Smoke at Mission Road Intersection,” CTUIR DNR FFPP 2018
- Inset Photo, “Huckleberry Court house on snowy day,” CTUIR Housing
- Inset Photo (top), “Possible proposed use of July Grounds from TPO,” CTUIR Tribal Planning Office 2021
- Inset Photo (bottom), “Artist rendition of Mission Community Master Plan improvements," CTUIR Tribal Planning Office
- Inset Photo, “Floodwaters pass through Walla Walla city during Feb 2020 flood,” CTUIR DNR 2020
- Background Photo, “Roadway destroyed by Feb 2020 flood,” CTUIR DNR 2020
- Background Photo, “Sunlight Through Tipi at TCI,” CTUIR DNR CRPP
- Inset Photo, “Broadband internet cable being laid on UIR,” CTUIR DECD
- Inset Photo, “Tribal Community and Staff Sandbag Around Buildings in Flood,” CTUIR DNR WRP 2020
- Inset Photo, “Boys shooting the breeze in floodwaters,” CTUIR DNR 2020
- Inset Photo, “CTUIR TERF Sign,” CTUIR DECD
- Inset Photo, “CTUIR Tribal Environmental Recovery Facility,” CTUIR DECD
- Inset Photo, “Community listening session for the Mission community,” CTUIR Tribal Planning Office
- Summary Inset Photo, “Juvenile salmon are transferred at the DNR rearing ponds,” CTUIR DNR
- Panel photo, “Bachelor Button Flowers Over Pendleton,” CTUIR DNR FFPP 2018
- Inset photo, “Flooded home and stranded vehicle along the Umatilla River,” CTUIR DNR 2020.

Many homes on the UIR exist in the Umatilla River floodplain, and are at risk of repeated inundation from every future flood event. Flooding can impact evacuation strategies. Relocating homes out of the floodplain would improve public safety.



"Páyš mún miyánašma pawá šapáʔituxta tananáwityaw."
Maybe someday the children will turn to the Indian way.

3D. *Šapánaknuwit ku Ḱʷałanáwit*
Human Health & Happiness

Climate Impacts for **Physical Health**

"Loss of traditional food resources exacerbates Tribal health issues including poor fitness, diabetes, and other health challenges. Research has shown that loss of traditional food resources is associated with lifestyle changes (e.g., increasing sedentary lifestyle while decreasing culturally-specific activities and food diversity) and health problems (increased diabetes, obesity, heart disease etc).

Thus, ensuring abundant First Foods across the landscape and restoring Tribal food resources is likely to benefit the health and culture of the Tribal community by providing traditional food choices and promoting activities (e.g. hunting, digging, gathering, and fishing) that draw on tribal knowledge and skills (First Foods Upland Vision, 2019)."

Impacts from climate change create challenges for Tribal people from exposure and chronic events, as well as from complicating factors to negative health outcomes that currently exist.

1. Complications from Extreme Heat

Heat is an incredibly dangerous form of storm, and can take a devastating toll on both healthy and vulnerable community members. As extreme heat worsens health complications, especially for those chronically exposed such as outdoor workers and unsheltered persons, and those with existing health issues.

Extreme heat (at or above 90˚F) has potential to cause health complications within humans in at least 27 different ways (Mora et al 2017)**,** as seen in Figure 3D.1 (page 141).

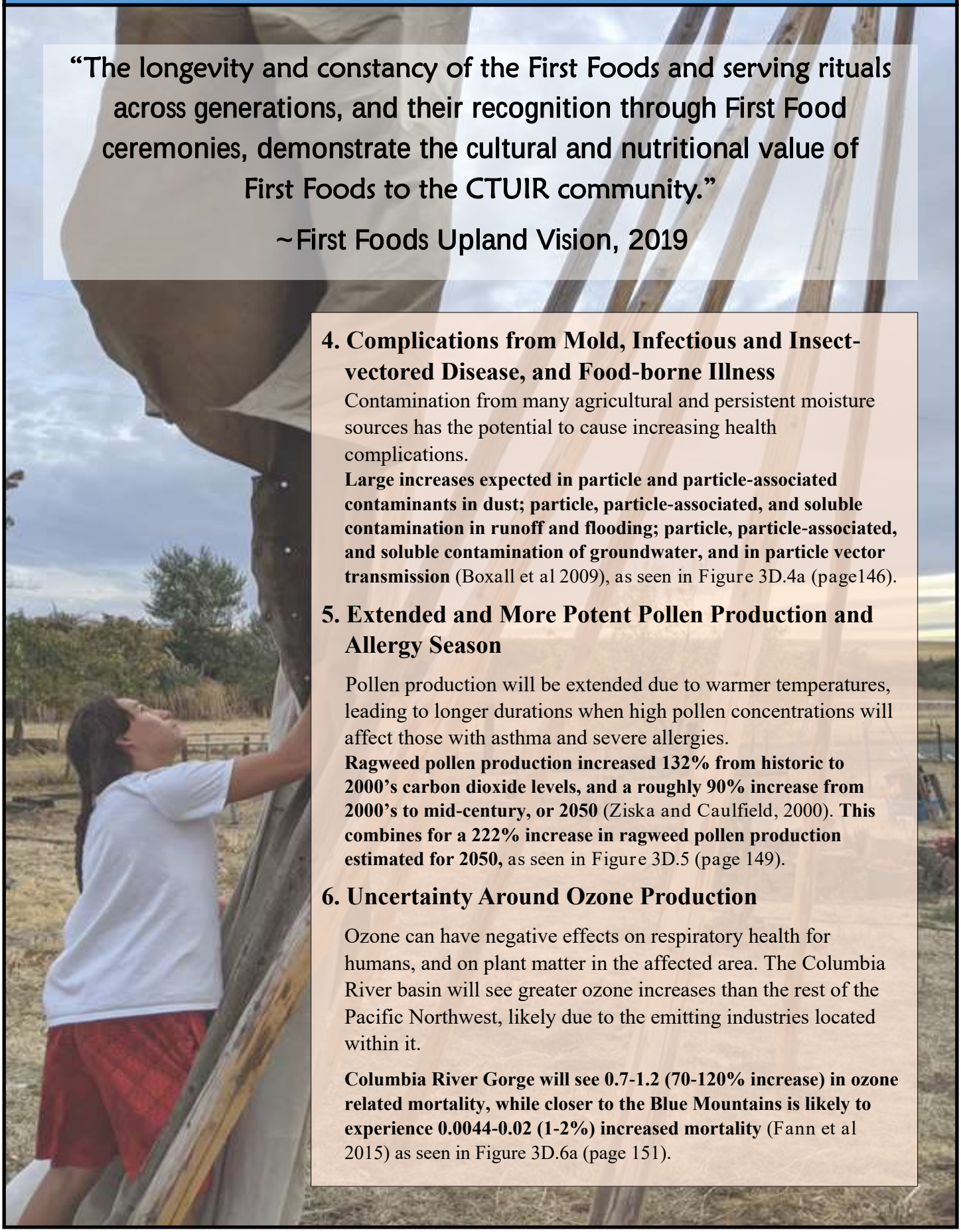
2. Complications From Wildfire Smoke

Particle pollution has a very negative effect on health, especially for those who are chronically exposed, and who live with pre-existing illness. Complications from smoke will increase morbidity and mortality around each event.

Heavy smoke events result in a **9.0% increase in the odds of same-day respiratory mortality, and a 14.0% increase in the odds of same day COPD mortality** (Doubleday 2020). **Cardiac arrest risk increased 70%** as seen in Figure 3D.2 (page 142)**.** There was also a **4.9% increase in lung cancer and 10% increase in brain cancer associated with smoke exposure** (Jones et al 2020).

3. Higher Potential for Biological Contamination of Surface Waters, Residential Wells, and Groundwater

Both fresh water and salt water bodies are at risk of contamination from different sources, as potential for harmful algal blooms (HABs) increases with temperature. A **2°C air temperature increase** results in an expanded HAB window of **almost 70 days; a 4°C increase expands this window by 127 additional days; and 6°C increase expands these seasonal conditions by 191 more days (**Moore et al 2008) as seen in Figure 3D.3 (page 144) .



"The longevity and constancy of the First Foods and serving rituals across generations, and their recognition through First Food ceremonies, demonstrate the cultural and nutritional value of First Foods to the CTUIR community."

~First Foods Upland Vision, 2019

4. Complications from Mold, Infectious and Insect-vectored Disease, and Food-borne Illness

Contamination from many agricultural and persistent moisture sources has the potential to cause increasing health complications.

Large increases expected in particle and particle-associated contaminants in dust; particle, particle-associated, and soluble contamination in runoff and flooding; particle, particle-associated, and soluble contamination of groundwater, and in particle vector transmission (Boxall et al 2009), as seen in Figure 3D.4a (page146).

5. Extended and More Potent Pollen Production and Allergy Season

Pollen production will be extended due to warmer temperatures, leading to longer durations when high pollen concentrations will affect those with asthma and severe allergies.

Ragweed pollen production increased 132% from historic to 2000's carbon dioxide levels, and a roughly 90% increase from 2000's to mid-century, or 2050 (Ziska and Caulfield, 2000). **This combines for a 222% increase in ragweed pollen production estimated for 2050,** as seen in Figure 3D.5 (page 149).

6. Uncertainty Around Ozone Production

Ozone can have negative effects on respiratory health for humans, and on plant matter in the affected area. The Columbia River basin will see greater ozone increases than the rest of the Pacific Northwest, likely due to the emitting industries located within it.

Columbia River Gorge will see 0.7-1.2 (70-120% increase) in ozone related mortality, while closer to the Blue Mountains is likely to experience 0.0044-0.02 (1-2%) increased mortality (Fann et al 2015) as seen in Figure 3D.6a (page 151).

1. Complications from Extreme Heat

Drought and extreme heat impact summer seasonal activities, disproportionately affecting those who lack access to adequate cooling, and those with existing cardiac, respiratory, or diabetic illness. In Umatilla County, frequency of days at or above 90°F is projected to increase by 29 days by the 2050s (doubling historical conditions of roughly 18 days on average) (Dalton et al 2020). Extreme heat events cause large disruptions in daily routine, and can have devastating impacts for those who spend large amounts of time outside, such as outdoor workers, unsheltered people, and subsistence cultural harvesters/ practitioners. Prolonged exposure can cause morbidity and mortality for those who are struggling with a chronic illness, and even those who are healthy can succumb to heat stress and heat stroke.

Figure 3D.1 displays the number of ways that extreme heat can cause damage within the human body.

- Organs within the human body are listed vertically on the left, while heat-affected pathways within the body are positioned horizontally along the top; where harmful pathways exist are marked with an "x" (Mora et al, 2017).
- When exposed to extreme heat, the hypothalamus dilates blood vessels to redirect blood from the core to the periphery of the body, where heat can be dissipated. This leaves insufficient blood flow to organs, resulting in ischemia.
- Heat cytotoxity occurs when body temperature surpasses cell thermal tolerance, causing cell death (necrosis) and break down of cell membranes.
- In the heart, compounding factors of heat cytotoxicity, ischemia, and hypokalemia-- potassium deficiency caused by sweating and urination-- can lead to the fragmentation of the myocardium, and increases the risk of cardiac arrest and decreases the effectiveness of the body to regulate heart rate and blood pressure.
- Dehydration thickens the blood and causes vasoconstriction, increasing risks of coronary thrombosis and stroke.
- Cell damage can lead to other conditions, such as acute tubular necrosis in the kidneys, permanent loss of brain function, liver endotoxins in the blood, inflammation of the pancreas, not enough oxygen getting to the lungs and into the blood because of injury of the pulmonary endothelium, and increase permeability of organs to pathogens and toxins.
- With all these factors combined, **extreme heat can cause health complications in at least 27 different ways** (Mora et al, 2017).

Adaptations that address heat exposure, such as increased shading, access to cooling and air conditioning, and behavioral adjustments like staggered work schedules to avoid the peak heat could save lives and reduce chronic exposure annually.

Figure 3D.1: Potential Pathways of Complication from Heat

	Mechanisms				
Organs	Ischemia	Heat Cytotoxicity	Inflammatory Response	Disseminated Intravascular Coagulation	Rhabdomyolysis
Brain	X	X		X	
Heart	X	X			
Intestines	X	X		X	
Kidneys	X	X	X	X	X
Liver	X	X	X	X	X
Lungs		X	X	X	X
Pancreas	X		X		

Assessing vulnerabilities to heat exposure for different community groups could also strengthen heat exposure prevention, as some groups will have more or less needs when it comes to adaptation.

(Credit: Mora et al 2017)

Gaps in Knowledge/Data/Policy:

- Inventory and understanding of how heat disproportionally affects vulnerable community members.

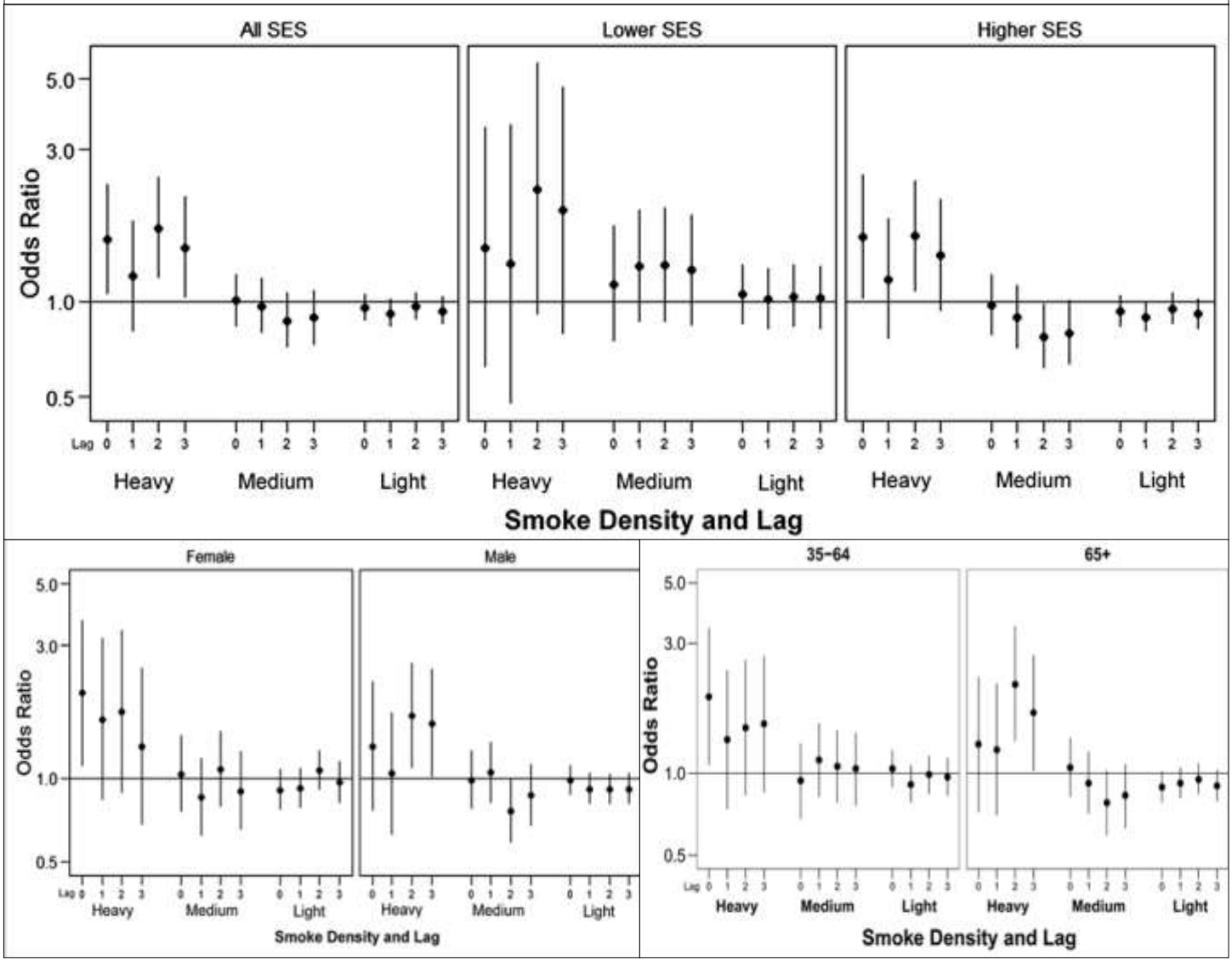
2. Complications from Wildfire Smoke

Wildfire smoke contains many compounds harmful to human health, including fine particulate matter (PM2.5), acrolein, benzene, carbon monoxide, and polycyclic aromatic hydrocarbons, threatening air quality near the fire source, as well as hundreds and thousands of kilometers away. As risk of wildfire increases due to climate change, more people will be exposed to chronic wildfire smoke from blazes locally and regionally.

Figure 3D.2 examines the association between wildfire smoke exposure, and the odds of cardiac arrest and hospitalization during and after wildfire smoke exposure, as measured for 14 counties in California from 2015-2017.

- Risk of out-of-hospital cardiac arrest (OHCA) incidences in relation to exposure to wildfire smoke is demonstrated for various categories of people: impact across "Socio-Economic Status" (SES) as measured generally (top left): marginalized classes (top middle), and privileged classes (top right). Risk ratios are also provided by gender (female

Figure 3D.2: Increased Risk of Out of Hospital Cardiac Arrest (OHCA) Due to Wildfire Smoke Over Time



versus male, bottom left), and by ages (ages 35-64 versus ages 65+, bottom right). All these risk ratios were measured for heavy, medium, and light smoke exposure, and in relation to same-day exposure (lag 0), and for 1-, 2-, and 3-days after exposure (lag 1, 2, and 3 respectively).

- Overall, although both SES groups had elevated risk with heavy smoke exposure, lower SES cases tended to have elevated effects at medium and possibly light smoke, while higher SES cases showed null results or deficits.
- Both men and women experienced increases in OHCA under heavy smoke conditions; risk in women was highest with heavy smoke on the same day as exposure, and highest in men two days after heavy smoke exposure.
- The 35- to 64-year age group experienced highest risk on the same day as smoke exposure, with elder patients experiencing a greater risk 2-3 days after heavy smoke exposure.
- Results of higher risk to women and younger ages may relate to lower awareness of their potential risk, causing them to continue activities involving exertion and exposure during wildfire smoke episodes (Jones et al 2020).
- Overall, **cardiac arrest risk increased on days of heavy smoke exposure and for several days afterward**, **peaking at 70% higher on the second day after smoke exposure** (Jones et al 2020).

Because of their chronic close proximity to smoke, wildland firefighters are at greater risk for adverse health effects.

Another study of wildfire smoke exposure and the odds of non-traumatic mortality (meaning death was not related to an injury) for respiratory associated illness, was measured in Washington State over a recent 12 year period.

- It is estimated a 1% increase in the odds of all same-day exposure, and a 1.3% increase in the odds of non-traumatic mortality on the previous day of wildfire smoke exposure for those without pre-existing respiratory illness (Doubleday, 2020).
- **9% increase in the odds of same-day respiratory mortality, and a 14% increase in the odds of same day COPD mortality (Doubleday, 2020)**.
- Among ages 65–84 specifically, a 2% increase in the odds of all same-day non-traumatic mortality was observed. With previous day exposure, there was a 2% increase in the odds of all non-traumatic mortality observed, and a 5% increase in the odds of respiratory mortality (Doubleday, 2020).

Risk of cancer has also been found to have a connection with wildfire exposure. Study shows that people living within 50-kilometer of wildfires over the past 10 years had a **10% higher incidence of brain tumors and 4.9% higher incidence of lung cancer**, compared to people living further away (Korsiak et al 2022).

Chronic smoke can have a negative impact on respiratory health for everyone, but can cause potentially life-threatening worsening of existing illness for those with respiratory, cardiac, and diabetic illness. It is predicted that the number of people exposed to wildfire smoke yearly will grow by 43% to over 82 million by midcentury across the United States (Jones et al 2020). With summers expected to be inundated with smoke regularly in coming years, ways of coping with long periods of smoke without losing connection will be required. Additional precautions and response is likely to be necessary for those whose occupations bring them into close contact with wildfire smoke, such as wildland firefighters and prescribed burning practitioners.

(Credit: Jones et al 2020)

<u>Gaps in Knowledge/Data/Policy:</u>

- Future wildfire risk reduction adaptations and impact this will have on air quality;
- Understanding of risk of smoke impacts among those most vulnerable.

3. Higher Potential for Biological Contamination of Water, and Incidences of Harmful Algal Blooms (HABs)

Water contamination creates human health issues, and climate change is likely to make these conditions more frequent. Water quality issues arise when water is warm and stagnant, creating conditions for algal growth and insect vectors to thrive. CTUIR has been proactive with addressing flooding issues that affect residential wells and sewage systems, however there are more adaptations, skills, and information networks that could reduce the potential for this source of health hazard.

Occurrences of mold due to damp conditions in Tribal housing are addressed by CTUIR Housing, which has worked to identify residences affected by chronic flooding, and relocated essential ventilation systems from foundations (where they were being inundated) to the attic space of residences. This adaptation has been done to reduce optimal growing conditions for mold in these spaces, which threatens health by contributing to respiratory infection.

Other biological health hazards are connected to water quality and temperature, most often impacting large and relatively still bodies of water like lakes, reservoirs, and pools. While most algae are not harmful, some species in high density can cause toxicity problems. These harmful algae blooms (HABs) produce potent natural toxins that are bio-accumulated (meaning they become more concentrated as species complexity increases) in some shellfish and other organisms that form the basis of food chains. Many of these can be toxic to touch or ingest for humans and other animals.

In freshwater, the most important HABs are caused by certain species of cyanobacteria (blue green algae) from the genera *Anabaena*, *Microcystis*, and *Aphanizomenon,* causing cyanobacterial poisoning. In both marine and freshwater systems, exposure to HAB toxins results from eating contaminated fish or shellfish, drinking contaminated water, inhaling contaminated aerosol, or by contacting contaminated water.

Figure 3D.3: Harmful Algal Bloom Seasonal Window in the Salish Sea (Puget Sound) as Temperatures Rise

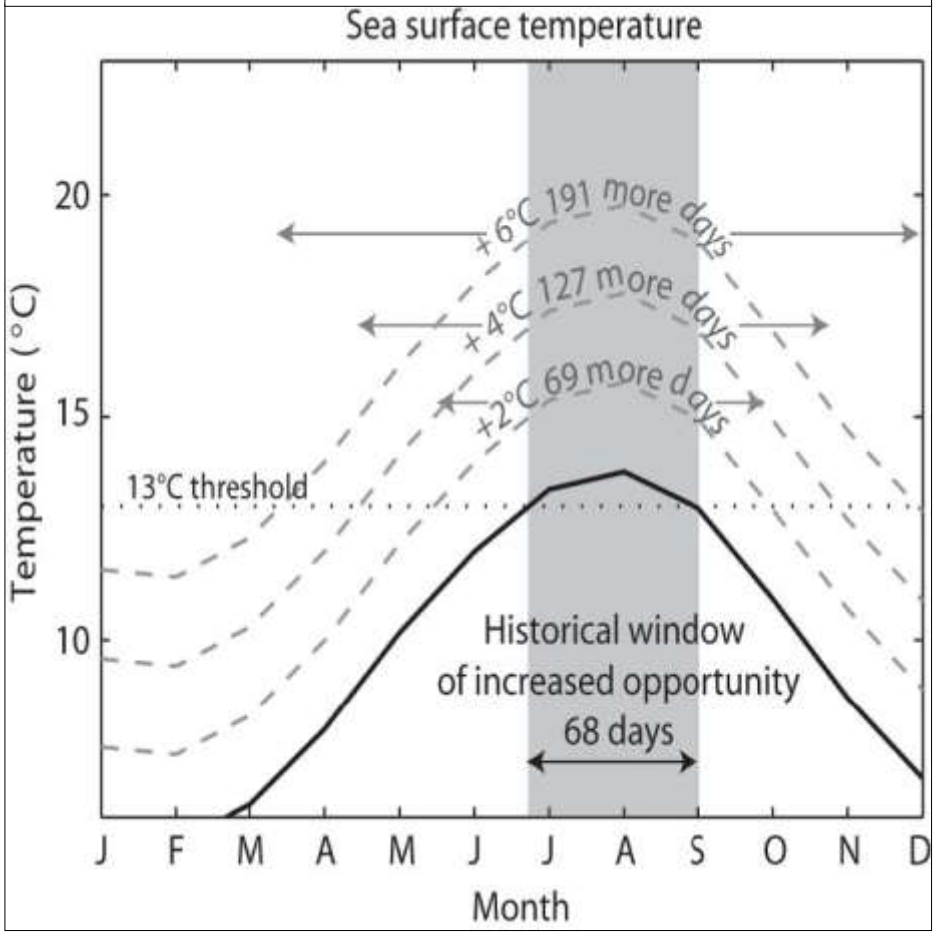


Figure 3D.3 demonstrates how warming water temperatures create additional opportunity for HABs to arise with the Salish Sea (Puget Sound) in Washington.

- This graph shows how water temperature over the course of the year creates conditions where it is possible for HABs to grow in concentrations that cause health problems. The black line represents the historical conditions for this saltwater inlet; checked lines projected this same seasonal window for increasing water temperatures. The temperature threshold for when planktonic dinoflagellate *Alexandrium catenella* (which is associated with paralytic shellfish poisoning) begins to form is shown as a vertical dotted line at 13 ˚C

(23.4°F).

- Scenarios for warmer water conditions by 2, 4, and 6°C (3.6, 7.2, and 10.8°F increase respectively) are shown in gray with the associated widening of the window of increased opportunity for *A. catenella* growth.
- **From the graph, a now almost-certain 2°C (3.6°F) results in an expanded HAB window of almost 70 days; a 4°C (7.2°F) increase increases this window by 127 additional days; and 6°C (10.8°F) increase expands these seasonal conditions by 191 more days** (Moore et al 2008).

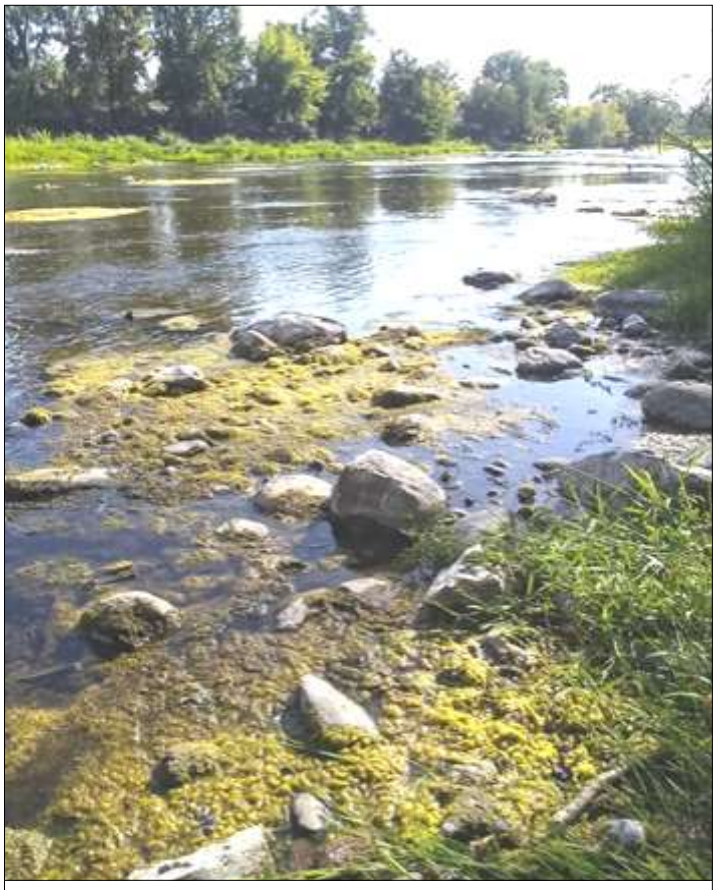
Toxic algae is emerging as a contamination concern for CTUIR's Ceded lands, as HABs in the Richland, WA area of the Columbia River have already resulted in the death of several domestic animals. Contact with the water was heavily discouraged during these blooms, decreasing Tribal Member access to the river. These proxy estimates were conducted for a saltwater environment, as information is lacking about how HABs in freshwater environments are likely to change. This is due to the complexity of watersheds, as well as the highly variable and integral component of land use management in the surrounding basin.

Both harmful and nontoxic algal blooms arise from over enriching of waterways with agricultural chemicals like nitrogen and phosphorus. Controlling for contamination of water sources with these chemicals could have a large impact on the formation of algal blooms, now and in the future.

(Credit: Moore et al 2008)

<u>Gaps in Knowledge/Data/Policy:</u>

- How water acidity will affect this seasonal potential for HABs to form;
- Relationships between HABs and aspects of the local and large-scale climate;
- Assessment of how human health effects from HABs are changing as more people come in contact with HABs, especially in reservoirs and rivers;
- How land use management might reduce or worsen conditions for HABs, especially in freshwater conditions.



Algal blooms in slow moving water are not always toxic, though many can have negative effects on aquatic organisms by reducing visibility and dissolved oxygen. Blooms are typically the result of agricultural fertilizer runoff.

4. Complications from Biological Contaminations (Mold, Infectious Disease, Insect-vectored, and Food borne Illness)

Life cycles and reproductive rates of biological organisms like bacteria, fungi, protozoa, and other rapidly reproducing organisms will be affected by warmer air temperatures, and are likely to experience an accelerated rate of reproduction as a result. Some of these organisms cause human health concerns, especially when they are found in drinking water, indoor air, and in food processing and consumption.

This is especially true in agricultural environments, like the croplands that makes up much of the CTUIR Ceded territory. In these settings, humans may be exposed to agriculturally derived chemicals and pathogens in the environment (i.e., air, soil, water, sediment) by a number of routes. This includes consuming contaminated plants and animals, breathing in harmful particles, and through contaminated drinking water.

Figure 3D.4a: Pathways of Contamination in Agriculture for Air, Water, and Soil

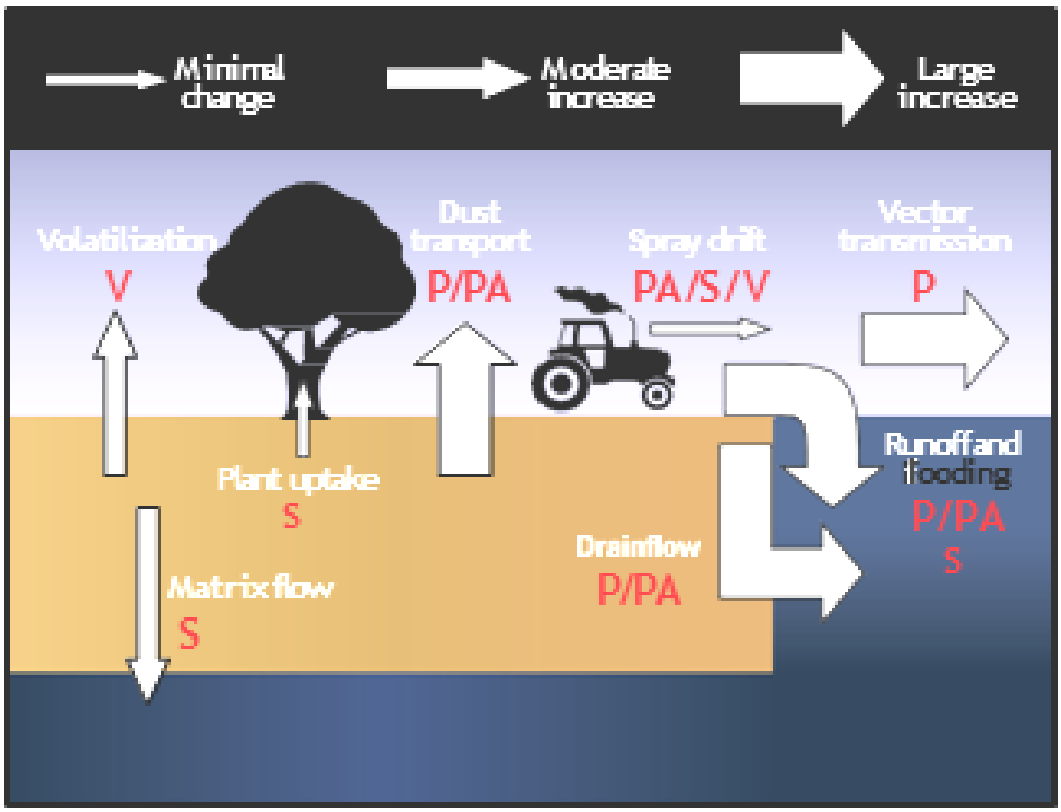


Figure 3D.4a illustrates the number of pathways through which exposure to agricultural contamination can occur, and the impact that climate change is likely to have on these contamination pathways.

- White text identifies pathways of exposure to contamination. Volatilization means chemicals become airborne. Plant uptake means plants absorb chemicals as they grow. Matrix flow means chemicals flow into groundwater. Dust transport means chemicals attach to soil particles and become airborne. Spray drift means chemicals are blown by winds as they are applied. Drainflow indicates chemicals flow into nearby surface waters through shallow aquifers. Vector transmission means chemicals are moved by vehicles, wind, animals, or other mobile entities. Runoff and flooding indicate chemicals flow into nearby surface waters through overland flow and erosion.
- Letters indicate which contaminant classes are likely to be transported via an individual pathway: P is "**particulate**" (e.g., bacteria, viruses, spores, engineered nanoparticles); PA is "**particle-associated**" (e.g., hydrophobic organics, ammonium, heavy metals); S is "**soluble contaminant**" (nitrates, reactive phosphorus, hydrophilic pesticides); V for "**volatile contaminants**."
- Three arrow sizes are provided along the top of the graphic: smallest arrows indicate a minimal impact of climate change on this element, while larger arrows demonstrate a moderate increase, and largest arrows indicating a large increase is anticipated.
- Little change is expected in S plant uptake and in PA/S/V spray drift; moderate increases are projected in volatilization of contaminants and in soluble contaminants in matrix flow.
- **Large increases are expected in particle and particle-associated contaminants in dust transportation; particle, particle-associated, and soluble contamination in runoff and flooding; particle, particle-associated, and soluble contamination of drainflow (groundwater transport), and in particle vector transmission** (Boxall et al 2009)**.**

There are still many unknown factors to how changing agricultural conditions will affect water, lands, food, and people. Examples of these kinds of exposure pathways include but are not limited to (Boxall et al 2009):

- Wetter seasons increase contamination of mycotoxins in grain and row crops;
- Livestock populations increasingly subjected to heat stress may lead to increased indoor housing of animals, enhancing the need to store and

dispose of manures;

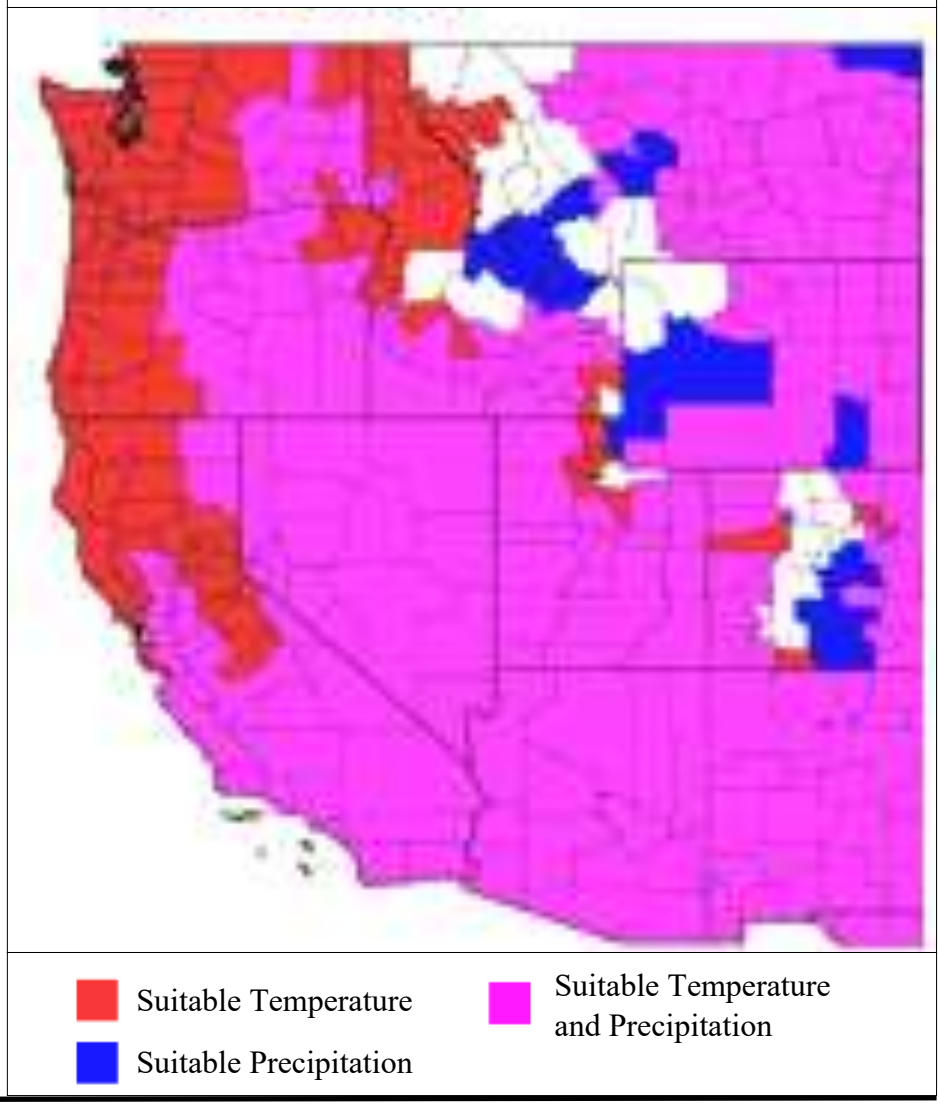
- Higher temperatures facilitate introduction of new pathogens, vectors, or hosts in livestock, leading to increased use of biocides and veterinary medicines in meats and other animal products;
- Workers may be in more frequent contact with livestock, so transmission of zoonotic diseases may increase;
- Flood events can transport pathogens, dioxins, heavy metals, cyanide, and hydrocarbons from a contaminated areas to a non-contaminated ones through runoff and groundwater movement;
- Drier summers create high soil moisture deficits, resulting in hydrophobicity of soil surfaces and contaminants become airborne through spray drift applied to agricultural fields, volatilization and dispersion from treated surfaces (e.g., plants and soils), and wind-blown dust particles from soil surfaces;
- Dust released during soil tilling and crop harvesting can carry particle-associated contaminants like bacteria, fungal and bacterial spores, steroids, pesticides, and poly cyclic aromatic hydrocarbons;
- Increases in tick populations (*Ixodidae* and *Argasidae* species) may occur, which could increase incidences of Lyme disease (though there are large gaps in knowledge about how this range will change);
- Pesticides application will likely increase as crop diseases become more prevalent, thus loadings of pesticides in the environment and rates of pesticide applied to food items will also increase.

Air-borne contaminants from agricultural soils particularly have the risk of introducing biological health issues, such as Valley Fever. Caused by the inhalation of *Coccidioides spp*. fungal spores that live in dry soils, these fungal species are known to proliferate during wet seasons, and to become brittle as soils dry under extreme heat following warm wet periods (Gorris et al 2019). When soils are disturbed by agricultural tillage or construction activity, these spores can become air-borne and affect human health in various ways for those who inhale this contaminant.

The U.S. Center for Disease Control (CDC) identifies the *Coccidioides spp* that causes Valley Fever as endemic in three counties in Washington State within the CTUIR Ceded lands: Benton, Franklin, and Walla Walla Counties are all identified as having existing *Coccidioides spp* fungi in these soils (Gorris et al 2019). These counties were the site of an outbreak of these fungal species in 2010-2011, and underwent soil treatment to eradicate the fungus (Gorris et al 2019).

Figure 3D.4b provides an projection of the spread

Figure 3D.4b: Projected Distribution of *Coccidioides spp* by 2100 (RCP 8.5)



of *Coccidioides spp* by 2100 under an RCP 8.5 scenario.

- Risk of endemicity (meaning fungi can persist in soils) depends on two factors: temperature and precipitation. Across the western U.S., warm temperatures and enough precipitation will facilitate the endemicity of the fungi that cause Valley fever, though both high temperatures and sufficient precipitation and moisture are required for the fungi to persist.
- Within this map, risk for endemicity for the fungi are indicated by color for each county: areas in red are where there is sufficiently warm temperatures; areas in blue indicate regions that will get enough precipitation; and areas in magenta/purple are where both temperature and precipitation will permit endemicity, and are at risk of developing Valley Fever fungi (Gorris et al 2019).

Judy Beers, a UIR resident, surveys damage to her home and property from the Feb 2020 flood. Inundated homes are at a greater risk for developing mold issues.

- The area endemic to Valley Fever will extend farther north in future decades, especially in the rain shadows of the Sierra Nevada and Rocky Mountain Ranges. Within the map, much of the CTUIR Ceded lands can be seen existing in the area at risk of developing *Coccidioides spp* in agricultural soils.
- By the end of the 21st century, the **area endemic to Valley Fever will increase by 113%**: the number of states with Valley Fever endemicity will increase from 12 to 17; the number of counties with endemicity will increase from 217 to 476, and the number of people living within the endemic region will increase by 17% across the U.S. (Gorris et al 2019).

Mold is another rapidly-growing, temperature-dependent indoor air quality concern affected by climate impacts. Currently, it is approximated that half of U.S. homes have visible evidence of a dampness problem or mold contamination, and this number is likely to rise in the future. Health risks from indoor mold are numerous: development of asthma with chronic exposure; triggering of asthma attacks; increased respiratory infections, allergic rhinitis, wheeze, cough, difficulty breathing, and other symptoms. Children are more sensitive to dampness and mold than adults, as are those with existing respiratory illness.

- Building dampness and mold is associated with 30-50% increases in a variety of respiratory and asthma-related health outcomes (ELI 2016).
- An estimated 21 percent of current U.S. asthma cases (and an associated $3.5 billion in treatment costs), as well as an estimated 8-10% of respiratory infections and bronchitis were attributable to dampness and mold in homes (ELI 2016).

Adaptations to indoor mold issues include tracking and correcting the sources of moisture that promote microbial growth, rapid drying or prompt removal of damp materials, and cleaning/removal of mold and moldy materials, as rapidly and safely as possible. Having a training/licensing program or other policies in place before the next severe storm can assist in ensuring mold assessment and cleanup services are performed adequately, safely, and responsibly. Proactive land zoning and permitting policies to avoid developing in flood-prone areas,

or establishing design and construction requirements that make new homes less susceptible to moisture problems would also assist in reduce future complications from mold (ELI 2016).

(Credit: Boxall et al, 2009; Gorris et al 2019)

Gaps in Knowledge/Data/Policy:

- How tick and mosquito populations are likely to change in the Columbia River Plateau area, and what disease dynamics are associated;
- Need for surveillance schemes to track presence and health effects of pathogens and chemicals arising from agriculture and other polluting sectors.

5. Extended and More Potent Pollen Production, Allergy and Dust Seasons

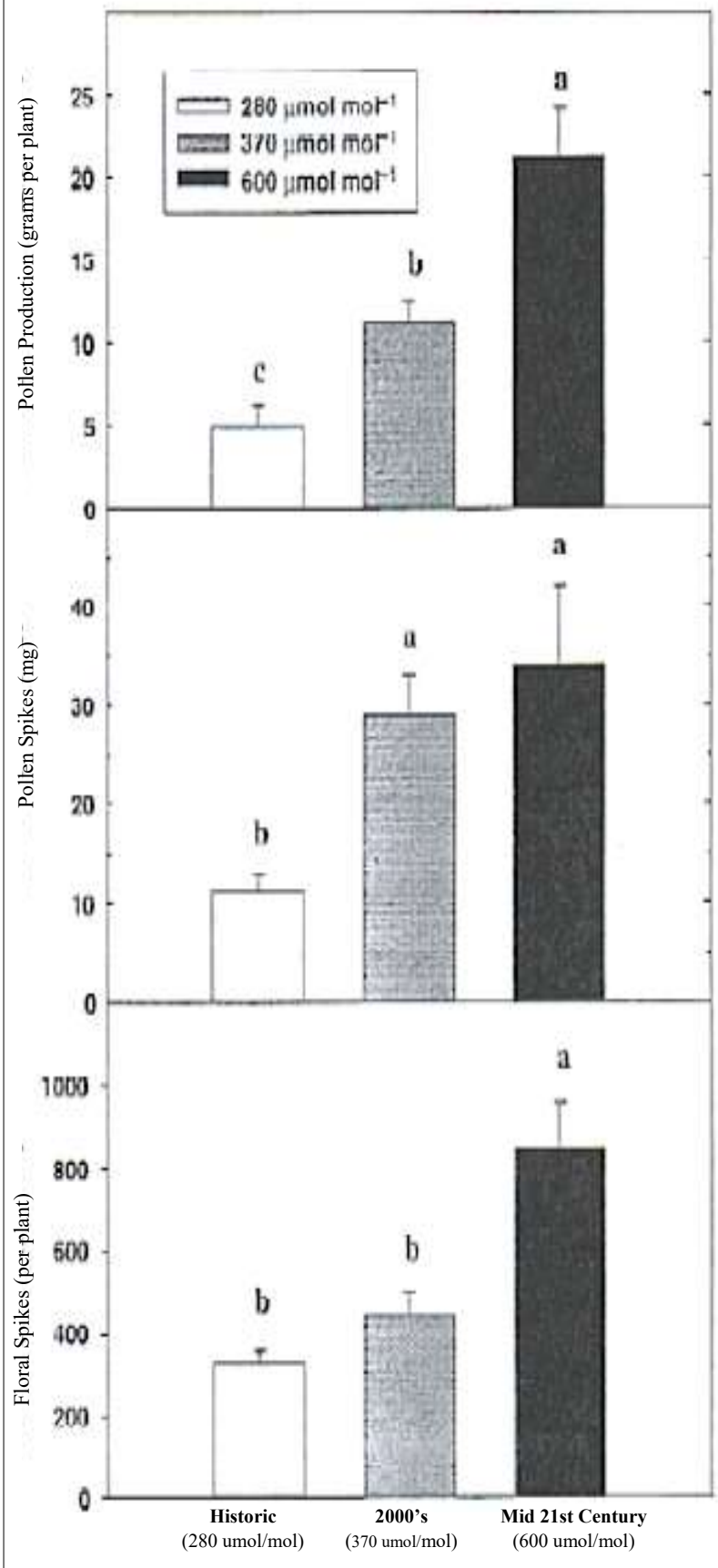
Seasonal air quality concerns come from many different sources, and climate impacts are likely to extend these sources to greater severity and for longer periods of time. Higher temperatures and carbon availability means some plants will experience an extended pollen production and growing season, affecting those with severe allergic or respiratory illness.

While information about Columbia Plateau-specific plant responses is lacking, proxy projections can be used to approximate this impact for the region. Ragweed (*Ambrosia artemisiifolia*) pollen is a common allergy, as a 2000 survey of the US general population documented roughly 70% of respondents had a noticeable allergic relationship with this invasive plant (Ziska and Caulfield, 2000).

Figure 3D.5 shows the relationship of ragweed pollen production and increasing concentrations of carbon dioxide, which can be used to project impacts for different future carbon scenarios.

- In the three-part graph is a comparison of ragweed plant attributes under different carbon dioxide concentrations (Ziska and Caulfield, 2000).
- Carbon concentrations of 280 micromols per mol represent Historic (1880's) conditions, and is shown by the white-fill bar on the

Figure 3D.5: Response of Ragweed Pollen to Increasing Carbon Dioxide Concentrations



left in the graph; 370 micromols per mol represent the present 2000's conditions, and is shown as the grayscale bar in the middle on the graph; and 600 micromols per mol of carbon represent potential future conditions circa 2050, shown as the black bar on the right in the graph.

- The top graph displays pollen production in grams per plant for three points of carbon dioxide concentration. The middle graph shows the number of pollen spikes at the three time points, while the bottom graph illustrates the number of floral spikes per plant.
- Pollen production was observed to **increase 132% from historic to 2000's carbon dioxide levels, and roughly 90% increase from 2000's to mid-century, or 2050** (Ziska and Caulfield, 2000). **This combines for a 222% increase in ragweed pollen production estimated for 2050.**
- Pollen production per flower spikelet has increased since historic conditions, and the number of flower spikes per plant is projected to jump dramatically into the 21st Century as carbon dioxide increases. Essentially, **each plant will be producing more flowers, each of which will be able to produce more pollen than under historic conditions** (Ziska and Caulfield, 2000).
- Additionally, a separate study conducted on ragweed pollen's antigen, Amb A 1 (Antigen E), is estimated to **increase 120% at 2000's current levels from historic levels, and 180% greater concentration into the mid-century** (Singer et al, 2005). This means that any pollen that is produced will have an increased potential to incite a histamine response in humans.

Since ragweed pollen production peaks between late August and November in North America, mitigation and preparation strategies focusing on that time period to reduce pollen exposure could prevent unnecessary morbidity or reduction in quality of life. Inventory of other high allergen-producing plants should be conducted to assess additionally increasing sources of allergens and their seasonal occurrences. Additionally, dust and other air-borne particles can also be a hazard for human health and safety. Severe dust storms can cause impaired vision to motor vehicle operators, resulting in traffic collisions, and can often carry biological contaminations that cause respiratory illness.

Extended and more potent pollen and allergy seasons are already contributing to quality of life issues for the CTUIR community. Allergies are identified as a factor affecting families in outreach exercises (pictured).

It is difficult to know how dust conditions are likely to change, as wind can be difficult to model accurately. There is evidence that for the CTUIR Ceded lands, precipitation affects dust event frequency in the spring, but air-borne particles are most affected by vegetation cover in the summer. Both of these determining factors will be affected by climate impacts. Early projections show a possible decrease in dust events in summer due to an anticipated increase in summer vegetation growth, and little change in other seasons (Dalton et al 2020), though more refined modeling for this region is necessary. More research is also needed to predict how wind storms are likely to change over the century as well.

(Credit: Ziska and Caulfield, 2000)

<u>Gaps in Knowledge/Data/Policy:</u>

- Region-specific information about allergen-producing plants for the CTUIR Ceded lands, and how these populations are likely to responds to changing conditions;
- How changing land management practices will affect soil erosion and vegetation cover;
- Little to no information on how wind conditions will change; refining of dust event modeling for this region is also required.

6. Uncertainty around Ozone Effects

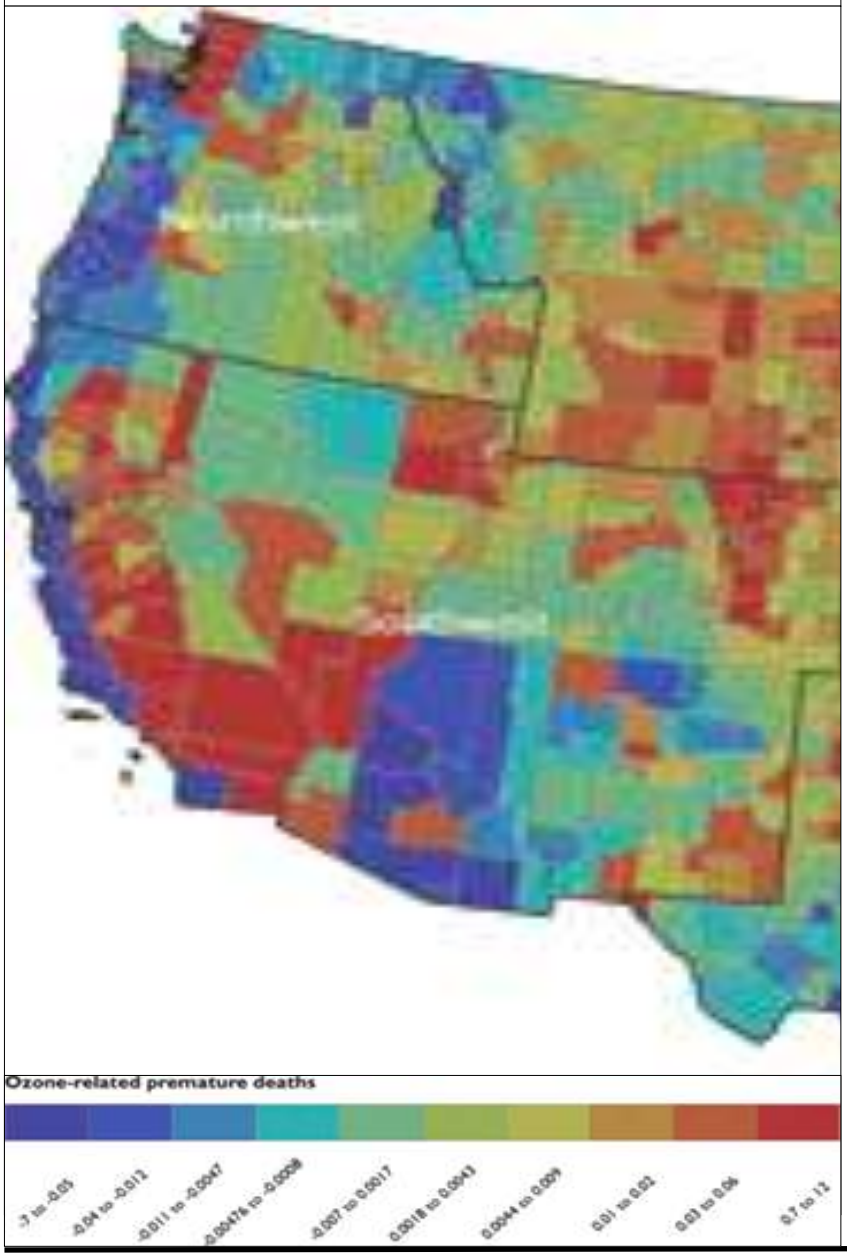
Ozone (O3) is a gas pollutant made of three oxygen molecules, and is a product of various atmospheric conditions and volatile precursors. At earth's surface, ozone is created by chemical reactions between oxides of nitrogen (NOx) and volatile organic compounds (VOCs), which are released when pollutants emitted by cars, power plants, industrial boilers, refineries, chemical plants, and other sources chemically, react in the presence of sunlight (EPA 2021).

Ozone concentrations are dependent on heat and air temperature, two things affected by climate change. Ozone is also associated with health and environmental impacts, and exposure to high levels of O3 can damage terrestrial ecosystems, including First Foods, grasslands, and forests, leading to negative consequences for Tribal Members harvesting and consuming traditional and locally produced plant foods.

Figure 3D.6a show the mapped results of ozone-related mortality and morbidity in the near future.

- On the map, severity of annual ozone impacts are shown on a color gradient: least impacted locations shown in blue may experience a decrease in ozone impacts, while moderate impacts are in yellow scale, and most severe in red as a percentage of additional mortality.

Figure 3D.6a: Annual Ozone-Related Premature Deaths by 2030 (RCP 8.5)



- This study predicts average temperature increases of 1- 4°C and climate-driven mean daily 8-hr maximum ozone increases of 1–5 ppb (Fann et al 2015), with seasonal (May–September) mean increases in ozone levels of 1–5 ppb RCP 8.5 scenario, resulting in more exceedances of the 75-ppb ozone than historical.
- The Northwest, the Great Plains, and the Southwest regions are projected to incur few ozone related health impacts, while the Northeast and Midwest regions are projected to have increases in ozone-related deaths (i.e., reductions in mortality avoided) for most of the years.
- Within the resolution of the map, it can be seen that CTUIR ceded lands are projected to experience more ozone impacts that other places in the Pacific Northwest. At this resolution**, Columbia River Gorge will see 0.7-1.2 (70-120% increase) in ozone related mortality, while closer to the Blue Mountains is likely to experience 0.0044-0.02 (1-2%) increased mortality** (Fann et al 2015);

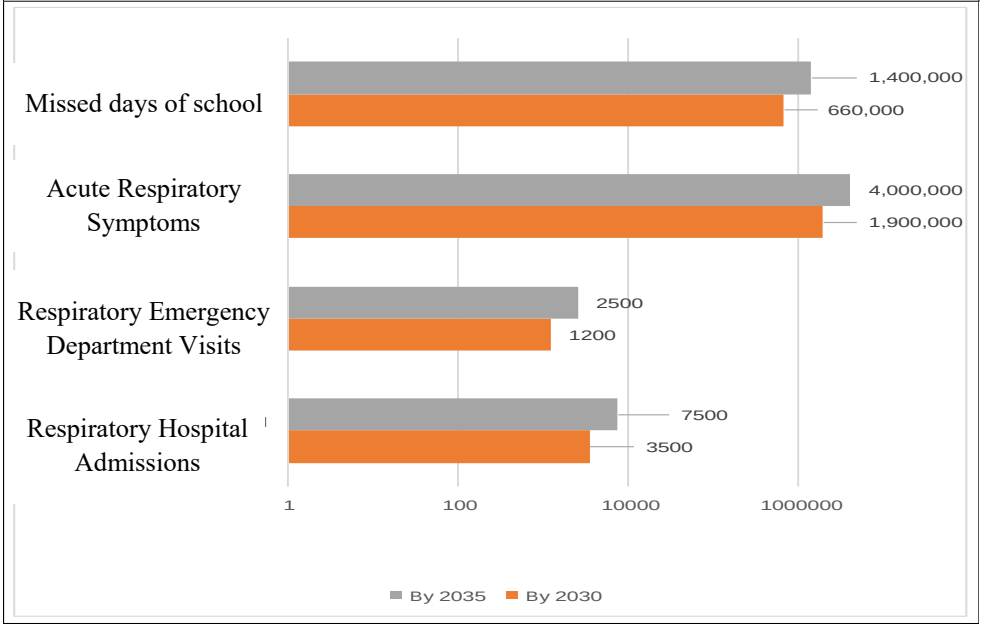
Additional ozone-related premature deaths and illnesses attributable to climate change under an RCP 8.5 across the U.S., including emergency department visits, hospital admissions, acute respiratory symptoms, and lost school days, and estimate the economic value of these impacts, as seen in **Figure 3D.6b:**

- By 2030, an additional average of: 3,500

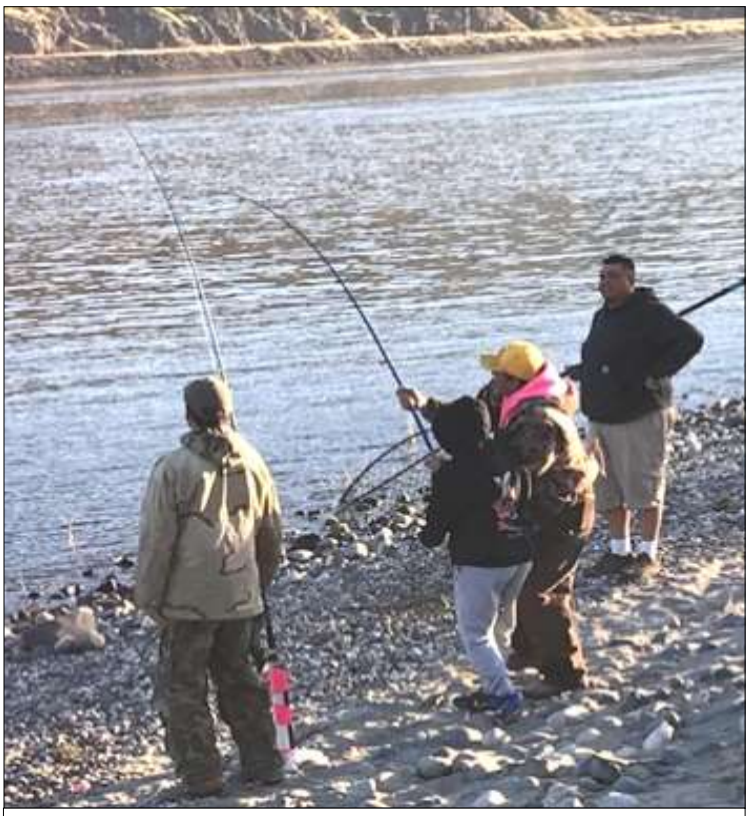
respiratory hospital admissions; 1,200 respiratory emergency department visits; 1.9 million acute respiratory symptoms, and 660,000 missed days of school are anticipated nationally.

- By 2035, an additional average of: 7,500 respiratory hospital admissions; 2,500 respiratory emergency department visits; 4 million acute respiratory symptoms; and 1.4 million missed days of school (ages 5-17) are anticipated nationally (Fann et al 2015).

Figure 3D.6b: Annual Additional Ozone-Related Impacts in U.S. (RCP 8.5)



While the Western U.S. is not likely to see the dramatic increase in ozone projected for the rest of the country, inland areas along the Columbia River can be seen to be more affected than other parts of the Pacific Northwest. It is likely these areas are going to be more affected because of the industries located along the Columbia River: Arlington landfill/incinerator, and the Port of Morrow, among others, are highly likely to be emitters of ozone precursors.



Tribal harvesters that fish, hunt, and gather in Zone 6 of the Columbia River are likely to experience more adverse health effects from ozone-emitting industries located along these same river reaches.

Ozone is complex to model, and globally-shared air circulation patterns can move these ozone and precursor pollutants far from their sources. In the Pacific Northwest, air patterns moving over the Pacific Ocean from Asia affects the creation of ozone within the Columbia River basin. Over recent decades, springtime ozone concentrations have increased by 30%, along the U.S. West Coast, an increase attributed to increase emissions in Asia that have traveled across the ocean (Jaffe et al 2003). Since "airsheds" (regional patterns of air movement) are shared across oceans and continents, ozone may be better controlled by reducing both ozone precursor emissions NOx and VOC, as well as greenhouse gases emissions globally.

(Credit: Fann et al 2015)

<u>Gaps in Knowledge/Data/Policy:</u>

- Higher spatial resolution to more finely resolve relevant areas regionally for CTUIR Ceded lands;
- Inventory and assessment of precursor emissions sources locally, and how these might change with increasing temperatures;
- How regulatory changes for air quality and greenhouse gas emissions will affect concentrations of precursor pollutants.

A. Support and Expand Community Health Capacity and Education

"Children used to learn much of this from their extended families in the great outdoor classroom. Fishing, hunting, digging, picking, trapping, grazing stock – all rights reserved in the Treaty of 1855 – cannot be taught indoors. Outdoor interaction with the everyday occurrences of changing weather and encounters with wildlife and the physical challenges of navigating the terrain teach how to live in, and how to solve problems in, our world. This is the kind of knowledge that bound our ancestors together over time and over space and that strengthened our kinship with the land (Morning Owl et al 2015)."

"Health" for Tribal communities is a rich and complex concept, interconnected with generational and historical trauma that adds additional consideration for healthcare practitioners. Tribal families from these impacted communities are best equipped to navigate this intricacies, thus expanding culturally competent health education will help improve healthcare response to climate impacts.

i. K12 Blended Science, Technology, Engineering, Math (STEM) with Culture

Beginning from an early age, children learn about culture and First Foods through participating with community and ceremony. CTUIR is already creating culturally competent lessons for Tribal children in different ways, but a dedicated curriculum that connects earth and physiological sciences to culture, and encourages family participation, would boost these efforts.

Short Term:

- **Support existing First Foods and cultural education** that is occurring:
  - ◊ Cultural knowledge keeper and educator Linda Sampson has been teaching cultural STEM (Science, Technology, Engineering, Math) lessons to kids as part of the CTUIR Afterschool Program;
  - ◊ Nixyaawii Community School (NCS) educator Althea Huesties-Wolf created her First Foods Academy curriculum, an observation-based learning experiences centered around cultural activities for high school students;
  - ◊ CTUIR Education's Language Program's Tamayct (pit/earth oven) revitalization and outdoor learning connects language and culture with First Foods, earth science, and Indigenous knowledge.

Long Term:

- **Develop additional curriculums and lessons that use culture and First Foods to teach science**, for use at Tribal schools like NCS, with other Education activities, and with non-Tribal schools with Tribal students. Activities that engage parents and families would have a greater impact within the community.

ii. Trainings, Scholarships, and Internships for Youth and Decision Makers

Encouraging opportunities for Tribal Members to pursue technical and healthcare sciences education will expand the capacity for culturally centered public health and medical services.

Short Term:

- **Create opportunities for paid internships** within CTUIR's departments, and with external organizations and universities. A large barrier to increasing Tribal participation in public health is availability of supportive funding. Education

support funding, like Nixyaawii Community Financial Services (NCFS)'s Education Loan, as well as grants, stipends, and honorariums, would provide more flexible funding for Tribal Members of all ages to participate in public health education. See Ch 3F pages 230-231 and 249 for additional detail.

- **Provide routine trainings about climate change impacts** for decision makers within the Tribal community, and as members on CTUIR's Commissions, committees, and advisory boards. Officials making climate impact-informed decisions will be able to more accurately plan and prepare for the CTUIR community.

Long Term:

- **Expand support of scholarships for Tribal Members** to pursue natural resource and medical sciences, as well as public health and policy education. Preparing for climate impacts will require decentralized understanding and action, and empowering Tribal families around adaptation will ensure greater success.

iii. Identify Needs and Gaps in Health Services with the Community

Improving healthcare service for Tribal communities is a constant process, and anticipating climate change impacts is another part of growing to suit changing needs. Creating frameworks that facilitate bi-directional flow between Yellowhawk Tribal Health Center programs, practitioners, patients, and the community will assist in meeting needs as they change due to climate impacts.

Short Term:

- **Prioritize feedback and suggestions from Tribal Members who are employees**, as they often have unique perspectives to observe gaps and opportunities. Providing mechanisms to prioritize and implement feedback from these unique perspectives can assist in equitable adaptation strategies.

- **Develop formal and informal channels of feedback** for patients, staff, family, and community members to identify possible improvements and alternative approaches. These could include:
  - ◊ Regular gathering groups that share information informally, such as Yellowhawk's Weavers Group, and Culture Night;
  - ◊ CRPP Excursions that offer a unique opportunity to identify where there may be gaps that exist, specifically when out exercising Treaty Rights;
  - ◊ Potentially developing policy and frameworks similar to a "No Wrong Door" approach in Tribal services, which facilitates inquiries and comments reach staff and providers with ability to address them.

Community events like the Yellowhawk Annual Fun Run (pictured) can provide an opportunity to solicit community observations and feedback.

Long Term:

- **Invite community to be part of evaluation and planning process** in ways that are accessible to those with different communication and engagement capabilities (internet access, mobility issues, housing status etc). Building community across communication obstacles will ensure more people are included with climate adaptation efforts.

iv. Build Capacity to Engage with Legislative Opportunities

Continue to engage with state, federal, international, and inter-Tribal discussions about health in Indian Country, and approaches that center Indigenous knowledge. Invitations for consultation and other levels of Tribal participation are unending, and limited only by Tribal capacity to engage.

Short Term:

- **Improve CTUIR's Office of Legal Counsel (OLC) capacity to engage with governmental funding and rulemaking**. OLC already participates with legislative affairs coordination on relevant House and Senate bills in Oregon and Washington, as well as with CTUIR's Health Commission and CTUIR Community Wellness Improvement Collaboration (CCWIC) interdisciplinary work group.

Long Term:

- **Support CTUIR Health Commission capacity to assign members to agency committees**. As these members are knowledge about unique issues facing this Tribal community, as well as the intricacies of healthcare management and government policy.

v. Credited Continuing Education (CCE), and Community Education

Knowledge about climate impacts changes rapidly as technology advances and new effects begin to emerge. CTUIR will need to train and educate staff and patients regularly on updated and new information related to climate change and health.

Short Term:

- **Facilitate patient-centered climate impacts education** that can help Yellowhawk healthcare practitioners be proactive in anticipating worsening health complications. There are many trainings that exist and can provide required CCE credits for practitioners, like the EPA's "Particle Pollution and Your Patient's Health," among others.

- **Map out CTUIR-specific Indigenous understanding of health**, like the Swinomish Indigenous Health Indicators (IHI) (2016) as it is unique for the Columbia River Plateau and Blue Mountains region and Tribal culture. Mapping a concrete understanding of the role that health plays in cultural connection provides a framework for its protection.

Long Term:

- **Build community knowledge and empowerment** around identifying and implementing wellness and prevention opportunities. This could include organizing group learning opportunities, including review of the Swinomish IHI (2016) online modules, and climate impacts and science community curriculum.

vi. Develop Dedicated Climate Adaptation Capacity

Implementing climate adaptation strategies requires tremendous effort from communities, governments, and families, and cannot be done by any one of these alone. Building capacity at individual, family, community, and government levels will be necessary for adaptation implementation. Governments can empowering families and communities through education, providing for needs, and creating decentralization of response that spreads capacity out.

Short Term:

- **Facilitate organizing of regular community engagement events**, like discussion groups/talking circles, and webinars to discuss ongoing climate impacts and adaptation; opportunities to gather – both virtually and in-person – can create spaces for community members to share their

experiences, observations, and learned knowledge to address both physical and emotional components of health impacted by the climate crisis. Efforts should be interdisciplinary, culturally accountable, and accessible to diverse audiences and education levels.

CTUIR Dept of Economic and Community Development (DECD) facilitates the annual Earth Day Community Clean Up to empower families around civic responsibility, community service, and caring for lands and water.

Long Term:

- **Build capacity to organize and implement projects** that improve adaptation and resiliency. This may include securing funding for additional field staff dedicated to observation and response, administrative positions that can respond to community need and project interest, and coordinative services that bridge connection between departments and with the community.

- **Provide a liaison for project implementation** between Tribal government and community, UIR residents, and non-Tribal stakeholders and organizations. Additional capacity should focus on being responsive to community interest and need, as well as to state and federal governmental initiatives being proposed.

B. Approach Public Health Holistically with Cultural Connection

"First Foods have sustained Tribal people since time immemorial and the relationship between First Foods and the Tribes is essential to the ongoing culture of the Confederated Tribes of the Umatilla Indian Reservation (CTUIR). The First Foods serve a fundamental role in the health, well-being and cultural identity of the Tribes. In 2007, to convey the important role of First Foods to the Tribes, the CTUIR's Department of Natural Resources (DNR) adopted a mission based on First Foods ritualistically served at Tribal meals.

"The CTUIR DNR considers First Foods to constitute the minimum ecological products necessary to sustain CTUIR subsistence and cultural needs. The mission was developed in response to long-standing and continuing community expressions of First Foods traditions and community member requests that all First Foods be restored for their respectful use, now and in the future (First Foods Upland Vision, 2019)."

Intentional re-envisioning of public health from a Tribal community perspective (an effort similar to the DNR First Foods Mission development) could build understanding of the holistic intersections of health for both Tribal Members and community, as well as non-Natives who work with Tribal patients, students, and families.

i. Develop Systems to Begin Tracking Tribally Unique Harm Exposure Pathways

Tribal Members and their families have many unique pathways of exposure to environmental contamination and climate change impacts not represented in conventional public health inventories.

Short Term:

- **Conduct an assessment with the Tribal community to inventory potential exposure pathways** Tribal Members encounter when exercising Treaty Rights, and how these are projected to change in

future scenarios. This is likely to include surveying the CTUIR community to gather anecdotes of harms and challenges encountered while harvesting First Foods.

- **Identify gaps in data collection and information** on unique exposure sources, remediation actions, and progress evaluation of these to monitor improvements. CTUIR's Hanford NRDA and Injury Assessment process could be helpful in developing this protocol. See Ch 3E pages 193-194 for additional detail.

Long Term:

- **Expand capacity of DNR Energy and Environmental Science Program (EESP) and Yellowhawk laboratories, and Tribal enterprise/business capacity to collect data** to provide information about changes in disease and contamination trends. These kinds of testing capacities could include water coliform testing, First Foods contamination of metals and other chemicals, insect-vectored illness, biological samples from humans, animals, plants and soil to determine the presence of bacterial, fungal, or viral contamination, among others.

- **Develop various exposure threshold points for policy action** based in public health and science, and with a knowledge of cultural practices and additional complications Tribal communities face. These could be strengthened to use in legal defense of rights and remuneration if necessary.

- **Expand Tribal data collection and monitoring for ozone precursors** and other relevant air pollutants across Ceded lands. These are likely to be distinct for CTUIR among Pacific Northwest Tribes, and could provide additional context and information on adverse health effects from poor air quality.

ii. Address Climate Impacts that Compound Lifetime Illness Factors

Health is built over a lifetime, but much of conventional medical science is focused on treating symptoms once a disease has already occurred. Preventative public health intervenes at points throughout a lifetime to reduce burdens of illness worsened by climate change.

Short Term:

- **Reduce potential for climate-affected factors that contribute to poor health**, and proactively address social determinants of health. Examples include (but are not limited to):
  - ◊ Improving indoor and outdoor air quality all year around;
  - ◊ Preventing mold and bacteria growth, and moisture issues in homes and buildings;
  - ◊ Reducing heat exposure, and ensure access to cooling capacity;
  - ◊ Reducing barriers to accessing public transit, knowing increased exposure potential for riders and operators is likely;
  - ◊ Controlling for chemical contaminants in land management to prevent harmful algal blooms;
  - ◊ Mitigating for social isolation during shelter-in-place warnings.

- **Ensure Tribal Members have access to air purification and personal protection equipment**. This includes residential filtering capacity like HVACs and Central air, supplementary air purifiers, personal protective equipment like N95/99 and P100 masks, and access to real-time air quality information.

- **Conduct a cultural health mapping exercise with Yellowhawk staff and Tribal community** using the Indigenized Building Resilience Climate Impacts (BRACE), or with the Swinomish IHI module to identify those unique exposure pathways, and how these are likely to change.

Long Term:

- **Encourage frameworks that allow for wellbeing and connection**, such as Yellowhawk's physical fitness and healthy First Foods-based diet classes, Cultural Resource Protection Program (CRPP) First Foods Excursions with the Dept of Child and Family Services (DCFS), gathering and discussion groups, talking circles, and many other current and planned wellness and connection opportunities.

Cultural knowledge keeper Linda Sampson demonstrates how to separate tomato seedlings during Yellowhawk Tribal Health Center's "Seed to Supper" gardening class.

- **Strengthen and support mutual aid networks within communities**, not just in times of emergency response, but routinely. Some examples of non-emergency mutual aid includes tool libraries, seed saving networks, bulk purchasing groups, and wellness check telephone trees, and screening for food security and mental health in wellness checks, among others. See Ch 3F page 255 for additional detail.

iii. Center Elders, Two-Spirit, Disabled, and other Marginalized Identities in Emergency Planning and Response

There are a number of subgroups within communities that are likely to have different needs unique from the majority, thus it is essential to place these groups in the center of health policy and emergency planning efforts.

Short Term:

- **Actively seek opinions and perspectives of those voices not already involved** in planning and engage those perspectives intentionally. These perspectives are likely to demonstrate where there are gaps and unmet needs within the CTUIR community. This is likely to involve working with the Nicht-Yow-Way Senior Center, Cmuytpàma Warming Station, and many others.

- **Conduct air quality sampling and monitoring with marginalized people directing the study**. Those who work or live outside are most likely to experience negative physical and mental health outcomes. Actively seeking guidance and participation of these community members to participate in air quality initiatives, especially in a leadership capacity, will greatly improve poor air quality adaptation.

- **Collaborate with the Cmuytpàma Warming Station and other regional shelters** to identify how unsheltered community members specifically are affected. Unsheltered community members utilizing these services should be actively consulted on the climate impacts they are experiencing, and empowered to participate in guiding the planning and implementation of adaptation, particularly for heat and smoke response. This should also involve creating a plan for housing/caring for these community members under changing conditions.

Long Term:

- **Prioritize feedback and needs of elders and marginalized people** as they are often unique from the general population. Often the barriers to implementing or accessing climate adaptation are

routine things like internet access, lack of transportation, or other factors that complicate life for those who are multiply-marginalized. Seeking guidance from those in the community who experience unique adverse circumstances will greatly improve equity of climate adaptation implementation, including people who are unsheltered or undersheltered ("couch surfing," living in a vehicle etc), neurodivergent people and those with complex trauma, disabled people, those who routinely experience racism, homophobia, transphobia, or other forms of hate; and others of priority.

C. Expand Organizational Cooperation on Health Needs of Tribal Community

"What a beautiful sight, look at this healing that this has. We need to come out as a whole community because this does something for us in a whole different way. The beauty within us working together, gathering our Foods and that reconnection in the air, and putting everything into that work (Randy Minthorn, Rocky Ridge CRPP Excursion, 2017)."

i. Develop Community Science Reporting Tools, Education, and Protocol

Changes in landscape and First Foods are best monitored by the cultural practitioners and subsistence harvesters, who are constantly engaged with the Foods, and have ecological knowledge about seasonal indicators and patterns that are changing. Supporting them in acting as observers and reporters of change will help build capacity for monitoring.

Short Term:

- **Develop reporting protocols and platform for community identification of changes** in issues, indicators, First Foods, health observations, and other relevant information to be collected. This is likely to include (but not be limited to) locations of accessibility for various First Foods harvest opportunities; timing of harvest windows and range; density of presence of predatory insects like ticks; air quality and visibility at frequented harvest locations; voluntarily reported incidences of heat or smoke illness; degraded access infrastructure like roads and bridges; presence of harmful algal blooms and/or fish die-offs; and many other notable observations.

Long Term:

- **Organize and facilitate community trainings on using the developed protocol, reporting tools, and other monitoring science** information that would be key in receiving accurate and useful reporting of health related observations over time.

ii. Develop Climate Change-Specific Internships with Yellowhawk

Expanding capacity to address climate health impacts in a culturally connected way would increase the ability to implement adaptation and resilience projects.

Short Term:

- **Develop and fund health and climate change-specific paid internships for Tribal youth** within the organization, with an aim of connecting CTUIR and Yellowhawk climate adaptation efforts. Engaging youth in climate planning will increase knowledge and skills around climate impacts, and build CTUIR capacity to implement adaptation.

Long Term:

- **Support and expand training and internship opportunities for Tribal students and community with public health and research partners**, particularly with Oregon State University (OSU) School of Public Health, and other institutions. Initiatives that focus on incorporating Indigenous knowledge into public policy, supporting and expanding mechanisms of Tribal sovereignty, and Tribal-led research would ideally be prioritized for internship placement.

iii. Collaborate with Oregon State University Superfund Research Program (SRP) Work Group and Other Agencies

Tribal students and researchers are in a unique position to improve understanding of health from an Indigenous perspective, and to have a closer relationship with what changes in First Foods means for Tribal communities.

Short Term:

- **Collaborate with university research consortiums** that understand Tribes' data sovereignty concerns; 'data sovereignty' is an important component of Free, Prior, and Informed Consent (FPIC) necessary for Tribal consultation and research, and placing the community in control of data collected about the Tribe is a component of sovereignty. CTUIR's Central Data Management System (CDMS) provides secure data storage and portal access for not only CTUIR, but for other Tribal Nations as well.

Long Term:

- **Participate with Indigenous-led research efforts** at Tribal colleges and organizations.

iv. Actively Incorporate Climate Change Impacts in Health Assessments, Services Evaluation, and Project Planning

CTUIR Health Commission and Yellowhawk leaders regularly conduct formal and informal evaluations of their health services to ensure they are keeping up to date with changing community needs.

Tribal knowledge keepers work with outside and non-Tribal partners to facilitate educational opportunities, including with Oregon State University work groups and county Extension Services to offer Master Food Preserver and Master Gardener classes, like the Bread & Butter Pickles workshop pictured.

Short Term:

- **Modify community health assessments to include measures of climate change impacts**, especially as they impact existing chronic health issues. These additional measures could include an inventory of access to cooling and air filtration, connection to community, and water contamination/septic system issues, among others.

Long Term:

- **Include evaluation of climate change impacts in other Tribal assessment and planning processes**, such as transportation, land development, housing planning efforts, economic development, assistance services, and energy production, among others.

Measuring Success and Gaps in Physical Health Adaptation

How Do We Measure the Success of These Adaptations?

"These disruptions have intensified into a new kind of ecological awareness about the growing impacts of human activity on the environment. For example, traditional fishing practices and salmon biodiversity have been significantly transformed due to modern dam-building on major tributaries and elsewhere. Decisions on how salmon fisherman accessed traditional fishing sites were commonly made based on the availability and distribution of key salmon runs.

The same is true for many of our traditional food-gathering sites, where our once naturally abundant wild foods are beginning to show signs of fading away due to human impacts and climate change. Our ecological knowledge makes us especially sensitive to changing conditions in the surrounding global environment; and our ongoing, common historical experience suggests that these changing conditions will continue unabated." (Phillip E. Cash Cash, 2015)

- Yellowhawk Community Health Assessment Benchmarks (2016, 2022)
- Yellowhawk Annual Plan Goals and Objectives
- **Comprehensive Plan Objective 5.4.3:** Implement educational programs to increase employability of Tribal Members (see Comp Plan page 74 for benchmarks);
- **Comprehensive Plan Objective 5.5.7:** Enable Tribal members to pursue excellence in education, become self-reliant and to contribute to the Tribal community (see Comp Plan page 76 for benchmarks);
- **Comprehensive Plan Objective 5.7.9:** Promote wellness awareness and education toward the prevention of drug and alcohol abuse, diabetes and other preventable health issues as well as all forms of violence (see Comp Plan page 76 for benchmarks);
- **Comprehensive Plan Objective 5.11.3:** Aggressively promote chronic illness and diabetes prevention and early detection with focus on cardiac illness (see Comp Plan page 108 for benchmarks);
- **Comprehensive Plan Objective 5.11.6:** Expand Tribal and clinical services to address health, wellness, case management and quality of life services for CTUIR Elders
- **Comprehensive Plan Objective 5.11.11:** Provide a positive educational learning experience for Tribal youth to enable them to be successful adults while promoting cultural learning experiences (see Comp Plan page 108 for benchmarks);
- **Comprehensive Plan Objective 5.13.1:** Develop and maintain a transportation system that is safe and promotes the public health (see Comp Plan page 117 for benchmarks);
- **Comprehensive Plan Objective 5.12.3:** Assure that community facilities are maintained in a safe and sanitary condition (see Comp Plan page 112 for benchmarks).
- **CTUIR Hazard Mitigation Plan (2021) Section 3**: Hazard Identification and Risk Assessment Results (page 68-190).
- **CTUIR Hazard Mitigation Plan (2021) Section 4:** Hazard Mitigation Strategy (page 192-212)
- **Good Health and Wellness in Indian Country (GWIC) Grant Objective 1**: Improve Tribal food and beverage programs/systems
- **GWIC Grant Objective 3:** Expand and enhance awareness of high blood pressure and high blood cholesterol within the CTUIR community.
- Channels of feedback on services and community needs for Tribal Members, patients, and families.

What Gaps in Knowledge, Policy, Capacity, or Education Exist?

- Unique exposure pathways for Tribal people
- Ozone effects on vegetation and consumption of potentially contaminated Foods;
- Changing land management practices that affect chemical exposure;
- Effects on disease vectors and disease potential;
- Anticipated changes in food-, water-, and air-borne illness, testing, and monitoring;
- Community observation and reporting capabilities and knowledge.

Climate Impacts for **Emotional Wellbeing**

"Hundreds of generations of ancestors have known this land intimately from living on it for thousands of years. Every creek, spring, pond, swale, saddle, box canyon, draw, and peak witnessed people's long history here, and our people knew all the features of this land. Our children also must know this land if they are going to take care of it when they inherit this responsibility (Morning Owl et al 2015)."

Disconnection from the seasonal and cultural indicators is already creating anxiety and sense of loss when First Foods are inaccessible. Community connections are also negatively impacted, as extreme events require emergency preparedness, and shelter-in-place recommendations reduce access to social engagement for those with chronic illness and other health and mobility considerations.

7. Potential Disconnection from First Foods, Indigenous Culture, and Spiritual Connection

First Foods historic migration routes and timing are likely to shift and increasing frequency of natural disasters can trigger existing emotional health issues and potentially create new ones. Indigenous health is integrally tied to land, First Foods, community, and culture.

Environmental climate impacts create challenges to traditional foods access, which in turn affect the Indigenous Health Indicators: **Natural Resources Security, Self Determination, Cultural Use, Community Connection, Well-Being, and Education.** These are used to inform needs, health policy, and resource planning (Donatuto et al 2016) as seen in Figure 3D.7a (page 163).

8. Exacerbated Climate Grief, Eco-anxiety, and Solastalgia

Indigenous communities' concept of health is woven with land management practices and religious ceremony. Health outcomes are greatly improved for Tribal people who are able to continue access to subsistence foods and cultural practice.

Vicarious distress for those experiencing intense weather or environmental hardship; access to, and time spent on, the land linked to fulfilling psychological needs; altered or loss of place results in negative consequences for livelihoods, cultural practices, and social networks, as well as to alterations in personal and collective identities (Middleton et al 2020) as seen in Figure 3D.8 (page 165).

7. Potential Disconnection from First Foods, Indigenous Culture, and Spiritual Connection

"This loss of traditional food resources exacerbates Tribal health issues (e.g., poor fitness, diabetes). Studies have shown that food resource loss is associated with lifestyle changes (e.g., increasing sedentary lifestyle while decreasing cultural-specific activities and food diversity) and health concerns (e.g., increased diabetes, obesity, heart disease). Thus, restoring Tribal food resources is apt to benefit the health and culture of Umatilla Tribe by providing traditional food choices and promoting activities (e.g., hunting, gathering, and fishing) that draw on Tribal knowledge and skills (Umatilla River Vision, 2011)."

Connection to culture and First Foods is essential for the health of Tribal people, physically, emotionally, and spiritually. "Health" then, has its own unique definition to Tribal communities, and safeguarding these connections are required in climate adaptation.

In **Figure 3D.7a**, a concept map illustrates one Tribal community's specific and intimate connection of health with traditional foods.

- This mapping exercise was conducted by the Swinomish Nation on the Washington state coast. They developed their "Indigenous Health Indicators" to map all the ways traditional foods dictate what components of "health" are for that unique community.
- Within the red box are the community-identified indicators that make up "health" to the Swinomish people. The flow chart maps the ways in which this interconnected concept of health is impacted by climate change.
- **Climate impacts create challenges to traditional foods access, which in turn affects these Indigenous Health Indicators: Natural Resources Security, Self Determination, Cultural Use, Community Connection, Well-Being, and Education.** These are used to inform needs, health policy, and coastal planning (Donatuto et al 2016).

In **Fig. 3D.7b** on the following page, importance of each Indicator was weighed by Tribal community. Validation ranking for each Indicator quantifies the extent to which the community member felt these concepts reflected their values. Most of these Indicators were valued evenly among participant, with the greatest variability being how the Education indicator was viewed (Donatuto et al, 2016).

- Without clear methodologies of how to equitably incorporate Indigenous health values and concerns into non-Indigenous health assessment frameworks, the Indigenous values are at risk of

Figure 3D.7a : Swinomish Indigenous Health Indicators and Climate Impacts (2016)

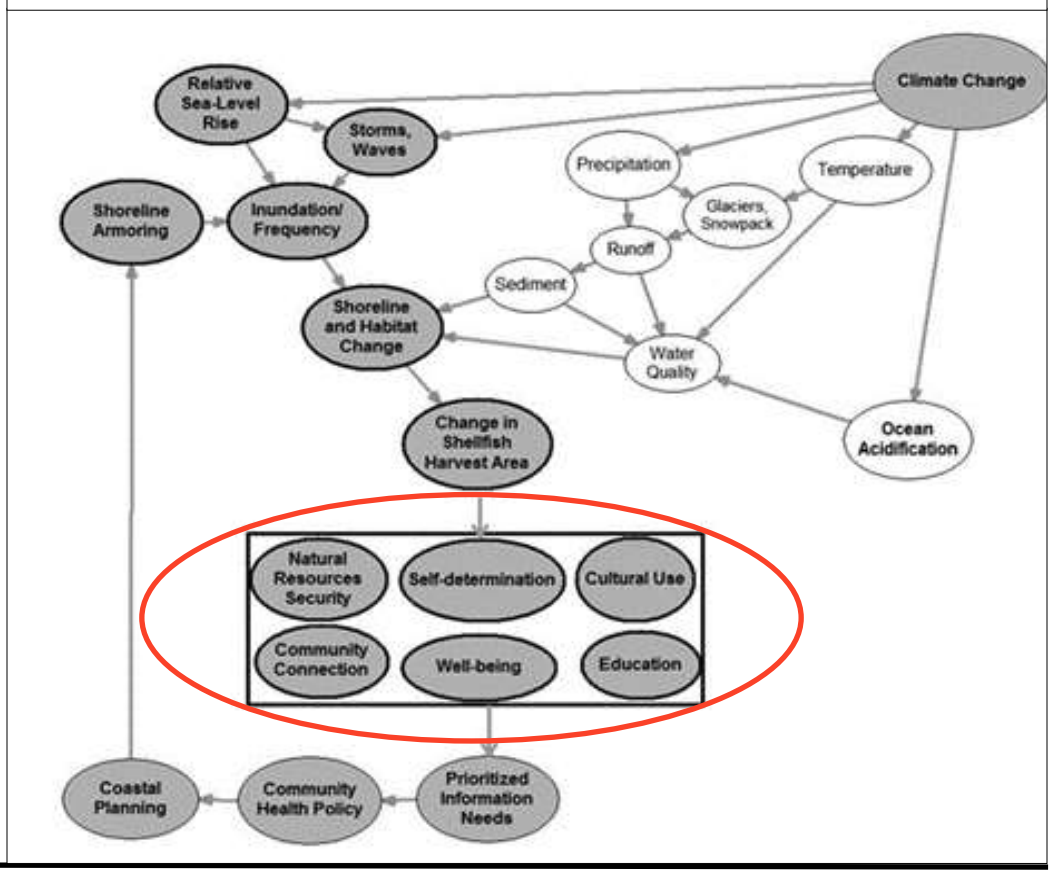
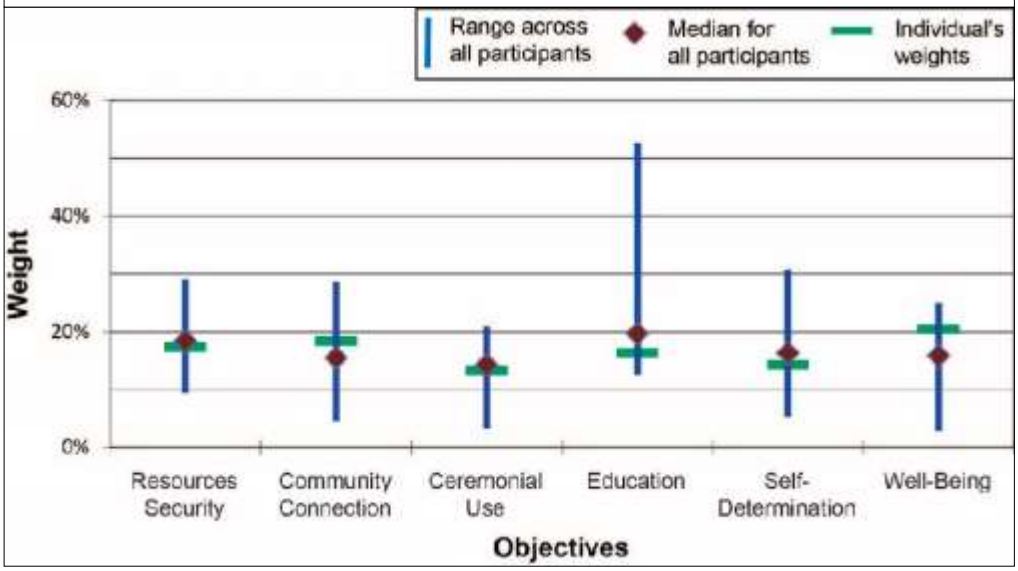


Figure 3D.7b : Swinomish Community Evaluation of IHIs for Relevance, Accuracy



co-optation, or of becoming irrelevant or inaccurate to the community.

- Current public health assessment indicators often disregard key cultural values, beliefs and practices, and don't account for explicit exposure pathways that exist uniquely for Indigenous communities.
- Examples include: harvest and use of culturally important resources such as salmon, wild rice, reeds for basket weaving, or the use of water for sweatlodges, among others (Donatuto et al, 2016).

Other studies have attempted to quantify the impact cultural connection has on health for Indigenous peoples globally. In studies of Indigenous Australians, Aboriginal spirituality is land-centered, and considers not just physical well-being but social, emotional and cultural well-being of the whole community (Green and Minchin, 2014). Studies of these communities report that health of Aboriginal people with diabetes improved dramatically when they returned to traditional subsistence activities (Green and Minchin, 2014).

Similar studies have also found Indigenous people involved with environmental and cultural activities are more physically active, have better diets, and suffered lower rates of obesity, diabetes, renal disease, cardio-vascular disease and psychological stress. All this indicates self-determination is an important driver of health and well-being (Green and Minchin, 2014).

A number of protective factors for Indigenous well-being were identified, including strength of people's connections to land and culture, and that remote living can help Indigenous people better cope with stressful circumstances at an individual, family and community level (Green and Minchin 2014).

(Credit: Donatuto et al 2016)

<u>Gaps in Knowledge/Data/ Policy:</u>

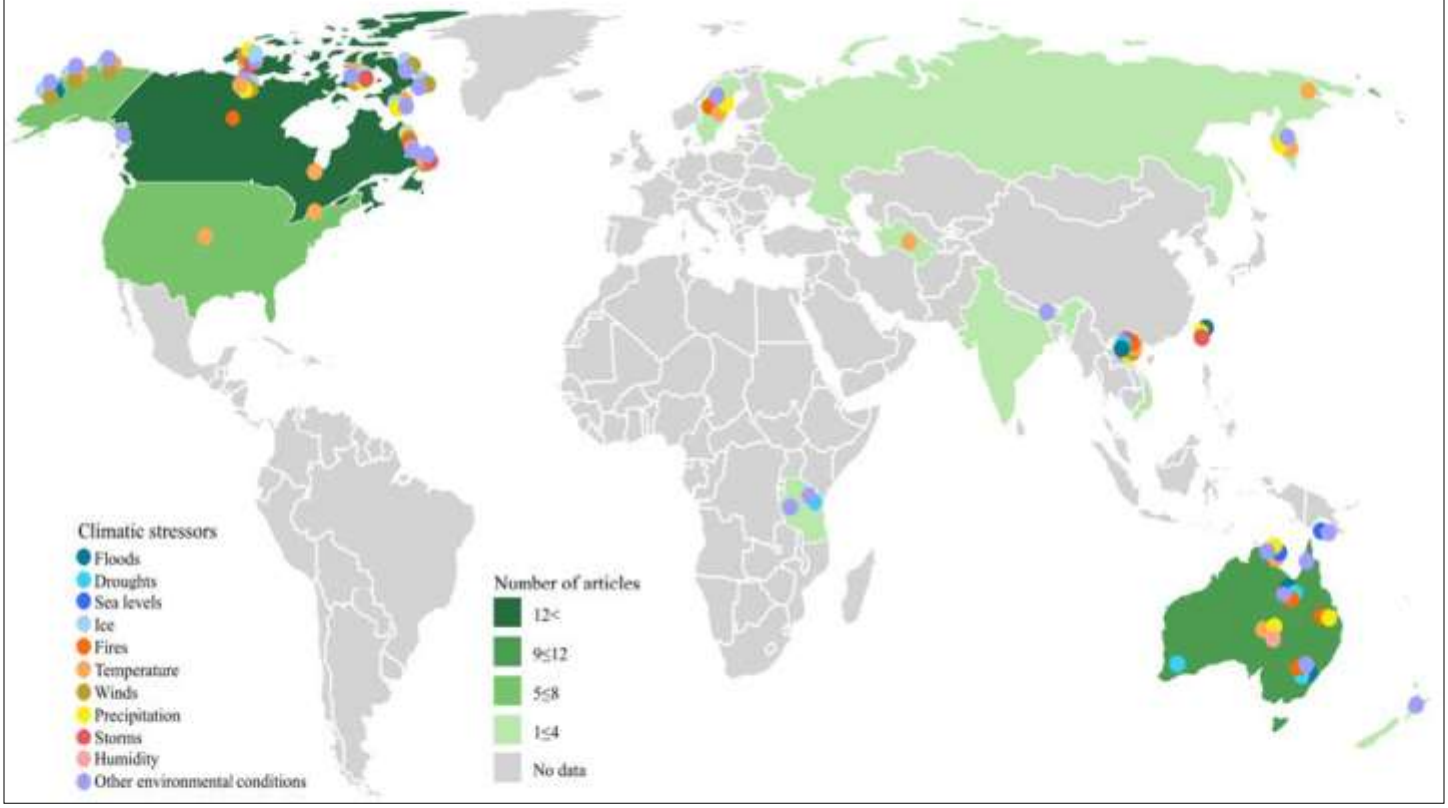
- Mapping of specific health and culture connections for the CTUIR Tribal community;
- Updating the current Community Health Assessment by incorporating climate impacts;
- How connections to culture are impacted by changing climates and access issues for the CTUIR community specifically.

8. Exacerbated Climate Grief, Eco-anxiety, and Solastalgia

"In Tribal creation belief, in the time before people, the Creator gathered all the plants and animals and explained that there were going to be people and that they would be like infants and would need to learn about their new world. The Creator asked the plants and animals 'who will take care of the Indian people?' Salmon was the first to promise his knowledge and body, then other fish lined up behind salmon. Next came Deer and the other game animals, then Cous and other roots, then Huckleberry and all the other berries."

"In return, Indian people promised to respectfully harvest and care for the First Foods. The First Food serving ritual in the Longhouse is based on the order of the First Food promised themselves and serves as a reminder of the promise and people's reciprocal responsibility to respectfully use and take care of the foods. Embedded within this promise is that people need to harvest First Foods in order to fulfill their responsibility to the First Foods. Many in the CTUIR, therefore, regard plants, like animals and other natural objects, to have a spirit and morality (First Foods

Figure 3D.8: Global Research Into Mental Health Impacts Associated with Climate Change for Indigenous Communities



Upland Vision, 2019)."

Stress and mental health issues have tangible effects on a person's wellbeing, and impacts from the climate crisis will create more risk for communities to experience chronic stress. Mental health refers not just to mental illness, but states of mental wellness, emotional resilience, and psychosocial wellbeing.

'Psychosocial wellbeing' is the interaction between social and psychological conditions that shape human welfare. Impacts to mental health can be categorized as direct impacts (like stress around extreme weather events), community and environmental disruption, and increasing emotional distress, depression, and anxiety, that create conditions for post-traumatic stress disorder (PTSD) (Hayes et al 2018).

Long-term changes create a disconnection between landscapes, water, animals, and people that can exacerbate mental health issues, especially for Indigenous people. This can also ripple out to built and social environments, as climate weaken critical infrastructure, intensifies financial and relationship stress, increases risks of violence and aggression, and threatens to displace entire communities (Middleton et al 2020).

Figure 3D.8 displays a map of existing research that has been conducted on mental health impacts to Indigenous communities specifically, and notes the primary climate impact being examined in each case.

- Mental health research on climate effects of Indigenous people are shown on the map in green-scale based on the number of articles published within these countries: light greens indicate between 1 and 8 articles available; darker colors show countries with significant investment in Indigenous-specific mental health, with 9 or more published articles. Countries in gray had no published studies (Middleton et al 2020).
- Many of these studies examined a specific category of climate change impact. These specific focuses are identified with a range of colors: water impacts like flood, drought, sea level rise and ice change are indicated in blue shades; fires and extreme heat are shaded in oranges; wind and precipitation impacts are shown in yellow, while storms and humidity are colored pink. Other impacts are colored gray.
- The majority of primary research was conducted in Canada (39.6%), Australia (25%), or the United

States (10%), with most occurred at a local/ community level and predominantly set in remote or rural contexts. Within the map, the United States is indicated to have published 5-8 articles specifically documenting Indigenous people's connection with mental health, with the only climate factor addressed within these studies being extreme heat.

- This shows that Indigenous mental health is impacted by multiple interconnected pathways, as several studies reported **vicarious distress among Indigenous participants who feared or empathized for those experiencing intense weather or environmental hardship**, particularly within their social networks, family, and friends.
- Others cited **deep ancestral connection to place and land, showing that access to, and time spent on, the land was not only important for subsistence and livelihoods, but was also linked to fulfilling psychological needs**. These included a strong sense of identity and self-worth as well as strengthening interpersonal relationships and cultural practices (Middleton et al, 2020).
- Changes linked to an **altered or loss of place resulted in negative consequences for livelihoods, cultural practices, and social networks, as well as to alterations in personal and collective identities** intimately tied to the health of the environment, generating negative mental health outcomes.

However, psychosocial resilience is often a complex thing, and early evidence suggests that these desperate conditions can also inspire communities to altruism, compassion, optimism, and a sense of meaning and post-traumatic growth. Awareness of changes is another avenue for mental health concerns, especially for Indigenous people who are in constant communication with the non-human world. Psychoterratic syndromes include phenomena such as 'ecoanxiety', 'ecoparalysis', and 'solastalgia' are being recognized.

- 'Ecoanxiety' refers to the anxiety people face from constantly being surrounded by the 'wicked' and threatening problems associated with a changing climate.
- 'Ecoparalysis' refers to the complex feelings of not being able to take effective action to significantly mitigate climate change risks.
- 'Solastalgia' refers to "the distress and isolation caused by the gradual removal of solace from the present state of one's home environment," and is commonly associated with displacement following a climate change-related extreme weather event (Middleton et al 2020).

Mental health impacts can be felt differently across various age groups, genders, and livelihoods. In global studies of Indigenous communities, **female respondents reported higher levels of frustration, sadness, fear, anger, helplessness, and distress** in response to observed and lived climatic change and the odds of reporting symptoms of solastalgia (Middleton et al 2020).

For Indigenous men, anxiety, suicide, and substance abuse were more of a challenge as an emotional response, particularly for those who depend on seasonal and climate-dependent employment (e.g. farming, hunting), and those who highly value their land-based identity (Middleton et al, 2020).

For Tribal youth, mental health experiences can differ from other generations: they are experience changing climate conditions unprecedented for previous generations, and child and adolescent experiences are formative for wellbeing later in life. Elders also face mental health challenges related to identities, livelihoods, and

Cultural knowledge keeper David Wolf demonstrates net-repair techniques to a youth group participant. Connection and sharing of culture will be essential to climate adaptations for mental health.

wellbeing that is deeply rooted in time spent on the land, especially as conditions for shelter-in-place responses to climate impacts are prioritized.

Food security (or knowing where one's next meal will come from) will also be affected. Many studies show the practice of harvesting and sharing traditional food is tied to fulfilling psychological needs at both individual and community levels. The ability to provide food for one's family was reported as a source of positive identity, and the process of harvesting and food-sharing contributed to stronger social networks.

Both planned and unplanned relocation creates negative impacts to Indigenous communities, studies report **individuals who were able to stay in their community following a natural disaster showed higher resilience compared to those who relocated to urban centers**. Poor planning and policy can have more severe psychological consequences than the disaster itself, demonstrating that governments should set aside more space, hold longer discussions, and provide different alternatives' for relocation. Some negative health outcomes were linked to feelings of abandonment by governments and the broader global community.

Repeated exposure to multiple climatic stressors and subsequent environmental adversities can compound emotional and behavioral distress over time, and become precursors to mental illness, suicidality, substance abuse, and limited psychological resilience (Middleton et al 2020). Preserving connection to place has been highlighted as an important mental health adaptation for Indigenous communities, particularly those with land-based livelihoods and identities.

(Middleton et al 2020)

Gaps in Knowledge/Data/Policy:

- Community health assessments insufficiently measure sources of mental health issues for Indigenous people, thus knowledge of how these are changing is lacking.

Adaptation Goals for **Emotional Wellbeing**

D. Create Opportunities to Gather, Learn, and Share Stories Together

"Through the ages, these stories connected individuals to this land. Our stories explain the nature of behavior or the encapsulated events and worldviews of our Tribal people." (Phillip E. Cash Cash, 2015)

i. Support and Normalize Asking for Help with Physical and Emotional Pain

Starting within each individual, and within each family, and reaching out to communities and governance; being comfortable asking for help is essential in building resilience.

Short Term:

- **Facilitate gathering opportunities for those with marginalized identities including disabled, chronically ill, and Two-Spirit community members** to support each other and to listen to one another, and to be heard by health care staff and administrators. Solidarity from others affected by similar circumstances can reduce feelings of isolation, improve services to meet distinct needs, and empower families to embrace adaptation that suits their needs.
- **Expand opportunities for Tribal Members to access informal mental health and counselling services**; regularly available informal opportunities reduce administrative hurdles to receiving care that can be a barrier for those who are struggling.

Long Term:

- **Create policies to encourage medical and mental health practitioners to earnestly listen to complaints** of pain

and suffering, and proactively address them. Often medical staff disbelieve patients about pain, particularly in communities affected by opioid crises.

ii. Facilitate a Community-led Climate Shifted Revision of Seasonal Round

Disconnection between First Foods and traditional timing has been documented by cultural practitioners. Hunters, fishermen, and gatherers who are closely connected with seasonal change indicators have noted the shift in First Foods timing they are experiencing, but it has been difficult to apply this knowledge to cultural timing due to lack of modeling and data around native species.

Short Term:

- **Organize and facilitate a community-led initiative to document a seasonal hazards round**, to identify where health and emergency needs may overlap with various harvesting windows. This could help families anticipate seasonal hazards and incorporate mitigation into their own planning. A version of this seasonal hazard rounds has been attempted for air quality impacts, and could be expanded and verified by the Tribal community. A version of this round is found on page 171.

Long Term:

- **Organize and facilitate a community-led initiative to document CTUIR's climate-shifted First Foods seasonal round**, based in observations of Tribal Members' experiences, noting any gaps in information or planning.

iii. Support opportunities for Healing Connections with First Foods, Land, Community, and Culture

Tribal people are emotionally and spiritually connected to place-based culture, but few studies have specifically examined emotional health and connection to land that Indigenous communities experience. Health outcomes are improved for tribal communities when they have access to their traditional lands and cultural practices.

Short Term:

- **Support and expand DNR's Cultural Resources Protection Program (CRPP) First Foods Excursions**; these are being organized and facilitated by CRPP and Yellowhawk Community Wellness staff, and aim to provide opportunities for Tribal Members and community to reconnect with First Foods guided by cultural knowledge keepers.

- **Support and expand cultural revival activities that center Tribal language learning**, like the Tamyct (earth oven) revival facilitated by the Language Program within the Education Department. Reconnection to language is integral to Indigenous knowledge and Tamanwit that creates climate resilience. See Ch 3G pages 288-290 for additional detail.

- **Collaborate with regional organizations hosting youth and adult First Foods Camps**, such as Salmon Camp with Columbia River Intertribal Fish Commission (CRITFC), and with cultural revival camps held by Naknuwithlama Tiichamna (Caretakers of the

Bringing community together for intergenerational learning creates families that are resilient and prepared for emergencies mentally and physically.

Land) in Cove, OR, and develop new extended cultural and First Foods learning opportunities.

- **Expand K12 and family-based learning opportunities for learning through play engagement**; both structured learning opportunities like Outdoor School and Watershed Field Days, as well as unstructured learning like the Indian Lake Campground Fish Derby can build positive connection with First Foods.

Long Term:

- **Expand First Foods mutual aid frameworks** for Tribal community to provide cultural and nutritional assistance to each other. These could include seed banks, kitchen equipment cooperatives, canning classes and gatherings, ingredient sourcing and sharing, CTUIR salmon and bison distribution, and building connection with local and Tribal seed producers. nutritional assistance to each other; these could include seed banks, kitchen equipment cooperatives, canning classes and gatherings, ingredient sourcing and sharing, CTUIR salmon and bison distribution, and building connection with local and Tribal seed producers. See Ch 3F page 255 for additional detail.

- **Identify land development and living standards that support Treaty Rights exercise and community participation**. These might include diversified land development that facilitates community, intergenerational connection, living and working in reasonable proximity, and carbon-free (biking, walking, horse trails etc) commutable neighborhoods. New Nixyaawii Community Neighborhood (formerly known as the "Bowman Property") is an example of this kind of diversified land development and planning. See Ch 3F pages 231-233 for additional detail.

iv. Continue to Work with Seniors Center, Elders, and Education Opportunities

Elders are precious keepers of knowledge, and have seen much change over their lives. Cross-generational learning and sharing creates opportunities for knowledge to be passed between individuals and generations, and keep strategies for resilience alive.

Short Term:

- **Conduct and compile knowledge keeper interviews** to identify ecological and First Foods changing trends that have occurred within living memory. A number of interviews with knowledge keepers include information about changes these Elders have seen within the archives of CRPP; a coordinated project to collect and expand on this existing information could inform seasonal round activities, and other Indigenous knowledge and adaptation implementation projects.

- **Develop community participation projects that encourage youth to engage their family and Elders** in questions of change and shifting cultural connection; organize gathering opportunities to share those expressions with the community, such as talking circles, art displays, theme pow wows, film festivals, painting murals, and other collaborative creative expressions.

Long Term:

- **Partner with Nicht-Yow-Way Seniors Center and other Elder care services** to provide listening and education opportunities with a cross-generational learning focus.

E. Continue to Revitalize Cultural First Foods Harvest, Processing, and Connection

"The CTUIR traditionally harvest about 135 species of plants as sources of food. Other plants and plant products are used for a variety of other purposes. For example, over 125 plants were used for dyes, cordage, containers, glues, weaving materials and other uses. Plateau cultures, including the Tribes of the CTUIR also used over 125 plant species for medicinal and spiritual purposes. While not First Foods, these culturally important resources are also a fundamental part of the health, cultural identity and sovereignty of the CTUIR (Hunn et al. 1998, First Foods Uplands Vision 2019)."

i. Develop Employment Frameworks for First Foods Procurement by Tribal Harvesters

Cultural teachings revitalization, like the Huckleberry Cedar Basket workshop series pictured, connects Tribal Members with harvest opportunities on Traditional Use Area lands, and with processing knowledge previously dormant.

Tribal subsistence harvesters are keepers of knowledge from their time in connection with land, and are critical to preserving First Foods ecological knowledge. Some examples of frameworks that could currently assist in developing First Foods procurement employment are (but not limited to):

Short Term:

- **Policy advances like 638 contracting for Tribal food assistance programs** (FDIPR, SNAP etc) which could create opportunities for harvesters to become USDA "vendors" to programs that serve low income Tribal families. See Ch 3G pages 278-279 for additional detail.
- **Tribal grant support to Tribal enterprises and startups aimed at providing fresh, local, and culturally appropriate foods** and plant medicines within the community; this could include assistance with enterprise operator health and business insurance, and other operations costs. See Ch 3F pages 231-233 for additional detail.
- **Nixyaawii Community Financial Services (NCFS) Food Sovereignty loans** will provide financial assistance to home food producers to start or expand small business operations for Tribal Members and UIR residents. See Ch 3F pages 231-234 for additional detail.

Long Term:

- **Develop and implement frameworks for flexible employment arrangements** that allow for Tribal Members to participate more fully with First Foods harvests and activities.
- **Advocate for cultural leave implementation** at schools and other institutions that employ or educate tribal members around the region.
- **Investigate potential for cultural foods harvest and processing of First Foods to account for social contract payments**, such as child support, minor infractions, and other outstanding debt that would be eligible for this framework.

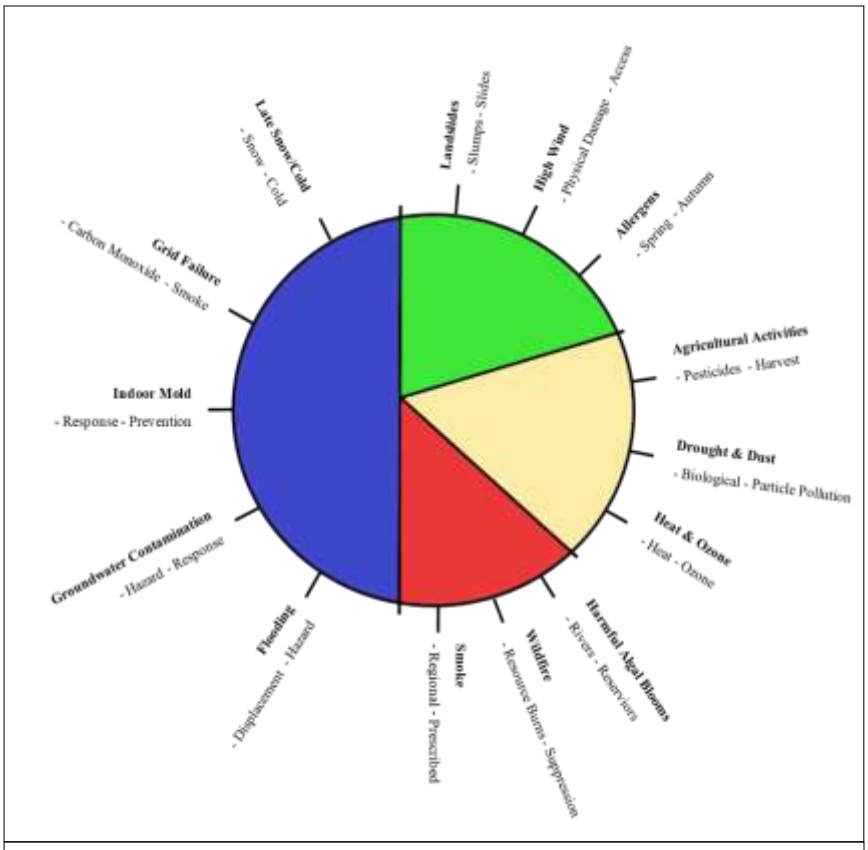
ii. Plan for Extreme Heat, Toxic Algal Bloom, and Wildfire Hazards

Seasonal hazards are set to become more frequent and severe, and many hazards create multiple pathways for harm to human health. Risk is highest for subsistence harvesters who are out on the land for extended periods of time in hazardous conditions.

Short Term:

- **Facilitate opportunities for education around personal risk mitigation** for climate impacts to cultural activities and practitioners. This could include workshops that stress recognition of hazards present, signs and symptoms of associated illnesses, mitigation strategies, and opportunities for practitioners to share their observations and strategies.

- **Assess community needs for risk mitigation equipment** and provide assistance with procurement, maintenance, and skills around proper use and safety. Much of the equipment that would help mitigate for harm is costly, which can be a barrier to families. Assessing these needs and barriers will provide more information for services and funding requests.



Climate impacts to seasonal hazards will shift and new ones will emerge. Conceptualizing these hazards within a season in a round (pictured) can help harvesters anticipate these challenges.

Long Term:

- **Planned excursions and gatherings must account for seasonal hazards and have protocols in place** for assessing threat levels to health, with contingency action triggers established. With action triggers set by leaders and community, decision making about safe conditions to hold individual events will be standardized to relieve pressure on organizers and staff.

iii. Expand First Foods Revitalization Efforts that Embrace Uncertainty

Uncertainty is the biggest impact the climate crisis creates, and seasonal weather patterns will become less reliable into the future. Accurately assessing risks from climate and non-climate related impacts to human health is necessary for protecting Tribal communities while building cultural connection.

Short Term:

- **Retain virtual options for gathering and meeting attendance**, even as additional attendance options for in-person events, to maximize the ability for people with different circumstances to participate. Retaining a diversity of communication and gathering options allows greater access for those with mobility and transportation barriers, though improving internet access for those who lack it will improve equity of this adaptation.

- **Create contingency plans for cultural and First Foods education** activities that assesses risk and likelihood of modification to seasonal plans, and proactively plan for sudden changes that may need to be made. Assuming seasonal hazards are likely to complicate plans encourages organizers to plan secondary activities, should hazards actually occur, without disrupting continuity of these efforts.

Long Term:

- **Implement flexible work frameworks to allow for smooth service**s in natural and public health disaster situations; in surveys to the Tribal community, "time" is consistently identified as a

barrier to engaging in cultural practices. While CTUIR as an employer provides some amount of "cultural leave" for participation, flexible and condensed employment schedules would create additional opportunities for Tribal Members to practice cultural connections and First Foods harvest. See Ch 3F pages 231-233 for additional detail.

- **Conduct periodic First Foods knowledge and access assessments** similar to the 2020 First Foods Assessment, with a greater emphasis on identifying non-education barriers to access. Understanding where barriers exist and how they are changing helps staff, knowledge keepers, and services remain relevant and supportive as needed.

iv. Expand knowledge of First Foods Harvest Opportunities through Data and Reporting

Information about how First Foods are changing is necessary for maintaining connections with these species, and updating knowledge about their locations and timing.

Short Term:

- **Develop reporting protocols for First Foods issues, as well as community education on these protocols**, and raise awareness of key indicators for Tribal Members to observe; these could include timings of First Foods harvests, obstacles to harvest that were encountered, invasive species that have increased or are newly present, and behaviors of symbiotic and indicator species, among others. See Ch 3B pages 88-90 for additional detail.

Long Term:

- **Expand DNR capacity to collect population monitoring data for First Foods** in their known locations, and implement scouting efforts to identify new and potential locations. CRPP has begun this cataloging work through staff surveys conducted ad-hoc, using Survey 123 software and GIS mapping. Expanding this work would provide greater information on existing and changing First Foods harvest opportunities. See Ch 3B pages 83-84 for additional detail.

v. Support Tribal Community in Documenting First Foods Knowledge

Conventional medical science is lagging behind Indigenous knowledge in terms of understanding the holistic nature of health, but supporting Tribal scientists and practitioners conducting this work is the best strategy for addressing gaps.

Short Term:

- **Pursue funding opportunities that build scientific knowledge of First Foods relationships to land and people**. These could include testing capacity to document contamination issues with certain species, documenting access barriers experienced, and changing education needs.

Long Term:

- **Participate and organize Tribal-led research projects into First Foods nutrition** and properties, as guided by knowledge keepers, Tribal youth and Elders, and the Tribal community, and supported by outside partners.

Measuring Success and Gaps in Emotional Wellbeing Adaptation

How Do We Measure the Success of These Adaptations?

"When we do not visit the places that our ancestors knew or when we do not tend to the rituals of honoring those places in prayer, do we deprive ourselves of the insight and wisdom the land provides? If knowledge of the land is a reflection of knowledge of ourselves, do we become separated from our history when we are separated from our land, the place of our history? The answers depend on how well we keep the stories alive and whether we can maintain our inextricable relationship with the land. After over two hundred years of cultural disruption, we are doing the best we can (Morning Owl et al 2015)."

- Yellowhawk Community Health Assessment Benchmarks.
- Yellowhawk Annual Plan Goals and Objectives

- **Comprehensive Plan Objective 5.4.8:** Support Tribal members to pursue and excel in education to become self-reliant and to contribute to the Tribal community (see Comp Plan page 74 for benchmarks);
- **Comprehensive Plan Objective 5.5.10:** Encourage Tribal community participation in Long House practices and promote freedom of religion on the UIR (see Comp Plan page 76 for benchmarks);
- **Comprehensive Plan Objective 5.7.4:** Provide training and education to CTUIR employees, Tribal community and outside entities on the importance of the First Foods and the federal, state and Tribal laws which protect them. Coordinate with CTUIR Education and other programs on culturally related ceremonies, activities, foods and heritage (see Comp Plan page 90 for benchmarks);
- **Comprehensive Plan Objective 5.11.8:** Actively participate in State, Federal and area Indian Health Board health care related policy and legislative activities to the best interest of all CTUIR members (see Comp Plan page 108 for benchmarks);

- **Comprehensive Plan Objective 5.11.9:** Promote the well-being of all Tribal Members (see Comp Plan page 108 for benchmarks).

- Access to mental health services and group sharing opportunities for community.

- **CTUIR Hazard Mitigation Plan (2021) Section 3**: Hazard Identification and Risk Assessment Results (page 68-190).
- **CTUIR Hazard Mitigation Plan (2021) Section 5:** Mitigation Strategy Implementation and Integration (page 214-225)
- Reduced displacement of Tribal Members and families from homelands and property.
- Family connection in learning and knowledge-sharing.
- Flexibility in self, family, community, and governance.
- Continued reciprocity with First Foods.

What Gaps in Knowledge, Policy, Capacity, or Education Exist?

- Changing population dynamics and projections of climate migration;
- Community emergency displacement needs that may change as disasters intensify;
- Mental health and wellness check measurements in health assessments;
- Pathways for feedback and ways to reach out for help;
- Stress testing of health services in anticipation of emergencies;
- How climate disasters will compound and exacerbate one another.

Health Adaptation Summary

Physical Health Adaptations

A. Support and Expand Community Health Capacity and Education

B. Approach Public Health Holistically with Cultural Connection

C. Expand Organizational Cooperation on Health Needs of Tribal Community

Health for Indigenous communities is much more complex than conventional public health frameworks understand, and increasing capacity for Tribal Members and community to direct their own research and wellness creates climate resilience in public health.

Measures of Success:

- Yellowhawk Tribal Health Center Annual Work Plans, and Community Health Assessments
- Comprehensive Plan Objectives 5.4.3, 5.5.7, 5.7.9, 5.11.3, 5.11.6, 5.11.11, 5.13.1, and 5.12.3
- CTUIR Hazard Mitigation Plan (2021) Sections 3 and 4
- Good Health and Wellness in Indian Country (GWIC) Grant Objectives 1,2, and 3 and sub-objectives and benchmarks.
- Chronic health prevalence in communities

Emotional Wellbeing Adaptations

D. Create Opportunities to Gather, Learn, and Share Stories Together

E. Continue to Revitalize Cultural First Foods Harvest, Processing, and Connection

Emotional wellbeing is closely tied with land and cultural wellbeing, and the two must be treated simultaneously in climate adaptation. Opportunities to connect with land, community, culture, and intergenerational knowledge create psychosocial well-being for Indigenous people.

Measures of Success:

- Yellowhawk Tribal Health Center Annual Work Plans, and Community Health Assessments (2016 and 2022)
- Comprehensive Plan Objectives 5.4.8, 5.5.10, 5.7.4, 5.11.8, and 5.11.9
- CTUIR Hazard Mitigation Plan (2021) Sections 3 and 5
- Family connection in learning and knowledge-sharing.
- Flexibility in self, family, community, and governance.
- Continued reciprocity with First Foods.

Chapter 3D References and Credits

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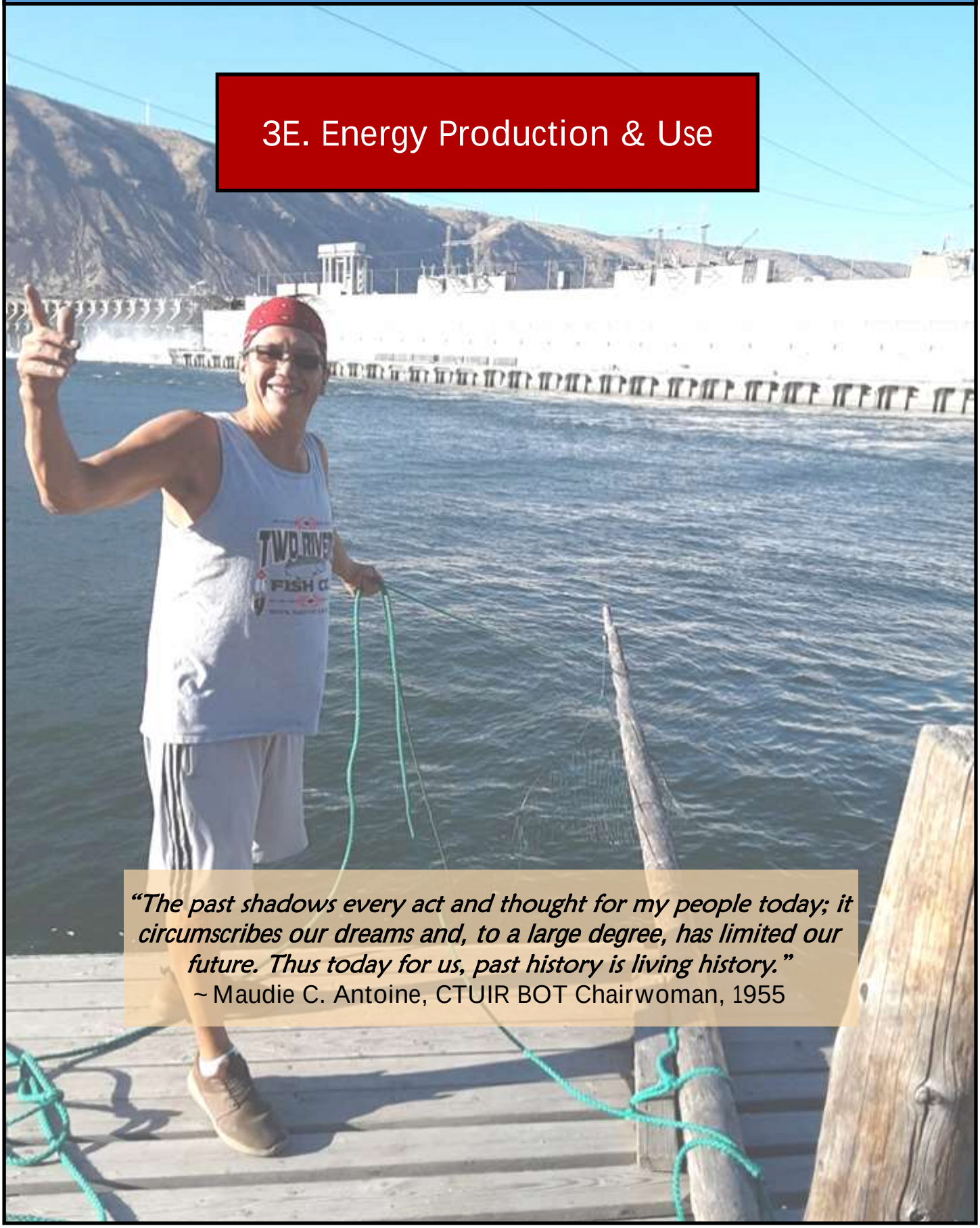
Photo Credits

- Part D Cover photo; "First Foods Excursion Family Outing." CTUIR DNR FFPP Aug 2018.
- Background photo; "Smoky summer skies." CTUIR DNR FFPP Aug 2018.
- Background photo; "Tribal Youth Assembles Tipi." Althea Huesties Wolf.
- Inset Photo, "CTUIR wildland fire crews use drip torches in prescribed burn," BIA Umatilla Agency Fire Operations, Oct 2021.
- Inset Photo, "Algae grows along the shore of the Umatilla River," CTUIR DNR FFPP Sept 2022.
- Inset Photo, "UIR resident Judy Beers surveys Feb 2020 Flood damage," CTUIR DNR 2020.
- Inset Photo, "Community identified allergens as significant climate impact," CTUIR DNR FFPP Aug 2022.
- Inset Photo, "Tribal fishermen scientists/ practitioners teach youth on Columbia," CTUIR FWC Bud Herrera.
- Panel Photo, "Salmon bake in traditional cooking methods over fire," CTUIR DNR CRPP.
- Inset Photo, "Participants visit Yellowhawk Fun Run outreach booths," CTUIR CUJ 2022.
- Panel Photo, "Winter landscape in the Wallowa Range," CTUIR DNR CRPP.
- Inset Photo, "CTUIR DECD staff pass out shirts and PPE at Earth Day Clean Up," CTUIR CUJ 2021.
- Panel Photo, "Umatilla River North Fork in summer," CTUIR FFPP Aug 2022.
- Inset Photo, "Tribal Knowledge Keepers teach and learn with food classes," Oregon State Extension Service, 2018.
- Panel Photo, "Raised beds in home gardens help with food production," Althea Huesties-Wolf.
- Inset Photo, "Yellowhawk Bread and Butter Pickles workshop," Oregon State Extension Service, 2017.
- Background Photo, "Outreach staff and volunteers smile during CTUIR Community Picnic," CTUIR CUJ Aug 2022.
- Inset Photo, "Tribal Knowledge Keeper David Wolf teaches youth to repair fishing nets," CTUIR DNR CRPP.
- Panel Photo, "Tipi on the July Grounds for Community Picnic," CTUIR DNR FFPP 2022.
- Inset Photo, "Tribal Member and toddler smile at Community Picnic," CTUIR CUJ Aug 2022.
- Panel Photo, "Tribal youth learn home meat processing lessons," Althea Huesties-Wolf.
- Inset Photo, "Tribal Members learn from cedar basket weaver Ramona Kiona," CTUIR DNR CRPP Wenix Red Elk, 2019.
- Inset Photo, "Draft concept of seasonal hazard round," CTUIR DNR FFPP 2021.
- Panel Photo, "BIA Umatilla Agency fire crews light prescribed burns," BIA Umatilla Agency Fire Operations, Oct 2021.
- Summary Inset Photo, "Cultural excursions for youth and community expand knowledge of First Foods and practices," CTUIR DNR CRPP.
- Panel Photo, "Native plan Prairie Smoke (*Geum triflorum*) before bloom," CTUIR DNR FFPP 2019.

3E. Energy Production & Use



"The past shadows every act and thought for my people today; it circumscribes our dreams and, to a large degree, has limited our future. Thus today for us, past history is living history."
~ Maudie C. Antoine, CTUIR BOT Chairwoman, 1955

Climate Impacts for **Energy Generation & Transmission**

"Dams were constructed on the Columbia River during the Depression era, creating jobs for non-Indians and promising to provide cheap electricity. Promises were made to the Columbia River Tribes that the concrete walls across the Columbia River would not have a negative impact on the salmon, and, if they did, that hatcheries would be built to mitigate for those impacts (Tovey et al, 2006)."

Modern Indigenous food systems are largely reliant on modern energy, but also suffer harm, as generating facilities invariably cause incidental damage to First Foods. Transmission lines bisect Tribal lands, often restricting Treaty Rights access and creating challenges for migrating wildlife. Energy networks are vulnerable to multiple climate impacts, and are linked to wildfire ignition. Electricity interruptions threaten community safety and stability, amid reductions in generating capacity, and increased maintenance costs to public infrastructure.

1. Shifted Hydropower Generation Potential Due to Changing Hydrology

Energy generated from hydroelectric facilities will face a constriction in the amount of power they are able to generate from seasonal water supplies due to shifting hydrologic patterns.

By 2040s hydropower production in summer decreases 13-16% (2.5-4.0% annually); by 2080s hydropower production in summer decreases 18-21% (3.0-3.5% annually) (Hamlet et al 2010) as seen in Figure 3E.1a (page 180).

2. Transmission Interruptions Become More Frequent

Energy transportation will see impacts from aging infrastructure as well as climate change. Moving energy from generation sites to end users depends on a highly integrated network of transmission infrastructure that will be threatened.

Storms and severe weather cause 59% of weather-related outages, 19% by cold weather and ice storms, and **2% by a combination of extreme heat events and wildfires (**Kenward and Raja 2014) **with roughly 800% increase in interruption over the past 26 years,** as seen in Figure 3E.2 (page 183).

3. Energy Facility Operating Costs Increase

Increasing intensity of extreme weather events creates challenges for energy generation facilities, and cost to operate facilities is likely to increase as routine and emergency maintenance is required. These costs are likely to be passed on to taxpayers and utilities customers.

State of Oregon may experience a projected 2-4$/MWh for a Proactive response, 3-4 $/MWh increase for a Reactive response, and a 4-6 $/MWh for No Adaptation response by the end of the century (Fant et al 2018) as seen in Figure 3E.3 (page 185).

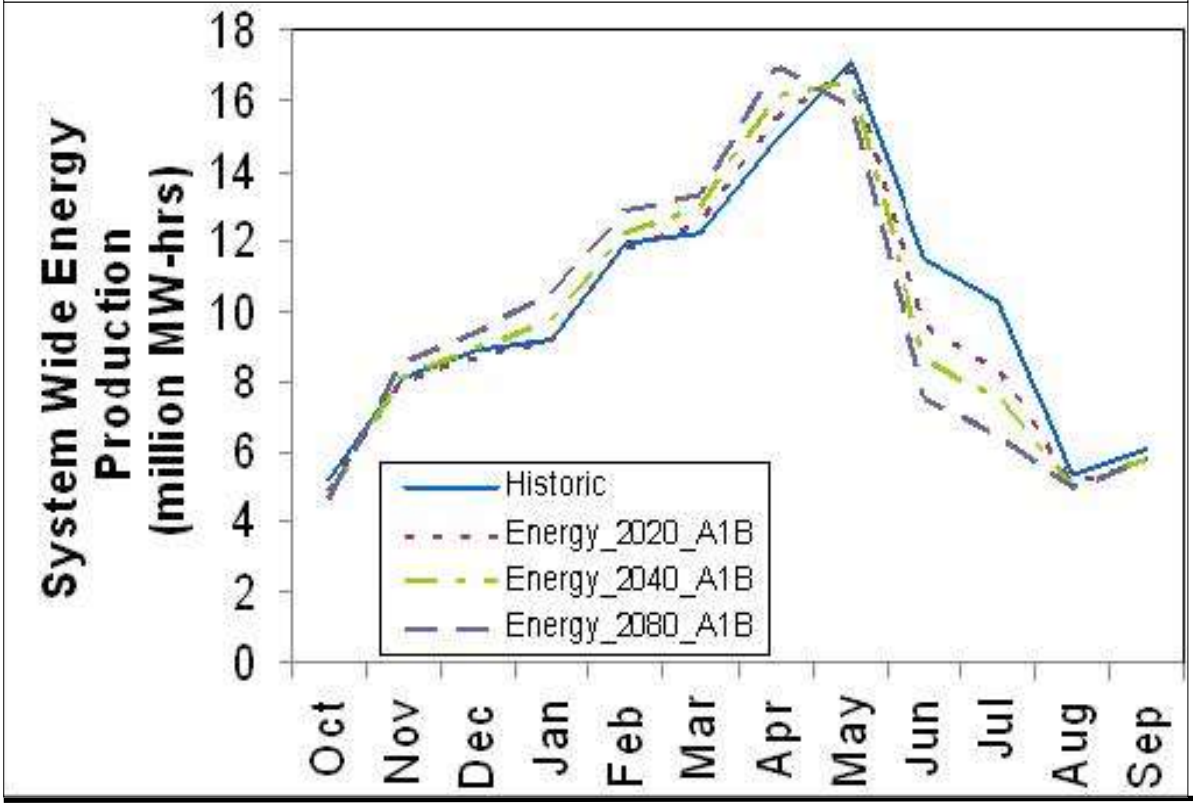
1. Shifted Hydropower Generation Potential Due to Changing Hydrology

Hydropower is a large source of electricity within the Pacific Northwest (PNW), accounting for approximately 70% of electrical energy generation in the PNW, with several generating dams located along the Columbia River. This type of energy source relies on the flow of the river to spin turbines, which generate electricity. Thus the hydrology of the river dictates the amount of electricity that can be generated at any time. Because climate change will alter Pacific Northwest hydrology, hydroelectric generating potential will also be affected.

Figure 3E.1 illustrates how this changing hydrology is likely to shift the energy generating potential of dams along the Columbia River, for an A1B scenario.

- The graph shows the historic and projected hydroelectric generating potential in million megawatt hours (MWh) over the course of a year: the solid blue line indicates the historic generating potential at the Dalles Dam on the Columbia River; purple hashed line shows projections for early 21th century (2020), while the hashed green line projects into mid-century (2040), and the gray checked line projects into the late 21st century (2080) (Hamlet et al 2010).
- Hydropower production in the Columbia River basin is projected to decline slightly on an annual basis by mid-21st century overall, with seasonal projected increases in winter and declines in summer.
- By the 2020s, regional hydropower production is projected to increase by 0.5-4% in winter, decrease by 9-11% in summer, with annual reductions of 1-4% (Hamlet et al 2010).
- By **the 2040s hydropower production is projected to increase by 4.0-4.2% in winter, decrease by about 13-16% in summer, with annual reductions of about 2.5-4.0%.**
- By the **2080s hydropower production is projected to increase by 7-10% in winter, decrease by about 18-21% in summer, with annual reductions of 3.0-3.5%.**
- The largest and most robust changes in hydropower production are projected to occur from **June-Sept, during the peak air conditioning season**.

Figure 3E.1a: The Dalles Dam (OR) Future Hydroelectric Generation Potential



Hydroelectric generating potential also experiences indirect effects, including, but not limited to (Hamlet et al 2010):

- Changes in hydropower production related to climate change adaptation for other water

management objectives (e.g. changes in flood control, attempts to adapt to losses of instream flow in summer through aquifer storage initiatives etc);
- Climate-related effects to fossil fuel costs or availability that may drive market forces;
- Climate-related effects to renewable energy resources such as wind turbines or photovoltaic cells;
- Shifts in population that may be partly related to changes in climate or water supply; and
- Changes in energy demand from emerging sources like large scale data server sites and cryptocurrency mining operations.

Drought impacts in spring and summer are worsened in these simulations, with lower energy production occurring for these seasons. Changes in energy demand and regional hydropower production indicate adaptation to climate impacts in the cool seasons will be easier than in the warm seasons, due to changing demand and availability. Peak electrical loads for air conditioning is also likely to increase, creating potential capacity, distribution, or voltage stability problems.

The ability to transfer electrical energy from the PNW to other regions for monetary profit is likely to decrease in May, June, July, and August. This is due to reduced hydropower supplies and increased local demand, as local demand may meet and potentially exceed production capacity. Regions like California and the Southwest, which purchase electrical capacity from Columbia River generating sources historically, are rapidly implementing their own renewable energy generation sources, which could free up capacity available to Pacific Northwest utilities.

Bonneville Dam on the Columbia River is one of several hydroelectric generating facilities located on the river. Construction of these dams had a huge impact on Tribal fishing and cultural sites, including Celilo Falls.

Energy generation in the inland PNW also still remains reliant on fossil fuel production facilities. Utilities like Pacific Power and Umatilla Electric Cooperative, which serve the Umatilla Indian Reservation (UIR) and much of eastern Oregon and Washington, draw their electricity predominantly from coal-fired power plants in eastern Oregon and Idaho. These facilities are also likely to see a decrease in energy production capacity during summer months, as climate impacts reduce efficiency of electrical generation.

Energy generation that supports additional demand above base load (known as "peaking") is generated by gas turbines, solar cells, and wind turbines, which are vulnerable to extreme changes in atmospheric conditions (Bartos and Chester 2015).

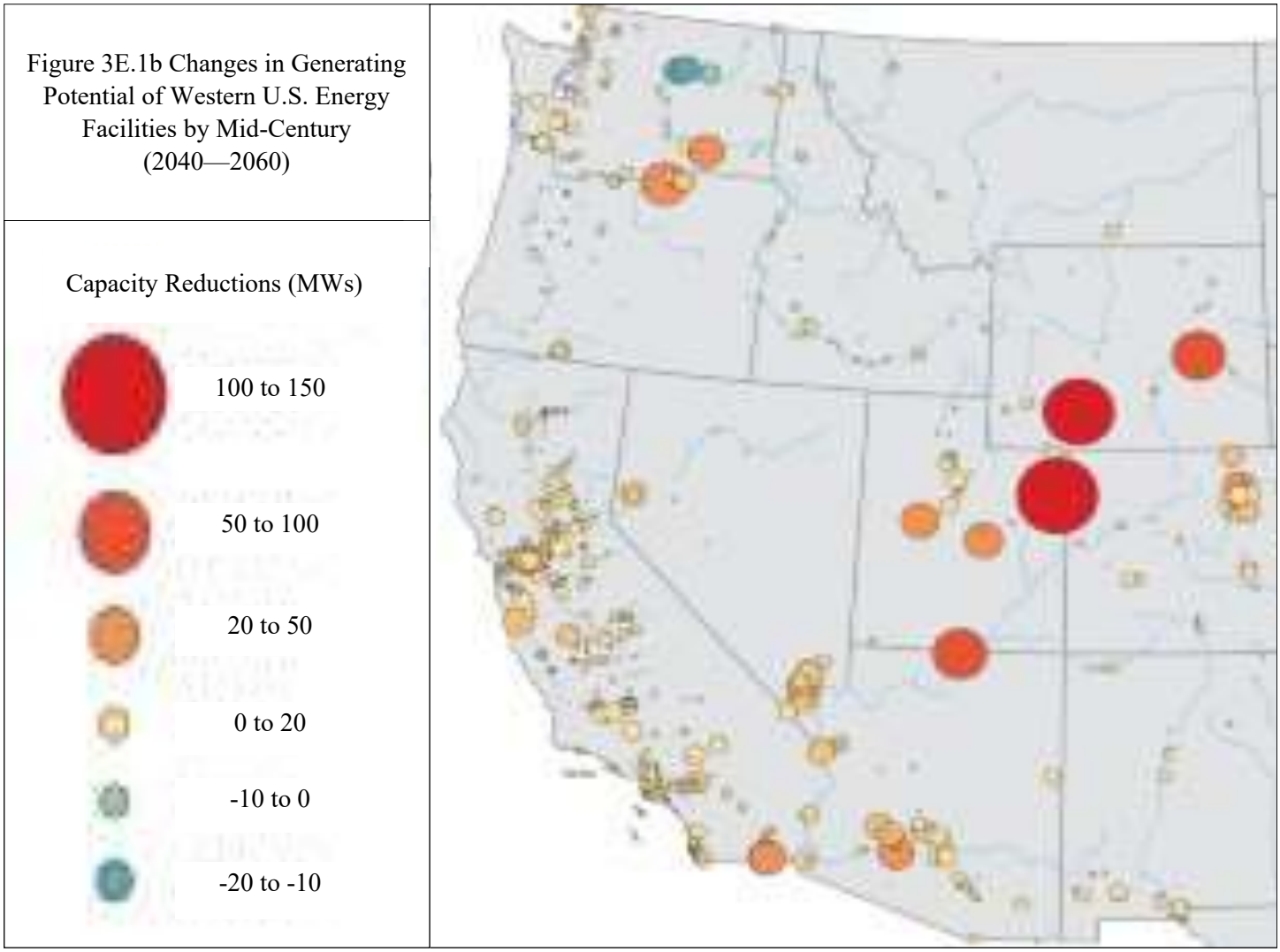
In the Western U.S., renewables and combustion turbines comprising roughly 56% of these kinds of generating capacity for the grid. Sustained reduced level energy production (known as "base-load") is typically generated by steam turbine facilities, like coal and nuclear power plants. Generating capacity of these technologies is controlled by available streamflow from nearby rivers, as cooling water demands depend on the heat, pressure, and volume of air and water entering the cooling system. Combustion turbines and photovoltaic cells experience capacity reductions as air temperatures increase. Wind turbine performance depends on wind speed and air density (Bartos and Chester 2015). All these factors are affected by climate change as extreme events become more frequent.

Figure 3E.1b maps projections for average reductions in summertime capacity by mid-century (2040-2060) for vulnerable facilities in the U.S West.

- The map shows average reductions across multiple model/scenario runs and emissions scenarios (A1B, A2 and B1): circles on the map represent individual energy generating facilities of all kinds, as measured by the change in generating capacity by mid-century. Larger circles with red and orange hues represent large reductions in generating capacity (reductions of 150 to 20 MegaWatts), while modest or no change is indicated in yellow, and gains in generating capacity indicated in blue colors (increases up to 20 Megawatts).
- Thermoelectric technologies (steam turbines and combustion turbines) suffer the largest climate-attributable capacity reductions—about 1.6-3.0% for vulnerable facilities by mid-century, with **average summertime losses of 1.4-3.5% for combustion turbines, and by 7.4-9.5% for steam turbines** (Bartos and Chester 2015).
- **Utility-scale photovoltaics (solar panels) may experience 0.7-1.7% reductions of summertime capacity** due to higher air temperatures (Bartos and Chester 2015).
- Climate change may slightly increase wind turbine performance due to lower average atmospheric humidity.
- As illustrated in this mapping projection, many facilities in the CTUIR Ceded lands will experience a reduction in generating capacity. **Two facilities are projected to experience a 50-100 MW decrease, with others anticipated to have modest reductions of 10 - 50 MW** (Bartos and Chester 2015).

There are many factors that affect regional energy generation in the future. The Western U.S. energy grid is interconnected with various electrical generating technologies, which is likely to largely insulate the Western grid from the worst of climate impacts

Figure 3E.1b Changes in Generating Potential of Western U.S. Energy Facilities by Mid-Century (2040—2060)



(Bartos and Chester 2015). Encouraging decentralized supplementary energy generation would assist in buffering much of the climate impacts to generating capacity. Renewables like wind turbine and photovoltaics can be implemented in small scale grid formats, with special attention paid to critical infrastructure and service needs. Low energy prices from cheap hydroelectricity have been a consistent barrier to implementing wide-scale renewable energy generation, but with declining energy availability from this source, adaptations that increase local energy generation will provide a buffer for this impact.

(Credit: Hamlet et al 2010)

Gaps in Knowledge/Data/Policy:

- Changing energy demand due to technological advances, emergency demand for cooling, and other emerging energy intensive industries like data centers and cryptocurrency mining;
- Reduction in demand from regional energy purchasers like southwestern utility companies, and how this may change local energy availability;
- Scale and timing of reduction in capacity from fossil fuel generating sources due to heat;
- Scale and timing of reduction in capacity from photovoltaic (PV, solar) generating sources due to heat and wildfire smoke effects;
- Transmission interruptions that could coincide with summer extreme weather events like heat waves and wildfire.

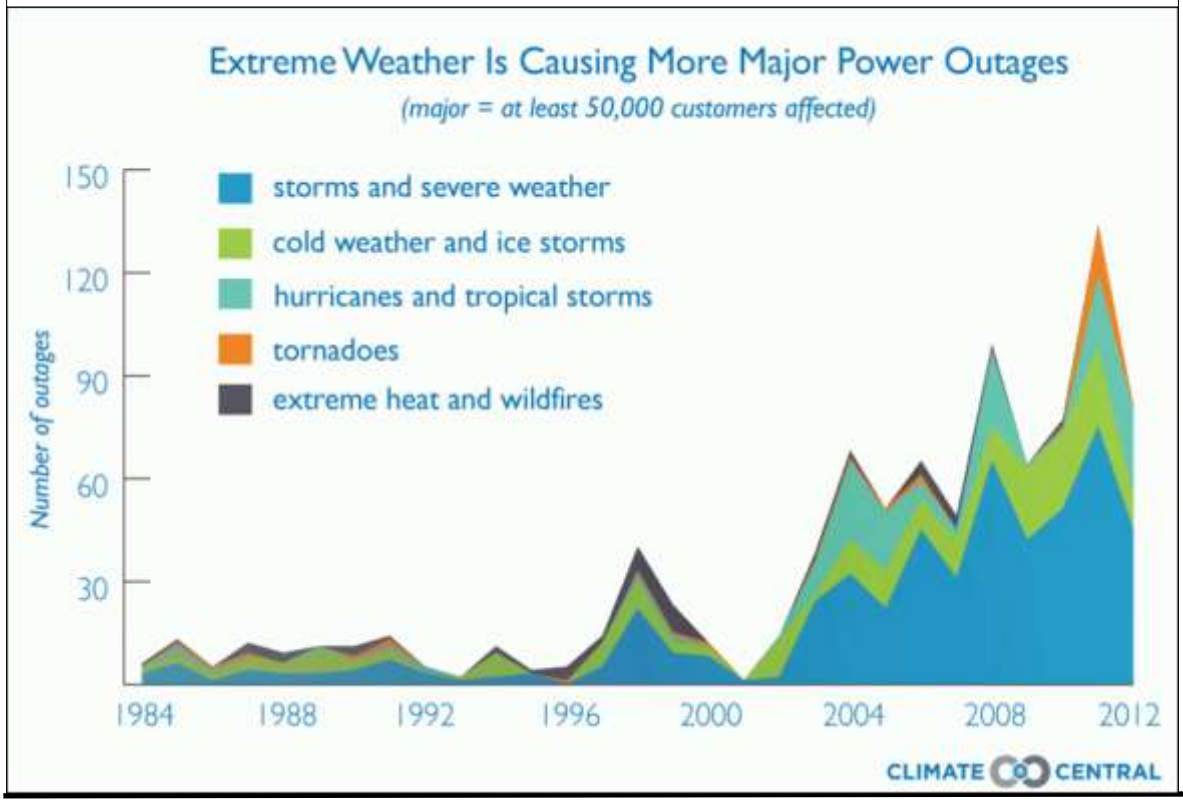
2. Transmission Interruptions Become More Frequent

The U.S. electricity grid is comprised of three basic sections: the Eastern Interconnection grid, which serves utilities from the Great Plains to the East Coast; the Western grid, which services utilities from the Rocky Mountains to the West Coast, and the Texas Interconnection, which serves much of the state of Texas. These grid systems are connected together by transmission lines that run from generating stations to sites of electrical delivery, such as homes, businesses, facilities, and industries. These lines can be buried underground or located overhead with other essential transmission infrastructure. This interconnected network will be threatened by climate change impacts, causing interruptions in service to people who depend on it.

Figure 3E.2 shows the number of major power outages (defined as affecting at least 50,000 utility customers) nationally caused by extreme weather events from 1984 to 2012.

- Outages caused by different extreme weather events are categorized by color on the graph: blue indicates storms and severe weather such as wind and thunderstorms; cold weather and ice storms are indicated in green; hurricanes and tropical storms in

Figure 3E.2: Electrical Transmission Interruptions Increased in Recent Years



teal; tornados indicated in orange; and extreme heat and wildfire in black. Nationally, **59% of weather-related outages were caused by storms and severe weather; nearly 19% by cold weather and ice storms**; 18% by hurricanes and tropical storms; 3 % by tornadoes, and **2% by a combination of extreme heat events and wildfires**. Most of these outages come from damage to large transmission lines or substations, as opposed to the smaller residential distribution networks (Kenward and Raja, 2014).

- From 1984 to 2012, the number of transmission interruptions caused by extreme events of all kinds **increased roughly 800% over the past 26 years**, from approximately 10-15 events in 1984, 30+ in the 1990's, 60+ in the early 2000's, and reaching 120 in the early 2010's (Climate Central, 2012).
- Annual costs of U.S. power outages ranged from $100 billion to $164 billion (2001 USD), with the majority of the cost associated with indirect consequences of the power loss, rather than the repair of damaged power lines (Kenward and Raja, 2014).
- Adverse weather is the most common cause of power interruptions, with weather causing 80% of all outages between 2003 and 2012 (Kenward and Raja, 2014).

Some of this increase was the result of improved reporting, however even after stricter reporting requirements were widely implemented in 2003, the average annual number of weather-related power outages doubled. Electrical grid vulnerability includes power loss at individuals' houses (which cause lighting, heating, and air-conditioning losses), and large-scale power
outages which pose larger threats to entire communities and business sectors. Examples include, but are not limited to (Kenward and Raja, 2014):

- Water treatment facilities that depend on electricity, with extended power outages interrupting flow of clean water and solid waste removal;
- Hospitals and medical facilities can lose power or clean water, as well as some critical equipment necessary for patient treatment, raising health concerns;
- Power losses often force businesses to close, affecting sales and overall profitability, and potentially disrupting extended business-to-business supply chains;
- Traffic signals and other transportation communication relies on electricity to power poles and lights;
- Combined disasters of extreme heat, wildfire, or flooding with power loss can exacerbate an existing health and public safety crisis.

Climate change impacts conflate with aging grid infrastructure serving greater electricity demand, to create recent increases in major power outages. These unreliable grids can cause health complications and safety risks as well (Markolf, 2019). California State's deadly Camp Fire in 2018 was the direct result of aging energy transmission infrastructure sparking catastrophic wildfire, and resulted in 85 fatalities, as well as the financial bankruptcy of the utility company responsible, Pacific Gas and Electric (PG&E). In years since, California electrical utilities have tried to address hazardous conditions caused by cutting power to vulnerable transmission lines during storm events, leaving entire communities without electricity for hours and even days. A warming planet provides more fuel for increasingly intense and violent storms, heat waves, and wildfires, which will continue to strain, stress, and overload highly vulnerable electrical infrastructure. The replacement of aging power system infrastructure can improve reliability in uncertain future years.

(Credit: Climate Central, 2012)

<u>Gaps in Knowledge/Data/Policy:</u>

- Pace of electrical grid infrastructure replacement;
- Speed of renewable and decentralized energy generation infrastructure;
- How other non-infrastructure adaptations might impact transmission, like vegetation management and customer behavior changes.

3. Energy Facility Operating Costs Increase

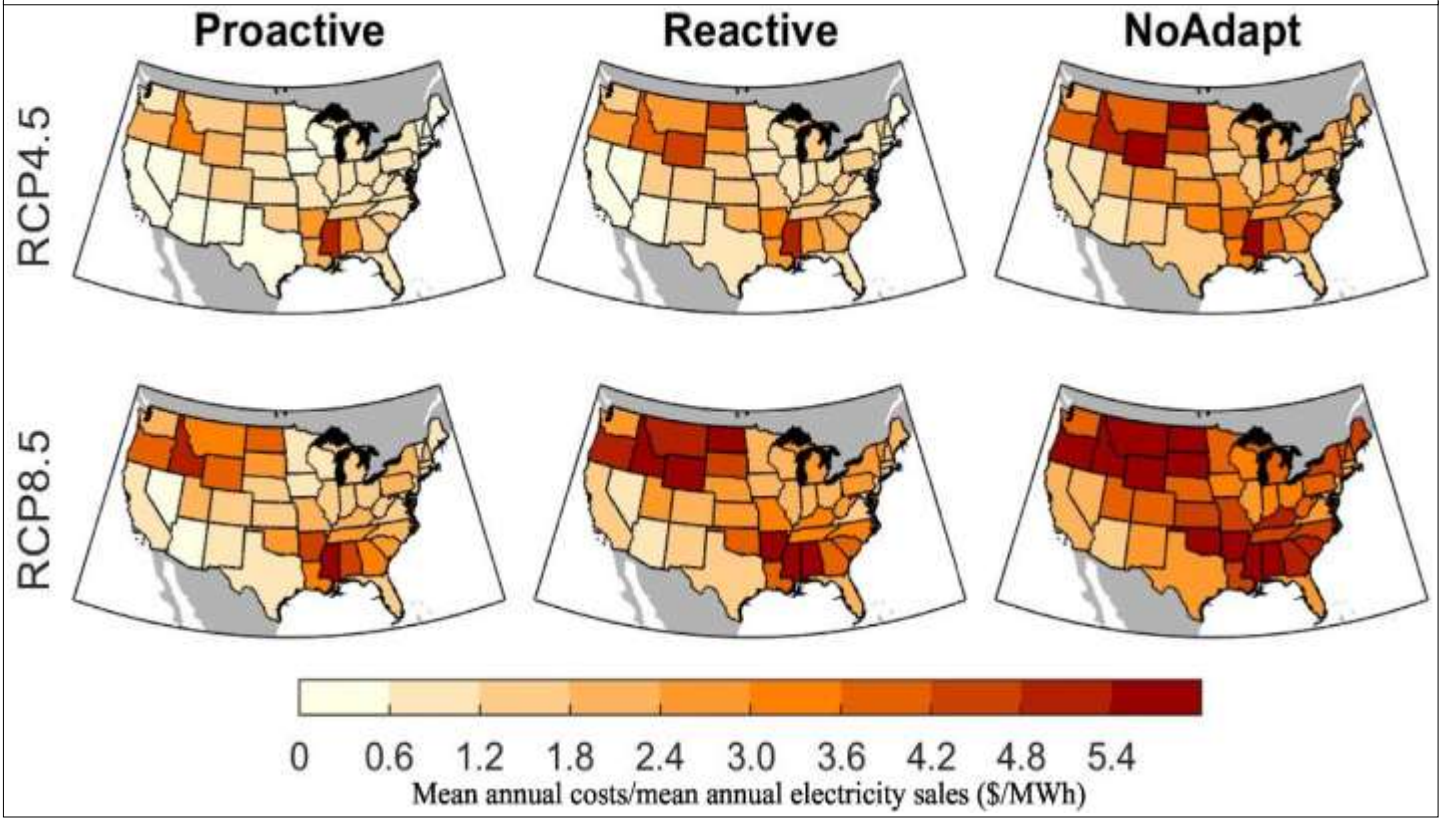
Energy generating facilities cost billions of dollars to construct, and maintaining these buildings and their associated transmission infrastructure is required to prevent interruptions in service, or decreases in generating capacity. These facilities are also negatively impacted by climate changes and future uncertainty, which creates risk for national energy supply and transportation.

Figure 3E.3 illustrates cost increases that can be anticipated by energy producers as a result of climate change under two carbon emissions scenarios, and which geographical regions can expect more severe impacts to their electrical grid.

- Three categories of utility response to climate change adaptation were studied: the chart shows these as "No Adapt," where no action to adapt to change was taken; "Reactive," which demonstrates utilities replacing infrastructure "as needed" using historical weather information; and "Proactive" costs estimates if utilities are using climate projections in their construction and maintenance planning.
- Increasing temperature is the primary driver of compounding costs to the energy grid. Hotter summers increase resistance to the channeling of electricity along transmission lines. Heat also increases the demand for vegetation management around storage and distribution infrastructure, and creates ideal conditions for fungal and mold decay of wooden grid poles (Fant et al 2018).
- Nationally climate impacts create a 25% increase in cost for operation. **Oregon is projected to experience 2-4$/MWh for a Proactive response; 3-4 $/MWh increase for a Reactive response; and 4-6 $/MWh for No Adaptation by the end of the century.**
- Overall, the study found that incorporating climate change projections in current energy planning and construction projects would reduce potential cost increases by at least 50% (Fant et al 2018).

Because of the long lifespan of energy projects, accounting for climate change projections in planning and construction can encourage projects being built now to anticipate a future climate that looks nothing like the current one. This can reduce the burden on operators and utilities customers.

Figure 3E.3: Increased Cost of Facility Operations Based on Adaptation Strategy



(Credit: Fant et al 2018)

Gaps in Knowledge/Data/Policy:

- How many Pacific Northwest energy generating facilities (existing and planned) are adapting to climate change;
- How rapidly communities will implement microgrid and local generation capabilities.

Adaptation Goals for Energy Generation & Transmission

A. Support and Expand CTUIR Renewable Energy Generation Potential

"Both on and off-Reservation, renewable energy development poses challenges for the CTUIR in protecting its natural and cultural resources from such developments while still encouraging renewable energy to combat climate change. For example, the CTUIR does not support categorizing hydropower as a renewable energy when it impacts fish. Large scale wind farms are not appropriate in all locations where they can impact important natural resources or destroy the view shed and quiet of residential areas.

Further, some renewables such a thermal solar require large amounts of water for cooling which in some cases might not be appropriate for our region. In evaluating both on and off reservation renewable energy projects, we shall examine each projects on a case-by-case basis, looking at both on and off-Reservation impacts and benefits, with an emphasis on protecting its cultural and natural resources, including the cumulative impacts of multiple energy projects, as well as creating economic opportunity for the CTUIR (CTUIR Energy Policy, 2009)."

Energy sources that reduce greenhouse gas burdens are key to adaptation, and methods that reduce dependence on grid connectivity will also improve resilience to risk of transmission failure.

i. Photovoltaic (PV) Solar Potential

Solar electrical potential for the Umatilla Indian Reservation (UIR) is viable for energy generation at moderate levels, and there is potential across the reservation to generate this form of energy. Existing CTUIR solar energy projects demonstrate the feasibility of this kind of energy source, and could provide a roadmap to future solar energy development projects.

Short Term:

- **Celebrate and expand site-specific PV generation like the Antuksh Tinqapapt Solar Array with the Energy and Environmental Sciences Program (EESP)** completed in 2018. Real time updates for Antuksh Tinquapapt PV array are available at the online dashboard, which displays an instantaneous feed from the array, found at the below website: https://ctuir.org/departments/natural-resources/energy-and-environmental-sciences/energy-projects/field-station-solar-project/
  This site provides a lifetime energy count for the project, recorded at 474 MWh (as of March 3 2022). With this information, impacts from wildfire smoke and extreme heat on solar energy generation could be quantified and used in future generating estimates.

Long Term:

- **Expand and pursue solar generation potential preliminary studies for the UIR;** current estimates of solar energy generating potential approximate 4.2 kWh/m²/day (annual average) are

possible. Generating potential is higher in the summer, and lower in the winter. Further feasibility and resource assessments would need to be conducted to better understand this potential.

- **Celebrate and expand other solar arrays include generating panels located at Tamástslikt Cultural Institute (TCI), and at Yellowhawk Tribal Health Center.** There are also tentative plans to develop solar generating potential with Nixyaawii Education Center, and further generation planned at Yellowhawk, but not yet installed.

Fisheries support infrastructure like hatcheries, rearing ponds, and fish ladders could be excellent locations to co-locate microhydro generating opportunities due to their essential proximity to stream flows.

ii. Geothermal Systems Potential

Heat from the earth's core is another source of renewable energy: energy generated can be turned into electricity and other forms of transportable energy, and is a viable source of energy for the UIR. Geothermal energy is typically harnessed using deep bore holes that reach down to areas of tectonic hotspots which provide enough of a temperature gradient to heat specialized conducting fluid used to power turbines to create electricity. As a closed loop system, these operations allow for the conservation of resources during electrical or heat production.

Short Term:

- **Continue to pursue Geothermal Phase 2 planning,** which is scheduled to begin in the near future; this includes the drilling of boreholes in identified locations, with an ideal drilling depth of 5,000 feet to examine temperature gradients at that depth. Phase 1 included this initial generating potential study that identified potential feasibility locations, and was completed in 2018. Drilling of boreholes could also be paired with further studies on groundwater resources in these locations.

Long Term:

- **Continue and support identification of geothermal locations on the UIR that are optimal for electrical generation with EESP**. Currently an existing resource assessment that is underway, which should provide additional data for determining feasibility of a geothermal plant in identified locations.

- **Explore potential for hydrogen fuel generation, which could be paired with geothermal energy,** as an option for transportable renewable fuel. Hydrogen energy requires power to create, but could be a replacement fuel for liquid fossil fuels. This could be considered "renewable" if the originating energy comes from a non-carbonized energy source. Hydrogen has potential for transportation and grid balancing in energy systems.

iii. Micro-Hydrogeneration Opportunities

Power from hydroelectrical generating stations is debatably referred to as "renewable" in many conversations about energy, however Tribes are not united in viewing this energy source as favorable. Many of these operations block river flow either partially or entirely, and create daunting passage barriers for migratory fish like salmon and lamprey. Decision-making around large-scale hydroelectric facilities must be considered in an evolving and ongoing way by tribal leadership. There are also opportunities for hydroelectric energy generation that does not include river-blocking infrastructure to accomplish generation, though no resource assessments have been conducted for these energy sources on the UIR.

Short Term:

- **Explore potential for irrigation modernization to create opportunities for hydropower**

generation. By placing generating turbines within irrigation piping, particularly as old irrigation ditches are converted into closed piping circuits to reduce water loss through infiltration into soil and evaporation to the air. Irrigation modernization planning and project assistance funding are available to irrigation districts, and CTUIR should consider partnering with irrigation districts in the Ceded lands on irrigation modernization and hydropower project planning and implementation. These include Stanfield, Hermiston, Westland, Owyhee, Powder River Water Control, and other Oregon and Washington Irrigation Districts.

- **Explore potential for run-of-the-river small scale hydrogenation as an alternative hydropower option** that diverts surface water to power turbines, but does not pool or heat diverted water in the process. These small generating turbines can be located at residences near streams and rivers, and at other locations on the UIR where floodplain restoration is impeded by prioritized infrastructure, such as at salmon rearing and release ponds operated by CTUIR.

Long Term:

- **Explore potential co-generation opportunities with a future CTUIR water treatment plant.** Co-generation with water infrastructure provides additional options for energy generation in conjunction with planned infrastructure improvements and developments. Water treatment facilities pump water around their systems for treatment and release, and thus could be potential partners for co-locating in-pipe turbines for small scale hydroelectrical production. This kind of operation could also function as an energy storage opportunity for grid balancing.

iv. Wind Turbine Potential

Wind energy in the inland Pacific Northwest is relatively controversial, and this regional division of opinions also exists within the CTUIR Tribal community. Generating potential for wind energy on the UIR is highly dependent on topography, and other factors, though generally there is higher generating potential at higher elevations on the foothills of the Blue Mountains. Resource assessments and feasibility studies have not been conducted for this energy potential.

Short Term:

- **Celebrate community implementation of alternative energy, such as the wind turbine at TCI, as they provide an example of the opportunities that exist** for wind energy generation for Tribal facilities.

Long Term:

- **Engage Tribal community and leaders around wind energy development, especially to identify barriers to implementation.** Impacts to wildlife migration and cultural "viewsheds" are consistently factors mentioned in opposition to wind energy projects, though it is important to note that not all Tribal Members and departments share these concerns.

v. Biomass Energy Potential

Rethinking a traditional source of fuel, biomass energy is a carbon-balanced power source that relies on the combustion of plant-based carbon sources to produce heat and electricity. Biomass energy typically comes from the combustion of excess or waste plant materials, such as the

kind that comes from forestry thinning projects and commodities processing, and from biological waste from large animal feeding operations. While this energy source does involve burning carbon, these carbon fuels have been sourced from non-fossil fuel sources, and represent a balancing of the carbon extraction that was required for their production. Resource assessments and feasibility studies have not been conducted for these energy sources.

Short Term:

- **Explore potential for forestry thinning projects as a local source of energy generation using biomass fuel**. Slash from these projects is currently burned in place, but potentially could be utilized in biomass energy generating equipment. The US Forest Service (USFS) offices that serve the Umatilla, Wallowa-Whitman, and Malheur National Forests, which border the UIR and for which the CTUIR has co-management agreements, have expressed interest in partnering with CTUIR on investigating this energy potential.

Long Term:

- **Explore potential for energy generation potential using biomass fuel from Confined/ Concentrated Animal Feeding Operations (CAFOs)** within the Columbia River region. While not an industry that CTUIR traditionally supports, there are currently a number of these CAFOs permitted and operational within CTUIR Ceded lands. There is potential to partner with or support these operations in pursuing biomass energy generation. A local example exists with Three Mile Canyon Farm and Dairy's methane digester near Boardman OR.

- **Explore potential for energy generation using biomass fuel from food processing facilities.** There are a number of these industrial facilities within CTUIR's Ceded lands, such as Smith Foods in Weston, and Newlywed Foods in Pendleton. If CTUIR decides to support pursing biomass recapture efforts, these companies are potential partners in this effort.

vi. Energy Decentralization

Electrical grid reliability has been identified as an existing challenge for energy sources which supply the UIR with electricity. With electrical sources from Pacific Power and Umatilla Electric Cooperative, residents on the UIR experience chronic power outages, connected to both extreme weather events, as well as smaller routine failures. Implementing renewable energy generating sources that provide grid redundancy can help buffer for these connection interruptions.

Short Term:

- **Identify facilities and other locations that are considered "critical" for prioritizing in energy project development**, such as healthcare facilities, community emergency gathering locations, and wastewater treatment operations, among others. Some of this identification occurred as part of the development of the Energy Strategies Plan, and could be expanded for more robust input.

Long Term:

- **Organize and facilitate opportunities for CTUIR's Tribal community to identify energy needs, priorities, and preferred strategies** for ongoing energy independence. The Strategic Energy Plan is a first step in this process, and sustained community engagement is an identified component to updating this document.

Forest thinning projects that promote appropriate stocking density and improve conditions for prescribed burn implementation create "slash" waste that could be used as biofuels.

B. Implement Tribal Sovereignty in Regional Energy Planning

"For the Tribes, major ecological change is not new. Our oral history and current science demonstrate that, for more than 10,000 years, we have adapted to climatic shifts that produced changes in the region's vegetation and wildlife. In the past 200 years, our environment changed dramatically as non-Indian settlers invaded our homeland. Overgrazing by livestock decimated our traditional root crops. Irrigation, hydropower and soil erosion from farming and forestry destroyed our salmon runs. Over-hunting, homesteading, new towns, and road building drove off our wildlife. But now, a new kind of environmental threat, rapid climate change, threatens us all (CTUIR Energy Policy, 2009)."

i. Extend Energy Generating Potential Studies to CTUIR Ceded Lands

Energy generating potential on the Umatilla Indian Reservation (UIR) has undergone a preliminary estimate of resources, but areas around the reservation and in Ceded lands and traditional use area have not been examined in much detail. Energy projects are often large in their scale and funding needs, thus partnering with regional organizations and agencies on efforts throughout the Ceded lands could yield additional opportunities for renewable energy development.

Short Term:

- **Explore opportunities to partner with regional Irrigation Districts for modernization planning** that includes implementing in-pipe hydro-electric generating turbines as part of these updates. Irrigation districts with an Improved Watershed Plan can apply for critical federal funding through PL-566 with Natural Resources Conservation Service (NRCS). Examples include Three Sisters Irrigation District, and the Central Oregon Irrigation District that can be used as guides in this process. CTUIR should consider partnering with irrigation districts in the Ceded lands on irrigation modernization and hydropower project planning and implementation, such as Stanfield, Hermiston, Westland, Owyhee, Powder River Water Control, and other Oregon and Washington Irrigation Districts.

Long Term:

- **Explore opportunities to collaborate with other potential bio-energy sources within CTUIR's Ceded lands**. These could include industrial partners with local feedlots, dairies, breweries, commercial food waste and water resource recovery facilities, and pulp mills, among others. Opportunities exist to partner with or support these operations in pursuing biomass energy generation, and local examples include Three Mile Canyon Farm and Dairy's methane digester. Biomass energy associated with forestry thinning projects through USFS have also been offered to CTUIR as a potential biomass energy project.

ii. Consider Micro-grids

"Micro-grids" are a renewable energy generating operation that is paired with some capacity of battery storage and control. This allows for energy generated to be stored for future use or fed back into the connected electrical grid. A micro-grid system can be for a single residence, several facilities linked together, or for a connected community powered by the same source. Micro-grids increases energy

resilience by allowing for power to critical loads to continue during outages, and enables those critical lifelines to continue functioning.

Short Term:

- **Organize and facilitate a community visioning session around the creation of micro-grids**, including identifying facilities and functions that would be a high priority for energy resilience. Some of this has already been conducted with the Energy Strategies Plan; planning future opportunities for community engagement will improve implementation.

Wind turbine blades are transported via rail through the Umatilla Indian Reservation, to be installed in renewable energy projects around the region and boost energy availability.

Long Term:

- **Pursue funding for planning and implementation of energy resilience projects** like micro-grid formation through governmental and private funding sources. Funding sources from federal, state, and private sources should be considered.

iii. Support and Expand CTUIR Monitoring of Air, Water, and Soils to Maintain "Treatment as State (TAS)" Status

Tribal sovereignty is loosely measured by a Tribe's ability to regulate itself, which relies on scientific information, routine data collection, evidence-based policy planning, and regulation enforcement. All of this combines together to provide eligible Tribes with functional "Treatment as State (TAS)." TAS frameworks create conditions for Tribes to continue to exercise sovereignty in matters of natural, built and social resources in various capacities. Much of the work that CTUIR does within its Tribal government supports its Tribal sovereignty as a result, and CTUIR is strong in its ability for self-determination, particularly when it comes to regional energy generation.

Short Term:

- **Support Federal Air Rules for Indian Reservations (FARR) programing and Clean Air Act regulation administration and enforcement** within the UIR. FARR includes monitoring air shed and establishing burn permits, and providing education and outreach. Financial assistance agreements with Environmental Protection Agency (EPA) strengthen CTUIR regulatory and TAS abilities.

Long Term:

- **Expand capacity for *de facto* Tribal sovereignty through monitoring of air, water, soils, First Foods, and other relevant avenues for providing necessary information**. Once these practices are routine and established, they increase regulatory justification for Tribal self-determination.

- **Consider regulatory priorities as a Tribal community, should legal challenges to Tribal sovereignty arise**. Governance activity may eventually be questioned legally, and proactively identifying "must act" priorities for the Tribal government and community could assist with timely court and legal defense of challenged sovereignty.

iv. Fund Capacity to Address Energy and Climate Issues

Funding to build capacity and implement projects is a large component to the success of Tribal self-determination. It is a point of pride in CTUIR's Tribal sovereignty development that its government has been

able to hire and administer internal staff and programs. Federal government funding in recent decades has expanded Tribes' ability to conduct their own affairs internally. Continued funding from these state and federal sources, along with private funding as necessary, will continue to expand CTUIR's ability to perpetuate self-governance.

Short Term:

- **Continue to develop and pursue CTUIR's Strategic Energy Plan**. This plan establishes CTUIR community's energy vision and guides the organization's energy conservation and generation efforts for years to come.

- **Organize and implement resource assessments and feasibility studies for community-identified preferred energy options**, as outlined in the Strategic Energy Plan and the associated strategic energy visioning exercises.

Long Term:

- **Continue to expand and implement climate adaptation planning as prescribed in this and other Tribal policy document.** Planning documents are ultimately useful for directing project development in a long-term coordinated strategy, so as to facilitate continuous funding from various sources.

- **Continue to pursue and advocate for inclusion of Tribal-specific funding pools in governmental legislation**. Funding is critical to supporting and expanding Tribal sovereignty for climate change and energy projects.

v. Youth Engagement with Tribal Sovereignty

Tribal youth are future government leaders and community decision-makers, and education around energy and Tribal sovereignty should be prioritized from a young age. Organizing opportunities for youth to learn about and engage with Tribal sovereignty will prepare them to have a role in Tribal governance at many different levels.

Short Term:

- **Explore and expand opportunities to engage CTUIR Tribal Youth Leadership Council in climate resilience planning.** Tribal Youth Council is an excellent example of building youth capacity for self-determination, and collaboration with this Council to increase youth-specific renewable energy education opportunities.

- **Expand participation with Energy Trust of Oregon's Strategic Energy Management (SEM) program**. SEM is a holistic approach to improving energy performance of communities through cohort-driven engagement. The program helps participants understand how building design, occupancy, and staff are affecting energy efficiency, by examining building systems, equipment, operating procedures, and occupant behaviors. Current CTUIR engagement with SEM includes projects associated with Wildhorse Resort and Casino (WRC) and Cayuse Technologies facilities.

- **Encourage Tribal student engagement with EESP Antuksh Tinquapapt Solar array and online dashboard**. Analyzing and quantifying solar generating capacity under different conditions, such as extreme heat and wildfire smoke, would make for an engaging high student, undergraduate, or graduate research project/internship/ thesis. https://ctuir.org/departments/natural-resources/energy-and-environmental-sciences/energy-projects/field-station-solar-project/

Energy sources for processing of First Foods, like smoking huckleberries (pictured), were historically "renewable." Teaching about these methods expands cultural energy knowledge.

Long Term:

- **Develop a K-12 educational approach to engaging youth in understand what sovereignty means in practice**. Tribal youth will need to be prepared to manage complex Tribal sovereignty issues like climate change, energy generation, and Hanford restoration. Approaches like the CAP Webinar Series that utilize Tribal Members who are professionals working in these fields, can help youth envision themselves future similar roles. Frameworks that engage families in these learning exercises will experience greater success.

vi. Build Renewable Energy Solidarity with Impacted Communities

No form of energy is without environmental impacts. Many renewable energy opportunities available have potential to outsource materials extraction impacts to other vulnerable communities. Technologies used in solar and wind energy development are often built from materials extracted from Indigenous communities globally. "Global South," is a term referring broadly to the regions of Latin America, Asia, Africa, and Oceania. Use of the term marks a shifted recognition of focus on development or cultural difference, toward an emphasis on geopolitical relations of power (Dados and Connell, 2012). Many global Indigenous communities are part of this "Global South" designation, and are negatively impacted by renewable energy materials extraction. Among minerals used in renewable energies technologies, 7% of nickel, 89% of copper, 79% of lithium and 68% of cobalt reserves and resources in the U.S. are located within 35 miles of Native American reservations (ESG Research, 2021). In building renewable energy generating capacity, CTUIR must do so in solidarity with — not at the expense of — other Tribes and Indigenous Nations.

Short Term:

- **Organize and facilitate opportunities to provide Tribal community engagement and education of communities impacted by energy development**. One regional example within CTUIR's traditional use area is Tribal communities impacted by lithium mining on the Oregon-Nevada border at Thacker Pass, or Peehee mm'huh, sacred land for the Northern Paiute, Fort McDermitt Tribe, Western Shoshone, and Reno-Sparks Indian Community Tribal people, and with other Indigenous people globally.

C. Continue to Monitor and Engage with Hanford Nuclear Reservation

"With the Tribes successes there has also been many issues to attend to. The Columbia River fisheries are dwindling, the forests are sick, the water is polluted. Through our Country passes thousands of miles of roads, power lines, pipelines, extensive irrigated land, water issues, forest and mineral speculators, private industry, developers, county, state, and Federal agencies and governments. Within the CTUIR aboriginal territories is the Hanford Nuclear Site the most polluted place in the Western Hemisphere (CTUIR Comprehensive Plan 2010)."

i. Support NRDA's Tribal Loss Service Scenario and Injury Determination Process

Previous sections have identified the need to determine Tribal Member-specific exposure pathways for climate change impacts. The CTUIR Hanford Natural Resource Damage Assessment (NRDA) has already begun to conduct these kinds of exercises. Steps

within this process are reaching a completed stage, and CTUIR is in a unique position to include human health exposure within this legal damage assessment process.

Short Term:

- **Engage with Tribal-specific estimates of impacts from energy development and climate change**. NRDA team members have developed formulas to incorporate radiation exposure injuries incurred through practicing Treaty Rights at the HNR site that put CTUIR members at risk, and need to be understood. This risk calculator could be used as a template for similar considerations of climate change impacts to Tribally-specific cultural activities and practices.

Long Term:

- **Develop a CTUIR "threshold opinion" about the risk of exposure at Hanford to inform health policy**. Using the NRDA risk calculator tool, Tribal policy makers are able to consider and model complexities that exist around radioactivity exposure and impacts to human health, with the benefits and opportunities to culturally connect with Hanford's unique ecosystems and artifacts.

ii. Develop Education around Hanford Concerns

Millennia-long half-lives of many of the radioactive contaminants from operations at Hanford will persist far longer than can be reasonably controlled by current government access restrictions. CTUIR retains Treaty Rights into perpetuity on this same site. Cultural sites like pit houses on the UIR and Ceded lands date back 4,500 years at least, and provide undeniable evidence that CTUIR has managed and utilized the Columbia River Central Plateau for First Foods harvest and cultural practices far longer than any other stewards of these lands, and that Tribal people will always be present on the site.

Short Term:

- **Develop opportunities for education about processes and issues with Hanford restoration efforts**, long term planning, injury assessments and Tribally specific exposures, as well as opportunities to create new "Coyote Stories" that could be used to extend these lessons and warnings to generations in the far future.
- **Organize and implement opportunities to educate CTUIR staff and leadership on Hanford issues**, and build communication capacity on negotiation process input between departments and programs.

Long Term:

- **Organize and facilitate regularly-occurring educational outings to learn about the effects and governance of the Hanford 100-F site, especially for Tribal youth and students** who will be the next generation of stewards. These could include field trips to the site as appropriate, student research projects about remediation and long term stewardship, and a dedicated on-site learning exchange/"day camp" format, to increase understanding of these issues, among other opportunities.

iii. Build CTUIR Capacity to Biomonitor Hanford Ecosystems

In connection with "Treatment as State (TAS)" Tribal sovereignty goals, continuing to monitor and collect information about conditions at Hanford will be essential to long term stewardship of this unique site. CTUIR has a number of developing

opportunities to conduct biological monitoring of ecosystems and First Foods in these affected areas.

Short Term:

- **Secure and implement funding for internal program or contracting capability to implement biologist full time equivalent (FTE)** (1.0 or more) position, dedicated to building monitoring capacity for the Hanford site specifically. Dedicating staff energy to a coordinated monitoring approach for the unique conditions of Hanford would improve engagement with the site.
- **Develop additional contaminant monitoring protocol and activities using the Hanford NRDA risk calculator as a foundation.** Other environmental contaminants of concern could include microplastics and polyfluoroalkyl substances (PFOS/PFAS), among others.

Long Term:

- **Conduct and support artificial environmental monitoring projects,** which involve the use of sampling tools or artificial mimics of First Foods like freshwater mussels, to uptake targeted contaminants at a documented rate. These monitors and can be used to approximate the potential contamination of First Foods in these locations to estimate risk and safety to engage with and consume those plant and animal species.

- **Conduct and support comparative environmental research approaches.** This is likely to involve performing or inventorying scientific studies with a goal to improve CTUIR understanding of how environmental threats affect First Foods (as well as access and availability). These research approaches can be extended to other questions of contamination such as per-and PFAS and fate & transport of mobile contaminants.

- **Invest in and expand use of long term stewardship control technologies** like the Ishtish Project, which involves developing natural institutional traffic control 'technologies' for CTUIR on sites like Hanford. Improving conditions to restore culturally-significant species on the site for multiple purposes can reduce non-cultural access to lands and reduce risk of unintended radioactivity exposure. These projects and are aimed at providing traffic-reducing services for access into an uncertain future.

Hanford Nuclear Reservation (HNR) is culturally part of CTUIR history. Cultural knowledge keeper Althea Huesties-Wolf examines historical artifacts while on a tour of the site.

iv. Engage with Cultural Site Protection

Tribal burial grounds are located in the northwest section of the 300-Area on the Hanford site near the Columbia Generating Station, and are of great cultural significance to CTUIR. In 2011, a process was started to identify specific contaminants on the site, but there still hasn't been any conclusions released on exactly what contaminants are present to date. Though it is an ongoing process with which CTUIR Energy and Environmental Science Program (EESP) is monitoring and engaged. Artifact pit houses on Columbia River islands near the Central Plateau HNR site are also

present as evidence of CTUIR's historic and ongoing claim to lands and resources used by Hanford.

Short Term:

- **Coordinate discussions with CTUIR Board of Trustees (BOT), General Council (GC), and committees and commissions to determine issues of access to the Hanford site**, including legal and technical definitions of "human exposure." Such definitions could be part of an access agreement as part of a future Hanford NRDA settlement.

Long Term:

- **Advocate for the recognition of cultural and First Foods concerns at the Hanford site, and for the inclusion of Tribal leadership and engagement in demonstrating the complexity of Hanford issues**. NRDA and EESP staff need to coordinate on certain activities, and provided capacity and guidance to participate in intergovernmental discussions for long term planning. There are still large gaps in knowledge of highly toxic contaminants for the site that impact Tribal resource decision-making.

v. Define "Renewable" and "Alternative" Energy Positions at a BOT Level, Especially with Potential Use of Small Modular Nuclear Reactors (SMNRs)

Nuclear energy is another source of power often classified as "renewable" or "alternative" to carbon-intensive energy sources, though it poses significant challenges in the resource impact it creates. CTUIR has a unique relationship with nuclear energy, as the legacy of nuclear development looms with the Hanford Nuclear Reservation is located within the Tribe's Ceded lands, with Treaty Rights retained on some of the most contaminated soils in existence. Clean-up efforts at Hanford have identified the need for ongoing power generation at the site, and have proposed the use of Small Modular Nuclear Reactors (SMNRs) to meet this energy demand.

Short Term:

- **Advocate for community and leadership understanding of nuclear energy concerns at Hanford.** Nuclear energy issues are extremely complex, and thus must be considered by Tribal leadership in an evolving and ongoing process. CTUIR Board of Trustees (BOT) and General Council are the formal decision-makers within Tribal governance, and frameworks that allow for constructive and progressive conversations about the role of nuclear power within Hanford, and around the region must be implemented for ongoing decisions.

- **Update CTUIR Hanford Policy to provide guidance around SMNRs**. Currently guidance on additional nuclear capacity provided in this document states: "It is the policy of the CTUIR that. . . Hanford and Hanford-affected lands and resources should not be further developed and no new nuclear missions or expansion of nuclear energy. . . undertaken unless explicitly permitted by the CTUIR Board of Trustees through government-to-government consultation (CTUIR Hanford Policy, 2007)."

Long Term:

- **Update CTUIR Energy Policy to expand on issues like Hanford and climate impacts to energy generating potential.** Currently the document provides guidance, stating

"CTUIR may face some difficult choices in whether to accept such risks in order to see power generation sources built that are large enough to offer real alternatives to power generation sources that impact salmon, whether through climate change (coal and natural gas fired power plants), or through more direct impacts (hydropower) (CTUIR Energy Policy, 2009)."

vi. Engage with Ongoing Hanford Restoration and Decision Making

CTUIR will always retain Treaty Rights on Hanford site lands, and are actively engaged with decision making and long term planning for restoration and remediation of contaminants, with a focus on Tribal Member health and safety. CTUIR will continue to participate as a sovereign entity with these processes in many different ways. U.S. Department of Energy (DOE) has produced a "Vision of the Future for Hanford" document, which largely revolves around energy, with which CTUIR needs to be involved to maintain Tribally-desired outcomes.

Short Term:

- **Participate as appropriate with current Hanford activities** (2021-2026), including Tank Waste Clean Up, Central Plateau Clean Up, and River Corridor Clean Up efforts. CTUIR has managed the lands Hanford is located on since time immemorial, and has a long-term investment in remediating these lands and waters.

- **Maintain and expand Hanford Air Quality Monitoring Plan** to assert CTUIR's involvement as a sovereign entity to be recognize by other state and federal sovereign participants. Tribes have unique mechanisms to improve monitoring and reporting of conditions for Hanford, thus maintaining and expanding sovereignty in the form of regulation and data collection is essential.

- **Organize CTUIR staff involvement in Hanford reporting**, and estimate staff time needed to provide science-based comments to the Hanford NRDA process.

Long Term:

- **Continue with Tri-Party Agreement (TPA) Milestone Tracking**, which allow CTUIR to leveraging relationship capital to influence TPA regulators towards Tribally-desired outcomes. As a uniquely sovereignty entity that participates with this agreement, continuing to emphasize CTUIR's presence and interest in the site reminds all involved of the longer legacy of the location and the importance of Tribal sovereignty.

Hanford's 100-F site in CTUIR's northern Ceded lands is a paradox of risk and beauty. Because of the nature of work conducted with the Manhattan Project circa 1945, the site is both contaminated by radioactivity and preserved from the type of development that occurred along the rest of the Columbia River ecosystems.

Measuring Success and Gaps in Energy Generation Adaptation

How Do We Measure the Success of These Adaptations?

"The Creator placed us here, at this place, and ever since we have been inextricably connected to the lands, processes, resources, and other people of the Columbia Plateau and beyond. The Creator loaned us the air, the water, the fish, the game, the plants and the medicines, and we honor this by conserving these resources to ensure their availability for current and future generations (CTUIR Energy Policy, 2009)."

- **CTUIR Energy Policy (2009)** Energy Goals (pages 20-24)
- **CTUIR Strategic Energy Plan (2022)** Part 3: Energy Vision Qualitative Performance Measures (Table 6, page 22) and Targets and Tracking Measures (Table 7, page 23)
- **Comprehensive Plan Objective 5.15.1:** Enhance Tribal sovereignty through energy independence (see Comp Plan page 127 for benchmarks);
- **Comprehensive Plan Objective 5.15.7:** Diversify sources of energy and reduce overall energy use to reduce the CTUIR's consumption of fossil fuel (see Comp Plan page 127 for benchmarks);
- **Comprehensive Plan Objective 5.15.3:** Diversify the CTUIR economy through energy investment in all feasible aspects of energy including power generation and bio fuels (see Comp Plan page 127 for benchmarks).
- **CTUIR Comprehensive Economic Development Strategies (CEDS) Objective 20:** Support CTUIR efforts to acquire lands through federal land transfer, such as at the Hanford Site.
- **CTUIR Hazard Mitigation Plan (2021) Section 3**: Hazard Identification and Risk Assessment Results (page 68-190).
- **CTUIR Hanford Policy (2006)** benchmarks
- Geothermal generation potential feasibility study (2018)

What Gaps in Knowledge, Policy, Capacity, or Education Exist?

- Many gaps exist for renewable energy generating potential; resource assessments and feasibility studies are needed.
- Future energy generating potential for regional small-scale renewable projects.
- How future policy and legislation will impact what is permitted in energy development and transmission.
- Whether market forces will encourage a regional shift to non-hydroelectric renewable energy.
- How other unforeseen circumstances like cyberattack, terrorism, and huge disasters, like a potential Cascadia earthquake, will affect future energy production, among others.

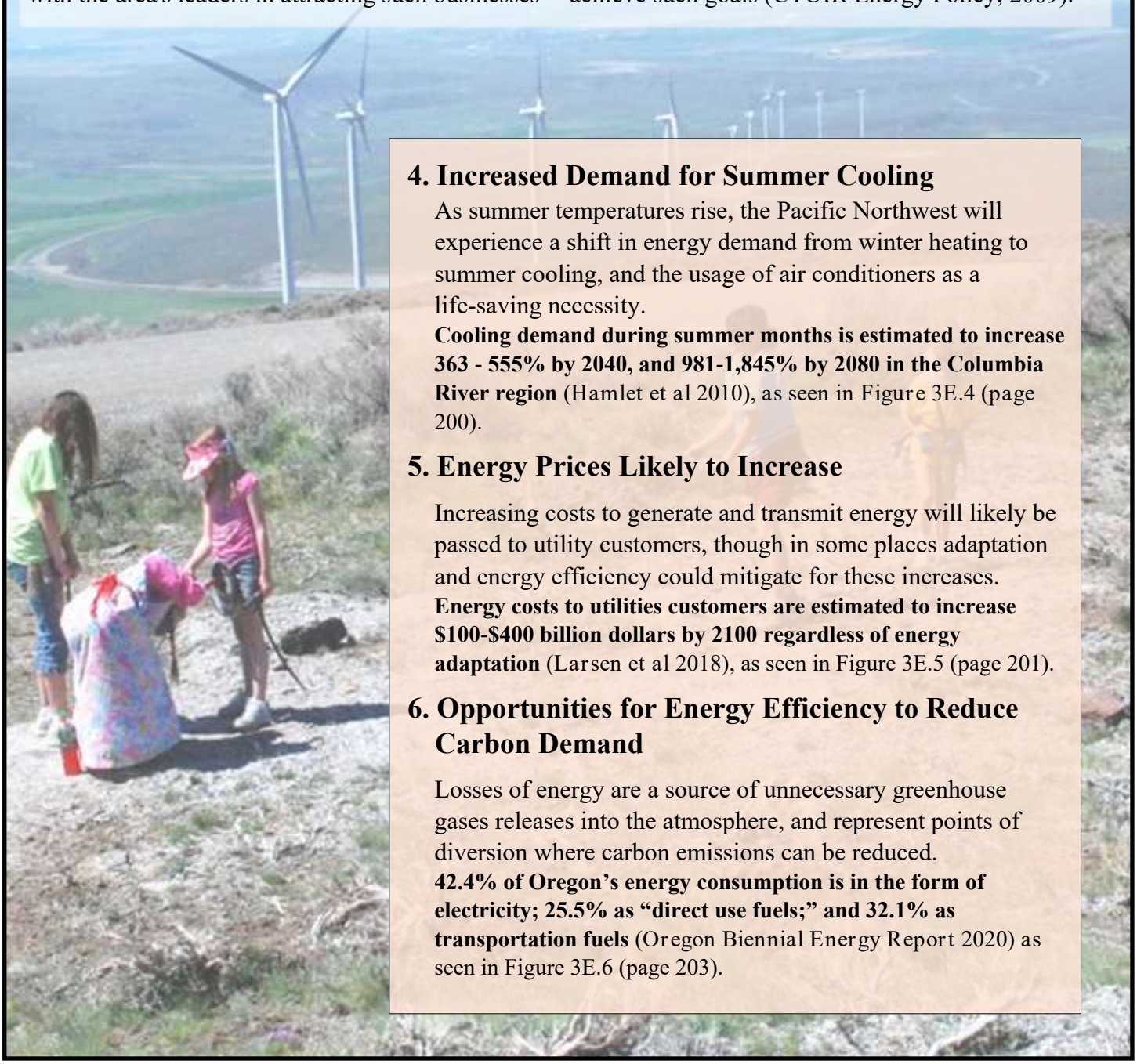
View of Bonneville Dam on the Columbia River in Oregon at night, as seen from a Tribal fishing scaffold, as the facility is lit up. Photo by Bud Herrera.

Climate Impacts for **Energy Use & Cost**

"Climate change and rising energy costs are creating economic opportunities in developing more efficient appliances, vehicles and buildings, increasing energy conservation, alternative fuels development, and renewable energy, especially wind and solar.

CTUIR must continue its efforts to maximize such economic development opportunities and help Tribal members gain access to related job training opportunities. To expand on such opportunities, we must reach out to potential partners, work closely with the area's leaders in attracting such businesses to the Reservation or our neighboring communities, and work closely with the State legislature and Congress to ensure that Tribal governments can benefit from tax incentives and bond financing available to private individuals and state and local governments.

CTUIR must focus on upgrading its workforce, improving its infrastructure and creating efficient business organizations if it is to capitalize on new development opportunities, as well as improving the necessary coordination between our departments to achieve such goals (CTUIR Energy Policy, 2009)."



4. Increased Demand for Summer Cooling

As summer temperatures rise, the Pacific Northwest will experience a shift in energy demand from winter heating to summer cooling, and the usage of air conditioners as a life-saving necessity.

Cooling demand during summer months is estimated to increase 363 - 555% by 2040, and 981-1,845% by 2080 in the Columbia River region (Hamlet et al 2010), as seen in Figure 3E.4 (page 200).

5. Energy Prices Likely to Increase

Increasing costs to generate and transmit energy will likely be passed to utility customers, though in some places adaptation and energy efficiency could mitigate for these increases.

Energy costs to utilities customers are estimated to increase $100-$400 billion dollars by 2100 regardless of energy adaptation (Larsen et al 2018), as seen in Figure 3E.5 (page 201).

6. Opportunities for Energy Efficiency to Reduce Carbon Demand

Losses of energy are a source of unnecessary greenhouse gases releases into the atmosphere, and represent points of diversion where carbon emissions can be reduced.

42.4% of Oregon's energy consumption is in the form of electricity; 25.5% as "direct use fuels;" and 32.1% as transportation fuels (Oregon Biennial Energy Report 2020) as seen in Figure 3E.6 (page 203).

4. Increased Demand for Summer Cooling

Demand for energy intensive cooling in the Pacific Northwest has historically been low compared to other places in the U.S., but climate change is likely to increase the demand for air conditioning through the century, as extreme heat events become more common.

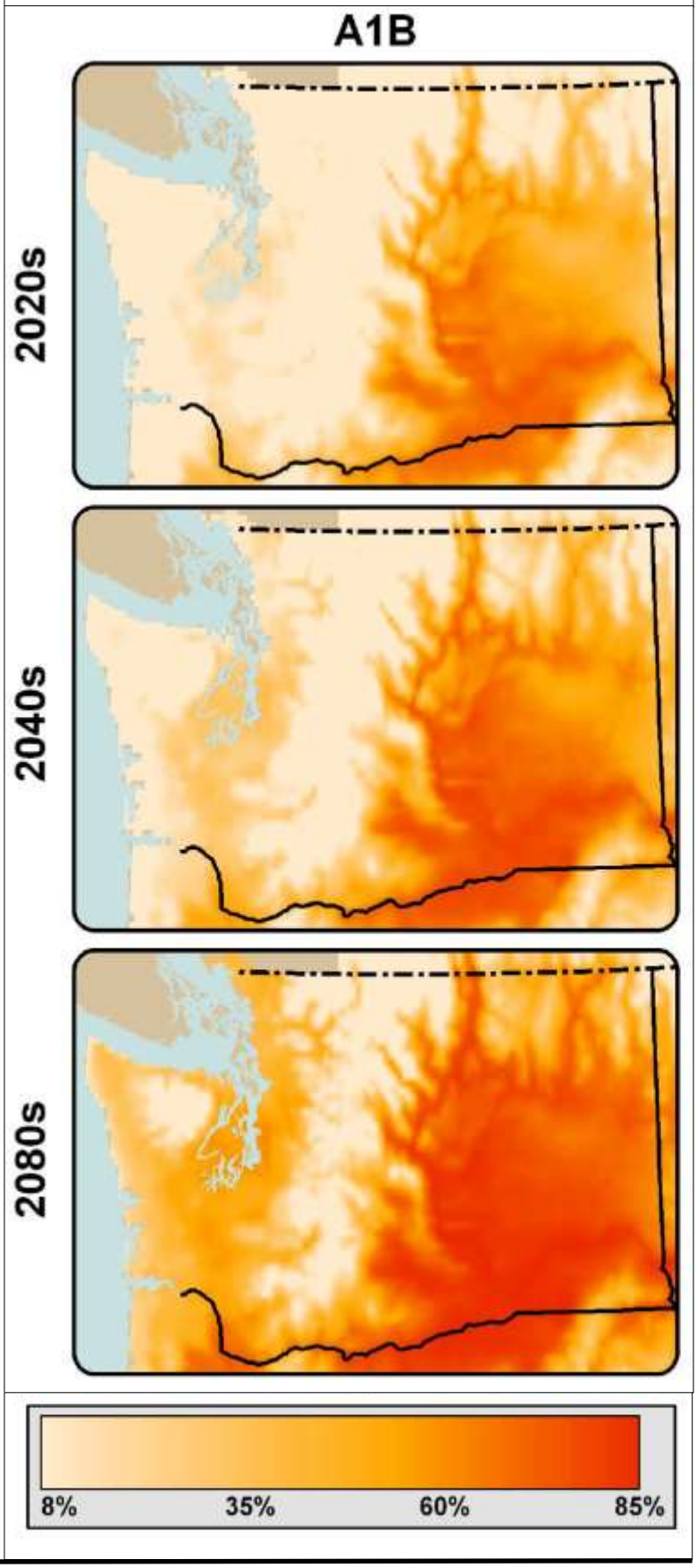
Figure 3E.4 shows how the current density of energetic cooling demand increases over time, as a percentage of historic air conditioning demand, under an A1B scenario at three future points.

- Through the 21st Century (2080), demand for air conditioning dramatically increases, in even the coastal regions of the Pacific Northwest. This summer demand for increasing energy comes during a season when hydroelectric energy generation will be reduced. This disconnect in supply and demand is likely to negatively affect energy users in both energy availability and affordability of services.
- **Cooling demand during summer months is estimated to increase by 165-201% by 2020, 363-555% by 2040, and 981-1,845% by 2080 in the Columbia River region**, due to increasing heat, and to population growth.
- For many places in the Pacific Northwest, the presence of air conditioning will become a life-saving technology and a human right.

For many people, emergency and health needs may face unfortunate choices in managing for indoor air quality, extreme heat, and ventilation needs. Combined with increasing risk of energy transmission interruption, securing cooling needs during extreme heat events is a public health concern. Health policies that assist with equipment and decision-making needs, as well as increased energy resilience, could help mitigate again these effects.

(Credit: Hamlet et al 2010)

Figure 3E.4: Future Summer Cooling Demand Increases



Gaps in Knowledge/Data/Policy:

- Initiatives to improve passive cooling and how these could reduce energy burdens;
- Population changes that incorporate potential domestic and international climate migration;
- Additional heat burdens from "heat dome" events like June 2021.

5. Energy Prices Likely to Increase

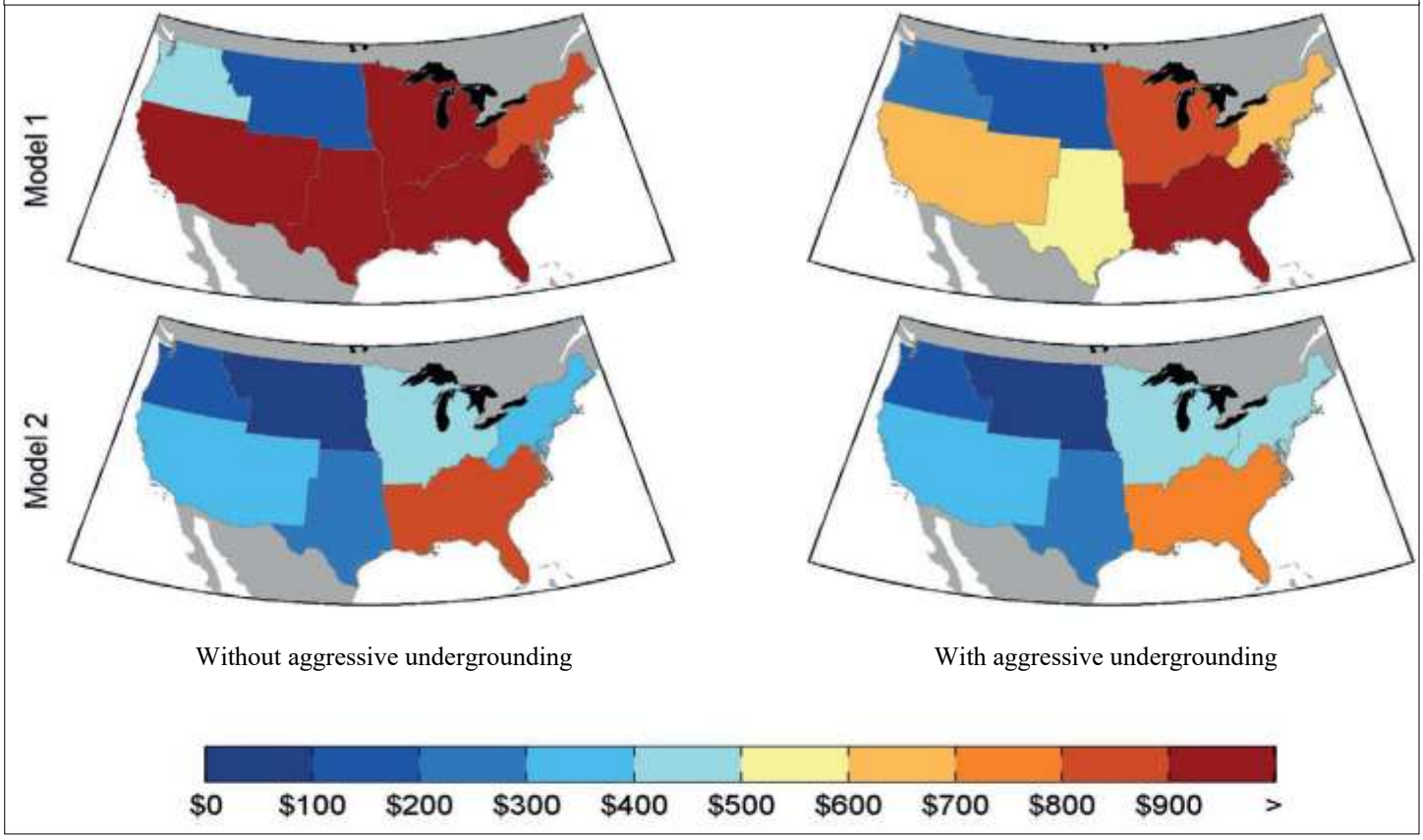
Climate impacts to energy generation will likely cause increasing maintenance costs, decreased reliability of delivery, and risk of hazard due to transmission. The cost burden of this increase is likely to fall largely on utilities users and taxpayers. Regions of the South-western United States could provide some information about future conditions the Pacific Northwest may experience. Rolling blackouts are now a seasonal norm in California State, while extreme heat events cause surges in demand for cooling as a life-saving measure.

In addition to the potential for increased risk from extreme weather events, aging power systems infrastructure, and decrease in power system reliability add to the risk of rising electricity costs and shortages.

Figure 3E.5 illustrates the importance of planning ahead for these electrical grids.

- Two different predictive models were run to estimate power system reliability: these maps show cumulative costs through the end of the century for RCP 8.5 scenario.
- Cumulative energy costs at the end of century (2100) in billions of dollars (2015 USD) are shown in the color coded gradient: colors in blue represent $0-400 billion dollars for electricity; yellows and oranges represent $500-800 billion dollars, and red colors indicate 900+ billion dollars in energy costs directly tied to increasing demand of production and transmission.
- Models 1 (top row) and 2 (bottom row) represent the highest and lowest cost estimates across the four models considered, respectively. Within the models, energy reliability was measured by how often customers experience sustained electrical interruptions, as well as how long an average electrical interruption lasts. These two measures were

Figure 3E.5: Cost of Electric Utility Service With (Right) and Without (Left) Climate Adaptation under RCP 8.5



incorporated in the two models in ways that were based on realistic customer and energy utility behavior (Larsen et al 2018).

- For the study, "undergrounding" indicates an assumption that power system planners and policymakers at all levels have perfect foresight for risks, and immediately implement proactive strategies to reduce the frequency, typical duration, and the cost of power interruptions to customers. The effect of this planning is represented in the maps on the right in the figure (Larsen et al 2018). Factors include: abnormal weather, utility sales, Operations and Maintenance (O&M) spending, share of underground line miles, and other variables relevant to energy transmission resilience.
- Mid-Century estimates (2050) for cumulative customer costs nationally are projected to be $1.52 -$3.43 trillion per year without aggressive undergrounding; and $1.50-$2.51 trillion per year with aggressive undergrounding (Larsen et al 2018).
- End of the century costs (2100) nationally are projected to be $1.92-$5.62 trillion without undergrounding; and $1.95- $3.63 trillion with aggressive undergrounding.
- For the Pacific Northwest region, **energy costs are estimated to increase $100-$400 billion dollars by 2100 regardless of energy adaptation**. This non-response to adaptive measures in PNW region was the only part of the U.S. where this prediction was observed (Larsen et al 2018).

Full-scale implementation of potential technologies to reduce energy demand and improve transmission reliability would likely reduce future costs, though installation and maintenance of these technologies will require large investments by utilities. For the risk reduction scenario in Fig 3E.5 "with aggressive undergrounding," it is known that future power system reliability will continue to worsen, and there are only a limited number of options available to planners to reduce the impacts to customers. Advocacy of regional energy suppliers to proactively plan for increasing costs could buffer some of these effects for utility customers.

(Credit: Larsen et al 2018)

Gaps in Knowledge/Data/Policy:

- Rate of implementation of energy decentralization by communities;
- Advancements in energy efficiency, generation, and resilience that could improve outlook;
- How co-occurring impacts to energy systems could compound issues.

6. Opportunities for Energy Efficiency to Reduce Carbon Demand

"One of the most effective methods of fighting climate change is to reduce the use of energy that releases carbon dioxide into the atmosphere, i.e. conservation of energy. Conservation is also important in reducing Tribal Member's power bills, reducing Tribal government costs, and reducing the pressure to trade salmon for hydropower. Our challenge will be in promoting the development of and making use of new technologies, tax incentives and grants, and other tools to conserve energy. We need to more aggressively address weatherization of and energy efficiency in Reservation homes, businesses and government buildings through investing in improvements, providing incentives and updating Tribal laws. More energy efficient transportation and reduction in our use of fossil fuels also will be key (CTUIR Energy Policy, 2009)."

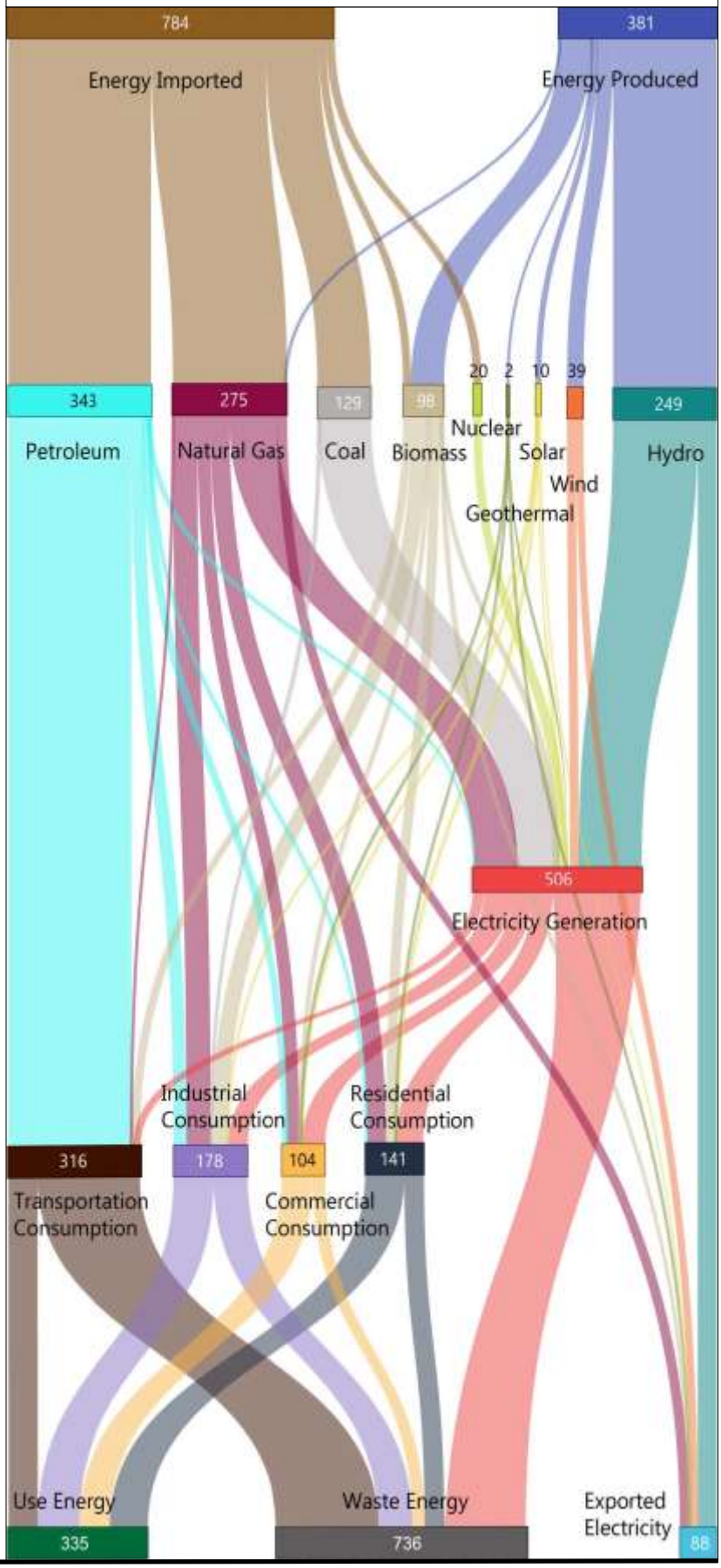
Energy used by Oregon utilities comes from a variety of sources, and goes to many different end uses. Loss of energy due to poor efficiency is possible at every step of this process, and represents a waste of carbon used in the generating process. Because many energy sources still come from burning fossil fuels, reducing the inefficiency of energy transmission and use creates opportunities to reduce losses and require less energy as a result.

Figure 3E.6 traces the flow of energy in the state of Oregon from its source to its end use in recent years, and illustrates opportunities to improve energy transfer and reduce waste.

- At the top of the figure, types of energy are both imported to and produced in Oregon, measured in trillions of British Thermal Units (BTUs) (measurement of the heat content of fuels or energy sources). This data is representative of current conditions measured during 2020.

- The energy lines flow down to show the different types of resources that produce them (hydroelectricity, natural gas, solar/ photovoltaic, and others), and where they end up in Oregon's energy story— from transportation fuels to the natural gas and electricity that supplies homes and businesses. Some energy ultimately goes unused as "waste" (bottom center) and some is exported to other states (bottom right).
- "Energy imported" includes all imported energy to the state, both in raw form or after transformation into other usable forms. For example, some resources are used to create electricity, which is then distributed to different sectors. Other resources are transported to sectors to be consumed as 'direct use fuels,' like those used in supplementary power generators.
- The flow to "waste energy" includes all of the energy that is not harnessed, from the point of extraction, to the point of use. This includes energy lost as heat during combustion or transformation into electricity, losses during transmission, and many other factors. This flow represents opportunities to improve transmission systems to reduce demand for the production of new energy sources (Oregon Biennial Energy Report, 2020), measured at 736 BTUs in 2018.
- **42.4% of Oregon's energy consumption is in the form of electricity** that powers our daily life. Much of this is generated in the Western U.S. and within Oregon.
- **25.5% of Oregon's energy consumption is as "direct use fuels,"** which include fuel oil and natural gas used to heat homes and commercial spaces, fuels used for other residential purposes, like gas stoves, solar thermal heating, and fuels used directly in industrial processes. In 2018, Oregon used 251.5 trillion BTUs of direct use fuels.
- **32.1% of Oregon's energy consumption as transportation fuels** like personal, passenger, and commercial vehicles, both on and off the roads; plus airplanes, boats,

Figure 3E.6: Energy Products and Destinations in Oregon State



barges, ships, and trains. Nearly all transportation-related sources of energy are imported from out of state for in-state use. Oregon's transportation sector consumed 316 trillion BTUs in 2018 — a 185% increase since 1960 (Oregon Biennial Energy Report, 2020).

- In 2018, just 2% of transportation fuel used in Oregon was produced in the state, including 7.3 trillion BTUs of biodiesel and fuel ethanol. Oregon electric utilities provided 0.42 trillion BTUs of electricity to fuel zero-emission vehicles in 2018, about 0.2 trillion BTUs or 48% of which was produced from Oregon resources.

Oregon's emphasis on energy efficiency has helped reduce both total and per capita energy use despite an increasing population, thereby avoiding the need to build new electricity generation plants so far (Oregon Biennial Energy Report, 2020). Petroleum product consumption has steadily increased over time and currently dominates the transportation fuel use in Oregon. Crude oil used at Washington State refineries comes from Alaska, western Canada, and North Dakota.

If energy demand reduction strategies are robust into the future, there is a lot of potential for Oregon to meet its energy demand by investing in renewable and small scale energy, and pairing these efforts with aggressive energy efficiency initiatives. There is also opportunity for greater electrification of heating and transportation sectors that could reduce demand for fossil fuels found in natural gas and gasoline.

(Credit: Oregon Biennial Energy Report, 2020)

<u>Gaps in Knowledge/Data/Policy:</u>

- Speed of electrification of services and how that will change energy demand;
- Scale and speed of other regions in the U.S. to produce energy, and how this generating potential impacts the flow of energy in Oregon;
- How incentives to improve energy efficiency will impact energy demand;
- How policy and market obstacles like net metering will affect energy production.

Tamástslikt Cultural Institute (TCI) implemented renewable energy generation on-site to power climate control services of their museum collection archives. TCI is an excellent example of providing reliable and insulated electricity to important historical artifacts. An electrical grid that is resilient to climate impacts will include diverse energy sources, and is able to interconnect to the larger Western grid, while providing localized generation, especially to priority locations.

D. Pursue Energy Efficiency for Tribal Homes, Businesses, and Facilities

"As a rural Indian Tribe, rising fuel costs are of special concern. High fuel costs will limit Tribal Members' access to health care, educational opportunities, jobs, and cultural practices. High fuel costs will reduce the number of travelers and tourists visiting our Reservation, impacting our Tribal economy. It will impact the ability of the CTUIR to coordinate with state and federal agencies. The CTUIR must support the region's development of alternative fuels and more efficient vehicles to address these concerns, while taking steps to increase public transportation, greater efficiency in its own vehicle fleet, and other methods of reducing fuel consumption (CTUIR Energy Policy, 2009)."

i. Inventory Energy Demand on UIR

Understanding how energy is distributed, demanded, and used on the Umatilla Indian Reservation (UIR) is essential to determining feasibility of energy generation projects. A coordinated energy audit across all CTUIR departments and enterprises, combined with an education and self-reporting outreach effort, could provide necessary information about how energy is used, and how these needs are changing.

Short Term:

- **Organize and implement an education and outreach effort aimed at providing information about energy** use impacts, energy efficiency strategies and assistance programs, renewable energy sources and concerns. This effort should encourage discussion and conservation of energy within Tribal families and communities.

Long Term:

- **Organize and implement a coordinated energy audit of CTUIR facilities, businesses, industry sectors, and other relevant energy uses** on the UIR. This information will be essential in determining feasibility of energy generation projects. Initial data collection about energy use was conducted as part of developing the Energy Strategies Plan, but a dedicated scoping and data collection effort would improve information.

- **Develop and implement a voluntary and confidential self-reporting energy use protocol for families and residents within the UIR.** Initiative participants would consent to identify and share their energy use and reduction strategies, aiming to assist and normalize energy efficiency practices. This information could be used during outreach and incentivizing initiatives, as well as for grant and project funding planning.

iii. "Commission" Existing Tribal Facilities

"Commissioning" is a process of examining the functionality, occupancy, and infrastructure of a facility to determine opportunities for energy use improvement. This process involves balancing the heating/cooling system to run optimally and most efficiently, and can be done for both new buildings, for existing facilities, and can result in significant savings.

Short Term:

- **Partner with Energy Trust of Oregon (ETO) on their commissioning assistance**, which has a robust incentive and cohort program that provides

Passive energy strategies like PV shading for parking facilities. This one at TCI (pictured) provides electricity generation and reduces heat island impacts.

technical assistance with this process, and involves building staff in training and evaluation. Partnering with other reputable and like-minded energy organizations could also bring additional opportunities. and involves building staff in training and evaluation.

Long Term:

- **Continue to support and expand energy commissioning on Tribal facilities** using others that have been thorough the process. Such examples include Yellowhawk Tribal Health Center, which functions at a 60% more efficient energy use rate compared to other buildings, and saves $58,000 annually through passive and active energy reducing building design. Nixyaawii Education Center also received incentives and support for commissioning, early design assistance and "Path to Net Zero" planning (ETO, 2021).

iv. Conduct Passive Features Inventory and Implementation

Building design, orientation, landscaping, and maintenance behaviors can all affect energy efficiency. Utilizing strategies that reduce energy demand without requiring energy input is "passive." There are many strategies that can achieve this reduction that can be implemented.

Short Term:

- **Identify and inventory energy savings come from both passive and active building design**. These include building orientation, daylighting, high performance building envelope, high performance windows, solar heat gain and shading, among others. Strategies which do not actively use energy can reduce energy demand for heating and cooling.

- **Investigate the potential for use of "Variable Refrigerant Flow (VRF)"** in planned and retrofitted CTUIR facilities. Ductless heat pump installation provides heating/cooling through liquid rather than air, in new and existing tribal facilities, as appropriate.

Long Term:

- **Plan to incorporate available passive energy technology into new construction plans and work to retrofit existing facilities** as is feasible. Many of these are likely to require securing capital expenses to implement, though intermediate steps are available to pursue.

- **Develop landscaping strategies that provide opportunities for increasing passive energy savings**. These include planting shade-generating deciduous trees on south facing windows and along walking routes, implementing solar generating panels over parking lot areas to reduce heat island effects, and geothermal exchange building components, among many others.

v. Support and Expand Ongoing Projects and Address Barriers

CTUIR has been actively developing energy efficiency advances in both existing, new, and planned facilities, and works with many partners to make these energy savings successful. Continuing to support these efforts and identifying barriers where they occur,

would improve on these successes and expand energy conservation potential for the CTUIR government and community.

Short Term:

Celebrate and expand on existing Wildhorse Resort and Casino (WRC) Expansion Phase B efficiency measures. These improved energy saving through interior & exterior lighting, Energy Star gas fryers, and tankless water heaters. WRC has received $47,657 in incentives from Energy Trust of Oregon (ETO) to date (2021), with an estimated annual energy savings of 198,000 kWh.

- **Celebrate and expand on existing Nixyaawii Community School (NCS)** energy efficiency obtained through passive and active building design and commissioning, which was completed in 2019. This facility boasts annual energy savings estimated at 330,620 kWh per year, and building performance is 44.7% more efficient than similar buildings. Renewable generation is planned, but not yet installed, and would be an excellent goal for expansion and improvement of this facility.

- **Celebrate and expand on existing Yellowhawk Tribal Health Center energy efficiency.** These gains have been obtained through passive and active building design, high performance envelop, efficient heating and cooling energy recovery, solar panels on covered parking areas, LED lighting, low flow water fixtures, and "Path to Net Zero" planning, completed in 2017. Estimated annual energy savings, is 646,000 kWh, with renewable generation planned, but not yet installed.

Long Term:

- **Continue to pursue and fund planned future energy efficiency measures at Mission Market,** which currently has improved high efficiency LED Lighting.

- **Continue to pursue and fund planned energy efficiency measures at Wildhorse Golf Clubhouse**, which currently has planned improved efficiency for LED lighting, Heating Ventilation and Air Cooling (HVAC) systems, and kitchen equipment.

- **Continue to pursue and fund planned energy efficiency measures for UIR residential development**, which has planned improved energy efficiency for Tillicum Grange in 2015, and Lucky 7 Mobile Home Park existing buildings in collaboration with CTUIR Housing and individual homeowners on different programs available.

- **Continue to pursue and fund planned residential energy efficiency incentives for the new manufactured homes** in the Lucky 7 Mobile Home Park, as well as planned efficiency with the new Nixyaawii Community residential development.

vi. Electrification Capacity

Energy efficiency advances have accelerated in recent years, and electricity provides a large number of opportunities to transition away from fossil fuel sources to renewable energies. Much of the fossil fuel sources that are still used in Oregon are within direct use fuels (ex: natural gas heating for residences) or transportation fuels (ex: gasoline in personal vehicles) and represent potential for electrification.

Short Term:

- **Incentivize or reduce barriers to electrification** of home heating, cooking and other direct fuel uses for facilities and residences within the UIR. Examples for opportunities include (but are not limited to) CTUIR's Nixyaawii Governance Center (NGC), which is heated to a temperature baseline with natural gas, and UIR residences using inefficient wood-burning stoves.

Long Term:

- **Support and expand opportunities to reduce dependence on carbonized transportation fuels**. This could include (but is not limited to) encouraging ridesharing and use of public transportation options, particularly with CTUIR's Kayak Public Transit, expanding the availability of electric vehicle charging stations such as those located at Wildhorse Resort and Casino, and exploring alternative fuel options like biodiesel and hydrogen. See Ch 3C pages 119-121 for additional detail.

E. Improve Access to Energy Training, Education, Financial, and Technical Assistance

Electrification of tasks and services could facilitate a shift to renewable energy, though investment in infrastructure is necessary to making this successful. Electric vehicle (EV) charging stations like the one at Wildhorse Resort and Casino (pictured) expand the capacity of EV feasibility, as "range anxiety" for these vehicles is cited as a large barrier to their wide-spread implementation.

Microenergy projects can be prohibitively expensive, especially if efforts are made to source ethically and responsibly produced energy technologies. Many Tribal communities exist in "credit deserts" that have been systemically denied resident access to financing and reasonable lending to get these projects up off the ground. Renewable and energy efficiency investments often require access to borrowing power, which can be a barrier to implementation for many Tribal communities and families.

Short Term:

- **Connect Tribal communities with weatherization and energy assistance program regional partner organizations**. Partners in this work include Energy Trust of Oregon, which is mandated to assist in finding energy efficiency opportunities and supporting measures to promote it, among others locally and nationally. Working with these agencies can help Tribal families tap into additional funding and networks, and opportunities to expand renewable energy and weatherization for its community. These organizations may also be able to work with the Tribes in technical skills and community development capacity building. Programs like the AmeriCorps Resource Assistance for Rural Environments (RARE) program can provide capacity building. There are also opportunities to partner with AmeriCorps Climate and Energy Corps, and ETO's Trade Ally Network, among others.

Long Term:

- **Expand and support Tribal community access to credit for residential renewable investments**; working with energy assistance organizations and CTUIR's Nixyaawii Community Financial Services (NCFS) to build and bolster Tribal family access to credit for implementing or expanding micro-energy projects would reduce and eliminate many barriers to energy resilience.

Measuring Success and Gaps in Energy Use & Cost Adaptation

How Do We Measure the Success of These Adaptations?

"Decisions on how salmon fisherman accessed traditional fishing sites were commonly made based on the availability and distribution of key salmon runs. The same is true for many of our traditional food-gathering sites, where our once naturally abundant wild foods are beginning to show signs of fading away due to human impacts and climate change. Our ecological knowledge makes us especially sensitive to changing conditions in the surrounding global environment; and our ongoing, common historical experience suggests that these changing conditions will continue unabated (Phillip E. Cash Cash, 2015)."

- **CTUIR Energy Policy** (2009) Energy Goals (pages 20-24)
- **CTUIR Strategic Energy Plan** (2022) Part 3: Energy Vision Qualitative Performance Measures (Table 6, page 22) and Targets and Tracking Measures (Table 7, page 23)
- **Comprehensive Plan Objective 5.5.7:** Enable Tribal members to pursue excellence in education, become self-reliant and to contribute to the Tribal Community (see Comp Plan page 76 for benchmarks);
- **Comprehensive Plan Objective 5.12.2**: Assure that community facilities are operated under the most efficient energy conservation measures. (see Comp Plan page 112 for benchmarks);
- **Comprehensive Plan Objective 5.15.2**: Develop strategies to protect the CTUIR and its Tribal Members from rising energy costs through conservation and development of reliable and affordable energy supplies (see Comp Plan page 108 for benchmarks);
- **Comprehensive Plan Objective 5.15.4**: Empower Tribal Members to take advantage of opportunities in energy related job training (see Comp Plan page 127 for benchmarks);
- **Comprehensive Plan Objective 5.15.5**: Promote energy sustainable business practices on the Reservation and assist local businesses with information and access to tax incentives and grant (see Comp Plan page 127 for benchmarks);
- **Comprehensive Plan Objective 5.15.6**: Encourage energy efficient building practices (see Comp Plan page 127 for benchmarks);
- **Comprehensive Plan Objective 5.15.8**: Utilize all available energy programs that provide incentives for energy efficiency and funding for renewable energy development (see Comp Plan page 127 for benchmarks).
- Energy affordability and reliability for UIR residents.

Tribes have been using "biofuel" to process and preserve First Foods since time immemorial. Modern life requires access to electricity, and is closely linked to burning fossil fuels. Energy efficiency improvements can reduce energy cost and demand, and improve quality of life.

What Gaps in Knowledge, Policy, Capacity, or Education Exist?

- UIR-wide energy audit, or voluntary self-reporting on energy use and energy demand of facilities and communities;
- Knowledge of how disruptions in electrical transmission will become more frequent;
- Speed of investment in infrastructure improvements that could reduce energy burdens.

Energy Adaptation Summary

Energy Generation and Transmission Adaptation

A. Support and Expand CTUIR Renewable Energy Generation Potential

B. Implement Tribal Sovereignty in Regional Energy Planning

C. Continue to Monitor and Engage with Hanford Nuclear Reservation

Transitioning away from carbon-intensive fossil fuel based systems requires implementation of renewable energy generation. Various sources of energy are potentially feasible for CTUIR, following community visioning and resource assessments.

Measures of Success:

- CTUIR Energy Policy (2009) Energy Goals (pages 20-24)
- CTUIR Strategic Energy Plan (2022) Part 3: Energy Vision Qualitative Performance Measures (Table 6, page 22) and Targets and Tracking Measures (Table 7, page 23)
- Comprehensive Plan (2010) Objectives 5.15.1, 5.15.3, and 5.15.7
- CTUIR Hazard Mitigation Plan (2021) Section 3
- Geothermal generation potential feasibility study (2018)

Energy Use and Cost Adaptation

D. Pursue Energy Efficiency for Tribal Homes, Businesses, and Facilities

E. Improve Access to Energy Training, Education, Financial, and Technical Assistance

Reducing energy waste has enabled Oregon to meet growing energy demand without the need to create new generation sources. There are still many opportunities to improve energy transfer efficiency, and to reduce demand for energy, especially from carbon-intensive sources.

Measures of Success:

- CTUIR Energy Policy (2009) Energy Goals (pages 20-24)
- CTUIR Strategic Energy Plan (2022) Part 3: Energy Vision Qualitative Performance Measures (Table 6, page 22) and Targets and Tracking Measures (Table 7, page 23)
- CTUIR Comprehensive Plan (2010) Objectives 5.5.7, 5.12.2, 5.15.2, 5.15.4, 5.15.5, 5.15.6, and 5.15.8
- Energy affordability and reliability for UIR residents.

Chapter 3E References and Credits

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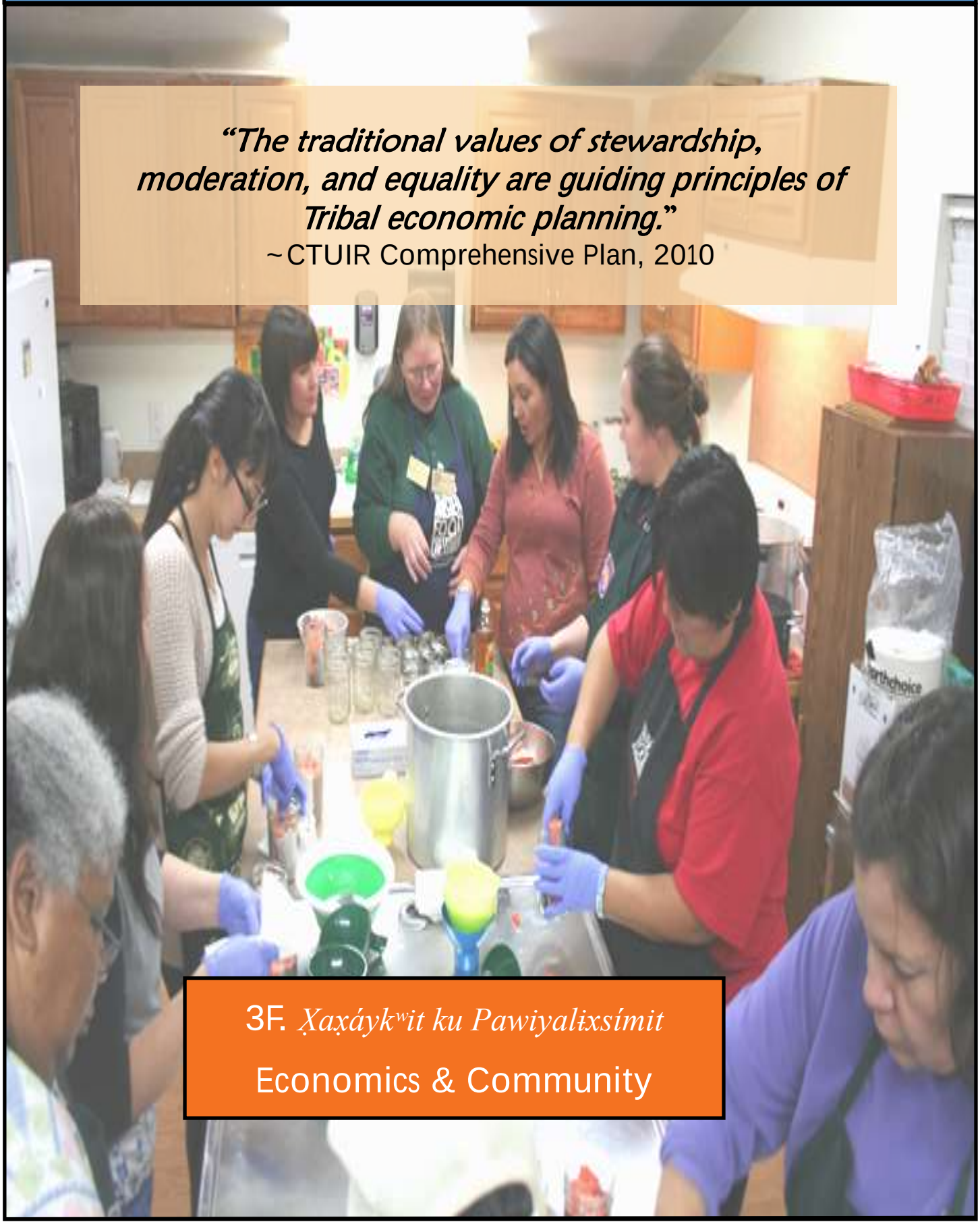
Photo Credits

- Part E Cover Photo; "Greeting from Columbia River Fishing Scaffold." Bud Herrera CTUIR FWC
- Background Photo, "Holding down the Powwow during Storm," CTUIR CUJ July 2022
- Inset Photo, "Fishing Scafolds in the wake of Bonneville Dam," CTUIR DNR CRPP
- Panel Photo, "Bend in the Umatilla River," CTUIR DNR CRPP
- Inset Photo, "Irrigation diversion and fish ladder on Umatilla River," CTUIR DNR
- Panel Photo, "Sunset over Columbia River Bridge through transmission lines," CTUIR DNR CRPP Wenix Red Elk
- Inset Photo, "Tribal forest managers sort through slash," CTUIR DNR
- Panel Photo, "Sunset hues over Winter Blue Mountains," CTUIR DNR
- Inset Photo, "Wind turbine blades traveling through UIR by rail," CTUIR DNR FFPP 2022
- Panel Photo, "Irrigation wheels and straw bales near WRC," CTUIR DNR FFPP 2022
- Inset Photo, "Huckleberry drying on Tuli mats in cultural revival," CTUIR DNR CRPP
- Panel Photo, "High Voltage Transmission towers over HNR and

Columbia River," CTUIR DNR FFPP 2020
- Inset Photo, "First Foods being prepared for cultural longhouse meal," CTUIR DNR CRPP
- Panel Photo, "Purple Fireweed blooms in Blue Mountain forest understory," CTUIR DNR CRPP Wenix Red Elk
- Inset Photo, "The Dalles Dam lit up at night viewed from fishing scaffold," CTUIR FWC Bud Herrera
- Background Photo, "Tribal youth exercise Treaty Rights near wind turbines," CTUIR DNR CRPP
- Inset Photo, "View of TCI wind turbine and building on approach," CTUIR DNR FFPP 2022
- Panel Photo, "Blue sky and white clouds over CTUIR lands," CTUIR DNR CRPP Wenix Red Elk
- Inset Photo, "Solar panels generate electricity and shade for TCI," CTUIR DNR FFPP 2022
- Panel Photo, "Wind turbine at TCI," CTUIR DNR FFPP 2022
- Inset Photo, "Electric vehicles charge at stations in WRC parking lot," CTUIR DNR FFPP 2020
- Inset Photo, "First Foods cook traditionally over longhouse fire pit," CTUIR DNR CRPP
- Summary Photo, "Antuksh Tinqapapt Solar Panel Array powers EESP Field Station," CTUIR DNR FFPP 2022
- Panel Photo, "Glacier on Wallowa Mountains ridge," CTUIR DNR CRPP Wenix Red Elk
- Inset Photo, "CTUIR Fisheries technicians troll Columbia River waters," CTUIR DNR

CTUIR Dept. of Natural Resources (DNR) Fisheries program staff using a transportation fossil fuel in their motorboat to navigate along the Columbia River. Tribes have been adapting to change for millennia, and will continue to adapt. Transitioning to a renewable energy economy and grid must prioritize Tribal connection to First Foods, access to cultural and subsistence harvest, and minimize harm to all communities affected in development of energy generation.



"The traditional values of stewardship, moderation, and equality are guiding principles of Tribal economic planning."
~CTUIR Comprehensive Plan, 2010

3F. *Xaxáykʷit ku Pawiyaɬixsímit*

Economics & Community

Climate Impacts for Economic Development

"Trade and barter was a significant aspect of Indian life on the Plateau, and essential for the survival of Indian people. Indians relied on other Indians to provide goods they themselves were not able to obtain. Often, groups from a single village community would travel different directions as part of their seasonal round. Through years of trade relationships, Elders knew exactly what other Indians needed in exchange for goods they needed (CTUIR Comprehensive Plan, 2010)."

While many current metrics of economies don't capture a number of different elements that make life worth living, economies are important for maintaining trade and the ability to fund different adaptation strategies. Indigenous people in North America have had thriving trade and commerce routes that pre-date European contact, and many of these economies are still thriving today. Diversified sources of income that can help buffer changes and losses that might occur in one or a few sectors, and training, education, and certification, can build resilient families and economies. A robust economy is one that is prepared for change, and one that supports the community in building equitable access to strategies that improve economic and income diversity.

1. Increased Household, Governance, and Emergency Expense

Acute and chronic climate impacts to health and emotional wellbeing will increase costs for healthcare, emergency treatment, insurance compensation, and cost of doing business for all sectors and communities.

Heat exposure related emergency department visits alone will cost an additional $21.9-30.2 million dollars by 2050, and $30.1-69.2 million dollars by 2090 per year across the U.S. (Lay et al 2018) as seen in Figure 3F.1 (page 216).

2. Impacts to Tourism from Disaster and Displacement

Tourism has a role to play in responding to climate impacts, but is also likely to see changes, due to increasing natural disasters locally and regionally.

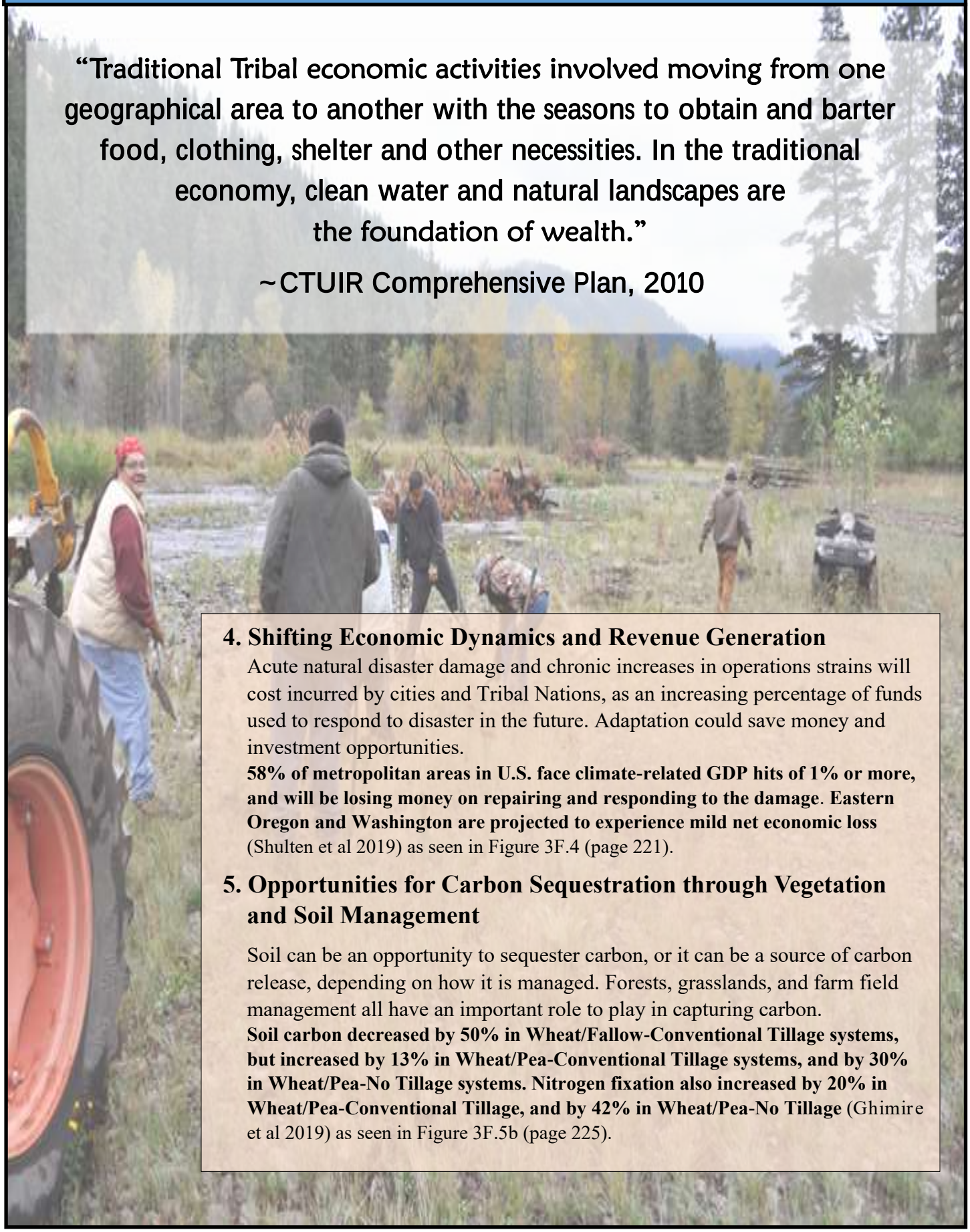
Hotel occupancy increased 43.3% in the directly affected area during the Camp Fire (CA 2018), but decreased by 13.4% during the wildfire event, and by 15.8% post-fire in nearby metropolises (Ward and Mattern 2020) as seen in Figure 3F.2 (page 218).

3. Increased Potential Disruption of Businesses and Supply Chains

Dependence on globally-integrated supply chains leaves communities vulnerable to climate impacts around the world, and even small events can cause direct and indirect risk to production and goods available.

One single natural disaster event, Typhoon Haiyan in the Philippines in 2013, disrupted 6% of U.S. goods production directly, and posed a risk to 21% of all U.S. production indirectly (Levermann 2014) as seen in Figure 3F.3 (page 220).

Climate Impacts for **Economic Development** (cont.)



"Traditional Tribal economic activities involved moving from one geographical area to another with the seasons to obtain and barter food, clothing, shelter and other necessities. In the traditional economy, clean water and natural landscapes are the foundation of wealth."

~CTUIR Comprehensive Plan, 2010

4. Shifting Economic Dynamics and Revenue Generation

Acute natural disaster damage and chronic increases in operations strains will cost incurred by cities and Tribal Nations, as an increasing percentage of funds used to respond to disaster in the future. Adaptation could save money and investment opportunities.

58% of metropolitan areas in U.S. face climate-related GDP hits of 1% or more, and will be losing money on repairing and responding to the damage. Eastern Oregon and Washington are projected to experience mild net economic loss (Shulten et al 2019) as seen in Figure 3F.4 (page 221).

5. Opportunities for Carbon Sequestration through Vegetation and Soil Management

Soil can be an opportunity to sequester carbon, or it can be a source of carbon release, depending on how it is managed. Forests, grasslands, and farm field management all have an important role to play in capturing carbon.

Soil carbon decreased by 50% in Wheat/Fallow-Conventional Tillage systems, but increased by 13% in Wheat/Pea-Conventional Tillage systems, and by 30% in Wheat/Pea-No Tillage systems. Nitrogen fixation also increased by 20% in Wheat/Pea-Conventional Tillage, and by 42% in Wheat/Pea-No Tillage (Ghimire et al 2019) as seen in Figure 3F.5b (page 225).

1. Increased Household, Governance, and Emergency Expense

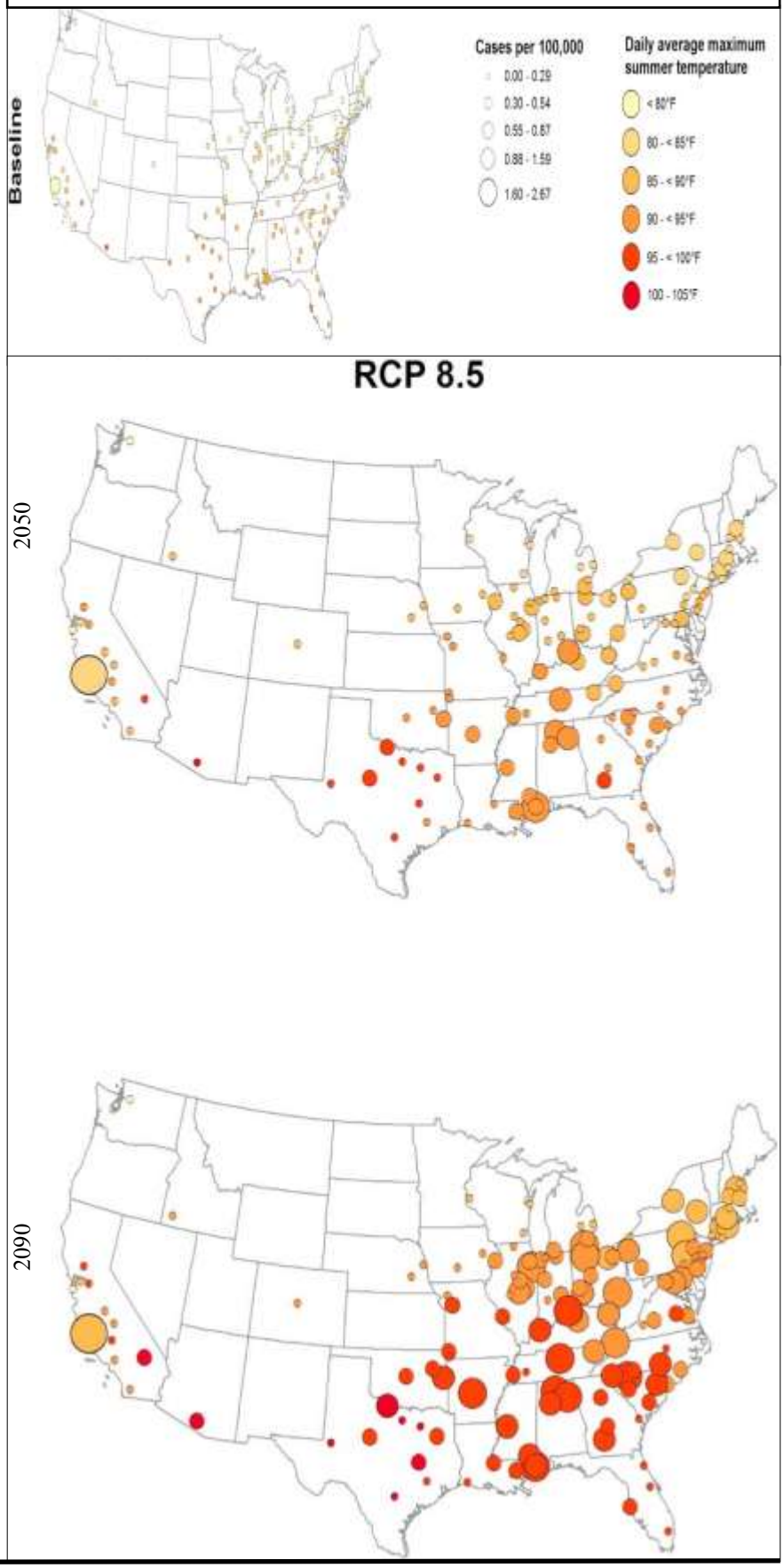
Natural disasters are disruptive events that cause morbidity and mortality, and incur a lot of financial costs in the form of response and recovery. These kinds of disasters are varied in nature, and each will have its own suit of challenges for communities and economies.

Some events like extreme heat can cause damage in many ways, causing complications for people with existing medical conditions, and an increase in urgent care appointments and emergency visits. While extreme heat is likely to have a more devastating effects for other parts of the U.S., atmospheric phenomena like the 2021 "heat dome" are likely to continue to occur, and present acute extreme heat challenges to the Pacific Northwest in the future.

Figure 3F.1 shows the estimated increase in emergency room visits across the United States as a result of increasing extreme heat events in the future.

- Three timeframes are presented under an RCP 8.5 scenario projection: historic conditions are presented as "baseline" in the top map; mid-century (2050), and end-of-century (2090) are shown in the middle and bottom maps. Dot size indicates emergency department (ED) visits per 100,000 cases, while dot color indicates daily average maximum summer temperature in a red scale gradient.
- This research is focused on the effects of summer (May–September) temperatures on three categories of ED visits: hyperthermia, general cardiovascular disease, and myocardial infarctions (heart attacks), in a large portion of the U.S. population, age 64 years and

Figure 3F.1: Projected Increase in Extreme Heat in U.S.



younger, covered by employer-based insurance (Lay et al 2018).

- Heat increases under the RCP8.5 scenario would be associated with an **additional hyperthermia ED visits of 7,800 per year by 2050, and 36,800 per year by 2090,** across the United States (2010 population density). Monetized annual impact is estimated to be **$21.9-30.2 million dollars (2015 USD) by 2050, and $30.1-69.2 million dollars (2015 USD) by 2090** per year across the U.S., solely due to climate-increased heat exposure. These values are conservative and highly dependent on course of treatment and emissions scenarios (Lay et al 2018).
- Within this study, the Pacific Northwest (PNW) is anticipated to see less increase in ED visits due to heat than other regions, though atmospheric phenomena like the 2021 "heat dome" are likely to continue to occur periodically.
- Projections for Umatilla County find occurrences of 90˚F+ days will increase from historic 19 days per year to **29-31 days by early 21st century (2030), and to 39-48 days by mid-century (2050)** (Dalton et al 2020). This expands the seasonal window during which extreme heat is a concern to communities.

Construction workers take a break from work on the new Nixyaawii apartment buildings under extreme heat which will become more frequent.

These results are a conservative estimate of the true economic impact of heat, as it does not account for lost patient or caregiver productivity associated with the ED visit, or a patient's subsequent treatment. Data also do not include large segments of the population that may be vulnerable to hyperthermia and other temperature-related adverse health effects, such as rural residents ages 64 years and younger, all persons age 65+, and those lacking insurance.

Adaptation measures could reduce impacts from heat and other extreme events, especially if preventative public health is centered in response. Proactive adaptations include (but are not limited to): prioritizing natural and engineered shading for buildings and streets, rescheduling events and construction activities to avoid the hottest parts of the day, and ensuring equitable access to cooling, particularly for subsistence harvesters, outdoor workers like field and construction laborers, and for unsheltered community members.

Values presented for emergency department visits due to extreme heat are just one proxy estimate for the cost of responding to the climate crisis. Extreme heat events will occur alongside numerous other extreme weather events, each of which will carry their own additional response costs, and at times occurring simultaneously. Anticipating increasing costs in responding to these disasters will help Tribal families, communities, and governments to absorb impacts to emergency response as they are made worse in the future.

(Credit: Lay et al, 2017)

<u>Gaps in Knowledge/Data/Policy:</u>

- Occupational workers claiming workplace injury compensation as a result of heat exposure;
- Changing population dynamics and how influx of residents to the region might change;
- Effects of adaptation measures on reducing harm from heat exposure.

2. Impacts to Tourism from Disaster and Displacement

Tourism is an industry that brings revenue to the CTUIR businesses and community, with Interstate-84 creating a heavily used thoroughfare connecting densely populated coastal cities with inland wilderness recreation opportunities. Challenges to tourism are likely to occur as an indirect result from other natural disasters, as travel corridors and destinations experience climate impacts.

Not much data is available on how increasing extreme

weather events are likely to alter the ability of tourists to travel, but the hospitality industry can offer some insight into how increasing natural disasters may alter tourism impacts directly from disasters themselves, as well as through the displacement of communities affected. Hotels and other hospitality facilities often become displacement centers during disasters, much like the Wildhorse Resort and Casino (WRC) was able to shelter those who were displaced by the massive flooding event in February 2020.

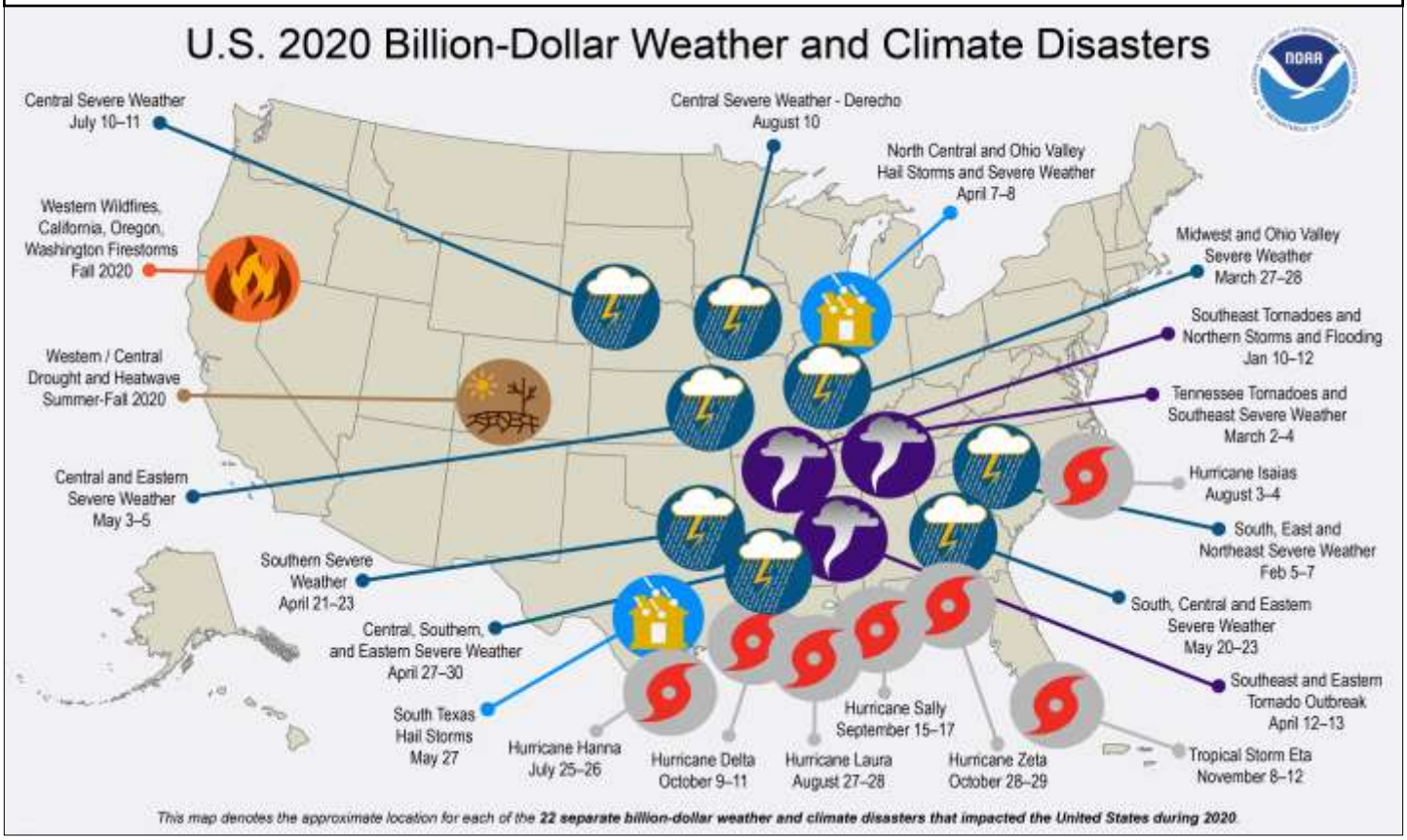
Figure 3F.2 shows the locations of 22 extreme weather events that occurred in 2020 alone that caused at least $1 billion dollars in damage (NOAA, 2020). **The disaster events shown are for just one year, and created $22 billion dollars in damage**. If this trend continues into the future, response and recovery from natural disaster will present a massive drain on local and national economies.

Here in the Pacific Northwest, northern California's deadly 2018 Camp Fire (Nov 8th – 25th 2018) presents an opportunity to examine tourism impacts from a single wildfire event, as well as the response of the hospitality industry in meeting those disaster response needs.

- While Camp Fire had a negative impact on the broader hospitality industry, **demand for hotels increased 43.3% through November 7th to November 27th, 2018** (during the fire) (Ward and Mattern, 2020) in the area directly affected by the wildfire. It is unclear the extent to which this local demand for hotels was driven by displacement of residents, though it is likely to be significant.
- San Francisco, located about 165 miles away from the town of Paradise as the epicenter of the fire, experienced negative impacts due to poor air quality. Average occupancy rates in the San Francisco Bay area in October 2018 are typically 84.4%, but in November 2018, occupancy rates dropped to 71.0%, and by January 2019 (even though the wildfire was fully contained and smoke from the fires was gone), average occupancy rates in San Francisco dropped to 68.6%. This represents a **13.4% drop during the fire, and a 15.8% post-fire decrease in tourism.**

Capacity of the hospitality sector has played a role in emergency response. Many survivors of Camp Fire lost their homes and required immediate assistance, and the hospitality industry provided them with

Figure 3F.2: Number of Billion Dollar Weather Events in the Year 2020



various resources, such as free housing, free transportation service, leisure services, discounts for hotels, and free meals. Local hotels and vacation rentals offered special rates for rooms to Camp Fire evacuees, and were able to find shelter for over 2,500 people fleeing the Camp and other California state wildfires. Ridesharing services also provided discounted and free transportation to evacuees in reaching emergency shelters, hospitals, hotels, and food banks (Ward and Mattern, 2020). Tourism has also played a role in providing mutual aid by partnering with first responder organizations to encourage tourism in support of post-fire recovery efforts.

Wildfires are a significant risk for CTUIR Reservation and Ceded lands, especially if fire erupts in a highly populated and major gathering area like the Wildhorse Resort and Casino (WRC) (CTUIR EOP 2016). Previous wildfire events include a wheat field fire on Kanine Ridge behind WRC; a 2002 fire that burned from Riverside to Highway 331 across seven miles and required 15 responders to extinguish it; a 2002 lighting strike ignited fire near the Pendleton airport that burned almost 200 acres; 14 separate fires during the 2015 fire season, with the largest being the Rock Fire that burned 230 acres, and the Table Rock Fire which burned 218 acres (CTUIR EOM 2016).

Moving forward, communities might prioritize restoration and revitalization of popular tourist attractions to rebuild both community infrastructure and a sense of shared empowerment while actively promoting tourism. Positioning tourism, hospitality, recreation and culinary organizations as facilitators and responders to this process becomes increasingly compelling for linking sustainability, safety and security for guests, visitors and gatherings.

(Credit: NOAA 2020)

Gaps in Knowledge/Data/Policy:

- Detailed information about how tourism is shifting in response to disasters;
- Role that adaptation and mitigation may play in reducing impacts in the future;
- How disasters in other locations may impact local tourism to the UIR.

3. Increased Potential Disruption of Businesses and Supply Chains

Food, energy, and assembled goods are all heavily influenced by supply chain management, and their availability and affordability depend on reliability in production and distribution. Local reliance on globally-produced goods is vulnerable to disruptions in the supply chain, impacting availability and cost.

Fire burns along the Interstate 84 corridor during 2022 fire season, causing road closures that lasted for hours. Risk of fire close to travel infrastructure is likely to increase in the future.

Potential disruptions could be related to natural disasters, human conflict, labor shortages, and other kinds of production obstacles. Transportation is another point of vulnerability for supply chains, as many land and water shipping routes are impacted by the same climate impacts that threaten production.

Figure 3F.3 demonstrates the interconnectedness and vulnerability of a typical supply chain.

- Upper and lower world maps shows how a single natural disaster event in one country can affect global supply chain continuity and availability. These maps show the impact to U.S. and other national supply chains from a single hurricane event that devastated the country of the Philippines in 2013.
- Direct impacts are shown in the top map, and include impacts to production resources sourced in the Philippines. As a direct impact from the

natural disaster, Philippines exports fell after the effects of Typhoon Haiyan in 2013. **6% of United States production relies on supplies from the Philippines,** and these industries were directly affected by supply disruption from one single natural disaster event (Levermann 2014).

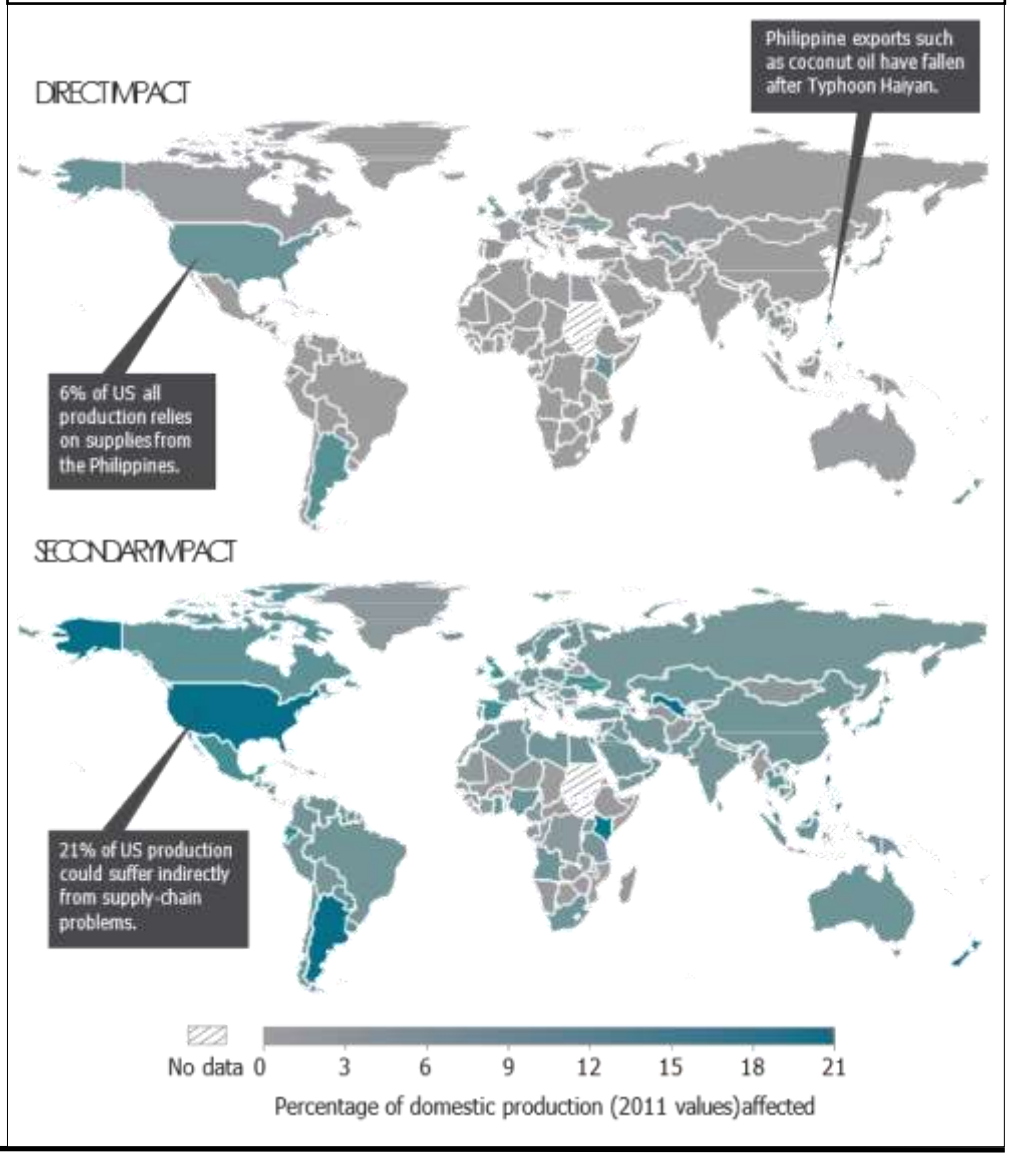
- Secondary impacts are downstream delays and shortages that are a result of direct impacts. Typhoon Haiyan posed an indirect **disruption risk to 21% of all U.S. production**, as a large number of manufacturers and other distribution companies rely on good produced within a globalized supply chain, and will experience greater harm from disasters that occur around the world (Levermann 2014).

Climate impacts to supply chain function and infrastructure are numerous. Sea ports are at risk from direct climate impacts like sea level rise, and ocean acidification that causes accelerated corrosion. Inland communities are also impacted by delays and disruptions, and tend to be reliant on a limited network of supply hubs. Disruption of supply chains has broad implications for both local and global economies, as direct damage to infrastructure and superstructure of ports and their supply chains. Indirect costs are incurred to employment sectors and taxpayers, hazards and unsafe conditions for outdoor workers, as well as intangible consequences like environmental degradation and reduced quality of life in communities near ports.

Additionally, other modes of transportation like railway and vehicle travel will also experience impacts from extreme weather events. Examples include extreme heat and smoke inundation events, which are likely to affect transportation worker productivity. Additionally, energy consumption of chillers and refrigeration units will climb with increasing temperature; flooding damage to Union Pacific railways on Meacham Creek during the Feb 2020 flood resulted in emergency and unpermitted streambank armoring construction work to rescue infrastructure, and may have had a negative impact on First Foods restoration in that area.

Complexity in supply chains -- including a higher number of nodes, links, networks, and redundancy -- will build resilience in the way goods can be sourced and delivered. To build resilience for food systems, diversified and adaptive trade relationships, and robust local production chains will need to be supported. Performing a region-wide inventory to assess which goods are available from local sources could help build redundancy in supply chains, and alleviate

Figure 3F.3: Supply Chain Interconnectivity Affected by a Single Extreme Event



some impacts from global uncertainty. Such an inventory would also allow Tribal businesses, enterprises, and governments to assess what things are being receiving from potentially vulnerable sources. It would also assess where there may be opportunities to support regional efforts to produce these goods locally.

(Credit: Levermann 2012)

Gaps in Knowledge/Data/Policy:

- Sourcing locations of essential goods and what impacts these are likely to experience;
- Uncertainty around global production of goods, currently and in the future.

4. Shifting Economic Dynamics and Revenue Generation

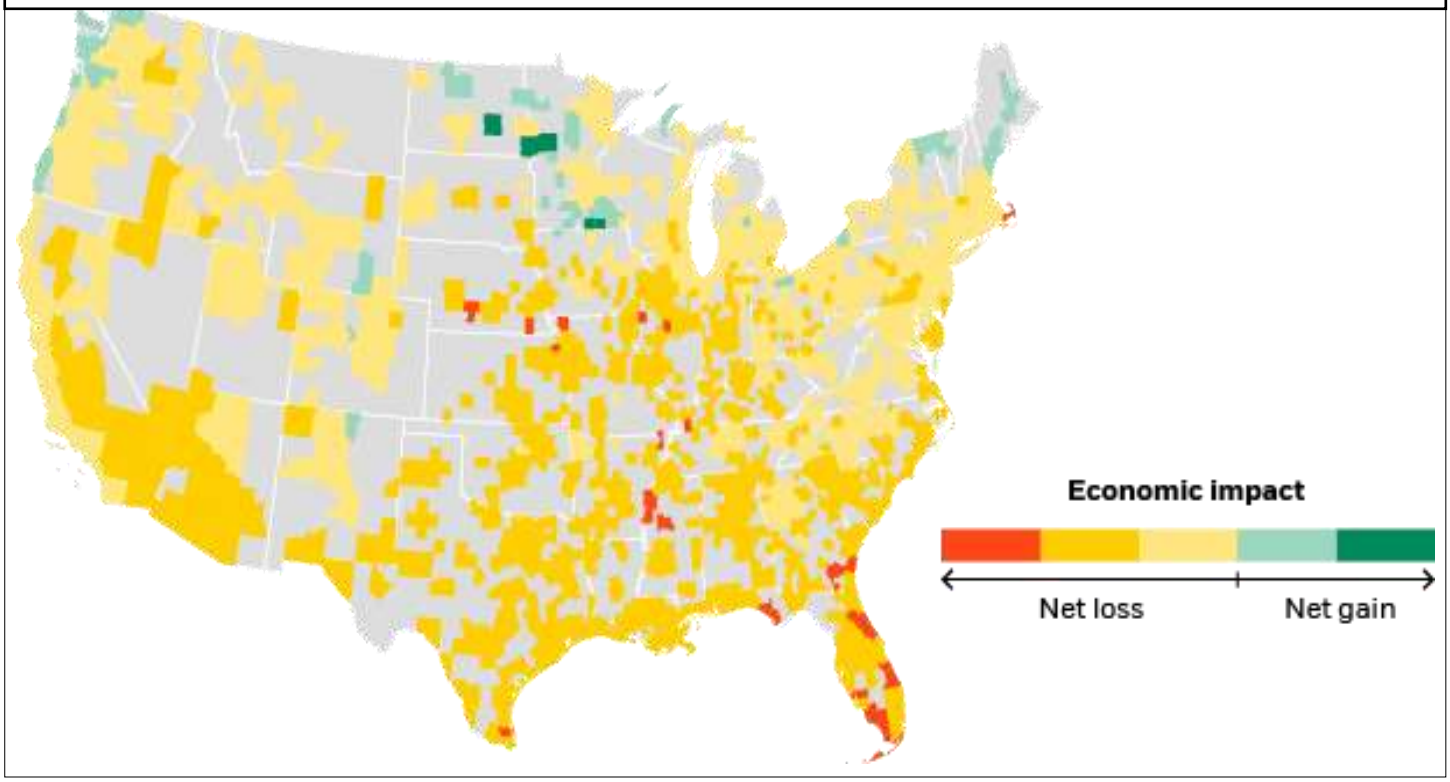
With the effects of the climate crisis, it becomes increasingly difficult to predict the severity and frequency of extreme events. This uncertainty comes with a sticker price to nations, companies, and investors who make up the Global Market.

Calculating investment opportunities is estimated using relatively stable options like municipal bonds, commercial mortgage-backed securities (CMBS), and electric utilities. These are often used to estimate the trajectory and volatility of investment opportunities at local and regional scales. These opportunities are often integrally tied to local communities and governments, and are a good way to analyze effects that proactive climate adaptation might have for securing financial stability in a region.

Figure 3F.4 shows cumulative projections for these three investment options across the United States by the end of the century (2060-2080) under a RCP 8.5 scenario (Shulten et al 2019).

- This study examined climate change impacts to U.S. municipal bonds, commercial mortgage-backed securities (CMBS) and electric utilities across the country, and compared the price of these three market indicators between municipalities that were at higher and lower risk from various natural disasters
- This analysis breaks down the potential net economic impact, and it includes estimates of direct impacts (such as the expected losses from hurricane damage), as well as second-order effects such as changes in mortality rates, labor productivity, energy demand and crop yields.
- These values can be used as proxy estimates on the ability for cities to generate revenue, which sets

Figure 3F.4: Projected Economic Impact of Climate Adaptation on Investment Opportunities



their market value for trading municipal bonds which insure cities against disaster. Estimated economic impacts are indicated on a color gradient: green shades indicate a potential net gain from municipalities that are adapting and preparing for climate change, or are likely to benefit in some way. Yellow to red colors indicate a net loss of economic potential, due to scale of impact and/or a lack of preparation efforts.

- Within this map, **Eastern Oregon and Washington are projected to experience mild net economic loss** from climate change forces. This net loss is likely from a lack of preparation; reliance on vulnerable industries like farming and forestry; and effects from drought and wildfire. Of national large municipalities, Seattle, WA, shows the most resilience, with little projected damage to GDP over time (Schulten et al 2019).
- Across the United States, roughly **58% of metropolitan areas face climate-related GDP hits of 1%** or more, meaning that more than half of the U.S. will be **losing money on repairing and responding to the damage** being done by climate effects.

CTUIR Board of Trustees and other representatives tour the DCFS Tutuilla Food Sovereignty Center under construction in 2021. New infrastructure developed to withstand historic conditions will be unprepared for future conditions with greater stress on systems.

Aging infrastructure tops the list of high costs impacts. This makes the national electric sector vulnerable to physical damage from hurricanes and wildfire, and will pose challenges for the necessary electrification of the transportation sector. Electric utilities exposured to extreme weather events typically suffer temporary price and volatility shocks in the wake of natural disasters, and the impacts of rising temperatures affect national crop yield, home and business insurance pricing, and create risk to the reliability and affordability of energy, and is likely to disrupt supply chain connectivity and shipping traffic stability. The rising incidence of extreme weather events over time might lead to spiking property and casualty insurance premiums, and reduced or denied coverage.

Extreme heat impacts to businesses include lowered productivity in regions that rely on outdoor labor, such as agriculture and construction work. Industries may experience rising mortality rates as the incidence of extreme heat rises, and greater energy expenditure is required to cool buildings. Agriculture is another sector that is vulnerable, as extreme heat reduces crop yields and drought threatens water availability for irrigation.

Taxes bases of municipalities could experience population migration as a result of frequent extreme weather events, and could create declining property values. A small number of northern states may see an influx of climate migration, due to their relative economic stability. Businesses may also relocate to other regions, further eroding local tax bases. Response after natural disasters plays a role in the current and future costs analyses, as many places are insured and repairs funded by the Federal Emergency Management Agency (FEMA), which could become less reliable if mounting disaster costs were to overwhelm FEMA's financial capacity or political will to respond.

Risks to municipal bond insurance include (Schulten et al 2019):

- Higher insurance premiums or decreased insurance coverage;

- Rising operational costs such as energy use for air cooling systems;
- Greater capital needs to make buildings more resilient (ex. backup generators, water-pumping systems and reinforcement of building exteriors);
- Increased delinquencies as tenants default or walk away from properties after extreme weather events;
- Potential hits to valuations and declining liquidity of properties in vulnerable areas.

Energy and utility expenses make up roughly 15% of operating expenses for commercial buildings, and is likely to rise as extreme heat events become more common. Acute climate shocks create impacts, such as damage to generating facilities. Chronic events tend to play out over longer time periods and wider areas of impact, and these estimates do not account for potential damages to transmission and distribution networks. The potential impact of climate events on power plants varies by location and fuel source: gas (35% of total U.S. generation capacity) and coal-fired power plants (27%) are exposed to a broader swath of climate risks, and though high temperatures pose a significant risk to almost all types of fuel sources (Schulten et al 2019). To prepare for risk management, suggestions include geo-locating power plants and determining their physical climate exposure to allow utilities investors to better assess exposures. This analysis can also provide information to CTUIR about future investments in acquiring and placing enterprises in locations with robust adaptation efforts.

(Credit: Schulten et al 2019)

Gaps in Knowledge/Data/Policy:

- Specific projected impacts to energy utilities in the CTUIR Ceded lands;
- Estimate of magnitude and frequency of events like drought and wildfire on economic prosperity.

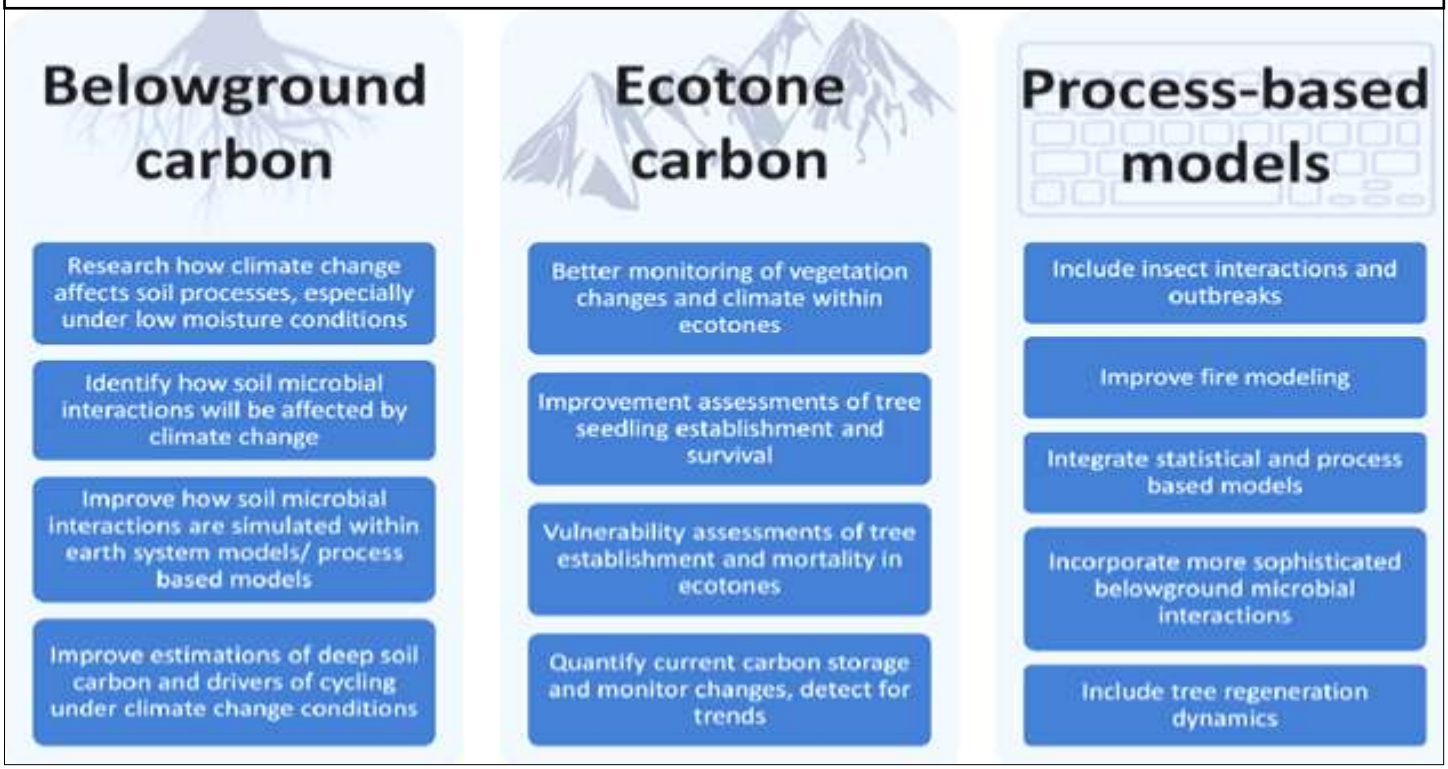
5. Opportunities for Carbon Sequestration Through Vegetation and Soil Management

Soil is an excellent storage sink for carbon. Carbon within soil organic matter (SOM) helps improve soil health and productivity, and there are ways to manage forests and grasslands that can maximize these carbon sequestration benefits. Globally, forests absorb 15–20% of annual human carbon emissions (Case et al 2021), and healthy forests have added benefits of promoting water infiltration and improving habitat conditions for First Foods. Detailed descriptions of forest types for the CTUIR Reservation and Ceded lands, as well as approaches to forest management that benefit First Foods, can be found in the First Foods Upland Vision (Endress et al 2019).

Damage to essential infrastructure from flooding, like to this railroad access bridge increases disaster recovery costs. Tribal Nations and local governments can reduce future costs by considering climate projections in current program and infrastructure development.

Human management of these lands has a large impact on whether soil is a carbon sink, where carbon is removed from the atmosphere through vegetation growth and organic matter accumulation. Or if it is a carbon source, soil disturbances like tillage can cause the rapid decay of soil organic matter into the atmosphere. Continued human disturbances, such as harvest, fire fuels reduction, construction, and land-use effects may decrease carbon storage and

Figure 3F.5a: Various Approaches to Forest Carbon Storage at Different Management Levels



adversely affect some ecosystem services. However, managing for multiple forest management objectives like economics, fire resilience, Treaty Rights access, and biodiversity, is challenging.

Figure 3F.5a illustrates opportunities that are available for managing forested lands to anticipate climate impacts and improve forest management for carbon storage (Case et al 2021).

- Potential for knowledge in management and monitoring of forest lands can be done at a "Belowground Carbon" level (left), which includes research opportunities into soil dynamics, microorganisms, and deep carbon storage; at an "Ecotone Carbon" level (center), which examines tree lifecycle patterns and migrating species impacts; and at a "Process-Based Models" level (right) in which modeling for forest disturbances is anticipated in projections.
- While some projections under increased atmospheric carbon scenarios indicate some dry forests may increase in productivity, decreased water availability and nutrient limitations may still limit growth, and increase tree mortality.
- Landscape-scale modeling in dry forests of Eastern Oregon suggest large shifts in tree species composition. This includes a decline in subalpine species and increases in lower-elevation species under future climate scenarios (Case et al 2021).
- Tree seedling establishment is hampered by hotter temperatures and lower snowpack, which results in lower water availability during the growing season. In these conditions, seeds may be unable to germinate, seedlings have increased mortality rates, and wildfire may create larger distances to seed sources, inhibiting vegetation establishment.
- Model simulations in the Blue Mountains of Eastern Oregon and Washington project a **longer growing season, more wildfire events, and a potential contraction of some forest types in dry areas** (Kim et al 2018).
- Snowmelt during the dry, summer months is critical for tree growth and seedling establishment at high elevations, and may eventually reduce potential gains in carbon sequestration.
- In general, future projections show potential carbon gains east of the Cascade Crest. This is largely due to increased productivity during non-summer months, and at high elevations, most likely driven by warming temperatures and a longer growing season.

Soils contain more carbon than plants and the atmosphere combined, and can comprise nearly three quarters of total ecosystem carbon. Many projections anticipate a net primary productivity increase for forests, due to a longer growing season, increased decomposition of forest duff and vegetation deposition, and microbial carbon respiration, which consumes older soil carbon (Case et al 2021). Soil microbes also play a large part in carbon sequestration, though microbial interactions and carbon release are difficult to quantify or predict.

When assessing areas at risk for species composition changes, intersection between two or more biomes/ ecosystems -- like upper and lower treelines, forest-grassland ecotones, and riparian corridors -- are crucial to examine due to their impact on the movement of animals and nutrient cycling. These are also likely to be areas of new colonization.

Farming activities can also make a big difference on whether soils are acting as a carbon storage or release source. Soils release more than 60 Gt of carbon dioxide annually, seven times more than the amount of carbon released from fossil fuel burning (Ghimire et al 2019). Soil disturbance like tillage often triggers soil organic carbon (SOC) loss because it increases soil biological activity, and brings organic residues in contact with decomposers. In contrast, reduced- and no-tillage minimize SOC loss.

Crop rotation, cropping intensification, and diversification increase microbial substrates, microbial biomass and activity. This ultimately increase SOC sequestration. Plots at the Columbia Basin Agricultural Research Center (CBARC) near Pendleton OR have long-term experiments on soil disturbance and carbon storage, some of which date back to 1931. This historical research site provides a wealth of knowledge on how cropping systems management influences soil organic carbon in dryland wheat production in the CTUIR Ceded lands.

Figure 3F.5b: Carbon Sequestration of Farming Techniques at Temperatures

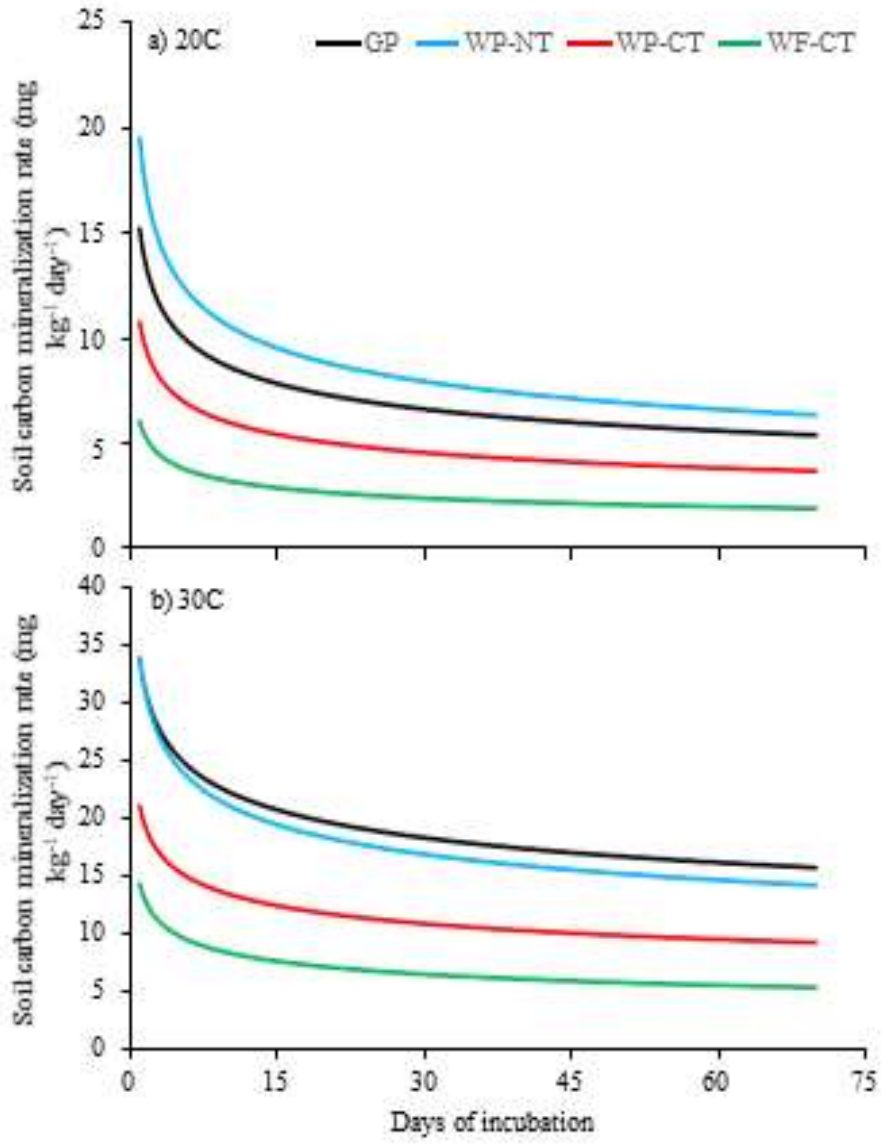


Figure 3F.5b shows results from these long term plots under different cropping systems.

- The top graph shows cropping systems' ability to store carbon under 20 °C (68˚F) and under 30 °C (86˚) in the bottom graph, to illustrate how increasing temperatures are likely to affect these kinds of systems. These graphs are measured in soil carbon mineralization rate (micrograms of carbon per kilogram per day) (Ghimire et al 2019).
- "GP" indicates perennial grass pasture (black line); "WP-NT" indicates a wheat-pea crop rotation under no-till conditions (blue line); "WP-CT" indicates a wheat-pea cropping

system under conventional tillage (red line); and "WF-CT" indicates a wheat-fallow rotation under conventional tillage (green line). All are measured by the carbon sequestration potential of each system over time.

- Through this comparison, it is shown under cooler conditions (top graph) that wheat-pea no-till systems create the most opportunity for carbon storage, with grass pasture opportunities surpassing these under warmer conditions (bottom chart). Typically, perennial grassland systems sequester more SOC than agricultural soils. SOC is sensitive to disturbance, so accrued SOC is easily lost when the grasslands are cultivated.

Small scale diversified and "regenerative" farming, such as the Yellowhawk Community Garden (pictured), is an opportunity to improve soil health for carbon sequestration, as well as provide fresh and healthy food to the Tribal community.

- SOC mineralization rate in elevated temperatures was lower in wheat-pea cropping rotations (both no-till and conventional tillage) than grassland or WF-CT.
- Long-term observations illustrate **loss of SOC stock by 50% in WF-CT systems**, while systems maintained for over 50 years **increased organic matter by 13% in WP-CT systems, and 30% WP-NT systems**. Organic matter also **increased 20% in WF-TN and 42% in WP-TN**, respectively (Ghimire et al 2019).
- SOC content was the **highest in GP**, the grassland system that has not been disturbed for more than 80 years, and **lowest in WF-CT**, an intensively tilled winter wheat-fallow system (Ghimire et al 2019).

Studies show that reduced tillage and higher cropping intensity lowers soil temperature and favors SOC sequestration. Cultivated soils in the dryland inland Pacific Northwest have already lost 30–60% of SOC in the past century. Soil warming could accelerate SOC loss, and combine with decreasing crop yields to negatively affect agricultural productivity. Increase in the fresh organic matter and quality due to improved management (e.g., no-tillage, legume integration) can affect microbial utilization of soil and changes in SOC storage. Some microorganisms are better adapted to climate change and variability than others, but there is evidence that mineralization is higher in diversified systems that retain more carbon than even grass-only systems (Ghimire et al 2019).

CTUIR's Department of Economic Community Development (DECD)'s Farm Program has historically generated revenue for the Tribal government to operate, and still farms 12,000 acres across the Umatilla Indian Reservation (UIR) today. Much of this dryland farming is wheat-fallow rotations, with a mix of conventional tillage and no-till cropping systems. To prevent a loss of soil carbon predicted by this study, DECD should consider:

- Transitioning farmed lands into grass pasture;
- Including legumes like peas into rotation schedules;
- Reducing acreage in conventional tillage;
- Perpetuating and expanding acreage in Conservation Reserve Program (CRP) stewardship.

Grasslands provide another land-area category for building SOC stocks. Over the lifetime of conservation practices, implementation can result in 0.01 - 0.20 tons of carbon per acre per year accrued on average a decade, especially on grazing and pasture lands treated with carbon-focused conservation practices (Chambers et al 2016).

Nitrogen sequestration can also benefit soil health as an essential nutrient for plants. In this study, more nitrogen was found in the wheat/pea no-till plot than all other treatments. This is because no-till farming maintains a consistent soil environment for microbial growth and activity, conserves soil moisture, and helps soil aggregation that improves nutrient storage and cycling. Additionally, other studies show that including legumes like peas in rotation support crop production through atmospheric nitrogen fixation.

Native plants will always be the best option for soil health and conservation. Native grasses and forbs of CTUIR's Ceded lands are especially efficient at creating deep root systems that hold soils in place, and create pathways for precipitation to infiltrate and be absorbed. In upland areas where invasive grasses like Cheatgrass has taken over, soil erosion is evident by large soil "slumps" that can be seen along the ridgetops after heavy precipitation events.

One example of these "slumps" is pictured here, located on the ridge line above the Meacham Creek Restoration Project.

Prioritizing land use that utilizes native and perennial plants will play an important role in climate adaptation. Many kinds of land uses can incorporate these kinds of plants into their regular functions. Examples include (but are not limited to) maintaining grazing public lands in a manner that reduces invasive grasses and prohibits grazing during sensitive life cycle phases for native plants, and to use the Conservation Reserve Program (CRP) practices and land leasing, especially in highly erodible lands and near riparian areas along streams and rivers.

(Credit: Case et al 2021, Ghimire et al 2019)

CTUIR Reservation and Ceded lands are topographically diverse, with many different soil types. Soil erosion, such as a the deep gully forming (center photo, dark brown) is a result of shallow-rooting invasive grasses. Revegetation efforts that prioritize native species with deep rooting systems benefit First Foods, increase water infiltration, and hold soil efficiently in place.

<u>Gaps in Knowledge/Data/Policy:</u>

- Quantified benefits that perennial and native grasslands for soil health and conservation;
- Grazing and fire disturbance optimum density for the Blue Mountain ecoregion;
- Seasonal shifts in native plant life cycles that may be impacted by land management activities;
- How farming is likely to adapt to changing environmental conditions.

A. Diversify Economic Opportunities, Trainings, and Options

"One goal of economic development efforts is to provide economic opportunity for all CTUIR members. Another primary goal is to provide resources to maintain the CTUIR and Tribal lands forever. A key component of long-term economic strategies is to create diversified revenue sources for the CTUIR (CTUIR Comprehensive Economic Development Strategy, CEDS, 2017)."

i. Continue to Update and Adapt Business Services

As seasonal variability fluctuates and technology advances, keeping pace with changes will help CTUIR retain its competitive edge in promoting its businesses and opportunities. These kinds of changes could be virtual, physical, and social, and should promote capacity to embrace future uncertainty. Coyote Business Park is a continuing example of business services being adaptive in meeting changing needs.

Short Term:

- **Build capacity in online infrastructure for providing services,** including internet vending capability, attractive and accessible websites, social media outreach options, and friendly interfaces, among others. Access to virtual infrastructure will assist in creating viable business opportunities for Tribal enterprises and nonprofits. Initiatives to build online infrastructure would pair well with DECD efforts to expand broadband internet access on the Umatilla Indian Reservation (UIR).

Long Term:

- **Promote resilience in physical infrastructure like offices and landscaping**, by incorporating engineered water infiltration, utilizing drought tolerant native plants, and developing minimal use irrigation systems, among other strategies. This would align with efforts to reduce water use in irrigation demand across Tribal businesses and facilities. See Ch 3A pages 50, and 61-62 for additional details.

- **Support and expand frameworks that promote flexible work and living schedules** to accommodate for seasonal disruptions, (ex: natural disasters etc), and opportunities (ex: First Foods harvest etc). As emergencies and economic instability alter reliability of many aspects of life, allowing families to live flexibly will improve their ability to meet modern living requirements, work/life balance, and quality of life. See Ch 3D pages 171-172 for additional details.

ii. Expand and Support Small Business Development Services

Economic resilience is based in access and availability of diversified job and revenue opportunities for families and Tribal nations. Job training and business start-up support could help Tribal families build capacity to adjust to changing revenue generation. These services

Graphic from CTUIR Comprehensive Economic Development Strategies (2017) highlighting barriers to business development on the UIR. Lack of skills is ranked highest with 39% of respondents feeling it was a barrier.

help by filling needs and gaps in the community, and providing essential services currently conducted off-reservation.

Short Term:

- **Organize and facilitate diverse training and education events** to provide connection and certifications for emerging fields like renewable energy, First Foods procurement and safety, and information technology, among others. Educational initiatives complement those found in other focus areas; see Ch 3B pages 88-90, Ch 3D pages 153-155, Ch 3E pages 194-195 and 207, and Ch 3G pages 288-289 for additional detail.

- **Continue to support and expand the Credit Loan program within NCFS** to provide access to fair capital for Tribal Members and families. This program would ideally also support other disaster relief and patient capital approaches that promote flexibility in repayment. Access to flexible capital for families and businesses will reduce climate impacts to economic services and address financial barriers.

Long Term:

- **Conduct economic opportunity listening sessions and mapping exercises** to identify and update changing and emerging needs in services for the Tribal community and government. A listening session was conducted as part of the CEDS (2017) document development, and sustained conversations will capture shifting and emerging needs of the community into the future.

TCI gift shop (pictured) and Kinship Café are a great place for local artisans and food producers to connect with retailing options.

iii. Encourage and Support "Regenerative" and Alternative Farming for Soil and Community Health

Farming is an engineering activity that can either provide carbon sequestration or release, depending on land management approaches. Global food security will experience challenges in production due to climate impacts, therefore boosting local food production and utilization will build economic and community resilience to buffer food shortages and supply chain interruptions.

Short Term:

- **Continue to support and implement gardening, home food production, safety, and nutrition classes** for the Tribal community to build capacity to provide food for families, like the kind offered by Yellowhawk Community Wellness Program. Improving production of healthy foods and processing regionally can reduce disruptions on local accessibility from global disasters; see Ch 3D pages 167-170 for additional detail.

- **Build capacity to provide composting opportunities and nutrient cycling information** for soil carbon sequestration to various audiences, with a focus on carbon recapture and storage. An initiative to reduce food waste would complement increased capacity for biological waste management through DECD, with the Tribal Environmental Recovery Facility (TERF); see Ch 3C pages 132-133 for additional detail.

- **Advocate for and develop diversified processing options for alternative dryland cropping systems,** like incorporating other grains and legumes like peas, barley, sorghum, hemp, and other potential dryland crops. Increasing processing and marketing options for these crops will improve their viability for agricultural producers.

Long Term:

- **Promote opportunities for diverse vending opportunities for Tribal businesses** of all kinds, and especially for those providing fresh and local produce, and/or textiles. Collaboration with community conversations on commonly used goods that experience supply chain disruptions could improve the focus of these efforts; see Ch 3C page 120 for additional detail.

- **Collaborate with and support diversified and small scale farming operations on the UIR and the Ceded lands**, with a focus on providing fresh food procurement for the Tribal community. Access to irrigation water from Columbia River tributaries is likely to be a complication to this effort.

iv. Update CTUIR Policies and Codes to Support Renewable Energy

Policies and social frameworks must also be adaptable and create protocols to incorporate changing needs and conditions. Land development codes, energy metering requirements, and guiding policies must incorporate the potential for small scale renewable energy generation (as appropriate) into building, land use, and community growth plans. See Ch 3E page 186-192 for additional details.

Short Term:

- **Continue to include permissions for renewable energy capability future developments**, as appropriate. DECD and Tribal Planning Office (TPO) coordinated to ensure the new Nixyaawii community/subdivision land development code is zoned. A number of renewable energy generating initiatives are in early phases, and could inform expanded generating projects; see Ch 3E pages 186-192 for additional information.

- **Promote online resources and information on Tribal Planning websites and other outreach avenues about renewable energy financing, installation, networks, and opportunities** that UIR businesses and residents could utilize. See Ch 3C pages 119-121 for additional detail.

Long Term:

- **Update CTUIR Energy Policy to include information and outreach about emerging renewable energy technologies** as they come available; see Ch 3E pages 186-193 for additional detail.

v. Cultivate Partnerships to Support Diverse Opportunities

Regional prosperity is a priority for CTUIR governance, and is necessary for economic resilience. CTUIR builds many partnerships for natural resource, infrastructure and emergency response management needs, and to promote social connection and commerce.

Long Term:

- **Continue to build partnerships with other Tribal economic and community development initiatives**, such as Oregon Native American Chamber of Commerce, Intertribal Agriculture Council, and other Native Community Development Financial Institutions (CDFIs) like Quinault, Colville, and Nez Perce Tribes, plus many others.

B. Build Capacity to Address Economic Challenges

"Economic volatility on the national level is a threat to economic stability in the community. It is difficult to plan for unwanted contingencies when externalities can be unpredictable…The CTUIR priorities of managing assets wisely, offering worker training and education to its members, diversifying CTUIR revenue sources, and being stewards of the environment are sound responses to these unknown impacts that can occur from the national level (CTUIR CEDS 2017)." Capacity to respond to challenges and opportunities will rely on a trained and flexible workforce, community, and government.

4th of July Powwow participant keeps hold of a tent pole against high winds and heavy rains which interrupted one evening of the event. Vendors lost out on sales and some had damaged goods from the storm that cancelled that evening.

Short Term:

- **Continue to proactively fund food security and aid initiatives** such as DCFS's food and supply distributions, Dept of Natural Resources (DNR) fish and bison distribution events, and a First Foods ceremonial and subsistence "pantry" to meet community need.

Long Term:

- **Continue to address and adapt to ongoing challenges identified by Dept of Economic and Community Development (DECD)**, including (but not limited to):
  - ◊ Land ownership and fractionation issues;
  - ◊ Workforce skills, business funding, and affordable housing availability;
  - ◊ Permitting and land development restrictions (as appropriate);
  - ◊ External misconceptions of working with Tribes and Tribal regulations;
  - ◊ Infrastructure availability and transportation interruptions.
- **Address policy and infrastructure barriers for food assistance programs, identified by Department of Child and Family Services (DCFS)**. These include (but are not limited to):
  - ◊ Equipment and infrastructure needs such as freezers, coolers, and storage space;
  - ◊ Transportation and skills needs for distributing and providing access to food;
  - ◊ Policy flexibility to allow food assistance supplies from Food Distribution Program on Indian Reservations (FDPIR) "commodities" and other community donations to occur in shared spaces like freezers and pantries.

C. Expand NCFS Capacity to Provide Small Business Support

"In addition to continuing marketing efforts to attract tenants, there is potential to help CTUIR members create new Native-owned businesses with the Business Service Center, a Community Development Financial Institution (CDFI), and significant training for small business development. The Business Service Center provides services that assist entrepreneurs at all stages of the business lifecycle, from pre-start-up to exit strategy, including business counseling, computers with business software, marketing, and access to capital. A Community Development Financial Institution, or CDFI, is a non-profit financial institution that can make a wide range of loans and provide development services such as education, training, and technical assistance (CTUIR CEDS 2017)."

Disruptions from natural disasters and supply chain wrinkles create challenges for businesses working to

finance their operations; flexible and patient capital services can ease this burden.

Short Term:

- **Support and expand Nixyaawii Community Financial Services (NCFS) operations and lending capacity** to provide Tribal Members, UIR residents, and other eligible entities and businesses with Flexible Lending, Patient Capital, and Fair Credit, now and into the future.

- **Continue to provide (and expand where appropriate) technical assistance capacity for Tribal businesses** as "risk reducer" for financial planning, with an aim to increase operations success. Risk for businesses will increase due to supply chain disruptions and extreme weather events, and increasing access to climate-informed credit planning can mitigate for many of these concerns.

- **Collaborate with NCFS and other Native/local CDFIs to develop a coordinated plan for mitigating market abnormalities** and stabilizing supply chains to buffer climate impacts to customers and communities. Building regional networks of credit can reduce challenges to accessing financial services.

Staff with Nixyaawii Community Financial Services (NCFS), a Native CDFI, raise awareness of financial options available to Tribal Members for personal and business support at the annual Community Picnic.

- **Organize and facilitate community education and engagement opportunities for diverse audiences** focused on self-sufficiency practices and defining what "wealth" means for CTUIR. Reducing dependence on global supply and demand can insulate CTUIR and the region from instability.

- **Support and expand Tribal youth finances education opportunities**, like the Summer Youth Entrepreneur Camp, education loans, and financial literacy courses. Tribal youth are leaders in climate adaptation, and Tribal businesses have a large role to play in implementing many of these strategies.

Long Term:

- **Expand NCFS and CTUIR credit service capacity to provide assistance to clients in planning for uncertainty** through short term payment flexibility, and incorporating climate crisis planning into business plans.

- **Advocate for and provide support to NCFS for its operations and lending expenses,** in order to building economic resilience for Tribal families. CDFIs are "an overnight success 30 years in the making," and CTUIR has a great advantage in credit services through this burgeoning Native CDFI.

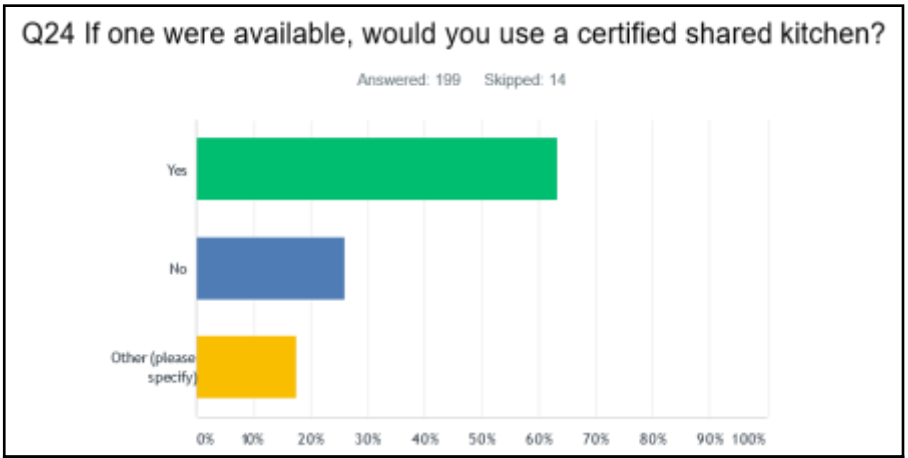
- **Expand NCFS capacity to offer programs of lending**. This includes: small business, food sovereignty, education, land leasing, and land acquisition lending, plus new types for renewable energies. As lending capacity grows, services that support local food and renewable energy will be necessary in implementing adaptation for families and businesses.

D. Build Interest and Capacity in First Foods Stewardship, Procurement, and Processing

"Closing the supply chain gap for manufactured products in food and transportation equipment manufacturing has the potential

to add great value to the economy. Although there is a larger share of supply chain requirements already being met for in-region services, additional revenue could be generated through expanding services such as wholesale trade, finance and insurance, and the healthcare industries (CTUIR CEDS 2017)."

Food security and availability from global supply chains is likely to continue to experience interruptions. Building local and family capacity to produce and process food will mitigate for these impacts and build Tribal resilience rooted in First Foods.



Yellowhawk First Foods Assessment (2020) surveyed the CTUIR community about food access. Many were supportive of shared kitchen infrastructure if available, with almost 200 survey responses.

i. Promote Traditional / First Foods Cuisine and Tourism

Traditional and Indigenous foods are finally beginning to be recognized for their sustaining power that has succeeded for millennia. Because First Foods are "pre-fossil fuel foods" that existed before the burning of carbon, they provide an essential opportunity to return to foodways that are closely connected to land, water, people, and culture.

Short Term:

- **Organize and facilitate opportunities for Tribal community conversations around First Foods access and knowledge**. These opportunities could be similar to the First Foods Forums, and aim to identify barriers, opportunities, and networks that exist in availability and access of First Foods. Engaging the community in developing adaptations will improve their success and relevance to the Tribe.

- **Develop and distribute a First Foods Cookbook and food processing recipes** as it is permitted by the Tribal community and cultural knowledge keepers. Cultural Resources Protection Program (CRPP) and CTUIR Culture Committee should be heavily consulted during any development, and sensitivity to cultural information that should not be shared is essential.

- **Continue and expand existing technical support for "food truck" training and financial assistance**. This service was previously through the Wildhorse Small Business Development Center, and can be continued with NCFS. Mobile food vending establishments have boomed in recent years, and can provide flexibility in offering local food and Tribal business opportunities.

Long Term:

- **Reflect on and examine previous Indigenous foods events and competitions** which CTUIR has hosted or participated with, such as "Rez Kitchen Tours" and Top Chef, to determine if there is interest or potential to organize similar events for Tribal regional audiences.

ii. Develop and Implement Shared Food Processing Infrastructure

Safe spaces and access to processing equipment are two barriers that communities often encounter as a challenge to implementing a desired food system. Food for resale or community consumption especially requires additional levels of policy and equipment support that can be provided by certified commercial kitchen availability and infrastructure.

Short Term:

- **Fund and conduct a CTUIR Community/**

Shared Kitchen feasibility study that examines the infrastructure and equipment needs of the community, and develops a plan (including potential funding sources) to implement necessary shared kitchen capacity. See Ch 3C page 120 for

- **Develop and implement community sharing programs to increase access to food processing equipment**. Examples include a Kitchen Equipment Library and borrowing protocol, among others. Increased access to equipment like pressure canners, oil presses, mixers, blenders, and many other pieces of kitchen equipment, and could improve home food processing options for those with cost of equipment barriers.

Long Term:

- **Organize and support community-scale purchasing clubs, networks, and/or cooperatives** to facilitate bulk purchasing on the Umatilla Indian Reservation (UIR). Purchasing in bulk reduces costs of staple goods for Tribal families that are interested and able to participate. Purchasing household staples in bulk often reduces costs for these products significantly, but can be difficult to afford in chunked payments, experience transportation issues, and be difficult to store in large quantities. Coordinating household needs and administering strategic bulk purchasing and distribution would improve access to goods at affordable prices.

iii. Expand Food Safety and Processing Knowledge for Fresh and First Foods

Broad understanding of food safety issues and best handling practices will be important for community protection against climate impacts like rising temperatures and unreliable electrical grids. Education and access to sanitation supplies also provides risk reduction for food borne illness.

Short Term:

- **Expand capacity to offer educational programs for food production for youth**, like 4H, Future Farmers of America Program (FFA), and other agricultural skills-building supported by NCFS loans and Nixyaawii Community School (NCS). In recent years there has been interest in establishing a Tribal 4H program (or something similar) for NCS, though staff capacity, funding, and consistent partnerships have been a barrier to implementation.

NCFS Youth Entrepreneur Camp (2019) provides Tribal youth an opportunity to develop products, business plans, and marketing skills.

Long Term:

- **Support and expand community-scale food safety classes and certifications**, such as the kind offered by Tribal Planning Office (TPO) to food producers. TPO currently offers periodic food handlers certification courses to those operating food businesses on the UIR. Increasing frequency, offering alternative formats (such as virtual or by mail), and expanding hands-on learning could improve Tribal community access to food safety knowledge and certifications for Tribal businesses and families.

E. Develop Land Acquisition Plan and Implement Strategies

"Multiple ownership of trust allotments continues to hinder individual Tribal Member efforts to use their lands to meet their individual needs. Exchanging interests in land to achieve consolidation or single owner control seldom occurs. Much of the land in multiple ownerships is in small interest, or in lands of low value not suitable for making exchanges for useable lands. Many of the lands on the UIR are in interests held by members of other Tribes who may not want to improve their performance. CTUIR continues to purchase fee lands and interests in allotted trust in amounts that have out grown the Tribes' management capacity (CTUIR Comprehensive Plan 2010)."

Closing the "checkerboard" is a high priority for building resilience on the UIR, and returning land to Tribal stewardship should be paramount.

Short Term:

- **Fund dedicated efforts to develop a "Land Acquisition Plan"** through community-identified and driven strategies to return reservation boundaries to pre-theft borders, and to increase regional land acreage under Tribal stewardship. Such a plan would include information on when, and by which entities, lands have been dispossessed from the Tribe historically, and propose long term strategies for their return.

- **Develop a community-identified approach to "Land Back" efforts from a CTUIR perspective and approach, that emphasize and strengthen Tribal land ownership**. Examples include schemes like the "Real Rent Duwamish" initiative created by the Duwamish Tribal Community to collect revenue voluntarily from non-Tribal occupants of Duwamish lands (more information can be found at the website: www.realrentduwamish.org). Other examples include work conducted by Naknuwithlama Tiichamna (Caretakers of the Land) with the Episcopal Diocese at the Ascension School in Cove, Oregon, and the donation of 2600 acres of land at McCoy Meadows Ranch to CTUIR by Mark Tipperman and Lorna Williams in 2019, currently co-managed by Blue Mountain Land Trust.

Long Term:

- **Support and expand credit and borrowing capability through NCFS and the Credit Program to address land fractionation** of ownership that many families encounter in land planning and financial assistance. Addressing credit barriers to returning lands to Tribal management aids in expanding Indigenous stewardship across the region.

Events like the annual 4th of July Powwow (pictured) bring crowds to CTUIR's land, providing an opportunity for economic benefit to Tribal enterprises and small business vendors, and gathering to connect with different communities. These events are likely to experience disruption into the future. An example of one such disruption was a severe thunderstorm that forced one day's cancellation of this event with heavy rains and wind.

How Do We Measure the Success of These Adaptations?

"Resiliency is rapidly becoming an important focus of economic development professionals and community leaders. Regional resiliency, as commonly described in economic development efforts, refers to a region's capacity to cope with, and recover from, unexpected challenges. The phrase refers to both economic capacity and environmental resiliency. These two concepts merge, for example, during an environmental disaster. In such cases, the affected region must garner the economic resources to recover from the environmental event and take action to mitigate or prevent future threats (CTUIR CEDS 2017)."

- **CTUIR Comprehensive Economic Development Strategies (CEDS) (2017) Part 5, Objective 2**: Create a comprehensive program to retain and expand existing businesses located on CTUIR industrial/commercial properties. (Page 25-27);
- **CTUIR CEDS (2017) Part 5, Objective 5**: Identify and evaluate opportunities for new CTUIR enterprises, acquisitions, and/or partnerships. (Page 25-27);
- **CTUIR CEDS (2017) Part 5, Objective 6**: Establish and fund an Economic Development Capital Investment Fund that can be used to invest in infrastructure development, building construction, business startups, and other business opportunities. (Page 25-27);
- **CTUIR CEDS (2017) Part 5, Objective 9**: Support and promote programs that assist Tribal entrepreneurs, including the proposed CDFI (Page 25-27);
- **CTUIR CEDS (2017) Part 5, Objective 10**: Increase CTUIR staff involvement and collaboration with regional, state, and other workforce development programs. (Page 25-27);
- **CTUIR CEDS (2017) Part 5, Objective 11**: Collaborate with other economic development organizations to create a regional economic development partnership – leverage resources to promote regional economic development interests. (Page 25-27).
- **CTUIR Comprehensive Plan Objective 5.2.1:** Diversify the Tribes' public sector economy by creating and strengthening CTUIR-owned enterprises both on and off-Reservation see (Comp Plan page 62 for benchmarks);
- **CTUIR Comprehensive Plan Objective 5.2.2**: Expand and diversify job opportunities for Tribal Members on the Reservation (Comp Plan page 62 for benchmarks);
- **CTUIR Comprehensive Plan Objective 5.2.3:** Strengthen the tribes' private (small business) economy by creating suitable conditions for Tribal members to start and expand businesses and social enterprises (Comp Plan page 62 for benchmarks);
- **CTUIR Comprehensive Plan Objective 5.2.5:** Plan for long-term economic security in the face of changing global environmental and economic conditions (Comp Plan page 72 for benchmarks);
- **Comprehensive Plan Objective 5.3.1**: Acquire lands that can be used to enhance the cultural, natural resource and economic development needs of the Tribes (Comp Plan page 67 for benchmarks);
- **Comprehensive Plan Objective 5.3.5:** Reduce fractionated interest land ownership (Comp Plan page 67 for benchmarks);
- **CTUIR Comprehensive Plan Objective 5.4.2:** Expand and diversify job opportunities for Tribal Members on the Reservation (Comp Plan page 62 for benchmarks);
- **CTUIR Comprehensive Plan Objective 5.4. 6:** Restore the Umatilla Indian Reservation land base to the 1855 Treaty Reservation boundary (Comp Plan page 95 for benchmarks);
- **CTUIR Comprehensive Plan Objective 5.15. 9:** Incorporate the values of environmental responsibility into all CTUIR educational, workforce and community activities; reduce, reuse, recycle (Comp Plan page 127 for benchmarks).
- Department of Economic Community Development (DECD) Annual Work Plans

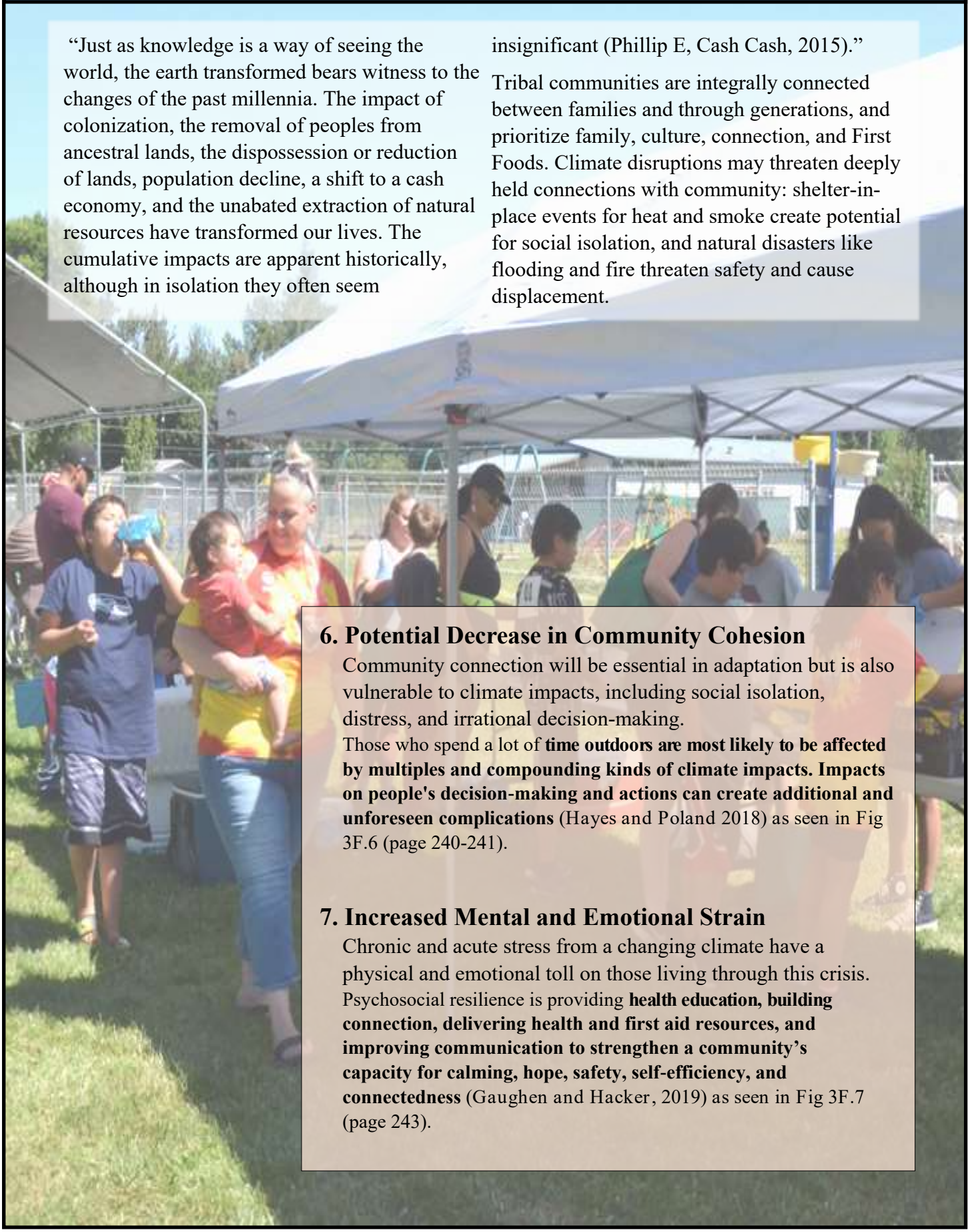
What Gaps in Knowledge, Policy, Capacity, or Education Exist?

- Changing economic revenue generating patterns, and urban/rural differences;
- Population dynamics change and climate migration models.

Climate Impacts to **Community Support**

"Just as knowledge is a way of seeing the world, the earth transformed bears witness to the changes of the past millennia. The impact of colonization, the removal of peoples from ancestral lands, the dispossession or reduction of lands, population decline, a shift to a cash economy, and the unabated extraction of natural resources have transformed our lives. The cumulative impacts are apparent historically, although in isolation they often seem insignificant (Phillip E, Cash Cash, 2015)."

Tribal communities are integrally connected between families and through generations, and prioritize family, culture, connection, and First Foods. Climate disruptions may threaten deeply held connections with community: shelter-in-place events for heat and smoke create potential for social isolation, and natural disasters like flooding and fire threaten safety and cause displacement.



6. Potential Decrease in Community Cohesion

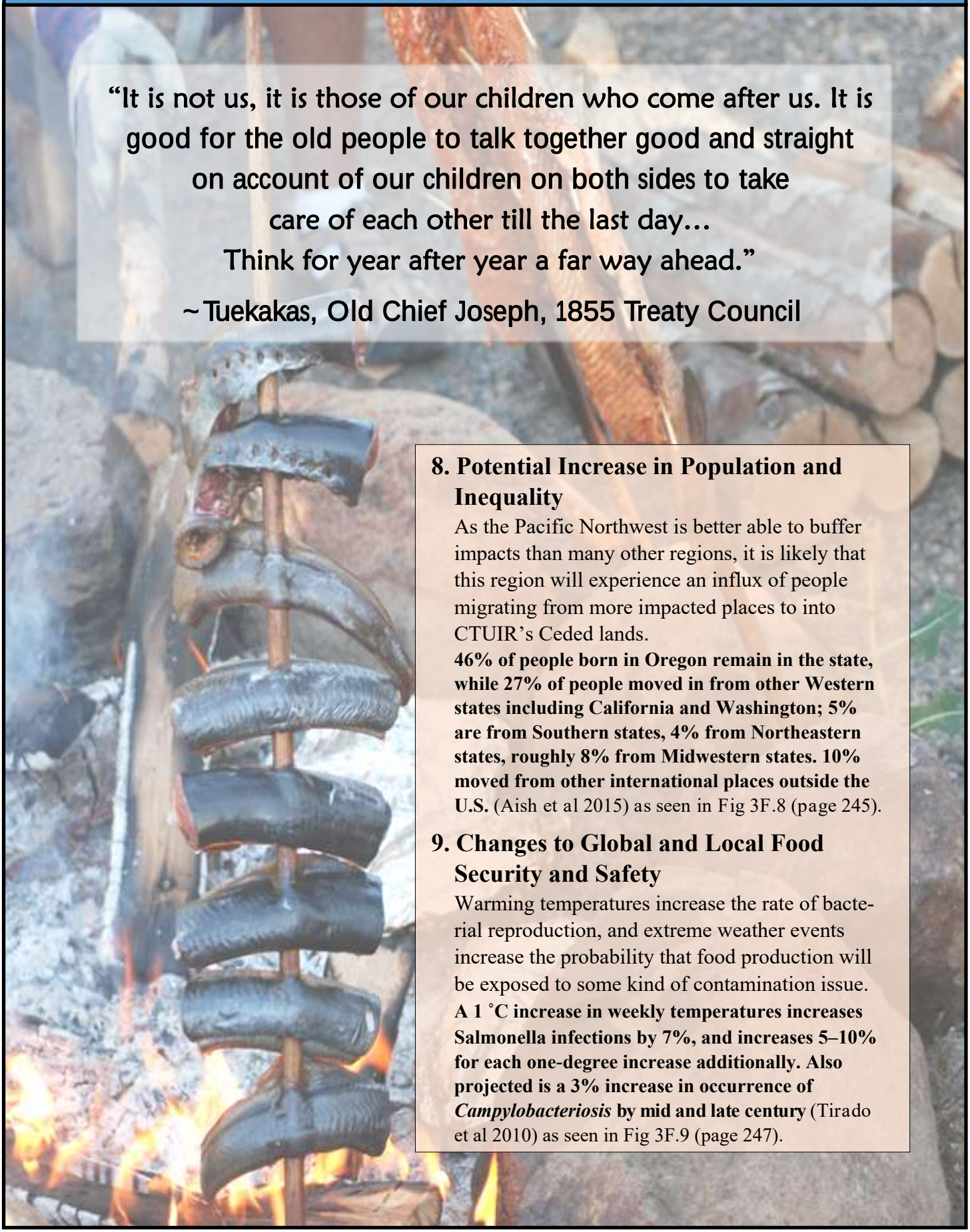
Community connection will be essential in adaptation but is also vulnerable to climate impacts, including social isolation, distress, and irrational decision-making.

Those who spend a lot of **time outdoors are most likely to be affected by multiples and compounding kinds of climate impacts. Impacts on people's decision-making and actions can create additional and unforeseen complications** (Hayes and Poland 2018) as seen in Fig 3F.6 (page 240-241).

7. Increased Mental and Emotional Strain

Chronic and acute stress from a changing climate have a physical and emotional toll on those living through this crisis.

Psychosocial resilience is providing **health education, building connection, delivering health and first aid resources, and improving communication to strengthen a community's capacity for calming, hope, safety, self-efficiency, and connectedness** (Gaughen and Hacker, 2019) as seen in Fig 3F.7 (page 243).



"It is not us, it is those of our children who come after us. It is good for the old people to talk together good and straight on account of our children on both sides to take care of each other till the last day…
Think for year after year a far way ahead."

~Tuekakas, Old Chief Joseph, 1855 Treaty Council

8. Potential Increase in Population and Inequality

As the Pacific Northwest is better able to buffer impacts than many other regions, it is likely that this region will experience an influx of people migrating from more impacted places to into CTUIR's Ceded lands.

46% of people born in Oregon remain in the state, while 27% of people moved in from other Western states including California and Washington; 5% are from Southern states, 4% from Northeastern states, roughly 8% from Midwestern states. 10% moved from other international places outside the U.S. (Aish et al 2015) as seen in Fig 3F.8 (page 245).

9. Changes to Global and Local Food Security and Safety

Warming temperatures increase the rate of bacterial reproduction, and extreme weather events increase the probability that food production will be exposed to some kind of contamination issue.

A 1 ˚C increase in weekly temperatures increases Salmonella infections by 7%, and increases 5–10% for each one-degree increase additionally. Also projected is a 3% increase in occurrence of *Campylobacteriosis* by mid and late century (Tirado et al 2010) as seen in Fig 3F.9 (page 247).

6. Potential Decrease in Community Cohesion

Extreme weather events, and long term emotional and financial strain in emergency response can strain community connection. When public health authorities initiate “shelter in place” advisories, many who have mobility issues, who are homebound, or who are otherwise isolated can suffer from this restriction in contact with their communities.

Figure 3F.6 is a table overview of climate crisis impacts to vulnerable groups of people, and some ways these impacts could be measured as part of routine public health assessments (Hayes and Poland 2018).

- Community-scale mitigation strategies could alleviate negative mental and behavioral health impacts of distress, and community public health can play an important role in monitoring and intervening in adaptation.
- Dedicated healthcare staff time to make routine check-ins during prolonged events are essential to preserving community connection, and should be supported. One example are the services provided to Tribal Elders by Dept of Child and Family Services (DCFS) staff during the Covid-19 epidemic.
- **Those who spend a lot of time outdoors are most likely to be affected by multiples and compounding kinds of climate impacts**. Most at risk are people who make their living outdoors like laborers, fire responders, construction and farm workers, those who spend time on the land such as Tribal harvesters and outdoor recreationists, and under- and unhoused people due to lack of shelter and access to services.
- For Indigenous people, spending time on the land is part of keeping connection and reciprocity, and must be prioritized in physical and emotional health adaptation.
- **Impacts on people's decision-making and actions can create additional and unforeseen complications.**
- Transportation infrastructure is also affected; many CTUIR Kayak Transit system route stops are open air and unsheltered, and riders can be exposed to inclement conditions during their wait times.

Often, Tribal communities are tight-knit, and are able to come together in times of crisis to provide mutual aid to those affected, such as the outpouring of community support during the Feb 2020 flooding event. Communication networks between responding Tribal departments like Public Safety and Public Works internally, as well as with community volunteers and other mutual aide partners externally, is integral to coordinating first responders and ensuring safety. This service would be additionally improved through dedicated Tribal staff capacity and coordination.

Places like the CTUIR Longhouse provide consistent gathering space for the Tribal community. Numerous events for cultural, religious, and outreach purposes are regularly scheduled there, including celebrations like Treaty Day (pictured).

Figure 3F.6: Overview of Climate Hazard Impacts to Community and Progress Indicators			
Climate Hazard	**Populations of Concern**	**Potential Mental Health Outcomes**	**Indicators and Measurement Tools**
Extreme Heat	• People with pre-existing mental health conditions. • People taking psychotropic medications that affect thermoregulation. • Elderly (who have poor thermoregulation). • People with substance abuse problems • People living in urban heat islands • Urban poor without access to air conditioning • Those living on the street • Outdoor laborers	• Exacerbated mood or behavioral disorders • Violence • Aggression • Suicide • Other	• Monitor emergency department visits after heat waves for an increase in patients reporting mood or behavioral disorders. • Monitoring mortality statistics following extreme heat events—look for co-morbidities related to mental health and incidents of suicide. • Interviews or questionnaires with people who experienced heat waves or extreme heat events to ask about their mental health in relation to heat events. • Review of police records following extreme heat events to monitor elevated incidences of violence or aggression
Extreme Weather Event (Flood, hurricane, drought, mudslides, etc.)	• Gender (Female, particularly pregnant women) • Age (children, infants, seniors) • Race and ethnicity (non-Caucasian, non-white) • Immigrants • People with pre-existing health conditions • People with low-socioeconomic status • The under and non-insured (health care & home insurance) • The under-housed and homeless • Outdoor laborers • First responders	• Post-traumatic stress disorder (PTSD) • Depression (including major depressive disorders) • Anxiety • Suicidal ideation • Aggression • Substance abuse and addiction • Violence • Survivor guilt • Vicarious trauma • Altruism & Compassion • Post-traumatic growth • Other	• Surveys -General Health Questionnaire (GHQ) Self-report surveys of mental illness and mental problems: - Disaster-PAST; the Generalized Anxiety Disorder Scale (GAD-7); the Post-Traumatic Stress Disorder Checklist (PCL); The Center for Epidemiologic Studies Depression Scale (CES-D); the Kessler Psychological Distress Scale (K6) Self-report surveys of affirmative mental health. Consider using: - Stress-Related Growth Scale (SRGS); Post-Traumatic Growth Index (PTGI); Benefit Finding Scale (BFS) • Patient Records • Monitor emergency department visits after extreme weather events for an increase in patients reporting mental health problems or illness. • Review of new prescription use for mental health and behavioral disorders after an extreme weather events.

Figure 3F.6 (cont.): Overview of Climate Hazard Impacts to Community and Progress Indicators

Climate Hazard	Populations of Concern	Potential Mental Health Outcomes	Indicators and Measurement Tools
Extreme Weather Event (cont.) (Flood, hurricane, drought, mudslides, etc.)			• Interviews -Interviews with primary care physicians and mental health care providers about any surges in patients reporting mental health issues following extreme weather events. -Interviews with people who experienced an extreme weather event about their perceptions regarding their mental health related to the extreme weather event.
Vector-borne disease (VBD) (e.g., Lyme Disease, West Nile Virus, Ticks)	• Under-housed and homeless people • People with pre-existing mental health conditions • Outdoor workers	• VBD disease (particularly: Lyme Disease or West Nile Virus) w/compounded mental health problems (e.g., cognitive or neurological impairment, behavioral disorders)	• Interviews or questionnaires with patients who have been diagnosed with VBDs to ask about perceptions of their mental health. • Interviews with primary care physicians and mental health care providers about any mental health co-morbidities for patients diagnosed with VBDs.
Sea-Level Rise or Melting Permafrost	• People who work or live near the ocean (sea-level rise) or in the arctic • Outdoor laborers • Indigenous people	• Anxiety, worry, or fear of displacement • Anxiety, worry, or fear of job loss • Loss of place (grief, solace)	• Interviews or questionnaires with residents who have or are experiencing sea-level rise or prolonged drought in their communities. Interview questions may focus on the mental health implications of: displacement, job loss associated with sea-level rise, infrastructure damage, agricultural or resource loss and resource scarcity, food and water safety and security.
Climate Change (in general) (i.e., awareness of climate change threats to human and planetary health and survival)	• People at greater risk from & exposure to climate change • Researchers investigating climate change & Environmental studies students • Environmental and climate change activists • Outdoor recreationalists • Indigenous peoples	• Anxiety • Worry • Stress • Fear	• Interviews or questionnaires with people who experience concern, anxiety, worry, related to awareness of climate change threats. • The Generalized Anxiety Disorder Scale (GAD-7)

Communication between knowledgeable authorities and target audiences is key to conveying information necessary for decision making (Hayes and Poland 2018). CTUIR Emergency Operations Plan (2016) Section 3 (pages 49-73) assigns roles and responsibilities to various departments within the Tribal government, and outlines how these departments are meant to function together to respond to emergency situations.

Alerts and warnings communications are the responsibility of CTUIR Dept of Public Safety, Office of Information Technology (OIT), and the Dept of Communications (CTUIR EOP 3.2.3.2). These departments should be involved in climate adaptations that involve improved communication at an intergovernmental and intragovernmental level, and to the Tribal community. In anticipation of future events, emergency response should gain a firm sense of: 1) how a climate stressor may impact infrastructure, and 2) how a disruption to certain components may affect people's decisions/behavior. Poor judgement and irrational decisions due to distress can create unwanted feedbacks, especially for communities who are already impacted by historical and generational trauma.

February 2020 flooding event (pictured) required first responders from CTUIR departments and volunteers from the Tribal community, as Dept of Public Safety, Public Works, and the Incident Command Team coordinated operations and responders.

Stress tests provide health authorities with the opportunity to examine resilience of components of health systems like health facilities, specific organizations or departments. These scenarios also examine how these components interact in emergency scenarios, such as integrated disease surveillance and warning, pharmacies, community care, and health insurance services, among others. This planning tool can be used by decision-makers responsible for broad health system functions, like CTUIR Health Commission, Yellowhawk Health Center leadership, CTUIR Incident Command System, and other community health teams. Scenario-based emergency management exercises are mandatory components of all-hazard risk planning, including the CTUIR Hazard Mitigation Plan. Introducing or augmenting existing activities with climate stress testing would add value to these efforts, and would enhance preparedness planning for a climactically different and potentially more dangerous future.

(Credit: Hayes and Poland 2018)

Gaps in Knowledge/Data/Policy:

- How simultaneously-occurring climate crises may worsen one another;
- Capacity of regional health care system to handle physical and mental crises;
- How updates to CTUIR Emergency Operations Plan (EOP) can integrate climate crisis projections and planning.

7. Increased Mental and Emotional Strain

Challenges from the climate crisis will increase long-term and acute stress, which will affect mental and emotional health through many mechanisms. Learning productive ways of handling stress requires finding positive coping mechanisms. The concept of “psychosocial resilience” may be a resource to families and communities.

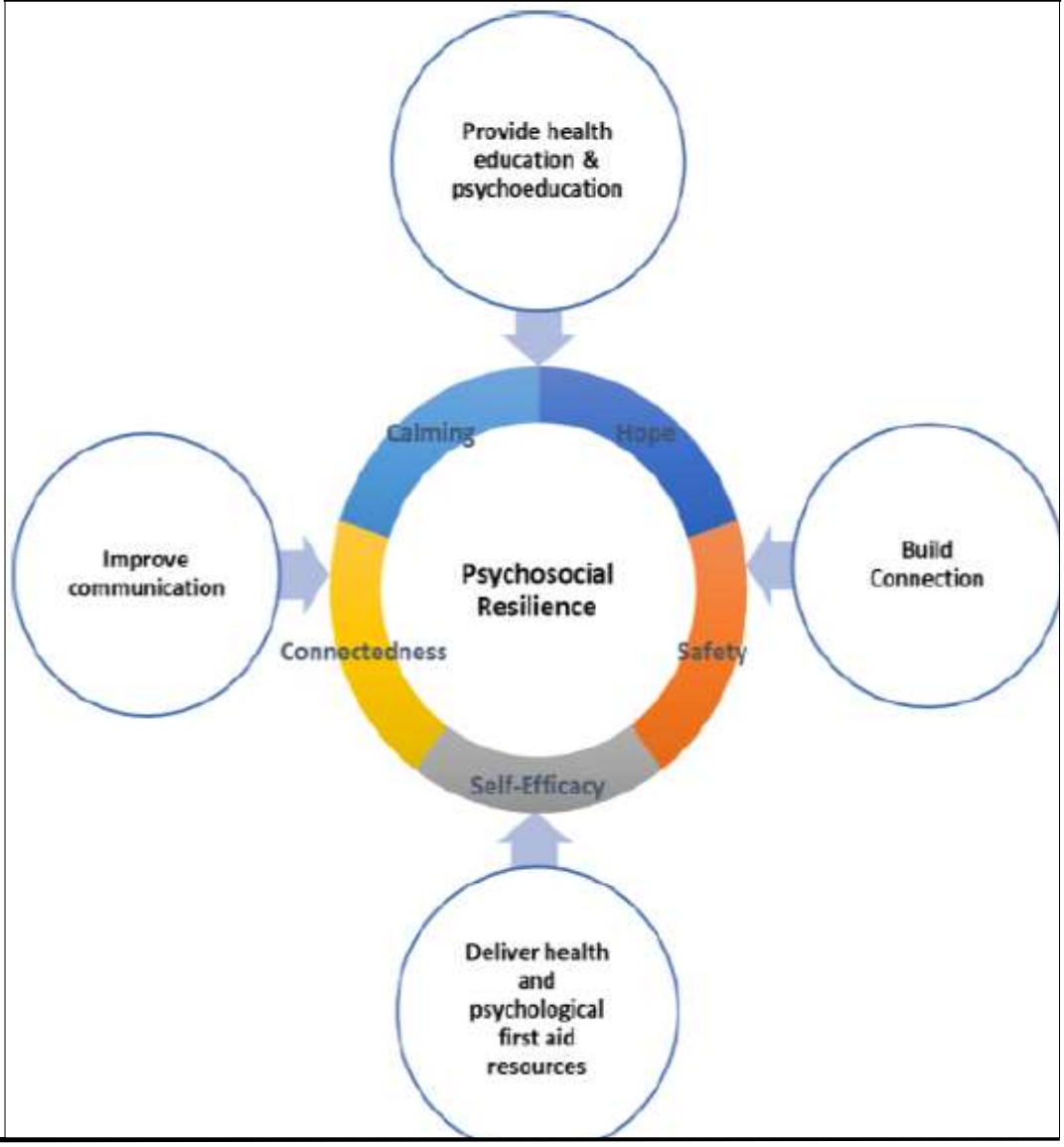
One goal of psychosocial recovery and resilience frameworks is to achieve greater independence and wellbeing before, during, and after trauma, without

the need for formal mental health treatment. It also prioritizes community connection as an integral part of that resilience. Knowing one's neighbor is an important way community members can build resilience, and Tribes have long-standing traditions and cultural ways that support community cohesion and increase their ability to cope with traumatic changes (Gaughen and Hacker, 2019).

Figure 3F.7 provides a diagrammatic overview of the Psycho-social Resilience Framework developed by the Pala Band of Mission Indians (California), to build capacity for social networks and community to withstand prolonged distress.

- Response frameworks contribute to building emotional coping and psychosocial resilience. **Providing health education, building connection, delivering health and first aid resources, and improving communication** can strengthen a **community's capacity for calming, hope, safety, self-efficiency, and connectedness** (Gaughen and Hacker, 2019).
- Psychosocial strategies can include: providing health education and psychoeducation to train adults, youth, and organizations to recognize and mitigate health risks; stabilize, and assist community members who are struggling; and promote positive coping and problem-solving strategies.
- Education to facilitate recognition of illness symptoms, avoid risks (including food/water dangers), and build skills to psychologically cope would empower families and individuals. Trainings to recognize exposures and related illness and mental health impacts for nurses, coaches, school and employee counselors, and other decision makers and to act preventatively. Collaboration with other Treaty Tribes enhances training and capacity of emergency Tribal response teams.
- Health and psychological first aid resources will be necessary to meet immediate needs, and provide rapid and practical help during/after climate events. Developing collaborative referral systems to ensure access to available resources and services should include psychological first aid resources. This also includes emergency-, disaster

Figure 3F.7: Pala Indian Community Psycho-Social Resilience Framework



response-, and/or health management plans that anticipate and prepare public services and evacuation plans for exposure risks. Typically these include procedures for post-disaster repairs, and post-health incident continuity of care for vulnerable people.

- This could also involve identifying existing community assets, like the Tribal fire station and Tutuilla Food Sovereignty Center, businesses, and other entities that can play a role in preparedness and recovery.
- Initiatives for helping communities cope with psychosocial spiritual stress, reconnect with purpose and hope, and achieve post-traumatic personal growth will build psychological flexibility for families. Developing preventative initiatives before the next disaster occurs builds resilience skills, as does expanding social support networks like learning groups, community mapping and other story-telling events.
- Community dinners, Tribal cultural events, or conversations in places where neighbors already gather (like schools, libraries, Longhouse, General Council etc.) to build connection can be much more effective than bringing in unfamiliar new strategies or technologies. Increasingly, digital connection can provide flexibility and access to information, and Department of Economic Community Development (DECD)'s Broadband project is expanding access to internet services on the Reservation.
- Improving communication channels through access to clear and reliable information helps reduce danger and stress, and increase safety and trust in responders and decision makers. To do this, provide early, real-time warnings and clear emergency notifications before and during exposure events. Use diverse tools like websites, text, social media, TV, radio, and other media, like the CayUmaWa Camp Crier smart phone online application tool. Notifications should include: relevant safety tips (e.g. limit outdoor activities, don't drive through flooded roads, limit water usage, evacuation zones, boil advisories, etc.), and how to access additional information or help.

New communications technologies like social media and online applications such as the CayUmaWa Camp Crier tool (pictured) can help spread communications to communities in times of emergency.

For the CTUIR Tribal community, many of the culture, religion, and foodways build opportunities for psychosocial resilience into the fabric of practices. In Longhouse religious ceremony, worshipers are customarily encouraged to share their thoughts, feelings, and perspectives with their community as a regular part of rituals.

Building social connection to increase trusted, compassionate, and helpful relationships with emotionally supportive community members creates improved circumstances for community assist each other through challenging times. Examples include working together, community dinners/discussions, etc. The Tribe's Department of Child and Family Services (DCFS) organizes and coordinates many of these events, and other Tribal departments also host community outreach events to build intercommunity connection. These events and programs are beneficial to increasing community cohesion and building trust, though tend to lack a coordinated plan and goal for these efforts, and may benefit from long term integration

of these services.

(Credit: Gaughen and Hacker, 2019)

Gaps in Knowledge/Data/Policy:

- Understanding of how federal funding for preventative mental health services might change;
- How technological advances are likely to alter/ improve the ability to communicate within the Tribal community.

8. Potential Increase in Population and Inequality

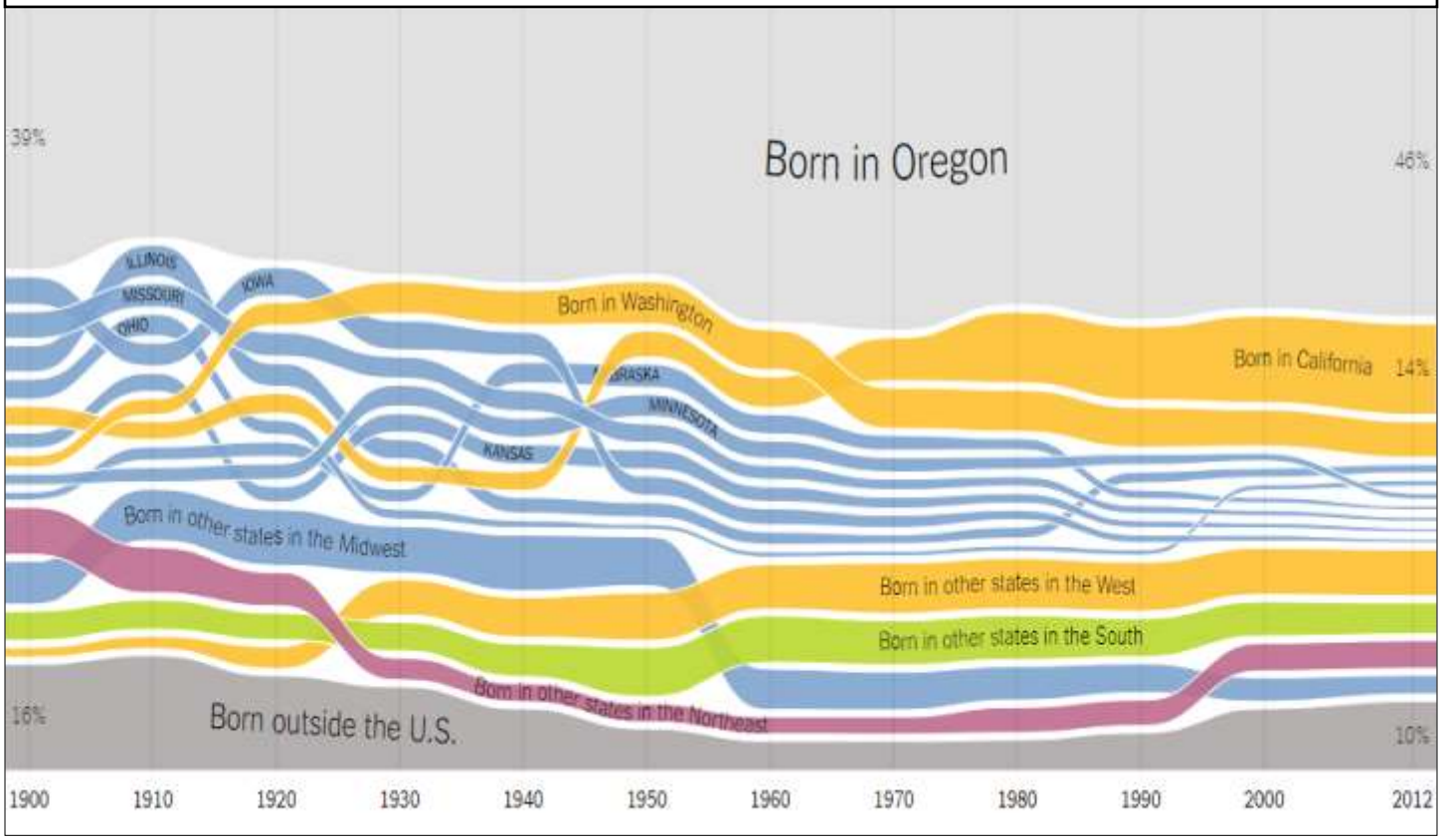
While the Pacific Northwest (PNW) will experience milder climate impacts compared to other regions, people fleeing harsh and increasingly hostile environments around the world may see the this area as a desirable destination. Long-term planning for transportation, public health, utilities, and other public services requires population forecasts and demographic trends to account for the possible impacts of climate change on population flows.

Changing population dynamics are difficult to model, and there are large gaps in current approaches to predicting shifts in population migration. Early estimates indicate people are most likely to move in established patterns globally and domestically, and are likely to relocate to an area where they have existing family, others of similar heritage/culture, or access to economic opportunity (Saperstein 2015).

Figure 3F.8 illustrates trends in population changes in Oregon State, based on where migrants emigrate from, and the percentage change of those population dynamics over time.

- Color coded population dynamics represent different groups of people, and percentage of Oregon's population they comprise: light gray on top indicates a large portion of Oregonians remain in the state; other blue lines show migrants from other regions in the United States; yellow lines indicate those moving from other western states; purple indicates those from Northeastern states; charcoal grey shows those moving to Oregon from other countries (Aisch et al 2015).

Figure 3F.8: Historic Migration Patterns of People Living in Oregon State from Domestic and International Locations



- In 2012, **46% of people born in Oregon remain in the state, while 27% of people moved in from other Western states, including California and Washington. 5% were from Southern states, 4% from Northeastern states, roughly 8% from Midwestern states and 10% moved from other international places outside the U.S.** (Aish et al 2015).
- California is the greatest source of net in-migrants to Oregon, while the largest out-migration was to Washington State, many of them seeking lower cost housing in urban areas (Nelson, 2020).
- "Push factors" related to the place of origin, including: lack of economic opportunity, political/ religious persecution, and environmental risks and dangers. "Pull factors" related to the place of destination: demand for labor, attractive wages, or climate-related amenities. "Intervening factors" that aid or hamper migration, include: existence of social networks, immigration policies, trade relationships, access to resources and capital (Saperstein 2015).

- Material and political wealth is a large factor in individual decisions to relocate or remain in place and adapt to climate extremes. Wealthy people may choose to remain in place and adapt or protect themselves, people of medium wealth may be driven and able to relocate, and people of very low wealth may become trapped, with the desire to relocate but without the ability to do so.

- Storms and flooding often result in short term migration/displacement. Droughts are associated with an increase in permanent migration.

- Wildfire was not found to inspire migration for most, though populations who migrated away from fire-prone areas had a higher wildfire risk perception, and migrants tended to make short-distance moves to places where they had existing social ties.

- Washington State ranks 8th in U.S. states in receiving international refugees, with the largest share of people currently coming from countries in **South and Southeast Asia, Sub-Saharan Africa, and the Middle East** (Saperstein 2015, Fathi 2015). These connections with Pacific Northwest migrant, asylum seeker, and refugee communities are existing social connections that could also provide a conduit for climate migration into the future.

- Oregon has retained a healthy share of its instate-born population. Additionally, and Washington and Oregon originators leave, it's almost always for another Western state (Aish et al 2015).

- Growing sectors of employment could also be examined, as economic trends are likely to impact migration opportunity.

Climate migration is generally split into voluntary and forced migration, based on population motives. For those that are able to undertake it, migration can be thought of as an adaptation strategy, though many barriers make this impossible for other groups of people. Within CTUIR's community, family connections between Tribes could prove to be a pathway for migration support, as Tribal Members with family that live on reservations and in Tribal communities in other Western states could see the need to migrate. Connections to the Pacific Northwest providing migration opportunities to the CTUIR Ceded lands.

Drought is likely to be a factor in the magnitude and direction of migration. Various agricultural practices are threatened by a changing climate, and could alter overall economic projections for any of the three states, as well as shift employment opportunities for farm workers (Saperstein et al 2015). Research that seeks to understand how and why people are migrating could provide insight into how these changes might be magnified over time. Creating structured channels to facilitate migration and smooth transitions for new arrivals could help CTUIR anticipate for changing population dynamics.

(Credit: Aish et al 2015)

<u>Gaps in Knowledge/Data/Policy:</u>

- Understanding of how and why people are migrating over time;
- Economic projections for major industries in the future, and how adaptation could alter this.

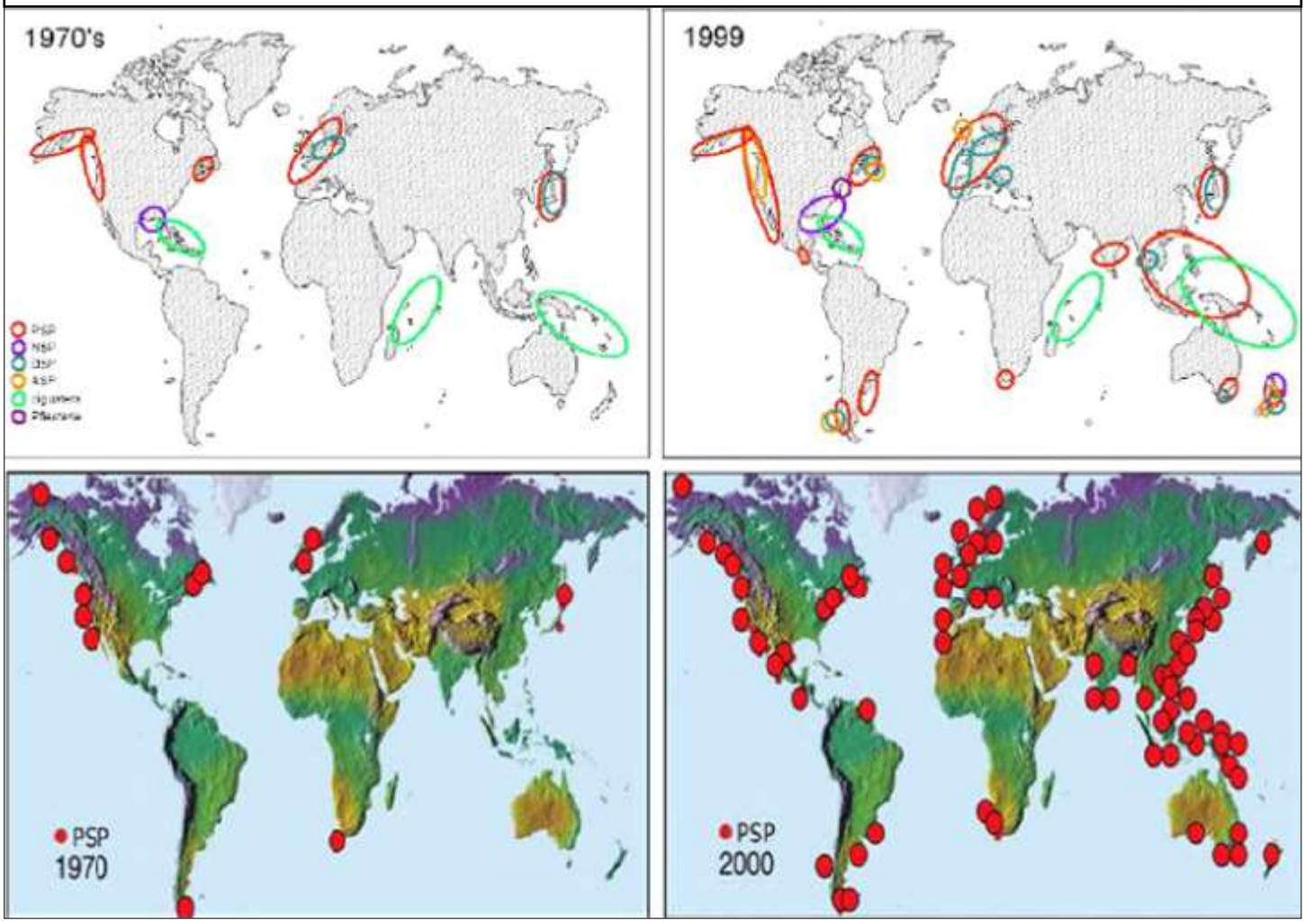
9. Changes to Global and Local Food Security and Safety

Variability and extreme weather events across the world are likely to have an impact on the food that is provided to, and consumed by CTUIR's Tribal community. Hazards to food safety will occur at various stages of the food production and distribution chain, and can have food-borne illness impacts to communities and families. While these threats to food safety come in many, focusing on one area of potential contamination as a proxy estimate can serve as an entry point for a larger food systems examination.

Figure 3F.9 shows the shifting impact on the food safety of marine foods, as harmful algal blooms (HABs) show a changing distribution into waters not previously impacted (Tirado et al 2010).

- From primary production through to consumption, changes in temperature and precipitation patterns, frequency and intensity of extreme weather events, ocean warming and acidification, changes in contaminants' transport pathways, agricultural practices, animal production, global trade, demographics and human behavior, all influence food safety.
- Temperature increases and changes in rainfall patterns have an impact on the occurrence of bacteria, viruses, parasites and fungi, and their corresponding foodborne diseases. These changes can have an impact on microbial ecology and growth, plant and animal physiology and host susceptibility, which may create changes in the incidence and intensity of plant and animal diseases and pest infestations.
- Harmful algal blooms (HABs) also threaten the food safety of coastal shellfish harvests, as the temporal period during which HABs occur annually may also expand. Modeling for the Puget Sound (WA) projects the period of optimal growth of the

Figure 3F.9: Harmful Algal Bloom Density Changes Globally (1970-1999)



toxic dinoflagellate *Alexandrium catenella*, which produces paralytic shellfish toxins that can cause death if consumed by humans. See Ch 3D pages 145-149 for additional information. Bloom period for this algal species will expand from its historical length of **68 days to up to 259 days by 2100** due to warmer water temperatures, and would have severe implications to regional food safety, as shellfish farming is an important industry in Puget Sound (Tirado et al 2010).

Dept. of Child and Family Services (DCFS) organized and implemented near-monthly food distributions for the CTUIR community during the Covid-19 pandemic to provide for those who had additional need.

- Studies of climate impacts to food safety focus on food microbiological and chemical contamination and associated foodborne diseases, including biotoxins like marine toxins and mycotoxins. Foodborne diarrheal diseases are a priority for routine monitoring. Priorities include *salmonellosis, campylobacteriosis, vibriosis, listeriosis*, other bacterial infections, parasitic infections, viral diarrheal syndromes.

- A potential **1°C (1.8°F) increase in weekly mean maximum temperature increases Salmonella infections in cities by 7%** (Tirado et al 2010). One study anticipates **salmonellosis will increase 5 –10% for each 1°C increase in weekly temperature.** Studies for Australian communities predict a **doubling of the morbidity associated with salmonellosis in South Australia by the year 2050**, and a study from Ireland predicted a **3% increase in the occurrence of campylobacteriosis** by mid and late century (Tirado et al 2010).

Elevated temperature during the week preceding the onset of the food-borne disease suggests inappropriate storage temperature and food handling may be important factors in the transmission. Most foodborne bacterial pathogens can grow at room temperature, but reproduce faster at elevated temperatures. So increases in ambient temperatures speed up the rate of pathogen proliferation across the food system. Increasing frequency of severe weather events also compound threats to food safety, including (but not limited to):

- Flooding causes overflow of untreated human sewage, increasing likelihood of enteric virus contamination during the production of fresh produce and molluscan shellfish.
- Parasitic foodborne and water-borne diseases are transmitted by protozoan parasites like cryptosporidiosis and giardiasis, and can be transmitted by contaminating foods through irrigation or wash-water (Tirado et al 2010).
- Emerging zoonotic (transmitted from animals to humans) diseases may increase due to survival of pathogens in the environment, changes in migration pathways, carriers and vectors and changes in the natural ecosystems. Climate change affects animals' living conditions, which are favorable to pathologies such as parasitic diseases, nutritional disorders, sunstroke or dehydration.
- Increasing disease pressure may result in an increased use of veterinary drugs, and possibly unacceptable levels of veterinary drugs in foods of animal origin.

Infection of crops by fungi could encourage production of mycotoxins in food crops, especially grains. Mycotoxins are naturally-occurring substances produced by toxin-producing fungi that grow in food crops, and cause adverse health outcomes when

consumed by humans and animals. Mycotoxins exist as a concern in a number of ways, including (Tirado et al 2010):

- Direct human dietary exposure to mycotoxins occurs through consumption of contaminated crops. Mycotoxins can also reach the human food supply indirectly through animal products (e.g. milk), from livestock that have consumed contaminated feed.
- At high doses, mycotoxins produce acute symptoms and deaths. At lower doses, particular mycotoxins may possess carcinogenic, cytotoxic, immunosuppressive, neurotoxic, estrogenic or teratogenic activity.
- Adverse plant growing conditions like drought stress, temperature stress, pest attack, poor nutrient status, and others, encourages mycotoxins to develop. Changes in the geographical range of crops produced could provide opportunity for new fungus plant associations to arise.
- **Storage of dry grains also contribute to fungal contamination, if the fungus is present in grains when they are harvested and stored in damp conditions**. Future variation of conditions in the harvest/post-harvest period threatens stability of the crop between harvesting and marketing, and could be adversely affected.
- Mycotoxins are not generally understood by the public, and are difficult to publicize effectively being an 'invisible threat.' Informing the public about risks of exposure and the nature of the food that carries these risks might help to reduce use of substandard food in times of need.

Food safety risks during disasters and emergencies are mainly linked to unsafe food storage and cross contamination from the environment, or from people during food handling and preparation. Cooking foods may be impossible in emergency situations because of lack of electricity, facilities or fuel, and poor sanitation, including lack of safe water and toilet facilities. Close personal contact can compound the risks of illness among already susceptible groups.

Changing climate patterns have increased the urgency to invest in disaster risk reduction, preparedness and response plans. Such plans should address food safety risks in the aftermath of natural disasters along the whole food chain. Strategic and effective food safety management requires understanding microbiological hazards, and how their presence in foods can be prevented or maintained within tolerable levels. There is a need for improved epidemiological surveillance for early identification of emerging food and water-borne diseases, and for monitoring of zoonosis and other animal diseases and rapid investigation of unusual outbreaks.

(Credit: Tirado et al 2010)

<u>Gaps in Knowledge/Data/Policy:</u>

- Detailed information on how dryland wheat agriculture is likely to produce myotoxins;
- Security and safety of global food supplies that are consumed by Tribal community;
- How these agricultural diseases may affect First Foods and other native plants and animals;
- Policies and guidance on food safety concerns that occur during disaster events.

Community events that serve foods, like the annual Community Picnic (pictured), will need to account for to prevent food-borne illness, which could include having a pre-planned protocol for serving.

F. Expand and Support Tribal Stewardship Training and Education Opportunities

"The ancestors visited their relatives and trading partners in other groups beyond the homeland to maintain kinship, nurture protective alliances, obtain new trade items, and tend to reciprocal relationships. Because these peoples relied on nature's gifts for continued survival, there was variation in travel and they knew alternative areas for gathering and hunting (Hunn and Haug, 2015)."

Disaster preparedness, emergency response, and community capacity all depend on networks of communication and information sharing. Education for self-sufficiency skills, first aid and first responder training, community and volunteer organizing, and many other knowledge-building opportunities strengthen frameworks for the passing of information between generations and across experiences.

i. Workforce and Craft Skills

Training and certification for carpentry, electrical, plumbing, construction, textiles production, clothing and goods crafting, and many other technical skills are necessary to maintain community function and quality of life, especially in disaster response. Over 80% of CTUIR CEDS respondents identified "Job Training (lack of necessary skills)" as a barrier for Tribal Members in finding employment (CTUIR CEDS 2017, Ch 3F page 227). Skills and services training would not only improve economic mobility and flexibility of Tribal families, but would also build local and regional capacity to produce basic necessary goods and services, buffer global supply chain impacts, and improve local response to community need.

Short Term:

- **Support and expand DCFS Workforce Development and Building Our Life Skills, Training, and Employment Readiness (BOLSTER) Programs** in providing accessible service and trade education opportunities.

- **Organize and facilitate community-led discussions of additional trade and craft services education that could improve regional production of essential goods and services**. These have previously been noted to include building a culture center for master craftsmen to teach making bows, weaving, beading, building a library, small assembly plants, clothing manufacturing, and others. See Ch 3F pages 227-233 for additional detail.

Long Term:

- **Conduct preparedness exercises that examine impacts on availability and supply of construction and operations materials**. Impacts such as flooding, wildfire smoke, extreme heat, and drought on essential materials for Tribal operations should be anticipated to build additional regional capacity, including ways to provide mitigation support. These exercises could be paired with community conversations about changing need; see Ch 3B pages 97-98, Ch 3C pages 114-116 and Ch 3D pages 156-158 for additional detail.

ii. Treaty Rights and Tribal Sovereignty

"The three Tribes worked in alliance to regain and rebuild their self-sufficiency from the government. The traditional leadership of chiefs and headmen at the head of table as key negotiators evolved into a new form of leadership. This leadership was intertwined with the negotiations not only for the Tribal people and their wellbeing, but also with decision making that would develop into the economic stimulus that

would enable the Tribes to acquire the financial sustainability that would give them a new found independence (CTUIR Comprehensive Plan 2010)." First Foods and the Peoples' reciprocal promise are the core of Tribal climate resilience. Therefore the governance and stewardship of Tribal communities is an essential element in adaptation.

Education on the scope and complexity of Treaty Rights is necessary for both Tribal Members engaging in those rights, as well as for non-Tribal agencies and landowners who may attempt to either restrict or enhance those rights in various capacities.

Treaty Rights education for both Tribal and non-Tribal audiences will expand the number of people who are willing to prioritize Indigenous stewardship.

Short Term:

- **Support dedicated Treaty Rights enforcement through retention of Conservation Officers** within Tribal and non-Tribal law enforcement agencies. These officials are important for following through on regulatory policy set by the Tribe, and by other entities like the Columbia River Inter-Tribal Fish Commission (CRITFC), and by states.

- **Continue to support and implement Tribal-focused Treaty Rights education opportunities**, such as the Hunters and Fishers Forums, CRITFC's camps and outreach initiatives, and many others being conducted. Educational opportunities for understanding of First Foods life cycles, harvesting and processing practices, first aid and safety, and other topics could easily be paired with education on rights and legal protections that Tribal Members have secured; see Ch 3B pages 89-90, 99-100 and Ch 3G pages 285-288 for additional detail.

Long Term:

- **Support and expand Tribal Treaty Rights education to appropriate non-Tribal audience**s, through participation in regional events, college and university courses, state and federal work groups, and other outreach opportunities. Education of this nature could expand opportunities for Treaty Rights exercise through network building, and improving understanding the role of Indigenous stewardship in climate adaptation. See Ch 3B pages 89-90, 99-100 for additional detail.

iii. Financial Literacy and Management

Financing resilience will also require the sharing of information for financial understanding, particularly where it can reduce borrower "risk" and improve access to fair and equitable credit. Nixyaawii Community Financial Services (NCFS) offers education and technical assistance for businesses in different phases, and additionally provide education to youth and school education opportunities as well.

Short Term:

- **Support and expand K-12 and young adult financial preparedness efforts,** such as the Youth Entrepreneur Summer Camp and the NCS youth outreach financial fairs. Preparing Tribal youth to be leaders requires understanding financial implications of decisions; see Ch 3F pages 230-233 for additional detail.

Long Term:

- **Continue and expand adult financial literacy and management courses,** such as "The One,"

homeowner program, and other credit and borrowing education courses offered. Improving understanding and access to financial knowledge builds resilience for individuals and families. See Ch 3F pages 230-233 for additional detail.

iv. Community Organizing

Strengthening community capacity to respond to need will help Tribal communities be there to care for each other in times of disaster, and identify and address gaps in government services as they emerge. Training community members on event and direct action organization, facilitation, grant proposal development, and sharing networks for supplies and equipment (among others) could expand CTUIR capacity to respond to changing conditions, and support any gaps in Tribal government services.

Short Term:

- **Build capacity to support community response initiatives and events**, like the Earth Day Clean Up, Community Picnics, disaster response volunteers, and other initiatives of grassroots organizing within the Tribal community.

- **Organize and implement recycling and repurposing education opportunities**, especially around goods, clothing, and equipment that could be repurposed for community benefit. See Ch 3C pages 132-133 for additional detail.

Long Term:

- **Organize and facilitate community education opportunities to learn about Tribal government and nonprofit initiatives**. This would involve building space to learn about how the community may want to support or supplement these initiatives to expand the responsiveness of CTUIR, and of Indian Country, in times of crisis.

v. Native Vegetation and First Foods

Landscaping and gardens are excellent places to encourage the use of native plants instead of non-native and invasive ornamental plants, which use greater amounts of water. Native plants support native pollinators and unique soil microorganisms to preserve local biodiversity, and can help educate families about earth science, plant and animal life cycles, and benefits of native plants.

Short Term:

- **Support and expand programs and learning opportunities with Indian Lake Recreational Area**, which annually hosts the annual Fish Derby, and provides an excellent space to be immersed in nature and engage with native plants and animals. These opportunities increase understanding and awareness of native species and the importance of Indigenous stewardship. See Ch 3 B pages 89-90, 99-100 for additional detail.

- **Continue to utilize native plants for landscaping of Coyote Business Park**, as well as for developing new facilities, and provide water efficient irrigation systems for these. Native plants are used in landscaping for most of CTUIR facilities, including at Wildhorse Resort and Casino (WRC), Tamástslikt Cultural Institute (TCI), Nixyaawii Governance Center (NGC), Nixyaawii Education Center (NCS), and many others. See Ch 3A pages 60-61 for additional detail.

Long Term:

- **Support and expand Department of Natural Resources (DNR) Tribal Native Plant Nursery (TNPN) operations**. TNPN capacity to provide plants to restoration projects, and to landscaping and retail demands is robust, and would be excellent partners in developing educational capacity to provide information to local outreach groups. See Ch 3B pages

Native plants are used in landscaping for many of CTUIR's facilities, reducing water demand needed to irrigate these greenspaces. Paired with the potential for renewable energy to power these operations, there is much Tribal businesses can do to conserve.

88-90 for additional detail.

G. Continue to Develop and Implement Safe and Energy Efficient Tribal Housing and Community

"Where development is located and the type of materials used in building construction are important factors in determining the risks facing a jurisdiction. The housing-type and date of construction are also important factors in assessing the risk from certain hazard. Certain housing types tend to be less disaster resistant and warrant special attention. For example, manufactured homes are generally more prone to wind and water damage than standard stick-built homes… For these reasons, having information about the date and type of buildings found on the reservation will be useful in developing and prioritizing hazard mitigation actions (CTUIR Hazard Mitigation Plan 2016)."

Developing safe and energy efficient homes for Tribal communities strengthens families to be prepared. Homes can be constructed with strategies that build resilience to acute natural disasters, and to long term negative environmental trends, like smoke inundation or mold contamination of indoor air. Installing renewable energy technologies on new and existing housing would mitigate against rising energy costs and transmission interruptions to electrical service.

Short Term:

- **Develop, design, and continue to implement zoning and permitting for mixed -use community planning**, which concentrates residences with other retail and other appropriate commercial spaces to facilitate non-motorized transportation. The new Nixyaawii subdivision neighborhood is an excellent example. See Ch 3C pages 119-120, and Ch 3E pages 204-206 for additional detail.

- **Support and expand business tenant access and leasing options for renewable energy options for Coyote Business Park,** as implemented by DECD. Conversations within DECD highlight the potential for business tenants to see sustained benefits from reduction in energy use and irrigation demand as part of leasing agreements.

Long Term:

- **Support and expand renewable energy installation and leasing options for housing within the Nixyaawii Subdivision,** as implemented by Tribal Planning Office (TPO) and DECD. Continue to amend and update zoning and permitting processes to further encourage renewable energy leasing where appropriate. See Ch 3E pages Ch 3E pages 204-206 for additional detail.

- **Continue to support home capital lending and borrowing capacity for Tribal families**, such as the homeowner and land leasing courses facilitated by Nixyaawii Community Financial Services (NCFS). See Ch 3F pages 230-233 for additional detail.

H. Support Use of Tutuilla Food Sovereignty Center for Community Need

"Trade and barter was a significant aspect of Indian life on the Plateau and essential for the survival of Indian people. Indians relied on other Indians to provide goods they themselves were not able to obtain. Often,

groups from a single village community would travel different directions as part of their seasonal round. Through years of trade relationships, elders knew exactly what other Indians needed in exchange for goods they needed (CTUIR Comprehensive Plan 2010)."

Funds made available to Tribes during the Covid-19 pandemic were used by CTUIR to construct the Tutuilla Food Sovereignty Center, a facility to be used to store and distribute food assistance and other community needs in an efficient and effective way. Department of Child and Family Services (DCFS) has been utilizing this building to store food supplies from federal and nonfederal assistance sources, and the building could be used in the future to facilitate additional community assistance supply distributions.

Short Term:

- **Fund and hire a dedicated staff position within DCFS or another related department to coordinate the current and future use potential of the Tutuilla Food Sovereignty Center**. This position would ensure that uses are consistent with funding requirements, as well as providing as much usefulness as possible to Tribal departments and the community.

- **Support and expand DCFS's capacity to partner with Tribal and non-Tribal organizations** to provide food and household supply distributions, as well as the Tutuilla Food Sovereignty Center's ability to provide storage to other departments, such as Public Works and DECD's Broadband project's servers and infrastructure.

Long Term:

- **Develop strategies or a coordinated plan to expand food storage and additional infrastructure within the Tutuilla Food Sovereignty Center**. The goal would be to accommodate both federally provided food assistance, as well as locally donated fresh produce and First Foods, since shared infrastructure is prohibited.

- **Continue to support DCFS food distributions and other assistance needs deliveries** that can be effectively and efficiently conducted at the Tutuilla Food Sovereignty Center site.

I. Provide for Needs of Community in Crisis and Non-Crisis

"Testimony has served and still serves a purpose in Tribal life. Following the oral tradition, it is a way to pass down information in a public forum to those bearing witness to an event. This testimony teaches life lessons, morality, and consequences of actions… In this tradition, what is spoken is the truth of the world, a proclamation. Testimony is a deliberate thoughtful form of speech that carries gravity in the fewest words possible (Caw Pawa Laakini | They Are Not Forgotten, 2015)."

Often crisis situations present unique opportunities or funding sources that can strengthen community response to crisis in the short term. With additional planning, these benefits can be extended into non-crisis times to provide expanded community support networks. Current needs for the Tribal community have been identified below, though the list is not exhaustive.

Short Term:

- **Celebrate and support the CTUIR Longhouse as a community gathering location,** both for regular worship services as well as for other community needs. These include kitchen and meal preparation space, and public outreach like the Dept of Natural Resources Open House educational events. Places for gathering and sharing testimony will be essential in building community psycho-social

resilience. See Ch 3D pages 167-169 for additional detail.

- **Expand community action and mutual aid networks for the CTUIR community**. These could include supporting Tribal Member grassroots initiatives like the Pendleton Community Action Coalition (PCAC), Tribal government services like the Tribal Youth Council and Nicht-Yow-Way Senior's Center, or aspirational programs that would improve Tribal community access to knowledge, equipment, or transportation.

DCFS offers programming that provides for community need for access to food and supplies. During the Covid-19 pandemic, this included organizing fresh food boxes, personal protective equipment, and school supplies (pictured).

- **Support and expand youth education and engagement as future Tribal leaders.** This includes continuing to support the CTUIR Tribal Youth Council, immersive earth sciences camps and outdoor schools like CRITFC's Salmon Camp, and other formal and non-formal community organizing education options. See Ch 3G page 277 for additional detail.

- **Develop and facilitate consumer purchasing networks/collectives**, and community and family storage options, to provide families with opportunities to source supplies at cost-effective prices and share with other community members and across the region. See Ch 3F page 251 for additional detail.

Long Term:

- **Support monetary and non-monetary needs of Elders and vulnerable people in the Tribal community**. These needs include access and availability of food, funds for utilities, and emergency services such as medical and disaster response.

- **Develop support for children and families to continue to be provided food assistance** as needed, both in and away from school as situations require. Flexibility and opportunity to increase cultural connection through these foods services should be prioritize, with examples including providing First Foods to the CayUmaWa Head Start program, pursuing Tribal harvester eligibility for USDA vendor certification, and others. See Ch 3 D pages 170-171, and Ch 3F pages 250-251 for additional detail.

- **Expand CTUIR community internet access and broadband infrastructure across the Umatilla Indian Reservation (UIR)** to ensure community members have access to digital age services and communication channels. Access to communication networks improves emergency response, and builds capacity for flexible governance. See Ch 3C pages 123-126, and Ch 3D pages 171-172 for additional detail.

How Do We Measure the Success of These Adaptations?

"The three Tribes worked in alliance to regain and rebuild their self-sufficiency from the government. The traditional leadership of chiefs and headmen at the head of table as key negotiators evolved into a new form of leadership. This leadership was intertwined with the negotiations not only for the Tribal people and their wellbeing, but also with decision making that would develop into the economic stimulus that would enable the Tribes to acquire the financial sustainability that would give them a new found independence (CTUIR Comprehensive Plan 2010)."

- **CTUIR Comprehensive Economic Development Strategies (CEDS) (2017) Part 5, Objective 21**: Identify opportunities to support CTUIR culture and the reservation community that are consistent DECD's mission.
- **CTUIR Comprehensive Plan Objective 5.5.5:** Develop programs for assisting Tribal Members to become financially stable; such as maintaining good credit ratings and family resilience (Comp Plan page 76 for benchmarks);
- **CTUIR Comprehensive Plan Objective 5.5.6**: Provide effective community protection; life-saving rescue, emergency medical, fire protection, emergency management and natural hazard mitigation (Comp Plan page 76 for benchmarks);
- **CTUIR Comprehensive Plan Objective 5.10.2:** A CTUIR education system that has a progressive delivery structure with a responsive adaptable administration (Comp Plan page 101 for benchmarks);
- **CTUIR Comprehensive Plan Objective 5.10.4:** Provide educational services to all tribal-member students within Umatilla and Morrow Counties (Comp Plan page 101 for benchmarks);
- **CTUIR Comprehensive Plan Objective 5.13.3**: Develop economically and ecologically sound transportation opportunities (Comp Plan page 114 for benchmarks);
- **CTUIR Comprehensive Plan Objective 5.14.4:** Develop a comprehensive emergency management program through cooperative relations with other Tribes, federal, state and local agencies (Comp Plan page 121 for benchmarks);
- **CTUIR Comprehensive Plan Objective 5.14.5:** Provide effective emergency services to the CTUIR community including lifesaving rescue services, emergency medical service, fire protection services and HAZMAT response (Comp Plan page 121 for benchmarks);
- **CTUIR Comprehensive Plan Objective 5.14.6:** Encourage fire safety through fire prevention and public education (Comp Plan page 121 for benchmarks);
- **CTUIR Comprehensive Plan Objective 5.14.11:** Maintain mutual aide agreements in all areas of emergency response preparedness (Comp Plan page 121 for benchmarks);
- **CTUIR Comprehensive Plan Objective 5.14.14:** Implement projects and programs identified in the CTUIR Hazard Mitigation Plan (Comp Plan page 121 for benchmarks).
- **CTUIR Mission Community Plan (1993) Part C: Land Use Element 4.11** Redevelop the Lucky Seven Trailer Park to create a modern mobile home park with improved infrastructure and amenities;
- **CTUIR Mission Community Plan (1993) Part C: Land Use Element 4.12** Provide residential areas with safe bicycle / pedestrian connections to Tribal employment, shopping, and community facilities.
- **CTUIR Mission Community Plan (1993) Part C: Land Use Element 7.4** Open spaces should be improved and maintained with native plants and vegetation where possible.
- **CTUIR Mission Community Plan (1993) Part D: Tribal Services Element 6.6** Develop opportunities for all Tribal youth to have traditional recreational experiences such as horseback riding, hunting, gathering, and fishing.
- **CTUIR Hazard Mitigation Plan (2021) Section 3**: Hazard Identification and Risk Assessment Results (page 68-190).
- Department of Economic Community Development (DECD) Annual Work Plans
- Department of Child and Family Services (DCFS) Annual Work Plans

What Gaps in Knowledge, Policy, Capacity, or Education Exist?

- Changing community needs with emerging climate impacts;
- Population dynamics impacts anticipated
- Supply chain and services needs currently and how these are changing

Economics & Community Summary

Economic Development Adaptations

A. Diversify Economic Opportunities, Trainings, and Options

B. Build Capacity to Address Economic Challenges

C. Expand NCFS to Provide Small Business Support

D. Build Interest and Capacity in First Foods Stewardship, Procurement, and Processing

E. Develop Land Acquisition Plan and Implement Strategies

Economic resilience means having access to flexible credit opportunities, being financially knowledgeable, and able to buffer impacts through diversification of revenue and capital sources.

Measures of Success:

- CTUIR Comprehensive Economic Development Strategies (CEDS) (2017) Objectives 2, 5, 6, 9, 10, and 11
- DECD and DCFS Annual Work Plans and Benchmarks
- CTUIR Comprehensive Plan Objectives 5.2.1, 5.2.2, 5.2.3, 5.2.5, 5.4.2, 5.4.6, 5.3.1, 5.3.5, 5.15.9
- Tribal family and community financial prosperity

Community Support Adaptations

F. Expand and Support Tribal Stewardship Training and Education Opportunities

G. Continue to Develop and Implement Safe and Energy Efficient Tribal Housing and Community

H. Support Use of Tutuilla Food Sovereignty Center for Community Need

I. Provide for Needs of Community in Crisis and Non-Crisis

A connected and interdependent community is a resilient one. Networks and support systems that strengthen existing mutual aid initiatives should be pursued in crisis and non-crisis.

Measures of Success:

- CTUIR Comprehensive Economic Development Strategies (CEDS) (2017) Objective 21
- CTUIR Comprehensive Plan Objectives 5.5.5, 5.5.6, 5.10.2, 5.10.4, 5.13.3, 5.14.6, 5.14.11, 5.14.14
- CTUIR Hazard Mitigation Plan (2021) Section 3
- Mission Community Plan (1993) Parts C: Land Use and Part D; Tribal Services
- DECD and DCFS Annual Work Plans and Benchmarks

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- Background Photo, "Cattails and reeds on Indian Lake," CTUIR DECD Indian Lake Staff
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- Inset Photo, "Construction crew of Nixyaawii apartment site," CTUIR DNR FFPP 2022
- Inset Photo, "Brushfire burns along I-84 highway closure," East Oregonian 2022
- Inset Photo, "CTUIR Representatives Tour Construction." CTUIR DECD 2021
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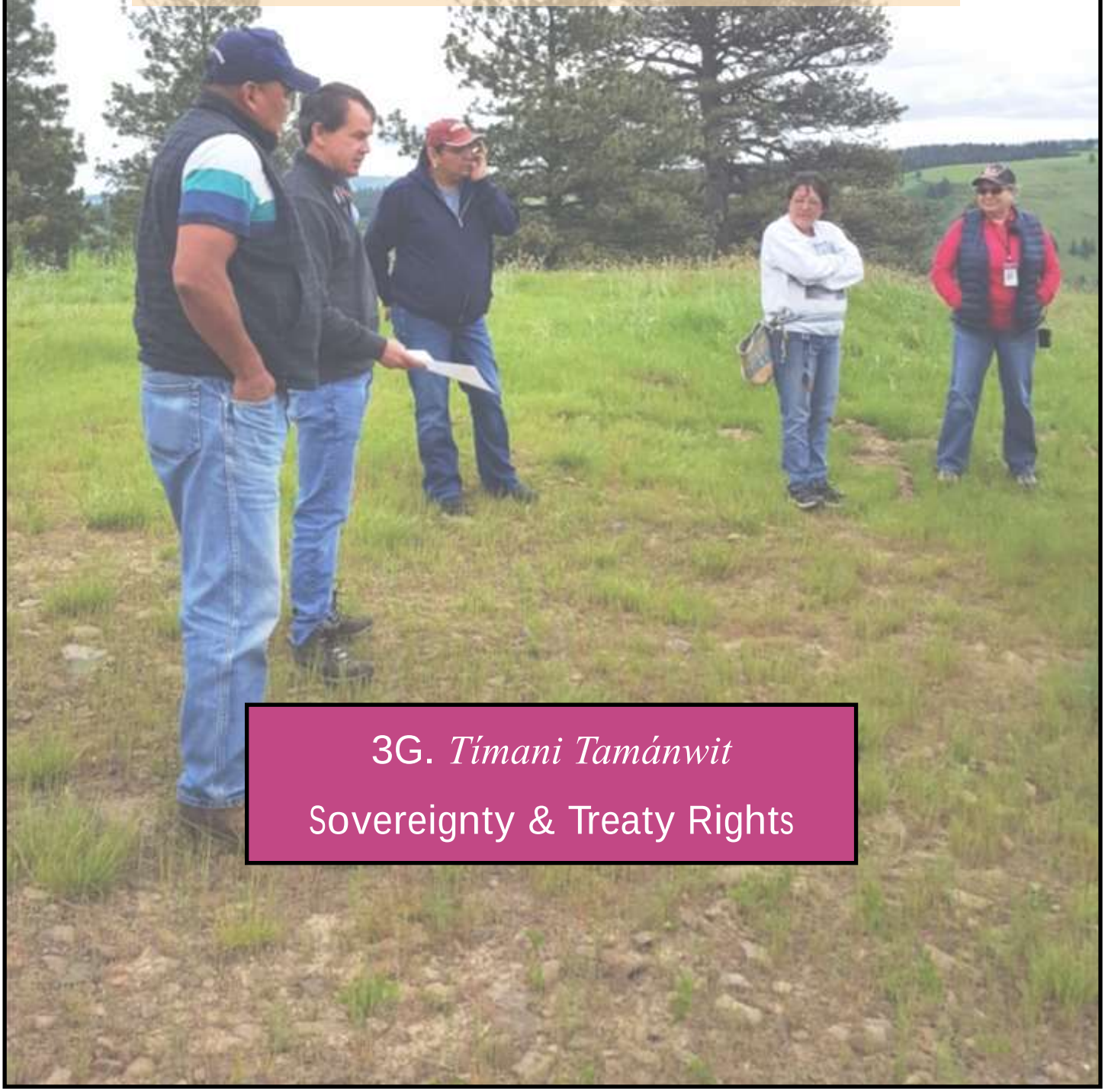
- Inset Photo, "Yellowhawk Community Garden and Gardener." Umatilla County OSU Extension Service 2017
- Inset Photo, "Upland Soil Slumps Resulting from Heavy Rain." CTUIR DNR Fisheries
- Inset Graphic, "Graphic from CTUIR CEDS Community Survey." CTUIR DECD CEDS
- Inset Photo, "Displays at TCI Gift Shop," CTUIR Confederated Umatilla Journal (CUJ) 2022
- Panel Photo, "Elk Browse Grass above Meacham Creek." CTUIR DNR CRPP
- Inset Photo, "4th of July Powwow participant buffers thunderstorm," CTUIR CUJ 2022
- Inset Photo, "NCFS staff table booth at Community Picnic," CTUIR CUJ 2022
- Inset Graphic, "Graphic from Yellowhawk Food Systems Assessment." Yellowhawk 2020
- Inset Photo, "NCFS Youth Entrepreneur Camp." CTUIR NCFS 2019
- Inset Photo, "Participants dance at annual 4th of July Powwow," CTUIR CUJ 2022
- Background Photo, "Participants engage with each other at Yellowhawk Fun Run 2022," CTUIR CUJ 2022
- Background Photo, "Lamprey cook in traditional method over fire," CTUIR DNR CRPP
- Inset Photo, "Drummers at Longhouse celebrate CTUIR Treaty Day," CTUIR CUJ 2022
- Inset Photo, "Tribal Fire Crews Navigate Floodwaters." CTUIR DNR Fisheries Feb 2020
- Inset Photo, "CUJ Promo for CayUmaWa Camp Crier App," CTUIR CUJ 2022
- Inset Photo, "DCFS Staff and Volunteers Prepare Food Distribution." CTUIR DNR FFPP
- Inset Photo, "CTUIR Community enjoys a celebration together at Community Picnic," CTUIR CUJ 2022
- Panel Photo, "Lupine and snowy ridgetop Blue Mountains." Craig Kvern
- Inset Photo, "Tribal youth learn about First Foods," CTUIR DNR CRPP
- Panel Photo, "Snowy Trees in Blue Mountain Forests." CTUIR DNR FFPP 2019
- Inset Photo, "Native landscape plants outside Wildhorse Resort," CTUIR DNR FFPP 2022
- Panel Photo, "CTUIR Grain Elevators in Smoky Summer." CTUIR DNR FFPP 2018
- Inset Photo, "DCFS School Supply Distribution to Community," CTUIR CUJ 2022
- Summary Photo, "Sailboat travels on Indian Lake in Summer," CTUIR DECD Indian Lake staff
- Panel Photo, "Overlooking CTUIR Ceded Lands from Ridge." CTUIR DNR CRPP

"Mayní pawáta miyánašma?"

How will the children be?



3G. *Tímani Tamánwit*

Sovereignty & Treaty Rights

Climate Impacts for **Tribal Sovereignty**

"The Tribes will always exercise our national sovereignty and preserve our traditional cultural ways in harmonious existence with our homeland. We will always provide for the well-being of our people in the future. We will live in balance with the land and use our natural resources only when traditional and cultural teachings dictate use.

We will respect all persons; acknowledge the wisdom of our elders and religious leaders; sustain the hopes of our people; and accept responsibility for our actions realizing that we are accountable to the Creator. The Creator's spirit lives in our homeland and our national sovereignty protects the spirit with the land, waters, people, culture, religion and language (CTUIR Comprehensive Plan, 2010)."

There are many mechanisms that federally-recognized Tribes like CTUIR can use to assert sovereignty over land and jurisdiction issues, at local, regional, national, and international levels. Issues of climate change become inseparably tangled with the history of Tribal recognition and respect. The history of Tribal dispossession of land, culture, language, and community cannot be ignored in the adaptation process. Tribes can utilize their sovereignty to impact land and resource management strategies, and returning Indigenous knowledge and cultural practices to lands dispossessed of them is essential in building a resilient future.

1. Potential Increase in Conflict over Water and Land Resource Management

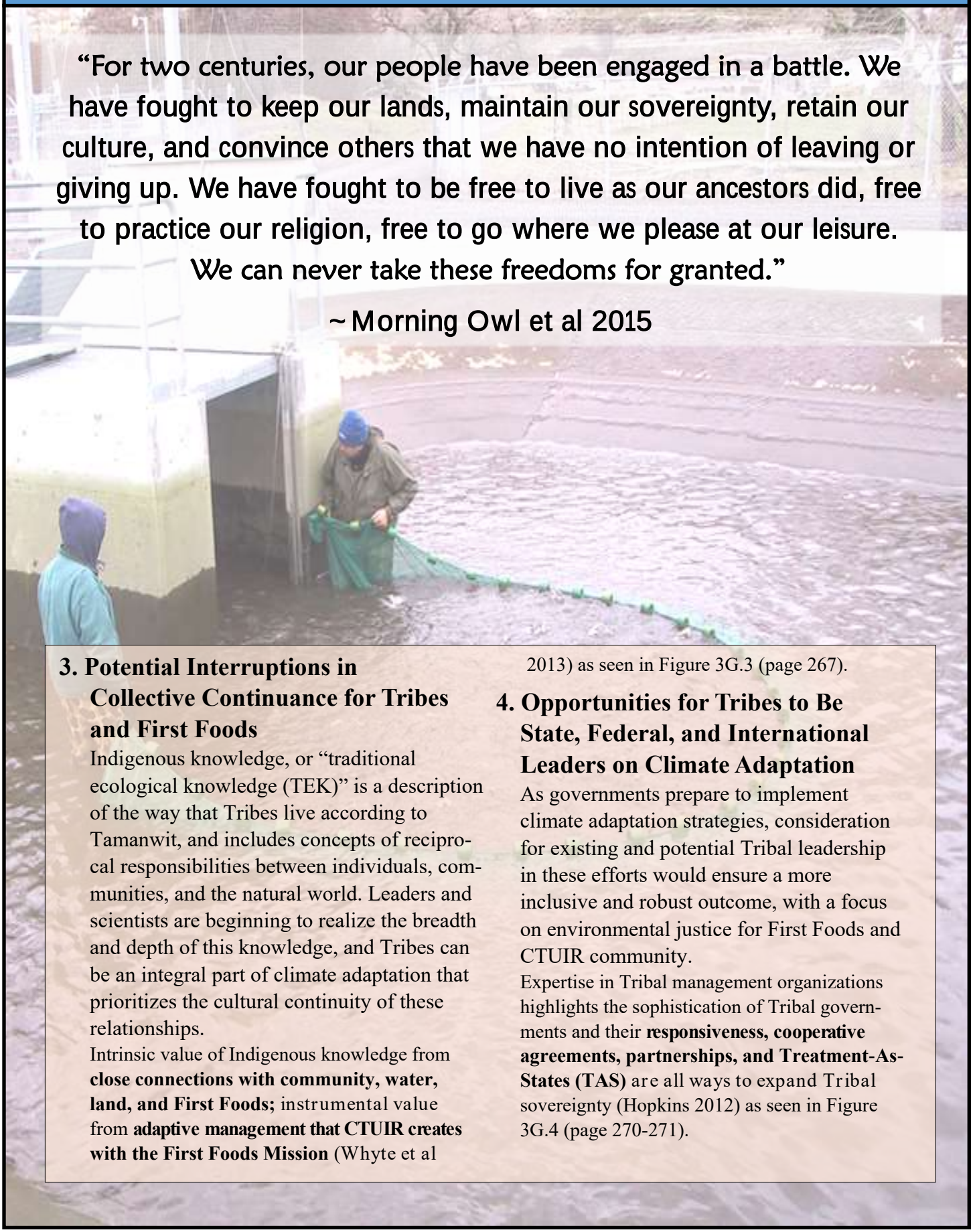
As resource availability changes, conflicts over who can access the existing resources is likely to increase; this is particularly true of water. Conflicts over water in the region are likely to intensify, though there are proactive ways to anticipate for conflict.

High potential for water availability conflict the **Eagle Cap Wilderness, the Imnaha River, the Elkhorn Mountains along the Wallowa-Whitman National Forest, and Anthony Lakes recreational area** due to 30% reduction in summer base flow (Clifton et al 2018) as seen in Figure 3G.1 (page 263).

2. Increases in Criminal Activity and Harsher Sentencing

Heat causes impairments in rational decision making, and causes people to act in unpredictable ways. Violent crime and arrests are likely to increase as a direct result of extreme heat, especially incidences of assault with a weapon.

General arrests increase by 15% on extremely hot days, with **largest effects on weapons charges and assault with a weapon. Violent crime arrests still increase by 9% per year by 2050 regardless of adaptation** (Behrer and Bolotnyy 2021), as seen in Fig 3F.2a and Fig 3F.2b (page 265-266).



"For two centuries, our people have been engaged in a battle. We have fought to keep our lands, maintain our sovereignty, retain our culture, and convince others that we have no intention of leaving or giving up. We have fought to be free to live as our ancestors did, free to practice our religion, free to go where we please at our leisure. We can never take these freedoms for granted."

~ Morning Owl et al 2015

3. Potential Interruptions in Collective Continuance for Tribes and First Foods

Indigenous knowledge, or "traditional ecological knowledge (TEK)" is a description of the way that Tribes live according to Tamanwit, and includes concepts of reciprocal responsibilities between individuals, communities, and the natural world. Leaders and scientists are beginning to realize the breadth and depth of this knowledge, and Tribes can be an integral part of climate adaptation that prioritizes the cultural continuity of these relationships.

Intrinsic value of Indigenous knowledge from **close connections with community, water, land, and First Foods;** instrumental value from **adaptive management that CTUIR creates with the First Foods Mission** (Whyte et al 2013) as seen in Figure 3G.3 (page 267).

4. Opportunities for Tribes to Be State, Federal, and International Leaders on Climate Adaptation

As governments prepare to implement climate adaptation strategies, consideration for existing and potential Tribal leadership in these efforts would ensure a more inclusive and robust outcome, with a focus on environmental justice for First Foods and CTUIR community.

Expertise in Tribal management organizations highlights the sophistication of Tribal governments and their **responsiveness, cooperative agreements, partnerships, and Treatment-As-States (TAS)** are all ways to expand Tribal sovereignty (Hopkins 2012) as seen in Figure 3G.4 (page 270-271).

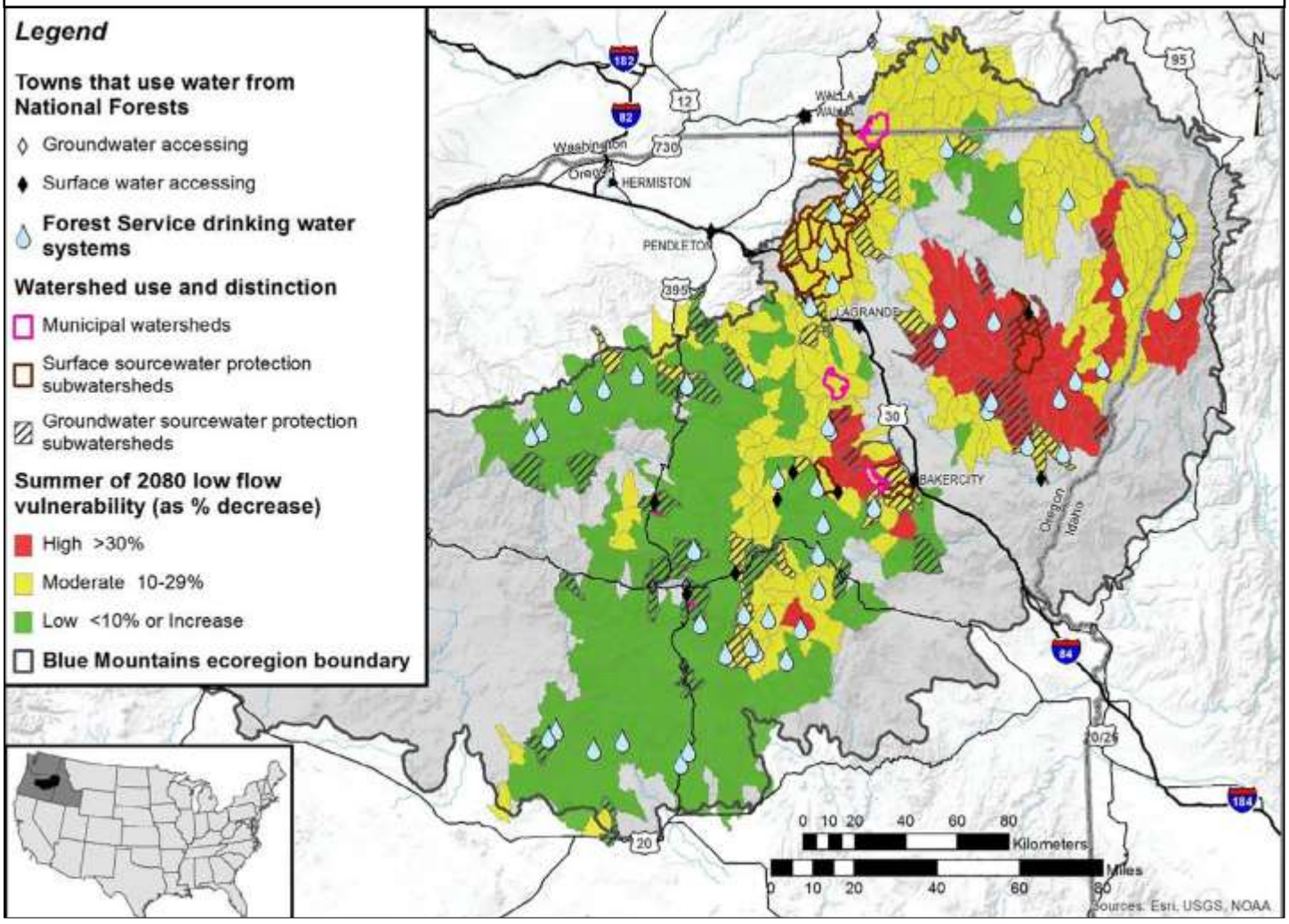
1. Potential Increase in Conflict over Water and Land Resource Management

Tribes like CTUIR that are federally-recognized have a number of different diplomatic and regulatory mechanisms that are able to be employed to manage resource conflicts encountered. Water is an excellent case study to use in anticipating potential barriers, and opportunities for collaboration on large landscape management in a changing climate.

Figure 3G.1 shows locations in the Blue Mountain region (OR/WA) where water availability is unlikely to meet future demands by 2080, causing conflicts between groups of water users.

- Low flow vulnerability as a percent decrease is shown in a color scale: in green regions, summer water availability will decrease less than 10%; yellow-colored regions are projected to experience a 10-29% decrease; locations in red are likely to experience 30% or more reduction in the amount of water that will be available during summer months (Clifton et al 2018).
- Regions like the John Day Basin and the Malheur National Forest are not projected to see dramatic reductions in their summer base flow. This may be because of forested land coverage, as well as a lower demand from local irrigators and municipalities.
- Areas with moderate loss of future summer flow includes the Umatilla and Walla Walla River basins, the Wenaha-Tucannon Wilderness and the main stem Snake River. These are likely to experience rising consumptive demand as municipal and evaporative water consumption rise with

Figure 3G.1: Areas of Anticipated Water Scarcity Conflicts in the Blue Mountains



future heat and drought (Clifton et al 2018).

- **Highest potential for conflict reduction needs are those with 30+% reduction in summer base flow: the Eagle Cap Wilderness, the Imnaha River, the Elkhorn Mountains along the Wallowa-Whitman National Forest, and Anthony Lakes recreational area**, where municipal and irrigation consumptive demand clashes with recreational and in-stream water uses, all highly valued in the area both environmentally and economically.

CTUIR is especially proactive in anticipating potential conflict and working collaboratively to find a solution that works for the stakeholders involved. The Tribe already has a number of strategies that assert sovereignty in issues of conflict:

- Technical documents like the DNR Umatilla River Vision;
- Internal institutions like the First Foods Mission, Water and Land Development Codes, and Tribal Water Commission (TWC);
- External negotiations like the Umatilla Basin Water Rights Settlement;
- Scientific and policy based water quality and quantity standards that exceed those of the state (TMDL);
- Active involvement in collaborations and partnerships.

Problem-solving collaborations like the Walla Walla Basin Partnership, the Oregon 100 Year Water Vision, and negotiations around the Columbia River water conveyance system all provide evidence and mechanisms for CTUIR to assert and enforce Tribal sovereignty. Another successful pilot initiative has been the Oregon Water Resources Department (OWRD) "Place Based Planning" initiative, with which CTUIR has been actively engaged in the Grande Ronde Basin since 2019.

Proactive and collaborative planning efforts like this in areas where conflict is highly anticipated could help build working relationships with other regional water users that may be helpful in the future. CTUIR's role as a sovereign and Treatment-As-State (TAS) could provide a strong and adaptive backbone on which to base regional policy that benefits First Foods and the region as a whole.

Water availability is likely to be a large source of regional conflict in the future. Tribal people have a close connection with Water as a First Food, and many are willing to demonstrate in support of clean water (pictured).

(Credit: Clifton et al 2018)

<u>Gaps in Knowledge/Data/ Policy:</u>

- How water conservation and adaptation initiatives are likely to affect water demand;
- Other natural resource scarcity issues additionally, and that affect water availability specifically;
- How adjustments or changes to "first in time, first in right" water policy might benefit or impact seasonal water supply.

2. Likely Increases in Criminal Activity and Harsher Sentencing

Potential increases in crime was identified as a concern in CTUIR's Climate Change Vulnerability Assessment (2015), and is closely linked with effects of extreme heat. Heat affects the behavior of individuals involved in criminal events, including defendants, police officers, prosecutors, and judges (Behrer and Bolotnyy 2021). Heat reduces self-control, negatively impacts mood, increases aggression, and places heightened stress on cognitive faculties. These effects are present for all individuals participating in the criminal justice process.

Figure 3G.2a and **Figure 3G.2b** show the effects of increasing daily temperatures on violent crime and non-violent crime.

Figure 3G.2a: Effects of Heat on Violent and Non-Violent Crime

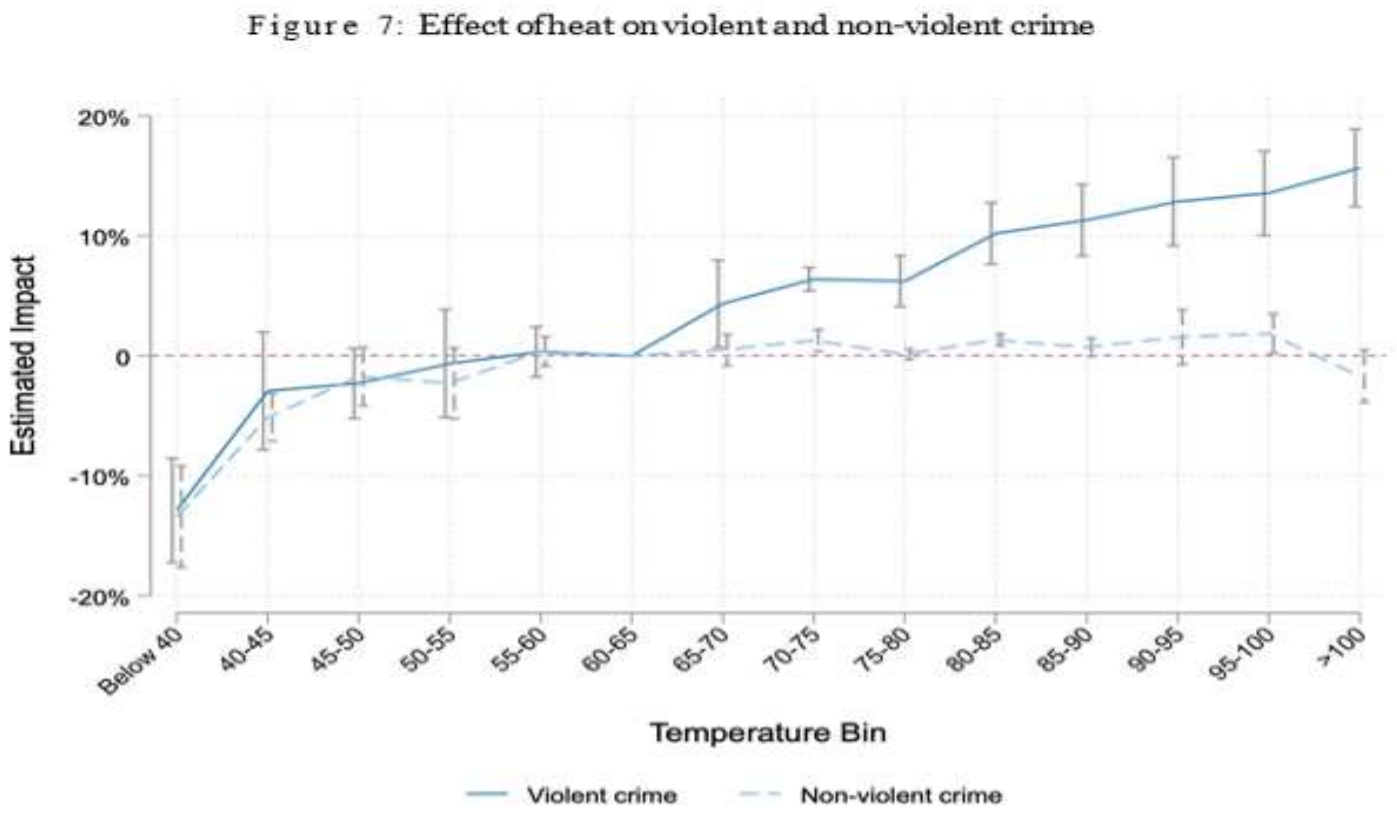


Figure 3G.2a and **Figure 3G.2b** show the effects of increasing daily temperatures on violent crime and non-violent crime.

- In Fig 3G.2a, cumulative heat effects on violent (solid blue line) and non-violent (hashed blue line) crime are shown. As heat increases ("temperature bins" in ˚F on the horizontal axis), both types of crime increase, though violent crime increases at a greater magnitude than non-violent crime (Behrer and Bolotnyy 2021).
- Fig 3F.2b shows some examples of specific types of crime and the effect heat has on them. Stolen property (labeled "C" in the top graph) increases slightly, as does domestic assault (labeled "E" in the middle graph), while aggravated assault with a weapon (labeled "H" in the bottom graph) increases substantially with increasing heat.
- Temperatures above 65°F (°C) lead to increases in crime. Intra-group conflict increases with increases in heat, and may not only affect potential criminal defendants, but also the police charged with arresting them, the prosecutors responsible for prosecuting them, and the judges who preside over their trials (Behrer and Bolotnyy 2021).
- These increases are driven almost entirely by violent crime, with arrests for such offenses as traffic violations and larceny unaffected. Heat has the **largest effects on weapons charges and assault with a weapon.**
- **General arrests increase by 15% on extremely hot days**, driven by increases in violent crime rather than by changes in police behavior.

- Individuals arrested on hot days are more likely to have their case dismissed, with anecdotal evidence to suggest this is due to police officers being more likely to make arrests, but which prosecutors choose not to prosecute, or that judges decide to dismiss.

- Prosecutors appear to be unaffected by heat on the day of the charge filing, likely because the decision-making in the process happens over many days and in a team.

- Judges, conversely, are adversely affected by heat. **Judges are less likely to dismiss cases, and**

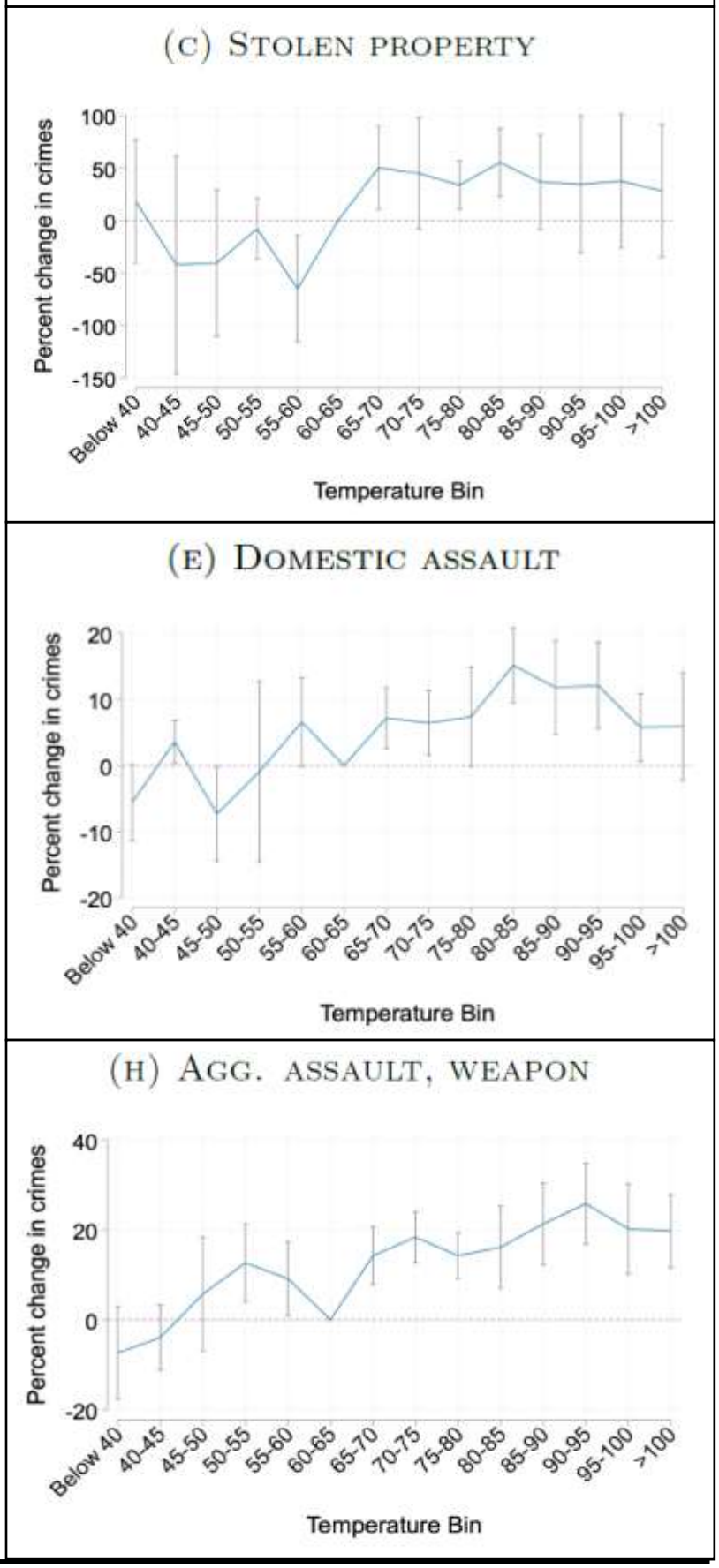
more likely to hand down harsher sentences on hot days. The fact that judges are overworked, have a limited amount of time to determine sentence severity, and have to do so by themselves, likely makes them more susceptible to the effects of heat.

- Those working in teams and with long processing times are less likely to be susceptible to the effects of heat (Behrer and Bolotnyy 2021)
- Adaptation reduces this impact by approximately 25%, but **violent crime arrests still increase by 9% per year by 2050, regardless of adaptation.**
- The impacts are not spread evenly across the population, as adaptation will not occur evenly: lower income areas see increases in crime that are roughly 70% larger than high income areas, and minority neighborhoods see increases that are ~20% higher than white neighborhoods.
- Without adaptation, **current projections anticipate a 12% increase in the probability of arrest and conviction** relative to present day levels (2020) (Behrer and Bolotnyy, 2021).
- **Regions with homes that lack air conditioning generally, and lack central air conditioning specifically, were most impacted**. Thus, the impact of heat across neighborhoods is likely due to differences in the ability of individuals to protect themselves from heat.

Heat reduces self-control and rational cognitive reasoning, thus individuals are more likely to reach for weapons when they are available. Also judges working on tight schedules make harsher and more punitive judgements. Higher income, newer housing, more team work, and less accessible weapons may decrease the adverse effects of heat. However, while adaptation will significantly mitigate future impacts, it will not eliminate them.

Future increases in heat appear to increase criminal arrests and to increase them substantially more in more vulnerable communities. Adaptations in criminal justice systems must be aware

Figure 3G.2b: Heat Effects on Specific Non-Violent and Violent Crimes



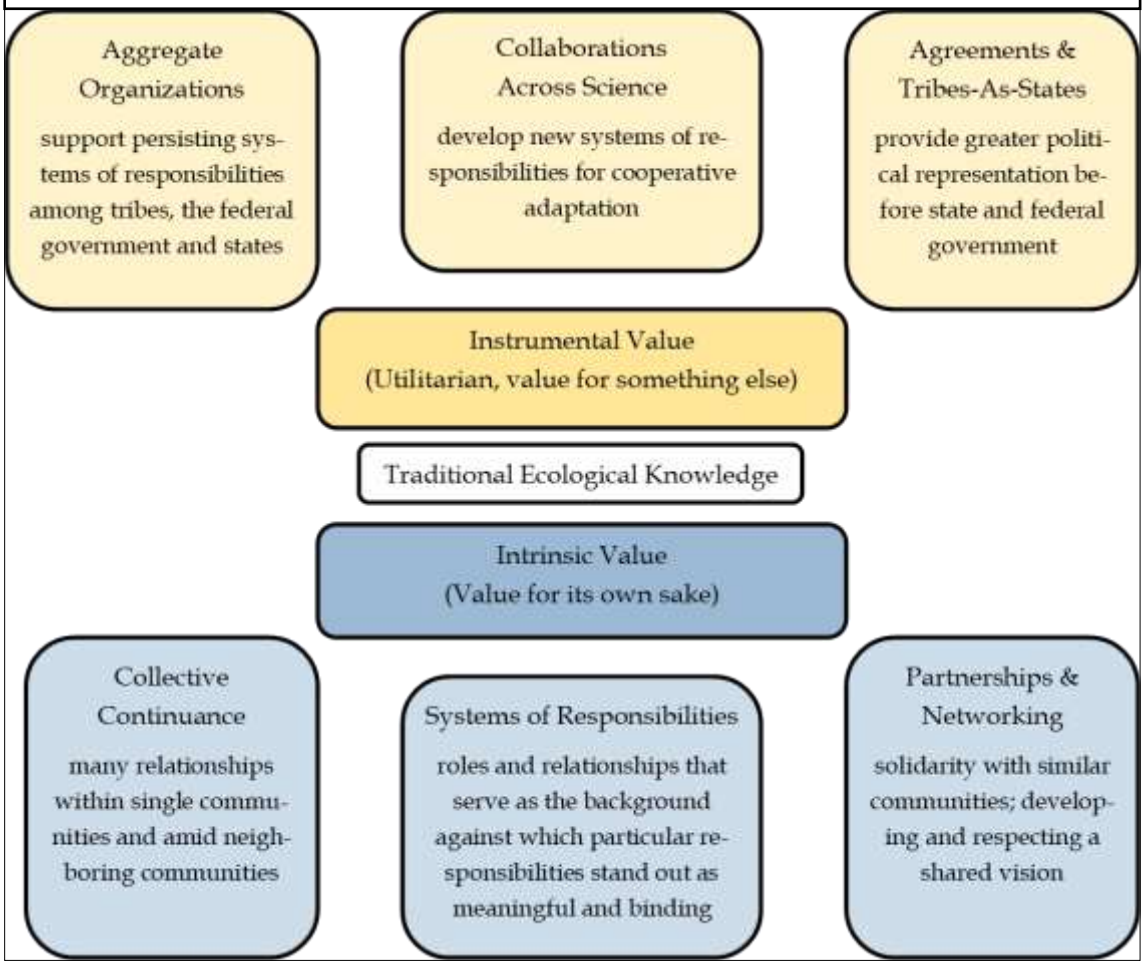
of the effects of heat on sentencing. This involves developing protocols to ensure judges are not over-burdened and making decisions without sufficient oversight.

(Credit: Behrer and Bolotnyy 2021)

Gaps in Knowledge/ Data/Policy:

- Data on how existing patterns in crime may be affected by heat locally;
- How other climate impacts such as flooding may affect violent and non-violent crime;
- Understanding of how Tribal court systems and interactions with state and federal criminal justice agents may affect these adaptations for Tribal communities.

Figure 3G.3: Tribal Sovereignty Instrumental and Intrinsic Values



3. Potential for Interruptions in Collective Continuance for Tribes and First Foods

Indigenous knowledge is integrally guided by many systems of responsibility, with layers of "collective continuance" to keep it connected. Collective continuance is a community's capacity to be adaptive in ways that allow for livelihoods of its members to flourish into the future. Continuance is made of many relationships within single communities, amid neighboring communities, and with non-human kin (Whyte et al 2013).

With the climate crisis, Tribal collective continuance is also a community's capacity for making adjustments to ways of living that make it possible to sustain robust cultural connection, community cohesion, and reciprocity with First Foods.

Figure 3G.3 illustrates the role that Indigenous knowledge (also called "Traditional Ecological Knowledge," or TEK), has in Tribal sovereignty.

- Tribal sovereignty has **instrumental value** (utilitarian, value for something else) including: connections with aggregate organizations that perpetuate responsibilities; collaborations across science for cooperative adaptation; and agreements and Treatment-As-State (TAS) provide political and regulatory representation. These values are represented in the orange bubbles along the top of the graphic (Whyte et al 2013).
- Tribal sovereignty also has **intrinsic value** (value for its own sake): through collective continuance within and between communities, systems of responsibility bind participants in relationships, and through partnerships and networking to develop a shared vision. These values are represented in the blue bubbles along the bottom of the graphic (Whyte et al 2013).

- **Relationships that form collective continuance, such as CTUIR's reciprocal relationship with First Foods, could potentially become uncoupled through environmental and policy inflexibility in the face of changing climatic conditions.**
- First Foods have intrinsic and instrumental value for communities: intrinsic value as a seasonal calendar that drives cultural activities, and extrinsic value through commercial salmon harvest, deer and elk tag revenue generation, and selective timber harvest, as examples.
- Systems of responsibilities are created through individual roles and connections. Economies require relationships to generate feasible, culturally appropriate opportunities, and that regulate economic production. Peaceful relations with neighbors require relationships that respect differences in culture, relative power, needs, and capacities to exercise agency (Whyte et al 2013). Together, these create the complex network of knowledge that informs Indigenous knowledge, accountable to reciprocal responsibilities.

Collective continuance is threatened by changing contexts in which systems of responsibilities are meaningful (Whyte et al 2013). Changes in landscapes may provide less opportunity for Elders to teach youth in practical situations. Change also places stress on the community's ability to perpetuate those systems of responsibilities going into the future.

- Institutions that function internally and externally can be helpful in maintaining systems of responsibility. Internal integrative planning provides consistent guidance to operations, with examples like the CTUIR Comprehensive Plan (2010, 2018) and the Climate Adaptation Webinar Series. External integrative planning, like the Columbia River Gorge Commission (CRGC) Climate Action Plan, can help Tribes connect within Tribal departments, and between Tribal Nations to protect First Foods and Treaty Rights.

- Tribal governance networks, like the Columbia River Fish Commission (CRITFC) and the Intertribal Bison Commission, perpetuate understanding and facilitation of Treaty Rights across traditional use lands in an expanding way. These relationships are helpful in adapting to species migration, as distributions of First Foods shift.
- Sheltering and amending are two strategies that inter-Tribal and non-Tribal institutions can do to protect Tribal sovereignty. "Sheltering" means protecting systems from disruptions, while "amending" involves actions that improve and reform the systems themselves to be responsive (Whyte et al 2013).

Federal governments have a responsibility to collaborate with Indigenous people and Tribal nations in their efforts, to expand Tribal political authority off-reservation, and to pursue ecological outcomes favored by both sovereigns. Tribes are responsible for being accountable local partners and functioning with Treatment-As-States (TAS) to determine and enforce Tribal-developed standards that serve as a template for regional improvement.

Collaboration across science and TEK systems must involve conversations about how different groups of people understand the nature of reality and responsibility. It must also involve research practices about

Tribal people have a unique and place-based relationship with natural ecosystems through systems of responsibility like the People's promise to the First Foods.

understanding of shared responsibilities, like those with First Foods. These should be highlighted in adaptation, management, and stewardship strategies (Whyte et al 2013).

Aggregate organizations like CRITFC support continuance of systems of responsibilities among Tribes and governments. Networking opportunities like summits and symposia gather Tribal and non-Tribal communities together to develop new systems of responsibilities for cooperative adaptation, and to facilitate a shared vision.

Drafting and publishing knowledge about First Foods management is also helpful for expanding CTUIR's management priorities outside the Reservation. Technical documents like the Umatilla River Vision, and First Foods Upland Vision provide this knowledge in an actionable way.

(Credit: Whyte et al 2013, graphic by CTUIR DNR FFPP)

Gaps in Knowledge/Data/Policy:

- Changes to federal and state programs that support Tribal sovereignty in the future;
- Administrative and staffing capacity of CTUIR programs and departments;
- Expansion of services and administrative responsibilities CTUIR is able to operate.

4. Opportunities for Tribes to Be State, Federal, and International Leaders on Climate Adaptation

With respect to climate crisis policy, recognizing and understanding of the role of Tribal governments creates new opportunities to challenging the idea that only states and federal agencies have influence over planned responses, adaptation, mitigation, and the role and application of science.

Jurisdictional powers of Tribal governments are under constant pressure from judicial interpretation. The patchwork of landholdings resulting from allotment illustrates this vulnerability. Non-Indian landowners within reservation boundaries sometimes challenge Tribal jurisdiction about regulatory or land use decisions. This is relevant for CTUIR due to its "checkerboard" of land owner status on the Reservation. If Tribal governments are unable to enforce laws within the Reservation regardless of Tribal status, there is little recourse for Tribal governments to correct this injustice.

This also applies to decisions and enforcement of regulatory standards for improvement like clean air standards, and can hinder the implementation of adaptation actions like cultural burning. Often, the paternal and dependent relationship Tribes have to the federal government has resulted in lands being owned and utilized for non-Tribal profit. This has forced Tribes into a commodifying relationship with First Foods, land and water, and has limited Tribes' ability to be autonomous in managing resources.

Figure 3G.4 lists the history between the US Federal Government and Tribes across the nation, all of which have a direct and ongoing impact on the power

Climate events like the Feb 2020 flooding could potentially hamper CTUIR TAS status, through the disruption of information collection. Biomonitoring efforts like DNR Fisheries project effectiveness evaluation was temporarily disrupted by flood damage to rotatory traps (pictured left). This same flood event also damaged water quality monitoring equipment (pictured right) that is essential in measuring restoration efforts and impacts funding reporting.

Figure 3G.4: Historical Legislation and Court Rulings that Impact Tribal Sovereignty (Hopkins 2013)	
	Historical Legislation and Court Rulings that Impact Tribal Sovereignty
American Revolution (1871)	Tribes engaged in Treaty-making with the federal government on a nation-to-nation basis, seeking mutual friendship, respect, and recognition of one another's autonomy. Treaties were made between the Executive branch and a specific Tribe/group of Tribes, based on the foregoing mutuality and set aside significant tracts of Indigenous territory. Inherent powers of Tribal self-government were held by the Tribe in reserve and the Treaty affirmed Tribal authority to specific demarcated territory liken CTUIR's Treaty of 1855.
Marshall Trilogy (1823-1832)	Supreme Court case decisions from 1823-1832 affirmed the autonomy of Indian Tribes, but made them dependent on federal plenary oversight. These decisions recognize Native American sovereignty prior to European contact, but with diminished autonomy. Within the American legal system, Tribes held a collective status as 'domestic dependent nations;' wards that were dependent upon federal protection. As domestic dependent nations, the jurisdictional powers of Tribal governments are under constant pressure from judicial interpretation. Patchwork of landholdings resulting from allotment illustrate this vulnerability when non-Indian landowners within reservation boundaries reject Tribal jurisdiction.
Allotment and Assimilation Era (1871 - 1928)	Use of Treaties ended as westward expansion and pressure increased from settlers and local governments for Congress to open up Tribal lands for development. Federal policies imposed plenary authority over Indian lands and affairs, and land theft through survey and legislation, impacting CTUIR's reservation boundaries.
Dawes Act (1887)	Transferred large Tribal land holdings into federal surplus trust lands, and made possible the privatization of these lands. Also involved the assimilation of Tribal governments by undermining their territorial base and ability to govern over non-Indians within reservation boundaries. UIR is "checkerboarded" as a result.
Indian Reorganization Act (1934)	Sought to restore expropriated Treaty lands. Statute provided a widely adopted model for Tribal governance that emphasized the separation of powers. Also provided a framework for Tribal government to interface with the growing array of federal services that were responsible for Indian affairs. While lands were put into trust for Tribal governments, questions over the rights of non-Indian fee owners who found themselves inside the reservation set the stage for a new struggle over the scope of Tribal authority.
Termination Era (1950's)	Congress began identifying prospective Tribes and withdrawing federal recognition through targeted legislation.

Figure 3G.4 (cont.): Historical Legislation and Court Rulings that Impact Tribal Sovereignty	
Indian Self-Determination and Education Assistance Act (1975)	Gave Tribal governments the option to administer federally-funded programs where the Tribe had jurisdiction. Presented opportunities like 638 compacting to provide and determine services by Tribal governments. Many CTUIR services are currently provided through federal compacting, including forestry management and healthcare services.
Montana Exemptions (1981)	Established that Congressional delegation and a Tribe's inherent retention of its Tribal power could be validly executed under one of the two conditions: - When a consensual relationship has been entered into between the Tribe and the non-Indian (such as a commercial contract, lease, or partnership); - Or where the Tribe's political integrity, economic security, or health and welfare is directly affected by the non-Indian's conduct These have historically been very narrowly interpreted by the Supreme Court in the past, and rarely in favor of the Tribal nations involved.
Tribes Treatment-As-States (TAS) (1970-1984)	The U.S. EPA's role as regulatory and enforcement of air quality, safe drinking water, waste management, and hazardous materials standards does not prohibit states and Tribal governments from filling in gaps or establishing higher standards. EPA adopted the 'Policy for the Administration of Environmental Programs on Indian Reservations' in direct response to legitimate Tribal criticism of the agency's previous oversight of Tribal sovereignty, and the need for Tribal governments to enact their own environmental protections. EPA successfully lobbied Congress to authorize the treatment of TAS: this enabled Tribal authority under TAS provisions in the Clean Water Act, Clean Air Act, Safe Drinking Water Act, National Historic Preservation Act, and the Comprehensive Environmental Response, Compensation, and Liability Act.
United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) (2007)	Created a framework for global Indigenous communities to turn to having exhausted domestic routes of advocacy within the nation-state system. Mechanism to seek recourse to international and regional human rights decision-making bodies, which recognize that Indigenous communities can suffer loss of land, cultural identity, and the ability to self govern under domestic systems. UNDRIP also establishes procedural standards around institutional responses by nation-states in complying with international human rights. This has particular significance to global climate change issues. UNDRIP can also play a role as a tool for shaping domestic climate change policy. Historically though, attributing climate change impacts to specific polluters has not been successful.

that Tribes have over their own lands and resources. This chart summarizes a timeline of legal decisions between the U.S. federal government and Tribal nations that has impacted Tribes' ability to self-govern (Hopkins 2012).

- From the beginning, U.S. federal government, Supreme Court decisions, legislative actions, and international declaration of rights have impacted how Tribes have had many decisions impact their land ownership and right to self-determination. This has also created channels through with Tribal sovereignty can act to perpetuate Tribal nations' priorities and perspectives.
- Tribal sovereignty creates important collaborative co-management opportunities for adaptation. Federal environmental laws need to **create cooperative systems that incentivize the implementation of local, regional, and state environmental protection measures**.
- "Treatment as State" (TAS) is a Tribal sovereignty mechanism that allows Tribes to act as their own regulatory and enforcement entity. Within standards set by the Tribal government for many regulatory activities, TAS provides a model for inclusive regulatory and regional decision making. **TAS status is further evidence that Tribal governments can change the practices of underperforming governmental actors** that may not readily fit into common understandings and practices. This is relevant to shifting government action (or inaction) on climate adaptation.
- The ability of Tribal governments to form strategic coalitions and pursue international venues is another potential strategy for collective adaptation. **The expertise contained in many Tribal management organizations fosters the development of new partnerships and highlights the sophistication of Tribal governments and their responsiveness**. This further supports regulatory decision making that is inclusive and participatory, and that provides meaningful process to all parties concerned, especially Tribal nations.

This history is important to recognize, as current federal policy echo past legislation and court decisions being made today. This also suggests there are channels of sovereignty that may be useful in expanding certain adaptation and restoration strategies on a larger scale.

Having a better understanding of Tribes' unique role will shape future discourse within environmental federalism. This includes Tribes' ability to anchor jurisdictional rights to cooperative resource management agreements, and the preservation of TAS status to create a tripartite system of governance over common resources.

(Credit: Hopkins 2012)

Gaps in Knowledge/Data/Policy:

- How carbon crediting schemes and calculating will affect Tribes' ability to regulate themselves as states;
- Changing capacity of Tribes to act as TAS, given funding and staffing availability.

Monitoring and regulating Tribal interests involves developing additional data collection initiatives, like the DNR Women's Foods Monitoring Project (pictured). Tribes are often at the forefront of data collection and modeling for native plant and animal species, and have a role in regional information gathering.

A. Capacity Building and Expansion of Tribal Self Determination

"Many of them name places where people customarily and traditionally do things. Other names memorialize the actions of the Animal People at that place and the events that ensued. They tell us that Indian people occupied the land and that they used and enjoyed it – indeed, they possessed and owned it. The place names, then, are also implicated in the classical regional indigenous system of land tenure and use (Bruce J. Rigsby, 2015)."

i. Recognition of Tribal Sovereignty and Resilience

CTUIR specifically, and Tribes in general, have been sustainable stewards of lands and waters since time immemorial. Tribes have also done the least to contribute to the causes of the climate crisis. Recognizing and celebrating this status is essential for cooperative adaptation.

Short Term:

- **Encourage state and federal agencies to formally and informally recognize CTUIR and other Tribes as rightful co - or sole managers of natural and other resources**. This may look like statements of support, prioritizing Indigenous knowledge alongside (and at times as superior to) academic science, and actively planning for Tribal community engagement as part of Tribal consultation and project implementation.

- **Actively support and build connections within the Tribal community and with Tribal businesses/enterprises who can provide additional capacity to Tribal services**. Examples include (but are not limited to): training and supporting Tribal Members engaged in prescribed burning operations, composting and waste management, food production and processing, renewable energy installation and service, and cultural learning and connection. See Ch 3B pages 88-90, Ch Ch 3D pages 153-155, and Ch 3E pages 194-195, 3F pages 227-229, and Ch 3G pages 288-289 for additional detail.

Long Term:

- **Advocate for funding sources and mechanisms to provide routine programmatic support of Tribal departments and staffing**, rather than just 'project-based' funding approaches. Consistency and reliability for program staffing maintains built capacity, and is essential to continuity of work.

- **Celebrate CTUIR and other Tribes as models of self-governance, facilitate Treaty Rights wherever possible, and recognize the natural laws that govern Tribal systems of responsibility** may differ from other Western and U.S. frameworks.

ii. Maintain and Expand Treatment-as-State (TAS) Status

As a sovereign entity with the right to govern itself, CTUIR has rapidly expanded facilities and functions over recent decades, and provides full government services for its Tribal community. For the Tribe, it is essential to have connection and access to resources now and into the future, and to exercise those co-management opportunities wherever possible.

Short Term:

- **Maintain data collection and monitoring for all fields of regulation CTUIR is currently engaged with, and expand these efforts** to include additional collection of enforceable and defensible data

and monitoring programs, as funding and capacity supports.

- **Maintain current government capability to provide services, and plan to expand these into areas of community need as the Tribe is able**. This could include (but is not limited to): working with partner agencies to build capacity, small business credit and financing to support Tribal contractors with services they are able to provide, co-management authority on public lands through the Good Neighbor Authority, and others.

Outreach to Tribal and non-Tribal audiences like those held at Treaty Day (pictured) improves regional understanding of Tribal sovereignty and climate resilience.

Long Term:

- **Pursue new opportunities to expand TAS and Tribal co-management as they come available**. This could include (but not limited to): new areas of opportunity to secure programmatic and continued funding, agreements and co-management authority with state and federal lands, developing new data collection and monitoring protocols and projects like the DNR Women's Foods monitoring project and Hanford Biomonitoring projects, pursuing new regulatory opportunities as capacity allows, and others.

iii. Exercise and Advocate across CTUIR Traditional Use Area

Rights secured by the Treaty of 1855 protect Tribal sovereignty, and the rights of Tribal Members to protect and perpetuate reciprocal systems of responsibility to First Foods. These rights are strengthened when Tribal Members exercise them, consistently and extensively, not only within CTUIR's Ceded lands, but across traditional use areas.

Exercising rights in expanded and previously underutilized locations builds justification for Tribal Member access to those areas. Acknowledging harvest and management rights throughout an expanded range will accommodate for shifting plant and animal habitat and migration patterns that affect harvest opportunity.

Short Term:

- **Celebrate and recognize the Treaty of 1855 and its signers** for the forethought to secure lands and rights for future generations of Tribal members. Participation in Treaty Day (June 9th) celebrations is already encouraged for Tribal staff and community members, and non-Tribal people are welcome and invited to engage with this event.

- **Encourage and facilitate Tribal Member exercise of Treaty Rights and harvest opportunities**. This could include partnering with agencies and other Tribes on harvest trips to previously underutilized locations, supporting First Foods Excursions and classes hosted by DNR, DCFS, and Yellowhawk Tribal Health Center, mapping new locations of First Foods for harvest, organizing gatherings to discuss the state of First Foods and plant medicine harvest conditions/barriers/opportunities, and many other strategies to expand knowledge and access. See Ch 3B pages 88-90 and Ch 3D pages 153-155 for additional detail.

Long Term:

- **Continue and expand CTUIR co-management and engagement with resources throughout the traditional use area "from buffalo to sea lion."** CTUIR manages resources through inter-Tribal collaboration efforts across a broad geographic range over which it has been historically engaged. Supporting these collaborations will be essential to protecting and preserving Treaty Rights and Tribal sovereignty across this region.

iv. Identify Areas of Strength and Areas of Opportunity

Recent years have brought numerous opportunities to witness how a changing future might affect CTUIR. Each of these events is an opportunity to examine gaps and improvements that systems of service may experience. Community conversations around these events reduce anxiety and stress associated with disaster events, as well as inform areas where strengthening or adjusting efforts can improve future response.

Short Term:

- **Develop protocols to organize and facilitate community "debrief" discussions in response to emergency events**. These proceedings can be formal or informal gatherings to facilitate community feedback and testimony about individual experiences during emergency events, and generate reporting documents to archive resulting guidance.

- **Continue and expand protocols found in CTUIR's Emergency Operations Plan (EOP) and pursue development of a formalized Continuity of Operations (COOP) or Continuity of Governance (COG) plan** to provide processes for accomplishing administrative and operation functions during emergencies. These plans are an opportunity to inventory Tribal services already being provided, and identify gaps in services, barriers to access, and future opportunities to support community response. Widely publicize any improvements to government and community response, recommendations, and procedures to communicate knowledge to the community.

Long Term:

- **Continue and improve coordination with other agencies and governments in emergency response;** mutual aide agreements between CTUIR Public Safety and local municipal/county governments area already in place to provide emergency services to both the UIR and impacted non-Tribal communities, and supporting this coordination will ensure these services are provided consistently into a future with greater need. Guidance on these strategies is found in CTUIR's Emergency Operations Plan (2016), as well as delegation of roles and responsibilities for Tribal departments, staff, and executive management team in Part 3, pages 49-73. The CTUIR Hazard Mitigation Plan (2016, 2021) also has guidance on emergency response to various hazards on the UIR; see Section 4: Hazard Mitigation Strategy (page 192 -212), and Section 5: Mitigation Strategy Implementation and Integration (page 214-225) for detailed information.

- **Examine opportunities to improve First Foods and language connection, even in times of emergency.** Opportunities to include cultural components to emergency response include (but are not limited to): facilitating language classes/story telling sessions during community-scale "cleaner air" shelters for wildfire smoke, including First Foods in emergency food distributions where possible, and exploring cultural testimony around dramatic natural disaster and "apocalyptic" stories/ events to create connection to Indigenous emergency response, among many others.

B. Encourage Cooperative Partnerships and Agreements

"As a relatively new and rapidly developing government, CTUIR will need to continue to diversify and expand its revenue base to maintain the substantial and growing amount of real property and programmatic assets. One of the greatest challenges is the continued development of political power and economic influence to take on the external challenges of changes in water, environmental and energy policies, business regulation and the right to exercise sovereignty (CTUIR Comprehensive Plan 2010)."

i. Tribes as Co-Managers of State, Federal, and Private Resources

As active stewards of ancestral homelands, Tribes have been and will always be the best managers of resources and have helped shaped this landscape. There are many mechanisms that create opportunities for Tribes to be directly involved with managing decisions about natural resources.

Creating partnerships with outside agencies is essential for expanding Tribal priorities, particularly for co-management of lands and waters; U.S. Forest Service is one such management partner.

Short Term:

- **Continue to participate in existing and (if necessary) new Natural Resource Trustee Councils for contaminated sites**; CTUIR already participates with the Portland Harbor (PHNRTC) and Hanford (HNRTC) Natural Resource Trustee Councils to determine the future cleanup efforts at these two contaminated sites. See Ch 3E pages 193-197 for additional detail on CTUIR's Hanford NRTC issues.

- **Continue to participate in cluster and collaborative state legislative affairs groups, especially inter-Tribal assemblies**. CTUIR is an active participate in the Legislative Commission on Indian Services (LCIS) through the Oregon Legislature to lead with consensus on issues that affect Indian Country.

- **Support and expand memorandums and agreements between local municipalities and CTUIR**. Agreements with cities and county entities can expand Treaty Rights opportunities, enable the Tribe to have a more formalized relationship with the smaller subunits of the state government, and provide a structure with which potential conflicts can be proactively addressed. CTUIR has a number existing of Memorandums of Understanding (MOU's), including with the City of Kennewick-WA, City of Richland WA, Port of Kennewick, and a series of MOU's throughout Oregon and Washington.

- **Continue to work with private companies and corporations on land reclamation and access issues as appropriate**. CTUIR already has existing relationships with private corporations like Union Pacific Railroad and Amazon Inc. to mitigate for First Foods harm.

Long Term:

- **Support and expand partnerships with state and federal agencies to manage land, forests, water, food, air, and other "resources"** regulated under applicable government agencies. CTUIR has existing partnerships with the United States Forest Service (USFS), Department of Interior (DOI), Bureau of Indian Affairs (BIA), Indian Health Services (HIS), and Department of Energy (DoE), among others, to include Tribes in management decisions and actions at different participation levels.

- **Support and expand government-to-government (G2G) relationship with the State of Oregon and the State of Washington.**

ii. Economic, Resource Management, Health, and Education Partnership Opportunities

CTUIR has a huge influence on the Columbia River region, and provides many opportunities for potential partners and agreements that are mutually beneficial to the Tribe and to other stakeholders.

Short Term:

- **Support and expand economic partnerships and opportunities**, such as those already present through employment and services. Partnerships with Wildhorse Resort and Casino, Coyote Business Park, and Wanapa Industrial Park, as well as the UIR's location between major Pacific Northwest cities like Portland, Spokane, and Boise, and adjacent to Interstate 84 build networks and capacity.

- **Support and expand education partnerships**. Many already exist: with Whitman College for student groups and other learning exchanges; with the Walla Walla Community College through the Water and Environmental Center (WEC); with Washington State and Oregon State Universities through Tribal member students and MOUs; with Blue Mountain Community College through Umatilla Language courses and Tribal Member Student Body President Megan Van Pelt; and through the Pendleton Early Learning Center with Umatilla Language classes for young learners, among others.

Long Term:

- **Support and expand resource management partnerships**, such as those listed in 3G.B.i, as well as with individuals, landownership entities, and enterprises whose goals align with CTUIR management goals.

- **Support and expand healthcare partnerships that facilitate adequate and culturally appropriate care for Tribal Members and access to services**. Yellowhawk Tribal Health Center has been recognized for its Covid-19 pandemic response, testing, contact tracing, and vaccine administration. Partnerships with local county health departments, Oregon Health Authorities, and Oregon State University College of Public Health assist in providing and expanding health services to Tribal Members now and into the future.

iii. New Partnerships for First Foods Restoration and Tribal Stewardship

Many partnerships exist informally as mutually beneficial relationships that arise organically from the presence and activities of Tribal Members. Relationships that support Tribal family connection to First Foods and community access, knowledge, and policy protections are likely to be ones that benefit both Tribes and these relationship partners.

Short Term:

- **Encourage and support relationships built with academic institutions where Tribal students attend**. These enrich schools through diversity of knowledge and perspective, and builds capacity for Tribal communities. Ideas for projects and opportunities with CTUIR are suggested in Ch 3D pages 153-160 and Ch 3E page 192.

Long Term:

- **Encourage and support inter-Tribal coalitions, particularly around landscape and First Foods management and restoration**. CTUIR has existing coalition relationships with the Affiliated Tribes of Northwest Indians (ATNI), Inter-Tribal Buffalo Council,

National Congress of American Indians (NCAI), and Columbia River Inter-Tribal Fish Commission (CRITFC), among others. Supporting First Foods access across a broad region supports climate resilience; see Ch 3B pages 83 and 88-90 and Ch 3G pages 276-277 for additional detail.

iv. Establish Frameworks for Conflict Resolution and Harm Reduction

While Indigenous worldviews typically reject narratives of scarcity that create division between priorities and communities, resource usage is unsustainable as currently managed. Planning to neutralize potential conflict requires proactive engagement and cooperative frameworks to facilitate constructive and ongoing dialogue.

Short Term:

- **Support and expand "Place Based Planning" for cooperative resource strategies**. These approaches involve convening all stakeholders affected by resource management decisions, and facilitating a collaborative process where all parties agree on the decision-making procedures and protocols, ahead of any actual disaster event. One example CTUIR has been involved with is the Oregon Water Resource Department's planning for the Grande Ronde basin and associated water users. See Ch 3A pages 53-54 for additional detail.

Tribal atmospheric weather stations (pictured) improve information on native plant population changes. Data sovereignty and sharing networks are essential in implementing climate adaptation.

- **Organize and facilitate listening sessions with Tribal community and other stakeholders** to improve relationships, access to decision making information, inventory of shared knowledge, and to provide an avenue for community engagement with government climate adaptation response.

Long Term:

- **Develop protocols for addressing resource conflict proactively and equitably,** and with natural solutions as the priority. Drought early warning systems, prescribed and wildfire response, and community public health are examples that can be used when developing these kinds of protocols for additional concerns as they emerge.

- **Develop and implement community and staff training aimed at strengthening conflict prevention**. Types of trainings could include (but are not limited to): conflict de-escalation, police interaction and reporting, bystander intervention, self-mindfulness and emotional regulation, and addiction intervention services.

C. Support Tribal Policy, Frameworks, and Services

"The three Tribes worked in alliance to regain and rebuild their self-sufficiency from the government. The traditional leadership of chiefs and headmen at the head of table as key negotiators evolved into a new form of leadership. This leadership was intertwined with the negotiations not only for the Tribal people and their well-being, but also with decision making that would develop into the economic stimulus that would enable the Tribes to acquire the financial sustainability that would give them a new found independence (CTUIR Comprehensive Plan 2010)."

Short Term:

- **Pursue new 638 Compacting opportunities as they become available, and as CTUIR capacity allows**. Compacting/ contracting with the federal government typically involves a "638" agreement that facilitates Tribal nations to receive funding and directly provide services previously being rendered by the federal government. Securing 638 compacts requires a Tribe to "prove" it is capable of taking over the services in question, which requires documentation and having appropriate policy structures in place. See Ch 3F pages 232-234 for additional detail.

Long Term:

- **Continue to advocate for programmatic funding for Tribal services and programs, as well as for capacity to incorporate climate impacts into planning**. Many private and public funding sources are designed to implement "project" based efforts for Tribal communities, however success of such project efforts requires sustained program staff to make it happen. Climate resilience and other funding programs need to recognize that sustaining program staff is a component of climate adaptation measures, and advocating for inclusion of programmatic and operations needs as eligible under these funding sources would expand the capacity of Indian Country to implementing adaptation strategies.

Measuring Success and Gaps in Tribal Sovereignty Adaptation

How Do We Measure the Success of These Adaptations?

"The Tribes' sovereign powers also include judicial authority to enforce valid legislation and executive orders. Many progressive actions have occurred to preserve, protect, and strengthen our national sovereignty in line with our songs, dances, prayers, and longhouses. For the Creator and the land itself vests ultimate authority in The People (CTUIR Comprehensive Plan, 2010)."

- Confederated Tribes of Umatilla Treaty of 1855 Article One
- **CTUIR Comprehensive Plan Objective 5.7.2**: Maintain collaborative partnerships with other tribes, federal, state and local jurisdictions, agencies, institutiTns to manage cultural resources from a tribal perspective, including repatriating items or information belonging to ancestors of the CTUIR (See Comp Plan page 90 for benchmarks);
- **CTUIR Comprehensive Plan Objective 5.7.8:** Maintain, safeguard, conserve, and insure cultural and historical assets of the CTUIR including facilities, objects, records, documents, photographs and recordings (See Comp Plan page 90 for benchmarks);
- **CTUIR Comprehensive Plan Objective 5.8.4:** To the extent permitted by law, provide for and protect the exclusive exercise of CTUIR management authority over the Umatilla Indian Reservation, over Treaty reserved rights related activities off- Reservation and for co-management of Treaty reserved resources off-Reservation (See Comp Plan page 95 for benchmarks);
- **CTUIR Comprehensive Plan Objective 5.8.5:** Integrate the missions, goals and work plans of CTUIR to provide for the most proactive, effective and aggressive protection of 1855 Treaty -reserved rights (See Comp Plan page 95 for benchmarks).
- **Mission Community Plan (1995) Part C**: Land Use Element 9.5: Tribal lands in the planning area should be reserved, protected, and developed for land uses and buildings servicing the social services and law enforcement needs of the community.
- **CTUIR Water Code (2005) Section 1.05. Statement of Policy P:** Water Quality. The Water Code will be the primary source of regulation and enforcement for water quality standards and the TMDL for the Umatilla Indian Reservation.

- **CTUIR Water Code (2005) Section 1.05. Statement of Policy T:** Intergovernmental Cooperation and Coordination. The nature of the Clean Water Act governing the use and protection of water make it necessary for close intergovernmental cooperation and coordination to ensure successful implementation of the Clean Water Act;
- **CTUIR Water Code (2005) Section 3.07. Water Quality Management Planning** Goals and Objectives (page 42, benchmarks on pages 42-46);
- **CTUIR Emergency Operations Plan (EOP) Section 3.2.1, 3.2.1.1:** roles and responsibilities for CTUIR's Executive group (Board of Trustees, Executive Director, Deputy Executive Director (page 49-51);
- **CTUIR EOP Sections 3.2.2.1:** roles and responsibilities for department directors (page 51);
- **CTUIR EOP Sections 3.2.3.1:** roles and responsibilities for transportation; includes Public Works, Tribal Planning Office, and Public Safety (page 53);
- **CTUIR EOP Sections 3.2.3.2:** roles and responsibilities for alert and warning communications; includes Public Safety, Office of Information Technology, and Communications (page 54);
- **CTUIR EOP Sections 3.2.3.3:** roles and responsibilities for public works and engineering; includes Public Works, Tribal Environmental Recovery Facility (page 55);
- **CTUIR EOP Sections 3.2.3.4:** roles and responsibilities for firefighting; includes Umatilla Tribal Fire (page 55);
- **CTUIR EOP Sections 3.2.3.5:** roles and responsibilities for emergency management; includes Public Safety (page 56);
- **CTUIR EOP Sections 3.2.3.6:** roles and responsibilities for emergency assistance; includes Yellowhawk Tribal Health Center, Public Safety, Housing, Child and Family Services, Tribal Planning Office, Public Works, and outside partners (page 57);
- **CTUIR EOP Sections 3.2.3.7:** roles and responsibilities for logistics and resource support; includes Administration and Finance/Purchasing (page 58);
- **CTUIR EOP Sections 3.2.3.8:** roles and responsibilities for public health and medical services; includes Yellowhawk Tribal Health Center and Public Safety (page 59);
- **CTUIR EOP Sections 3.2.3.9:** roles and responsibilities for search and rescue; includes Public Safety (page 60);
- **CTUIR EOP Sections 3.2.3.11:** roles and responsibilities for agriculture and natural resources; includes Natural Resources, and Public Safety (page 61);
- **CTUIR EOP Sections 3.2.3.12:** roles and responsibilities for energy and utilities; includes Public Works and private utilities (page 62);
- **CTUIR EOP Sections 3.2.2.1:** roles and responsibilities for law enforcement services; includes Public Safety (page 62);
- **CTUIR EOP Sections 3.2.3.14:** roles and responsibilities for damage assessment; includes Public Safety, Public Works, and Tribal Planning Office (page 63);
- **CTUIR EOP Sections 3.2.3.15:** roles and responsibilities for external affairs; includes Public Safety and Communications (page 64);
- **CTUIR EOP Sections 3.2.3.16:** roles and responsibilities for evacuation and protection; includes Public Safety and Public Works (page 64).
- **CTUIR EOP Sections 3.2.3.17:** roles and responsibilities for legal services; includes Office of Legal Counsel (page 65);
- **CTUIR EOP Sections 3.2.3.18:** roles and responsibilities for volunteer and donation management; includes Public Safety and Administration (page 65).
- **CTUIR Hazard Mitigation Plan (2016, 2021) Section 5**: Mitigation Strategy Implementation and Integration (page 214-225)

What Gaps in Knowledge, Policy, Capacity, or Education Exist?

- How state and federal carbon legislation could impact Tribes' TAS status;
- Energy and capacity to collaborate within and among Tribal departments for adaptation implementation.

Climate Impacts for **Treaty Rights**

"That struggle is not yet ended. Deeds of such magnitude cannot be undone and over with, as many of you believe. They cannot stand alone in a period of time. Their tentacles reach out to on-coming generations and touch the lives of our people. We live centuries after the deeds themselves seem only echoes in history.

I am an Indian living in the present now, but I, like all my people, carry the burden of those distant years. So do you, whether Indian or white. We cannot be understood separate from the past for what happened to our ancestors over the past centuries has had its large share in molding the character that is ours today (Maudie C. Antoine, CTUIR BOT Chairwoman, Walla Walla June 11 1955)."

As Tribal Members exercise rights guaranteed by the Treaty of 1855, there is connection to lands and practices that has sustained Tribal people since time immemorial. These rights have legal protections, but are also constantly being questioned through court cases and litigation nationally. Access to Treaty Rights requires strong legal frameworks to ensure Tribal Members are protected as they practice these relationships, and have safe conditions under which to do so.

"Over millennia, our oral traditions have given us an understanding of the natural world, the capacity of life, and the fundamental human relationships that are bound by it."

~Phillip Cash Cash, 2006

5. Opportunities to Reduce Climate Impacts Risk through Cultural Practices

For Indigenous people, cultural and religious practices are integrally tied with sustainable land management practices. Traditional burning is an excellent example of the diverse benefits of returning cultural practices to the land, especially out in the relatively rural areas of CTUIR Ceded and traditional use lands.

Returning **cultural burning to the Eastern Oregon and Washington region** is least risky and has potential for great benefits (Gilbertson et al 2018) as seen in Figure 3G.5 (page 282).

6. Challenges to Healthy Conditions to Exercise Treaty Rights Safely

Intangible access barriers to Treaty Rights exist and should not be treated lightly. These kinds of barriers can be thought of as conditions that reduce the ability of Tribal Members to maintain physical and emotional health while exercising Treaty Rights. Exposure can have a lingering effect on Tribal Member health and desire to continue to participate in harvest and processing opportunities.

Roughly **20% improvement in seasonal air quality can be maintained through use of intentional burning** (Long et al 2017) as seen in Figure 3G.6 (page 284).

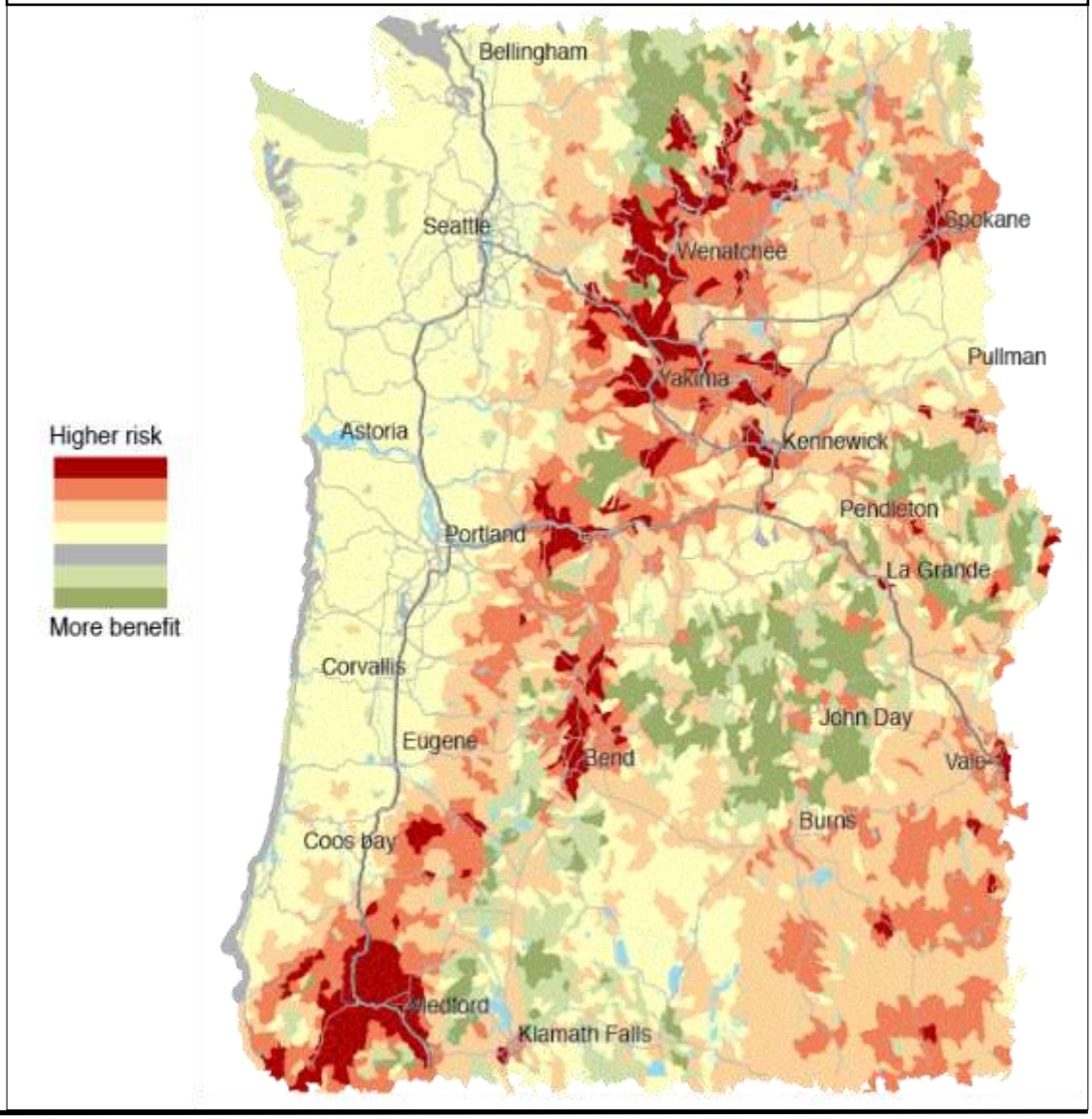
5. Opportunities to Reduce Climate Impacts Risk through Cultural Practices

Cultural burning is a sensitive topic for those who manage lands for multiple uses, but it also is becoming more acceptable to perform prescribe burning to reduce vegetation fuel loads. Implementation of fuels reduction strategies will be necessary to control wildfire risk, and burning has historically been used by Tribal people to clear vegetation and cycle nutrients in forest and grassland ecosystems.

Figure 3G.5 shows the results of a controlled burn risk analysis conducted for Pacific Northwest forests to determine the level of difficulty of returning a sufficient level of intentional burning to these very diverse types of forest.

- Areas in red indicate a high degree of difficulty in implementing controlled burning due to a number of different factors: infrastructure vulnerabilities, population density, sensitive species habitat concerns, and other metrics that feed into a multiple use risk analysis. Areas in green are the least difficult in logistics to return cultural burning, because the forest conditions, landscape, and land use make it easier to do so (Gilberston et al 2018).
- Assets are human-made features, such as commercial structures, critical facilities, housing, etc., that have a specific importance or value. Resources are natural features, such as wildlife habitat, federally threatened and endangered plant or animal species. Inventories of these assets and resources was conducted for 17 Administrative Forests: Colville, Deschutes, Fremont-Winema, Gifford Pinchot, Malheur, Mt. Baker-Snoqualmie, Mt. Hood, Ochoco, Okanogan-Wenatchee, Olympic, Rogue River-Siskiyou, Siuslaw, Umatilla, Umpqua, Wallowa-Whitman, and Willamette National Forests (NF), as well as the Columbia River Gorge National Scenic Area.
- As this map demonstrates, **CTUIR Ceded lands have a very high potential to benefit from the returning of intentional burning to these forests**

Figure 3G.5: Risk Potential for Prescribed Burn Implementation in OR and WA



and grasslands. CTUIR is working to increase their own use of prescribed fire on-reservation and with co-managed public lands.

- High voltage electric transmission lines respond favorably to low intensity fires, neutrally to moderate fire, but increasingly negatively to high intensity fire intensity. Low voltage lines are mostly wooden poles, and therefore, respond negatively to fires of increasing intensity.
- Railroads have an increasingly negative response to fires of increasing intensity but tend to be more resilient than other infrastructure (Gilbertson et al 2018).
- Roads have a neutral response to low intensity fire and a slightly more negative response with each increasing intensity level. However it is difficult to model the temporal nature of road closures due to wildfire.
- Communication sites have a slightly negative response to low intensity fire, and respond more negatively with each increasing intensity level (Gilbertson et al 2018).
- Bull trout were included in the assessment because of concern over species isolation and ability to recolonize habitat restoration sites following a severe wildfire. The bull trout response to fire is slightly beneficial for low to moderate fire, and increasingly negative to high intensity burns.
- Chinook and Steelhead critical habitat was also included due to the species' listed status and economic importance. Chinook salmon and Steelhead are characterized as slightly benefit from low to moderate fire, but increasingly negative impact from high intensity burns.

Everything indicates that returning beneficial fire to Eastern Oregon and Washington is a high priority for reducing wildfire risk for the area. Efforts that expand the ability of land managers to use fire would help this effort, and there are a number of barriers and opportunities for supporting these adaptations for public and private lands.

A prescribed burn moves through the Umatilla National Forest in March 2022. Pre-fire treatments like selective thinning, and interagency cooperation across jurisdictions make controlled burns possible, and are necessary to reduce wildfire risk.

(Credit: Gilberston et al 2018)

Gaps in Knowledge/Data/Policy:

- Understanding of how attitudes towards controlled burning from land managers, agencies, and the general public;
- How institutional supports for controlled burns might change, including changes in certifications, regulations, and insurance.

6. Challenges to Healthy Conditions to Exercise Treaty Rights Safely

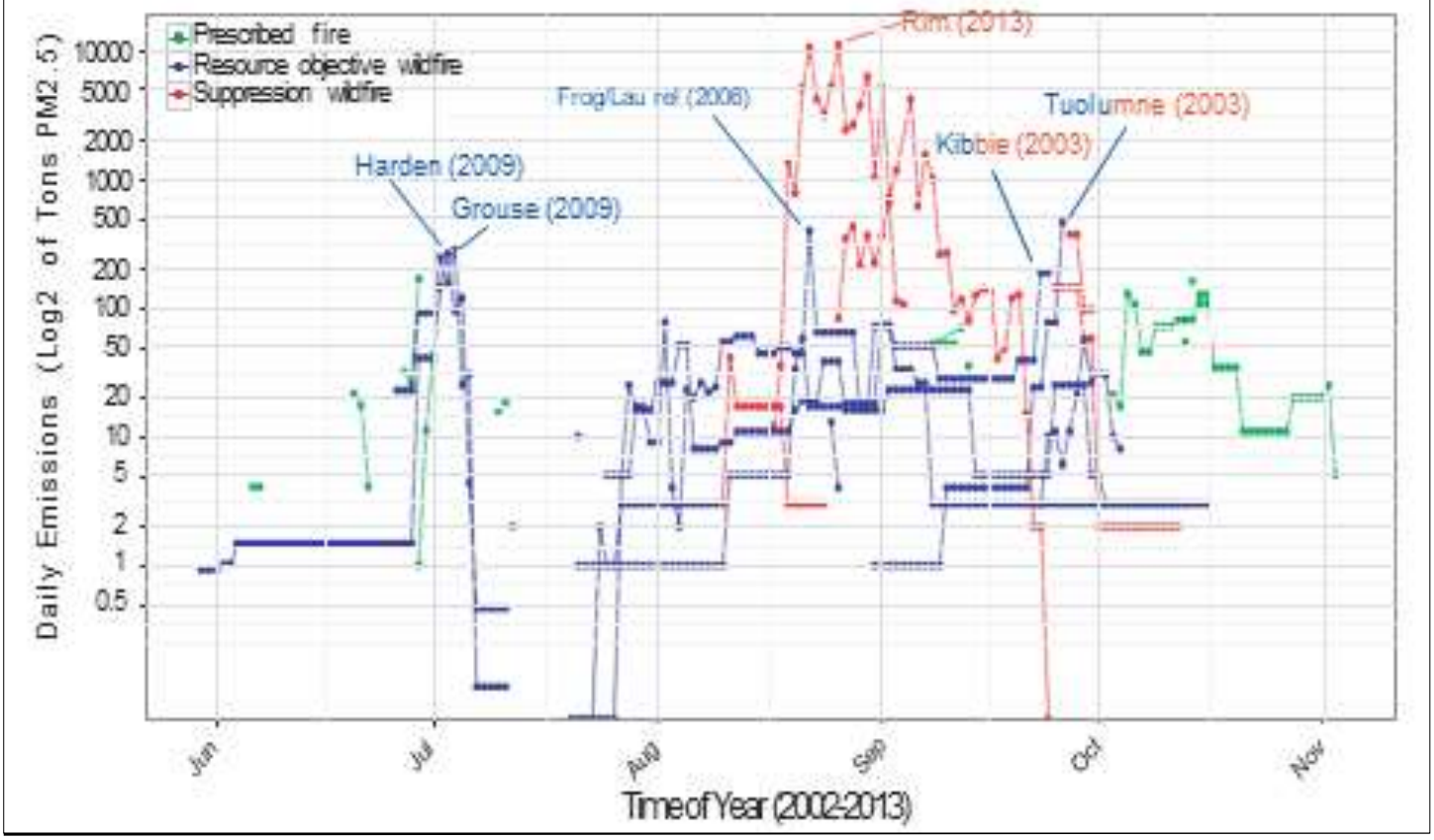
First Foods must be harvested when they appear on the land, and don't accommodate for inclement weather or human time constraints. Because of changing seasonal conditions, there is an increasingly short window for Tribal Members to harvest First Foods. During the summer, wildfire smoke is likely to be frequently persistent during time periods for summer ad fall harvest. Smoke has the potential to cause chronic and worsening health issues for Tribal Members who persevere to harvest during heavy and prolonged smoke events.

Figure 3G.6 shows a chart of the particulate matter (PM 2.5) generated by four different kinds of fire response in California between 2002 and 2013 (Long et al 2017).

- Colors in the chart are used to show the different kinds of fires: green lines represent prescribed burns; blue lines are 'resource-objective' fires (accidental fires that don't threaten structures and are allowed to let burn in a controlled way); and red lines show wildfires that started and were suppressed (put out rapidly).
- As the chart shows, fires set with planning and intention produced much less particulate matter than those immediately suppressed. Even fires that were not planned but allowed to burn strategically emitted less smoke.
- On average, prescribed burns and resource-objective wildfires released an estimated 10-20 tons of PM 2.5 daily, while suppression wildfires averaged 500-1000 tons of PM2.5 daily for the same period. Suppressed wildfires thus released about 50 times more PM2.5 than wildfires intentionally allowed to burn (Long et al 2017).
- While these exact corollary relationships require more research to determine benefits of intentional burn on air pollution, this study suggests that cultural burning could result in **roughly 20% improvement in seasonal air quality daily being maintained through use of intentional burning** (figures estimated visually from Fig 3G.6, Long et al 2017).
- This demonstrates that a proactive approach to managing vegetation fuels, through selective thinning and prescribed fire, can immediately and over the long term reduce the impact of wildfire smoke on the air over CTUIR Ceded lands. Intentional burns can also play a role in reducing chronic health hazards from smoke inundation events.

Chronic respiratory conditions like asthma, chronic obstructive pulmonary disorder (COPD), diabetes, and cardiac illness exist at a higher rates for Tribal communities than national average due to environmental racism, and this is also true for CTUIR. These conditions are all made worse by heavy smoke exposure, and are unfortunately likely to persist into the future; see Ch 3D pages 142-143 for additional detail.

Figure 3G.6: Smoke Emission Patterns from Prescribed, Resource Objective, and Suppression Fires



This will create a dilemma for Tribal communities choosing between maintaining reciprocal relationships with First Foods, and preserving physical health in the long term. This is true for those with pre-existing illness, as well as for those who don't have pre-existing conditions, as healthy people might see adverse health effects over many years of heavy smoke exposure during summer and fall months.

With wildfire projections set to increase in frequency and intensity, dry seasons like summer and (increasingly) fall are likely to experience some period of prolonged smoke, both from local fires as well as those from around the West Coast. Intentional burning can help with reducing the risk of catastrophic wildfire, and also reduce the overall air pollution involved with burning in forests and grasslands. Indigenous people must be at the forefront of these adaptation strategies.

(Credit: Long et al, 2017)

Gaps in Knowledge/Data/Policy:

- Understanding of how attitudes to using fire as a management tool are going to change within the general public;
- Effects and effectiveness of climate impacts on other forest and grassland management tools such as grazing and spraying;
- Other policy and legislative actions that may be taken to preserve air quality.

Adaptation Goals for Treaty Rights

D. Engage with Tribal Rights and Other Legal and Legislative Mechanisms

"The Tribes assert and exercise sovereign authority over the Reservation's current territory and any future territory that may come within Tribal jurisdiction, protecting Tribal rights and welfare in all areas. The Tribes complete sovereign power includes the following legislative authority: the power to define individual conduct, to regulate business enterprises, to tax, protect the environment, regulate natural resource uses, to provide for health, education, and welfare, protect religious freedom, and to make laws as any other nation (CTUIR Comprehensive Plan 2010)."

i. Bureaucratic Mechanisms

Red tape and bureaucratic process can be an annoyance at times, but many of these processes are in place to create mechanisms able stop arbitrary and harmful actions from being conducted without resistance. CTUIR and other Tribes have used these bureaucratic mechanisms to stall and reverse agency decisions that threaten Tribal resources, and can be lessons to look to for preventing action that would contribute to First Foods harm or climate crisis impacts.

Short Term:

- **Incorporate climate projections and impacts during participation in agency procedures and process for permit applications, and others as appropriate.** Previous cases have used 1) agency failure to recognize impacted Treaty Rights and 2) lack of adequate emergency response planning, to recommend permit denials for fossil fuel projects within CTUIR's territories. Incorporating climate projections and cultural documentation to these processes could provide further justification for permit objections.

Long Term:

- **Continue to pursue and participate in National Environmental Policy Act (NEPA) permitting and procedure** as a tool for 1) using partnership relationships with agencies to build well-considered processes that can be used to defend, and 2) delay or deny potentially harmful and poorly done processes that have not included sufficient Tribal participation. Additional incorporation of climate projections into processes would also strengthen defense of impacts to Tribal resources.

- **Continue to advocate for and participate in government-to-government consultation under the Administrative Procedure Act**. This Act governs the process by which federal agencies develop and issue regulations and requires meaningful consultation with Tribal nations. Adequate consultation with Tribes can be a powerful and flexible tool for building bureaucratic justification and defense. Using this Climate Adaptation Plan and other policy documents that incorporate climate impacts, CTUIR will be more prepared for meaningful consultation, now and into the future.

ii. State Legislative Mechanisms -- Carbon Pricing

Oregon and Washington States have, in recent years, dabbled with carbon pricing schemes, with little success in approving and implementing those initiatives. Market-based carbon initiatives are likely to continue to be pursued by future state legislatures, and Tribes will be affected by these efforts. Tribes are communities which contributed very little of carbon emissions responsible for this crisis, and decisions about Tribes and their fates should not be left at the behest of state legislatures, but for Tribes themselves to determine.

Short Term:

- **Conduct an internal inventory of perspectives and priorities r elated to carbon pricing schemes**. No Tribe is a monolith, and many opinions exist about carbon crediting approaches. Organizing community, staff, and leadership gatherings to explore decisions on the policy level is likely to improve CTUIR communication and commitment to carbon pricing mechanisms. Asking foundational analysis questions like 'what is most important? Why are we doing this? What do we need to protect?' as it relates to the legislation and implementation of carbon schemes will improve CTUIR's accountability to the Tribal community in pursing and/or responding to carbon pricing initiatives.

- **Advocate for carbon structures that allow Tribes to "opt in" to pricing and regulatory schemes**. Administration of such frameworks could pose a significant burden on governing capacity. Legislation that supports Tribes with additional capacity building, potential carbon pricing templates, and the ability for a Tribe to create their own carbon pricing structure would support Tribal self-determination in these frameworks.

Long Term:

- **Continue to advocate for elements in carbon pricing legislation that recognized Tribal sovereignty needs to be engaged over Tribal lands and Tribal resources.** Early reports about the success of carbon crediting from Indigenous communities in California and British Columbia are mixed. Some Tribes and First Nations have boasted success with participating in carbon markets, while others have expressed concern over forest management and access to landscapes for the purpose of traditional harvest and practices.

- **Continue to build good state-Tribal relations and engage with states on a legislative level**. Building functional and mutually beneficial relationships is foundational to accomplishing governance.

Language is an essential component of Tamanwit, and reciprocal connection to land and community for Tribal people. Access to educational opportunities to learn Tribal language, including the Immersion School, should be celebrated (pictured, Treaty Day).

Continuing to network and engage with other governmental agencies and entities creates opportunities for "soft power" in discussions and negotiations.

iii. Federal Mechanisms - Public Trust Doctrine and 5th Amendment

Protections of personal freedoms are preserved in various places within United States frameworks, including within the 5th Amendment and the Public Trust Doctrine. These protections can be drawn in direct parallel to Tribal Treaty Rights and rights to Self Determination. Examining opportunities to strengthen connection between Tribal rights and these other enshrined rights could provide additional pathways of protection for Tribal sovereignty and governance over climate adaptation measures.

Short Term:

- **Consider providing *Amicus* party justification/briefings in legal cases that have climate adaptation and pollution control implications**. Strengthening litigation that supports Tribal rights and the rights to a safe and prosperous future will provide Tribes with legal footholds to pursue further protections and enforcement of Tribal sovereignty.

- **Consider pursuing and strengthening protections that relate to the 5th Amendment, including Rights of Nature and Rights of Future Generations concepts,** among others. Under the 5th Amendment, property rights cannot be divested without due process. A parallel concept exists for Treaty Rights: considered "property rights" under the ownership or control of a Tribe, these are protected under the 5th Amendment. Collectively recognized, Tribes have legal claim to the Treaty Rights to cultural and subsistence practices. Previous U.S. Supreme Court cases have set precedent that protected rights to harvest and access are extended to populations of species inherent in these practices. One illustrative case, United States v. Washington (2018), demonstrates the power of Tribes to advocate for restoration action to preserve salmon populations through 5th Amendment protections to Treaty Rights. Pursuing discussions on how those protections extend to non-human relatives and future generations could build justification for extended legal personhood arguments to succeed.

Long Term:

- **Consider pursing and strengthening connections of Tribal rights to Public Trust Doctrine protections in any way possible**. Under the Public Trust Doctrine, general citizens to have rights to clean air and water and land, and the right to exist safely. These rights are parallel Tribal trust obligations with the Federal government, and failure to act on the climate crisis could be seen as a violation of Tribal and Public Trust obligations.

iv. International – United Nations Declaration of the Rights of Indigenous Peoples (UNDRIP)

International governing bodies have recognized Indigenous People have unique relationships and cultures, which require additional protection and translation on how these apply across global communities. The United Nations Declaration of the Rights of Indigenous People (UNDRIP) was ratified in 2007 and provides a mechanism by which Indigenous People can potentially circumvent "uncooperative domestic governments" and seek review from international courts. Several articles within UNDRIP correlate with rights and freedoms guaranteed by U.S. Treaties and amendments in the U.S. Constitution. These provide potential avenues of redress for grievances between Tribes and domestic governments under international review.

Long Term:

- **Identifying mechanisms could strengthen legal protections nationally and internationally**, especially in solidary with other Indigenous communities globally. These could include (but are not limited to) UNDRIP (2007):
  - ◊ *Article 31*
    1. Indigenous peoples have the right to maintain, control, protect and develop their cultural heritage, traditional knowledge and traditional cultural expressions, as well as the manifestations of their sciences, technologies and cultures, including human and genetic resources, seeds, medicines, knowledge of the properties of fauna and flora, oral traditions, literatures, designs, sports and traditional games and visual and performing arts. They also have the right to maintain, control, protect and develop their intellectual property over such cultural heritage, traditional knowledge, and traditional cultural expressions. 2. 2. In conjunction with Indigenous peoples, States shall take effective measures to recognize and protect the exercise of these rights.

CTUIR Education Dept staff conduct outreach for Tribal Language Program resources, including the Umatilla Language Dictionary.

  - ◊ *Article 37.1*: Indigenous peoples have the right to the recognition, observance and enforcement of treaties, agreements and other constructive arrangements concluded with States or their successors and to have States honor and respect such Treaties, agreements and other constructive arrangements.

This list provides a couple of examples found within UNDRIP; the full document can be found at the United Nations website: https://www.un.org/development/desa/indigenouspeoples/wp-content/uploads/sites/19/2018/11/UNDRIP_E_web.pdf

E. Strengthen Education and Communication

i. Education for Tribal and non-Tribal Community

Tribal people have deep cultural knowledge and connection that creates inherent climate resilience. Thus education about First Foods, cultural practices, Tribal sovereignty, and Treaty Rights becomes essential in planning and implementing adaptation.

Short Term:

- **Incorporate Tribal language and cultural learning into department and program operations as much as possible**. This could include encouraging staff to attend available language classes, and specifically seeking Tribal Language Program staff input into documents and reports, among others.

- **Intentionally pursue and secure necessary funding to support and continue Language education opportunities like Culture Camp and the Tribal Language Knowledge Bowl.** Opportunities to engage youth and families in Language learning improves understand and awareness of the importance of Tribal connection to place and First Foods.

- **Explicitly include community engagement and education into Tribal departments, services, and planning**. Many CTUIR planning and

technical policies currently do not include activities and benchmarks for sustained community education as part of their strategies.

- **Develop a protocol for CTUIR department/program plans and projects to collaborate with Nixyaawii Community School (NCS) Board and the Education and Training Committee (ETC)** as part of implementation and planning of these efforts.

- **Continue to implement and update the CTUIR Education Strategic Plan.** This plan informs how the Education Department conducts activities and goals, including the Oregon Department of Education Umatilla Bi-Literacy test for Tribal student language recognition.

- **Encourage community and staff to become familiar with and actively utilize the Umatilla Dictionary and Sahaptin keyboard** into documents and reports. Connecting Tribal services and plans to culture and sovereignty will build legally defensible justifications and strengthen Treaty Rights and Tribal sovereignty protections.

Long Term:

- **Continue to develop education around cultural knowledge and Treaty practices**. Examples include the Language Program Tamayct, CTUIR's Afterschool and Head Start Programs, and First Foods Excursions, among others. Activities should be planned for both exclusive education of Tribal Members and descendants, as well as others for non-Tribal audiences, as appropriate.

- **Formalize First Foods systems of responsibility in developing textbooks, policy documents, technical guidance, and government services**. This relationship builds defensible justification for Tribal self-determination, Treatment-as-State, and rights to Treaty practices across a vast and changing landscape.

- **Actively promote education of First Foods, Treaty Rights, and Tribal sovereignty to non-Tribal audiences.** Such activities should aim to increase understanding and opportunities for collaboration, resource co-management, Treaty Rights access, prescribed burn management, and generally a sense of shared fate with Indigenous knowledge as a protected priority.

ii. Communication of Tribal Knowledge and Policy

Many potential partners and collaboration opportunities have gone underutilized due to a lack of understanding about Tribal rights, culture, procedure, and governance. Expanding communication of Tribal priorities through official publications and engagement opportunities could boost participating with CTUIR in many different ways.

Short Term:

- **Organize and facilitate live and on-demand educational content through virtual recorded webinars** similar to the kind conducted as part of the Climate Adaptation Webinar Series (Nov 2020 – June 2021) on various Tribal program efforts and community projects.

- **Continue to implement and inform Senate Bill-13 on Tribal History/ Shared History** as part of a state effort to expand understanding and recognition of Oregon's Nine Tribes.

- **Promote and facilitate learning opportunities with the Šapátunx̣wit Community Curriculum and Online Resource.** These resources should be used to continue to engage Tribal community on climate impacts and adaptations. That resource is located here: https://ctuir.org/departments/natural-resources/climate-adaptation/s-apa-tunx-wit-community-curriculum-and-online-resource/

Long Term:

- **Organize and facilitate regularly occurring discussion groups for CTUIR's Tribal community on CTUIR policy documents,** to expand understanding and continued engagement on future improvements and updates to these documents. Regularly engaging the Tribal community is likely to improve long term planning success and identify gaps in services. See Ch 3D pages 156-158 and Ch 3F pages 249-250 for additional details.

F. Fortify First Foods in Systems of Responsibility

"As a group, we do not have the mastery of our language anymore, simply because of all the cultural influences that have been added to our world. But we exist, and we continue to view ourselves as a distinct group of people because of our ancestors' actions and their foresight in seeking to preserve our rights through treaty. We must, as our ancestors did, maintain the vision of our sovereignty, represented by our old ways, and we must do so while adapting to new predicaments (Johnson, 2006)."

Indigenous people have deep connections to homelands, which manifest in enduring relationships between place and people, like the First Foods. Translating these reciprocal relationships into policy and technical documents to guide governance contributes to preservation of culture and sovereignty.

Short Term:

- **Intentionally build opportunities for clear policy, structures, and frameworks that formalize First Foods relationships and responsibilities**, especially in ways that can be documented in support of Tribal capacity. This includes clear policy that integrates Tribal social, cultural, traditional, economic, and Treaty purposes. Also needed are structures/frameworks with demonstrable functions and impacts that relate (where possible) to existing Tribal capacity, such as the CTUIR Comprehensive Plan, policy statements, and services.

Long Term:

- **Promote understanding and awareness of documented services and policies that formalize First Foods systems of responsibility**. DNR's First Foods Mission, First Foods Policy Program (FFPP) and First Foods Policy are examples of translating cultural importance into government policy. These also help anticipate what leadership policy goals might be, as well as direct other programs about how to operate and provide services.

CTUIR Fisheries Project manager Jeremiah Bonifer teaches Tribal youth about salmon habitat and restoration work (pictured). Strengthening learning and education opportunities for Tribal and non-Tribal audiences of all kinds improves understanding of Treaty Rights.

Measuring Success and Gaps in **Treaty Rights Adaptation**

How Do We Measure the Success of These Adaptations?

"For two centuries, our people have been engaged in a battle. We have fought to keep our lands, maintain our sovereignty, retain our culture, and convince others that we have no intention of leaving or giving up. We have fought to be free to live as our ancestors did, free to practice our religion, free to go where we please at our leisure. We can never take these freedoms for granted (Morning Owl et al 2015)."

- **Confederated Tribes of Umatilla Treaty of 1855**
- Board of Trustees List of Priorities
- **CTUIR Comprehensive Plan Objective 5.2.2:** Manage Tribally owned lands to assure the highest and best use for Tribal Members consistent with their inherent capabilities (Comp Plan page 67 for benchmarks);
- **CTUIR Comprehensive Plan Objective 5.8.3:** Integrate CTUIR 1855 Treaty-reserved rights protection with the development and exercise of the Confederated Tribes' sovereignty, economic development and employment, and political and legal affairs. (Comp Plan page 95 for benchmarks);
- **CTUIR Comprehensive Plan Objective 5.10.7:** Promote national and local civic responsibility while educating students on the meaning of CTUIR sovereignty (Comp Plan page 103 for benchmarks).
- **CTUIR Emergency Operations Plan Section 3.3.3: Individuals and Households.** Suggestions include: reducing hazards in homes, preparing an emergency supply kit and household emergency plan, monitoring emergency communications carefully, volunteering with an established organization, and enrolling in emergency response training courses (page 67);
- **CTUIR Emergency Operations Plan Section 4.5: Response Priorities.** Priorities include: self-preservation for CTUIR employees and families, protection of life and property, protection of CTUIR cultural resources, emergency food and temporary housing, restoration of infrastructure, business enterprises, and recovery (page 79).
- **CTUIR Emergency Operations Plan Section 6.5: Community Outreach and Preparedness Education.** Identifies the need for an active community preparedness program (page 99).
- Annual/seasonal exercise of Treaty Rights by CTUIR Tribal community.
- Partnerships with agencies and landowners on Treaty Rights opportunities.
- Coordination with agencies and landowners on cultural and prescribed burning.
- Preservation and promotion of Tribal language learning opportunities and technologies.

Protecting access and ability to practice Treaty Rights, secured in the Treaty of 1855, preserves reciprocal relationships to First Foods into perpetuity for current and future generations.

What Gaps in Knowledge, Policy, Capacity, or Education Exist?

- Understanding of how land and water access might change with future energy and carbon crediting initiatives and how these might impact Treaty Rights;
- How expanding regional understanding and awareness of Tribal Rights and Indigenous stewardship strategies will affect land and water access for cultural practices.

Tribal Sovereignty and Rights Summary

Tribal Sovereignty Adaptation Goals

A. Capacity Building and Expansion of Tribal Self Determination

B. Cooperative Partnerships and Agreements

C. Support Tribal Policy, Frameworks, and Services

Tribal sovereignty has many strong mechanisms that can be used to pursue and protect climate adaptation strategies. These mechanisms strengthen connection to the land, and can benefit Tribal and non-Tribal communities and priorities.

Measures of Success:

- Confederated Tribes of Umatilla Treaty of 1855 Article One
- CTUIR Comprehensive Plan 5.7. 2, 5.7.8, 5.8.4, and 5.8.5
- Mission Community Plan (1995) and Water Code (2005)
- CTUIR Emergency Operations Plan (2016) Section 3
- CTUIR Hazard Mitigation Plan (2016, 2021) Section 5
- Coordination with agencies and landowners on cultural and prescribed burning.

Treaty Rights Adaptation Goals

D. Engage with Tribal Rights and Other Legal and Legislative Mechanisms

E. Strengthen Education and Communication

F. Fortify First Foods in Systems of Responsibility

Responsible and regular exercise of Treaty Rights is essential for maintaining and expanding Indigenous knowledge on CTUIR lands. These include traditional land management techniques like cultural burning, as well as the revitalization of dormant practices, and understanding of reciprocal responsibility.

Measures of Success:

- Confederated Tribes of Umatilla Treaty of 1855 Article One
- CTUIR Comprehensive Plan (2010) Objectives 5.2.2, 5.8.3, and 5.10.7
- CTUIR Emergency Operations Plan (2016) Sections 3.3.3, 4.5, and 6.5
- Annual/seasonal exercise of Treaty Rights by CTUIR Tribal community.
- Engagement with legal and legislative efforts on carbon accounting
- Partnerships with agencies and landowners on Treaty Rights opportunities.

Chapter 3G References and Credits

Literature References

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Photo Credits

- Part G Cover Photo; "Tribal staff and knowledge keepers discuss Rainwater acquisition," CTUIR DNR CRPP
- Background Photo; "Iskuulkpte Creek from ridgetop," CTUIR DNR CRPP
- Background Photo; "DNR Fisheries staff corral juvenile salmon for collection," CTUIR DNR
- Inset Photo; "Tribal community demonstrate in solidarity with Standing Rock," East Oregonian, 2016
- Inset Photo; "Tribal youth participate in hands-on learning about First Foods," CTUIR DNR CRPP
- Inset Photo Left; "Fisheries rotary trap damaged by floodwaters," CTUIR DNR 2020
- Inset Photo Right; "Water Resources stream flow gauging station damaged by floodwaters," CTUIR DNR 2020
- Inset Photo; "DNR staff view new Women's Foods Monitoring station on forestry tour," CTUIR DNR FFPP 2019
- Panel Photo; "Huckleberries and leaves," CTUIR DNR FFPP 2018
- Inset Photo; "DNR staff Wenix Red Elk provides outreach at Treaty Day," CTUIR Confederated Umatilla Journal (CUJ) 2021
- Panel Photo; "DNR staff work on Meacham Creek restoration," CTUIR DNR

- Inset Photo; “U.S. Forest Service’s Smokey Bear provides outreach at Community Picnic,” CTUIR CUJ Aug 2022
- Panel Photo; “Net repair tools and materials,” CTUIR DNR CRPP
- Inset Photo; “CTUIR OIT staff install atmospheric weather station,” CTUIR DNR RAF Amanda Lowe, 2020
- Inset Photo; “Endemic Blue Mountain Orchid species,” CTUIR DNR CRPP
- Background Photo; “View from Blue Mountains Ridge,” CTUIR DNR CRPP Wenix Red Elk
- Inset Photo; “Prescribed burn occurring in Umatilla National Forest,” U.S. Forest Service Umatilla National Forest, 2022
- Panel Photo; “Wildflowers bloom in Blue Mountains,” CTUIR DNR CRPP
- Inset Photo; “Language Immersion School represent in the Treaty Day parade,” CTUIR CUJ June 2022
- Panel Photo; “Flows of the Umatilla River,” CTUIR DNR Water Resources Program (WRP)
- Inset Photo; “CTUIR Language Program staff provide outreach at Treaty Day,” CTUIR CUJ June 2022
- Panel Photo; “Flowers bloom along the Columbia River at Hanford,” CTUIR DNR FFPP 2022
- Inset Photo; “DNR Fisheries staff provide Tribal youth education opportunity,” CTUIR DNR
- Inset Photo; “Youth participants have fun at Wildhorse Powwow,” CTUIR CUJ July 2022
- Summary Inset Photo; “Happy Canyon royalty ride in Treaty Day parade,” CTUIR CUJ June 2022
- Panel Photo; “Footsteps in the sand at Hanford cultural site,” CTUIR DNR FFPP 2022

Conclusions for Adaptation Across all Areas of Focus

1. First Foods Knowledge, Access, Processing, and Safe Harvest

- Secure and expand Tribal Member ability to uphold these reciprocal relationships.
- Build understanding of First Foods life cycles, appropriate harvest information, and processing.
- Gain a better understanding of sentiments and strategies around displaced species, species migration, and other facilitated migration opportunities.
- Develop strategies to address displaced species that threaten First Foods. These may be native species that are outside their range, that increase risk, or that predate on First Foods in their life stages.

2. Information Collection, Sharing, and Networks for Tribal Sovereignty

- Develop knowledge and observation sharing platforms and protocols for community.
- Information collection and analysis should center Indigenous knowledge and empowerment of Treaty Rights and cultural practices.
- Develop education and infrastructure to support local access to First Foods and safe opportunities for mutual aid and exchange.

3. Training, Education, and Opportunity for Tribal Community

- Tribal Youth and Students – who are future leaders and are most impacted by future changes.
- Tribal Harvesters and Entrepreneurs – who spend much of their time outdoors and will experience disproportionate mental and physical health impacts.
- Expand access to financial services through mechanisms that improve quality of life, empowerment around decision-making, and flexible financing for those in the Tribal community.

4. Flexibility/Adaptability in Governance, Economy, Community, and Self

- Build capacity to anticipate variability by implementing flexible and adaptive strategies for all services and events.
- This will include developing policy, infrastructure, and social protocols that facilitate flexible living.
- Provide opportunities to listen to the Tribal community around issues being experienced, and develop protocols to respond to these concerns.

5. Build Capacity to Implement Adaptation

- Support Tribal governments, and community knowledge and enthusiasm to tackle emerging problems, using capacity to fund, administer, and implement these strategies.
- Securing programmatic funding for adaptation strategies, expand Tribal community capacity to implement adaptations, and prioritize solutions with an interdisciplinary approaches.
- Maintain, improve, and expand every opportunity for Treatment-as-State, Land Back, Treaty Rights, litigation, partnerships, and other sovereignty mechanisms.

Next Steps

Future efforts will need to focus on building capacity and knowledge of climate impacts being experienced, and will need to involve both the CTUIR government and community.

1. Incorporate climate projections into the forthcoming update to the CTUIR Comprehensive Plan, set to occur in 2025.
2. Organize and facilitate community knowledge-sharing and gathering opportunities with the Sapatunxwit Community Curriculum.
3. Organize a process and relevant CTUIR staff and community members to develop department-specific CAP implementation plans.

Climate Adaptation Planning Timeline

Pre-Plan

(2018-2019)

- Synthesis of Data from Scientific Literature
  - ◊ Literature Review for regional, relevant, and recent Climate Projections and downscaled data modeling.
- Investigation of other Tribal Plans and Strategies
  - ◊ Engage with other Columbia River Plateau Tribes doing climate adaptation (Nez Perce, Yakama, CRITFC)
- Regional climate adaptation planning workshops and planning cohorts. This included workshops on health, native wildlife, smoke management, and Tribal climate planning, with various inter-Tribal partner organizations.

Drafting & Community Engagement

(2019-2022)

- Draft Plan Released June 2nd 2021– published in draft form on the CTUIR Climate Adaptation webpages on the CTUIR website.
- Engagement included mailing requested prints of drafts, providing printed drafts to DCFS Food Distribution participants, and at the CTUIR Seniors Center.
- Additional outreach and draft documents available at community events such as the Elders Lunch, Community Picnic, DNR Open House, and others.
- Climate Adaptation Webinar Series (Nov 2020—June 2021) - virtual community engagement highlighting Tribal knowledge keepers, staff, and partners.

Revisions and BOT Resolution

(2022)

- Incorporate feedback and revise draft accordingly. Community, leader, and staff engagement was tremendous and incorporating excellent feedback throughout the document took some time. Patience shown by community was greatly appreciated.
- Review of draft plan by CTUIR commissions and committees; multiple entities views different sections of the plan by relevance to area of focus, and vote on support for full document was done by polling.
- CTUIR Board of Trustees review sessions—BOT reviewed the revised final document as an overview of the Executive Summary, and a resolution to adopt.
- Resolution No. 22-103 to Adopt accepted on 19, December, 2022.

Next Steps

(2023 and beyond)

- Sapatunxwit Community Curriculum—establish a standardization of understanding climate impacts. Talking circles and discussion groups to guide engagement.
- CTUIR Comprehensive Plan Update in 2025— this scheduled update to the CTUIR guiding document will incorporate climate projections in benchmarks.
- Community Survey—improvements, updates, and revisions to future Climate Adaptation Plan revisions. Assess document accuracy and relevance to need.

C E R T I F I C A T E

The undersigned, N. Kathryn Brigham, and Sally Kosey hereby certify that they are the Chair and Secretary, respectively, of the Board of Trustees of the Confederated Tribes of the Umatilla Indian Reservation, and at a regular meeting of said Board of Trustees at the Board Chambers of the Nixyáawii Governance Center, Mission, Oregon, on the 19th day of December, 2022, a quorum of said Board was present and the following Resolution was regularly moved, seconded, and adopted by a vote of for, against, and abstaining.

R E S O L U T I O N

WHEREAS, the Board of Trustees is the governing body of the Confederated Tribes of the Umatilla Indian Reservation (Confederated Tribes) by the authority of Article VI, Section 1 of the Constitution and Bylaws of the Confederated Tribes, adopted on November 4, 1949 and approved on December 7, 1949, as amended; **AND**

WHEREAS, pursuant to Article VI, Section 1(e) of the Constitution and Bylaws, the powers of the Board of Trustees include the authority "to exercise any rights and powers heretofore vested in the Confederated Tribes, but not expressly referred to in this Constitution, or any powers that may in the future be delegated by an agency of local, state or Federal government"; **AND**

WHEREAS, the Confederated Tribes provides annual financial support to the Department of Natural Resources, to preserve, protect and enhance the First Foods for the perpetual cultural, economic and sovereign benefit of Confederated Tribes; **AND**

WHEREAS, the Confederated Tribes, through its Department of Natural Resources, has developed a Climate Adaptation Plan, conducted extensive community outreach, and has produced an archived Climate Adaptation webinar series that informs the plan; **AND**

WHEREAS, the Confederated Tribes, through its Department of Natural Resources, provides coordination and communication with other CTUIR Departments through the Climate Adaptation Planner and through CTUIR regulatory commissions and advisory committees, and a record of the committee and commission meetings and recommendations, and additional public outreach efforts regarding the Climate Adaptation Plan are outlined in Exhibit 3 to this resolution; **AND**

WHEREAS, the Confederated Tribes, since time immemorial, has prepared for changes in climate, and now is prepared to do the same in the face of the anthropogenic climate crisis caused by global colonization and the burning of fossil fuels, though the magnitude of these changes is still to be determined; **AND**

WHEREAS, the Confederated Tribes understands and is aware that the Umatilla Indian Reservation, its Ceded Lands, and its larger Traditional Use Area are likely to experience a suite of climate impacts that include an increased but variable magnitude of flooding; ecological drought causing stress to plants, animals, and water supply; increased frequency of extreme heat events that threaten health; frequent smoke inundation from wildfires burning near and far; increased risk of wildfire; and changes in the range and severity of many pathogens and pests that threaten economic and human prosperity; **AND**

WHEREAS, the Confederated Tribes recognizes and understands that climate impacts fundamentally alter the way water will be available, and affects all that depends on water, including First Foods, Tribal people, and future generations, as well as the abundance, health, and access of First Foods harvest opportunities to the Tribal community; **AND**

WHEREAS, the Confederated Tribes recognizes and understands that without coordinated and sustained adaptation, anticipated climate impacts could disrupt and destabilize the Confederated Tribes' exercise of self-determination and Tribal Sovereignty through the disruption of First Foods and cultural connection, increased strain on governance and community facilities, migration of First Foods out of Tribal jurisdiction, and increase mental and emotional strain on the Tribal community; **AND**

WHEREAS, the Confederated Tribes intends to exercise tribal sovereignty and resilience through the creation and adoption of a Climate Adaptation Plan that examines climate-shifted projections of future conditions for the purposes of long-term planning; **AND**

WHEREAS, the current Board of Trustees identified Climate Change Plan Implementation as the second highest priority for the 2022-2023 Board of Trustees priorities including the finalization and adoption of the CTUIR Climate Adaptation Plan, establishing greenhouse gas reduction goals, renewable energy development, and incorporating climate change actions for all CTUIR departments and entities/enterprises; **AND**

WHEREAS, the Confederated Tribes intends, by adoption of the Climate Adaptation Plan, to connect other existing plans and future updates to the Comprehensive Plan with climate change-associated planning; **AND**

WHEREAS, the Confederated Tribes intends, by the adoption of the Climate Adaptation Plan, to advance frameworks for climate adaptation implementation within its departments and enterprises, and in support of community initiatives; **AND**

WHEREAS, the Confederated Tribes, in adopting this Climate Adaptation Plan, demonstrates that it has developed a legally defensible and community-identified suite of possible

climate adaptation strategies, including services provided to the community, implementation of project objectives, and documentation of successful project implementation and lessons learned; **AND**

WHEREAS, revisions and updates to this Climate Adaptation Plan should be revisited at least every five (5) years to provide for the most recent and relevant information, or more frequently as it is necessary, and as capacity allows; **AND**

WHEREAS, at a work session held December 16th, 2022, the Confederated Tribes' Board of Trustees reviewed the revised final draft of the Climate Adaptation Plan, as outlined in Exhibit 1, Executive Summary, as outlined in Exhibit 2, and Record of Committee/Commission and Engagement and Public Outreach Efforts, as outlined in Exhibit 3; **NOW, THEREFORE, BE IT;**

RESOLVED, that the Board of Trustees hereby adopts the Confederated Tribes' Climate Adaptation Plan, attached hereto as Exhibit 1; **AND BE IT FINALLY**

RESOLVED, that the Board of Trustees hereby directs the Executive Director to implement the Climate Adaptation Plan where appropriate in CTUIR Department and Program work plans, funding proposals, and progress reports, as well as coordinating its implementation with CTUIR entities including Wildhorse Resort and Casino, Wildhorse Foundation, Cayuse Holdings, Nixyaawii Community Financial Services, Yellowhawk Tribal Health Center, and future enterprises.

AND, that said Resolution has not been modified amended or repealed and is still in full force and effect.

DATED this 19th day of December, 2022.

N. Kathryn Brigham, Chair
Board of Trustees

A T T E S T:

Sally Kosey, Secretary
Board of Trustees

Exhibit 1: **Climate Adaptation Plan**
Exhibit 2: **Executive Summary**
Exhibit 3: **Record of Committee/Commission Engagement and Public Outreach Efforts**

Name	Yes	No	Abstain	Leave
N. Kathryn Brigham, BOT Chair				
Aaron Ashley, BOT Vice Chair				
Sandra Sampson, BOT Treasurer				
Sally Kosey, BOT Secretary				
Corinne Sams, BOT Member				
Toby Patrick, BOT Member				
Lisa Ganuelas, BOT Member				
Boots Pond, BOT Member				
Lindsey X. Watchman, General Council Chair				