Potential Climate Change Vulnerabilities and Adaptation Strategies for Tribal Communities

California Department of Water Resource - Climate Change Program

Potential Climate Change Vulnerabilities

	Drivers								
	Higher Temperatures	**Earlier Snowmelt**	**More rain, less snow**	**More extreme flood events**	**Longer, more frequent droughts**	**Sea Level Rise/ Ocean Acidification**	**More Erosion**	**More frequent & intense wildfires**	**Cumulative Impacts**
Subsistence Activities	Shift or loss of traditional fish, plant and animal species	Barriers to fish species migration/ movement; shift or loss of traditional fish, plant, and animal species	Greater stress on cold-water species from warmer runoff; shift or loss of traditional fish, plant, and animal species	Reduced water quality for traditional aquatic species; habitat disturbance/loss	Reduced productivity/ greater stress on traditional fish, plant, and animal species	Loss of coastal/tidal wetland habitats and species; ocean and estuarine food web changes; loss of shellfish	Reduced water quality for traditional aquatic species; stream channel changes; habitat disturbance/loss	Reduced water quality for traditional aquatic species; increased sedimentation in streams; habitat and species disturbance/ loss	Dietary changes; loss of local food resources; change in hunting/ gathering practices; loss of income and culture
Traditional Practices									Loss of culture & traditional medicinal plants and materials for jewelry, sculptures, ceremonial pieces, basketry, nets, and lodgings.
Sacred Sites and Practices	Shift or loss of traditional fish, plant and animal species	Reduced streamflows in summer/fall	Reduced streamflows in summer/fall	Damage to sacred sites; temporary inaccessibility to sacred sites; exposure of sacred artifacts and remains	Reduction in streamflows; reduced productivity/ greater stress on traditional fish, plant, and animal species	Inundation of/ damage to sacred sites; loss of access to sacred sites; shift or loss of traditional coastal species	Damage to sacred sites; loss of access to sacred sites; exposure of cultural resources	Damage to sacred sites; species disturbance/loss	Loss of traditional materials for ceremonies; loss or exposure of sacred sites, artifacts, & remains; changes in traditional timing of spiritual practices
Water Supply	Changes in runoff timing reducing seasonal availability; higher water demands	Reduced reliability; less groundwater recharge; decrease in summer/ fall runoff	Changes in runoff timing reducing seasonal availability; less groundwater recharge; reduced reliability	Damage to conveyance infrastructure; increased treatment; service interruptions	Reduced availability and reliability of surface water; less groundwater recharge; increased treatment; increased potential for overdrafting groundwater	Damage to coastal conveyance infrastructure; reduced supplies; increased treatment; degradation of coastal aquifers	Damage to conveyance infrastructure; increased treatment	Damage to conveyance infrastructure; increased treatment; service interruptions; sedimentation	Reduction in water availability; reduced quality or increased contamination of local surface and groundwater supplies; increase in water-related illnesses; potential conflicts over water rights; higher human water demands reduce water needed to support ecosystems/ species
Water Quality	Increase in water-borne illnesses; taste and odor issues; decrease in dissolved oxygen increase in algal blooms; impacts to aquatic species	Seasonal changes in quality due to decreased summer/fall runoff	Seasonal changes in quality (such as reduced dissolved oxygen) due to decreased summer/fall runoff	Wastewater spills; contaminated stormwater runoff; turbidity	Increase in water-borne illnesses; taste and odor issues; higher contaminant loading; increase in algal blooms; decrease in dissolved oxygen; impacts to aquatic species	Increased by-products from treating brackish water; inundation of wastewater treatment facilities or discharge impacts; salinity intrusion into aquifers	Damage to conveyance and wastewater infrastructure; increased turbidity	Damage to infrastructure, increased turbidity/ sedimentation	
Health	Increased mortality rates (especially for children and elderly); poor air quality; allergens increase; illnesses[1] exacerbated; increased health care costs	Reduced water supply reliability and quality	Change in prevalence & spread of disease; reduced water supply reliability and quality	Change in prevalence & spread of diseases; mortality; displacement[2]	Change in prevalence & spread of diseases; mortality; reduced water supply reliability; increased malnutrition; increased health care costs	Displacement; illness due to poor water quality; reduced coastal water supply reliability	Displacement; poor water quality; mudslides	Poor air and water quality; displacement; illnesses exacerbated, esp. respiratory illnesses; mortality; mudslides	Overall reduction in community health; increase in chronic and infectious diseases; increased heath care costs; impacts associated with displacement

[1]Illnesses - includes chronic, infectious, and vector borne diseases

[2]Displacement - encompasses associated health consequences, including mortality, due to economic disruption, loss of personal income, and disruption of social networks

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Potential Climate Change Adaptation Strategies

		Drivers							
	Cumulative Impacts	**Higher Temperatures**	**Earlier Snowmelt**	**More rain, less snow**	**More extreme flood events**	**Longer, more frequent droughts**	**Sea Level Rise/ Ocean Acidification**	**More Erosion**	**Longer wildfire season/ More frequent & intense wildfires**
Subsistence Activities	Dietary/harvest changes; loss of local food resources; change in hunting/ gathering practices and crop yields; loss of income; changes in fire mgmt (fewer burning windows)	Restore habitat to provide thermal refugia (i.e. riparian corridors); manage ecosystems to promote native species; promote traditional practices to restore traditional landscapes; promote policies that ensure tribal rights for subsistence practices	Restore habitat to remove barriers to fish migration; restore meadows restoration and implement forestry practices that help retain water in upper watersheds	Restore habitat to provide thermal refugia for cold water species; manage ecosystems to promote native species; promote traditional practices to restore traditional landscapes; promote policies that ensure tribal rights for subsistence practices	Restore and enhance exisiting floodplain and wetland habitat; restore and manage watersheds to reduce erosion	Restore and manage habitat to promote native species; implement land use practices that promote water retention on-site; remove or minimize invasive species	Restore wetlands; manage sediment to maintain/ enhance wetland elevations; restore subtidal habitat to attentuate storm surge; promote traditional practices to restore traditional landscapes; protect upland habitat and transition zones to allow for wetland migration	Restore and enhance riparian corridors; promote ranch land and forest management practices that reduce erosion	Reduce forest density where needed via mechanical or hand thinning and/or prescribed burning; restore soil mantle; construct and maintain fuel breaks; restore meadows to help retain water; remove or minimize invasive species
Traditional Practices	Loss of culture & traditional medicinal plants and materials for jewelry, sculptures, ceremonial pieces, basketry, nets, and lodgings; change in harvest								
Sacred Sites and Practices	Loss of traditional materials for ceremonies; loss of sacred sites; changes in traditional timing of spiritual practices, restrictions on ceremonial use of fire	Restore and manage ecosystems to promote traditional materials/ native species; promote traditional practices to restore traditional landscapes	Restore forests and implement practices that help retain water in upper watersheds; promote traditional practices to restore traditional landscapes	Restore and manage ecosystems to promote traditional materials/ native species; promote traditional practices to restore traditional landscapes	Restore habitat to buffer sacred sites; build infrastructure (i.e., levees, sea walls) to protect sacred sites	Restore and manage habitat to promote native species; impement land use practices that promote water retention & reduce forest fuels; remove or minimize invasive species	Restore habitat to buffer sacred sites; build infrastructure to protect sacred sites; promote traditional practices to restore traditional landscapes	Restore habitat to buffer sacred sites; build infrastructure to protect sacred sites	Manage fuel loads to reduce fire severity; create fire breaks to protect sacred sites; remove or minimize invasive species; restore habitat
Water Supply	Reduction in water availability; reduced quality or increased contamination of local surface and/or groundwater supplies; increase in water-related illnesses; potential conflicts over water rights; reduction in water needed to support ecosystems/ species due to higher human demand; loss of ag. income	Increase storage capacity; improve conjuctive mgmt; conserve water; restore habitat	Increase storage capacity; facilitate groundwater recharge basins; conserve water and energy; restore habitat in upper watersheds	Increase storage capacity; facilitate groundwater recharge basins; conserve water and energy; restore habitat in upper watersheds	Reinforce or relocate vulnerable conveyance infrastructure; improve treatment capacity	Increase storage capacity; improve conjuctive managment; conserve water and energy; promote reduction of forest fuels	Reinforce or relocate vulnerable conveyance infrastructure; improve treatment capacity; diversify supply portfolio; consider desalination	Protect vulnerable conveyance infrastructure with habitat buffers; improve treatment capacity	Create fire breaks to protect infrastructure; improve treatment capacity; manage fuel and restore habitat to reduce risk
Water Quality		Improve treatment capacity; promote use of wetlands in wastewater treatment	Habitat restoration that help retain water in upper watershed to support summer/fall baseflows	Habitat restoration to support summer/fall baseflows; groundwater recharge/ conjunctive use	Improve wastewater systems to avoid spills; use green infrastructure to filter stormwater runoff	Improve treatment capacity; promote use of wetlands in wastewater treatment	Reinforce or relocate of wasterwater facilities; brackish water desalination; wetland restoration	Protect vulnerable conveyance and wastewater infrastructure; improve treatment capacity	Fire breaks to protect infrastructure; improve treatment capacity; fuel mgmt and habitat restoration to reduce risk
Health	Overall reduction in community health; increase in chronic and infectious diseases; increased heath care costs; impacts associated with displacement[1]	Establish community cooling centers; develop renewable energy sources; provide education and outreach on heat-related illnesses	Improve water supply reliablity and water quality (see stratgies above)	Provide education and outreach on disease prevention; improve water supply reliability and water quality (see strategies above)	Provide education and outreach on disease prevention; establish emergency shelters; establish funding for recovery assistance	Education and outreach on disease prevention; establish emergency water supplies; establish funding for assistance programs	Improve infrastructure to protect communities; improve water supply reliability and water quality (see strategies above)	Establish emergency shelters and water supplies; establish funding for recovery assistance	Establish emergency shelters and water supplies; establish funding for recovery assistance

[1]Displacement - encompasses associated health consequences, including mortality, due to economic disruption, loss of personal income, and disruption of social networks