

TAHOE CLIMATE ADAPTATION PRIMER



ADAPTING TO CLIMATE CHANGE AT LAKE TAHOE

LAKE TAHOE'S CLEAR BLUE WATERS and breathtaking forested mountains make it a world-renowned recreation and tourism destination. Sixty-five thousand residents and 15 million visitors enjoy Tahoe each year. The landscape provides easy access to hiking, biking, snowsports, beaches, boating, fishing, paddling, and wildlife viewing. The Basin encompasses ski resorts, hundreds of miles of trails, 20 communities, and one city. Its cosmopolitan mountain culture is unique in the Sierra Nevada. Climate change threatens these cherished aspects of Tahoe with warmer temperatures and longer droughts, less snowpack, earlier runoff, more severe floods, increased erosion, greater fluctuations in lake level, and more severe wildfires and smoke.

Tahoe's high number of visitors combine with its delicate ecosystems to make it challenging to build resilience. Yet Tahoe benefits from decades of strong environmental stewardship, perhaps best embodied in the Lake Tahoe Environmental Improvement Program that has guided over \$3 billion of public and private investment in restoration since 1997. These commitments make Tahoe a promising place for adaptation with the potential to serve as a national model.

Our bi-state partnership has protected Tahoe for fifty years. We are committed to continuing this partnership to get ahead of the climate change curve, and ensure that all Californians, all Nevadans, and all visitors to the Lake can enjoy its natural beauty and welcoming mountain culture far into the future.



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KEY MESSAGES

ADAPTING TO THE IMPACTS OF CLIMATE CHANGE is necessary to safeguard the quality of life, land, and waters at Tahoe. The states of California and Nevada, Tahoe Regional Planning Agency (TRPA), Tahoe Transportation District (TTD), Washoe Tribe of Nevada and California (Washoe Tribe), and federal, local, and private partners are proactively adapting to climate change and making our communities, infrastructure, and natural resources more resilient. Key findings of this work include the following:

TEMPERATURE & PRECIPITATION

HOTTER SUMMERS: By 2100 summer in Tahoe will feel almost as hot as summer in Reno does today.

EXTREME STORMS AND FLOODING: The amount of rainfall from the largest storms

will increase by up to 30 percent, causing more flooding to communities. It would cost three times less to adapt to flooding than to pay for damages.

SNOWPACK: Rising temperatures will cause more precipitation to fall as rain rather than snow at lake level.

LAKE TAHOE

LAKE CLARITY: Warmer temperature and decreased deep-water mixing will diminish clarity. Larger and more frequent wildfire and floods will increase sediment flows into the Lake.

LAKE LEVEL: The lake level will be above and below the natural rim more often in

the future. Tahoe City Dam will overtop one or two times each decade.

STREAM RUNOFF: Runoff will peak five months earlier, and affect ecosystems and downstream water resources.

INVASIVE SPECIES: Warmer temperatures will make nearshore water more hospitable for aquatic invasive species.

FORESTED UPLANDS

WILDFIRES: Wildfires will be larger and more frequent. By 2100 the total area burned each decade is projected to be 61 percent larger than in 2000. Wildfire threatens people and \$26.9 billion in total property value. Each \$1 million invested in adaptation would reduce property damages by \$10 million.

DROUGHTS AND FOREST HEALTH: Longer, more frequent droughts and increased insect outbreaks will kill more trees, further increasing wildfire risk.

NATIVE SPECIES: Reduced habitat will cause some native species to decline or even become locally extinct.

MEADOWS: Many meadows will dry out for longer periods, and eventually convert to forest or shrubs.



COMMUNITIES & INFRASTRUCTURE

WINTER RECREATION: By 2100 the length of the winter recreation season will decrease by half. The 12 ski resorts in the Tahoe region could lose \$268 million annually.

SUMMER RECREATION: The length of the summer recreation season will increase. Lower lake levels caused by extended droughts will impact boating, beaches, and water sports.

CULTURAL LANDSCAPES: Large high-severity wildfires will destroy culturally important resources, artifacts, and sites.

SMOKE EVENTS: Wildfires will cause more smoky days. By 2050 the health-related costs from a single wildfire could be \$7 million to \$40 million.

ROADS: The risk that landslides, wildfire, flooding, and avalanches damage highways will increase. Annual road damages could exceed \$75 million by 2100.

INFRASTRUCTURE: Extreme weather, wildfire, and other hazards could create more frequent outages for water, energy, and communication infrastructure. Higher lake levels may flood lakefront properties.

OVERVIEW

The California Tahoe Conservancy (Conservancy) has partnered with two dozen agencies and stakeholders, and a large team of technical experts, to produce three interlocking documents:

- 1. A SCIENTIFIC ASSESSMENT** of the vulnerability of the Lake, forests, and communities to climate change impacts (released in April 2020)*
- 2. THIS PRIMER** of major climate impacts and existing adaptation partnerships
- 3. A PROJECT PORTFOLIO** that lists adaptation actions that partners are already undertaking (forthcoming in 2021)

THIS PRIMER REVIEWS:

- 1.** Anticipated climate change impacts based on the integrated vulnerability assessment.
- 2.** Ongoing adaptation work by existing partnerships involving California and Nevada agencies, the TRPA, federal agencies, the Washoe Tribe, local jurisdictions, nonprofit organizations, and businesses.

This information is categorized into three Basin sub-systems: Lake Tahoe, Forested Uplands, and Communities



LAKE TAHOE including its chemistry, hydrology, water quality, and native fish.



FORESTED UPLANDS including vegetation, wildlife, and groundwater.



COMMUNITIES including cultural landscapes, public health and safety, recreation, and water, power, communication, and transportation infrastructure.

The primer concludes with what lies ahead for Tahoe. It reviews ongoing and upcoming statewide planning led by California and Nevada. It also reviews the goals of a new Basinwide mitigation, adaptation, and resilience initiative led by the TRPA, as well as local jurisdiction plans and initiatives.

RESILIENCE: The ability of a system to withstand disturbance without fundamental change.

ADAPTATION: Changing processes and behaviors in response to actual or expected climate conditions.

*INTEGRATED VULNERABILITY ASSESSMENT OF CLIMATE CHANGE

An assessment of how patterns of temperature and precipitation will change at Tahoe, and how these patterns will affect the things people care about, including an analysis of economic impacts by Industrial Economics, Incorporated. Economic data and modeled projections in this primer come from this assessment.

tahoe.ca.gov/climate-change



EXISTING MANDATES & PLANS

Several mandates and plans guide the adaptation work of public agencies and stakeholders in Tahoe.

STATE MANDATES & PLANS

California and Nevada have several laws, executive orders, and policies that require state agencies to integrate climate change adaptation into planning and investment, and to create corresponding programs and regulations.

KEY CALIFORNIA GUIDANCE

SAFEGUARDING CALIFORNIA PLAN (required by Executive Order S-13-08) serves as the State's climate adaptation strategy.

EXECUTIVE ORDERS B-30-15 AND B-52-18 require California state agencies to consider climate change impacts in all planning and investment, and direct state agencies to increase resilience to wildfire and adapt to climate change.

EXECUTIVE ORDER N-82-20 on biodiversity requires state agencies to conserve at least 30 percent of California's lands and coastal waters by 2030, including a Natural and Working Lands Climate-Smart Strategy to advance the State's carbon neutrality goal and build climate resilience.

THE CALIFORNIA TRANSPORTATION PLAN 2050 provides a vision, statewide goals,

The vulnerability assessment, this primer, and the project portfolio are consistent with these mandates and frameworks. These documents incorporate the best available science; stakeholder, agency, and public input; and adaptation strategies and actions that partners have tailored to the Basin.

and corresponding implementation recommendations. Caltrans is also developing a Strategic Management Plan and convening a Climate Action Goal Team to guide climate change integration throughout its programs.

KEY NEVADA GUIDANCE

NEVADA EXECUTIVE ORDER 2019-22 directs state agencies to collaborate with partners to help implement and accelerate climate solutions. Nevada agencies continue to evaluate policies and regulatory strategies to reduce greenhouse gas emissions, coordinate statewide efforts, and implement the State Climate Strategy (completed December 2020). This executive order complements and builds on Senate Bill 254 (2019), which calls for reductions in Nevada's greenhouse gas emissions.

REGIONAL AND LOCAL MANDATES & PLANS

The Basin has concurrent regional and local mandates.

THE LAKE TAHOE REGIONAL PLAN, which stems from the Tahoe Regional Planning Compact, and the Regional Transportation Plan both identify climate resilience as a goal and serve as the local implementation plans for state and federal climate mandates.

THE LAKE TAHOE ENVIRONMENTAL IMPROVEMENT PROGRAM (EIP) identifies actions and principles for forest and watershed restoration projects that advance adaptation.

THE TRPA'S 2014 SUSTAINABILITY ACTION PLAN provides a toolkit of potential mitigation and adaptation actions.

THE LAHONTAN REGIONAL WATER QUALITY CONTROL BOARD'S (LAHONTAN WATER BOARD) 2019 CLIMATE CHANGE MITIGATION AND ADAPTATION STRATEGY protects water resources and infrastructure and promotes resilience to wildfire.

FEDERAL MANDATES & PLANS

The Basin also has concurrent federal mandates.

EXECUTIVE ORDER 14008: Tackling the Climate Crisis at Home and Abroad calls for a government-wide approach to climate change and places the climate crisis at the forefront of foreign policy and national security planning. In addition, the executive order commits to conserving 30 percent of federal lands and waters by 2030.

THE REGION 5 ECOLOGICAL RESTORATION LEADERSHIP INTENT from the USDA Forest



Several local jurisdictions also recently completed climate change plans. Placer County's 2020 Sustainability Plan provides a roadmap to reduce greenhouse gas emissions and increase resilience to climate hazards. The City of South Lake Tahoe's 2020 Climate Action Plan outlines strategies to reduce emissions and adapt to climate change. The South Tahoe Public Utility District's (STPUD) 2019 climate action plan identifies actions STPUD will take to address the causes and effects of climate change. This primer reinforces these regional and local mandates and plans.

Service, Pacific Southwest Region calls for restoring landscapes and increasing capacity to adapt to climate change.

THE 2016 LAND MANAGEMENT PLAN of the USDA Forest Service, Lake Tahoe Basin Management Unit (LTBMU) guides management on 78 percent of Basin lands. The plan includes an overarching climate change strategy to increase resilience and protect vulnerable resources and incorporates adaptation actions throughout its management activities.

IMPACTS & ADAPTATION

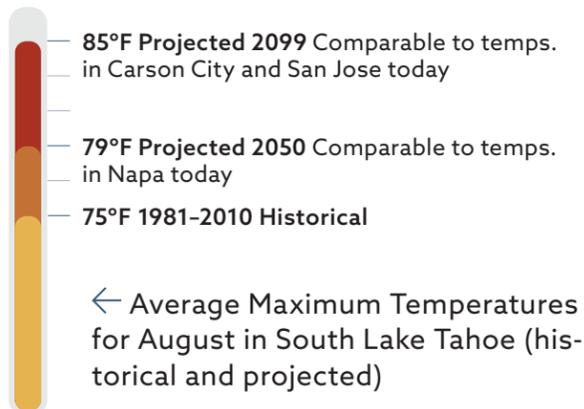
This section summarizes the vulnerability of Lake Tahoe and the surrounding forests and communities to climate change. It also identifies ongoing adaptation work in the region. It begins by identifying projected changes in temperature and shifts in precipitation, which touch all aspects of Tahoe’s ecology, economy, and culture.

■ **AVERAGE TEMPERATURES WILL INCREASE** by 3.6 to 9 degrees by 2100. This will make August at the end of the century as hot as August currently is in San Jose—85 degrees on average. (All degrees in this primer are given in Fahrenheit.)

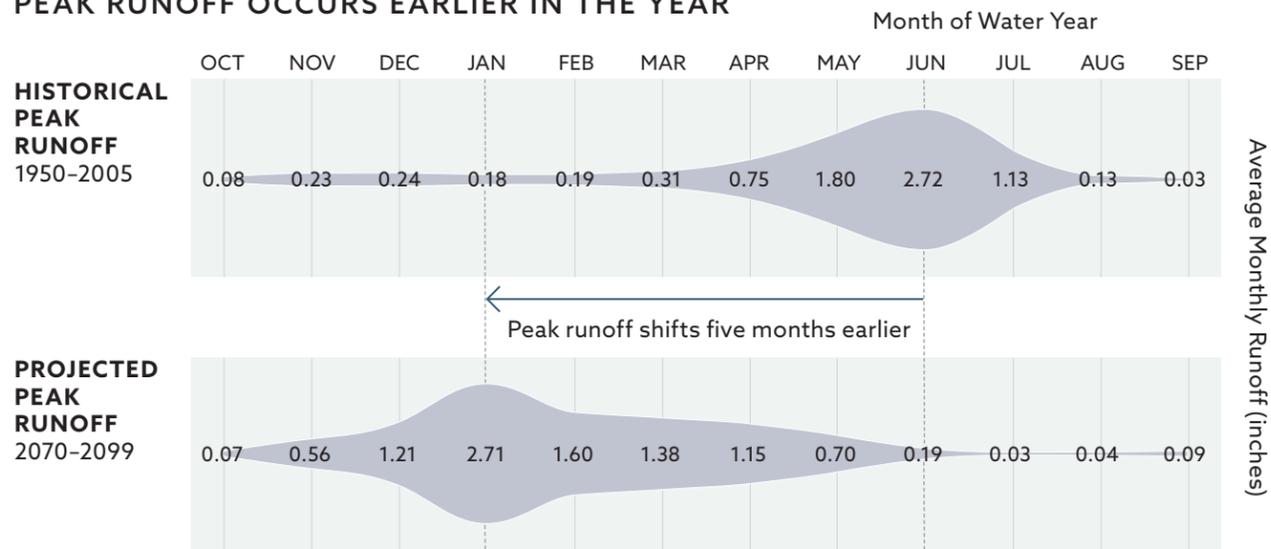
■ **PRECIPITATION AT LAKE LEVEL WILL SHIFT** from primarily snow to primarily rain due to warmer temperatures. In addition, rising temperatures will lead to more rain-on-snow events and earlier snowmelt.

■ **STORMS WILL BECOME MORE INTENSE.** While the total amount of precipitation in the Sierra Nevada will not likely change, year-to-year precipitation will become more variable and peak storm events will increase by up to 30 percent.

■ **BY THE END OF THE CENTURY PEAK RUN-OFF IN THE BASIN WILL OCCUR FIVE MONTHS EARLIER** in the year. This is because precipitation will fall more regularly as rain rather than snow, and flow into streams immediately, rather than accumulating as a snowpack that slowly melts into the summer.



PEAK RUNOFF OCCURS EARLIER IN THE YEAR



LAKE CLARITY

IMPACT Climate change will disrupt the deep water mixing in the Lake that occurs during the wintertime. This stronger thermal stratification, with warm water sitting on top of colder water for prolonged periods, will in turn expand the portions of the Lake that have low levels of dissolved oxygen (a critical factor for aquatic life), increase the trapping of sediment and nutrients near the Lake’s surface, and promote algal blooms. Ultimately this will decrease the Lake’s famed clarity.

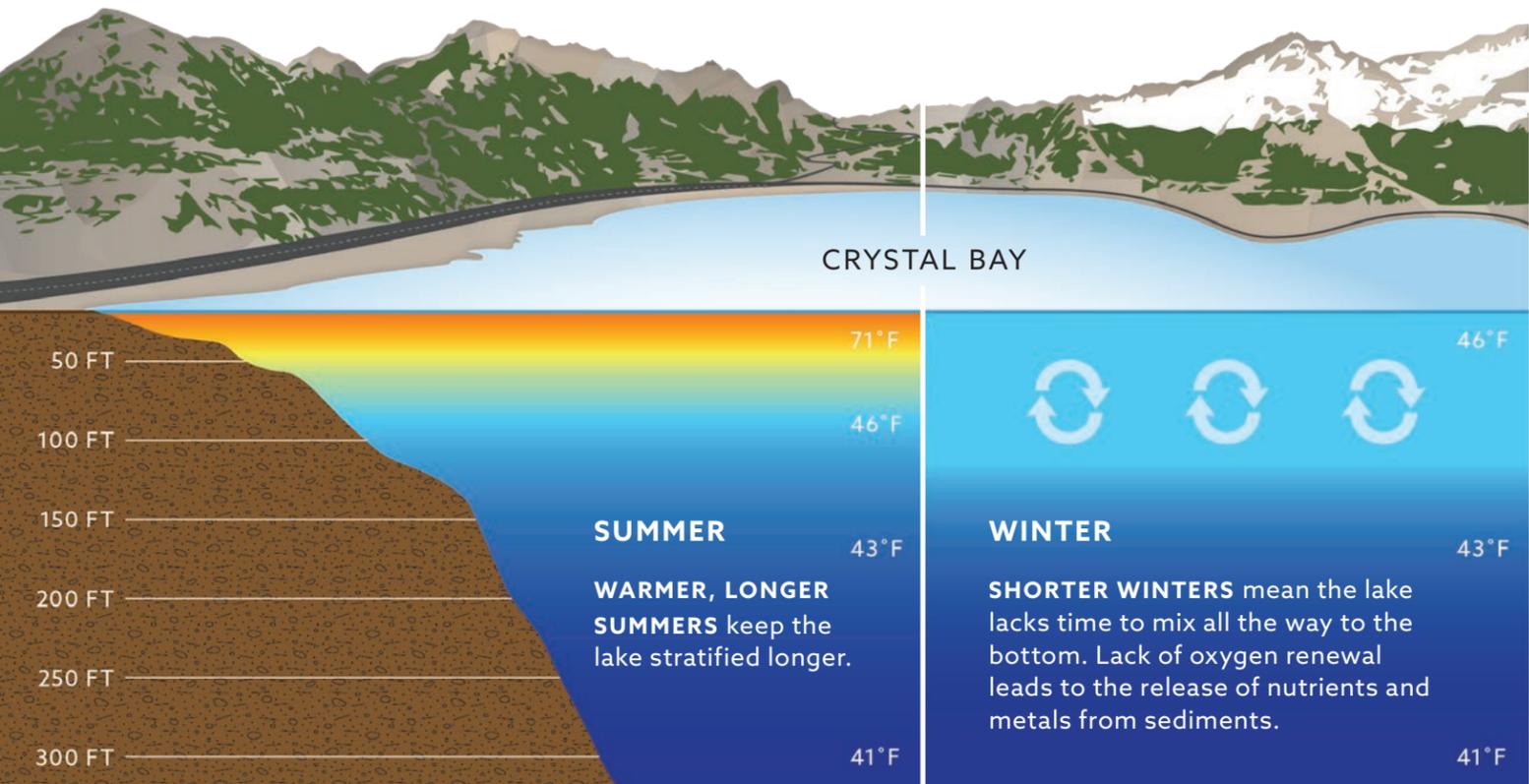
IMPACT The lake level will rise markedly during extreme precipitation events, and exceed the operable range of the dam at Tahoe City one to two times every decade. Steep slopes along the shoreline will fail more often, thus impacting infrastructure and water quality, and putting people at risk.

PROTECTING LAKE CLARITY

→ Numerous agencies are monitoring environmental and public health risks from storms; conducting outreach and advocacy for protecting lake clarity; and assessing the effectiveness of existing storm water infrastructure, design standards, and best management practices to account for changes in future hydrology.

→ Basin partners are also assessing how to update and integrate projected climate data into the models that provide the basis for regulating and improving storm water quality, including the Lake Tahoe Clarity Model and associated Pollutant Load Reduction Model. In collaboration with the two states and the TRPA, the Tahoe Science Advisory Council (TSAC) completed the 2019 Science to Action Planning, Project Briefing and Science Vision primer. The primer provides a framework for understanding and adaptively managing Lake Tahoe’s clarity as the climate changes.

DIMINISHED LAKE MIXING THREATENS LAKE CLARITY



ADAPTATION EXAMPLE

Lake Tahoe’s **Total Maximum Daily Load (TMDL)** provides a science-based approach to restoring the Lake’s clarity. The TMDL establishes targets for agencies to reduce storm water pollution from developed lands.

The Lahontan Water Board and Nevada Division of Environmental Protection oversee the program. Partners track progress at laketahoeinfo.org.

WATERSHED HYDROLOGY & STREAMFLOW

IMPACT Changes in temperature and the timing of peak stream runoff will shift hydrologic patterns, leading to long-term changes in ecosystem structure and function. With more annual precipitation arriving as rain rather than snow, the amount of water the Basin snowpack

holds will decrease, and summer streamflow will decline. Conversely, more intense storms, rain-on-snow events, and floods will lead to more runoff, and corresponding increases in erosion, transportation of pollutants downstream and into the Lake, and damage to infrastructure.

RESTORING STREAMS & WETLANDS

→ State, federal, and local agencies and the Washoe Tribe are planning, funding, and implementing wetland and stream restoration projects to accommodate increased flooding, withstand prolonged drought, and provide refuge for native species threatened by climate change. Locations of these projects include along the Upper Truckee River such as the Upper Truckee Marsh and Johnson Meadow, and at Meeks Meadow, Antone Meadows, Tahoe State Recreation Area, Burke Creek/Rabe Meadow, Marlette Creek, Spooner Meadow, and Polaris Creek.

→ The TSAC is assessing mitigation measures designed to offset potential impacts to streams from landscape-scale forest management practices like vegetation thinning and prescribed burning.

→ The Greater Upper Truckee River Watershed Partnership is an informal group of land and resource stewardship agencies that is preparing a synthesis of historical EIP investments in the watershed; identifying opportunities to coordinate project implementation and funding applications; and identifying regional and statewide planning trends to help guide future restoration.

ADAPTATION EXAMPLE

The **Upper Truckee River Watershed Advisory Group** partner agencies have invested over \$70 million in restoration projects covering nine miles of the river and over 1,000 acres of floodplain. The river is Lake Tahoe’s largest source of sediment. The Upper Truckee water-

shed includes the Basin’s most extensive and biologically diverse wetlands and provides outstanding recreation. Partner agency projects improve resilience by filtering more sediments, providing wildlife habitat, and maintaining groundwater levels.

AQUATIC BIOLOGICAL DIVERSITY

IMPACT Fluctuating lake levels and an earlier peak in stream runoff will impact aquatic habitat and the ability of native fish species to reproduce. This is because many native fish require cool streams in the summertime for spawning. Under climate change, these streams will become warmer much earlier in the spring and summer.

ADAPTATION EXAMPLE

The interagency **Lake Tahoe Aquatic Invasive Species (AIS) Coordinating Committee** prevents AIS from establishing in Lake Tahoe; controls existing AIS populations; and identifies new infestations. The committee coordinates education and outreach; secures funding; inspects watercraft; and implements priority projects.

trpa.gov/invasive-species



Photo courtesy of California State Parks

PROTECTING AQUATIC BIODIVERSITY

→ State, federal, and regional agencies are improving the cross-jurisdictional monitoring of existing AIS populations to prevent their spread, and to rapidly remove any newly discovered infestations. These agencies are also researching new technologies, climate scenario data, and strategies to increase the speed, efficiency, and effectiveness with which they control AIS populations and restore nearshore habi-

tat to benefit native species. While acting lakewide, Basin partners are focusing on iconic areas like Emerald Bay and Lake Tahoe Nevada State Park, and hot spots like the Tahoe Keys.

→ State and federal agencies are also monitoring the status and trends of stream temperatures to guide conservation, enhancement, and restoration of habitat for the growth, reproduction, and survival of native fish species.

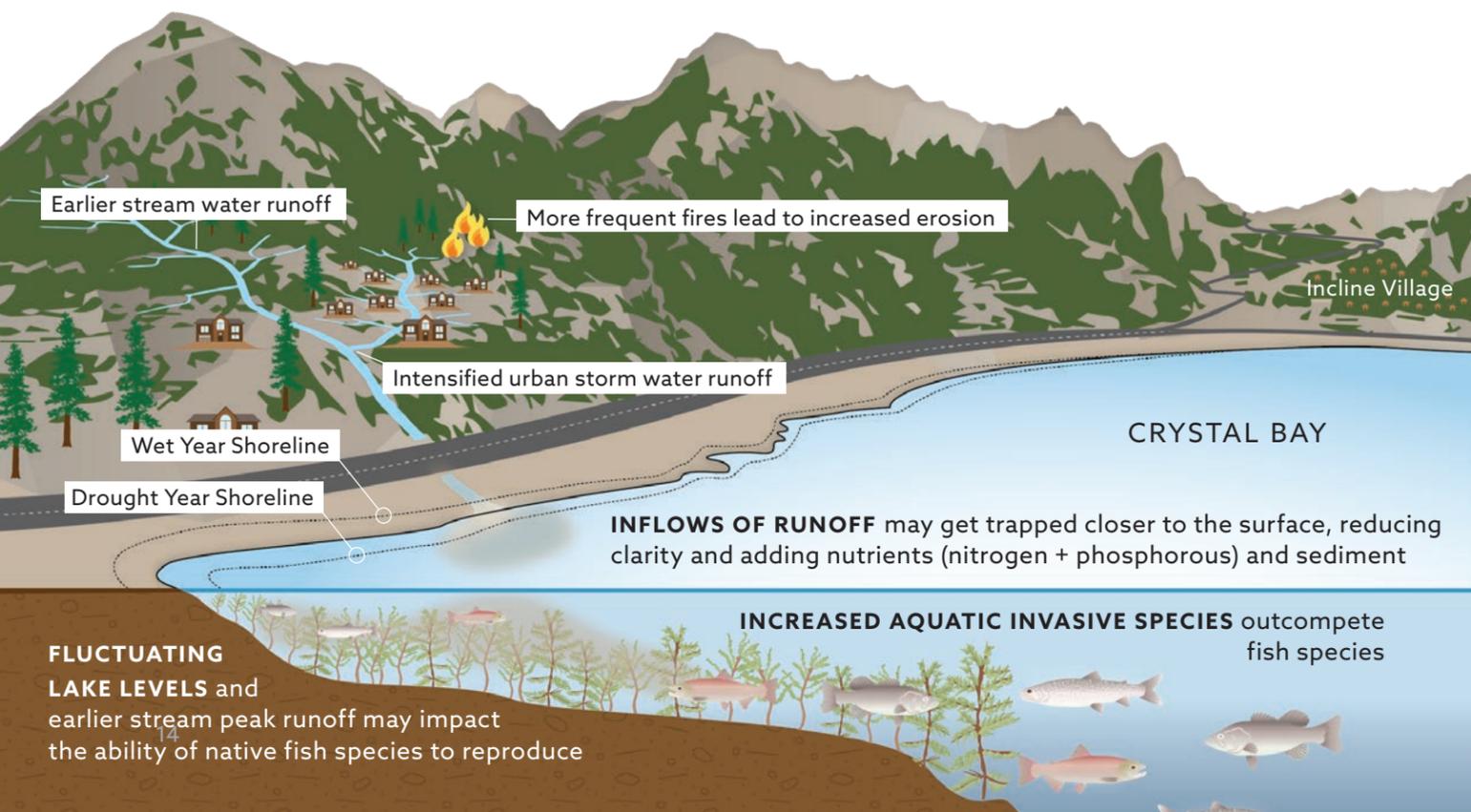
FORESTED UPLANDS

FOREST ECOSYSTEMS

IMPACT Longer droughts and reduced moisture in the soil will impact forests in many ways. These changes will lead to bark beetle and other insect outbreaks; kill large numbers of aspen trees; degrade

and reduce the size of meadows; increase the risk of wildfire, and threaten native plants, mammals, and birds. Conifers will entirely supplant meadows that lack consistently high groundwater. Drought stress is likely to be greatest on the east side of the Lake.

MULTIPLE CLIMATE IMPACTS DEGRADE NATIVE FISH HABITATS



MANAGING THE FORESTED LANDSCAPE

Basin land management and regulatory agencies are taking a multijurisdictional, landscape approach to more rapidly restore the resilience of the Basin's forests and watersheds (see diagram). This work improves the health of forest vegetation; uses biomass from forest thinning for home heating and energy; sequesters carbon in trees, meadows, and the soil; and creates efficiencies through novel management agreements and regulatory approaches. It also uses prescribed burning to cheaply reduce fuel loads and provide ecological benefits that enhance resilience to climate change across large tracts of land.



BIOLOGICAL DIVERSITY OF FORESTS

IMPACT Rising temperatures and shifts in precipitation will alter high-elevation forest habitat and change the composition of species within this ecosystem. Species that inhabit small ranges within alpine ecosystems may experience significant habitat loss and fragmentation.

PROTECTING NATIVE AND SENSITIVE BIODIVERSITY

- State, federal, and regional agencies are monitoring sensitive wildlife like the pika, California spotted owl, and mountain beaver to ascertain changes in their population sizes or distribution, and their use of habitat.
- Agencies will adjust their revegetation and reforestation practices, including the seed stocks that they use for replanting, to align with emerging climate science and monitoring findings.

WETLANDS, RIPARIAN AREAS, AND AQUATIC WILDLIFE

IMPACT Conifers will encroach upon and reduce meadow habitat as upland groundwater tables lower. And as mentioned earlier, changes in temperature and the timing of peak stream runoff will impact the structure and function of aquatic ecosystems. Increased stream water temperatures and reduced stream-flow in late spring and summer will affect which aquatic species can persist, and impact the cycling of nutrients and concentration of dissolved oxygen in streams.

ACQUIRING AND RESTORING SENSITIVE WETLANDS TO BUFFER CLIMATE CHANGE IMPACTS

→ State and federal agencies continue to acquire and restore environmentally sensitive riparian areas, aspen stands, and meadows. When planning restoration projects, however, ecologists and engineers are designing native revegetation plots and stream channels to provide greater resilience to extreme precipitation and flooding. Along with removing conifers and prescribed burning, these adaptations should improve the ability of native plants and animals to persist.

ADAPTATION EXAMPLE

Lake Tahoe West

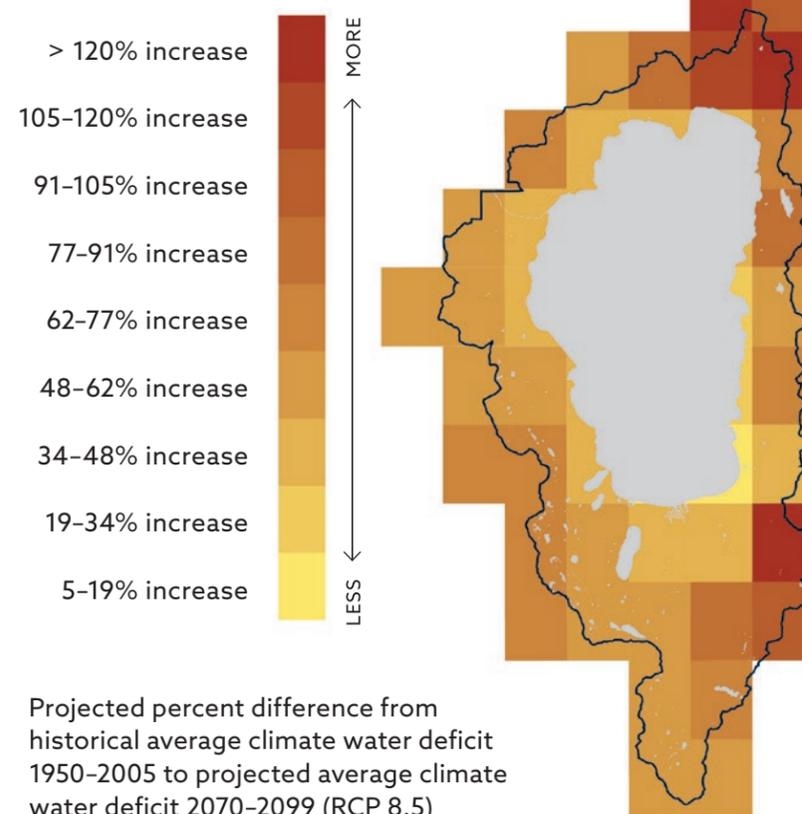
Restoration Partnership.

This interagency and stakeholder collaborative is restoring the resilience of 59,000 acres of west shore forests and watersheds to flooding, drought, insects and disease, and wildfire, all of which are amplified by climate change. Strategies include restoring creeks, floodplains, forest habitat, and meadows; removing barriers that prevent fish from swimming upstream; and connecting habitats to help native species thrive.

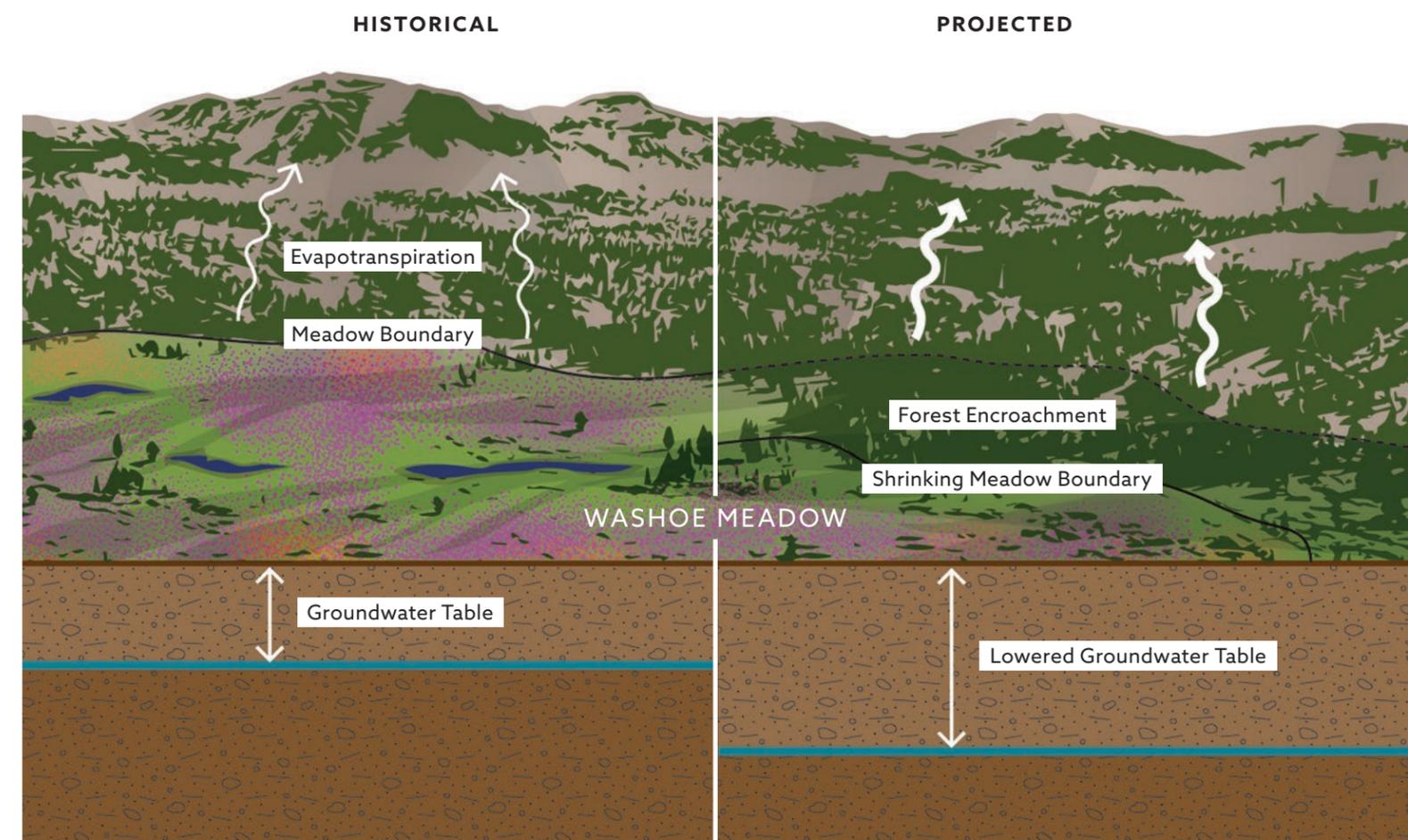
laketahoewest.org

CLIMATE CHANGE INCREASES DROUGHT STRESS ON SOILS AND PLANTS

2070-2099 MODELED CLIMATIC WATER DEFICIT:
An Estimate of Drought Stress on Soils and Plants



FOREST ENCROACHMENT LEADS TO LOSS OF WETLAND, MEADOW, AND RIPARIAN HABITAT



COMMUNITIES

PUBLIC HEALTH & SAFETY, INCLUDING WILDFIRE AND EMERGENCY RESPONSE

IMPACT The extent of wildfires is expected to increase significantly. Extreme heat events and wildfire smoke from inside and outside the Basin will jeopardize public health and summer recreation. According to modeling from the Lake Tahoe West Restoration Partnership, by mid-century the healthcare costs from a single large

and severe wildfire, including chronic respiratory illness and premature death, could range from \$7 million to \$40 million.

IMPACT The total area burned by wildfires each decade is expected to be 61 percent greater by 2100, and to threaten more than \$26.9 billion in total property value. By reducing the severity of future wildfires, each \$1 million invested in forest management actions would reduce property damages by \$10 million.

ADAPTATION EXAMPLE

The Tahoe Fire and Fuels Team (TFFT)—comprising 21 state, regional, and federal agencies, and the Washoe Tribe—protects communities and the environment from wildfire. Partners reduce forest fuels in neighborhoods and the surrounding lands. TFFT’s Tahoe Network of Fire Adapted Communities educates residents about making their homes safe from fire. TFFT’s Fire Public Information Team educates the public about fire risk and safety.

tahoelivingwithfire.com

STRENGTHENING DISASTER PREPAREDNESS & COMMUNITY RESILIENCE

State and regional agencies are planning and implementing a wide range of disaster preparedness and community resilience measures. These include updating and enforcing policies and standards for defensible space, home hardening, and evacuation and emergency response; advocating for improved fire insurance; preparing local and regional evacuation plans and shared communication systems; using specialized cameras to rapidly detect fires; and continuing overall wildfire prevention and response. These agencies are also completing community-scale plans that improve the efficiency and effectiveness of first responders.



TRANSPORTATION INFRASTRUCTURE

IMPACT Wildfire, landslides, and flooding will damage high-voltage powerlines, natural gas transmission lines, highways, and recreation facilities. All these impacts

will increase the risks to visitors and residents. Annual road damages could exceed \$75 million by 2100. Under a more variable anticipated climate, it would cost three times less to increase flooding prevention actions now than to pay for damages from a major flood event.

PREPARING, MITIGATING, AND RESPONDING TO HAZARDS THROUGH INTERAGENCY COORDINATION

→ Federal, state, and regional agencies are integrating climate change into hazard mitigation and regional development plans, and implementing engineering and construction projects that prioritize climate adaptation benefits.

→ In addition, multiple agencies are involved in planning for entire highway corridors and promoting alternative modes of transportation. For example, agencies are implementing the State Route 28 Corridor Management Plan, including relocating highway parking to designated mobility hubs, undergrounding powerlines, relocating a sewer line, adding fire hydrants, and adding conduit for hardened communications as protection against wildfire, landslides, and other hazards.

ADAPTATION EXAMPLE

Bi-State Consultation on Transportation. California and Nevada continue a consultation to improve the Basin’s transportation infrastructure, including building resilience to climate change impacts through a ten-

year list of priority projects. Basin partners are identifying sustainable financing mechanisms to construct the projects and implement the Regional Transportation Plan.

trpa.gov/transportation

WATER, POWER, AND COMMUNICATION INFRASTRUCTURE

IMPACT Extreme precipitation events will increase erosion and water pollution, interrupt water supplies, damage wastewater and recreation infrastructure, and threaten the Lake's famed clarity and aquatic biodiversity.

ADAPTATION EXAMPLE

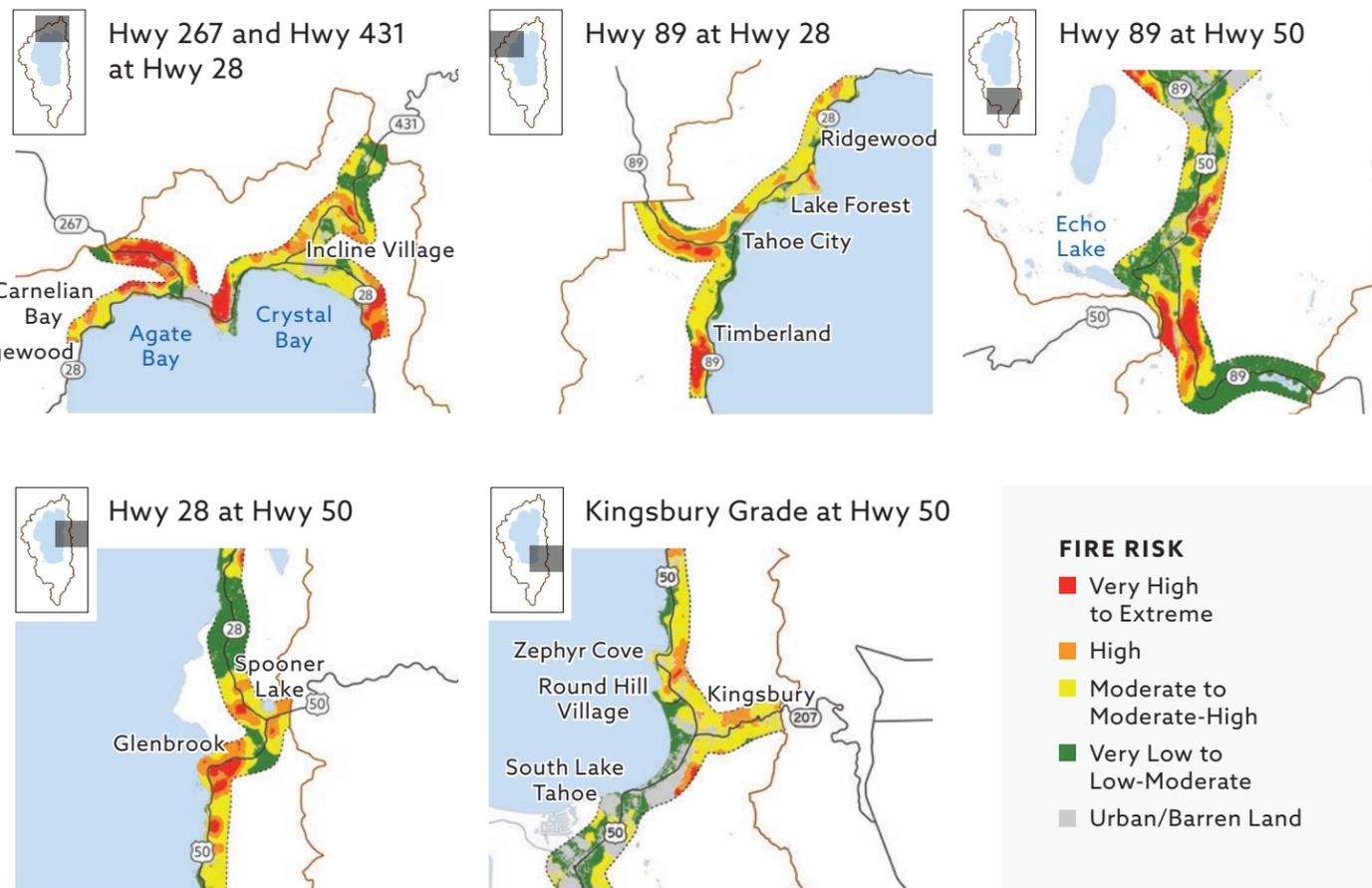
Through the **Powerline Resilience Corridors strategy**, Liberty Utilities and NV Energy are protecting high risk communities by removing hazards near utility lines, while the LTBMU, Nevada Tahoe Resource Team, and other participating TFFT agencies simultaneously improve the health of the surrounding forest. This approach can reduce wildfire ignitions, protect infrastructure, and create efficiencies by working across jurisdictions.

UPGRADING INFRASTRUCTURE TO WITHSTAND FUTURE HAZARDS

→ State and regional agencies as well as private companies are assessing the risks of extreme events to water and communication infrastructure, and monitoring this infrastructure for damages during winter storms and high wind events.

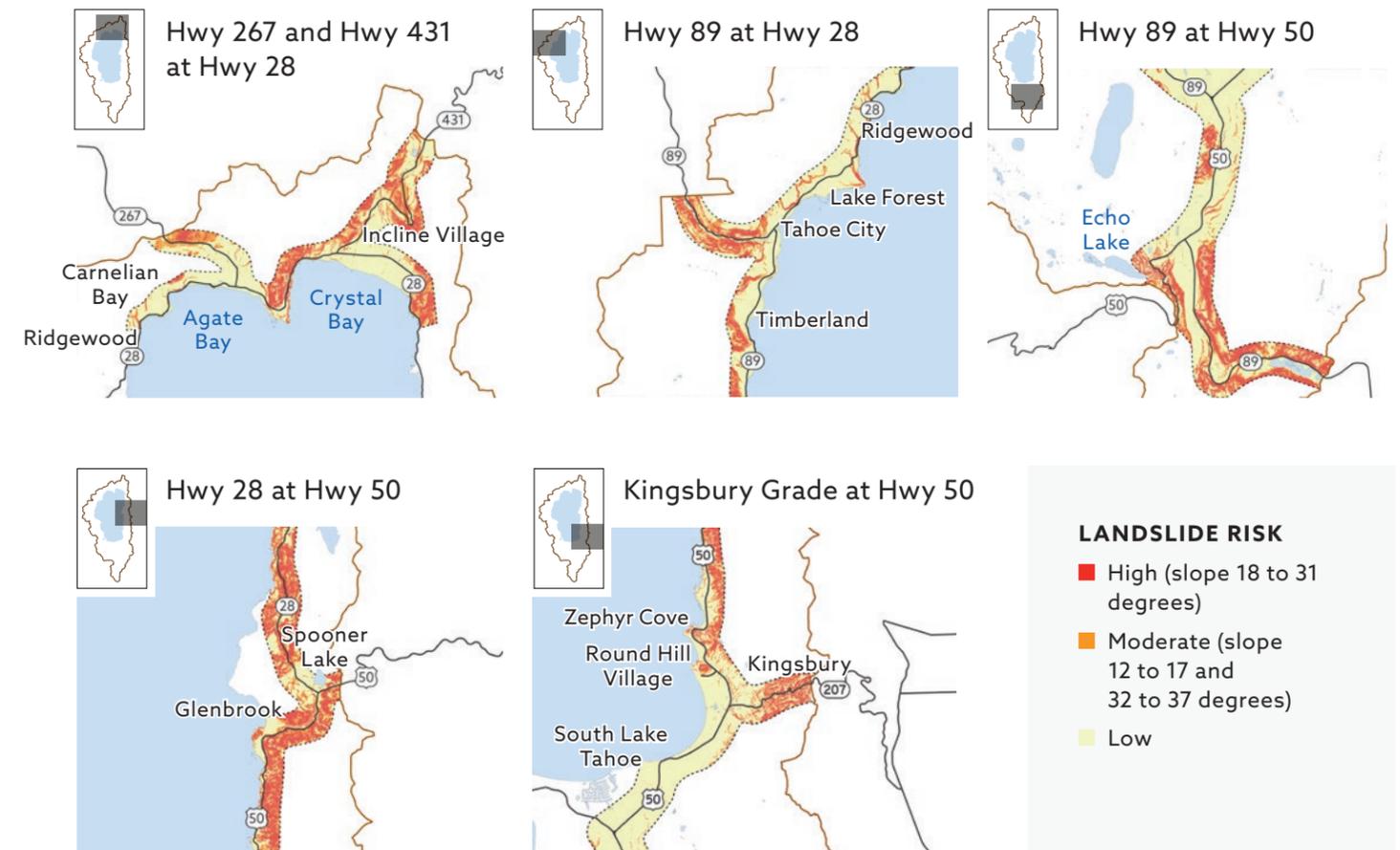
→ Local utility and fire districts are assessing the vulnerability of critical services such as drinking water supply, firefighting water supply, and wastewater systems, and upgrading this infrastructure accordingly.

WILDFIRE RISK SURROUNDING HIGHWAYS (Current conditions)



Fires grow faster on steep slopes. Climate change is expected to amplify the risk of wildfires to highways, leading to implications for mobility and evacuation routes.

LANDSLIDE RISK SURROUNDING HIGHWAYS (Current conditions)



Landslides occur more frequently on moderately steep slopes. Climate change is expected to amplify the risk of landslides to highways, leading to implications for mobility and evacuation routes.

TRIBAL LANDSCAPES

IMPACT Large high-severity wildfires will destroy culturally important biological resources, damage archaeological artifacts and cultural sites, and reduce access to traditional foods for the Washoe Tribe.

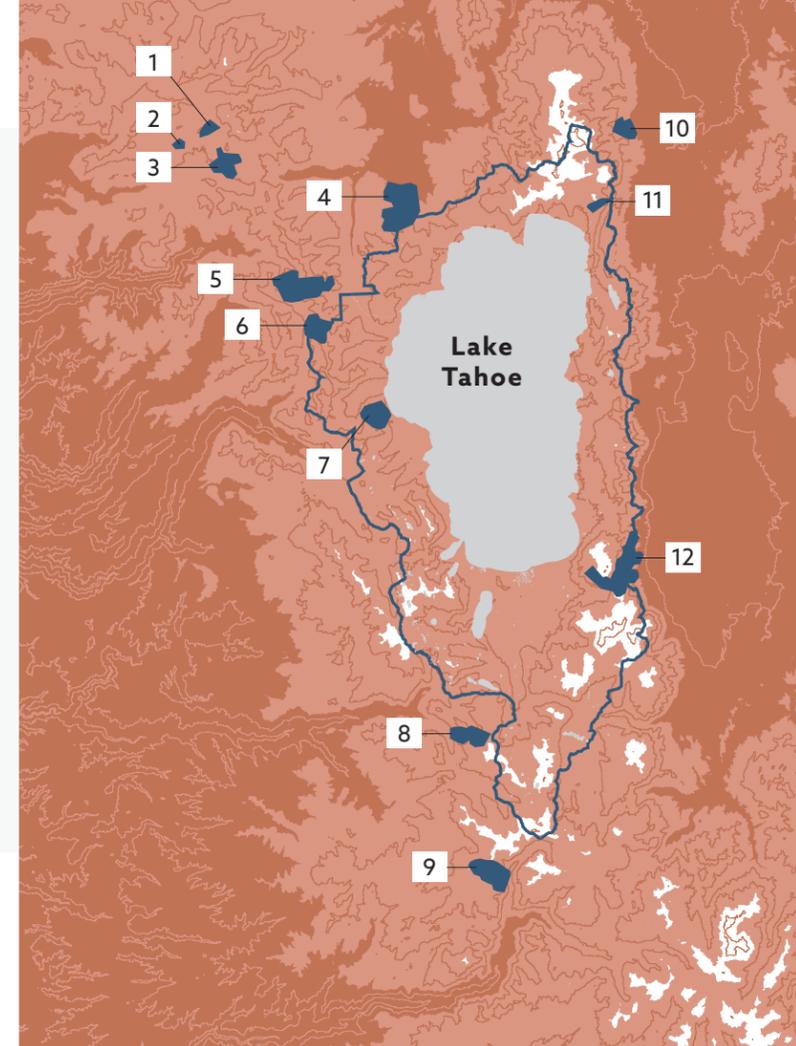
RAISING AWARENESS OF THE WASHOE TRIBE'S HISTORICAL AND ONGOING PRESENCE AT LAKE TAHOE.

→ Agencies are working with the Tribe to increase public education and awareness about its connections to Lake Tahoe, restore cultural heritage sites, and restore cultural place names.

→ In addition, agencies are implementing memoranda of understanding and co-management agreements to stabilize and enhance cultural resources and sites, and ensure they can withstand climate impacts.

ADAPTATION EXAMPLE

The **Máyala Wáta Restoration (Meeks Meadow)**. The Washoe Tribe is working with the LTBMU to restore 300 acres of Máyala Wáta. This project improves resilience for an important region of the Washoe Tribe's ancestral lands, and increases the Tribe's intergenerational capacity to restore land using tribal cultural practices. Work involves tribal elders, youth, and crews, and will include performing culturally guided prescribed burning. Goals include reducing wildfire risk, maintaining groundwater levels, improving species diversity.



INCREASING TEMPERATURES CAUSE RISING SNOWLINE

YEAR 2100 PROJECTION (RCP 8.5)
+9°F increase in average annual temperature from 2006

□ Snowfall likely (9,500 ft and above)

■ Rain more likely than snowfall (6,200 ft up to 9,500 ft)

■ Rain likely (6,200 ft and below)

— Lake Tahoe Basin Boundary

■ Ski Resorts

- | | |
|-------------------|----------------------|
| 1 Boreal Mountain | 7 Homewood |
| 2 Soda Springs | 8 Sierra-at-Tahoe |
| 3 Sugar Bowl | 9 Kirkwood Mountain |
| 4 Northstar | 10 Mt. Rose |
| 5 Squaw Valley | 11 Diamond Peak |
| 6 Alpine Meadows | 12 Heavenly Mountain |

RECREATION

IMPACT Rising temperatures will increase the elevation at which snow accumulates, decrease the size of the snowpack, and shorten the length of the winter recreation season by half. The Basin's ski resorts

and winter recreation economy will be heavily impacted. A study of the United States found that the ski season length is expected to decrease by 52 percent by 2099. Therefore, revenue generated from alpine skiing in the region is expected to decrease by \$268 million annually.

INTEGRATING CLIMATE CHANGE IN RECREATION MANAGEMENT AND FACILITIES.

→ The number of visitors to Lake Tahoe is rising steadily as people from the San Francisco Bay Area, Sacramento, the San Joaquin Valley, Reno, and Los Angeles seek cooler summertime temperatures. Warmer weather will lengthen the sum-

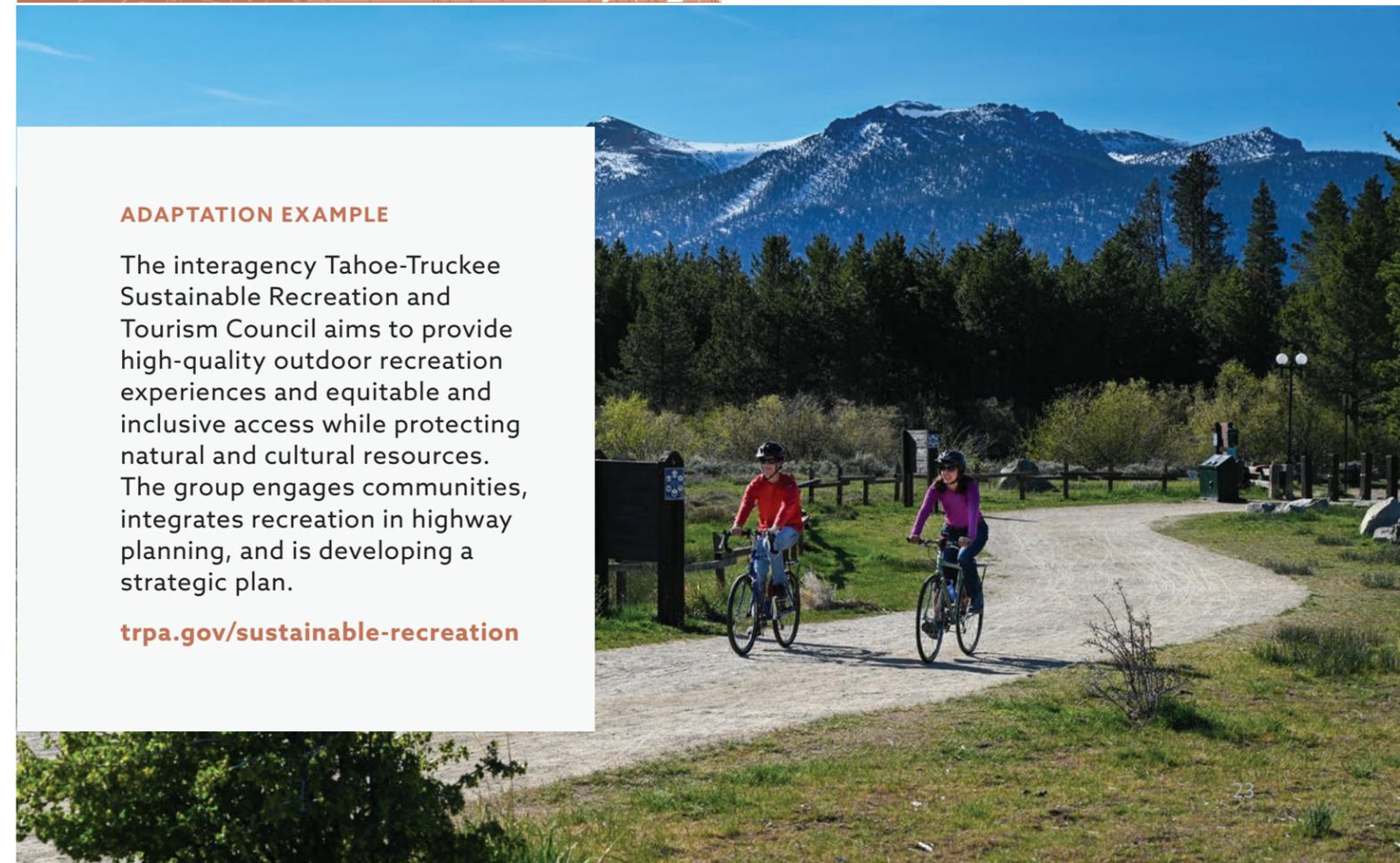
mer recreation season, requiring land managers to keep recreation sites open and staffed longer. Land managers are also adjusting how they design roads, trails, facilities, and parking.

→ Agencies are adjusting how they protect natural and cultural resources, and their management, educational, and emergency services.

ADAPTATION EXAMPLE

The interagency Tahoe-Truckee Sustainable Recreation and Tourism Council aims to provide high-quality outdoor recreation experiences and equitable and inclusive access while protecting natural and cultural resources. The group engages communities, integrates recreation in highway planning, and is developing a strategic plan.

trpa.gov/sustainable-recreation





LOOKING AHEAD

Basin partners have started adapting to climate change through numerous ongoing efforts. Successful adaptation integrates climate science and economics in building community resilience, resource management, infrastructure engineering, and business operations. Some climate change impacts may be so significant that they transform the ecology and culture of Tahoe. Adaptation will be essential for the foreseeable future, and will necessarily involve many more partners. The two states, the TRPA, the Washoe Tribe, and numerous federal and local agencies have already started leading the way. This closing section highlights what is already in motion and what is on the horizon.

STATE OF CALIFORNIA

- In 2021 the State of California is updating its Climate Adaptation Strategy, which will outline key climate resilience priorities; include specific and measurable steps; and serve as a framework for action across sectors and regions in California.
- In 2022 the California Air Resources Board will update its Climate Change Scoping Plan, which identifies how California will achieve carbon neutrality by 2045.
- The California Natural Resources Agency is coordinating the development of pathways to achieve the State's goal of conserving at least 30 percent of California's land and coastal waters by 2030.
- The California Natural Resources Agency is coordinating the first statewide Natural and Working Lands Climate

Smart Strategy to guide and accelerate long-term climate action across key California landscapes.

- Caltrans will consider and adopt adaptation options along the State Highway System based on each district's Climate Change Vulnerability Assessment. Caltrans is developing Adaptation Priority Primers that will evaluate and prioritize at-risk assets within each district, and help incorporate climate resilience in project development.
- The California State Transportation Agency will be finalizing its Climate Action Plan for Transportation Infrastructure in summer 2021. The plan details how the State recommends investing billions of discretionary transportation dollars annually to combat and adapt to climate change while supporting public health, safety, and equity.

STATE OF NEVADA

The State of Nevada has launched the Nevada Climate Initiative to collaborate with public, private, and nonprofit entities to implement the State Climate Strategy to reduce greenhouse gas emissions. Nevada agencies are developing innovative solutions that build resilience across communities and protect natural resources. Among other things, the strat-

egy describes climate impacts in Nevada, creative approaches to financing climate actions, effective climate governance, and the role of climate action in economic recovery. It provides a framework for Nevada policymakers to evaluate how well climate policies and programs align with the timelines and benchmarks necessary for Nevada to achieve its greenhouse gas emission reduction goals.

TAHOE REGIONAL PLANNING AGENCY

The TRPA has started a new Climate Resilience Strategic Initiative. Through stakeholder collaboration and public engagement, the TRPA will use the 2014 Lake Tahoe Sustainability Action Plan as a basis for developing a Tahoe Climate Resilience Strategy. The TRPA will integrate the states' actions into the strategy. Partners

will identify and prioritize mitigation, adaptation, and resiliency actions that fill climate information and implementation gaps. Ultimately, the TRPA will create a bi-state climate strategy that guides its environmental review, code, policy, and plan amendments. The TRPA will also update its sustainability indicator dashboard to create a real-time climate scoreboard to track regional progress.



Photo: courtesy of Tahoe Fund

IMPLEMENTATION OF EXISTING CLIMATE ACTION PLANS

Several state and local jurisdictions have already started or will begin to implement their recently completed climate plans. These include:

- Lahontan Water Board's 2019 Climate Change Mitigation and Adaptation Strategy
- Placer County's 2020 Sustainability Plan
- City of South Lake Tahoe's 2020 Climate Action Plan
- South Tahoe Public Utility District's 2019 Climate Adaptation Plan

OPPORTUNITY AREAS

Basin partners can provide additional state and national climate adaptation leadership by aligning more closely with California and Nevada planning frameworks in the following areas:

- 1.** Demonstrating the importance of equity and climate justice, including engaging tribal, low-income, and minority communities.
- 2.** Developing an implementation and monitoring plan to track adaptation success and adjust strategies as needed.
- 3.** Evaluating co-benefits and synergies between adaptation strategies to maximize multiple-benefit outcomes.
- 4.** Filling critical knowledge gaps, focusing on the research and monitoring needs identified by the Tahoe Science Advisory Council in its Science to Action Plans.

Through continued partnership, the Basin can get ahead of the climate change curve, and ensure that all Californians, all Nevadans, and all visitors to Lake Tahoe can enjoy its natural beauty and welcoming mountain culture far into the future.

