CLIMATE CHANGE MITIGATION AND ADAPTATION ACTION PLAN 2018

Bear River Band of the Rohnerville Rancheria

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INTRODUCTION

Bear River of the Rohnerville Rancheria (BRBRR or "the Rancheria") seeks to take a proactive position in planning for climate change impacts. In 2016 the BRBRR Tribal Council approved its first plan known as "the Climate Action Plan," which describes climate change and some of the vulnerabilities the Rancheria faces. The Climate Change Mitigation and Adaptation Plan is intended to build upon the Climate Action Plan. This plan describes the risks and vulnerabilities to BRBRR resources as well as recommends specific steps the Rancheria can take to mitigate and adapt to the climate change impacts affecting tribal trust and fee lands.

There are several approaches that can guide management decisions around climate change.

- Business as usual: no adaptation plan.
- Prevent the loss: reduce the vulnerability to structures i.e. building sea walls, or relocation.
- Change project locations: Relocate from climate vulnerabilities such as relocating infrastructure that will be inundated by sea level rise.
- Change the activity: Ban or regulate unsustainable activities such as burning of fossil fuels or permitting structures in the coastal sea level rise inundation zone.
- Enhance adaptive capacity: Support the resiliency of environmental, social and economic systems to cope with change such as restoring coastal wetlands or riparian zones to absorb flood water.

The BRBRR seeks primarily to mitigate climate change effects, but also engage in adaptation strategies to prepare for climate change. Definitions of these strategies are described below.

- Mitigation is defined by the International Panel on Climate Change (IPCC) as "a human intervention to reduce the sources or enhance the sinks of greenhouse gasses (GHGs), or interventions to reduce the sources of other substances which contribute directly or indirectly to climate change."[30] The Environmental Protection Agency (EPA) defines mitigation as a process to "slow the rate of climate change." [24]
- Adaptation is defined by the IPCC as, "the process of adjustment to actual or expected climate change and its effects". The EPA defines adaptation as a process to "anticipate and prepare for climate impacts." [24]

Mitigation is an after the fact action that seeks to reduce the impacts already felt by climate change or the underlying causes of climate change, e.g. burning of fossil fuels. Adaptation, on the other hand, takes a more proactive approach and looks ahead to understand the future impacts in order to create steps to move toward a more resilient system equipped to deal with climate change impacts.

This document begins by providing broad scale impacts of climate change as projected for Humboldt County. Then it looks at the Rancheria's natural resources as well as built environment in order to provide background information and analysis of the impacts before providing bulleted lists of general actions that can be implemented to both mitigate and adapt systems to better tolerate climate change impacts.

Climate Change Impacts

Temperature

Temperatures are expected to rise for Humboldt County and California over the course of the century by approximately 3.1° F to 5.5° F. The historical average temperature in Humboldt County is 45.8°F. A low emissions scenario projects the average to rise to 54.6°F. A high emissions scenario projects the average temperature to increase to 57°F by 2100 (figure 1).[9]

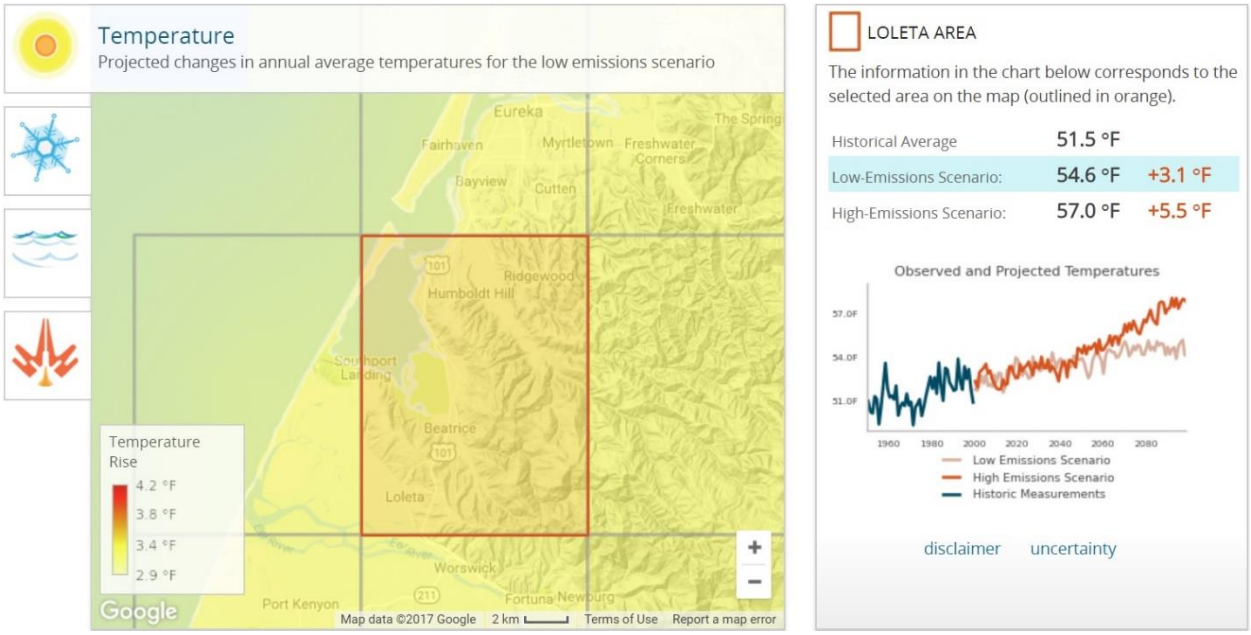

Figure 1 Temperature for the Loleta area is projected to rise 3.1-5.5° F by the end of the century. Image adapted by CalAdapt's online climate change data portal.[9]

A rise of just 3 degrees will impact the economy, environment, and social well-being in this area. According to Climate Scientist, James Hansen, a world that is three degrees warmer leads us closer to edge of a great tipping point where the earth will look and feel much different. The closest climate analog to present day Earth is the Pliocene epoch (5.3-2.6 million years ago). The mid-Pliocene (3 mya) had similar conditions of today including temperatures approximately 19° C warmer, there were arctic forests, less ice sheets, different global ocean currents and higher sea levels including a permanent El Niño condition. [64, 78]

Precipitation

California's Mediterranean climate is variable and cycles between periods of wet and dry. This pattern is expected to continue with more drastic swings and rising temperatures that will affect water resources more severely.[69] Precipitation amount and timing is expected to change by 2100, yet how it will change is uncertain depending on the model used and the region under investigation.[19, 20] A 2017 study modeling future precipitation from University of California Riverside showed that California is likely to experience an increase in precipitation in the central and northern part of the state while the southern part of the state will experience a decrease in precipitation. Northern California is projected to receive an increase of 14.1% in

annual precipitation, which will likely fall in the winter months. A cause for this is an increase in sea surface temperatures which encourages a southeastward shift of the jet stream which would send more rain-producing weather to California. [56]

Sea Level Rise

Climate change will bring sea level rise (SLR) to all of coastal California, but the Humboldt Bay region will experience SLR at twice the rate of the rest of California due to local tectonic subsidence, meaning our land is sinking in addition to the sea rising.[39] Humboldt Bay has already experienced 1.5 feet of SLR in the last century due to the combined factors of shoreline alteration, tectonic subsidence, and SLR.[39] The Eel River Valley will experience similar accelerated SLR impacts because of similar tectonic forces, yet no studies demonstrate the current rate of subsidence in the Eel River Valley (figure 2). Sea level in Humboldt Bay and the Eel River Valley is projected to rise 2.1 feet in a low emissions scenario and 5.1 feet in a high emissions scenario by 2100, which will inundate coastal land and infrastructure. [39]

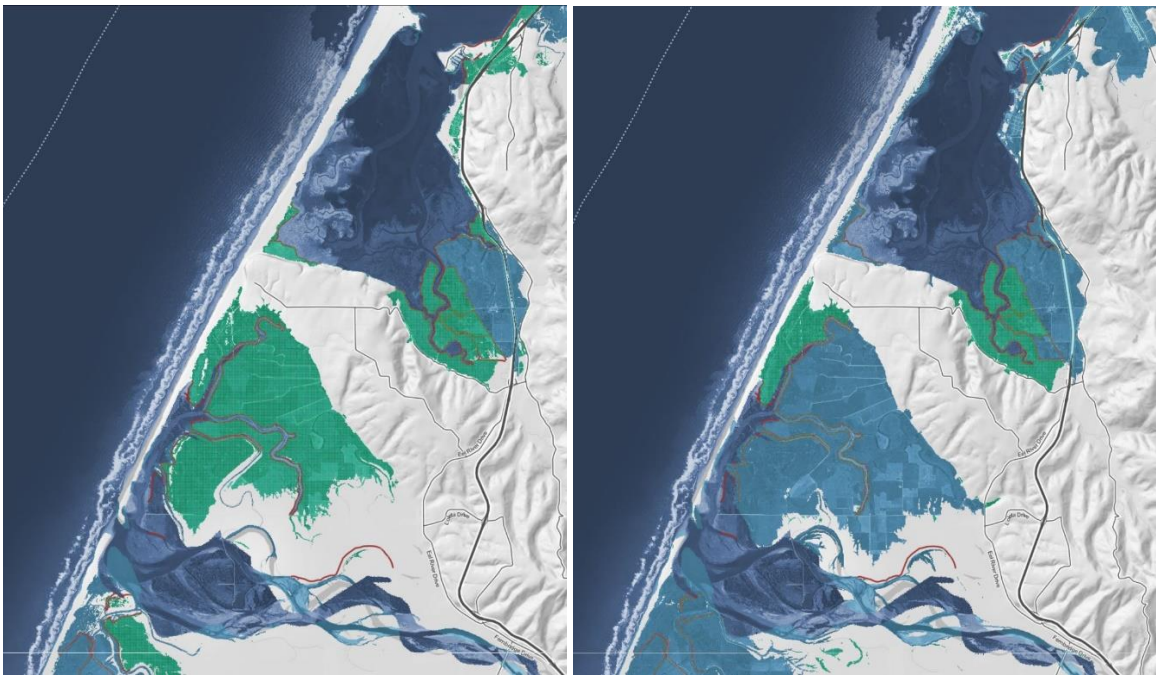

Figure 2. Projected Sea level rise (SLR) for the Eel River Estuary and South Humboldt Bay by 2100. The left image shows inundation caused by 2 feet of SLR while the right image show inundation caused by 5 feet of SLR. The green shows areas of inundation that are not connected to the ocean and the blue shows areas of inundation that are connected to the ocean. Image adapted from the Surging Seas Risk Zone Map. [68]

Wildfire

Fire hazard severity zones are categorized into three categories including, moderate, high and very high. The Rancheria is located in the moderate zone. As the climate changes the potential area burned will increase 3.5% by 2085 (figure 3).[41]

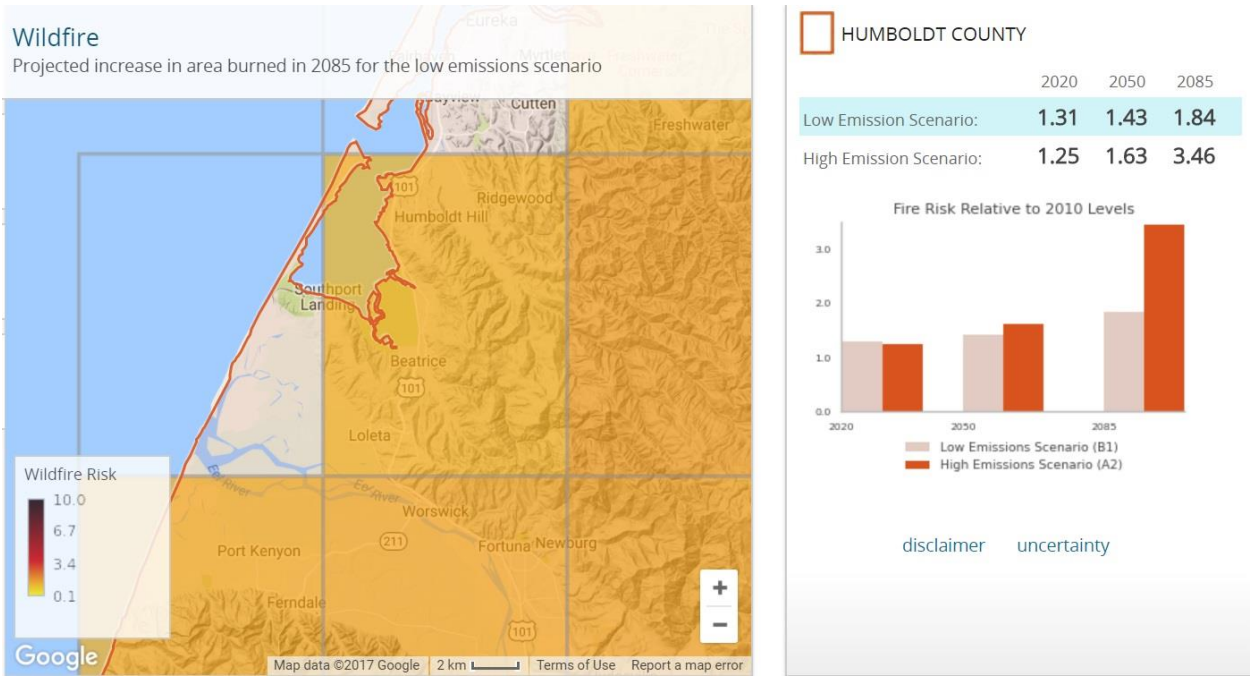

Figure 3. Risk of Wildfire will increase minimally in a low emissions scenario but area burned will nearly double by 2085 in a high emissions scenario.

RESOURCE BACKGROUND, RISK, AND CLIMATE ACTIONS

Natural Resources

LAND

The BRBRR consists of 177 acres of federal trust lands and 97 acres of fee lands totaling 274 acres (figure 4). The land is currently host to a housing district, community district, public work utilities such as drinking water facilities, waste water treatment plants, energy producing solar-wind micro-grid as well as a commercial district with a casino, hotel, gas station and tobacco shop. The land is host to ephemeral and perennial streams, wetlands, mitigation wetlands, native plant gardens, vegetable gardens, riparian mixed forest, as well as mixed shrubs and open grassland formerly used as ranchland for cattle grazing. 1940 aerial photographs show a minimally developed landscape consisting of rolling grassland prairies, with stream carved ravines and associated mixed conifer/hardwood riparian forest and scrub.[38] According to survey and analysis conducted in the 1990 Environmental Assessment Proposed for the Rancheria, the land is characterized as containing “plateau” vegetation communities that are natural to this area though impacted by grain cropping, cattle grazing, and timber harvesting dating back to the 1890s.[74]

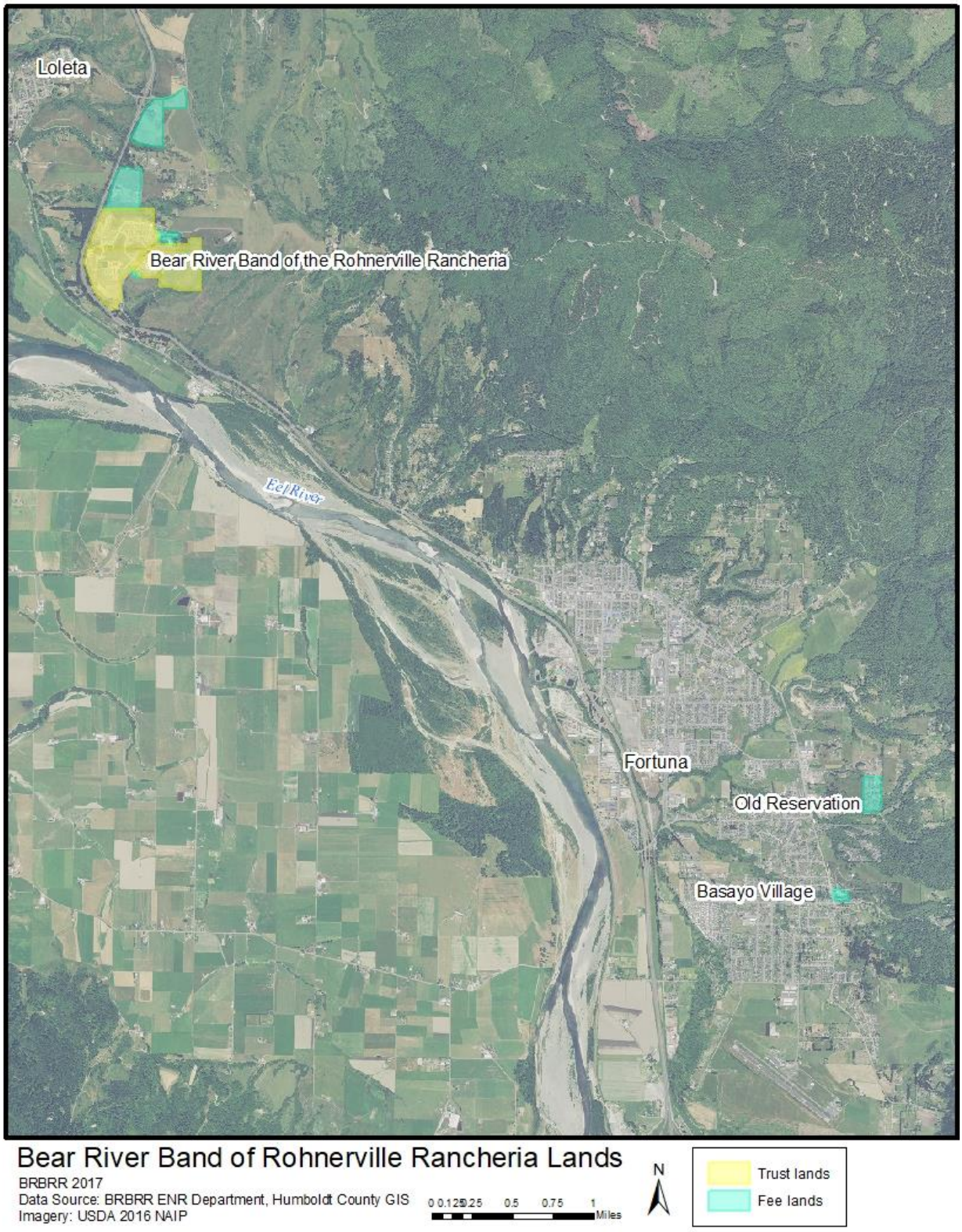

Figure 4. Trust and fee lands held by Bear River Band of the Rohnerville Rancheria on the North Coast of Humboldt County, CA.

At 315 feet elevation, the Rancheria sits northeast of the Eel River, on a southwest facing lobe of the Table Bluff ridgeline in the California Coast Range. The Rancheria is underlain by Pleistocene Hookton formations which consist of unconsolidated, but locally cemented non-marine to shallow marine deposits of gravel, sand, silt, and clay.[66] Due to groundwater fluctuation and poorly drained clay loam soils with a slow infiltration rate, groundwater can be as close as 4 feet below the surface.[25, 66] The clay soils contribute to higher rates of runoff due to a low infiltration rate.

Of the Rancheria's 177 acres approximately 33.45 acres, (19 percent) of the trust lands are impervious to water which causes runoff during storm events. Continued development on the Rancheria will increase the area of impervious surfaces thus increasing: storm water runoff, stress on storm drains, and the likelihood of flooding and impacts to water quality.

Climate Change Risks to Land:

- Increased flooding
- Reduced water quality
- Increased surface runoff
- Increased erosion
- Landslides
- Shifting plant and animal communities
- Loss of natural functions due to development

Mitigation and Adaptation Actions:

- Zone Tribal trust land appropriately i.e. residential, open space, agriculture, wildlands, ceremonial, commercial, and industrial. ENR GIS Specialist and Environmental Director will create and propose the Zoning map to Tribal Council. Zoning can help the Rancheria keep track of land use changes in order to reduce impacts from development and climate change.
- All relevant departments (i.e. ENR, Public works, Maintenance, Housing) should utilize geotechnical and hydrological reports for planning new developments.
- Incorporate permeable surfaces (rain gardens, bio swales, detention ponds) when developing new infrastructure (relevant departments).
- Pave with permeable materials (relevant departments).
- Develop rain gardens or other LIDs outlined in the BRBRR Subwatershed-based Plan as mitigation for loss of permeable lands. Permeable surfaces absorb surface runoff and storm-water runoff (relevant departments).
- Restore native plant communities (forest, scrub, prairie grasslands, and wetlands) (THPO and ENR).

ATMOSPHERE

Introduction

The atmosphere has changed substantially in the last 150 years due to the increased concentrations of greenhouse gasses (GHGs) and pollutants resulting from human activity (table 1).[2] Global surface temperature has increased 1.7° F since 1880,[30] CO_2 concentrations have consistently exceeded 400ppm since 2015,[25] and locally CO_2 has consistently exceeded 400ppm since 2011 (figure 5). Pollutants such as sulfur dioxide (SO_2), nitrogen oxides (NO_X), carbon monoxide (CO), volatile organic compounds (VOCs), ozone (O_3), aerosols, smog, mercury (Hg), and acid rain have all significantly increased since 1850.[2] These GHGs and pollutants cause climate change and have a substantial effect on human health.

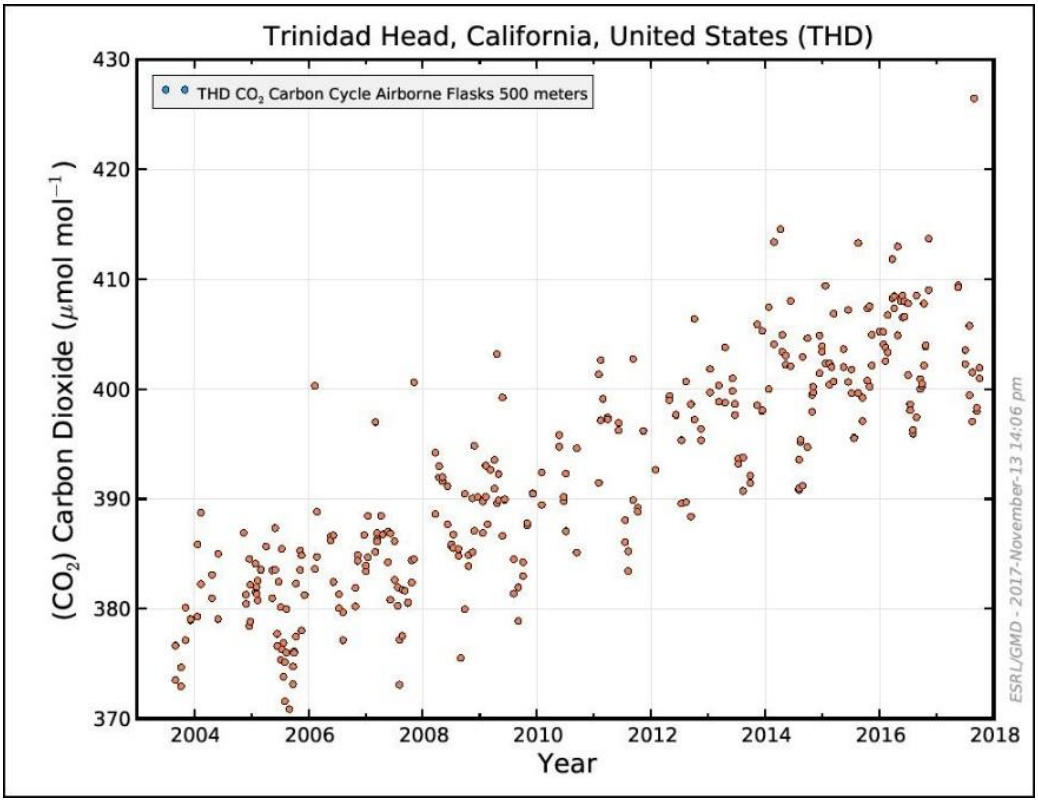

Figure 5. Atmospheric CO2 measurements taken at 500m from the Trinidad Head Earth System Research Laboratory between 2002 and 2017. The concentration of CO2 in the atmosphere now resides well above 400ppm.

Table 1. Human caused GHG emissions have increased in the atmosphere over time. Adapted from the UN climate change training. Not all GHGs or pollutants are listed.

Greenhouse Gas (GHG)	Global warming potential in carbon equivalents (C_e) over 100 years	% of emissions are human caused	% increase since 1750
CO_2 (carbon dioxide)	1 C_e	76 %	40 %
CH_4 (methane)	25 C_e	16 %	150 %
N2O (nitrous oxide)	298 C_e	6 %	20 %

Air pollution is affected by four processes including emissions (burning of fossil fuels), atmospheric chemistry (chemical reactions in the air), transport (wind carrying pollutants) and deposition (pollution returning to Earth via precipitation). Temperature, pressure, humidity, wind patterns, global circulation patterns, and topography determine the movement and dispersal of air pollutants in the atmosphere.[2, 10] Pollution generated in one part of the world can be transported by global winds and deposited in another region. East to west transport by the westerlies can carry air around the globe in a matter of weeks while north-south air exchange takes months.[2] Humboldt County may not generate significant amounts of pollution, yet it can receive pollutants from major polluters such as China via the westerlies.[12, 80] In addition to global circulation, local weather patterns affect local air quality.

Air quality on the Rancheria

There is no air quality monitoring conducted on the Rancheria, however the nearest monitoring station is located 10 miles north on Humboldt Hill. Generally, the Rancheria's location on the rural north coast of California in Humboldt County contributes greatly to the good air quality and low pollution experienced here. The Rancheria's location on a hill may help air quality as pollutants tend to settle into valleys, where temperature inversions can trap pollutants. Temperature inversions occur when there is no mixing of the air and warm air traps cold polluted air close to the ground. Two types of inversion occur in Humboldt County. Radiation inversion occurs mostly at night and early morning during late fall and early spring, while the subsidence inversion common on the coast occurs in the summer.[10]

Pollutants of Concern

Ground level ozone (O_3) and particulate matter (also called aerosols) less than 10 microns (PM-10) and less than 2.5 microns (PM-2.5) cause the primary air quality concerns in Humboldt County. Ground level ozone is a byproduct of human caused emissions, such as, carbon monoxide (CO), nitrogen dioxide (NO_2), and volatile organic compounds (VOCs), that undergo complex chemical reactions to become ozone causing haze. Ground level ozone is not to be confused with stratospheric ozone which forms differently and acts as an atmospheric shield reflecting harmful levels of UV light away from Earth.[2] Particulate matter consists of fine materials such as minerals, metals, soot, and dust that are suspended in the air. PM-2.5 is harmful as it penetrates deep into the lungs and bloodstream.[50] Both ozone and PM contribute to respiratory problems, such as cardiovascular disease, cancer, shortness of breath, headaches, fatigue and lung damage.[2, 50]

Air Quality Monitoring

The Rancheria does not monitor air quality, yet the Federal and State Clean Air Acts provide a regulatory framework for air quality monitoring and enforcement. The Rancheria is within the north coast air basin managed by the North Coast Unified Air Quality Management District (NCUAQMD) which is responsible for monitoring and mitigating air quality for Humboldt, Del Norte, and Trinity Counties.[9] Data collected and distributed by the NCUAQMD indicates that overall Humboldt County meets the Federal and State standards considered safe for ozone and PM. Occasionally PM-10 has been measured above levels considered safe by the EPA (figure 6).[50] As temperatures rise and economies continue to emit pollutants, air quality may change in the future. Temperature can accelerate the chemical reactions that transform chemicals into problematic

pollutants or neutral compounds. It could prove beneficial to monitor air quality on the Rancheria in order to see the changes and better inform residents when air quality reaches unsafe levels.

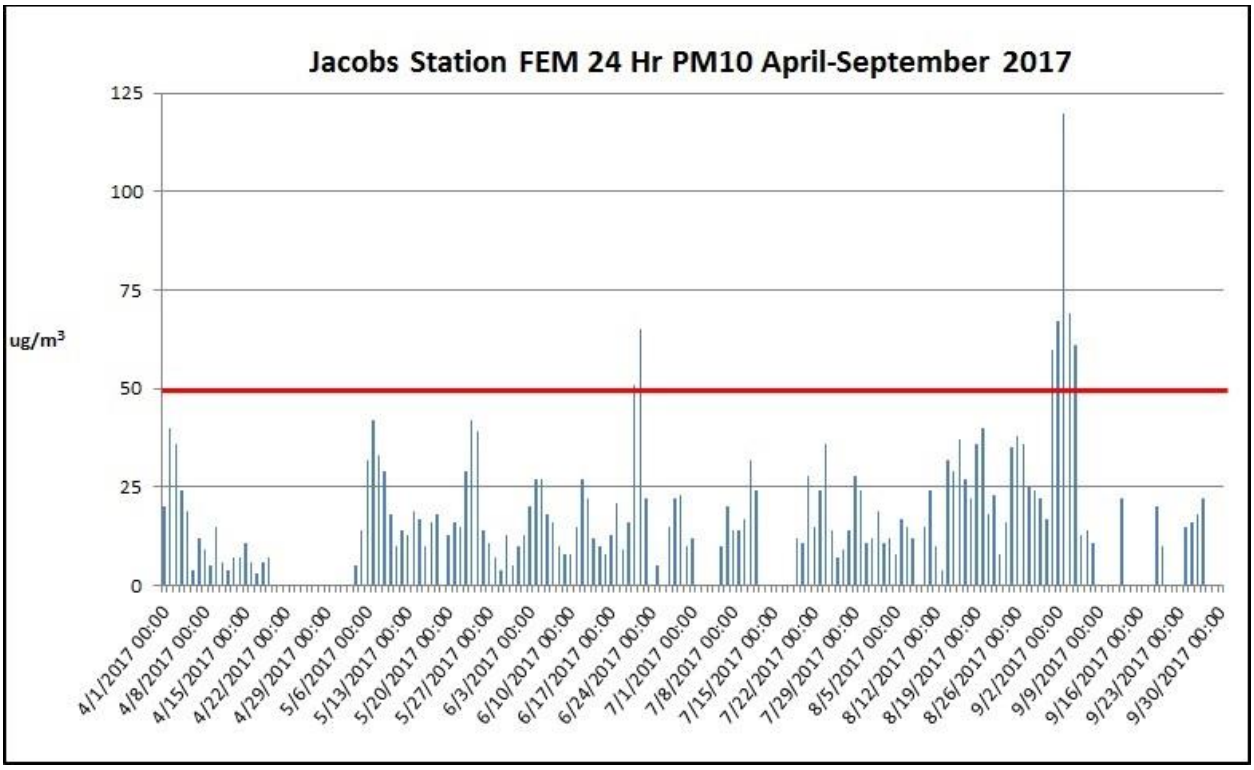

Figure 6. Particulate matter size 10 microns is measured at Jacobs station. The red line indicates safe levels. Figure pulled from the NCUAQMD Air Monitoring Report for April-September 2017.[48] Air quality standards exceeded standards due to local seasonal wildfires.

Climate Change Risks for Atmosphere:

- Increasing temperatures accelerate atmospheric reactions that generate ozone and other pollutants.
- Increase in pollutants and GHGs exacerbate climate change if emissions are not reduced.
- Increase in cardiovascular disease, asthma, and cancer.
- Increased occurrence of temperature inversions that trap pollution.
- Reduced air quality.

Mitigation and Adaptation Actions:

- Monitor air quality on the Rancheria (conducted by ENR staff).
- Reduce greenhouse gas emissions (Rancheria Wide).
- Convert to an electric vehicle fleet (Rancheria Wide).
- Convert infrastructure to renewable energy sources (Rancheria Wide).
- Educate tribal members about air quality and appropriate measures to take if air quality reaches unsafe levels (conducted by ENR).

WILDLIFE

Bordered by the Hwy 101, and private agricultural land, wildlife habitat on the Rancheria consists mostly of open grasslands, wetlands, riparian forest and coastal scrubland, which is fragmented, by roads, buildings and agricultural lands. A full species list has yet to be compiled by the Rancheria, however surveys have documented avian and amphibian species occupying the wetland, riparian forest and scrub habitats. Anecdotal reports reveal that mammals, occupy and utilize habitats within the Rancheria. All animals are protected from hunting on the Rancheria.

Climate Change Risks to Wildlife:

- Increased air and water temperature lead to habitat loss e.g. exceed biological tolerances such as, dissolved oxygen needs and temperature thresholds, loss of riparian forest habitat.
- Altered hydrological cycles can alter developmental process, reproductive success, migration, and food availability.
- Decline in population or increase in species extinction.
- Increasing temperatures can exceed biological thresholds for reproduction and survival of aquatic organisms.
- Increased flooding could decrease reproductive success of aquatic organisms.
- Increase wildfire frequency and severity can kill organisms and destroy habitats.
- Increased air temperatures and humidity can increase the range, distribution, and transmission of parasites and pathogens.

Mitigation and Adaptation Actions:

- Maintain and enhance riparian plant communities to benefit riparian birds and water quality for aquatic organisms (ENR – Water Quality).
- Restore native grassland communities to increase biodiversity and food for wildlife and insects (ENR).
- Limit use of toxic chemicals on the Rancheria and properly dispose of toxins (All relevant departments).

Riparian Birds

A 2010 avian survey detected 44 different avian species in the riparian areas and 26 avian species in the wetland areas (table 2). A 2014 survey detected 28 different avian species occupying the wetlands, riparian forest and coastal scrub. A total of 54 different species of birds have been detected on the Rancheria.[67] Climate stressors affecting riparian birds are those that cause physiological stress and/or alter the structure and function of riparian vegetation. The yellow-breasted chat and yellow warbler are two birds observed on the Rancheria that are experiencing notable decline within their historic range.[20] Improving riparian habitat will benefit these birds today and into the future.

Climate Change Risks to Riparian Birds

- Increased drought can impact the riparian forest and reduce habitat quality, and food availability.

- Increasing temperatures may lead to more heat waves which can affect the reproductive success of birds and affect migratory birds with narrow thermal ranges.
- Wildfire may alter riparian forests causing less habitat and a reduction in food availability, however fire may be beneficial in resetting the successional clock and setting back conifer encroachment.
- Diseases, including the transmission of West Nile Virus, may increase with increase in temperature.[19,20]
- Birds are highly mobile making them adaptable to climate change, however the riparian forests of the north coast are highly fragmented (85% reduction in last century). [19, 20]
- Continued habitat loss will further fragment the remaining available habitats thus reducing bird populations.

Table 2. Avian Species documented in riparian and wetland habitats.

Common Name	**Scientific Name**
Allen's hummingbird	*Selasphorus sasin*
American crow	*Corvus brachyrhynchos*
American goldfinch	*Spinus tristis*
American robin	*Turdus migratorius*
Anna's hummingbird	*Calypte anna*
Audobon's warbler	*Dendroica coronata audobonia*
Band-tailed pidgeon	*Patagioenas fasciata*
Barn swallow	*Hirundo rustica*
Bewick's wren	*Thryomanes bewickii*
Black pheobe	*Sayornis negra*
Black-headed grosbeak	*Pheucticus melanocephalus*
Black-capped chickadee	*Poecile atricapillus*
Brown creeper	*Certhia americana*
Brown-headed cowbird	*Molothrus ater*
Bullock's oriole	*Icterus bullockii*
California quail	*Callipepla californica*
Canada goose	*Branta canadensis*
Cedar waxing	*Bombycilla cedrorum*
Chestnut-backed chickadee	*Poecile refescens*
Common Raven	*Corvus corax*
Downy woodpecker	*Picoides pubescens*
European starling	*Sturnus vulgaris*
Golden-crowned kinglet	*Regulus satrapa*
Hutton's vireo	*Vireo huttoni*
Lazuli bunting	*Passerina amoena*
Lesser goldfinch	*Spinus psaltria*
Mourning dove	*Zenaida macroura*

Northern red-shafted flicker	*Colaptes auratus*
Northern rough-winged swallow	*Stelgidopteryx serripennis*
Olive-sided flycatcher	*Contopus Cooperi*
Orange-crowned warbler	*Vermivora celata*
Osprey	*Pandion haliaetus*
Pacific-slope flycatcher	*Empiodonax difficilis*
Purple finch	*Carpodacus purpureus*
Red-shoulder hawk	*Buteo lineatus*
Red-tailed hawk	*Buteo jamaicensis*
Savannah sparrow	*Passerculus sandwichensis*
Song sparrow	*Melospiza melodia*
Spotted towhee	*Pipilo maculatus*
Stellar's Jay	*Cyanocitta stelleri*
Swainson's thrush	*Catharus ustulatus*
Tree swallow	*Tachycineta bicolor*
Turkey vulture	*Cathartes aura*
Violet-green swallow	*Tachycineta thalassina*
Western wood-pewee	*Contopus sordidulus*
White-crowned sparrow	*Zonotrichia leucophrys*
White-tailed kite	*Elanus leucurus*
Wilson's warbler	*Phylloscopus trochilus*
Winter wren	*Troglodytes troglodytes*
Wrentit	*Chamaea fasciata*
Yellow warbler	*Dendroica petechia*
Yellow-breasted chat	*Icteria virens*

Amphibians

A 2014 survey of amphibians found four species present in the lower middle creek wetlands **(**table 3). [67] Amphibians are sensitive organisms dependent on aquatic environments and/or moisture rich habitats to hydrate their permeable skin. They often live within narrow biological tolerances, therefore slight changes in air and water temperature are detrimental to these organisms.

Climate Change Risks to Frogs and Salamanders

- As ectotherms, changes in water temperatures, moisture availability and flows will likely be the greatest threats to these organisms. [19, 20]
- Changes is precipitation and increasing drought will alter flows, available habitats and distribution of species.
- Disease outbreaks may increase with warming temperatures and decreased stream flow.
- Warmer water temperatures can reduce dissolved oxygen and reproductive success.

- Increased wildfires can kill organisms and destroy their habitats, but post-fire debris flows could create long-term habitat over time.[19, 20]

Table 3. Amphibians observed within the middle creek mitigation wetlands.

Amphibian Species Documents on BRBRR	
Common Name	**Scientific Name**
Northern alligator lizard	*Elgaria coerulea*
Northern red-legged frog	*Rana aurora*
Slender salamander	*Batrachoseps attenuates*
Western terrestrial garter snake	*Thamnophis elegans*

Mammals

Anecdotal observations of mammals include: Columbian black-tailed deer, black bear, coyote, bobcat, raccoon, skunk, deer mice, rabbit, and gophers. BRBRR is also within the habitat range of Roosevelt elk, mountain lion, and bobcat. Mammal presence is affected primarily by food and habitat availability.

Climate Change Risks to Mammals

- Changes to forage availability and shifts in plant phenology.
- Weather patterns that affect migration and forage availability.
- Increase in wildfire severity can damage habitat and reduce available forage, yet small fires could promote habitat diversity and higher quality forage.[19, 20]

Pollinators

Pollinators have not been inventoried on the Rancheria, yet have been observed. Pollinators, such as bees, butterflies, moths, beetles, and flies are important to plant reproduction by pollinating flowers that generate fruit which disperse seeds.

Climate Change Risks to Pollinators

- Pollinators are sensitive to climate stressors that alter food availability, habitat, and phenological changes that can cause mortality.
- Changes in precipitation and increased drought can reduce native plant diversity, while foraging activity is reduced during heavy rains.
- Increased temperatures can affect the timing of blossoms and cause mismatches between pollinator presence and flower blooming period.
- Increased wildfire can cause direct mortality and destroy habitat.
- Pollinators are also susceptible to increased exposure to pathogens and parasites.

RIPARIAN FORESTS

Riparian forests are an important forest type and are associated with stream channels and wetlands. These forests are defined as having direct physical and biotic interactions between the aquatic and terrestrial

system.[18] Riparian forests interact in multiple dimensions connecting land, air and water. Spatially they grow parallel to streams from their headwaters to river mouths. Forest interactions run vertically from the subsurface root structure to the upper canopy of the trees and laterally as riparian forests may extend hundreds of feet away from the stream on either side. Forest interaction vary temporally—from seedling recruitment—to the natural falling of timbers into the creek which creates greater habitat complexity in the system. Little is known about the history of the forests here on the Rancheria, but it is thought that the property consisted mostly of a native grassland and scrub plant communities interspersed with drainages that supported riparian forests.

Riparian forests on the Rancheria consist of alder, willow, cottonwood, wax myrtle, Sitka spruce, douglas-fir, and beach pine making up approximately 44 acres or 25 percent of the Rancheria (figure 7). State-wide vegetation change has been analyzed for Pacific coniferous and riparian forests by the University of California, Davis. Depending on the climate model, by the end of the century 24%-84% of coniferous forests will be climatically exposed to conditions out of their norm, and 1%-64% of the current area will remain suitable including around Humboldt Bay. Between 23% and 39% of current extent of riparian forests will no longer be climatically suitable, while 61%-77% will remain suitable and 12%-23% of climatically appropriate area will become newly suitable.[70] Despite the loss of the extent of suitable habitat, restoration and protection of these habitats can serve as climate mitigation to reduce the effects of long term climate change as well as strengthen the structure and function of these habitats as they adapt to climate change.

Figure 7. Middle creek riparian forest near the Rancheria's western parcel boundary.

Trees serve many ecological services beneficial to urban and natural settings including: wildlife habitat, water storage, retention, filtration, protection against flood hazards including landslides and soil erosion. Forests create soil, produce food, regulate temperature, conserve energy, replenish oxygen, and absorb greenhouse gasses (GHG).[1, 21, 59] Carbon Dioxide (CO_2) is a primary GHG driving anthropogenic climate change, and using

trees to absorb excess Carbon (C) from the atmosphere is critical to mitigating climate change. Because trees breathe in CO_2 and use it to drive their metabolic processes, they eventually store this C in woody structures such as trunks, branches, roots and leaves. When a tree or an entire forest takes in more carbon than it releases, it acts as a sink and can offset a portion of society's GHGs.[59]

Climate Change Risks to Forests:

- Moisture induced stress due to changing temperature and precipitation regime including fog reduction and reduced soil moisture.[19, 20]
- Increased drought changes the amount and timing of precipitation, and reduces surface and groundwater flows.
- Shifts in composition of riparian vegetation toward more drought tolerant vegetation including conifers and non-native plants.
- Lower summer stream flows may affect plant community, structure and function.
- Pest and pathogen outbreaks due to longer warm/dry seasons.
- Increased frequency and intensity of fire.
- Reduced soil moisture can decrease plant growth, seedling recruitment and increase plant mortality.
- More frequent and/or severe flooding can increase erosion and remove vegetation.
- Increased evapotranspiration can enhance drought related stress.[19, 20]
- Increased wind throw of trees during winter storms or high hind events in summer when trees are dry and brittle.

Mitigation and Adaptation Actions:

- Maintain and expand riparian forests (ENR – Water Quality).
- Restore native mixed forests and scrub where appropriate (ENR).
- Carbon sequestration mitigation via planting trees (ENR, Maintenance, THPO, Public Works).
- Adopt a 3:1 mitigation ordinance for cutting and planting trees. Plant 3 native trees per one tree removed**.** All relevant departments should work together to ensure the mitigation occurs. ENR could propose the ordinance and propose a simple tree cutting form that permits the cutting and mitigation of trees. The form would need to be filled out and approved prior to tree cutting or removal. ENR could maintain a tree mitigation database. The 3:1 ordinance could be written to be void if required environmental analysis called for vegetation mitigation.
- Consider shifting distributions when determining which species to plant and where; evergreen forests (evergreen hardwoods and conifers) may expand upslope into mixed conifer habitats.
- Maintain a minimum of 100 feet defensible space around structures in defense of wildfire.

GRASSLANDS

1940 aerial photographs and early environmental assessments indicate that the primary vegetation type on the Rancheria historically was a "plateau" or prairie grassland type (table 4).[38, 74] A wide variety of grasses, forbs, rushes and sedges made up the dominant vegetation, yet the land was converted to grain cropping

around 1890, which altered the deep prairie soils as well as impacted the native plant community.[74] The Rancheria is now host to maintained lawn and invasive annual grasses which covers the majority of the property at approximately 100 acres.

Lawn maintenance including use of fertilizers, herbicides and pesticides has a measureable impact but currently shows no impairment to water resources.[5] Maintained lawns put added pressure on drinking water wells to provide irrigation. In a future with higher temperatures and changes in timing and amount of precipitation, the Rancheria must consider the sustainability of maintaining such a large area of lawn. Native grasslands tend to be more resistant and resilient to climate stressors. Forbs are less tolerant to drought, while perennial grasses tolerate drier conditions due to their deep roots systems. Annual grasses have long-lived seedbanks allowing seeds to remain dormant and germinate in good years (EcoAdapt). Grasslands are adapted to high inter-annual variability thus making them tolerant to climate stressors.[20] Increasing the presence of native grassland plants to the open space on the Rancheria could help save water and increase biodiversity, thereby increasing on-site resiliency.

Table 4. Common plants found in Plateau of Prairie Grassland type. Adapted from Visions Enterprise 1990.[71]

Common Plants found in and around the Plateau or Prairie Grassland Type	
Common Name	**Scientific name**
Black cottonwood	*Populus tricocarpa*
Willow	*Salix sp.*
Oregon grape	*Berberis nervosa*
Western azalea	*Rhododendron occidentale*
Brodiaea	*Brodiaea sp.*
Nootka reedgrass	*Calomagrostis nutkatensis*
Velvet grass	*Holcus lanatus*
Weedy grass	*H. mollis*
Douglas iris	*Iris douglasiana*
Nemophila	*Nemophila menziesii*
Blue eyed grass	*Sisyrhynchium bellum*
Annual fescue	*Festuca sp.*
Silver hairgrass	*Aira caryophyllea*
Annual dogtail	*Cynosurus echinatus*
Oatgrass	*Danthonia*
Sweet vernal grass	*Anyhoxanthum odoratum*
Soft chess	*Bromus hordeaceus*
Clover	*Trifolium sp.*
Vetch	*Vicia*
Fireweed	*Chamerion angustifolium*
Blue Wild rye	*Elymus sp.*

Climate Change Risks to Grasslands:

- Changes in precipitation amount and timing.
- Reduced soil moisture.
- Increased drought.
- Increased air temperatures and evaporation.
- Increased frequency and intensity of fire.
- Loss of habitat suitability.

Climate Actions Include:

- Reduce irrigation in times of drought (Rancheria wide).
- Irrigate lawns at evening or night-time to reduce water loss (homeowners, maintenance).
- Restore native perennial and annual grassland community (ENR, THPO).
- Remove and replace residential lawns with native drought tolerant plants or dry-landscaping techniques (Housing, maintenance, ENR, THPO).
- Convert Rancheria-wide invasive grasslands and lawns to native grasses, native plant gardens, forests, rain gardens, or food orchards (ENR, THPO).

WATER RESOURCES

Background

Water is an important resource and the Rancheria should take a climate informed approach to water management as a changing climate can affect water resources in a number of ways. Impacts from climate change include the redistribution of the amount, timing, and location of precipitation.[61] Characterized by a Mediterranean climate with wet winters and dry summers, the North Coast of Humboldt County receives nearly all of its precipitation as rainfall and fog. Rain typically falls between October and May, while fog is present year round and is an important source of water for the surrounding ecosystems. Data compiled by the National Oceanic and Atmospheric Administration (NOAA) shows a decline in fog along California's coast in the last century.[72] Projections indicate that the trend will continue, however there is high uncertainty in the projections due to the complex nature of fog as it is intertwined with the atmospheric, oceanic and terrestrial systems.[72] The Eureka National Weather Service Forecast Office's precipitation trend data, dating back to 2000, shows the ten year averages have remained relatively stable. The average rainfall for 2000 through 2009 water years is 40 inches and the average rainfall for 2010-2016 water years is 40.62 inches.[46] The average rainfall on the North Coast is steady, however, there have been periods of prolonged drought where the region received less than normal rainfall; for example, in water year 2013-2014, Eureka only received 21 inches of rain. Drought is defined in a number of contexts, including meteorological, agricultural, hydrological, and socioeconomic, yet all definitions state that drought is characterized by the departure of precipitation and water availability from a region's average precipitation.[46, 47, 79]

Changes to precipitation patterns are challenging to predict on a fine scale for Humboldt County and sources are variable. The Community Climate System Model 3 (CCSM3) using a high emissions scenario, projects the

region will see a four inch decrease in precipitation by 2050 and a decrease of six inches by 2100.[41] Alternatively, Cal-Adapt's online tool suggests a four inch increase in precipitation, and research from University of California Riverside indicates that rainfall is likely to increase in Northern California.[29, 56] Overall, California is known for its year to year variability in annual precipitation with periods of wet and dry years.[34,69] The Mediterranean seasonal precipitation pattern is expected to continue with winter storms providing the bulk of precipitation in CA.[9] It is also predicted that surface warming in the Pacific Ocean will encourage more El Niño years where mid-latitude cyclones form and migrate toward California.[29]

As the climate changes in California and Humboldt County, the new averages will likely include changes in rainfall, increased temperatures and drought. Temperatures are projected to increase between 3.1 and 5.5°F by 2100.[9] It is important for the Bear River Band of the Rohnerville Rancheria to consider adapting to changes in the hydrological cycle, prolonged drought and temperature impacts on water resources. This section will outline adaptation and mitigation strategies for water resources of the natural and built environment.

Rivers and Streams

A Subwatershed-based Plan was crafted by GHD consultants and approved by Tribal Council on May 16, 2016. This plan describes the streams that flow through the Rancheria and drain into the Eel River. It outlines impacts to the watershed, water quality monitoring and low impact development (LID) techniques to mitigate new development. This plan should be consulted when developing new infrastructure on the Rancheria.

Three unnamed streams flow through the Rancheria and total approximately 5,300 feet in length. The stream that flows east through the center of the Rancheria, characterized by a complex of natural and mitigation wetlands, will be referred to as middle creek. Middle creek is an intermittent stream flowing approximately 1,900 feet in length. It flows west off the property under highway 101 until it reaches an agricultural parcel where it loses its defined channel, yet likely follows a ditch along property lines that lead toward the Eel River. The other two streams are situated on the eastern side of the Rancheria and eventually flow together downstream of the parcel boundaries. The unnamed west fork tributary is 2,100 feet in length and the unnamed east fork tributary is 1,350 feet in length. These streams flow westward off the Rancheria, under Hwy 101 and toward the Eel River (figure 8).

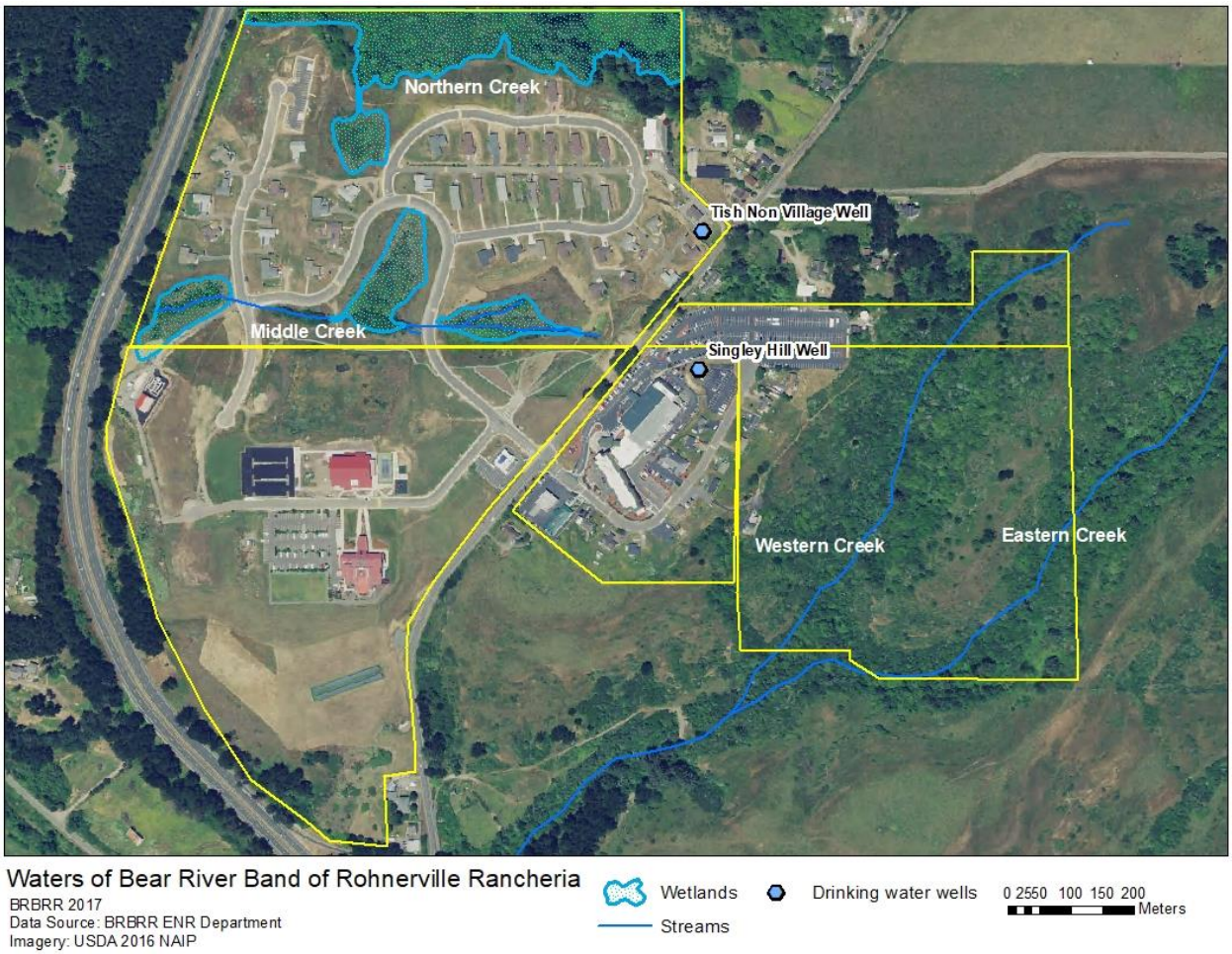

Figure 8. Streams and wetlands within the Rancheria boundaries. These waters are part of the greater Eel River watershed.

Streams support terrestrial and aquatic communities, provide groundwater recharge, act as natural flood protection, and maintain water quality.[43] The lower Eel River is a water quality limited segment (sediment, temperature) listed by the North Coast Regional Water Quality Control Board under section 303(d) of the Clean Water Act. Activities on the Rancheria add to the cumulative impacts to the Eel River and lower watershed because sediment, and other pollutants flow downstream into the Eel River from source streams on the Rancheria.

Climate Change Risks to Rivers and Streams:

- Low stream flows due to increased drought, changes in precipitation and increasing atmospheric temperature.
- Reduced water quality (increased water temperature, reduced dissolved oxygen, increased turbidity, and presence of toxic algae).
- Loss or changes to habitat (thermal/velocity refugia, riparian corridors, altered river bed and loss of topographic complexity such as pools, riffles, runs, side channels…etc.).
- Reduced soil moisture.

- More frequent and/or more severe wildfires.
- Increased flooding due to more frequent and/or more severe storms.[19, 20]
- Species loss.

Mitigation and Adaptation Actions:

- Monitor surface water on the Rancheria in accordance with 106 standard operating procedure (ENR – Water Quality).
- Protect and enhance existing native riparian vegetation (ENR – Water Quality).
- Adopt buffers to reduce potential for erosion and pollution, keep temperature low, and allow migration of plants and animals (ENR – Water Quality).
- Plant more native riparian vegetation to sustain ecosystem function (ENR – Water Quality).
- Remove invasive species within stream and riparian zone (ENR – Water Quality).
- Prevent fragmentation to stream corridors (ENR – Water Quality).
- Prevent agricultural grazing within riparian corridor (ENR – Water Quality).
- Implement low impact development (LID) projects into construction plans (Rancheria wide, housing, maintenance) to protect riparian areas.
- Implement best management practices (BMPs) (Rancheria wide, housing, maintenance).

Wetlands

There are approximately 13 acres of forested and non-forested wetlands on the property located within 2 sub-watersheds drained by Middle creek and unnamed northern creek (figure 8). Approximately 12.3 acres of wetland are naturally occurring including wetlands in the middle and northern creek drainages, while 0.7 acres of wetlands were created as mitigation for the construction of the Tish Non Village and casino parking lot. Middle creek wetlands span the central core of the Rancheria and flow downslope off the property, while the northern wetlands are located on the northern boundary of the Rancheria and flow west off the property toward the Eel River. Surface water quality monitoring and restoration efforts are conducted by the ENR Water Quality Specialist under the Clean Water Act sections 106 and 319 grant funded programs.

Wetland health on the Rancheria has been classified using the EPA classification for impervious cover of the associated sub-watershed to determine if wetlands are sensitive (10% impervious), impacted (10-25% impervious), or non-supporting (>75% impervious). Middle Creek is ranked as non-supporting, and the northern wetlands are ranked as impacted.[5] The health of these wetlands is important in order to provide their many ecosystem services including: water quality improvement, groundwater recharge, wildlife habitat, stream bank stabilization, and flood control as wetlands slow and capture storm water runoff.[13, 44]

Wetlands are considered important for their inherent environmental services but also are seen as mitigation tools to decrease the impacts of climate change. Wetlands sequester atmospheric carbon and store it in the soil. They cover 5-8% of the global terrestrial landscape and it is estimated that 20-30% of global soil carbon is stored in this small percentage of land.[44] Wetland ecosystems also buffer against increasing temperatures

as forested wetlands provide cooling shade. [13] Steps need to be taken to adapt our wetlands to climate change, as well as use them to mitigate and adapt to climate change.

Climate Change Risks to Wetlands:

- Wetland reduction and/or loss due to increasing temperatures and changes in amount and timing of precipitation.
- Moisture induced stress due to increasing temperatures and changes in amount and timing of precipitation and increased evapotranspiration rates.
- Conversion to dry adapted and/or non-native plant and animal species.
- Species loss.

Mitigation and Adaptation Actions:

- Continue wetland protections and monitoring efforts currently conducted under the Clean Water Act section 106 and 319 programs (ENR – Water Quality).
- Maintain and enhance riparian buffers to reduce potential for erosion and pollution, keep temperatures low, and allow migration of plants and animals (ENR – Water Quality).
- Restore, enhance, and create wetland area to increase groundwater recharge and carbon sequestration potential (ENR – Water Quality).
- Prevent fragmentation of wetlands and reestablish riparian corridors which allow for plant and animal migration (ENR – Water Quality).
- Address invasive species in climate stressed wetlands; particularly mitigation wetlands.
- Monitor water quality (ENR – Water Quality).
- Increase permeable surfaces on the Rancheria to increase groundwater infiltration (Rancheria wide, ENR – Water Quality).
- Prevent storm water runoff pollution into wetlands with the use of LID (rain gardens, storm water detention ponds) (Rancheria wide, ENR – Water Quality).
- Install water control structures at outlets to help maintain water levels during dry periods (ENR – Water Quality).
- Implement low impact development (LID) projects into construction plans (Rancheria wide, housing maintenance).
- Implement best management practices (BMPs) (Rancheria wide, housing, maintenance). .

Drinking Water Wells

The Public Works department provides drinking water to all Rancheria infrastructure via two wells. The Tish Non Village well is approximately 600 feet deep and the Singley Hill well is approximately 700 feet deep. These wells tap in to the greater Eel River groundwater basin which is estimated to store between 125,000 and 136,000 acre-feet of groundwater.[49] These wells tap into the water bearing sediments of the Carlotta Formation (upper layer of the wildcat group) which occurs approximately 500 to 3,000 feet deep. Both wells produce hard water with high levels of naturally occurring total dissolved solids (TDS) including iron and

manganese (Public Works staff). Hard water is not harmful to drink, but over time leads to buildup in pipes, reduced efficiency in water filters, hot water heaters and causes a bitter or salty taste.[77] The drinking water is treated to soften the water using salt which reduces the iron and manganese compounds in the water.

The wells currently provide water to nearly 200 residents and 1,000 visitors and employees on site via 76 water hook ups.[60] A majority of Rancheria residents surveyed deny drinking the tap water due to its "bad taste" despite treatment.[4] Residents and staff who do not drink the well water rely on purchasing and importing water, which is costly and likely to become more expensive and less reliable in the future.

Climate Change Risks to Drinking Water:

- Seawater intrusion due to sea level rise.
- Reduced groundwater recharge due to changes in precipitation amount and timing.
- Lowering of the water table due to drought.
- Increased temperatures and drought could lead to overdrawing of the aquifer.
- Reduced access to retrieve and deliver water to the Rancheria due to sea level rise and damage to roads from storms and an increasing cost of water.

Seawater intrusion generally impacts shallow aquifers in coastal groundwater basins. The Rancheria's wells are deep and located 5.5 miles from the coast and 0.5 mi from the Eel River. A seawater intrusion study in the Eel River basin was conducted by the Department of Water Resources (DWR) in 1970-71 and found that seawater intrusion into the basin was apparent dating back to 1950.[17] Seawater intrusion seems to coincide with the tidal zone of influence and porous alluvial deposits that allow seawater to percolate into the soil. DWR concluded that no further intrusion took place between 1950 and 1971, unfortunately, DWR did not publish maps to illustrate the inundation zone.[17]

The Eel River coast is influenced by a mixed diurnal tide system, meaning it receives two high tides and two low tides daily that are of different heights. The seawater intrusion from tidal influence in the Eel River extends upriver to Fernbridge, approximately 7 miles upstream of the mouth with the Pacific Ocean.[45] It is reasonable to conclude that as sea level rises the zone of intrusion will increase. Although the Rancheria's wells are located approximately 0.5 miles east and down river of Fernbridge. Due to the well's distance from the river, depth and geologic makeup, it is unlikely that seawater will inundate the Rancheria well system, but we do not know for certain.

Mitigation and Adaptation Actions:

- Monitor groundwater levels monthly, and monitor closely during droughts (Public Works).
- Monitor groundwater for chloride levels once per year. 250mg/L chloride is the EPA limit for safe potable drinking water (Public Works, ENR).
- Maintain and expand wetlands and riparian areas to increase groundwater recharge and carbon sequestration potential (ENR – Water Quality).
- Increase permeable surfaces on the Rancheria to increase water infiltration (Public Works, ENR).

- Increase water storage potential. Install rainwater catchment systems in residential and agricultural areas (ENR, Housing, and Public Works).
- Provide educational resources and workshops on water saving techniques (ENR, Housing).
- Improve drinkability of well water and create trust with residents about water quality and drinkability (Public Works).
- Develop a Drought Contingency Plan

Wastewater Treatment

A new wastewater treatment plant (WWTP) replaced two older and undersized wastewater facilities in 2016. It is located on the western boundary of the Rancheria, adjacent to the HWY 101 and has the capacity to treat 125,000 gallons of sewage per day. The new WWTP collects and treats water from approximately 2,000 users on the Rancheria including residents of Tish Non Village, temporary guests at the Bear River Casino and Hotel, and staff.[5]

Treated wastewater effluent was previously permitted through the National Pollutant Discharge Elimination System (NPDES) to be discharged to the wetlands which eventually flow to the lower Eel River, however the permit was terminated January 2018, and treated wastewater no longer leaves the Rancheria. Instead it is pumped to the Echo Lane parcel and discharged onto a leach field.

The WWTP is managed by Public works and consists of a drum screen and wash press, two first stage aeration tanks, two second stage aeration tanks, two clarifiers, two digesters, a disc filter, and ultra-violet (UV) disinfection.[5]

Climate Change Risks to Wastewater:

- Potential for increased storm severity may cause runoff from leach field.
- Oversaturation of leach field during heavy or prolonged rain events may cause land slumping or landslides.
- Loss of power or damage to WWTP from a possible increase in storm severity.

Mitigation and Adaptation Actions:

- Conduct a soil analysis of the leach field to determine suitability for discharge rates (Public Works).
- Determine a stable maximum saturation level for leach field soils (Public Works).
- Define a maximum daily discharge rate to the leach field based on soil zone (see North Coast Basin Plan Soil Zones), maximum saturation level, and soil percolation rates (Public Works).
- Monitor leach field saturation levels monthly and during storm events (Public Works).
- Identify alternatives for wastewater effluent when leach fields are unable to accept scheduled discharge i.e. recycled water use for irrigation of landscaping, vegetable garden, flushing toilets, operating cooling systems, etc. (Public Works).
- Build capacity to operate a recycled water program including ability to plan for and maintain compliance with CA Title 22 laws (see Article 3, §60304, §60306, §60307) (Public Works).

- Build capacity to plan and implement a bio-solids program to compost waste filtered out during wastewater treatment.

Built Environment

The built environment is a complicated ecosystem that is entirely human constructed. This environment is complicated in that the creation and maintenance of it is a root cause for climate change. Nevertheless, built infrastructure supports human functions and is vulnerable to the climate change impacts it is partly responsible for causing. This section is separated into two parts and will first provide an overview of the infrastructure present on the Rancheria as well as energy use, emissions, pollution and waste generated by Rancheria infrastructure. Recommendations are outlined to reduce climate change inducing impacts caused by Rancheria infrastructure. The second part outlines infrastructure vulnerabilities to climate change before making recommendations to withstand climate change impacts.

INFRASTRUCTURE

The built environment consists of the following infrastructure: Bear River Casino and Hotel, Tish Non Community Center (TNCC), Bear River Recreation Center, offices (HR, accounting, gaming, environmental), Pump and Play gas station, Tobacco Traders, Tish Non Village, two wastewater treatment plants (one is decommissioned), two drinking water wells, roads and parking lots. Future development on the Rancheria include the construction of a family fun center, multi-story housing complex, health center, swimming pool, and baseball field. Not including roads, the built environment consists of 33.45 acres (19 percent) of the trust lands, and its footprint is expected to increase with future development (figure 9). Roads cover approximately 2.3 miles of the Rancheria.

Utility lines include: water lines, sewage lines and storm drains. Joint utility lines include gas and electric services, all of which are located under the roadways of the Rancheria. Storm drain inlets are located on curbs, water service locations are on the sidewalk and roadways, while sewer service locations are on the roadways.[36] Locations of these utilities have not been fully inventoried and mapped in GIS, however building plans and blueprints from contractors do illustrate the location of some of these utilities.

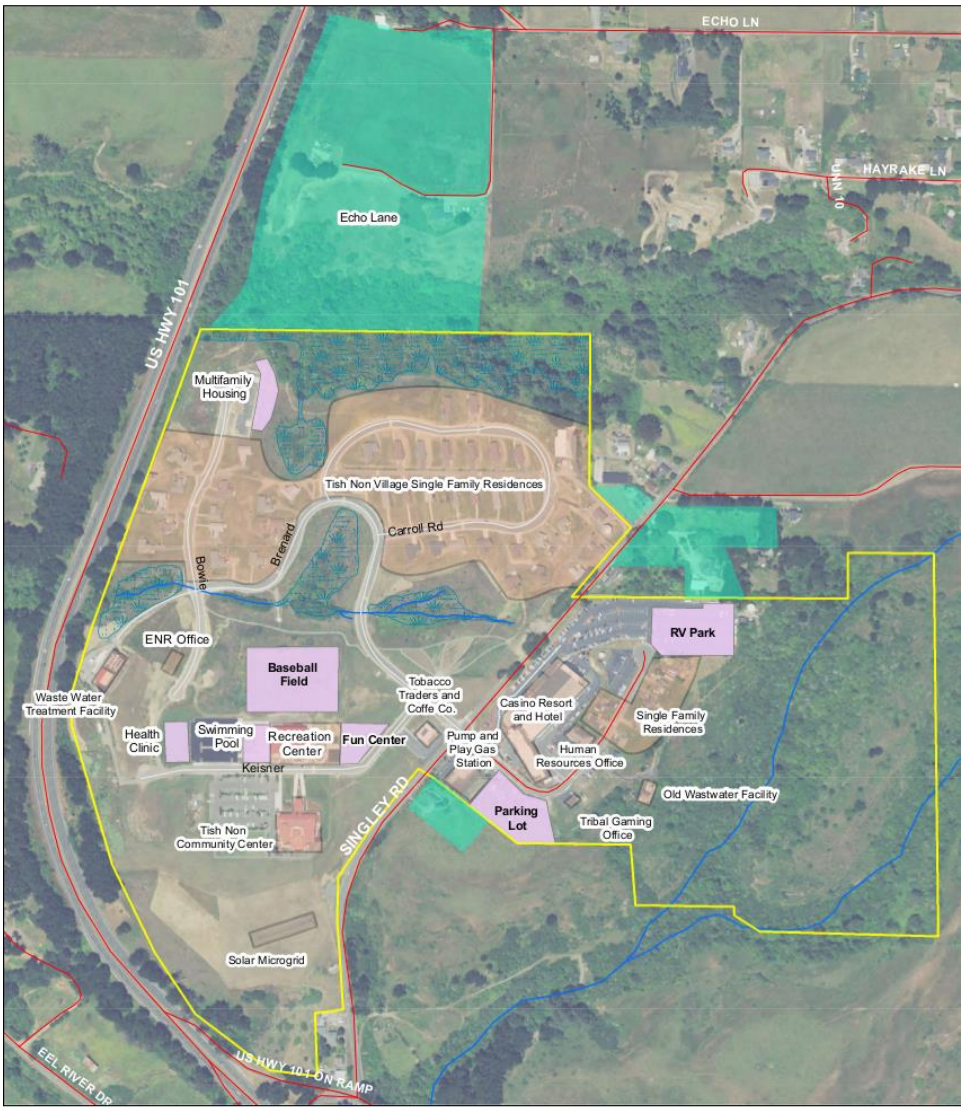

Figure 9. Current and future sites for infrastructure on the Rancheria. Much of the new infrastructure is slated for development in summer 2018.

Energy Use

Current energy sources for Rancheria operations include electricity and natural gas purchased from Redwood Coast Energy Authority (RCEA) and delivered via PGE infrastructure. Renewable energy is generated on-site via a 100 kW solar array and 30 kW mini wind turbines. Onsite energy generation provides energy to the TNCC, but is supplemented with grid supplied energy. Nine homes in Tish Non Village have solar panel roof tops, but it is unknown what percentage covers their total energy use.

Energy use for most buildings on the Rancheria was audited, analyzed and reported as part of the Renewable Energy Sovereignty Master Plan (RESMP) developed in 2016 by Redwood Energy and Freshwater

Environmental Services. The report also lays out options for a conversion to 100% renewable energy and provides an energy sovereignty building code for renovations and new construction.[58]

The audit identified the Casino as the major energy consumer on the Rancheria consuming 84% of the energy purchased from RCEA (figure 10). Annually, the Casino consumes over 10 million kWh of electricity (figure 11), the equivalent to 824 homes' electrical use in a year. The casino consumes over 44,400 therms of natural gas per year, the equivalent use of 25 homes in a year (RESMP, 2016, EPA GHG equivalencies calculator). Energy costs for the casino alone average to $40,000 per month.[58]

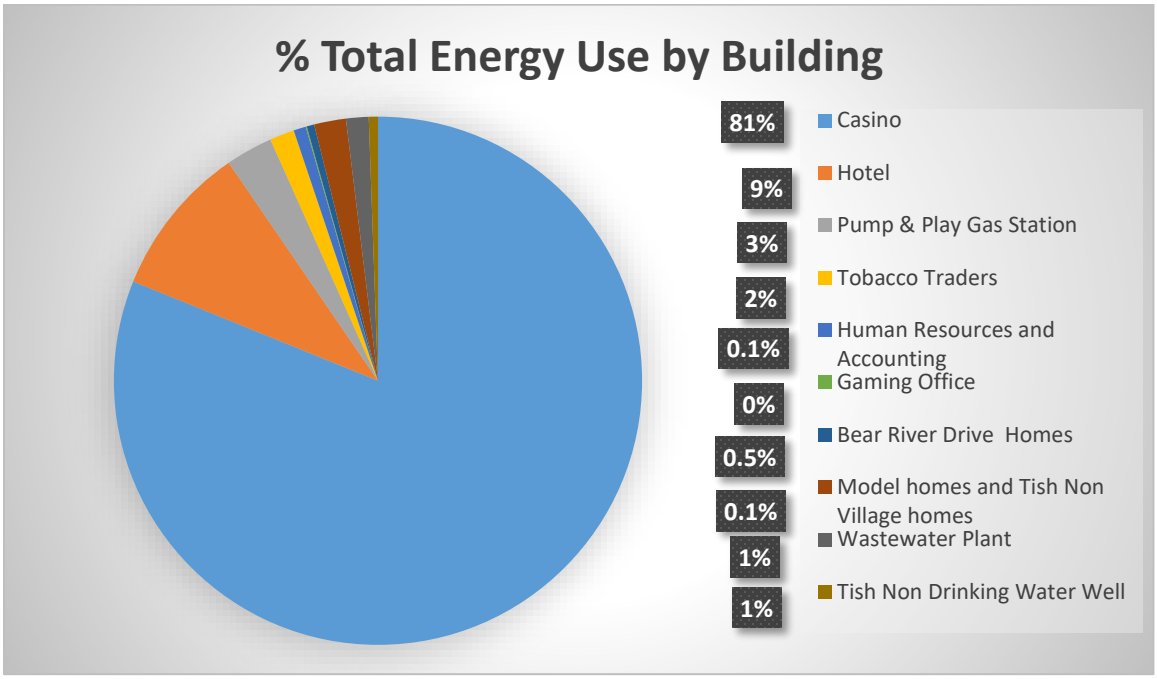

Figure 10. Shows the percentage of total energy use by building on the Rancheria with the casino being the primary energy user. The recreation center is omitted due to it not being constructed, and the TNCC was not audited due to its use of renewable energy although it is important to note that the TNCC does use energy both from renewable and non-renewable sources. Data was obtained from the RESMP.

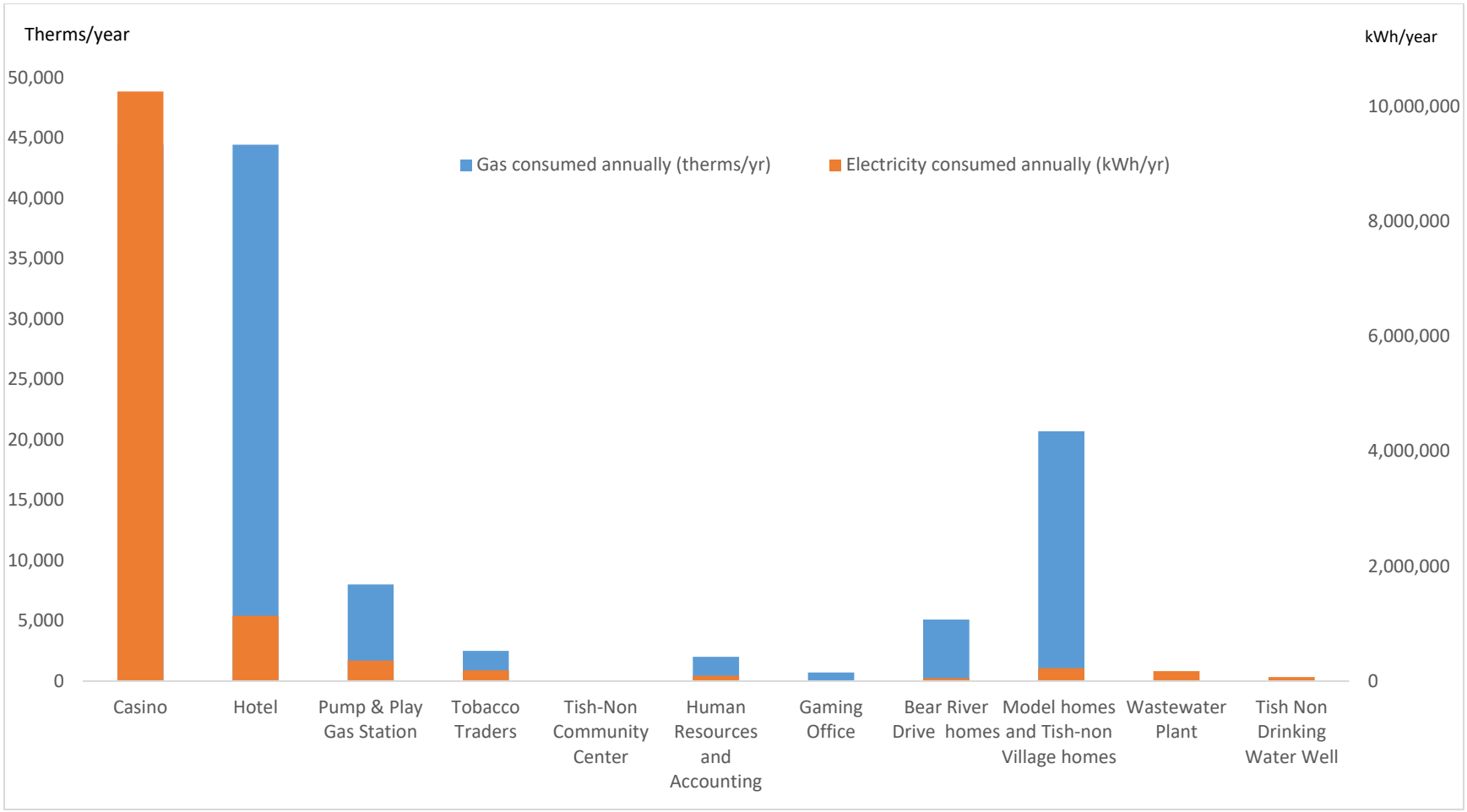

Figure 11. Annual energy consumption per building on the Rancheria. Gas, shown in blue, is measured in therms and is measured against the left axis while electricity, shown in orange, is measured in kWh and is measured against the right axis. The Recreation Center is omitted due to it not being constructed when the energy audit took place, and the TNCC was not audited due to its use of renewable energy although it is important to note that the TNCC does use energy both from renewable and non-renewable sources. Data was obtained from the RESMP.

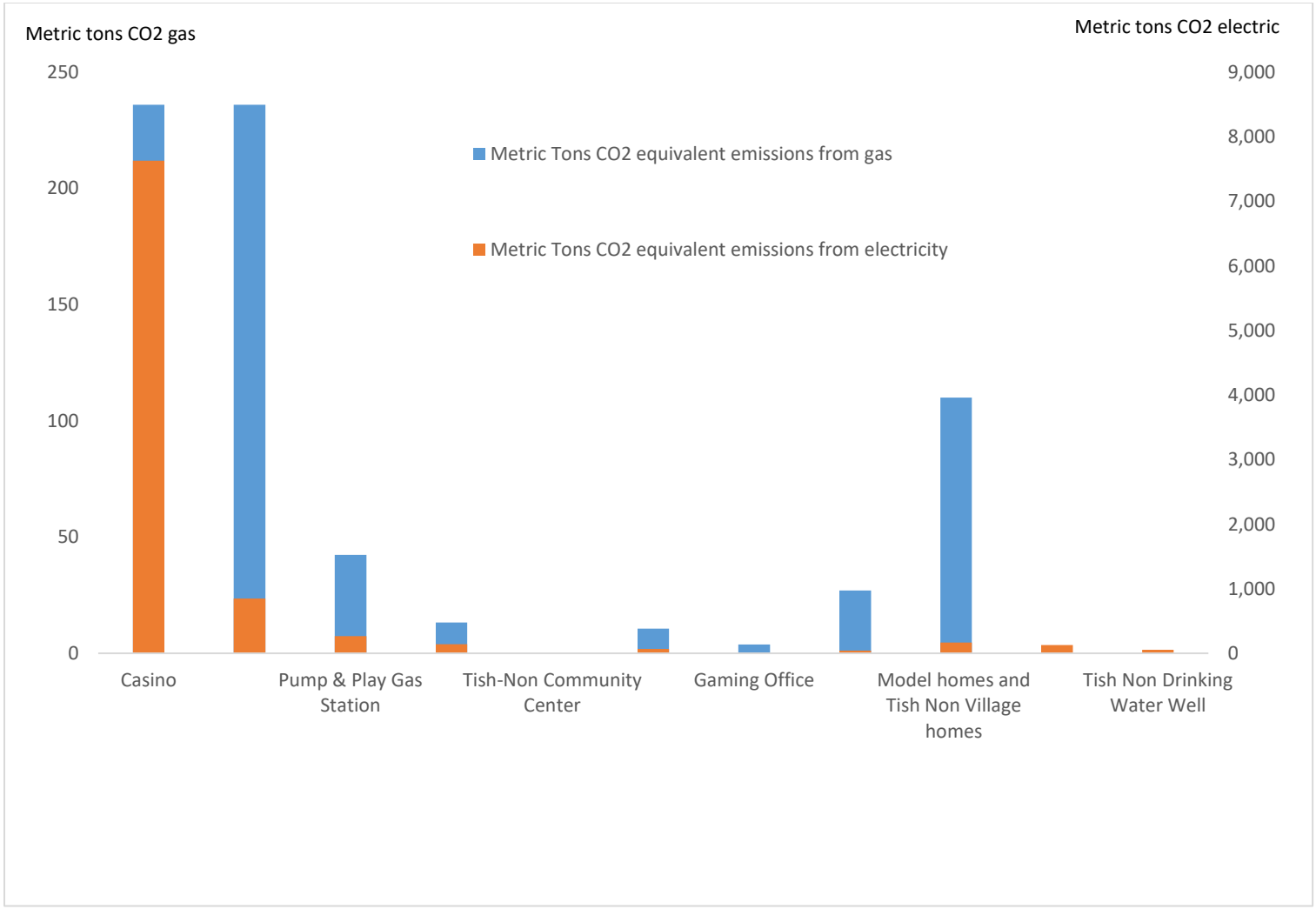

Figure 12. Metric tons of C02 emissions from both gas and electricity produced annually by building operations on the Rancheria. Gas equivalencies, shown in blue, are quantified on the left axis while electricity equivalencies, shown in orange, are quantified by the right axis. The Recreation Center is omitted due to it not being constructed when the energy audit took place.

The hotel is a large user of gas consuming over 44,000 therms annually, followed by homes and the pump and play gas station. The Tish Non Community Center was not audited due to its connection to the solar and wind array, however, on a cloudy day upwards of 90% of the community center is powered from the electrical grid and gas is used to power the boilers and appliances in the commercial kitchen.[63]

Buildings and Emissions

Energy consumption, from energy generated from fossil fuels, corresponds to greenhouse gas emissions which cause climate change. 80-90% of energy consumption takes place during the operational phase of the building's life, while 10-20% of energy is used to extract and process raw materials, construct and demolish a building.[42] Annually, 9,864 metric tons of CO_2 equivalents (CO_2e) enter the atmosphere due to building operations on the Rancheria (figure 12). That's as much CO_2 as 2,108 passenger vehicles emit in one year. The Casino's energy use is equivalent to emitting close to 8,000 metric tons of CO_2e from electricity and over 200 metric tons of CO_2e from gas, the equivalent of emissions from 1,684 cars on the road per year.[23, 58]

The Rancheria has great potential to reduce its energy use and emissions as outlined in the RESMP and is currently looking to convert to 100% renewable energy to gain energy sovereignty and reduce GHG emissions generated by fossil fuels. Buildings represent a critical piece of a low carbon future if modern efficiency and sustainable designs are implemented. By changing building standards and practices, the Rancheria can break from the dirty energy system and begin to thwart the impacts of climate change and impacts of fossil fuels on human health. Implementing the recommendations provided in the RESMP sections 2.3, 3.4, 4.4, 5.3, 6.3, 7.3, 8.3, 11.2 can provide a good first step to improving energy efficiency and decreasing GHG production by current infrastructure.[58]

Mitigation and Adaptation Actions:

- Relevant departments include Bear River Casino and Hotel, maintenance, and housing.
- Retrofit buildings and homes with energy efficient electric appliances and LED lightbulbs (relevant departments).
- Convert indoor lights to LEDs and outdoor lights to fully shielded LEDs for dark sky compatibility (Rancheria wide, housing, maintenance).
- Conduct weatherization and energy efficiency renovation on inefficient homes as outlined in the RESMP (relevant departments).
- Install renewable energy infrastructure to obtain 100% renewable energy on the Rancheria (wind, solar, battery storage) (Rancheria wide, housing).
- Zone Rancheria for solar and wind and look to purchase and/or acquire land for solar and wind development (ENR, Procurement).
- Install solar arrays above all parking lots and select walk ways (Relevant departments).
- Install solar arrays on all residential rooftops (housing).
- Follow guidelines in the Energy Sovereignty Building Code for Existing Construction and New Construction. This document is found within the RESMP (Relevant departments).

Pollution from Infrastructure

Buildings and construction contribute to nonpoint source pollution (NPS) that can pollute waterways, soil, air, and impact wildlife and human health. Runoff from roads, parking lots, residential areas and the Bear River Casino and Hotel drains into streams and wetlands which are impacted and affected by the following NPS pollutants: fecal coliforms, fuels, metals, suspended solids, sediment, pesticides, fertilizers, paints, solvents and thinners.[5] Pollutants to soil and water can be mitigated by pollution prevention planning and the installation of LID and use of BMPs. Currently BRBRR practices pollution prevention measures by the use and maintenance of stormwater detention basins and underground detention/infiltration chambers. BRBRR currently utilizes two above ground detention basins and two below ground detention/infiltration chambers to capture and detain stormwater generated on the BRBRR property. The first above ground detention basin is located centrally in Tish Non Village and has enough capacity to capture and detain stormwater runoff generated on the existing Tish Non Village housing development from a 100-year storm event. Stormwater is detained in this basin and released at a 2-year pre-development flow rate through an outlet control structure. The second above ground detention basin is located north of the multi-family apartment complex development, and like the other aboveground detention basin, capture and detains stormwater generated on the apartment complex site and releases it at a 2-years pre-development flow rate. The Pump and Play gas station utilizes an underground stormwater chamber which captures stormwater and release it at 2-years pre-development flow rate. The chamber is located beneath the parking lot and is also fitted with an oil/water separator directly upstream. The final detention system is a combination below ground detention/infiltration system located in the casino/hotel parking lot. This system captures stormwater and utilizes 36" perforated pipe to allow for stormwater infiltration as well as 36" soil pipe for stormwater detention and storage. The end of this system is also outfitted with an outlet control structure to limit the flow to a 2-years pre-development flow rate. The parking lots for the Tish Non Community Center and Recreation Center also were constructed to drain toward a series of bio-swales that collect and filter water prior to it flowing into the storm brain and through the wetland complex. LID and BMPs are outlined in many plans already developed for the BRBRR and are found within the Energy Sovereignty Building Code, Sub-watershed Based Plan sections 3.3.2, 4, table 2, and Nonpoint Source (NPS) Management Plan table 3. The continued use and application of the recommended practices is advised.

Mitigation and Adaptation Actions:

- Incorporate LID into new construction plans. LID includes the use of bio swales, storm-water detention ponds, vegetation buffers, permeable pavement, and planting native vegetation.
- Incorporate BMPs during construction including pollution, sediment and erosion control.
- Contain, reduce or eliminate the use of toxic chemicals on the Rancheria.
- Zone the Rancheria in order to keep construction and growth to safe and appropriate locations.

Waste

BRBRR conducted a small waste characterization survey January 2018 and found many recyclables and compostables in the trash bins. Each building on the Rancheria had at least one bag pulled from its dumpster,

and four household garbage bins were included in the sort. The percentage of the waste sorted in relation to overall waste produced could not be determined, but it is known that the sort only captured a small percentage of overall waste. Annual waste generation data was estimated from the weekly totals and input into the EPA's Waste Reduction Model (WARM) to predict the annual greenhouse gases (GHG) created from waste produced on the Rancheria. The model concluded that BRBRR GHG emissions are insignificant, however, it is important to note that emissions are generated along the entire life cycle of a product, from resource extraction, manufacturing, distribution, purchase, to disposal, which WARM does not account for.

The Rancheria can improve and reduce its waste sent to the landfill by reducing single use items, recycling and composting. 57% of waste in the waste characterization survey consisted of mixed recycling materials while 7% consisted of compostable materials. The remaining 36% consisted of materials deemed for the landfill. By purchasing a recycling service and providing recycling dumpsters and bins to Rancheria buildings the Rancheria could increase its recycling rate. By implementing a Rancheria wide recycling and composting program the Rancheria could keep recyclables and compostables out of the landfill. The composted materials can be used on site to be used in the food gardens and native plant gardens. .

Mitigation and Adaptation Actions:

- Purchase a recycling service from Recology or other local service provider (Public Works/Maintenance).
- Reinstate the compost program to collect compostables from the TNCC and Casino kitchens, Tobacco Traders and other interested and willing participants (ENR).
- Zone for a small scale compost facility (Public Works, ENR).
- Purchase multiple small scale composters that can process a minimum of 500 pounds per week. See Green Mountain Technologies Earth Tub Composter (Public Works, ENR).
- Provide waste reduction education to residents and staff on the Rancheria (ENR).
- Incorporate waste reduction signage near the waste bins in the casino and hotel to increase recycling practices by visitors (ENR, Casino and Hotel).
- If possible, integrate the composting program with a future bio-solids program implemented by Public Works (Public Works, ENR).

Infrastructure Vulnerabilities to Climate Change

Infrastructure is also at risk for increased damage from sea level rise, flooding and more intense storms. Hwy 101 is the primary route connecting the Rancheria with other communities particularly for work, school, shopping and travel. Hwy 101 is subject to road closures due to landslides and floods with today's current climate conditions. Sea-level rise will pose an increased risk to this important transportation corridor as Hwy 101 dissects coastal marshlands, and skirts steep coastal bluffs and low lying land adjacent to the Pacific Ocean and Humboldt Bay.

Transmission lines are vulnerable with increased storm severity and sea level rise. BRBRR is reliant on PGE infrastructure for electricity and gas that could be impacted by many climate and non-climate change related

stressors. Severe storms and sea-level rise could impact natural gas lines and transmissions lines, due to wind damage, flood/seawater inundation, and landslides. On the Rancheria, high winds, landslides and flooding pose the greatest concern for infrastructure.

Mitigation and Adaptation Actions:

- Complete the transition to 100% renewable energy to secure energy sovereignty (Rancheria wide).
- Construct buildings to withstand high winds and only build on stable ground (Building maintenance).
- Develop a disaster preparedness plan that outlines how to prepare for and what to do if the Rancheria is cut off from outside resources short and long term (Rancheria wide).
- Map utilities including, fire hydrants, water, electric, and storm and sewer lines in GIS in order to prevent and fix damage to utilities quickly (ENR-GIS).
- Monitor infrastructure regularly and perform needed maintenance (Building maintenance).

Social Environment

The social environment is concerned with people and examines how humans may be impacted by climate change. This section outlines impacts to health, socioeconomics, food security and native culture.

HEALTH

As outlined in the 2017 Climate Change and Health Profile Report for Humboldt County, climate change can have various impacts on human health and can affect people via direct exposure, indirect exposure, and socioeconomic disruption.[41]

Health Impacts from Weather Extremes

Extreme weather events can cause flooding, landslides and damage to infrastructure which can cause fatal and nonfatal injuries. Homes, schools, and businesses can be destroyed and temporarily or permanently displaced. These events can cause individuals and families to experience mental health problems such as post-traumatic stress disorder, anxiety and depression.[41] Flooding can cause contamination of drinking water sources, cause hazardous materials spills, and reduce indoor air quality from mold growth.[35, 41]

Health Impacts from Increased Temperature

Heat Exposure and Air Quality

An increase in temperature will impact human health by increasing heat related illness such as heat rash, heat cramps, heat exhaustion, and heat stroke. Extreme heat is characterized by a prolonged period with temperatures that hover at or above 10 degrees the average high for that season and region. Extreme heat for the Rancheria in the summer would feel like 73 °F for a week or more.

Increased temperatures also intensify wildfires, dust and chemical reactions that form smog, ground level ozone, and aerosols from pollution.[41] These pollutants are linked to respiratory irritation, headaches, shortness of breath, lung damage, respiratory and cardiovascular disease, asthma and cancer.[2]

Wildfire and Drought

Increased temperatures will reduce moisture content in plants and the soil leading to more severe wildfires and drought. Wildfires pose direct and indirect risks to human health. Fires reduce air quality, destroy communities, cause human fatalities, landslides, mudslides and increase surface runoff that diminishes water quality. The 2017 Thomas Fire that hit Santa Barbara and Ventura Counties is a recent example of this extreme devastation. Increased drought decreases the availability and quality of water which increases vulnerabilities to adequate sanitation, food security, and the ability to fight fire.

Vector-borne Disease

Increased temperature has the ability to alter the range, biogeography, growth and reproduction of vector-born diseases, which are illnesses that can be transmitted by insect vectors including: mosquitoes, ticks and fleas. These vectors can carry infectious pathogens such as viruses, bacteria and protozoa.[7] Lyme disease is a disease of concern in Humboldt County, which is the 4th highest ranking county in California for cases of Lyme disease. Between 2003 and 2015, there were 103 confirmed cases of Lyme disease, however there could be over 1,000 cases due to data gaps from the Center for Disease Control.[71] The bacteria that cause Lyme disease is carried by deer ticks, and their life cycle is influenced by temperature. Increased temperatures will increase the suitable range for ticks, and shorter winters can extend the period when ticks are most active during the year, thus increasing the risk of exposure to Lyme disease.[22]

Mitigation and Adaptation Actions:

- Improve emergency planning and preparedness (Rancheria Wide).
- Update disaster preparedness plans to inform the Rancheria and tribal residents of how to prepare and deal with disaster (Rancheria wide).
- Educate residents on climate change health risks and ways to prevent illness (ENR).
- Monitor infrastructure regularly for damage and repair any detected damage quickly (Building maintenance, Public Works, Casino and Hotel).

SOCIOECONOMICS

Damage caused by sea-level rise, storms, and flooding can destroy infrastructure that enables human access to health care and basic needs for survival. Flooding can inhibit one from traveling to work and accessing resources for survival. Damaged infrastructure can lead to death, illness, loss of income, housing and food insecurity.[41] The Tish Non Village is considered low income housing where many, but not all, tribal members depend on tribal benefits to meet basic needs. In the case of a disaster situation many people may not have the resources, or means to access resources, to aid their safety and survival during a disaster.

Mitigation and Adaptation Actions:

- Develop a disaster response plan (Rancheria wide).
- Create and distribute disaster educational information for tribal members (Rancheria).

- Maintain enough supplies (food, water, medical) to maintain the basic needs of tribal members for three weeks in the event that the Rancheria is cut off from incoming or outgoing resources due to a disaster (Rancheria).

FOOD SECURITY

Food Security is defined by having continuous and reliable access to a sufficient quantity of healthy and culturally appropriate food.[35] The nearest town to shop for healthy food is 4 miles south in Fortuna, or 15 miles north in Eureka. BRBRR does not have a grocery store and has limited access to reliable healthy food. At BRBRR, food can be acquired at the Pump and Play gas station, Tobacco Traders coffee shop, and restaurants at the Bear River Casino and Hotel, yet these stores do not offer affordable or healthy food options (consisting primarily of processed meats and refined sugar snacks / lacking any nutritional value) as the basis for sustenance for tribal members. The Humboldt Transit Authority does operate the Tish Non Village bus route that connects the Rancheria to Fortuna to the South and College of the Redwoods to the North. To continue north to Eureka, bus patrons must transfer to another bus route. Having the transit authority is an important factor to assist tribal members with transportation for grocery shopping, however, use of this resource may be affected by schedule, and economic constraints.

Food deserts are prevalent on many Native American lands where one in four Native Americans faces food insecurity.[53] Food insecurity is linked to a number of health concerns including malnutrition, underweight, obesity, type 2 diabetes and heart disease.[31] A 2015 food and health survey conducted by the BRBRR found that 29% of respondents have been diagnosed with diabetes, 24% with obesity, and 48% with high blood pressure.[6] These issues have prompted the BRBRR to improve accessibility to nutritious and culturally appropriate foods on the Rancheria.

The TNCC offers programs to provide meals for tribal elders and youth in need. The Tribal Historic Preservation Office (THPO) has helped some tribal members to plant fruit trees and perennial food shrubs in their yards to improve accessibility to nutritious food. The THPO maintains a one acre traditional foods garden and a half acre vegetable garden while ENR maintains approximately 45 square feet of raised beds for a youth community garden. Each garden provides fresh produce to tribal members. Produce grown on the Rancheria is available seasonally typically from June to October and production scale can vary year to year. This leads to instability in food security on the Rancheria as accessibility depends on production levels and seasonality of the gardens. As the THPO works to increase productivity, future plans for fresh produce include: utilization of the TNCC kitchen for meals provided by the elder and youth programs, and tribal member pick-up for personal use. Though food insecurity is already problematic for BRBRR, climate change threatens to exacerbate the situation.

Climate Change Risks to Food Security

- Decreased access to, and distribution of, food due to destruction, inundation or blockage of transportation networks (e.g. highways, bridges).
- Increased food prices across the United States.

- Increased temperatures could exacerbate precipitation events such as droughts and flooding thus affecting water availability and crop yields.
- Pests, diseases and weeds can adapt faster to warmer temperatures thus threatening yields/competing with food crops (more money is spent each year to both manage/ breed/ research how to outcompete the proliferation of pest/diseases/weeds.[82]
- Changes to access to water for agriculture across California and the United States.
- Plants increased exposure to CO_2 can reduce the nutritional value of crops.[82]

Mitigation and Adaptation Actions:

- Increase food security by planting food orchards (ENR, THPO, and Housing).
- Maintain and increase production in the traditional food and vegetable gardens (THPO, ENR).
- Increase traditional edible landscaping on the Rancheria (THPO, ENR, and Maintenance).
- Continue to provide educational workshops about gardening, food preservation and meal preparation including traditional native foods (THPO).
- Capture and store rainwater for agricultural purposes (THPO, Public Works, ENR).
- Incorporate agro-ecological farm practices (e.g. building soil organic matter, conservation tillage, mulching, cover cropping, crop rotation, seed saving, etc.) (THPO, ENR).

CULTURE

The Bear River Band of the Rohnerville Rancheria represents Bear River, Eel River, Mattole and Wiyot people, whom, pre-contact, had practices that were embedded deeply with the land and were passed on from generation to generation. Much of this knowledge was lost when the tribes were brutally massacred by American settlers.[54, 63] The genocide and removal of Native Americans from their land and simultaneous settling of their ancestral lands led to the loss of a people and culture.

Bear River, Eel River, Mattole and Wiyot people were hunter gatherers who relied on the land, rivers and ocean for their survival. They managed the land in a way to promote the growth of plants and animals used in everyday life not only for food, but also for shelter, basketry, jewelry, clothing, etc. Tribal members recall their ancestors gathering salt, shellfish, seaweed, fishes from the ocean surf, salmon and lamprey from the rivers, and hazelnut, acorns and huckleberries from the forest. Controlled burning was used to protect acorns from pathogens, create favorable conditions for hunting grounds and promote the growth of plants used in everyday life.[63]

Today, the tribal community continues to hunt and gather as their ancestors did, however, many barriers hinder this cultural resurgence. Access to traditional plants and animals has been severely altered due to land privatization and loss of tribal water and fishing rights. Habitat loss, land use conversion, declining species populations, hunting conservation laws, and the proliferation of invasive species all hinder traditional practices. In order to revitalize these traditional practices the tribe needs access and/or ownership of land within their ancestral territory.

Bear River, Eel River, Mattole and Wiyot work to protect and save what remains significant to them and their tribal identity. The Tribal Historic Preservation Office (THPO) protects cultural resources in the ancestral territories of Bear River, Eel River, Mattole and Wiyot people. These resources include but are not limited to: burial sites, village sites, artifacts, traditional use plants and animals and tribal cultural resources. Climate change will impact all of these resources in a multitude of ways.

Climate Risks to Cultural Resources:

- Loss or damage to coastal village, burial sites and other coastal archaeological sites and artifacts due to sea level rise inundation and coastal bluff retreat due to increase storm surge.
- Increase archaeological site disturbance from proactive infrastructure relocation (e.g. power lines, water pipes, etc.) due to sea level rise.
- Continued loss of access to or availability of traditional use plants and animals due to species range shifts and sea level rise.
- Loss or damage to archaeological sites, artifacts and traditional use plants and animals due to increased wildfire and suppression efforts.
- Changes in the presence and distribution of plants and animals within ancestral territory due to species range shifts.
- Continued decline or extinction of salmon species.
- Continued decline of shellfish species.
- Reduced food security.

Mitigation and Adaptation Actions:

- Continue implementing the cultural resource protections implemented by the THPO.
- Determine best course of action of archaeological sites on a case by case basis (THPO).
- Expand plantings of native traditional use plants on site at the Rancheria (THPO).
- Provide support for fish and wildlife restoration programs (THPO, ENR)
- Purchase and/or acquire land for traditional use (THPO, Rancheria admin)
- Implement traditional burning practices (THPO, ENR)
- Promote the growth of traditional plants and animals (THPO, ENR).
- Increase traditional knowledge and practices by facilitating educational events and workshops by and for tribal members (THPO).

Traditional Ecological Knowledge

Traditional Ecological Knowledge (TEK) consists a cumulative body of knowledge, practice, belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment. Many tribal members live their lives and make decisions using the TEK that was passed down to them. For example TEK can inform when one can start fishing for lamprey in the river based on the observations and lessons learned from

ancestors over the generations. If there are willing tribal members who can share their knowledge, TEK can and should be used to inform climate change related management decisions.

ECONOMY

National Economic Context

Extreme weather events such as hurricanes, floods and wildfires are all examples of natural phenomena exacerbated by climate change, these disasters then create economic strain on individuals and governments. The United States is projected lose 3-6 percentage points off of its gross domestic product by the end of the century due to the impacts from climate change.[32] A 2017 report put out by the Government Accountability Office found that economic effects from climate change would be significant and unevenly distributed across sectors and regions. People's location on the landscape will determine to what extent climate change impacts will hurt communities and individuals economically.[27]

Extreme weather, agriculture and human health costs due to burning fossil fuels currently pose a great burden on the American economy. Over the last decade, $350 billion was spent on disaster relief for communities struck with climate related extreme weather events.[27] 2017 Hurricanes Harvey, Irma and Maria are estimated to cost the U.S. $300 billon alone.[40] Over the last five years, drought related agriculture losses are upwards of $56 billion. The medical industry serving patients with illnesses caused by pollution and the burning of fossil fuels poses a great burden on health costs and was estimated at $188 billion in 2011. The projected losses of coastal properties due to sea level rise range from $4 billion to $6 billion per year in 2020-2039 and could rise to $51 billion to $74 billion by the end of the century.[27] It is well articulated that climate change impacts are currently costing the U.S. government large sums of money and that cost will only grow larger.

The harmful impacts of a fossil fuel based economy are clear and shifting to a renewable energy economy provides an opportunity to grow in a cleaner way. Research suggests that doubling the renewable energy infrastructure could create 500,000 new jobs, and in 2016 the solar energy sector grew by 25%.[75] Conversion to renewables under the Obama era Clean Power Plan could cut air pollution health care costs by $1.1 trillion, however states no longer have to comply with the Clean Power Plan under the Trump administration.[32] California is taking a strong step toward the renewable energy and low emission economy. The Global Warming Solutions Act of 2006 requires California to reduce its GHG emissions to 1990 levels by 2020, approximately a 15% reduction. Through many actions such as carbon taxes, caps to carbon pollution, electric vehicle infrastructure development, and investments in renewable energy, this act is the driving force for innovating the low carbon economy in California.

Rancheria Economy

BRBRR Rancheria's economy is driven primarily by revenue generated by Bear River Casino and Hotel as well as grants awarded to eligible departments from various funding sources such as the Bureau of Indian Affairs (BIA) and the Environmental Protection Agency (EPA). Approximately 395 jobs are created by casino, hotel and Rancheria operations, and approximately 106 of those jobs are filled by tribal members.[63]

The Tish Non Village is a low income housing district, with a 52-56% unemployment rate amongst residents. Tribal members receive monetary support from BRBRR and the casino. A per capita monetary assistance program supports tribal members every three months. In addition to the per capita stipends, there are numerous tribal programs to assist tribal members, such as transportation to the United Indian Health Services (UIHS) Potowat Health Clinic in Arcata, low income energy assistance, monetary clothing allowances, food assistance and health and wellness emergency money. There is also a food program available to elders and youth in need. These programs help to support residents, but many residents continue to remain unemployed and low income.

The BRBRR provides a day labor program for tribal members so individuals can work up to four hours per day, three days per week. This program is important for tribal members, however, retaining them as employees is challenging as some individuals struggle with drug and alcohol abuse and/or are disinterested in the work.[63] The addition of a health center on site with a substance abuse treatment center by 2020, as well as job training programs, could increase the overall well-being and employment rates of tribal members.

Climate Change Economic risks include:

- Closure of roads from wildfires, floods, and landslides can hinder the transport of goods and services.
- Damage to infrastructure and telecommunications disrupts the movement of information, the delivery of power and basic services to communities.
- Increased cost of goods and services changes the accessibility of those goods and services to low income communities.
- Increased spending on climate change related health issues (injury for extreme weather, illness from fossil fuel based pollution).
- Increased spending on extreme weather disaster relief.
- Increased spending on drought assistance and agriculture losses.
- Increased energy costs.
- Increased spending on infrastructure relocation, upgrades, and retrofits caused by sea level rise, and extreme weather.
- Changes in Federal budget allocations.

Mitigation and Adaptation Actions:

- Create more jobs on the Rancheria e.g. installation and maintenance of solar panels, operation of a bio-solids compost facility, restoration jobs, and positions in new buildings (family fun center). (Rancheria, Casino and Hotel, Human Resources).
- Continue to provide job training for tribal members (Human Resources, Social Services).
- Increase access to substance abuse treatment (Social Services).
- Buffer from disasters by increasing sustainability and self-sufficiency on the Rancheria, e.g. increased food production and food storage, increase water storage, provide on-site health care, renewable energy and back up energy generation infrastructure (Rancheria wide).

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APPENDIX A

Vulnerability Assessment					
Area of Concern	Exposure	Sensitivity	Adaptive Capacity	Vulnerability	Vulnerability rating
Wetlands	3	4	5	1	Low
Streams	3	5	4.5	3	Moderate
Drinking water (wells, groundwater)	3	3	2	2.5	Low
Waste water treatment	4	5	2	8	High
Flood/storm water runoff	4	3	5	1	Low
Riparian forests	3	2	3	0	Low
Grasslands	3	4	2	4	Moderate
Air/atmosphere	4	4	2	6	Moderate
Land	3	4	3	3	Low
Fish	3	4	2	4	Moderate
Ocean Resources	5	4	3	7	High
Food Security	3	5	4	3.5	Moderate
Health	3	3	3	1.5	Low
Culture/ Traditional Knowledge	4	4	3	5	Moderate
Buildings	3	3	3	1.5	Low
Development	2	4	4	0	Low
Economy	4	5	4	6	Moderate

Vulnerability is generated by using the following equation adopted from EcoAdapt methods. V=((E*0.5)*S)-AC. Ratings for exposure, sensitivity and adaptive capacity are generated based on information from the literature review, understanding of the landscape and the capacity for change by the Rancheria. Rankings are generally conservative.

APPENDIX B

Department Actions

BRBRR Administration							
	Land		Ecosystem	Infrastructure		Economic	Social
Actions	Use geotechnical, hydrological, and other reports for Rancheria planning	Adopt a 3:1 ordinance for tree cutting and planting	Remove and replace lawn with native plants or dry landscaping	Reduce GHG emissions	Retrofit buildings with energy efficient appliances and LED lightbulbs	Increase job opportunities on Rancheria	Improve drinkability of well water and create trust with residents
	Maintain 100 feet of defensible space around structures	Limit use of toxic chemicals	Reduce irrigation during droughts	Install and convert to renewable energy	Convert outdoor lighting to dark sky compatible LEDs	Build capacity for recycled water program	Increase access to substance abuse treatment
	Zone tribal trust land	Irrigate landscaping at night	Zone and purchase land for renewable energy infrastructure	Follow guidelines in the Energy Sovereignty building code	Purchase recycling service	Provide job training	Maintain basic need emergency supplies
	Convert invasive grasslands to native grasses, native plant gardens, forests, rain gardens or food orchards	Incorporate Low Impact Development and Best Management Practices to development	Prevent storm water runoff pollution	Weatherize homes	Install solar roofing on all parking lots		Improve emergency planning and preparedness and disaster planning
	Purchase land for cultural uses	Provide support for fish and wildlife restoration	Support agro-ecological farm practices in the gardens	Purchase land for renewable energy infrastructure			

Casino						
	Land		Infrastructure			Economic
Actions	Incorporate Low Impact Development and Best Management Practices to development	Irrigate landscaping at night	Install and convert to renewable energy	Reduce GHG emission	Incorporate waste reduction signage in Casino and Hotel	Increase job opportunities on Rancheria
	Reduce irrigation during droughts	Prevent storm water runoff pollution	Convert to Electric Vehicle Fleet	Install solar roofing on all parking lots	Monitor infrastructure for damage and needed repairs	
	Limit use of toxic chemicals	Use geotechnical, hydrological, and other reports for planning	Convert outdoor lighting to dark sky compatible LEDs	Retrofit buildings with energy efficient appliances and LED lightbulbs		

Environmental & Natural Resources								
	Land		Ecosystem			Social		Infrastructure
Actions	Zone tribal trust land	Limit use of toxic chemicals	Restore native plant communities	Maintain and expand riparian plant communities	Convert invasive grasslands to native grasses, native plant gardens, forests, rain gardens or food orchards	Educate tribal members about air quality	Maintain and increase vegetable and native plant garden productivity	Maintain 100 feet of defensible space around structures
	Use geotechnical, hydrological, and other reports for Rancheria planning	Zone and purchase land for renewable energy infrastructure	Restore native grasslands	Adopt buffers to reduce erosion and pollution to streams	Monitor air quality	Waste reduction education for residents	Provide water conservation education	Build capacity for recycled water program
	Incorporate Low Impact Development and Best Management Practices to development	Prevent storm water runoff pollution	Remove invasive species within streams, wetlands, and riparian zones	Monitor stream flow and water quality	Prevent habitat fragmentation	Educate residents on climate change health risks and prevention	Increase food security by planting native plants and vegetable gardens	Purchase composter and operate a small scale composting program
	Adopt a 3:1 ordinance for tree cutting and planting	Implement traditional burning practices	Plant trees for GHG mitigation and carbon sequestration benefits	Provide support for fish and wildlife restoration	Increase water storage potential (i.e. rainwater catchment)	Increase food security by planting native plants and vegetable gardens		Integrate composting with a future bio-solids program

Housing									
	Land			Ecosystem		Infrastructure			Social
Actions	Use geotechnical, hydrological, and other reports for Rancheria planning	Prevent storm water runoff pollution	Limit use of toxic chemicals	Convert invasive grasslands to native grasses, native plant gardens, forests, rain gardens or food orchards	Remove and replace lawn with native plants or dry landscaping	Install and convert to renewable energy	Follow guidelines in the Energy Sovereignty building code	Retrofit buildings with energy efficient appliances and LED lightbulbs	Increase food security by planting native plants and vegetable gardens
	Incorporate Low Impact Development and Best Management Practices to development	Increase water storage potential (i.e. rainwater catchment)	Irrigate landscaping at night	Plant trees for GHG mitigation and carbon sequestration benefits		Weatherize homes	Install solar arrays on residential rooftops	Convert outdoor lighting to dark sky compatible LEDs	Provide water conservation education

Human Resources		
	Socioeconomic	
Action	Provide job training	Increase job opportunities on Rancheria

Social Services				
	Social		Economic	
Action	Increase access to substance abuse treatment	Educate residents on climate change health risks and prevention	Provide job training	Increase job opportunities on Rancheria

Tribal Historic Preservation Office					
	Land		Ecosystem	Culture	Social
Actions	Use geotechnical, hydrological, and other reports for Rancheria planning	Incorporate Low Impact Development and Best Management Practices to development	Convert invasive grasslands to native grasses, native plant gardens, forests, rain gardens or food orchards	Continue cultural resource protections	Provide education and workshops about food
	Implement traditional burning practices	Remove and replace lawn with native plants or dry landscaping	Plant trees for GHG mitigation and carbon sequestration benefits	Provide support for fish and wildlife restoration	Maintain and increase vegetable and native plant garden productivity
			Restore native plant communities		Increase food security by planting native plants and vegetable gardens

Tish Non Maintenance					
	Land		Ecosystem	Infrastructure	
Actions	Incorporate Low Impact Development and Best Management Practices to development	Remove and replace lawn with native plants or dry landscaping	Plant trees for GHG mitigation and carbon sequestration benefits	Install and convert to renewable energy	Follow guidelines in the Energy Sovereignty building code
	Irrigate landscaping at night	Prevent storm water runoff pollution		Install solar roofing on all parking lots	Monitor infrastructure for damage and needed repairs
	Limit use of toxic chemicals	Reduce irrigation during droughts			

Public Works					
	Land	Social	Infrastructure		
Actions	Increase water storage potential (i.e. rainwater catchment)	Improve drinkability of well water and create trust with residents	Monitor drinking water well depth and chloride content	Build capacity for recycled water program	Monitor infrastructure for damage and needed repairs
	Develop a drought contingency plan		Identify alternatives for wastewater effluent	Purchase and operate a small scale composting program	Integrate composting with a future bio-solids program
			Determine suitable and maximum discharge rate for leach field	Monitor leach field saturation during storm events	

APPENDIX C

Climate Change Action Matrix

Action	Lead or Partnering Department										Affected Resources									
	BRBRR Administration	Casino	ENR	Housing	Human Resources	Procurement	Public Works	Social Services	THPO	Tish Non Maintenance	Land	Atmosphere	Wildlife	Water	Riparian Forests	Grasslands	Infrastructure	Social	Cultural	Economy
Zone tribal land	x		x								x	x	x	x	x	x	x	x	x	x
Use geotechnical, hydrological, and other reports for Rancheria planning	x	x	x	x			x		x		x		x	x	x	x	x	x	x	x
Incorporate Low Impact Development and Best Management Practices to development	x	x	x	x			x		x	x	x	x	x	x	x	x	x	x	x	x
Restore native plant communities			x						x		x	x	x	x	x	x		x	x	x
Monitor air quality			x									x						x		
Reduce GHG emissions	x	x									x	x	x	x	x	x	x	x	x	x
Convert to Electric Vehicle Fleet	x	x										x		x			x	x	x	x
Install and convert to renewable energy	x	x		x						x	x	x	x	x	x	x	x	x	x	x
Educate tribal members about air quality			x									x						x	x	
Maintain and expand riparian plant communities			x								x	x	x	x	x			x	x	x
Restore native grasslands			x								x	x	x	x		x		x	x	
Limit use of toxic chemicals	x	x	x	x						x	x	x	x	x	x	x	x	x	x	x
Plant trees for GHG mitigation and carbon sequestration benefits			x	x			x		x	x	x	x	x	x	x			x	x	x
Adopt a 3:1 ordinance for tree cutting and planting	x		x								x	x	x	x	x			x	x	x
Maintain 100 feet of defensible space around structures	x		x							x	x	x	x		x	x	x	x	x	x
Reduce irrigation during droughts	x	x								x	x			x			x			
Irrigate landscaping at night	x	x		x						x	x			x			x			
Remove and replace lawn with native plants or dry landscaping	x			x					x	x	x					x	x			

Action	Lead or Partnering Department										Affected Resources									
	BRBRR Administration	Casino	ENR	Housing	Human Resources	Procurement	Public Works	Social Services	THPO	Tish Non Maintenance	Land	Atmosphere	Wildlife	Water	Riparian Forests	Grasslands	Infrastructure	Social	Cultural	Economy
Convert invasive grasslands to native grasses, native plant gardens, forests, rain gardens or food orchards	x		x	x					x							x		x	x	x
Monitor drinking water well depth and chloride content							x							x			x	x		
Monitor stream flow and water quality			x											x						
Adopt buffers to reduce erosion and pollution to streams			x											x	x					
Remove invasive species within streams, wetlands, and riparian zones			x											x	x				x	
Prevent habitat fragmentation			x								x		x	x	x	x			x	
Prevent storm water runoff pollution	x	x	x	x			x			x	x			x						
Monitor drinking water well depth and chloride content							x							x			x	x		
Increase water storage potential (i.e. rainwater catchment)			x	x			x							x			x	x		x
Provide water conservation education			x	x										x				x		
Improve drinkability of well water and create trust with residents	x						x							x			x	x	x	
Determine suitable and maximum discharge rate for leach field							x							x			x			
Monitor leach field saturation during storm events							x							x			x			
Identify alternatives for wastewater effluent							x							x			x			
Develop a drought contingency plan							x							x						

Action	Lead or Partnering Department										Affected Resources									
	BRBRR Administration	Casino	ENR	Housing	Human Resources	Procurement	Public Works	Social Services	THPO	Tish Non Maintenance	Land	Atmosphere	Wildlife	Water	Riparian Forests	Grasslands	Infrastructure	Social	Cultural	Economy
Build capacity for recycled water program	x		x				x							x			x			
Retrofit buildings with energy efficient appliances and LED lightbulbs	x	x		x													x			
lighting to dark sky	x	x		x													x		x	
Weatherize homes	x			x													x	x		
Zone and purchase land for renewable energy infrastructure	x		x			x											x	x		x
Install solar roofing on all parking lots	x	x								x							x	x		x
Install solar arrays on residential rooftops				x													x	x		x
Follow guidelines in the Energy Sovereignty building code	x			x						x							x			
Purchase recycling service	x										x	x					x			
Operate a small scale composting program			x				x				x	x					x			
Purchase small scale composters			x				x										x			
Waste reduction education for residents			x								x	x						x	x	
Incorporate waste reduction signage in Casino and Hotel		x															x	x		
Integrate composting with a future bio-solids program			x				x				x	x					x			x
Improve emergency planning and preparedness and disaster planning	x																x	x		x
Educate residents on climate change health risks and prevention			x					x										x	x	
Monitor infrastructure for damage and needed repairs		x					x			x							x	x		x

Action	Lead or Partnering Department										Affected Resources									
	BRBRR Administration	Casino	ENR	Housing	Human Resources	Procurement	Public Works	Social Services	THPO	Tish Non Maintenance	Land	Atmosphere	Wildlife	Water	Riparian Forests	Grasslands	Infrastructure	Social	Cultural	Economy
Maintain basic need emergency supplies	x																	x		x
Increase food security by planting native plants and vegetable gardens			x	x					x									x	x	x
Maintain and increase vegetable and native plant garden productivity			x						x								x	x	x	x
Provide education and workshops about food									x									x	x	
Continue cultural resource protections									x									x	x	
Provide support for fish and wildlife restoration	x		x						x		x	x	x	x	x			x	x	x
Implement traditional burning practices			x						x		x	x	x		x			x	x	x
Increase job opportunities on Rancheria	x	x			x													x	x	x
Provide job training	x				x			x										x	x	x
Increase access to substance abuse treatment	x							x										x	x	x