Sonoma County Climate Resilient Lands Strategy

PREPARED FOR THE COUNTY OF SONOMA
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This is a living strategy, and we look forward with hope for our collective stewardship of this remarkable place we share and call home.

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Header photo for the Sonoma-Mendocino Mixed Forest. Credit: Roy Luck / Flickr

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List of Acronyms and Abbreviations

Ag + Open Space	Sonoma County Agricultural Preservation and Open Space District
BRIC	Building Resilience Infrastructure and Communities
CalEPA	California Environmental Protection Agency
CAP	Climate Adaptation Plan
CARD	Climate Action and Resiliency Division
CLN2.0	Conservation Lands Network 2.0
CCA	Critical Coastal Areas
CNRM	Centre National de Recherches Météorologiques
CWD	Climactic water deficit
FEMA	Federal Emergency Management Agency
FIRO	Forecast Informed Reservoir Operations
GHG	Greenhouse gas
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
HMP	Hazard Mitigation Plan
IAG	Implementation Advisory Group
IPM	Integrated Pest Management
MTC	Metropolitan Transportation Commission
MIROC	Model for Interdisciplinary Research on Climate
NCRP	North Coast Resource Partnership
RCD	Resource Conservation District
RCPA	Regional Climate Protection Authority
TAC	Technical Advisory Committee
TNC	The Nature Conservancy
UCCE Sonoma County	University of California Cooperative Extension, Sonoma County
USDA	U.S. Department of Agriculture
U.S. EPA	U.S. Environmental Protection Agency

Executive Summary

Strategy Overview

Aerial View of Sonoma County.

Sonoma County, comprising over 1.1 million acres (1,500 square miles) and with a population of approximately 488,000 people, hosts a diverse landscape with coastal geography, varied topography, and a range of microclimates. Collectively, the landscape supports an array of ecological zones, plant and animal species, working lands, waters, and communities (Ag + Open Space, 2021a). Sonoma County's natural and working lands provide benefits that support the county's social, ecological, and economic health. These natural and working lands, however, are vulnerable to increasingly dramatic and rapid climate changes. To strengthen the climate resilience of natural and working lands throughout Sonoma County, the County of Sonoma (also referred to as "the County") has worked with partners and stakeholders throughout the county to develop this bold and critical Climate-Resilient Lands Strategy ("Lands Strategy"), which aims to address the following objectives:

- Conserve, manage, and restore as much of the county as possible across public, private, natural, developed, and agricultural lands.
- Focus early actions on areas with the greatest potential for climate risk reduction and biodiversity enhancement, and, where possible, promote carbon sequestration opportunities.
- Provide a forum for coordinated action on climate resilience in Sonoma County.
- Reduce fragmentation of the natural lands system by adding to conserved spaces, increasing connections and corridors, and working with private landowners to develop shared management strategies.
- Partner with local Native American tribes within Sonoma County to advance traditional ecological knowledge and preserve tribal cultural resources and tribal cultural properties.
- Identify funding and financing strategies from the county, state, and federal governments, as well as private funding sources, to advance this innovative and bold plan. Identify new concepts for funding and financing sources as well.
- Prioritize equity and climate justice approaches that are measurable and clear.

Defining Resilience in Sonoma County

Through this non-regulatory Lands Strategy, the County is working to build resilience into its natural and working landscapes, which encompass a diverse array of public and private uplands, soils, forests, chaparral, rangelands, coastal areas (including estuaries and oceans), riparian habitat, urban green spaces, wetlands, farms, and vineyards. A resilient landscape system can:

1. Adapt and offer protection to ecosystems and communities from extreme events and increasing climate risks.

2. **Provide critical ecological, economic, and social functions and benefits**—such as habitat for native species, improved agricultural production, methane reduction, carbon sequestration, clean water and air, food access and security, and more—to the county's human, built, and natural communities and systems.
3. **Reduce risk** to the county's natural, human, and built communities, with a priority on underserved and under-resourced communities.
4. **Promote equitable distribution of benefits** to the county's residents, with a focus on underserved and under-resourced communities.

Wildflowers at Cooley Ranch in Sonoma County.

To promote continued resilience of the natural and working lands system, the County will work with communities and public and private landowners to ensure that there are adequate financial and personnel resources, institutional capacity, and infrastructure for sustainable management and maintenance of the landscape system over time. Collectively, the natural and working lands of Sonoma County will serve as an adaptable and redundant (i.e., replicates the same land types, species, or features) system that is integrated into the county's water, mobility, housing, and public health systems and institutions to provide resilience, sustainability, and capacity over the next century and beyond.

Climate Hazards

A variety of hazards could impact Sonoma County's natural and working lands, and the County and its partners must consider these hazards in determining actions to strengthen resilience. The Lands Strategy provides details on historical and projected impacts of the following climate hazards:

Warming climate. Temperatures within Sonoma County are expected to increase by nearly 5 degrees Fahrenheit by the 2060s (U.S. Federal Government, 2021), with an increasing number of high-heat days with temperatures over 93 degrees Fahrenheit. Increased temperatures could result in desiccated plants and soils, increased likelihood of drought, and the creation of major public health concerns, especially among vulnerable populations.

Changing rainfall patterns and flooding. While rainfall projections vary regarding estimated annual precipitation for Sonoma County, projections concur that the timing and amount of rain that falls during individual events will change. Although rain can be beneficial, the predicted increase in intensity and volatility of these events can turn a much-needed rainstorm into a hazardous event due to concerns such as flooding, erosion, landslides, crop damage or loss, property damage or loss, and damage to roadways.

Drought. Although drought is a recurring feature of California's lands, climate change has led to more frequent, intense, and prolonged droughts in California and Sonoma County (Desert Research Institute & Western Regional Climate Center, 2021; Public Policy Institute of California Water Policy Center, 2021). These conditions will continue in the coming decades. Prolonged drought can make ecosystems vulnerable to pests and non-native species, impact water quality and ecosystem function, and increase wildfire risk (North Coast Resource Partnership, 2020). During droughts,

ranchers may also struggle with providing adequate food or grazing land for their animals, and farmers' water supplies may be limited or reduced.

Wildfire. A combination of historical fire suppression, prolonged periods of extreme drought, and increasing temperatures have led to increased frequency and severity of wildfires. Within Sonoma County, changes in land use and development—including development in the wildland-urban interface and low-density development patterns—have led to loss of life, property, and infrastructure due to fire. The potential for increased fires could reduce the ability of Sonoma County's natural and working lands to buffer climate impacts, store carbon, and provide ecological and economic benefits.

Sea level rise and coastal storms. Sea level rise, storms, and erosion are already impacting Sonoma's Pacific-side and Bayside habitats and communities. As seas rise, Sonoma County communities along the Pacific coast and San Francisco Bay shoreline will face damaging effects from El Niño–driven storm events combined with high tides and large waves. Without adaptation, homes, critical infrastructure, agricultural lands, tourist destinations, and important coastal habitat will be lost to flooding, permanent inundation, and erosion (Griggs, 2021). Additional impacts that could occur from sea level rise include landslides, migration of saline water farther upstream, groundwater rise and salinity intrusion, and limited shoreline access.

Climate-Resilient Lands and Ecoregions

RESILIENT LAND TYPES

The natural and working lands that are the focus of the Lands Strategy include many natural and agricultural land cover types. The Lands Strategy details eight specific land types that constitute the natural and working lands of the county. Table 1 below summarizes these land types. (Note that because some areas within Sonoma County have mixed or overlapping land types, the percent breakdowns in Table 1 may add up to over 100 percent).

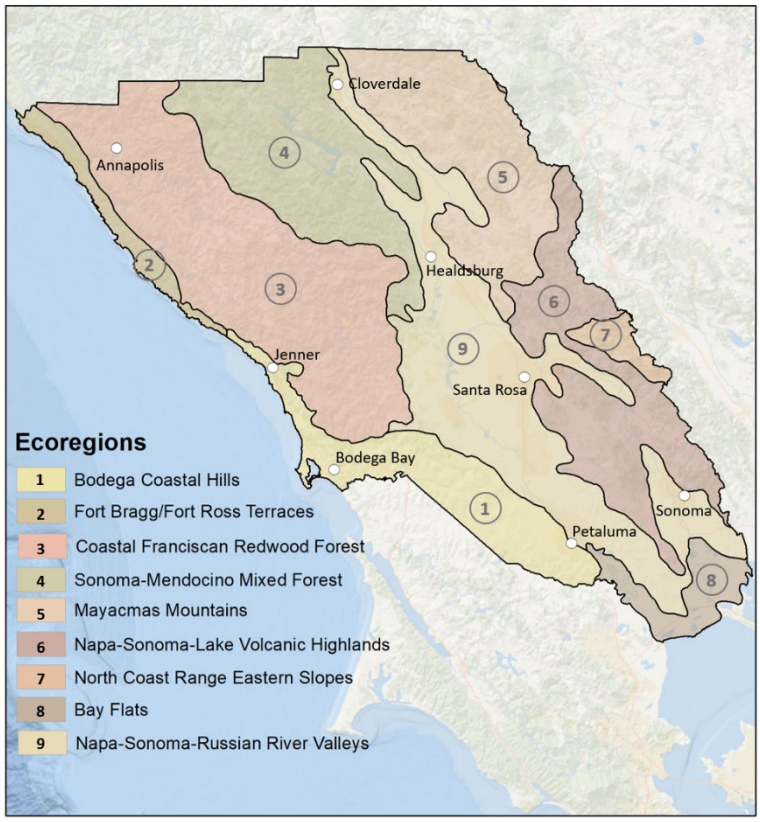
Table 1. Land types.

Land Type	Description
Forests	Composing 50% of the county and covering approximately 525,000 acres, the forests of Sonoma County contain oak woodland, coast redwood, Douglas fir, and mixed hardwoods. Forest communities are critical in building climate resilience and ecological and community health and can also play an important role in sequestration of atmospheric carbon. The forests are, however, at significant risk to climate-related changes including drought, warmer temperatures, and reduced precipitation, which are predicted to drive increasing intensity and frequency of wildfires and species range shifts.
Agricultural Lands: Croplands, Vineyards, and Grazing Lands	The 227,000 acres of agricultural lands (22% of lands) in Sonoma County are a cornerstone of the heritage and local economy of the region and an important element of a dynamic and diverse landscape. The vast rangelands support numerous agricultural industries, including meat and dairy farming, while preserving large tracts of land that provide habitat and movement corridors for a range of native species. The local farms, ranches, and vineyards that produce food as well as fiber and plant materials constitute an industry that generates approximately $1 billion dollars annually, with vineyards alone being responsible for half this amount.

Land Type	Description
Aquatic Ecosystems: Wetlands and Riparian Streams and Corridors 	Wetlands in Sonoma County constitute about 52,500 acres (5% of lands); additionally, Sonoma County also has riparian streams and corridors that have maintained some of their natural characteristics in spite of climate change and human intervention. Sonoma County's wetlands provide enormous benefits in terms of biodiversity, water quality, carbon sequestration, and flood protection. These wetlands also serve as key stops on the Pacific flyway and, as such, support incredible bird biodiversity. Benefits provided by a healthy riparian corridor include biodiversity, recreation areas, nutrient cycling, cool microclimates, reduced peak flows, flood risk reduction, and disrupted spread of wildfire (U.S. Forest Service, n.d.). These services are especially important in the context of a changing climate.
Grasslands 	Grasslands cover about 264,000 acres (25% of lands) of Sonoma County, and non-native grasses dominate most of this landscape. Some land managers, however, are working to bring back native grasses, which have deeper roots and provide more ecological and climate benefits. Grasslands have the potential to provide grazing land, open spaces, habitat, preservation, and water capture. Coastal prairie, a highly variable mixture of native perennial grasses and forbs, native and nonnative annual forbs, and non-native grasses, supports the highest plant diversity of all North American grasslands. One of the largest remaining areas of contiguous coastal prairie is situated west of Petaluma but encroaching invasive grasses continue to threaten its range (Kraft et al., 2007). Although Sonoma's grasslands have been significantly impacted by human activity, adjacent land use, and land management practices, they can increase carbon sequestration potential while also reducing risk from flooding, drought, erosion, wildfire, and heat.
Shrubland and Chapparal 	Shrubland and chaparral compose approximately 42,000 acres (4%) of Sonoma County's lands. Shrubland and chaparral areas are generally known to be rich in native species and biodiversity and are fairly resilient to heat and drought. However, resource users and managers have historically considered these lands less appealing than other land types. This has resulted in shrublands and chaparral suffering a significant amount of removal for agriculture and grazing, encroachment by development, and damage due to clearing for development and exposure to flooding and fires (Underwood et al., 2018). Recent studies have found that the extreme droughts, as well as an increase in the intensity and duration of extreme heat events, are causing significant damage to these vegetative communities.
Developed Lands 	Sonoma County has about 70,500 acres (6.7% of lands) of developed lands, which include urban areas, human development in non-urban areas, and infrastructure and utilities in both urban and non-urban areas. Interspersed within developed areas are a variety of natural communities and habitats, creating a mosaic of built environment and natural spaces. Urban forests, streams, wetlands, and community parks contribute significant social, economic, and ecological benefits, as well as contributing to climate resilience. However, the benefits from urban trees and green spaces, in addition to naturalized riparian corridors or green infrastructure, are not experienced equally across the county. Focusing these benefits equitably across the county will increase resilience to the entire county and reduce the intensity of hazard events, as well increasing the potential for carbon sequestration, creating a continuous network of healthy, climate-resilient lands across the county.

ECOREGIONS

Figure 1. Ecoregions in Sonoma County.



Characterizing and assessing the scope of the diverse and unique natural resources of Sonoma County required identifying a spatial framework that acknowledges the underlying physical processes and patterns that drive habitat suitability for living organisms and feasibility for different land uses, including agricultural lands and production. The Lands Strategy uses the U.S. Environmental Protection Agency (U.S. EPA) Level IV ecoregions as a foundation for defining ecological land classifications within the county using distinctive physical and biological features such as geology, landform, soil, vegetation, climate, wildlife, water, and human factors. EPA developed ecoregions based on similar variations of environmental characteristics that influence biological community use and composition. As shown in Figure 1, the regions are used to support a variety of planning and assessment applications for large geographic areas (Omernik & Griffith, 2014). The physical and biological characteristics of each ecoregion provide information on the suitability of the area for native plants and animals, as well as agricultural lands and production. The Lands Strategy contains more details on each of Sonoma County's nine ecoregions.

Landscape- and Watershed-Scale Project Recommendations

The impacts of climate change on Sonoma County's natural and working lands are not anticipated to be uniform and will vary based on some of the vulnerability characteristics that are inherent to specific vegetation communities, as well as throughout the landscape system (Weiskopf et al., 2020). Certain natural communities, species, agricultural types, and human communities are more likely to readily adapt to a changing climate based on existing resilience characteristics, while others will be more sensitive due to existing or underlying factors and stressors. The recommendations below are non-regulatory actions the County should consider prioritizing at the county-wide scale. Recommendations regarding specific projects and actions will be considered in more detail during implementation of the Lands Strategy, which may include permiting requirements, CEQA analysis, and will require additional stakeholder engagement.

1. **Bring climate resilience to people most at risk** so that resilience projects—such as resilient buffer zones, urban stream restoration, and support for regenerative agricultural practices—can provide benefits and reduce risks to disadvantaged and marginalized populations.
2. **Conserve and manage forests**—including conserving existing healthy forests and conserving, managing, and restoring degraded forests in high-fire-risk zones through climate-resilient management practices and reforestation approaches that mimic historical ecological patterns. These actions will promote a protected mosaic of different land types that can provide risk

reduction, promote genetic transfer and wildlife migration, and allow for habitats, wildife, and vegetation to shift and adapt to new climate conditions.

3. **Conserve and restore native grasslands** through promoting regenerative practices that can restore grasslands to native species and sequester and store carbon above and below the ground. These actions could help grasslands become an important contributor to the county's overall carbon reduction goals. These actions reduce water usage by increasing root depth and the water storage capacity of the soils, help the County find new sources of funding, and create more sustainable grazing lands. Climate-resilient rangeland management practices also contribute to flood, fire, and heat risk reduction countywide.

Cows Grazing on Uncle Henry's Ranch in Sonoma County.

4. **Develop partnerships to increase climate resilience** to leverage the skills, knowledge, and capacity of the wide range of agencies, organizations, private businesses, private landowners, farmers, grazers, agricultural organizations, community organizations, and local Native American tribes in Sonoma County. Many of these entities are already working on these issues at smaller geographic scales or in relation to a particular climate hazard, and promoting coordination among these organizations could help build trust, increase capacity, advance projects, and ultimately share the benefits and responsibilities of taking action to build climate resilience.
5. **Increase and connect the amount of conserved lands** to help reduce the current fragmentation of Sonoma County's conserved areas, increase the size of conserved lands, and create space for migration of species and habitat due to climatic shifts. Through tools such as conservation easements, strategic land acquisition, carbon banking and carbon sequestration planning, and more, the County has an opportunity to undertake actions at the scale of change necessary to improve climate resilience throughout its natural and working lands for the whole county's benefit.
6. **Make Sonoma County a sponge** so it can fully realize the climate resilience benefits offered by aquatic habitats, such as the ability to capture and store water and release it to adjacent rivers, streams, and soils. Through projects such as nature-based approaches to shoreline management, design and planning for flood resilience, and conservation and restoration of headlands, coasts, and bays, Sonoma County can greatly strengthen the resilience of its aquatic ecosystems.
7. **Support and increase regenerative agricultural practices** that can help strengthen efforts throughout the county to adapt to climate, reduce risks, and sequester and store carbon at a meaningful scale. Regenerative agricultural practices applied to croplands and vineyards would provide significant climate resilience benefits to soils, reduce water usage, improve water quality, protect and restore native species and aquatic areas, provide for wildlife and genetic corridors, protect and restore riparian corridors, increase food security, and serve as a buffer from other hazards such as flooding, wildfire, and heat.

How to Use the Lands Strategy

The sections below outline the function and structure of the Land Strategy and its intended use.

WHO SHOULD USE THE STRATEGY?

County agencies are intended to be the primary user group of the Lands Strategy. However, given the need for tribal governments and public, private, non-profit, and other agencies and organizations to work together to advance climate resilience in the county, the Lands Strategy also contemplates its use by other government entities, private landowners, farmers, grazers, grape growers, non-profits, and others. The transformative and significant changes needed to advance the climate resilience of Sonoma County's natural and working lands will require individual and collective actions by these agencies and organizations. To support the use by a range of actors, the Lands Strategy provides different entry points or approaches to advance action, including project concepts, geographic recommendations, potential funding sources, criteria to guide project planning and design, and indicators to measure progress. This comprehensive content offers a diversity of opportunities for County agencies and partners to advance climate resilience either individually or collectively in a way that can result in a comprehensive, landscape-scale approach. The following sections describe the content of the Lands Strategy in more detail.

RESILIENCE DEFINITION AND LAND STRATEGY OBJECTIVES

In Chapter 1 *(Introduction to the Sonoma County Climate-Resilient Lands Strategy)* and Chapter 2 *(Climate Resilient Lands Strategy Process)*, the Lands Strategy provides a definition of climate resilient natural and working lands found on pages 14-15 and Lands Strategy objectives on page 15. The definition of climate resilient natural and working lands was developed with the Lands Strategy Technical Advisory Committee (TAC) and Implementation Advisory Group (IAG) and includes important concepts and characteristics that should be included in projects that are designed and implemented to advance climate resilience. The Lands Strategy definition and objectives include prioritizing climate justice, sustainability, and biodiversity as well as designing and siting projects at a landscape scale to increase connectivity and provide for redundancy and vertical and horizontal migration corridors to enable climate adaptation.

PROJECT CONCEPTS

Chapter 3 *(Climate Hazards)* and Chapter 4 *(Climate-Resilient Lands and the Sonoma County Landscape System)* offer context that the Lands Strategy used to develop project concepts at two scales. The first is the countywide or landscape and watershed scale. The priority landscape and watershed-scale project concept recommendations can be found in the countywide findings section that begins on page 54. In this section, principles for both landscape-scale and watershed-scale resilience are defined and those principles are followed by priority landscape-scale or watershed-scale project concepts that apply countywide. The second scale of project concepts is the ecoregion scale. The ecoregions section of the Lands Strategy begins on page 66. The ecoregions describe the ecological and social characteristics of sub geographies within Sonoma County and provide an opportunity for more specific project concepts designed to address land use, ecological, demographic, and governance characteristics present within each ecoregion. The ecoregions also include a set of indicators to consider when planning, designing, and implementing projects to ensure that projects are locally relevant and responsive within each ecoregion.

Both scales of project concepts respond to Sonoma County's opportunities and challenges as identified by stakeholder and community engagement, the research and assessment conducted for the Lands Strategy (and outlined in detail with Chapters 3 and 4), and the County's risks, priorities, assets, and natural and community characteristics. Landscape-scale, watershed-scale, and ecoregion specific project concepts

that are being recommended and prioritized by the Lands Strategy are described in Appendix A. Each project concept outlines the locations where the concept should be implemented, with some being applicable at the landscape or watershed scale and others applying to specific ecoregions. These project concepts can be used as an entry point for a project to be applied in a specific location. For example, conservation and restoration of riparian corridors is a significant priority of the Lands Strategy. Project proponents who wish to advance a riparian conservation and restoration project can begin by using the project concept in Appendix A, Concept O on page 188 as a template to expand upon, in addition to using the funding sources, partners, indicators, and ecoregions to ensure new riparian corridor projects fit into a comprehensive county approach to climate resilience. As projects are implemented, the Lands Strategy could be updated to add additional project concepts or refine existing concepts to incorporate lessons learned, advance new opportunities, or adapt to changing priorities or conditions.

PROJECT LOCATIONS

Chapter 5 *(Sonoma County Ecoregions)* provides details on the ecological, land use, demographic, and governance characteristics within Sonoma County and identifies the critical assets and services within each ecoregion. The Lands Strategy recognizes that balancing countywide recommendations with the reality that the risks, characteristics, conditions, opportunities, and challenges facing Sonoma County's natural and working lands are different depending on their location. The coastal bluffs in the western portion of the county and the mountains in the eastern part of the county include different vegetative communities, habitats, land uses, populations, and demographics, and also face different risks. How climate justice, sustainability, community risks and priorities, and the availability of resources are considered also depends on these different conditions and characteristics. To address these differences, the Lands Strategy uses the EPA's Level IV Ecoregions for Sonoma County. The Lands Strategy also applies other geospatial data to identify the additional characteristics, including County land use designations and Metropolitan Transportation Commission's Equity Priority Communities data, as well as information from Ag + Open Space's Vital Lands Initiative, Sonoma Water's Climate Adaptation Plan, and data on parks and trails from Regional Parks. Collectively, this informs the most significant hazards and consequences within each ecoregion, the predominant habitat types and vegetative communities, the mix of land uses, and the presence of community characteristics that make community members more vulnerable to climate risk. Within each ecoregion, the Lands Strategy offers details on the natural and working lands assets and services, the land use and demographic considerations, and the priority project concepts. Please refer to pages 66 to 112 for these details.

PROJECT PLANNING, DESIGN, IMPLEMENTATION, AND MONITORING

Chapter 6 *(Project Planning, Design, and Implementation)* provides a framework and process for the County and other implementors to plan for, select, design, and implement new resilience-related projects, including recommendations related to project design, funding, and engagement. These categories are described in more detail below.

Engagement: The Lands Strategy includes a blueprint for successful engagement and partnerships during project development and implementation. The Team envisions that County-led projects will incorporate robust engagement and partnerships; they will also be carried out in the context of active and ongoing program-level engagement and partnerships. For example, the County will continue to work with local Native American tribes to strengthen partnership in planning, developing, and implementing projects to improve climate resilience in our shared landscape (for more discussion on this, see page 126). Effective future engagement and partnerships with communities, landowners, businesses, nonprofits, scientists, and other stakeholders will be critical to the success of individual projects and the Lands Strategy overall. While the Lands Strategy is not a regulatory document or a project as defined by CEQA, projects that are

ultimately implemented out of the Strategy should include robust engagement, participatory processes, and may need to comply with any applicable permitting requirements and CEQA review.

Funding: To advance climate resilience throughout the county's natural and working lands, additional funding and financing will be necessary. The Lands Strategy includes local, state, and federal funding and financing sources and approaches and highlights which ones are the best match for the different project concepts recommended in the Strategy. The funding and financing sources and approaches can be found on pages 116-122, including a comprehensive table on page 122 and additional details in Appendix D.

Project design: To guide design of projects and promote projects that meet the objectives of the County, the Lands Strategy includes screening criteria that are intended for use early in the project planning and design process. These screening criteria can assist project proponents and designers in considering critical issues such as advancing food security, increasing local jobs that pay a living wage, reducing risk to critical county assets, and increasing climate resilience for disadvantaged communities. While these issues are often referred to as "co-benefits," the Lands Strategy includes the screening criteria to emphasize the need to include these issues early in project design as core benefits and not as add-ons. While not every project will meet all screening criteria and there is no expectation that they do so, projects should be planned and designed to meet as many of the screening criteria as possible. These screening criteria, if used to guide project planning and design, will contribute to achieving the climate resilience definition, objectives, and principles identified in the Lands Strategy.

Project monitoring: To ensure that the Strategy is accountable and measurable, the Lands Strategy outlines indicators which are included at several scales. The primary countywide indicators—at a landscape or watershed scale— are detailed in Appendix F and designed to provide a way to identify desired outcomes and measure progress toward the resilience of the natural and working lands. Indicators at this scale focus on measurable factors for which data exist or is easy to obtain. There are also indicators in the Lands Strategy for the land types, such as forests and wetlands and for the ecoregions. These indicators are at a more refined scale and refer to specific land types or sub geographies or ecoregions. The data for these indicators are not always available and are more aspirational rather than measurable. The different scales of indicators are intended to provide a way to identify desired outcomes and to measure progress over time. As data and information increases, additional indicators could be added to the countywide indicators to increase the County's ability to measure and communicate progress. Beyond the listed indicators, the Lands Strategy also includes performance criteria on pages 115-116 that are designed for use toward the end of project design to assess how well each project addresses a more limited and measurable set of key criteria.

Hikers Near Jenner, Sonoma County.

1. INTRODUCTION TO THE SONOMA CLIMATE RESILIENT LANDS STRATEGY

I. Strategy Overview

Sonoma County, comprising over 1.1 million acres (1,500 square miles) and with a population of approximately 488,000 people, hosts a diverse landscape with coastal geography, varied topography, and microclimates that collectively support an array of ecological zones, plant and animal species, working lands, waters, and communities (Ag + Open Space, 2021a). Located at the heart of the California Floristic Province, a globally recognized biodiversity hotspot, Sonoma County encompasses a multitude of vegetative communities and northern California habitats (Sonoma County Community Foundation & Sonoma Water, 2010), ranging from aquatic ecosystems to agricultural lands to developed areas. Lands within Sonoma County have a high degree of climatic variation that ranges from a marine climate on the coast, and a coastal warm climate inland, in addition to a variety of topographic and geologic landscapes (Sonoma Veg Map, 2020). While these conditions currently support a range of habitat and species diversity, these habitats and species are also vulnerable to dramatic and rapid climate changes.

To increase climate resilience throughout Sonoma County, the County of Sonoma (hereafter referred to as "the County") and its partners must act now to conserve, manage, and restore the natural and working lands that support Sonoma's social, ecological, and economic health. This critical Climate Resilient Lands Strategy ("Lands Strategy") focuses on achieving climate resilience by preserving and enhancing the benefits provided by the county's natural and working lands—such as clean water, clean air, food security, parks and trails, biodiversity, and the ability to adapt to changing conditions. Natural and working lands also play a significant role in climate resilience. Healthy lands can reduce risks to wildfire, flood, drought, and heat, in addition to providing strengthened protection for the county's communities, critical infrastructure, and treasured forests, croplands, vineyards, grasslands, coastal areas, riparian habitats, and parks that are so integral to the county's ecological, social, and economic stability. This stability provides direct benefits to the communities, workers, and others who rely on a healthy and safe county for their livelihoods and wellbeing, food security, housing, and more. With its mix of forests, riparian corridors, grasslands, crops, vineyards, and grazing lands, Sonoma County has a great opportunity to improve the capacity of these lands to contribute to climate resilience, mitigation, and adaptation. Improving this capacity directly benefits the communities, workers, and others who rely on a healthy and safe county for their livelihoods and wellbeing, improving food security, protecting existing housing, and providing for jobs and working lands. By maximizing the resilience of natural systems and working landscapes in a way that prioritizes resilience, equity, and sustainability, the County can achieve multiple objectives in a way that is effective, efficient, and adaptable.

Animals Grazing at Taylor Mountain Regional Preserve, Sonoma County.

The state of California recognizes the power of natural and working lands to improve climate resilience through two recent major initiatives: the Natural and Working Lands Climate Smart Strategy, released in 2021, and the Pathways to 30x30, released in April 2022. California has been designated as one of the world's 36 biodiversity hotspots, and within the state, Sonoma County is specifically recognized for its high biodiversity. Sonoma County is also known around the world for its vineyards, croplands, and dairy products. Sonoma County's farms and ranches are critical to food security within the county and the livelihood of small farmers, farmworkers, local grocers, and many others who rely on the county's working lands.

The County of Sonoma—working with the state of California, local Native American tribes, and partners within the county that include Resource Conservation Districts (RCDs), other public entities, land trusts, farmers, grape growers, grazers, private landowners, businesses, and local organizations—has a once in a lifetime opportunity to increase the resilience of Sonoma County's natural and working lands, reduce climate risks, increase ecological and community resilience, and contribute the health and adaptability the whole county. To help the County work toward achieving these critical goals, the purpose of the Lands Strategy is to provide non-regulatory guidance that will help the County comprehensively assess climate risks and move toward implementing the following actions:

- Restore the resilience benefits of natural and working lands to protect biodiversity, ecosystem health, reduce climate risks, and, where possible, sequester and store carbon.
- Protect carbon storage by preventing the conversion and loss through deforestation, degradation of wetlands or riparian corridors, or land use type conversion.
- Reduce the frequency and intensity of climate risks to the county's natural and built assets.
- Provide other ecological and community benefits including clean air and water, abundant and equitably accessible green spaces, and increased trust and capacity among the public, private, tribal, and other partners necessary to achieving the Strategy's outcomes.
- Identify opportunities to integrate work across County agencies to strengthen climate resilience.

II. Opportunities to Strengthen Resilience

The County and its partners have completed a range of climate adaptation, mitigation, and resilience work within Sonoma over the last 10 years. In addition, a significant number of non-County organizations within Sonoma County work on natural and working lands issues. Collectively, these efforts have resulted in a number of unique opportunities and challenges. The County will need to address these challenges to develop and implement a coordinated, countywide strategy. Table 2 below highlights key opportunities and challenges throughout the county.

Table 2. Key opportunities and challenges to strengthen resilience in Sonoma County.

Theme	Opportunities	Challenges
Capacity, coordination, and funding	• High-quality and high-functioning nonprofit, public agency, research, and land trust organizations that work on Sonoma County climate issues (e.g., Sonoma Water, Sonoma Ecology Center, Regional Parks, Pepperwood Preserve, University of California Cooperative Extension Sonoma County, and more). • High-resolution, high-quality data on much of the lands and waters in the	• Lack of coordinated action among multiple partners. • Critical work is being done by organizations that rely on grant funding and donations, with few ongoing stable funding sources.

Theme	Opportunities	Challenges
	county, including through the Sonoma County Veg Map.	
Current land use patterns	• Sonoma County has historically used urban growth boundaries, zoning, and greenbelts to protect its natural and working lands and provide benefits to communities. • Significant amount of undeveloped land with high-quality habitat, biodiversity, diverse landscape mosaics, and a wide variety of elevation types and landforms. • Large proportion of conserved and protected land across all ecoregions. • Potential for increasing opportunities for home gardening and farming in urban and rural residential areas to increase food security.	• Natural and working lands have been altered and degraded by development, pesticide use, and invasive species, as well as lack of management, staff and financial resources, and community and organizational capacity. • Lands also face increasing risks from climate change, and the network of protected lands is fragmented and separated by significant gaps. • Natural and working lands have faced and continue to be at considerable risk from wildfire, heat, drought, sea level rise, and long-term flooding.
Governance structure	• Unique governance approaches of Ag + Open Space and the Regional Climate Protection Authority (RCPA) that offer an opportunity to take action more directly and across sectors and to leverage resources and capacity.	• Lack of staff and capacity to carry out needed work in a timely manner (e.g., engagement, outreach, planning and implementation). • County agencies operate at different levels of capacity related to climate adaptation, mitigation, and resilience.
Local communities and workers	• Many communities, workers, and others rely on and contribute to the robust economy and lands of Sonoma County and are committed to strengthening its resilience. • The use of regenerative farming practices could improve the health and safety of local communities and workers by reducing exposure to chemicals and pesticides.	• Farmworkers are being exposed to wildfire smoke, an increasing number of high-heat days, and air quality degradation. • A lack of climate resilience qualities exists in both urbanized and rural areas, exposing communities in parts of Sonoma County to high risks and fewer resources to respond to those risks. • A lack of affordable housing increases pressure on community members, workers, the land, and its resources.
Partnership	• Great potential for partnerships among local Native American tribes, RCDs, farmers, farmworkers, local business owners, environmentally aware community members, and government. • Many tribal communities are willing to partner and have significant ecological and cultural knowledge of the lands and waters of Sonoma County.	• Many organizations are already part of existing collaborations and partnerships and have limited capacity and bandwidth for new, climate resilience-focused efforts. • Organizations have various degrees of technical capacity related to adaptation, mitigation, and resilience.
Small landowner partnership and coordination	• Many small natural and working landowners are committed to applying ecological principles on their properties.	• Implementing new practices (some of which may be technically complex) can be difficult for small property owners with limited resources and capacity.

III. Lands Strategy Project Team and Engagement Approach

The Lands Strategy was led by a team with representatives from Ag + Open Space and the Climate Division and funded by both the Climate Division and Ag + Open Space. This team met weekly to coordinate engagement and outreach, identify data and information sources, and provide input on direction and desired outcomes.

It was critical for the project team to engage a broad range of organizations to ensure the Lands Strategy was informed by a diversity of perspectives and the expertise of local partners from other County agencies and outside organizations. The project team started by forming a Technical Advisory Committee (TAC) and an Implementation Advisory Group (IAG) to advise the project team on data sources, social and ecological indicators, project types, and existing projects and policies within the county. Over the course of the project, the TAC met five times and the IAG met four times, with two of the meetings being held jointly.

In addition to these advisory groups, the County and the project team conducted outreach and engaged with a range of organizations and community and issue area representatives. Topic areas discussed included climate equity, just transition, worker rights and health, and agroecological farming practices. The project team also initiated engagement with local Native American tribes through an informal consultation. The County invited all five federally recognized, local Native American tribes in Sonoma County to participate, and four tribes participated and provided their insights and priorities for the Lands Strategy. The County and tribes intend to continue and strengthen this partnership. For meeting agendas see Appendix B. In addition to the engagements and consultations described above, the County held a 30-day public comment period in June and July 2022 and a public workshop in June 2022. More details on the engagement process and outcomes are in Chapter 2.

IV. Strategy Objectives and Defining Resilience in Sonoma County

To guide implementation of the Lands Strategy, it is critical to have a clear definition of resilient lands and objectives for how the County and its partners will use this document. Through work with the TAC and IAG, the project team developed the definition and objectives below to guide this Lands Strategy.

Climate Resilient Lands Definition

Through this Lands Strategy, the county is working to build resilience into its natural and working landscapes, which encompass a diverse array of public and private uplands, soils, forests, chaparral, rangelands, coastal areas (including estuaries and oceans), riparian habitat, urban green spaces, wetlands, farms, and vineyards. A resilient landscape system is one that can:

1. **Adapt and offer protection** to ecosystems and communities from extreme events and increasing climate risks.
2. **Provide critical ecological, economic, and social functions and benefits**—such as habitat for native species, improved agricultural production, methane reduction, carbon sequestration, clean water

and air, food access and security, and more—to the county's human, built, and natural communities and systems.

3. **Reduce risk** to the county's natural, human, and built communities, with a priority on underserved and under-resourced communities.
4. **Promote equitable distribution of benefits** to the county's residents, with a focus on underserved and under-resourced communities.

Climate Resilient Lands Objectives

To promote continued resilience of the natural and working lands system, the County should work with communities and public and private landowners to help develop adequate financial and personnel resources, institutional capacity, and infrastructure for sustainable management and maintenance of the landscape system over time. Collectively, the county's natural and working lands will serve as an adaptable and redundant system that is integrated into the County's water, mobility, housing, and public health systems and institutions to provide resilience, sustainability, and capacity over the next century and beyond. Building on the County's goals for climate resilience, this Lands Strategy aims to support the County in working toward addressing the following objectives:

- Conserve, manage, and restore as much of the county as possible across public, private, natural, developed, and agricultural lands.
- Focus early actions on areas with the greatest potential for climate risk reduction and biodiversity enhancement, and where possible, promote carbon sequestration opportunities.
- Provide a forum for coordinated action on climate resilience in Sonoma County.
- Reduce fragmentation of the natural lands system by adding to conserved spaces, increasing connections and corridors, and working with private landowners to develop shared management strategies.
- Partner with local Native American tribes within Sonoma County to recognize and elevate traditional ecological knowledge and preserve tribal cultural resources and tribal cultural properties.
- Identify funding and financing strategies within the county, state, federal, and private funding to advance this innovative and bold plan.
- Prioritize equity and climate justice approaches that are measurable and clear.

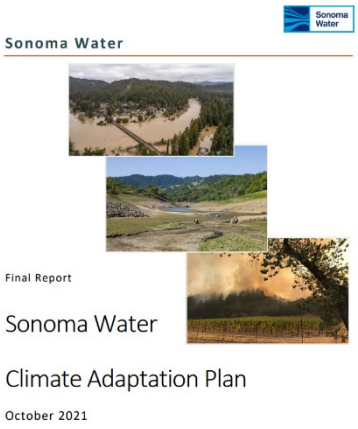
Community Hike at Taylor Mountain Regional Preserve, Sonoma County.

2. CLIMATE RESILIENT LANDS STRATEGY PROCESS

I. Existing Efforts and Plan Alignment

The Lands Strategy is informed by many recent plans and efforts in the county, region, and state related to climate change and resiliency. The project team worked with the TAC and IAG to identify the most relevant and recent resources. Since the Strategy is both multi-hazard and multi-issue, there were a significant number of high-quality, recent documents and resources to support this work and serve as a strong foundation for this strategy. A few key resources reviewed in developing this Lands Strategy are summarized below. Most resources reviewed related to Sonoma County itself (Table 3); however, the state of California also has a wide range of planning, policy, and programs related to climate adaptation, mitigation, and resilience of natural and working lands (Table 4). Sonoma County's resources and needs are closely aligned with the state of California climate resilience priorities, particularly the Natural and Working Lands Climate Smart Strategy and Pathways to 30x30, both of which are highlighted below in Table 3. A full list of work reviewed for this project is included in Appendix C.

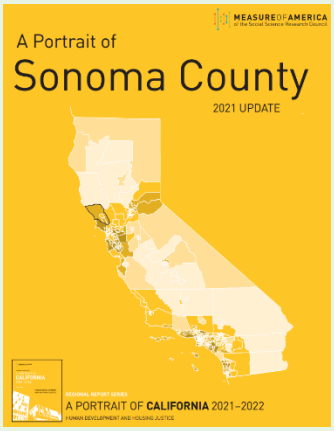
Table 3. Existing efforts related to Sonoma County.

Sonoma County–Specific Efforts
Sonoma County Ag + Open Space Vital Lands Initiative Ag + Open Space's Vital Lands Initiative, adopted in 2021, provides a vision for the conservation of Sonoma County's open spaces, biodiversity, agriculture, parks, trails, and wide range of natural communities, such as forests, rivers, and grasslands. The Vital Lands Initiative provides a clear summary of the current state of conservation in Sonoma County, including that Ag + Open Space has conserved over 122,000 acres of land, or the equivalent of 12% of Sonoma County's total acreage. Built on a significant amount of community engagement, it was important when developing this Lands Strategy to understand key themes from this engagement; these themes are discussed further in Section II below. These and other comments, as well as the goals and priorities of Vital Lands, were considered in the development of the Lands Strategy. 
Sonoma Water Climate Adaptation Plan Sonoma Water's Climate Adaptation Plan (CAP), adopted in 2021, is another important recent planning initiative. Specific to Sonoma Water's assets and services, the CAP includes climate objectives and climate change scenarios for temperature, flooding, wildfire, drought, sea level rise, and extreme precipitation, which were considered while developing the assessment and recommendations for project types to increase climate resilience. Sonoma Water's CAP also includes a summary of findings related to most significant risks to Sonoma Water's core functions: water supply, flood management, and sanitation. There were several relevant actions recommended in the CAP that this Lands Strategy also identifies as priorities, including developing and implementing a regional flood management strategy and improving watershed management with a focus on healthy headwaters. 

Sonoma County–Specific Efforts

Portrait of Sonoma County

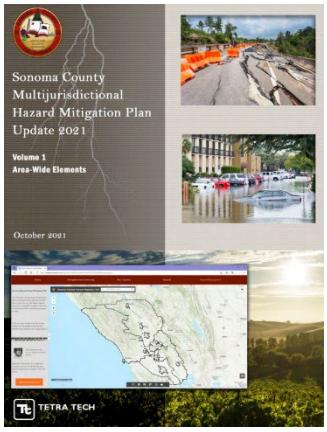
The Portrait of Sonoma County was updated in 2021 and provides an overview of the demographic characteristics of Sonoma County. The document is a summary of the data and information available about the people who live within Sonoma County and highlights demographic, health, and quality of life factors, such as life expectancy, access to knowledge, and a decent standard of living. In addition to the characteristics of the people within the county, the portrait includes a summary of the challenges people face in Sonoma County, which includes wildfires, the COVID-19 pandemic, the affordable housing shortage, economic insecurity, and disproportionate harm falling on communities of color. The information in the Portrait of Sonoma County, as well as the Metropolitan Transportation Commission's Equity Priority Communities data, informed the project locations, approach, engagement, planning, design, and implementation.



Sonoma County Multijurisdictional Hazard Mitigation Update 2021

In 2021, the County completed an update to its Multijurisdictional Hazard Mitigation Plan (HMP) (Permit Sonoma, 2021b). The County is using the HMP to help establish priorities for hazard mitigation. In developing this Lands Strategy, the project team assessed these priorities to ensure alignment with the recommendations and priorities being developed for the Lands Strategy. Relevant objectives related to retrofitting, purchasing, mitigating, and relocating structures in high-hazard areas; preventing or discouraging new development in hazardous areas; and considering the impacts of natural hazards in all planning mechanisms that address current and future land uses within the planning area.

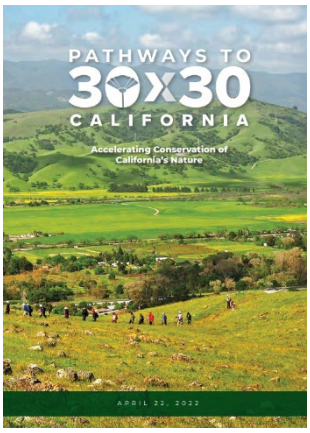
The HMP also included a survey of the community. One question asked which hazards people were most concerned about. Respondents ranked wildland fire first, followed by climate change and drought. Other relevant concerns included loss of development and vineyard expansions, damage to forests from the wildfires, as well as wildfire concerns related to development expansion and a lack of forest management.



Sonoma County RCPA's Climate Mobilization Strategy

The RCPA's Climate Mobilization Strategy details actions that could be taken within Sonoma County to reduce greenhouse gases significantly by 2030. Adopted by the RCPA Board of Directors in 2021, the strategy focuses on solutions that are resilient, equitable, and transformative. Within the Climate Mobilization Strategy, the RCPA organized policy strategies in relation to four key initiatives: decarbonization, carbon sequestration and ecosystem services, resilience and adaptation, and equity and community engagement. The Climate Mobilization Strategy provides broad findings and recommendations that are useful as a starting point when considering project types and priorities for this Lands Strategy, and it served as a helpful resource for developing carbon sequestration and greenhouse gas emissions projects.

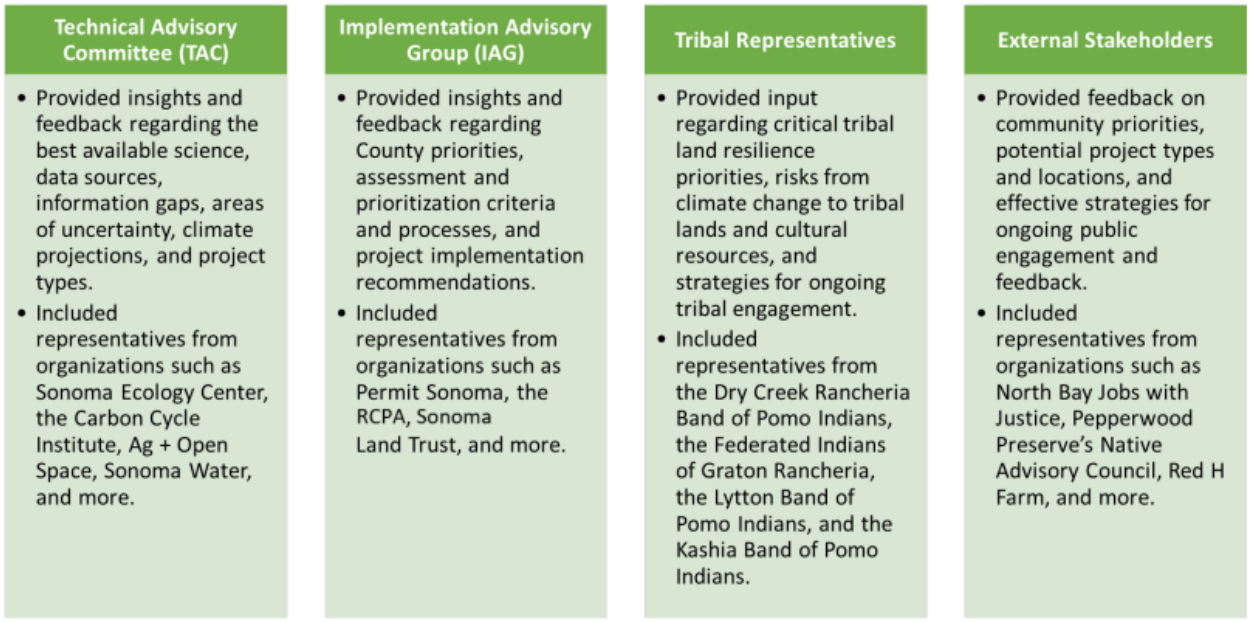
Table 4. Existing efforts related to the state of California.

Statewide Efforts	
Natural and Working Lands Climate Smart Strategy 2021 The state of California continues to be a leader in climate resilience, and the Draft Natural and Working Lands Climate Smart Strategy, which the state released for public comment in October 2021 and has yet to finalize, is an example of this leadership. The strategy includes an assessment of the benefits of the state's different landscape types, recommended priority actions and approaches, and profiles for different regions in the state (California Natural Resources Agency, 2021). The state's approach for considering the climate resilience potential of its various types of natural and working lands, as well as its consideration of opportunities to address climate change, informed the approach of this Lands Strategy in considering ecoregions, project types, and recommended actions.	
Pathways to 30x30 California 2022 The state released the Pathways to 30x30 California strategy in April 2022. The report provides a range of actions designed to result in 30% of California's lands being conserved by 2030. This goal translates specifically to six million acres of land and half a million acres of coastal waters. Currently, California has conserved 24% of its lands and 16% of its coastal waters; the strategy provides clear objectives for how California can reach its 30x30 targets and articulates the benefits of increased protection of land and waters. The 30x30 strategy also includes principles for advancing justice, equity, diversity, and inclusion. These principles provided support for the approach outlined in the Lands Strategy of including social indicators, as well as screening and performance criteria to ensure that climate equity and justice are built into the County's approach to project engagement, planning, design, and implementation.	

II. Engagement Process

The County coordinated a robust engagement process to ensure it considered multiple stakeholder perspectives during the development and refinement of the Lands Strategy. The Lands Strategy also draws upon the findings of the Vital Lands Initiative engagement process. The sections below summarize the County's engagement philosophy and the County's engagement approach while developing this strategy. Figure 2 highlights the main groups engaged throughout the development process, all of which are described in more detail in the sections that follow.

Figure 2. Groups engaged during strategy development.



Engagement Philosophy

Throughout development of the Lands Strategy, the project team engaged diverse members of the broader community to deepen understanding of both technical and cultural aspects of resilience and land management. This engagement helps identify data sources, connect to the best available science, offer input and advice on recommended resilience actions, and ensure County agencies and outside organizations can use the outcomes of the Strategy to advance their own priority actions. The County strove to provide a forum that allowed partners to:

- **Share ideas and information** regarding existing efforts and knowledge so the Lands Strategy builds on and leverages existing work, rather than replicating other efforts, to help develop a countywide approach to resilient natural and working lands.
- **Offer feedback and engage in conversation** on components of the Lands Strategy to ensure it reflects the priorities and needs of agencies, organizations, and communities in the county.
- **Strengthen relationships and trust** between the partners and the County to promote future collaboration on or funding of priorities and projects identified through the Lands Strategy. Engagement activities also helped identify partnerships that could allow different priorities to be implemented together more efficiently and effectively by finding shared issues and key geographies for priority action.

Existing Engagement Efforts

As mentioned earlier, the Lands Strategy is built on the foundation of many recently adopted plans and processes that identify community priorities and interests. With input from the TAC and IAG, the project team identified the following engagement processes as most relevant and useful for insights into the County's views and priorities on natural and working lands and climate resilience. For a summary of the work that reviewed for the Lands Strategy, see Appendix C.

Vital Lands Initiative Engagement

In developing the Vital Lands Initiative, Ag + Open Space conducted an extensive public engagement process. Beginning in 2017, it held over 150 meetings and workshops, which allowed for receiving input from over 600 community members. Ag + Open Space also coordinated closely with the public, local Native American tribes, technical advisors, and the Ag + Open Space Board of Directors, Fiscal Oversight Commission, and Advisory Committee. To ensure opportunities to engage Spanish-speaking populations, Ag + Open Space created a Spanish-language website and associated outreach material, in addition to providing simultaneous translation services at meetings and conducting specific outreach meetings to Latinx groups throughout the county.

The extensive community meetings held for the Vital Lands Initiative provided useful feedback that the project team drew upon in developing the Lands Strategy. (See Appendix B of the Vital Lands Initiative for a summary of findings from this process). Table 5 below highlights major themes from the Vital Lands Initiative engagement, in addition to detailing actions taken to address comments that arose from this previous engagement.

Table 5. Key themes from Vital Lands Initiative public engagement and how the Lands Strategy addresses these themes.

Theme	Actions Taken in Lands Strategy to Address Comments
The importance of connected conservation corridors for both recreational and wildlife purposes.	Indicators, as well as screening and performance criteria to prioritize projects, described within this strategy focus on the importance of habitat connectivity and corridors.
The need of the agricultural community for new and additional tools for agricultural protection, as well as increased agricultural diversity.	The project types described in the strategy present examples of potential tools and frameworks—with a focus on restorative agriculture and agroecological frameworks—the agricultural community could use to strengthen protection and resilience of agricultural lands.
The opportunity for using education of the public to increase understanding of the importance of protection and management of natural and working lands.	Development of this strategy included an extensive public engagement process to learn from the community regarding their priorities for resilient lands. The final chapter of this strategy also outlines how the County will continue to engage the public throughout strategy implementation.
The critical role of vegetation and fuels management in promoting resilient landscapes.	The ecoregions and project types presented in the strategy highlight the importance of diverse vegetative habitats, as well as fuels management and other proactive land management strategies, in strengthening landscape resilience.
The need for a clear prioritization process (including linkages to funding opportunities) for projects that strengthen resilience of natural and working lands.	This strategy includes a detailed decision-making process that will help the County prioritize climate-resilient lands projects.
The importance of public access to both urban and rural open space for communities throughout the county.	Indicators, as well as screening and performance criteria, within this strategy emphasize the importance of public access for urban and rural open space. Proposed project types also underscore the key role open spaces play in strengthening landscape resilience.

Other County of Sonoma Engagement Efforts

Extensive stakeholder engagement was conducted as part of two other recent initiatives: development of the Sonoma Water Climate Adaptation Plan (CAP) in 2021 and the Sonoma County Multijurisdictional HMP, led by Permit Sonoma and also adopted in 2021.

For the Sonoma Water CAP, Sonoma Water engaged contractors, Sonoma Water customers, partners, other state and federal agencies, research institutions, and the public as part of its engagement process. Sonoma Water held in-person meetings with stakeholders prior to the COVID-19 pandemic, as well as a series of targeted virtual engagement and individual meetings throughout the pandemic to discuss the vulnerability and risk assessment conducted for the CAP, as well as development of the adaptation strategy and preparation for the CAP. (See Sonoma Water's 2021 Stakeholder Engagement Plan for details regarding the various stakeholder groups engaged.)

For the HMP, Permit Sonoma established a stakeholder steering committee to provide guidance throughout the engagement process. The committee included representatives from partner organizations, as well as citizens and other stakeholders in the planning area. The steering committee held nine meetings in 2020 and 2021. These meetings allowed the committee to work through a range of topics, including the planning process, how to identify hazards of concern, plan objectives, and identified projects. (For a detailed summary of public engagement, see Appendix A of the Multijurisdictional HMP.)

Technical Advisory Committee

The project team formed a TAC to bring together experts in Sonoma County to help the project team identify the best data sources and data and information gaps, discuss areas of uncertainty, and assist the team with selecting downscaled hazard projections and scenarios to ensure recommended projects are robust and adaptable. A critical component of the TAC's work was to review and refine recommended projects, provide input on the decision-making process for designing and prioritizing projects, and ensure the County could maximize benefits and reduce negative externalities. The TAC included representatives from a variety of County government agencies, research organizations, and nonprofits (see box to the right), and the project team engaged with the TAC through a series of five virtual working meetings.

TAC Members

- Rob Bamford, Northern Sonoma County Air Pollution Control District
- Caitlin Cornwall, Sonoma Ecology Center
- Torri Estrada, Carbon Cycle Institute
- Susan Haydon, Sonoma Water
- Valerie Quinto, Sonoma Resource Conservation District
- Lisa Micheli, Pepperwood Preserve
- Melanie Parker, Sonoma County Regional Parks
- Allison Schichtel, Sonoma County Ag + Open Space
- Sam Veloz, Point Blue Conservation Science

During discussions with the TAC, the group affirmed the importance of considering and prioritizing critical County assets, equity, and marginalized communities within the context of this Lands Strategy and actions the County could take to strengthen the resilience of its lands. The TAC also provided extensive feedback regarding climate and hazard projections and helped direct the project team toward many relevant resources that subsequently were used while developing this strategy. Table 6 below summarizes additional key themes raised by the TAC and how these themes are reflected in the Lands Strategy.

Table 6. Key themes raised by the TAC and how the Lands Strategy addresses these themes.

Theme	Actions Taken to Address Comments
The importance of having specific, scientifically grounded indicators to assess resilience.	The social and physical indicators of climate resilience used to inform the Lands Strategy were revised extensively based on TAC feedback. TAC feedback on the indicators also helped inform development and identification of the screening and prioritization criteria that are part of this strategy's decision-making framework.
The communities and institutions that manage and are dependent upon natural and working lands must be reflected in defining resilience for Sonoma County. Having strong and high-capacity communities and institutions is a key component of resilience.	The Lands Strategy's resilience definition now reflects TAC feedback, in addition to identifying indicators, screening, and prioritization criteria that can help the assess how well potential projects may be addressing these issues.
Issues of worker health and safety (e.g., farmworker exposure to risk) are integral to considering social resilience of lands.	The Lands Strategy now includes additional indicators, as well as prioritization criteria, related to worker health and safety.
Food security is a critical issue and important indicator of resilience for the County.	The Lands Strategy now includes additional indicators and prioritization criteria related to food security; this theme is also now reflected in the definition of resilience.
Regenerative agriculture and agroecological practices are increasingly emerging as innovative techniques for advancing resilience of agricultural lands.	Recommended project types include a strong focus on regenerative and agroecological farming practices.

Implementation Advisory Group

In addition to the TAC, the project team also formed an IAG comprised of local agencies and organizations that hold a wealth of critical knowledge and are working on resilience projects and efforts (see box to the right). An important characteristic of this group is that the project team selected participants to represent agencies and organizations that will ultimately be the end users of the Lands Strategy. The purpose of the IAG was to advise the project team on available data and resources, identify County priorities, and provide input on assessment, evaluation, and project implementation recommendations. Their participation helped ensure that the Lands Strategy is not redundant to the work of their organizations but serves to integrate their work into the plan in a way that results in robust and implementable actions. By working in partnership with the IAG through a series of four working meetings, the project team worked to ensure the Lands Strategy will advance the goal of integrating the County's resilience work and positioning the County for funding and financing by building a vision that is shared and aligned across agencies, organizations, and sectors.

IAG Members

- Dee Swanhuyser (Taking Action for Living Systems)
- John Mack (Permit Sonoma)
- BC Capps (Sonoma RCPA)
- Sashi Sabaratnam (UC Cooperative Extension)
- Eamon O'Byrne (Sonoma Land Trust)
- Tom Gardali (Audubon Canyon Ranch)
- Danielle D'amour (Sonoma Wine and Grape)
- Representatives from the Federated Indians of Graton Rancheria

Like the TAC, the IAG provided feedback on the overall approach to the Lands Strategy, as well as detailed comments that helped shape the direction of the indicators, screening, and prioritization criteria. The IAG also affirmed the utility of analyzing the County's resilience and determining project types according to ecoregions (see Appendix A for more detail). Table 7 below summarizes additional key themes raised by the IAG and how these themes are reflected in the Lands Strategy.

Table 7. Key themes raised by the IAG and how the Lands Strategy addresses these themes.

Theme	Actions Taken to Address Comments
Clearly defining the different components of a resilience system is necessary to demonstrate the various factors that will constitute natural and working lands resilience within the County.	The strategy's definition of resilience now incorporates comments of the IAG and delineates the various aspects of a resilient landscape.
U.S. EPA Level IV ecoregions of California provide a useful data source for determining ecological zones within Sonoma County.	This affirmed the project team's approach and underscored the importance of defining project types and priorities based on EPA's ecoregions data.
In determining ecoregions and project types, it is important to consider some of the detailed and precise data available for different areas, such as that through EPA's ecoregions, as well as the Sonoma Veg Map.	The strategy includes detailed examination of existing data regarding the diversity of vegetation present in various ecoregions.
The potential of creating management strategies for biodiversity and carbon sequestration is an important factor in considering how natural lands may be able to strengthen resilience.	The project types described within this plan reflect potential practices that could help reduce methane and increase carbon sequestration potential.

Tribal Engagement

Local Native American tribes throughout the region are critical partners for the County's approach to climate-resilient lands. To identify tribal priorities and opportunities for aligned approaches and future partnerships, the County initiated engagement with representatives from the Dry Creek Rancheria Band of Pomo Indians, the Federated Indians of Graton Rancheria, the Lytton Band of Pomo Indians, and the Kashia Band of Pomo Indians. (Note that the County sent a request for participation to all five federally recognized tribes; however, only four were able to participate.) The tribal representatives worked with the County to identify common objectives and shared experiences, and raised many important themes related to this Lands Strategy, which are listed below. The box to the right provides details on actions the County has taken and will take to address tribal feedback.

- Local Native American tribes have considerable experience and expertise to draw upon in designing strategies and projects to strengthen resilience of natural and working lands. The County should continue to determine proactive strategies for tribal engagement through its efforts to advance resilience throughout Sonoma County.
- Local Native American tribes and tribal representatives should be included early on in project development to identify critical assets and issues related to natural land resilience.
- A list of land features and values that are important to tribes, and a list of acknowledged high-priority tribal cultural resources and tribal cultural properties, could be useful in considering

Actions Taken to Address Local Native American Tribal Feedback

Collaboration with tribes informed the County's development of indicators, screening and prioritization criteria, and project types. For instance:

- The County added indicators and screening criteria related to including tribal engagement, furthering tribal access, and considering tribal priorities and cultural resources.
- Moving forward, the County will hold regular meetings with tribes regarding Lands Strategy implementation to continue discussing themes that are important to the tribes, as well as details related to projects the County will implement based on the strategy.
- Future meetings will also help identify potential opportunities for federal funding related to tribal land resilience, elevate tribal knowledge, and experience and ensure prioritization of critical issues for the tribes.

potential priorities for landscape resilience and determining potential climate resilience projects.

- Tribal representatives expressed concerns regarding issues of access (including ingress and egress) to tribal lands through state and county roads and how these roads could be impacted during disasters. It is important for the County to consider and prioritize the resilience of this infrastructure to ensure the safety of the tribes and their resources.
- The County should consider creating clear indicators of how to prioritize tribal cultural properties, resources, and infrastructure in concert with other indicators of resilience. The County should also be transparent regarding the process they will use to continue collaboration with the tribes.

Additional Stakeholder Engagement

To ensure broad representation of stakeholders and elevate perspectives from underrepresented communities such as equity experts, agricultural workers, farmers, and tribal communities throughout Sonoma County, the project team coordinated two stakeholder focus groups and additional targeted, smaller meetings with key stakeholder representatives. These focus groups and meetings included representatives from the following entities:

- Ag + Open Space Advisory Committee
- Greenbelt Alliance
- LandPaths
- Municipal Advisory Councils
- North Bay Jobs with Justice
- Outdoor Afro
- Pepperwood Preserve's Native Advisory Council
- Red H Farms
- Sonoma County Regional Parks
- Sonoma County Community Development Commission

In the meetings, the project team provided stakeholders with an overview of the Lands Strategy and its development process, and requested feedback on the strategy goals, hazards, example projects, and the prioritization and decision-making process. Table 8 below summarizes key themes highlighted by the focus groups.

Table 8. Key themes raised by the Focus Groups and how the Lands Strategy addresses these themes.

Theme	Actions Taken to Address Comments
It is important to bring climate resilience benefits to areas that do not currently enjoy them. The County should design projects with the most vulnerable populations in mind. Additionally, the design of new open spaces, parks, and trails should be transparent and actively include the community in the planning and decision-making process.	Many of the project type concepts and their designs stemmed directly from comments heard at the stakeholder meetings. These comments informed final development of indicators and screening and prioritization criteria, including many related to providing benefits to underserved and under-resourced communities.
The County needs to design outreach regarding the Lands Strategy and its subsequent projects in clear, common language. To promote ongoing outreach, education, and participation, the County could partner with community organizations.	The Lands Strategy recommends continuing to prioritize public engagement early in project design as projects move forward from the strategy. The Lands Strategy also recommends continued collaboration with the groups engaged and other relevant community organizations throughout the implementation of this strategy.
Climate efforts should focus on systemic rather than individual change. Similarly, natural and agricultural	The Lands Strategy now reflects a more robust consideration of how to consider natural and working

Theme	Actions Taken to Address Comments
lands and the people are not separate; they are one system, and the County should consider them in that way.	land resilience benefits in the context of developed areas.
The County should consider how to protect and advocate for workers on natural and working lands whose jobs are threatened by climate change and additional social factors.	The Lands Strategy now includes additional indicators, as well as prioritization criteria, related to worker health and safety.
Transitioning from standard farming practices to more regenerative and ecologically based practices can be difficult and costly. Additionally, it can be difficult for small farmers to access the resources that they need for resilience-focused projects. Providing technical assistance (e.g., grant-writing assistance, implementation support) is a critical tool the County could design in partnership with the communities it intends to serve and engage.	The Lands Strategy now includes many recommendations and project types related to promoting regenerative and ecologically based practices.
Peer-to-peer learning among land managers, farmers, and others involved in resilience efforts in Sonoma can be a useful way to provide more technical assistance and grow capacity. RCDs could take a more active role in peer-to-peer learning.	The Lands Strategy now includes specific project types and recommendations related to promoting peer-to-peer learning.

Next Steps

As implementation of the Lands Strategy moves forward, the County will conduct ongoing community outreach and engagement to help ensure that community members, organizations, public agencies, and private landowners—as well as farmers, farmworkers, and community organizations working on climate justice and the rights of the underserved—are included in the scoping, planning, design, and implementation phases of each project. The County will use ongoing stakeholder engagement to adaptively manage and update the Lands Strategy as needed.

III. Planning Horizon

The Lands Strategy is intended to be broad enough to guide climate resilience projects in the near and mid-term and flexible enough to be adapted as conditions change to consider actions to address long-range climate projections. For the purposes of the Lands Strategy, near-term is within 10 years and mid-term is 10 to 30 years. Since the Lands Strategy is designed to serve as a basis for the County to consider ongoing actions to conserve, manage, and restore as much of the county as possible to address the great needs and risks that climate change poses, the planning horizon for the Lands Strategy is long-range, which is 30 to 100 years. While the recommended near-term actions will focus on areas with the greatest potential to reduce current and projected climate risks, preserve native species and biodiversity to allow them to adapt and persist, and reduce carbon where possible, there are many additional actions included in the Strategy that can be taken as opportunity arises, funding becomes available, or priorities shift.

In addition to the availability of resources, new findings will continue to emerge related to climate science and best practices for managing lands during extreme drought conditions, including reducing wildfire risks, and the projects that are implemented in the next five to 10 years will provide us with information that can be used to improve future project designs. These uncertainties and future opportunities are best addressed by a Lands Strategy that keeps open as many options as possible and provides the landscape

the best chance to adapt by conserving and restoring large, interconnected, and diverse lands, while preserving and supporting agriculture uses that promote regenerative practices to sustain the land through a range of potential futures.

Where appropriate in the project types, the Lands Strategy makes recommendations for near-term actions, and then potential adaptation measures for the mid-range and long-term resilience and sustainability of the lands. Additionally, some project types are programs, planning, or policy actions, and these will also have a near-term, mid-range, and long-range trajectory as they advance from scoping and planning to design and implementation. As projects continue to advance from the Lands Strategy, the County should revisit and revise it to ensure it remains relevant to the County and its partners.

3. CLIMATE HAZARDS

Sonoma County's communities and natural and working lands are already responding to the effects of climate change, including historically low water levels in the Russian River and Lake Sonoma, flooding of Guerneville and Monte Rio, and devastating fires across the county in 2017, 2019, and 2020. As such events become increasingly common, there are strategic investments and actions that Sonoma County can prioritize to increase the resilience of its natural and working lands and reduce risks from flooding, wildfires, drought, and heat.

Wildfire in Sonoma County.

The sections below outline historical and projected impacts of climate hazards by drawing frequently on climate and hydrology projection data by sub-watersheds developed by the Pepperwood Preserve and partners for the North Coast Resource Partnership (NCRP) in 2018. The NCRP products include four potential climate-hydrology future scenarios to capture the range of potential extreme conditions, while reflecting regional management concerns. The NCRP report shares the findings focused on two of the scenarios for the sake of brevity. The climatic trends modeled in these two scenarios are warm, high rainfall (the CNRM model) and hot, low rainfall (the MIRCO model) (Micheli et al., 2016, 2018). These two scenarios assume a high or business-as-usual greenhouse gas emissions scenario (known as RCP 8.5).[1] Please see "Climate and Natural Resource Analyses and Planning for the North Coast Resource Partnership: A Technical Memorandum Summarizing Data Products" for additional detail on methods for projecting future climate conditions. Additional information on the application of the NCRP data and other sources is provided for each of the climate hazards in Appendix E with key takeaways in the sections that follow. Total annual precipitation and climatic water deficit by water year and average monthly minimum and maximum temperature were averaged across four 30-year time horizons.

I. Warming Climate

Sonoma County has been experiencing an increase in temperature since the late 1990s, and further increases are expected. The average daily maximum is expected to increase by 3 degrees Fahrenheit in the 2040s and nearly 5 degrees Fahrenheit in the 2060s (as compared to the observed baseline) (U.S. Federal Government, 2021). Moving forward, average summer high temperatures and the number of high-heat days (over 93 degrees Fahrenheit) are also expected to rise. Higher temperatures will result in increased rates of evapotranspiration, drying out plants and soil and increasing the likelihood of drought conditions (Cornwall et al., 2016; Micheli et al., 2018). Higher summer temperatures and more high-heat days create major public health concerns, especially among vulnerable populations lacking air conditioning.

Natural and working lands are already experiencing the impacts of high-heat events, such as reduced water quality, heat-related death of wildlife and stress on plant life, and reduced groundwater runoff. For example, during the summer and spring of 2021, Santa Rosa and other towns in the county experienced

[1] Representative Concentration Pathway (RCP) 8.5 is the high or business-as-usual emissions scenario. RCP 2.6 is the low emissions scenario (i.e., aggressive emissions reduction), which is considered extremely unlikely given current global emission trends. RCP 4.5 is a more moderate emissions reduction.

record-breaking daily high temperatures, and harmful algal blooms were detected on the Russian River, Salmon Creek, and Gualala River (Minkiewicz-Martine, 2021). In the agricultural sector, heat waves and subsequent heat stress on livestock led to declines in dairy and beef production.

Drought in Lake Sonoma.

Winter temperatures are projected to increase over the coming century, and the number of nights where temperatures reach freezing is projected to decline (Cornwall et al., 2016; Micheli et al., 2018). Both wildlands and agricultural lands are expected to be impacted by an anticipated increase in pests that will no longer die off annually due to winter weather, a process known as overwintering. Insects rely on the temperature of their environment to regulate their own body temperature, so any increases in temperature will change insect range, behavior, and populations (Skendžić et al., 2021). More pests could lead to increased use of pesticides, which will in turn cause agricultural runoff and water quality issues following major rain events (Gross, 2021).

There are a wide range of strategies available for building resilience of natural and working lands to rising temperatures, with many of these strategies providing additional benefits. For example, for agricultural lands, key strategies include:

- **Maintaining healthy soils.** Higher temperatures mean high evapotranspiration rates and less water available for crops. Healthy soils have a higher moisture-holding capacity and help roots to penetrate and retrieve the moisture.
- **Water-efficient irrigation.** Irrigation systems that ensure efficient delivery of water can save water and reduce greenhouse gas emissions (State of California, 2022).

Key strategies for building resilience of open spaces and parks to rising temperatures include:

- **Preparing parks and recreation areas for heavier use.** Residents flock to lakes, river, and coastal recreation areas for a reprieve from the heat. Expanding infrastructure and facilities at these recreation areas can help residents to enjoy these recreation sites without applying stress of overuse by ecosystems that may already be stressed by heat (State of California, 2022).
- **Developing green buffers with shade trees to provide reprieves from heat.** Green buffers with shade trees around residential areas provide cooling while increasing permeable surfaces (important during rain events). Resilient lands—especially highly shaded lands and/or lands containing rivers, lakes, and coastline—provide residents with essential reprieves from heat.
- **Maintaining instream flows.** Instream flows prevent anadromous fish and other sensitive species from being stressed by high instream water temperatures. Instream flows can also support groundwater recharge.
- **Conserving and restoring potential climate refugia.** Identification and planning of refugia should consider range shifts and habitat connectivity (State of California, 2022).

These strategies should be designed to address both direct and secondary effects of extreme heat. Some of these secondary impacts have already been described above. Additional secondary impacts include risks to health of outdoor workers. Work crews, ranging from construction to restoration to farm work, will likely need to adjusted work hours (e.g., early morning or nighttime hours) to avoid heat stroke and heat-related illnesses. In addition, high temperatures increase the likelihood of drought and wildfires.

Higher temperatures cause higher rates of evapotranspiration and thus drought stress. Dry lands are more likely to ignite during a wildfire. The sections below explain drought and wildfire in detail. Note that many of the strategies for increasing resilience of lands to heat also support resilience to drought and wildfires.

II. Changing Rainfall Patterns and Flooding

While rainfall projections vary regarding estimated volume and trajectory of annual precipitation for Sonoma County, projections concur that there will be changes in the timing and amount of rain that falls during individual rainfall events. Atmospheric rivers are the primary source of rainfall in Sonoma County. Atmospheric rivers vary in size and intensity, and some are weak systems that appear as typical rainstorms or snowstorms. As the climate changes, atmospheric rivers are expected to increase in intensity, especially in California (U.S. Geological Survey, 2021). While more rain during a prolonged drought is welcomed, the predicted increase in intensity and volatility of these events can turn a much-needed rainstorm into a hazardous event.

In October 2021, an atmospheric river over the San Francisco Bay area and the Central Coast brought flood warnings to the North Bay and flash flood warnings for areas affected by the 2020 Glass Fire (National Weather Service, 2021). While the October rains ended the summer fire season, extreme rainfall following high-intensity fires can increase the likelihood of erosion, landslides, and debris flows. Additionally, forests and soils that have been severely burned absorb minimal water compared to unburned soils; therefore, heavy rainfall after a high-intensity fire leads to excess runoff and sediment, which can carry pollutants downstream into important water sources (National Oceanic and Atmospheric Administration, 2015). Because water is unable to penetrate severely burned soil, there is considerably less groundwater recharge during a post-fire heavy rainfall event, therefore doing little to alleviate drought conditions.

Several communities in Sonoma County have experienced considerable flooding in the past. For instance, for the city of Healdsburg, Russian River flows have reached flood stage four times since 1995. The Russian River flood gauge at Guerneville has reached flood stage approximately half of the years since 1943, with February 1986 as the flood-of-record (Jasperse et al., 2020). Guerneville also experienced flooding during the February 2019 flood, which caused an estimated $155 million in damages across the county, including major damages to 1,760 homes (CBS SF, 2019).

Russian River, Jenner, CA.

Sonoma County's natural and working lands, specifically healthy riparian and stream corridors, can play an important role in buffering or mitigating impacts from heavy rainfall and flooding. As discussed in the riparian and stream corridors section of this report (Chapter 4), healthy riparian areas provide a buffer zone around rivers that can slow, dissipate, and absorb floodwaters. If riparian and buffer zones are either damaged or nonexistent, they are unable to provide critical flood protection during high-water or extreme precipitation events. A resilient riparian zone allows rivers or streams to flow uninterrupted (e.g., no dams or impoundments) and has healthy, native plants that can filter and slow floodwaters, therefore contributing to flood attenuation, groundwater exchange, and water quality improvement (U.S. EPA, 1993).

Secondary hazards resulting from changing rainfall patterns, extreme precipitation, and flooding include:

- **Erosion** is a primary concern during and after extreme rainfall events. Erosion is especially a concern during heavy rainfall following high-intensity fires because it can weaken hillsides and lead to landslides. Erosion weakens soils and can bring pollutants into waterways and public water sources, and it can clog storm drains and culverts. Coastal cliff erosion is also a concern during extreme precipitation events; however, strong wave action is more often the cause of coastal erosion than rainstorms.
- **Landslides,** spurred by extreme erosion, are a secondary hazard of heavy rainfall. Steep slopes and mountainous areas of Sonoma County that have been burned are especially at risk for landslides.
- **Crop damage or loss** due to flooded croplands during and after extreme precipitation. Standing water in flooded fields, while beneficial to some crops, can damage ground crops such as strawberries or lettuces. Additionally, heavy rainfall can slow or delay harvests, which can also lead to loss of crops in some cases.
- **Property damage or loss,** as discussed above, can occur during extreme weather or flooding events. The most devastating flood in terms of property loss in Sonoma County occurred during a 2019 storm that caused the Russian River to flood, brining an estimated $115 million in damage across the county.
- **Damage to roadways** due to erosion, landslides, or flooding can interrupt public and emergency services, and block evacuation routes. Saturated roadways can also lead to hazardous conditions for drivers.

III. Drought

Drought is a reoccurring feature of California's climate, with severe droughts recorded in 1976–1977, 1987–1992, 2000–2002, 2007–2009, and 2012–2016 (California Department of Water Resources, n.d.). Climate change has led to more frequent, intense, and prolonged droughts in California and Sonoma County, and these conditions are anticipated to continue in the coming decades. Prolonged drought can make ecosystems vulnerable to pests and non-native species, impact water quality and ecosystem function, and increase wildfire risk (North Coast Resource Partnership, 2020). During a drought, ranchers may struggle with providing adequate food or grazing land for their animals, and farmers' water supplies may be limited or reduced.

Lake Sonoma and Lake Mendocino, the two major reservoirs supplying the Russian River watershed, both experienced significantly reduced supply in the 2020–2021 water year, with the reservoirs at 48% and 29% capacity, respectively (Mendocino County Water Agency, 2021). The 2020–2021 water year was the second driest on record. In response to the continued drought, Governor Gavin Newsom declared a

drought emergency in Sonoma and Mendocino counties. The State Water Resources Control Board issued a curtailment order, restricting water access for some water rights holders (California State Water Resources Control Board, 2022). Despite heavy rain events in October and December 2021 in Sonoma County, severe drought conditions persist into 2022, and curtailment orders—which were lifted in the spring—were reinstated in Summer 2022 (California State Water Resources Control Board, 2022).

Severe Drought

As classified by the U.S. Drought Monitor, severe drought means that grazing land is inadequate; fire season is longer, with more intense and larger fires; trees, plants, and native grasses are stressed; and wildlife disease is increasing (National Integrated Drought Information System, 2022). Severe drought also means that plants increase their reproductive mechanisms, which can contribute to increased wildfire risk due to an abundance of fuels (e.g., plants) (National Integrated Drought Information System, 2022).

One hundred percent of Sonoma County is affected by the severe drought conditions (see box to the left), and cities within Sonoma County are responding to the prolonged drought conditions with mandatory water use reductions and implementing various regulations such as prohibiting pressure washing, limiting landscape irrigation to nighttime hours (8 p.m. to 6 a.m. in the city of Santa Rosa), and allowing restaurants to serve water only by request (City of Santa Rosa, 2022). Additional programs include Santa Rosa Water's "Cash for Grass" rebate program, which pays residents to remove their lawns to reduce the need for watering. While municipal water saving programs are a step in the right direction, additional actions must be taken to conserve and manage water during severe droughts. For example, Sonoma Water manages water supply by working with the U.S. Army Corps of Engineers to use Forecast Informed Reservoir Operations (FIRO) decision support tools. Using FIRO, Sonoma Water was able to save 11,000 acre-feet of water in Lake Mendocino in early 2020. Water conservation and management measures such as FIRO and public outreach campaigns to emphasize the urgency of water conservation are critical to conserving water in Sonoma County.

In June 2021, farmers in central Sonoma County, who rely on reclaimed water, were told to expect to have 30–40% of a three-year water supply average (Sarfaty, 2021). As drought conditions continue, managing Sonoma County's natural and working lands to increase their resilience to drought is of the utmost importance. The University of California Cooperative Extension, Sonoma County (UCCE Sonoma County) provides a number of resources and suggestions for range and land managers for adapting to drought conditions. Range and livestock management strategies include:

- **Pasture rotation**, which allows a grazed area to rest and regrow after being grazed.
- **Pasture utilization**, which suggests grazing areas with more mature forage to allow other areas to grow.
- **Weaning calves and lambs as soon as possible** and grouping grazing animals according to nutritional needs (University of California Cooperative Extension Sonoma County, n.d.).

It is important to note that the suggested management strategies are not one-size-fits-all and there is no single management strategy that can be applied to ensure the land and livestock adapt to or withstand prolonged drought conditions. UCCE Sonoma County also suggests a number of strategies for farming in drought conditions (University of California Cooperative Extension, 2015). The primary focus of the strategies is to use as little water as possible. Suggested strategies include:

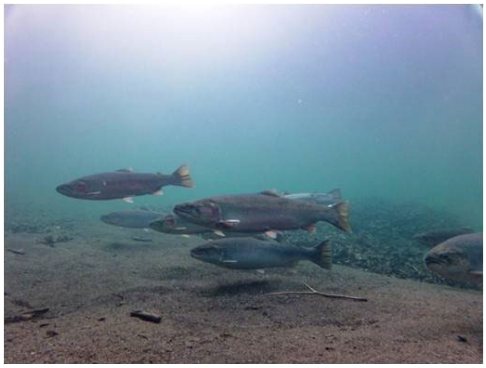
- **Planting cover crops early** when there is still moisture present in the soil and being vigilant of weeds and invasive species that may be competing for water with native or cover crops.
- **Increasing soil organic matter** by applying compost and cover crops. Increasing soil organic matter increases the "water holding capacity" of the soil considerably, which is particularly

important in Sonoma County, where the soils tend to be sandy with low amounts of organic matter.

- **Irrigating responsibly** by ensuring that irrigation systems are not leaking and that filters are in good condition and converting to drip irrigation as opposed to using sprinklers. Additionally, irrigating during cooler times will reduce the potential for irrigation water to evaporate.
- **Planting responsibly** by planting the right crops at the right time can help reduce water usage. For example, tomatoes can be grown during the summer using a dry farming method that involves watering seedlings three times after being planted in the field, and then stopping irrigating once the seedlings establish roots.

Secondary hazards, or side-effects from drought, include:

- **Loss of salmon and steelhead trout habitat due to low flows.** In 2021, low flows in the Russian River caused limited and late spawning of coho salmon, one of the rarest native fish species in California. The salmon populations faced limited tributary access and trapped smolts during peak outmigration because streams became disconnected from the river earlier than usual (Cameron & California Sea Grant, 2020). Presence of coho salmon and steelhead are an indicator of broader ecosystem health. They require cold, clean, and oxygenated water—conditions that may not be met during extended drought (North Coast Resource Partnership, 2020).

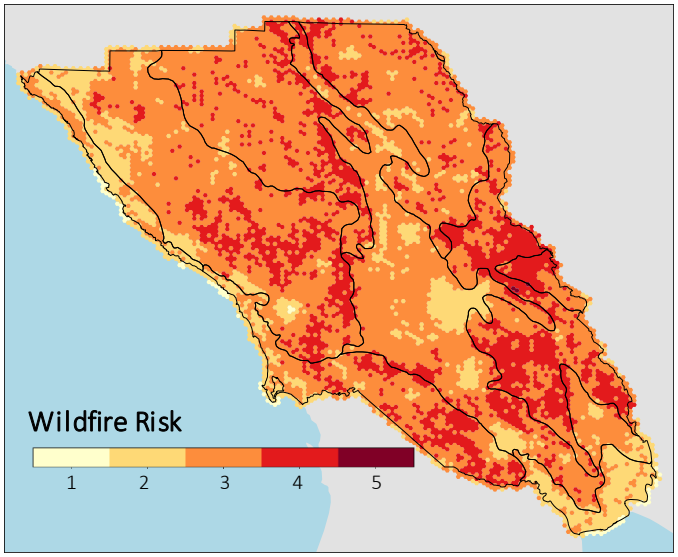


Steelhead Trout.

- **Loss of agricultural crops.** Low soil moisture levels and limited water for irrigation could cause crops to fail, or farmers could be forced to reduce the number of crops planted due to lack of water.
- **Increase in invasive species and pests.** While some native species are drought tolerant, droughts can cause prolonged stress to native species, making them more vulnerable to invasive species and pests. Research suggests that as warm seasons begin to appear sooner due to the changing climate, invasive species are often the first to pop up during spring growing seasons, leaving native species at a disadvantage with reduced likelihood of survival (National Invasive Species Awareness Week, 2021).
- **Increased wildfire risk.** As discussed in the following section, prolonged drought leads to increased wildfire risk as plants, especially dead trees and grasses, become drier and more likely to catch fire. Additionally, drier fuels (e.g., trees, grasses, plants) are more likely to burn at higher intensities than fuels that have some moisture content.
- **Water supply conflicts.** As discussed above, during drought periods, there may be water shortages and issues with water supply. Prolonged drought leads to increased demand for less water, and variations in water rights and usage lead to competing interests and therefore conflict.
- **Decline in water quality due to low flows.** Low flows often enhance the effects of water pollution. When pollutants and sediments flow into a large, fast-moving body of water, those pollutants are diluted and concentrations are reduced; during low flows, there is less water available for dilution, therefore increasing concentration of pollutants (U.S. EPA, n.d.a). Low flows also often lead to higher water temperatures because the water can heat up faster. As mentioned above, warmer water temperatures may be unsuitable, or even fatal, to native fish populations such as salmon (U.S. EPA, n.d.b).

IV. Wildfire

Figure 3. Wildfire Risk Index across Sonoma County.



A history of aggressive fire suppression in the American West has led to a buildup of highly flammable, dense fuels across the western landscape that can cause or contribute to high-intensity wildfires. Prolonged periods of extreme drought in California coupled with increasing temperatures have also led to increased frequency and severity of wildfires. Changes in land use and development in Sonoma County, including development in the wildland-urban interface and low-density development patterns, have led to loss of life, property, and infrastructure due to fire. Since 2015, three of the top ten most destructive wildfires in California history in terms of number of structures burned occurred in Sonoma County (Ackerly et al., 2018). Human-caused ignitions in the wildland-urban interface are often responsible for fire ignitions. While many of the ecosystems in Sonoma County are fire-adapted and even require fire to thrive, drought, biodiversity loss, and climate change are contributing to higher intensity and more destructive wildfires on the landscape. The Sonoma County Wildfire Hazard Index shows lower fire risk along the Pacific coast, San Pablo Bay, and the Sonoma Valley, and the index shows higher fire risk in the hills and mountain areas in northwest Sonoma County (see Figure 3).

Since 1990, Ag + Open Space has protected in perpetuity over 122,000 acres (roughly 12% of the county's total land area) of open space lands in Sonoma County (Ag + Open Space, 2021c). Large-scale land protection and conservation is a win for the county and its environments, but given rising temperatures and worsening droughts, land acquisition for conservation must be paired with vegetation management and fuel treatments to protect county lands and inhabitants from severe wildfire. Research suggests that "strategic land acquisition may be a more effective long-term approach for reducing fire risk and protecting biodiversity" than vegetation treatments alone (Greenbelt Alliance, 2021). The research found that there will be a higher return on conservation investments if biodiverse lands are protected from development rather than allowing development to occur in areas of high fire risk, even if the surrounding land is managed to reduce fuel buildup. However, absent long-term adaptive management strategies, the landscape will likely be less resilient and face increased risk of high-severity wildfires, even if the land is protected from development. Adaptive land management practices such as prescribed burning, vegetation management, and fuel reduction projects, and efforts that protect and improve biodiversity, are critical to building resilience on the landscape (Greenbelt Alliance, 2021; Kelsey, 2019; State of California, 2021a; USDA, 2015). Ag + Open Space, Sonoma County Forest Conservation Working Group, and Governor's Forest Management Task among others are working to expand complementary implementation of this range of wildfire risk management strategies, including buffers, forest management and restoration, reduced development in the wildland urban interface, and conservation (see Appendix A: Project Concepts for further discussion of these projects).

Grasslands in Sonoma County.

Sonoma County's natural and working lands play an important role in buffering climate impacts, storing carbon, and providing ecological and economic benefits. Increased wildfire activity reduces the land's ability to provide these ecosystem services. For example, much of Sonoma County's agricultural or farming land is open grassland or grazing land, which can sequester carbon. Additionally, biodiverse parks and open space preserves act as buffer areas that protect developed areas from fire, and they also provide critical inroads and staging areas from which firefighters can manage wildfires and protect people and structures. For example, Foothill Regional Park, adjacent to the town of Windsor in Sonoma County, provided a critical buffer to the town during the 2019 Kincade Fire. The park allowed firefighters to "pre-position strike teams" who built fire breaks and lit backfires to prevent the wildfire's spread into the town (Greenbelt Alliance, 2021). Regional parks and greenbelts that are well positioned and maintained are more effective at providing critical wildfire buffers than those that are not maintained or not strategically located.

In addition to the impacts that wildfire can have on the ecosystem, property and critical assets, and the economy, there are many secondary hazards associated with wildfire, including:

- Loss of life is an immediate concern during a wildfire. From 2017 through 2020, over 300,000 acres burned in Sonoma County, destroying nearly 7,000 structures and killing 24 people (Permit Sonoma, 2021b). Secondary impacts from wildfires, such as smoke exposure and poor air quality, are a concern for people, especially sensitive groups, in the immediate and surrounding vicinities.
- Economic and community impacts of wildfires can include job losses, loss or damage to crops and property, interrupted transportation pathways, and damage to public infrastructure and property. Wildfire-related evacuations disrupt lives and challenge large and small businesses. Additionally, if protected land is not adaptively managed, the millions of dollars spent on protecting these lands will be lost, in addition to loss of valuable ecosystem services.
- Property damage and loss is a concern for many wildfires. The 2020 Glass Fire burned 67,484 acres and damaged or destroyed close to 2,000 structures in Sonoma County. According to the Sonoma County Multijurisdictional HMP, 35% of residential structures and 59% of agricultural structures are in a "very high relative hazard zone" and the property value of structures in the "very high relative hazard zone" totals over $7.5 billion (Permit Sonoma, 2021b). In 2008, the California State Building Code was updated to include minimum standards for new buildings in relative fire hazard zones that would provide a certain level of protection for the buildings; however, less than 10% of housing in the county has been built since 2008, therefore leaving the majority of homes vulnerable to damage from wildfires (Permit Sonoma, 2021b).

- **Public Safety Power Shutoffs** occur during times of high wildfire risk, when utility companies will turn off power transmission to reduce the probability of electrical wires sparking a wildfire. These shutoffs pose threats to human health and safety, and in some cases can lead to death if people are unable to access adequate medical care during a shutoff.
- **Erosion** following wildfires contributes to high sediment loads entering stormwater facilities, and potentially county water supplies. Long-lasting, high-severity wildfires can burn soils and decrease their ability to absorb water, therefore contributing to heavy erosion, runoff, and potential landslides following extreme wildfire events.
- **Flooding** and flood risk increases following wildfires. Flood risk can remain high in burned areas for up to five years post-fire (Sonoma County, 2020b). Predicted increases in precipitation, coupled with predicted increases in fires and fire severity, point to increased flood and flash flood risk for Sonoma County. Areas with steep slopes will be especially vulnerable.
- **Invasion of non-native species** following a fire (e.g., Scotch broom) and other associated changes to vegetation composition (e.g., conversion from one plant community type to another). Incursion of invasive species can provide a particular challenge to landowners following fires and can present many management challenges.

V. Sea Level Rise and Coastal Storms

As seas rise, Sonoma County communities along the Pacific coast and San Francisco Bay shoreline will face damaging effects from El Niño–driven storm events combined with high tides and large waves. In 2050, 1.1 to 2.7 feet of sea level rise is projected along Sonoma County's coasts (see more discussion of projections below). Without adaptation, homes, critical infrastructure, tourist destinations, and important coastal habitat will be lost (Griggs, 2021).

San Francisco Bay supports the largest tracks of estuarine marshes in the state, including Sears Point and Sonoma Creek restoration efforts in Sonoma County. In 2018, The Nature Conservancy (TNC) conducted a coastal vulnerability assessment for California, finding that 30% of irregularly flooded estuarine marshes in the San Francisco Bay delta are highly vulnerable to sea level rise (The Nature Conservancy & State Coastal Conservancy, 2018). These high-biodiversity marshes serve as the transitional habitat between terrestrial and estuarine ecosystems. The whole system of marshes and living shorelines along Sonoma County's Bayside provide important coastal protection for Highway 37, a critical corridor connecting Marin, Sonoma, and Solano counties and adjacent agricultural lands. The marshes limit the effects of wind-driven waves that threaten to overtop the Highway 37 levee and flood the road. That said, Highway 37 was closed for 28 days in 2017 and 8 days in 2019 due to flooding (Quakenbush, 2021). These closures severely impact movement for commuters, freight, and recreation (Metropolitan Transportation Commission, 2019). As sea level rises, overtopping and flooding of the corridor is occurring more frequently, especially during king tides and major rains. County agencies are developing various adaptation measures, with many county residents calling for a solution that includes marsh restoration and support for migration. Such a solution could provide habitat and recreation value in addition to ongoing coastal protection (Kovner, 2021).

A 2018 assessment by TNC also found that 11 out of 18 of Sonoma County's Pacific-side sand beaches with public access facilities are vulnerable to 5 feet of sea level rise. Active conservation and management of both beaches and marshes is needed to help them migrate as seas rise so that these resources can maintain the many benefits they provide, including biodiversity, carbon sequestration, recreation, and coastal protection by buffering storms.

Aerial View of Jenner Headlands, Sonoma County.

Sea level rise, storms, and erosion are already impacting Sonoma County's Pacific-side habitats and communities. For example, Highway 1 near Gleason Beach is the only road connecting Bodega Bay and Jenner. There is rapid bluff erosion around the road due to wave action, sea level rise, groundwater intrusion, and runoff from land uses. The bluff erosion is compromising the road and has led the California Department of Transportation (Caltrans) to make emergency repairs since the early 2000s. Caltrans is currently working on a $26 million dollar project to realign the highway, moving it eastward to maintain the function of this critical route (Caltrans, 2022).

Sea level rise will also challenge flood and environmental management of the lower Russian River, the Petaluma River, and Sonoma Creek as the zone of tidal influence, runoff patterns, and sediment deposition are expected to change (Sonoma Water, 2021a).

Resilience measures to protect coastal habitats and communities include:

- **Relocating or raising infrastructure.** This measure will move infrastructure away from cliff erosion and flood hazard areas. In addition, this measure can create larger areas of continuous wetlands and open space, supporting biodiversity and allowing wetlands room to migrate as sea level rises.
- **Wetland restoration.** Wetlands act as a sponge, absorbing floodwaters. With restoration, flood protection for adjacent areas expands, while also supporting biodiversity and carbon storage.
- **Conserve coastal habits.** Protecting and conserving beaches, dunes, and wetlands can preserve biodiversity, allow habitats space to migrate, and maintain natural flood protection.
- **Inventory and adapt sensitive facilities that are vulnerable to sea level rise.** Stormwater facilities and contaminated sites that are not adapted to resist and/or accommodate flooding can lead to water quality issues with negative effects on humans and the environment (Ocean Protection Council, 2022).

As the County and its communities develop and implement resilience strategies, it is important to recognize and plan for secondary sea level rise hazards. Some of these hazards—such as property loss, damage to infrastructure, cliff retreat, and loss of coastal habitat—are described above. Other secondary hazards include:

- **Landslides.** In Sonoma County, areas of highest landslide risk are located along the Pacific coast. Sea level rise–induced coastal change, as well as increased severity and occurrence of major rainfall and fire events, will impact slope stability and landslide risk (Permit Sonoma, 2021c).
- **Migration of saline water farther upstream.** As tidal influence of rivers moves farther upstream, habitat and species composition will transition from freshwater species to those that are adapted to salt water (Sonoma Water, 2021a).
- **Groundwater rise and salinity intrusion into groundwater.** Sea level rise will raise coastal water tables, potentially leading to saltwater intruding into freshwater groundwater resources. The Sonoma Valley Groundwater Sustainability Agency is developing plans to address salinity intrusion (Sonoma Valley Groundwater Sustainability Agency, 2020).
- **Limited shoreline access.** Coastal erosion and flood events can damage key infrastructure that has been developed to help communities access shorelines for recreation, cultural activities, and subsistence (e.g., fishing); adaptation should include access for these activities as well.

4. CLIMATE-RESILIENT LANDS AND THE SONOMA COUNTY LANDSCAPE SYSTEM

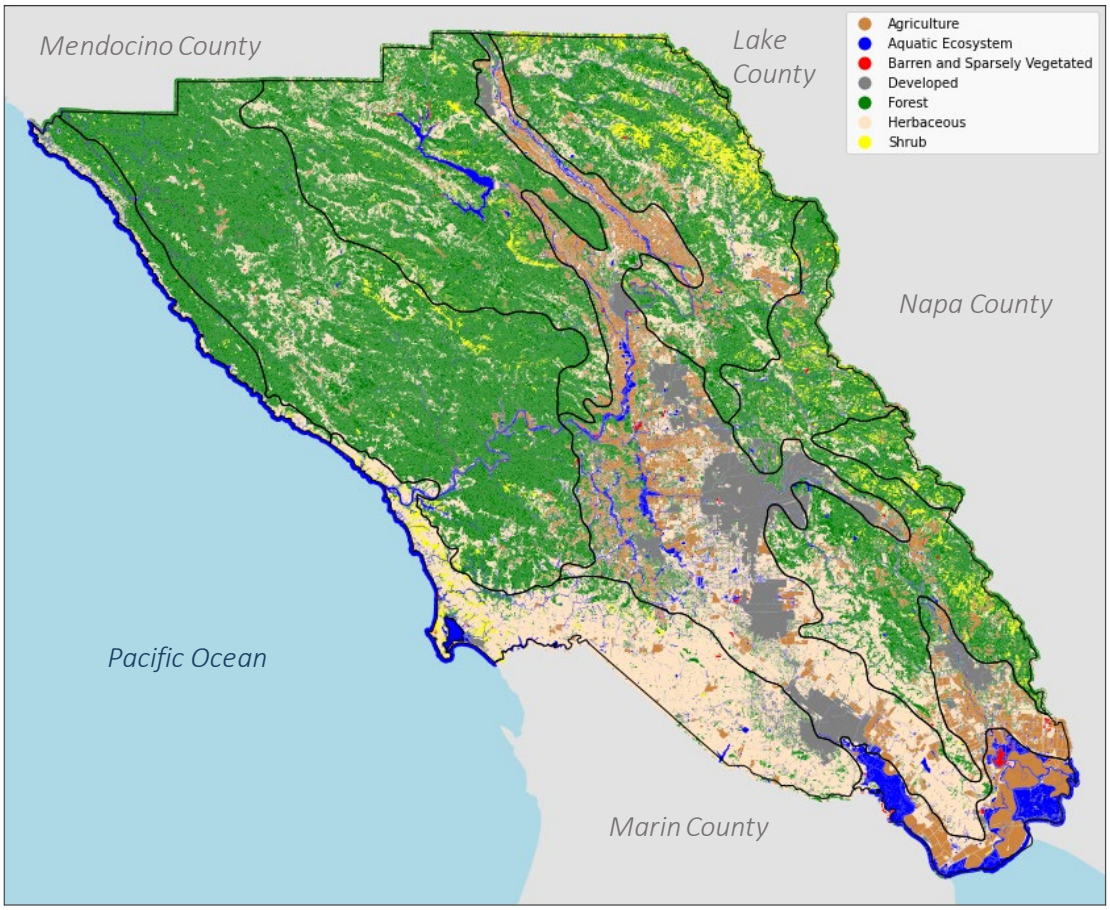
I. Climate-Resilient Land Categories

The natural and working lands that are the focus of this Lands Strategy are broadly grouped by natural and agricultural land cover types. Many of these broad land cover categories occur throughout the county and fall within multiple ecoregions (see Figure 4 below and box to the right). Lands may also fall into multiple land cover groups, may not meet model land cover characteristics, or may be at a mapping scale that is too small to be accurately categorized under a broad classification system. Using ecoregions facilitates grouping lands in similarly classified geographic areas based on physical and biological factors, while broader land cover categories provide additional detail on biological factors that the Lands Strategy uses to guide development of projects and actions. Using finer scale data sources on broader land cover categories, we can then identify specific characteristics of resilience, as well as vulnerable natural and human communities and their locations throughout the county.

Types of Natural and Agricultural Land Cover

- Forests.
- Agricultural lands (including croplands, vineyards, and grazing lands).
- Aquatic ecosystems (including wetlands and riparian streams and corridors).
- Grasslands.
- Shrubland and chaparral.
- Developed lands.

Figure 4. Sonoma County fine-scale vegetation and habitat map displayed according to lifeform, with ecoregion boundaries in black.



The Sonoma County Fine-scale Vegetation and Habitat Map (Fine-scale Veg Map) was developed in accordance with the Survey of California Vegetation alliance and association levels (Klein et al., 2015; Sonoma Veg Map, n.d.).[2] Vegetation alliances are repeating patterns of plants across a landscape that reflect local environmental factors such as climate, soil, water, and disturbance. Vegetation associations are members of one or more land cover classes that are used to indicate conditions such as temperature, moisture, and light. The results of this comprehensive spatial and field reconnaissance effort identified 103 tree overstory, 79 shrubland, and 148 herbaceous alliances and associations. For general descriptive purposes and to maintain consistency with the Vital Lands Initiative (Sonoma County Ag + Open Space, 2021), the Lands Strategy groups natural communities into higher-level lifeform categories (e.g., forest, shrub). However, projects or actions may more specifically target natural community alliances (e.g., Coast Redwood Alliance) or associations, agricultural land cover, and/or habitat type based on vulnerability to a specific climate hazard. Below are general summaries of the eight major land cover categories that compose Sonoma County. See Appendix F for more information regarding indicators of resilience.

Forests

The United States Forest Service defines forests as land in which trees comprise at least 10% of the land cover, including lands that formerly had such cover and can support natural or artificial reforestation.

Percentage of Sonoma County with forestland: 50%

Acres of forest within Sonoma County: ~525,000 acres

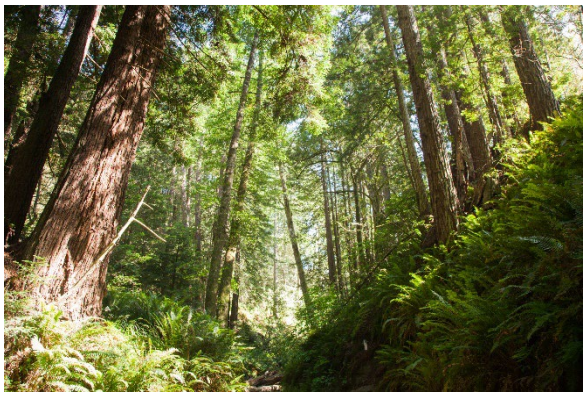
Sonoma County forest characteristics: Of the approximately 1 million acres of forestland in the county, half are mainly comprised of oak woodland, coast redwood, Douglas fir, and mixed hardwoods. Many of the county's rural landscapes are characterized by forest communities, which contribute important ecological, economic, and cultural benefits. Forest communities can also play an important role in sequestering atmospheric carbon but are at significant risk to climate-related changes including drought, warmer temperatures, and reduced precipitation, which are predicted to drive increasing intensity and frequency of wildfires and species range shifts.

Forest benefits: Healthy forests provide many benefits that help build climate resilience and ecological and community health—including clean water, biodiversity, and the capacity to moderate climate, store significant amounts of carbon, resist wildfires, and reduce flooding to adjacent areas (USDA, 2015).

Forests play a major role in carbon sequestration. Throughout the United States, forests sequester the equivalent of 12% of the nation's annual carbon emissions, with significant potential for that amount to increase with improved conservation, management, and restoration practices (Smith, 2021).

Due to these characteristics and the presence of significant acreage within the county, forests have great climate resilience potential. More than any other land cover type, existing forests and newly forested areas within the county have the most potential to increase climate resilience for the entire county, including increased carbon sequestration and storage capacity, soils, trees, and ground cover that can

[2] In the Sonoma Veg Map classification, the alliance level "is defined by plant species composition, habitat conditions, physiognomy, and diagnostic species; at least one of the diagnostic species is typically found in the uppermost or dominant stratum (Jennings et al., 2009). The association is the most detailed classification level and reflects more specific characteristics of vegetation such as finer-level differences in species composition, topography, soils, substrate, climate, hydrology, and disturbance regime (Federal Geographic Data Committee, 2008)."(Klein et al., 2015).



Forests in Jenner, Sonoma County.

slow and store water, and the cooling properties that are provided by tree density and cover. Tree canopies can reduce heat by up to 15 degrees Fahrenheit and are the most effective strategy in combating the increasing frequency and intensity of high heat (Stone, n.d.). Forests also play a significant role in the water cycle, including by regulating precipitation, evaporation, and flows. For example, the needles of coastal redwoods catch fog. That water drips down, providing water to both the trees and nearby creeks. (Jordan, 2021).

Forest challenges and risks: Despite these incredible life-protecting qualities, conservation, and management of forests across the United States has not kept pace with their importance to human, ecosystem, and climate health. Forests within Sonoma County, like many others throughout the country, have been removed or degraded by urban development and agricultural uses and compromised by poor management practices, pollution, and invasive species. These activities have resulted in fragmentation and isolation from other forests and have contributed to limited genetic exchange and native species movement (Schlaepfer et al., 2018). Despite the historic importance of fire in shaping and managing many of California's vegetation communities, tolerance of fire throughout the State of California has been limited due to an increase of housing and agriculture in the wildland urban interface. Fires used to burn more naturally in California and fire was used by local Native American tribes as a land management strategy to help clear debris and regenerate growth. Additionally, some timber practices have resulted in monocultures, pesticide use, the removal of the largest and healthiest trees, and a lack of diversity in age, size, and species. Many forests are no longer healthy enough to provide the climate, ecological, and social benefits they once provided. As a result, forests can become a source of emissions and risk rather than a benefit. Unhealthy forests are more at risk from climate impacts including wildfires, floods and erosion, and habitat shifts from forest to shrublands and grasslands. Climate change will also cause trees to migrate to more hospitable climate, water, and soil conditions.

Lands Strategy forest recommendations: In spite of the challenges described above, it is possible through a mix of conservation, management, and restoration practices to bring climate-resilient and ecologically beneficial qualities back or to preserve these qualities where they still exist. Sonoma County still has a significant amount of forestland, which makes up 50% of the land in the county. Preserving, better managing, and restoring forests in Sonoma County so that they are able to provide resilience benefits is one of the most critical actions the County can take to protect and preserve public health and wellbeing, ecosystems and biodiversity, water quality and quantity, and provide a stable and growing carbon sink in forests. Improving forest condition could also help reduce risk from flooding, wildfires, extreme precipitation, and extreme heat.

To have the most significant impact, the County and its partners within and beyond county borders should prioritize conserving and restoring forest areas adjacent to existing conserved forests, forests with riparian habitat, connections and corridors that can be restored to provide for wildlife movement, genetic diversity, tree migration, and habitat shifts due to climate change and extreme events. Forest conservation strategies should include areas in different ecoregions and provide for horizontal and elevational migration.

In addition to conservation strategies, management strategies to increase forest health require prioritized support. When forest ownership and/or management is the responsibility of different entities, it is

important to standardize approaches to management across property lines and across town/county borders through multi-jurisdictional land management strategies. To reduce wildfire risk, as well as flood and erosion risks, the ownership mosaic of forests should be viewed as a landscape-scale project in which actions are not delineated by ownership (Charnley et al., 2020).

Strategies to encourage and support forest management practices that increase forest health and reduce climate risk must also be part of the toolbox. Funding for such programs should also be prioritized in the short term, while conservation and restoration projects may take longer to realize and implement. Forest management strategies near residential homes and structures could not only increase forest health but help create defensible space that will be highly beneficial in reducing risk.

To provide guidance on prioritizing forest conservation, management, and restoration projects, this Lands Strategy includes indicators to help guide and measure the impact of actions. These indicators (see box to the right) were adapted from the U.S. National Climate Assessment (USDA, 2015). To implement forest conservation and management practices, the County should work with its partners to conduct monitoring and scientific studies that will help determine the efficacy of conservation and management actions (e.g., fuels treatments).

Forest Conservation, Management, and Restoration Indicators

- Forestland area and extent.
- Forest biomass density.
- Presence/distribution of native species/species richness.
- Forest growth and productivity.
- Forest insect and disease damage.
- Water balance deficit.
- Trait diversity and redundancy.

Agricultural Lands: Croplands, Vineyards, and Grazing Lands

This category of land cover encompasses all agricultural uses, including croplands, orchards/groves, non-vineyard perennial croplands, hayfields, plant nursery products, grazing lands, and vineyards.

Percentage of Sonoma County with agricultural lands: 22%

Acres of agricultural lands within Sonoma County: ~227,000 acres

Sonoma County agricultural lands characteristics: The agricultural lands of Sonoma County are a cornerstone of the heritage and local economy of the region and are an important element of a dynamic and diverse landscape. The vast grazing lands support many agricultural industries, including meat and dairy farming, while preserving large tracts of land that provide habitat and movement corridors for a range of native species. The local farms, ranches, and vineyards that produce food, fiber, and plant materials constitute an industry that generates approximately $1 billion annually, with vineyards alone being responsible for half of this amount. These agricultural lands contribute significantly to the local economy (Sonoma County, 2020b) and to increased food security, as well as providing residents with a livelihood with multiple social and economic benefits.

Agricultural lands benefits: Agricultural lands represent some of the greatest potential for increased climate resilience and carbon sequestration in Sonoma County and in the state of California. Some studies estimate that agricultural soils in the US have the potential to sequester 250 million metric tons of carbon (National Academies of Sciences, Engineering, and Medicine et al., 2019). The ability of agricultural lands to reach their potential to sequester and store carbon, increase water storage, reduce water usage, and serve as a buffer from climate-related hazards depends on the use of regenerative farming or ecologically based farming practices. Regenerative farming practices include minimal soil disturbance, year-round roots and soil cover, crop diversity, integration of animals, reduced use of chemicals, preservation of riparian areas and other sensitive land types, and carefully managed grazing. In addition to providing

climate resilience benefits, these practices also reduce water usage, increase biodiversity, improve water quality, enhance conditions for pollinators, provide for a safer and healthier environment for farmworkers, and allow for increased wildlife movement (Chesapeake Bay Foundation, 2021).

By shifting Sonoma County's current agricultural practices to more regenerative approaches, agricultural lands could serve as a significant tool in the County's climate mitigation and adaptation toolbox.

Agricultural lands challenges: Working lands stakeholders identified a number of challenges that impede conservation and management of agricultural lands for climate resilience and sequestration benefits. These challenges include a lack of financial resources to enact regenerative and ecological practices, the high cost of living within the Bay Area and Sonoma County, and a lack of access to technical, financial, and policy support. Additionally, the agricultural lands are confronting multiple pressures, including climate change impacts such as drought, wildfire, high heat, and flooding that require additional planning and new approaches. Being a farmer or rancher in the Bay Area can be difficult due to high land costs, high cost of living, and pressure from surrounding land uses.

Agricultural lands recommendations: To increase the carbon sequestration and storage potential of agricultural lands, the County should support farmers, ranchers, and other agricultural producers in conserving their lands and implementing regenerative management practices (see box on the right).

Examples of Regenerative Practices

- Reducing or eliminating tilling.
- Diversifying and rotating crops.
- Using cover crops.
- Conserving and restoring forests, riparian corridors, wetlands, and other habitats.
- Eliminating the use of petroleum-based fertilizers and reducing pesticide use to the extent possible.
- Using hedgerows instead of fencing.
- Integrating grazing animals to reduce crop waste, pests, and non-native species.
- Using buffer or filter strips.
- Applying mulch and compost.
- Managing nutrients and manure.
- Establishing trees and shrubs.
- Using prescribed grazing.

This support should include technical assistance, peer-to-peer learning, and financial support, including new funding mechanisms for ongoing support, grant writing assistance, housing assistance, worker training programs, and markets for crops, wine, and grazing animals raised to support climate resilience and carbon sequestration in the county. The County could explore new funding mechanisms that pay farmers, grape growers, and grazers for their climate contributions, such as carbon markets and conservation easements. The County could also consider providing funding or creating a dedicated fund to support farms that are already committed to carbon friendly and ecologically based farming practices, especially smaller farms which may be receiving less funding support from state and federal programs. Support to smaller farms can also include educational and technical support and incentives to encourage other farms to explore regenerative practices. In supporting small farms, consideration should be given specifically to agricultural workers, on whom the local agricultural industry relies. In prioritizing support for regenerative farming practices on small and larger farms, agricultural workers should be a priority in this support. There are many partners to draw on, including the RCDs, Ag + Open Space, local Native American tribes, and others who can support this critical shift in land management. Finally, the County could also consider supporting initiatives to pilot, scale, and test regenerative best practices, which could help farmers, ranchers, and other agricultural producers better understand the most suitable techniques and potential best practices to apply on their lands.

Agriculture Conservation, Management, and Restoration Indicators

- Acres of land with conservation easements.
- Acreage of agricultural land stewarded using regenerative or ecologically beneficial practices that help buffer against climate-related hazards (e.g., practices that increase water retention, increase soil nutrients, decrease erosion, promote plant health and resilience to climate impacts, encourage native pollinators, and more).
- Diversity of production on agricultural lands.
- Acres of land soil, slope, and water conditions that are projected to support agricultural uses into the future.
- Pollinator presence.
- Controllable levels of nuisance species, pests, and disease.
- Maintenance of current levels of biodiversity.
- Number of programs and funding available to support farmers' shifts to climate-resilient practices.
- Inclusion of small farmers in program development and design to ensure compatibility with needs and equitable access.

Sheep Grazing in a Vineyard in Sonoma County.

Given the prevalence of agricultural lands in Sonoma County, there is significant potential to increase climate resilience and carbon sequestration through different management strategies. Regenerative and ecological practices can also provide agricultural lands with greater ability to adapt to climate impacts and support agricultural uses in the face of climate change, in addition to promoting agricultural viability and food security. Healthy and sustainable farming practices provide multiple benefits, including worker health and safety, green jobs, food security, increased biodiversity, improved water quality and supply, provision of habitat and corridors, as well as carbon sequestration.

Aquatic Ecosystems: Wetlands and Riparian Streams and Corridors

Percentage of Sonoma County with aquatic ecosystems: 5%

Acres of aquatic ecosystems within Sonoma County: ~52,500

Definition: Aquatic ecosystems include both coastal and freshwater wetlands and riparian streams and corridors.

WETLANDS

A wetland is an area of land that is saturated with water and characterized by plants that can tolerate wet soils and low oxygen levels at their roots. Coastal wetlands include all wetlands in coastal watersheds—the entire area from which tidal streams drain to the ocean or inland seas. Types of coastal wetlands within Sonoma County include salt marshes, freshwater marshes, and seagrass beds.

Dickson Ranch Baylands, Sonoma County.

Sonoma County wetlands characteristics: Key wetland areas in Sonoma County include San Pablo Baylands (estuarine wetlands), the Laguna de Santa Rosa (freshwater wetlands), and Petaluma Marsh (estuarine wetlands). Sonoma County's wetlands provide enormous benefits in terms of biodiversity, water quality, carbon sequestration, and flood protection. These wetlands also serve as key stops on the Pacific flyway and, as such, support incredible bird biodiversity. Though 90% of California's wetlands have been lost, San Francisco Bay is a center of wetland restoration in the state and contains 77% of the state's remaining perennial estuarine wetlands (Ramsar, 2013).

Wetlands benefits: Wetlands are an essential tool for both combatting climate change and protecting communities from climate impacts. Coastal wetlands and mangroves sequester about ten times as much carbon as forests (National Oceanic and Atmospheric Administration, n.d.) and current studies indicate that tidal wetlands can maintain or increase their rate of carbon sequestration if they keep pace with sea level rise. The carbon sequestration process and organic matter accumulation are driven in part by tidal inundation, so more frequent tidal inundation means faster carbon sequestration (Wang et al., 2019). The San Francisco Bay wetlands also provide flood protection benefits by acting as a sponge that can absorb water from high tides and storm events.

Wetlands challenges: Primary pressures on the Baylands are marsh drowning and coastal squeeze due to climate change. If tidal marshes do not receive enough sediment to grow vertically or keep pace with sea level rise, they will convert to unvegetated mudflats, meaning a loss of salt marsh. From a carbon sequestration perspective, this flooding results in the loss of aboveground biomass and soil sequestration stops, while some carbon remains sequestered in the soil (Sheehan & Ries, 2020). Additionally, within freshwater wetlands, issues like nutrient runoff can result in eutrophication and invasive aquatic species. Key pressures from adjacent development can lead to increases in urban runoff, creation of urban heat islands, and increased exposure to wildfire. These impacts impair water quality and habitat value if not effectively managed. Climate change is projected to increase these impacts (e.g., an urban heat island will be even hotter under a hotter climate). Strategies such as low-impact development, urban greening, ongoing restoration, and agricultural best management practices can significantly reduce these impacts (San Francisco Estuary Institute, 2020). The box on the next page summarizes key indicators of wetland resilience.

Wetlands recommendations: While wetlands make up only a small percentage of land within Sonoma County, their climate resilience and sequestration potential are significant, and conservation and restoration can provide opportunities to realize that potential. Additionally, wetlands provide significant benefits to the other land types, such as flood risk reduction, improved water quality and quantity, and benefits to soils. Wetlands projects that conserve and restore wetlands and adjacent uplands, connect wetlands to uplands and watersheds, and provide for wetland migration as sea level rises and wetlands need to shift to higher elevations should be prioritized. One such project is the Sonoma Creek Baylands Strategy, which includes a watershed-wide planning approach that would increase climate resilience, carbon sequestration and storage, and reduce risks from flooding, fire, and heat (Sonoma Land Trust & San Francisco Bay Restoration Authority, 2020). To address potential losses of biological productivity due to climate change, land should be managed to provide adequate room for wetlands to migrate inland (and achieve higher elevations). Manual addition of sediments may also be necessary. Across the county and California, there are examples of adding a thin layer of sediment from dredged soils to boost sediment that naturally settles on marshes. This emerging marsh adaptation strategy aims to increase the elevation of the tidal marsh platform (Raposa et al., 2020). For instance, within Sonoma County, the Sears Point Wetland Restoration Project helped recreate tidal marsh habitat, decrease subsidence, and promote sediment retention, providing critical habitat for wildlife and endangered species that depend on intact marsh habitat (Sonoma Land Trust, n.d.).

Wetland Resilience Indicators

Coastal wetlands:

- Level of disturbance.
- Acreage of protected wetlands, buffers, and uplands.
- Acreage of restored and managed wetlands.
- Wetland migration potential.

Freshwater wetlands:

- Acres of freshwater wetlands conserved.
- Acres of freshwater wetlands restored.
- Presence of a range of wetland cover types.
- Level of connectivity between marshes and wet meadows.
- Level of connectivity among riparian areas.
- Extent of wetlands adjacent to channels.
- Extent of natural land cover in terrestrial areas around wetlands.

RIPARIAN STREAMS AND CORRIDORS

Riparian corridors are made up of the area of active stream or river flow and the strip of vegetation occurring along the river, as well as exposed bars and ponded water near the channel and the floodplain (National Research Council, 2002). In an ecologically healthy system, these components are highly interconnected; for example, riparian plants provide bank stabilization, wood supply, and sediment deposition on floodplains, all of which impact the complexity of channels and variety of instream habitat features (National Research Council, 2002).

Sonoma County riparian streams and corridors characteristics: Sonoma County has a significant number of riparian corridors and streams that maintain some of their natural characteristics. Ag + Open Space's Vital Lands Initiative identified priority riparian habitat as near-channel and floodplain areas dominated by native forest and shrub vegetation, as well as floodplain areas that may be restored to historical conditions. The Vital Lands Initiative also identified priority streams as having threatened or endangered salmonid and other aquatic species and having been identified as critical habitat by the U.S. Fish and Wildlife Service (Sonoma County Ag + Open Space, 2021). Some significant riparian and stream corridors include the Russian River, Sonoma Creek, Laguna de Santa Rosa, Mark West Creek, Petaluma River, and others.

Riparian streams and corridors benefits: Benefits provided by a healthy riparian corridor include biodiversity, recreation areas, nutrient cycling, cool microclimates, reduced peak flows, flood risk reduction, and disrupted spread of wildfire (National Research Council, 2002; U.S. Forest Service, n.d.). Many of these services are especially important in the context of the changing climate. For example, the wildlife corridors created by riparian corridors are important for wildlife movement in the event of a local wildfire or debris flow. In terms of cool microclimates, wooded riparian areas create shade and thus cooler local water temperatures, an essential benefit in Sonoma County creeks and streams that have suffered from harmful algal blooms. Cooler water temperatures are also essential for aquatic species; in August 2021, for instance, thousands of juvenile coho salmon had to be relocated from Lake Sonoma to another facility due to warm water (Bowler et al., 2012; California Department of Fish and Wildlife, 2021). These cool microclimates are important as summer air temperatures rise. Trees and grasses in riparian areas reduce water velocity, which in turn reduces peak flows (National Research Council, 2002). This flow reduction is a clear benefit for a county with a long history of floods. Finally, healthy riparian areas have high levels of moisture, which can disrupt the spread of fire (U.S. Forest Service, n.d.). Healthy riparian corridors and streams, with uplands, tree canopies, and vegetated banks, can also sequester and store carbon aboveground and beneath the soils (Dybala et al., 2019).

Duckworth Farm (Nahmens Conservation Easement), Sonoma County.

Riparian streams and corridors challenges: Key threats to riparian corridors and the benefits they provide are interrupted flows (e.g., dams), drought, adjacent land uses, lack of sufficient uplands and banks, high fuel loads, loss of vegetation, loss of floodwater storage, and water diversions. Interrupted flows create breaks in fish and aquatic animal passage corridors. High fuel loads turn riparian corridors from fire breaks into high-risk areas for high-intensity fires (North, 2019). Adjacent land uses can result in erosion nutrient loading and altered sediment levels and runoff.

Climate change risks include wildfire, heat, flooding, and drought. As California moves from fire suppression to prescribed burns and other efforts to address uncharacteristically high fuel loads, riparian areas should be prioritized as an effective way to reduce the risk. High-intensity fires in the riparian corridor are highly detrimental to water quality (for humans and wildlife) and the range of other benefits provided by riparian corridors (North, 2019). The box to the right summarizes key indicators of healthy and resilient riparian corridors to consider in prioritizing corridors for restoration and conservation.

Riparian Corridor Indicators

- Presence and extent of erodible river corridor/ protected mobility corridor.
- Amount of invasive, non-native vegetation.
- Water quality.
- Temperature.
- Summer baseflow.
- Acres of conserved riparian areas.
- Acres of restored riparian areas.
- Presence of native species.
- Extent of catchment connectivity.
- Topographic and climatic variability.

Riparian streams and corridors recommendations: To improve the climate resilience qualities that riparian corridors and streams can provide, Sonoma County should prioritize conserving, managing, and restoring those riparian corridors and streams that were identified by the Vital Lands Initiative and evaluate current regulations and land use requirements to reduce risks to these critical corridors, with a focus on preserving and restoring large, connected corridors with native vegetation, and supporting native species or those areas that have the potential to support native vegetation and species. Preserving and restoring healthy riparian corridors and streams throughout Sonoma County will provide many benefits, including wildfire buffers, reduced flood risk to lands adjacent and downstream to these areas, heat risk reduction, and the ability to slow and store water in soils and floodplains in high- and low-flow conditions to benefit ecological and human health.

Grasslands

Grasslands are defined as an area in which herbaceous vegetation and grasses dominate the landscape and canopies of trees and shrubs make up less than 10% of the vegetation cover present. Grasslands were historically composed of native perennial and annual grasses and a diversity of forbs, with a range in species composition driven by soil and climate differences.

Percentage of Sonoma County with grasslands: 25%

Acres of grasslands within Sonoma County: ~264,000

Sonoma County grasslands characteristics: Sonoma County grasslands are dominated by non-native grasses, though many are managing the lands to bring back native grasses, which have deeper roots and provide more ecological and climate benefits. While grasslands can be found throughout Sonoma County, these landscape types are most common in the southwest part of the county and in patches in the central and eastern parts of the county that are predominately zoned for agricultural purposes, such as grazing. Grasslands also provide valuable habitat for many wildlife species and serve as important movement and migration corridors. Coastal prairie is an important grassland group in Sonoma County as it supports a diverse range of native grasses and provides valuable habitat for sensitive species. Areas mapped as grassland/herbaceous also include oak savannah, which was once common in Sonoma County throughout the valley bottoms.

Grassland benefits: Grasslands across California provide grazing land, open spaces, habitat, preservation of open spaces, and water capture. Grasslands in the county are predominantly zoned for agriculture and provide forage for a diversity of grazers, including dairy cows, beef cows, goats, and sheep. If predominately made up of native species with their deeper roots and perennial ground cover, grasslands can contribute significant climate mitigation and adaptation benefits, in addition to providing habitat for native species, water and groundwater storage, wildfire risk reduction, and healthy grazing lands (Colorado State University, n.d.).

Grassland challenges: This land type has been significantly impacted by human activity, adjacent land uses, and land management practices across California and Sonoma County (Sonoma County Community Foundation & Sonoma Water, 2010). These changes have meant that many of California's grasslands do not realize their climate and ecological potential due to their degraded condition. Non-native species have been replacing California's native grassland species for centuries, and unfortunately these non-native species have shallow root systems and are annual grasses that die off rather than providing perennial cover (DeLonge & Basche, 2018).

Grasslands recommendations: Public and private grasslands present a great opportunity for Sonoma County to meet its climate adaptation and mitigation goals. There is significant acreage in the land type, and the benefits extend to being able to increase carbon sequestration potential while reducing risks from flooding, drought, erosion, wildfire, and heat. Retaining grasslands also reduces the pressure to shift land to higher density use, which would increase carbon emissions and introduce more conflicts into the wildland-urban interface. Sonoma County farmers and organizations such as the RCDs already have experience developing programs to support and increase climate-resilient grasslands management.

Grasslands Resilience Indicators

- Presence and predominance of deep-rooted, perennial native species.
- Soil water filtration ability.
- High native biodiversity.
- Management of erosion and runoff.
- Catchment connectivity.
- Reduction of fuel loads.
- Grazing practices that include factors such as landscape-appropriate herd size; rest, rotation, and complexity of lands grazed; minimizing use of fertilizer; mosaic of diverse perennials; landscape diversity; reserves for unique habitat (including riparian and aquatic habitat); monitoring and removal of non-native species; and management for biodiversity and ecosystem health.

The County, potentially in partnership with others, such as Ag + Open Space, could explore mechanisms to support the expansion of the agribusiness sector that provides managed grazing herds to control non-native species and reduce fire hazards. Implementing prescribed grazing for fuel reduction rather than mowing with heavy machinery rejuvenates soils and allows the land to sequester carbon more effectively, without consuming large amounts of gas and diesel fuels. The goal of prescribed grazing is to reduce "fine fuels" such as grasses and shrubs and is often used in areas near homes or hard to reach areas where prescribed fire or mowing is not a viable option for fuel management (University of California Agriculture and Natural Resources, n.d.). Additionally, some native vegetation groups, such as coastal prairie, have been shown to benefit from grazing as it reduces competition with non-native species (Jeffery (Immel) et al., n.d.). Increasing and prioritizing such programs would help capitalize on the climate resilience benefits of grasslands throughout the county. Finding ways to compensate landowners and grazers for land management practices that support so many climate, ecological, and social benefits should also be a priority for the County (Nett, 2018).

Shrubland and Chaparral

Shrubland and chaparral land types are defined as vegetation communities comprised of broad-leaf evergreen shrubs, bushes, and small trees under 8 feet in height, and are common in the southwestern parts of North America in coastal and inland mountains. Shrubland and chaparral contain significant biodiversity, and the specific mix of plants present depends on annual rainfall, elevation, soil type, soil temperature, land use, wildfire frequency and intensity, and land management.

Percentage of Sonoma County with shrubland and chaparral: 4%

Acres of shrubland and chaparral within Sonoma County: ~42,000

Sonoma County shrubland and chaparral characteristics: County lands dominated by shrubland, and chaparral are mainly confined to the coastal region (i.e., coastal scrub) and interior dry canyon slopes (i.e., chaparral). Coastal scrub habitats are found on coastal bluffs above the Pacific Ocean and inland mesas and canyons and provide important habitat for birds and other wildlife. Common species associated with coastal scrub communities are typically well-adapted to seasonal drought, as well as some fire conditions, and may expand into surrounding areas that have been disturbed (EcoAdapt, 2021). Chaparral habitat is

common to dry, rocky, and nutrient-poor soils associated with steep south-facing slopes and ridgetops (Sonoma County Community Foundation & Sonoma Water, 2010).

Benefits of shrubland and chaparral: California's shrubland and chaparral areas are known to be rich in native species and biodiversity and are fairly resilient to heat and drought.

Challenges of shrubland and chaparral: Shrubland and chaparral have historically been considered by developers and landowners and managers as less appealing than other land types. Due to this perception these lands have suffered a significant amount of removal for agriculture and grazing, encroachment by development, and damage due to clearing for development and exposure to flooding and fires (Underwood et al., 2018). In addition to disturbance and removal to provide for other land uses, recent studies have found that the extreme droughts experienced in California over the last few decades, as well as an increase in the intensity and duration of extreme heat events, are causing significant damage to these vegetative communities. The increased frequency of wildfires has also been a threat, with not enough time between fires for shrubland and chaparral to re-establish themselves. Unfortunately, the habitat shift that often occurs in these circumstances is to non-native grasslands, eliminating the habitat value and support for uniquely adapted species provided by this landscape type. A secondary consequence from the loss of shrubland and chaparral is increased erosion and risk from debris flows.

Shrubland and chaparral recommendations: To help maintain the health and climate resilience potential of shrubland and chaparral habitat, areas where these lands would be able to migrate successfully should be identified and preserved, such as canyons, north-facing slopes, deep soils, complex topography, and areas with few of the non-native species that could outcompete or displace shrubland and chaparral after an extreme event. While climate change may make it impossible to preserve all native species, there are some options for retaining shrubland and chaparral if resources are available to identify risks and possible adaptation strategies in advance of catastrophic loss. Preserving and restoring native chaparral provides significant benefit to biodiversity, soil retention, and flood risk reduction in conserving, restoring, and managing its migration as conditions change due to climate. This will be particularly important to reduce the shift of this native and critical habitat type from one that supports native species and to non-native grasslands that have far fewer benefits (Bohlman et al., 2018).

Shrubland and Chaparral Resilience Indicators

- Presence of biodiversity.
- Acres of shrubland and chaparral conserved.
- Acres of shrubland and chaparral restored.
- Moderate temperatures in the winter and summer.
- Access to moderate amounts of water.
- Trait diversity and redundancy.

Developed Lands

Developed lands are often characterized in natural and working lands plans as urban areas, human development in non-urban areas, and infrastructure and utilities that are in both urban and non-urban areas. Developed lands also contain natural areas such as urban forests, parks, trails, wetlands, riparian corridors and streams, and other similar land types, which are the focus for this section.

Percentage of Sonoma County with developed lands: 6.7%

Acres of developed lands within Sonoma County: ~70,500 acres

Sonoma County developed lands characteristics: Developed lands are a single category within the Sonoma Veg Map data and are represented by multiple county land use designations, including urban residential, rural residential, and commercial. Interspersed within developed areas are a variety of natural communities and habitats, creating a mosaic of built environment and natural spaces. Urban forests, streams, wetlands, and community parks contribute significant social, economic, and ecological benefits, as well as contributing to climate resilience. The developed lands category in Sonoma County is predominately located in the valley between the coastal areas to the west that are dominated by grasslands and forests and the inland areas to the east that are dominated by mountains, shrubland and chaparral, and forests. With its use of zoning, urban growth boundaries, and greenbelts, the cities and the County of Sonoma have limited the densest urban development to this more limited area. The indicators for climate-resilient developed lands are in the box on the right.

Developed Lands Resilience Indicators

- Number and density of urban trees.
- Acreage of parks and other green spaces.
- Equitable access to urban green spaces and the benefits provided by them.
- Location and length of new or enhanced bicycle and pedestrian corridors.
- Location and number of new or enhanced riparian area restoration. Location and number of new or enhanced riparian area restoration within urban areas.
- Location and number of new or enhanced corridors and connections.
- Location and type of green infrastructure.

Developed land benefits: Developed lands can provide ecological, social, and climate resilience benefits to Sonoma County. Natural, constructed, and restored green spaces and aquatic areas can provide recreational areas, croplands, and water quantity and quality benefits, in addition to supporting wildlife movement, native habitat, and biodiversity. The climate resilience benefits include providing buffers and staging areas for wildfires; reducing flood risk through buffers, bioswales, and water recharge areas; and limiting the impact of high heat by providing tree canopies and green spaces to cool surrounding areas. Planting trees can also provide significant benefits for carbon sequestration and storage. Bjorkman et al. (2015) estimated that the canopy shade from urban trees planted in California will reduce emissions by over 1.3 million metric tons per year, with an estimated value of $15 million. A similar study conducted of urban trees found an estimated carbon storage and carbon sequestration potential of over 25 million metric tons annually for the United States. Even in highly urbanized areas such as the city and county of San Francisco, a study found that urban trees managed by both public and private parties provided carbon sequestration benefits, as well as significantly reducing stormwater runoff where trees are present (Maco et al., 2003).

Developed lands challenges: The benefits from urban trees and green spaces, as well as naturalized riparian corridors or green infrastructure, are not experienced equally across urban areas. Studies of green space and urban trees have found that these beneficial characteristics occur in wealthier areas in cities, and a lack of trees and parks is common in areas that experienced redlining in the past, which are now areas with underserved and under-resourced communities. Focusing these benefits equitably across the county will provide benefits to the entire county and reduce the intensity of hazard events, as well increase the potential for carbon sequestration, creating a continuous network of healthy, climate-resilient lands across the county. Additional challenges in the developed lands include the high cost of land, creating challenges in purchasing land or using conservation easements. The mix of jurisdictions and land uses also presents additional hurdles when planning and implementing strategies robust enough to increase climate resilience.

Developed lands recommendations: By preserving and increasing the number of urban trees and forests, improving tree canopies, and adding green spaces in the developed lands, large contributions to greenhouse gas emission reduction goals can be made while providing significant benefits to the community, reducing heat, and improving air quality and quality of life (Bjorkman et al., 2015). The County should work together with cities, private landowners, urban farmers, grape growers, and other stakeholders to plan, design, and implement a system of urban greenspaces, greenbelts, riparian corridors, parks, green infrastructure (e.g., green roofs and streets, urban tree canopy, bioswales), and ecological variations on more traditional gray infrastructure including green parking lots, green streets. See box to the right for examples of green infrastructure types. Sonoma County has a strong history of deploying green spaces for a variety of purposes, including greenbelts and growth boundaries to limit development beyond city boundaries. Within Sonoma County, there is significant opportunity to increase the climate benefits provided by adding trees and green spaces into existing development, during retrofits and replacements, and whenever new development, reconstruction, or replacement is occurring throughout the county. The County could also provide support for urban farms and private landowners to participate in climate-resilient practices on their lands.

Examples of Green Infrastructure Types

- Downspout disconnection.
- Rainwater harvesting.
- Rain gardens.
- Planter boxes.
- Bioswales.
- Permeable pavements.
- Green streets and alleys.
- Green parking.
- Green roofs.
- Urban tree canopy.
- Land conservation.

Summary of Climate-Resilient Land Categories

Sonoma County has a significant amount of acreage in vegetation and land use types that make conserving, managing, and restoring its natural and working lands a powerful strategy to increase climate resilience for the whole county while improving ecological, social, and economic benefits as well. With well over 50% of Sonoma County's lands in forests, agricultural lands, aquatic lands, and grasslands, the County has the potential to significantly increase the climate resilience of these lands by building off many actions it is already taking. These actions include the use of conservation easements, zoning, urban growth boundaries, buffer zones, more effective wildfire management strategies, and regenerative agricultural practices. Additionally, Sonoma County has many high-functioning and active agencies and partners to work with to advance these and other actions at the scale necessary to improve climate resilience and reduce risks to the county's ecological assets, agricultural lands, communities, and economy.

Existing challenges include the fragmented nature of Sonoma County's conserved lands, a lack of consistent and sustained funding, and a lack of a shared strategic vision for a climate-resilient natural and working lands system among public entities and others. The next sections of the report describe the characteristics of climate-resilient natural and working lands system and identify priority projects to realize those characteristics in the system.

II. System-Wide Findings

The impacts of climate change on Sonoma County's natural and working lands are not anticipated to be uniform and will vary based on some of the vulnerability characteristics that are both inherent to specific vegetation communities, as well as those present in the management and condition of the ecosystem and agricultural lands (Weiskopf et al., 2020). Certain natural communities, species, agricultural types, and human communities are more likely to readily adapt to a changing climate based on existing resilience characteristics, while others will be more sensitive due to existing or underlying factors and stressors.

Landscape-Scale Resilience

At a landscape scale, components of the natural and working lands system will have different climate risk thresholds; however, changes or shifts of any one component of the system could have system-wide implications. This interconnectivity is evident when looking at vegetation communities, in which the dominant constituents are highly sensitive to extreme temperatures. Changes due to climate change could result in potential mismatches between plants and pollinators, causing reduced plant reproduction success (Gérard et al., 2020). Plant species may respond by shifting laterally or vertically to habitat or climate regimes that are more suitable but may be restricted by landscape fragmentation or reach the edge of their geographic ranges (Ackerly et al., 2020). Some studies suggest that generalist species may more readily adapt to changes, while specialist and endemic species may be less resilient (Gérard et al., 2020).

Due to the interconnected nature of how the lands will respond to climate change, it is important to consider the entire system rather than one species or small geographies when developing principles for climate resilience. Strategic conservation planning should provide ways for species and natural communities to adapt and shift by conserving and restoring areas that are larger and more connected, include buffers, and provide for vertical and horizontal movement. A climate-resilient landscape is one that can provide multiple benefits for the natural and human environments by accommodating shifts in habitat for a range of species, preserving biodiversity, restoring ecosystem health, managing environmental stressors, and incorporating climate-smart management practices of both natural and working lands. Ultimately, climate adaption strategies implemented at a landscape scale should recognize the interdependences of the different elements of the landscape and provide space, connections, redundancies, and opportunities to continue to adapt to future conditions.

Landscape-scale conservation, management, and restoration principles should include the following:

- **Protect areas of high native biodiversity.** Studies indicate that biodiversity has a positive correlation with climate-resilient land qualities (Hisano et al., 2018).
- **Protect large and intact landscapes.** Larger areas offer greater opportunity for species range shifts and mitigate geographic edges (Lehikoinen et al., 2021).
- **Restore habitat connectivity.** Fragmented landscapes increase risk of species loss and reduce movement of native species, migration during disasters, and gene transfer on the landscape (Hilty et al., 2020).
- **Conserve landscape mosaics.** Lands supporting networks of streams, wetlands, and riparian and upland areas reduce risk of monoculture failure and increase persistence of biodiversity (Bay Area Council, 2019).
- **Protect landscapes with topographic complexity.** Topographic diversity provides opportunities for adaptation and range shift (Ackerly et al., 2020).

- **Restore degraded lands and manage lands for climate adaptation.** Restoring lands to healthy conditions will increase carbon sequestration and storage, increase opportunities for adaptation, and reduce wildfire, flood, and heat risks (California Natural Resources Agency, 2021).
- **Provide climate resilience through regenerative agricultural practices.** Sustainable and regenerative agricultural practices used for croplands, vineyards, and grazing lands can provide climate, biodiversity, and social benefits. Using water and soil management practices to increase soil organic matter can lead to increased carbon sequestration, increased primary productivity, and improved soil moisture (Lal et al., 2011).

Watershed-Scale Resilience

Watersheds are a critical and interconnected systems that support all functions of life and ecology. The water supply protected within Sonoma County's watershed system will greatly affect the ability of ecosystems to adapt to changing conditions. The impacts on the landscape, natural resources, and human communities are already apparent. As of August 2022, the National Integrated Drought Information System showed 100% of Sonoma County in severe drought. Based on the 2020 crop report, low rainfall and excessive heat contributed to widespread reductions in agricultural production and values (Sonoma County, 2020a). Furthermore, despite proactive and aggressive measures to improve water use efficiency, water levels in the county's primary water storage reservoirs continue to dip under target levels (Wyant, 2022). Much of California is prone to periods of drought conditions, a regional phenomenon that can be traced back to more than 1,000 years (California Department of Water Resources, 2022b). However, in the past two years, the southwestern United States has endured what scientists are characterizing as the driest drought in the past 1,200 years, which was partially attributed to anthropogenic climate trends (Williams et al., 2022).

The severity and intensity of drought conditions due to rising temperatures and increased evapotranspiration, as well as the cascading impacts of prolonged droughts, are anticipated to put increased demands on water resources throughout Sonoma County. Adding to this demand, a number of water bodies in the county are already highly stressed and degraded due to anthropogenic causes, including development/increased impervious surfaces, road crossings, water quality issues, vegetation removal, diversions, dams, channelization, and flow managed for other purposes.

Watershed management principles to improve resilience should include:

- **Focusing on headwaters.** Conservation measures should protect rivers and streams at their origins by restoring headwater stream functions and conditions.
- **Restoring degraded natural systems.** Reconnect historical floodplains by slowing flow velocities through increased surface roughness, improving sediment capture, and stabilizing natural systems; restore and enhance seasonal wetlands and mesic meadows by improving infiltration and recharge (Nifong & Taylor, 2021).
- **Limiting development within floodplains.** Development and disturbance in the floodplain reduce the health of rivers and streams, decrease biodiversity, increase flood and fire risk, and place downstream ecosystems at risk (Jackson et al., 2019).
- **Managing forests in watersheds.** Manage tree cover (e.g., shading/temperature stabilization), slope stabilization, and soil moisture. Prioritize post-fire mitigation activities within impacted riparian/forested stream systems, in addition to fuel management in post-burn areas to remove burned material and control invasive species (e.g., a recent Coastal Conservancy grant issued to Dry Creek Rancheria).

- **Using vegetation to improve hydraulic residence times.** Slowing and storing water in vegetation and soils reduces flood risk and erosion, improves water quality, and increases native species' access to water. Vegetation in agricultural ditches was found to improve water and nutrient retention (Nifong & Taylor, 2021).
- **Integrating stormwater management into stream restoration efforts.** Combining stormwater management with stream restoration in urban settings can improve water quality, reduce channel erosion, and lower flood, fire, and heat risk (Lammers et al., 2020).
- **Avoiding piecemeal, small-scale stream restoration.** Increasing climate resilience requires restoration at both landscape and watershed scales. Small, site-specific actions that are disconnected from a larger system approach will not provide the scale of benefits necessary.

Selecting watershed conservation and restoration actions to improve resilience should involve evaluating the overall benefits of the action to the entire system. Furthermore, management decisions based on future climate scenarios should include downscaled modeling and, where available, existing monitoring data.

Priority Landscape- and Watershed-Scale Project Recommendations

To prepare for climate change and better position the natural and working lands within Sonoma County to adapt or withstand changes in climate, the County and partner agencies and organizations should prioritize conservation strategies that protect existing areas of high biodiversity, areas of high topographic complexity, current and historic ecological connections including riparian corridors, headwater streams, climate refugia habitats, and native vegetative communities. While climate change will result in shifts and loss of species ranges, the natural and working lands will have a better chance to withstand or adapt if they are conserved and managed to reduce non-climatic stressors, such as land use conflicts, pollution, loss of area, invasive species, loss or alteration of water sources, and soil erosion or degradation. The County and partner agencies and organizations should consider adding climate resilience to their missions and objectives and ensure that it is one of the primary factors considered when using limited land management and conservation dollars.

Specifically, within Sonoma County lands supporting headwaters, wide riparian and stream corridors, climate refugia, species range edges, unique soils, and horizontal and vertical transition zones should be prioritized for conservation. This approach would contribute to the long-term sustainability of natural and working landscapes and resources, including groundwater and soils, as well as reduce risks from fire, flood, and heat throughout Sonoma County. Focusing on these lands for conservation also would provide resilience benefits that encompass both the more remote areas of the county and the valleys rich in biodiversity and with denser human populations.

Prioritizing the conservation of riparian and stream corridors will likely require the reconfiguration of the current shorelines and restoration of upland transition zones, as well as the relocation of some current land uses within these corridors. Forested riparian areas provide a multitude of climate resilience benefits, including serving as important corridors for wildlife and plant species, protecting water and groundwater supplies, providing shade for temperature control and reduced evapotranspiration, decreasing soil erosion, mitigating high flow events, providing water quality benefits, and acting as natural or nature-based fire breaks. Additionally, the County should prioritize conservation and purchase of lands within and adjacent to forests and forests systems with headwater streams to assemble large, contiguous areas of conserved forest lands that can be well-managed over time. The County can implement climate-focused management and stewardship of forest lands to increase biodiversity and reduce fire risk, including allowing for a broader array of fire management strategies across more of the land including prescribed burns and grazing. Additional actions the County could take include landscape scale

approaches to addressing fire risk, such as protecting and restoring broad riparian corridors and resilient community corridors and buffers between forests and more densely populated areas.

Conservation strategies in Sonoma County have traditionally been focused on reducing development pressure and retaining grazing uses and farmlands. While these objectives remain important, the lens of climate resilience should be prioritized as a critical factor, and traditional conservation easements should include conditions, assistance, and support for regenerative practices, preservation and restoration of native species and diverse habitats, and strategies to support and protect groundwater and soil health. Conservation must begin to include climate resilience as a priority and advance the recommendations described above through additional funding sources, new partnerships, and explicitly stating climate resilience as a top priority.

Building upon the principles for landscape- and watershed-scale resilience described above, the following is a list of recommendations for priority actions. The recommendations below are actions that should be prioritized at the countywide scale, listed in alphabetical order:

BRING CLIMATE RESILIENCE TO PEOPLE MOST AT RISK

Why? Engagement for the Lands Strategy included organizations representing underserved and underresourced communities and workers. Representatives of these organizations shared the concern that underserved and underresourced populations were going to experience climate risks most acutely and would not be adequately engaged in the process to identify solutions. Representatives also observed that disadvantaged populations have less access to climate-resilient lands and their benefits. It is true that climate risks and resilience are not distributed equally (American Forests, n.d.). Disadvantaged and marginalized communities and populations are often the first to experience climate-related risks and have fewer climate-resilient characteristics in their communities (U.S. EPA, 2021). In Sonoma County, based on the data and findings analyzed for this Lands Strategy, many of these populations are located in developed lands, which have fewer naturally occuring and climate-resilient characteristics.

What? There are several projects recommended in the Lands Strategy that will provide climate-resilient benefits and reduce risks to disadvantaged and marginalized populations. For the projects recommended by this Strategy that will contribute to bringing climate resilience to those most at risk, see Appendix A: Project Concepts. The most relevant projects include Resilient Community Corridors, Resilient Buffer Zones, Support Regenerative Agricultural Practices, Urban Stream Restoration, and Green Infrastructure for Climate Resilience. Details on these projects are in Appendix A: Project Concepts.

Who? There are a number of agencies and organizations that could lead projects to increase the climate resilience of the lands within which disadvantaged and marginalized populations live and work. Given the

Andy's Unity Park, Southwest Santa Rosa (Sonoma County Regional Parks)

importance of these projects to reducing risk and increasing resilience to communities, workers, critical physical and ecological assets, and the economy, the County should prioritize taking the lead on securing funding, identifying partners, developing inclusive planning and design processes, and implementing these projects with private, nonprofit, educational, and other institutions. Prioritizing funding assistance for lower income communities that are most likely to experience disproportionate climate impacts will be critical.

CONSERVE AND MANAGE FORESTS

Why? Forests make up approximately 50% of the land within Sonoma County. Forests are the most important climate asset and risk within the county. Healthy forests are the best natural defense against wildfires. Fire-resistent forest characteristics include older and larger trees, the presence of biodiversity and a landscape mosiac, stand and landscape complexity, and predominance of native species, as well as larger, connected areas of forestlands and other land types such as native grasslands, riparian corridors, and wetlands. Healthy forests store water in soils, roots, canopy and ground cover, and leaves, reducing the impacts of drought (Braatz, 2012). They also provide for healthy riparian corridors that reduce flooding, erosion, and runoff, as well as impacts from drought, by slowing and storing water in the landscape. Healthy forests provide climate benefits to the entire county, and not just to adjacent lands. These countywide, landscape-scale benefits include reducing the effects of high-heat days and nights (particularly for forest in or near urban areas), serving as fuel breaks to communities across the county, and diverting water for environmental benefit that would otherwise create runoff, flooding, and erosion to downstream land uses.

Healthy, robust, and connected forests can sequester and store significant amounts of carbon. This sequestration and storage happens in layers, starting at the soils and root systems and moving up through the ground cover, leaves, and canopies. While many types of land can store and sequester carbon, forests have been found to have the second-largest potential (behind wetlands) for carbon sequestration if properly managed for that purpose (Fargione et al., 2018). Therefore, forests should be conserved to prevent conversion of these habitats to other land uses such as agriculture or development uses. Healthy forests also better resist wildfires, which contribute greatly to carbon emissions. In 2020,

Fire Manager Using Prescribed Fire to Maintain the Landscape (National Park Service).

the estimated carbon emissions from California's wildfires was 111.7 million metric tons, more than any economic sector except for transportation (Morris, 2020). Additionally, deforestation accounts for 45% of total CO_2 emissions from Agriculture, Forestry, and Other Land Uses (a.k.a "AFOLU"), according to Chapter 7 of the Sixth Assessment report of International Panel on Climate Change (IPCC), which evaluates AFOLU impacts (IPCC, 2022).

What? Conserve existing healthy forests and conserve, manage, and restore degraded forests in high-fire-risk zones. Prioritize conserving areas that increase the size of protected forestlands, provide connections with other conserved land, include aquatic lands and riparian corridors, and include topographic diversity and species complexity. Use climate-resilient forest management practices and test approaches including tree clustering and spacing that mimics historical ecological patterns. Implement the use of prescribed burns (including in coordination with local Native American tribes on tribal lands in areas with traditional cultural burns), grazing, and non-native species removal and fuel load thinning to benefit ecological resources and climate resilience. Introduce complexity and diversity of age and species to monocultural, dense forest stands. Conserve, manage, and restore the landscape to enable a protected mosaic of different land types that will provide risk reduction, genetic transfer, wildlife migration, and the ability for habitats, wildife, and vegetation to shift and adapt to new climate conditions (Kelsey, 2019).

For the projects recommended by this strategy that will contribute to conserving and managing forests for climate resilience, see Appendix A: Project Concepts. The most relevant projects are Adaptive Forest Management and Conservation Forestry, Fuels Treatment and Post-Fire Forest Restoration, Conserve and Restore Areas for Biodiversity, Prioritize Soils and Water, and Develop and Implement a Strategic Vision.

Who? Ag + Open Space should work closely with Regional Parks, Sonoma Water, RCDs, land trusts, local Native American Tribes and other community-based organizations in Sonoma County to identify priority actions to increase the climate resilience of Sonoma County. These partners, and others,should develop a common strategic vision to guide conservation, management, and restoration priorities and identify leads for each action and funding sources that can be used to implement the vision in phases based on the most urgent risk reduction and most significant resilience benefits.

CONSERVE AND RESTORE NATIVE GRASSLANDS

Why? Grasslands are referred to as herbaceous by the Sonoma County Vegetation Map. This vegetation type is frequently used as grazing land in Sonoma County and, at 25% of land cover, grasslands make up a significant percentage of the county's lands. Both the amount of acreage and the potential for improved management make grasslands an important climate resilience priority. Both the TAC and IAG identified grasslands and grazing lands as having agricultural and ecosystem value, presenting opportunities to increase climate resilience, and presenting concerns related to climate impacts. During stakeholder engagement that included agricultural representatives, concerns were raised regarding the challenges of being in agriculture in a high-cost area like Sonoma County. Based on these discussions, it was clear that grasslands represent an opportunity to increase climate benefits, are at risk from climate change, and are an important land type and land use in retaining agricultural uses and limiting the shift of these lands to high-intensity uses.

If managed for climate benefits, grasslands can provide the county with a range of benefits. The climate benefits of ecologically managed grasslands include healthy soils, water retention and filtration, biodiversity, landscape mosaics and connectivity, wildlife and genetic corridors in response to climate hazards and climate change, and wildfire and flood risk reduction. As part of a larger, connected network

of open spaces and ecosystems, grasslands can improve the health of adjacent vegetation types and native species, and provide space and topographic variety to support adaptation to future climate. Additional benefits include retaining lands for agricultural purposes, supporting local farmers, and providing for jobs and food security within the county.

Grasslands and grazing lands managed using regenerative practices can sequester and store carbon above and below the ground, with the majority of carbon storage occuring belowground and in the soils. The carbon potential is sensitive to management strategies, and degraded grasslands often emit rather than sequester carbon. The role that grasslands can play in carbon sequestration and storage can be an important contributor to the County's overall carbon reduction goals. Restoring and managing these areas to return them to native grasslands can significantly increase their carbon potential because native grasslands provide perennial cover, have deep root systems, and increase water storage and filtration—all significant factors for sequestration and storage potential (Ontl & Janowiak, 2017).

What? There are several projects recommended in the Lands Strategy that are intended to advance the conservation and restoration native grasslands. These projects include Climate-Resilient Rangeland Management Program, Carbon Banking and Carbon Sequestration Planning, and Support for Regenerative Agricultural Practices. For more detail on these projects, please see Appendix A: Project Concepts.

Dickson Ranch, Sonoma County.

Who? The County should provide support to existing organizations and programs designed to manage grasslands for climate resilience, biodiversity, and ecological health. Partners in this effort include Ag + Open Space, Sonoma County's RCDs, and Regional Parks as it relates to management and restoration potential on their lands. For more detail on the implementation and funding recommendations, please see Chapter 6: Planning, Design, and Implementation.

DEVELOP PARTNERSHIPS TO INCREASE CLIMATE RESILIENCE

Why? While the County must take a leadership role in advancing this Lands Strategy, it will require actions from a range of agencies, organizations, private businesses, private landowners, farmers, grazers, agricultural organizations, community organizations, and local Native American tribes. Particpants in the engagement for the Lands Strategy made it clear that there is widespread interest and concern regarding the climate resilience benefits and risks to that natural and working lands. A large number of organizations are already working on these issues at smaller geographic scales, or related to a particular

climate hazard or focused on a specific issue. Bringing these organizations together for the purposes of developing this Lands Strategy demonstrated the potential power that ongoing partnerships could have on advancing projects and programs out of the strategy, engaging in ongoing consultatation with local Native American tribes on climate resilience issues and priorities, and designing and convening a standing Lands Strategy working group.

What? There are several initiatives and processes the Lands Strategy recommends to advance projects, increase capacity, build trust, and share the benefits and responsiblities of taking action to build climate resilience of the natural and working lands to benefit the entire county. The recommended projects include Create Sonoma Climate Resilient Lands Strategy Working Group, Initiate Ongoing Climate Resilience Consultation with local Native American tribes, and Develop and Implement a Strategic Vision. For details on these projects, please see Appendix A: Project Concepts.

Volunteers at Saddle Mountain Open Space Preserve, Sonoma County.

Who? The County's Climate Action and Resiliency Division and Ag + Open Space should work together to advance the partnerships described above, as well as exploring opportunities for additional and new public-private partnerships that would bring together existing agencies with landowners, non-profits, and others throughout the County working on climate resilience. One consistent theme from input received by the TAC, IAG, and other stakeholders was the lack of coordination and capacity to advance climate resilience in Sonoma County. Establishing these partnerships will help build that coordination and capacity, advance the scale of action necessary to reduce the risks to the county and its natural and working lands, and realize the potential benefits from these lands. Please see Chapter 6: Planning, Design, and Implementation for recommendations on implementation and funding for this effort.

INCREASE AND CONNECT THE AMOUNT OF CONSERVED LANDS

Why? While focusing on specific types of ecosystems is important, given their unique climate resilience potential, it is also critical to expand the size of conserved lands, increase the connections between these lands, and reduce the current fragmented nature of Sonoma County's conserved areas. Engagement with the TAC and IAG, as well as other stakeholders, identified the need for increased connections, larger conservation areas, and space for climate adaptation and migration. These issues are reflected in the indicators recommended during the engagement for the Lands Strategy, which can be found in Chapter 6: Planning, Design, and Implementation.

Large areas of conservation provide a number of benefits, including a broader range of management strategies that are not limited by adjacent land uses, buffers and zones for species to migrate and adapt as climate changes, fewer non-climate stressors and shocks that usually lessen climate resilience and adaptability, and a range of topographic, climatic, and biologic conditions that also support the adaptation and preservation of native species. For example, as sea levels rise, wetlands will need space to

move inland and to higher ground to prevent being permanently innundated by high water. Riparian corridors and streams can better provide for native species when they have wide, forested buffers that reduce erosion, keep the waters cool, and resist floods and fire. Non-climate stressors on these systems—such as urban and pesticide runoff from adjacent land uses and encroaching land uses that limit management strategies needed to respond to climate change—can result in more signficant effects from climate change. By increasing the size of conserved lands, connecting management practices across different jurisdictions and owners, and adding corridors between fragmented lands, Sonoma County can acheive the scale of change necessary to improving climate resilience through its natural and working lands.

What? To realize the climate resilience potential from its natural and working lands, Ag + Open Space, land trusts and other entities in the county will need to prioritize conservation, mangement, and restoration actions based on climate benefits and climate risks. Historically, Ag + Open Space has used conservation easements and conservation actions to reduce development in agricultural and rural areas and for preserving ecosystems and habitat. There are also opportunities for the County to collaborate with local Native American tribes to determine potential processes and opportunities for creating tribal cultural use easements on regional lands within tribes' ancestral territories.

Protected Farmland in Sonoma County.

While these actions will remain important, it is also important to add a climate lens to conservation, management, and restoration projects and efforts from this point on. With both significant potential and significant risk associated with these decisions, and large-scale actions necessary, climate resilience should be one of the most important factors guiding these decisions. This Lands Strategy has specfic project recommendations to advance conservation for the purposes of climate resilience, including Climate Smart Land Conservation, Strategic Land Aquistion, Carbon Banking and Carbon Sequestration Planning, Conserve and Restore Areas for Biodiversity, and Conserve and Restore Headlands, Coasts, and Baylands. For further details, please see Appendix A: Project Concepts.

Who? The County should work with strategic partners to advance this large-scale action, including Ag + Open Space, Sonoma Water, Regional Parks, land trusts, large landowners and private businesses, and Native American tribes. For details on implementation and funding, please see Chapter 6: Planning, Design, and Implementation.

MAKE SONOMA COUNTY A SPONGE

Why? Sonoma County's Baylands, coastal areas, and rivers and streams provide a range of climate-resilient benefits throughout the entire county. Members of the TAC and the IAG, as well as those who

participated stakeholder engagement for the Lands Strategy, consistently brought up the importance of aquatic areas and healthy soils. The critical nature of Sonoma County's water resources was also clear when reviewing documents such as Ag + Open Space's Vital Lands Initiative and Sonoma Water's Climate Adaptation Plan.

The climate-resilient benefits provided by aquatic ecosystems such as wetlands, rivers, and streams include the ability to capture and store water in the ecosystem, releasing it slowly to rivers, streams, and adjacent soils (Madgwick, 2022). Aquatic habitats can also provide cooling of 1 to 3 degrees Fahrenheit during the summer heat (Zhang et al., 2022). Healthy wetlands and healthy headlands can also work in tandem to reduce flood risks, erosion, and runoff, providing enough space and connectivity throughout the watershed to reduce overtopping and erosive forces. These watershed systems can also serve as firebreaks if the riparian corridor is wide enough, healthy soils are present, native vegetation is present, and the vegetation is dense. Wetlands and coastal habitats can also provide flood protection to adjacent land uses, as can healthy riparian corridors. Aquatic habitats are also one of the most adaptable land types and, if provided the space, topographic, and hydrologic conditions, will shift and move to areas where they are better able to adapt and persist. In addition to these climate benefits, wetlands and aquatic habitats host incredible biodiversity and provide support for all adjacent vegetation types. Conserving, managing, and restoring the county's aquatic habitats, including its Baylands, coasts, rivers, and streams, will be critical if Sonoma County is to increase its climate resilience, provide for adaptation, and reduce climate risks.

Healthy wetlands and aquatic habitats also provide the most carbon sequestration and storage per acre of any ecosystem type, including forests, storing 33% of the world's carbon (Valach et al., 2021).

What? This Lands Strategy includes projects that would advance the conservation and restoration of headlands, coastal areas, and Baylands. These projects include Nature-Based Approaches to Shoreline Management, Design and Planning for Flood Resilience, Tidal Marsh Habitat Opportunities, and Conserve and Restore Headlands, Coasts, and Baylands. Please see Appendix A: Project Concepts for more details on these projects.

Who? Sonoma Water should partner with Ag + Open Space and the other land trust organizations to coordinate action to ensure high-priority aquatic areas and soil conservation and restoration efforts can find the funding and support necessary for implementation. Please see Chapter 6: Project Planning, Design, and Implementation for more detailed recommendations on implementation and funding for aquatic areas and soils projects.

Laguna de Santa Rosa, Sonoma County.

SUPPORT AND INCREASE REGENERATIVE AGRICULTURAL PRACTICES

Why? Agricultural uses can provide significant climate resilience benefits to the county if managed with that purpose. Agricultural lands make up approximately 22% of Sonoma County's lands, providing opportunity at a scale that could make a difference in the Sonoma County's ability to adapt to climate change, reduce risks, and sequester and store carbon at a meaningful scale. If managed to enhance climate resilience, agricultural lands hold an important place on the continuum of natural to working lands and can provide many critical climate benefits. Agricultural lands are also important to prioritize due to their role as sources of employment, cultural resource, food supplies, and a critical economic engine for Sonoma County. During the engagement for the Lands Strategy, many members of the TAC and IAG, as well as stakeholders representing agricultural interests, expressed a need to prioritize managing agricultural lands and to consider the climate impacts on small farmers and farmworkers. These concerns are reflected in the indicators that were developed for the Lands Strategy, which are located in Chapter 6: Planning, Design, and Implementation.

Regenerative practices applied to agricultural lands provide significant climate resilience benefits to soils, reduce water usage, improve water quality, protect and restore native species and aquatic areas, provide for wildlife and genetic corridors, protect and restore riparian corridors, increase food security, and serve as a buffer from other hazards such as flooding, wildfire, and heat. Such practices also eliminate or reduce some non-climate stressors such as pesticides, erosion, and runoff.

Regenerative agricultural practices also provide tools for agricultural lands to increase carbon sequestration and storage. Regenerative practices reduce soil disturbance, provide for perennial ground cover and a diversity of crops, and protect and restore native species and habitats, andcan store and sequester carbon at potentially significant rates (Health Care Without Harm, 2020).

What? While there are signficant climate benefits associated with regenerative agricultural practices, many farmers and ranchers lack the resources, information, or incentive to shift away from more traditional agricultural practices. While programs and support for these practices already exist, as well as the opportunity for peer-to-peer learning and for scaling up existing programs, the scale of change necessary will require additional resources and support. Projects recommended by the Lands Strategy to advance action on supporting and increasing regenerative agricultural practices include Climate-Resilient Agricultural Program, Carbon Banking and Carbon Sequestration Planning, Climate Smart Land Conservation, and Climate-Resilient Rangeland Management Program. For more details on these projects, please see Appendix A: Project Concepts.

Mustard Cover Crop.

Who? The County, Ag + Open Space, UC Cooperative Extension, and the RCDs should work together to scale up existing programs, identify additional resources and support to fill gaps, and evaluate the need to develop one countywide, robust program to support this shift in practice. For recommendations on implementation and funding for this action, please see Chapter 6: Planning, Design, and Implementation.

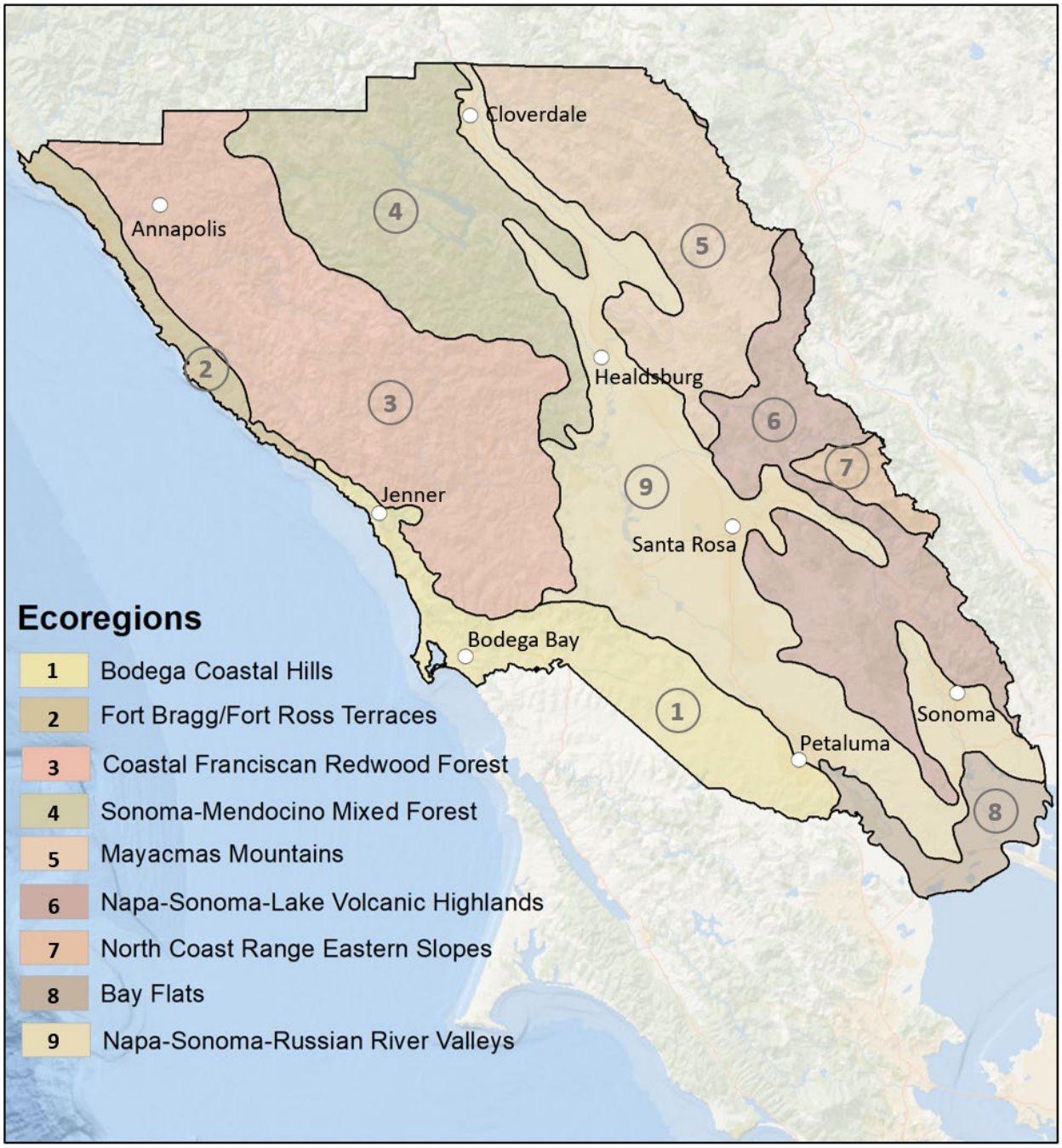
5. SONOMA COUNTY ECOREGIONS

I. Characterizing Climate-Resilient Lands by Ecoregions

To characterize and assess the scope of Sonoma County's diverse and unique natural resources, we identified a spatial framework that acknowledges the underlying physical processes and patterns that drive habitat suitability for living organisms and feasibility for different land uses, including agricultural lands and production. Future changes in physical factors and phenomena associated with them determine which human and natural communities can persist on the lands. The goal of the Lands Strategy is to identify projects and actions that address climate hazards to natural and human communities at multiple scales by considering the physical factors that influence these systems today and into the future. By exploring climate hazards, landscapes, and natural community characteristics across multiple scales, the Lands Strategy will help identify how particular projects can contribute to resilience at the local, regional, and landscape level.

The project team used the U.S. EPA Level IV Ecoregions as a foundation for defining ecological land classifications within the county using distinctive physical and biological features such as geology, landform, soil, vegetation, climate, wildlife, water, and human influence on land use and condition. EPA ecoregions were developed based on similar variations of environmental characteristics that influence biological community use and composition and are used to support a variety of planning and assessment applications for large geographic areas (see Figure 5) (Omernik & Griffith, 2014). The physical and biological characteristics of each ecoregion provide information on the suitability of the area for native plants and animals, as well as agricultural lands and production.

Figure 5. U.S. EPA California ecoregions in Sonoma County.



Using EPA ecoregions to define spatial boundaries based on landscape similarities, the project team then incorporated detailed landscape and demographic data to describe the vegetation communities, social, and land use characteristics present in each ecoregion. The vegetation data came from the Sonoma County Vegetation Mapping and LIDAR program (Sonoma Veg Map) (see Figure 4), the land use data came from the County of Sonoma's General Plan 2020 land use designations (see Figure 6), the critical assets were mapped and characterized by Permit Sonoma as part of the update to the County's HMP, and the demographic data was derived from census tract information and summarized by the Metropolitan Transportation Commission (MTC) (see Figure 7).

Figure 6. Land use designations in Sonoma County. Ecoregions are shown in black outline.

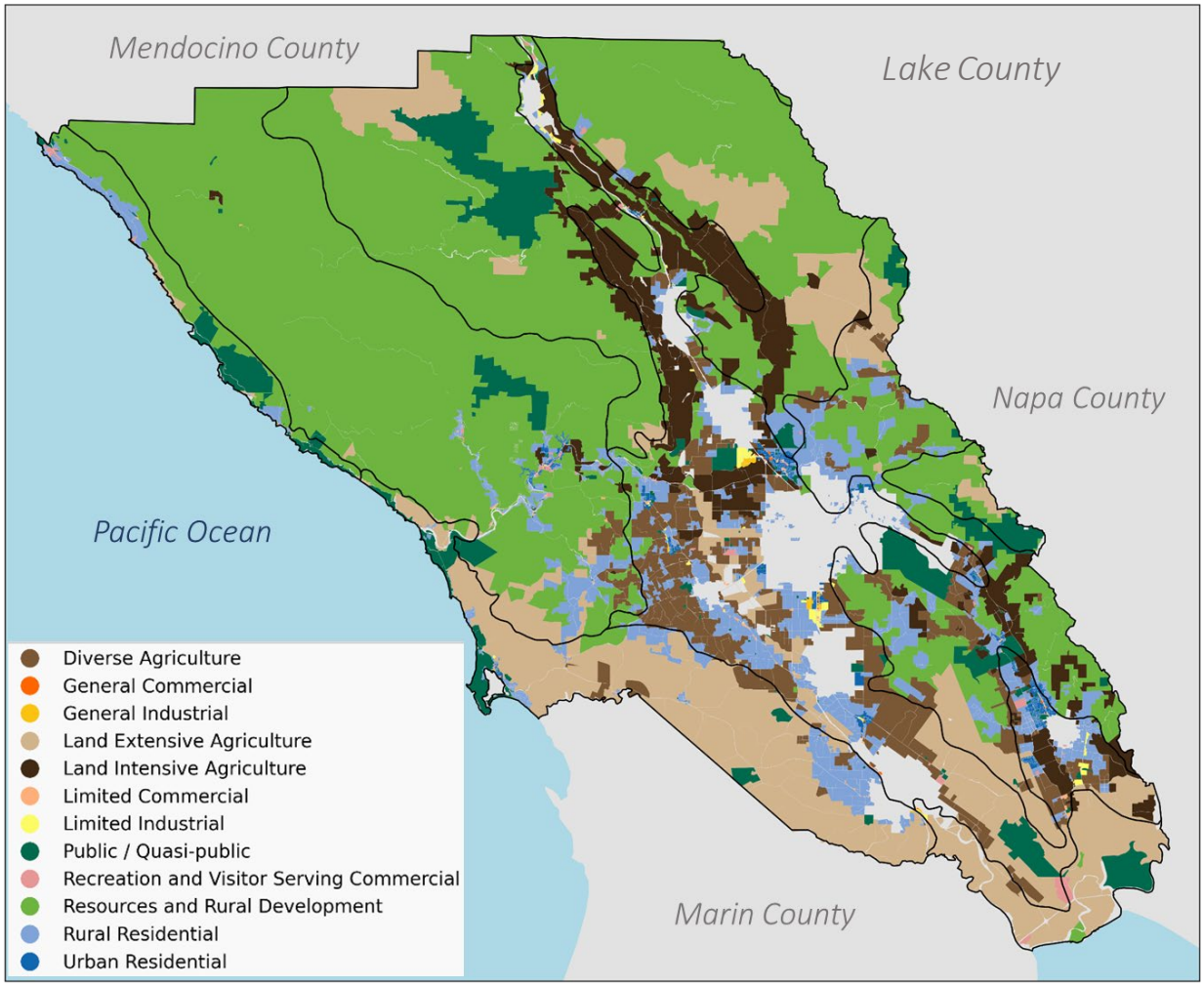
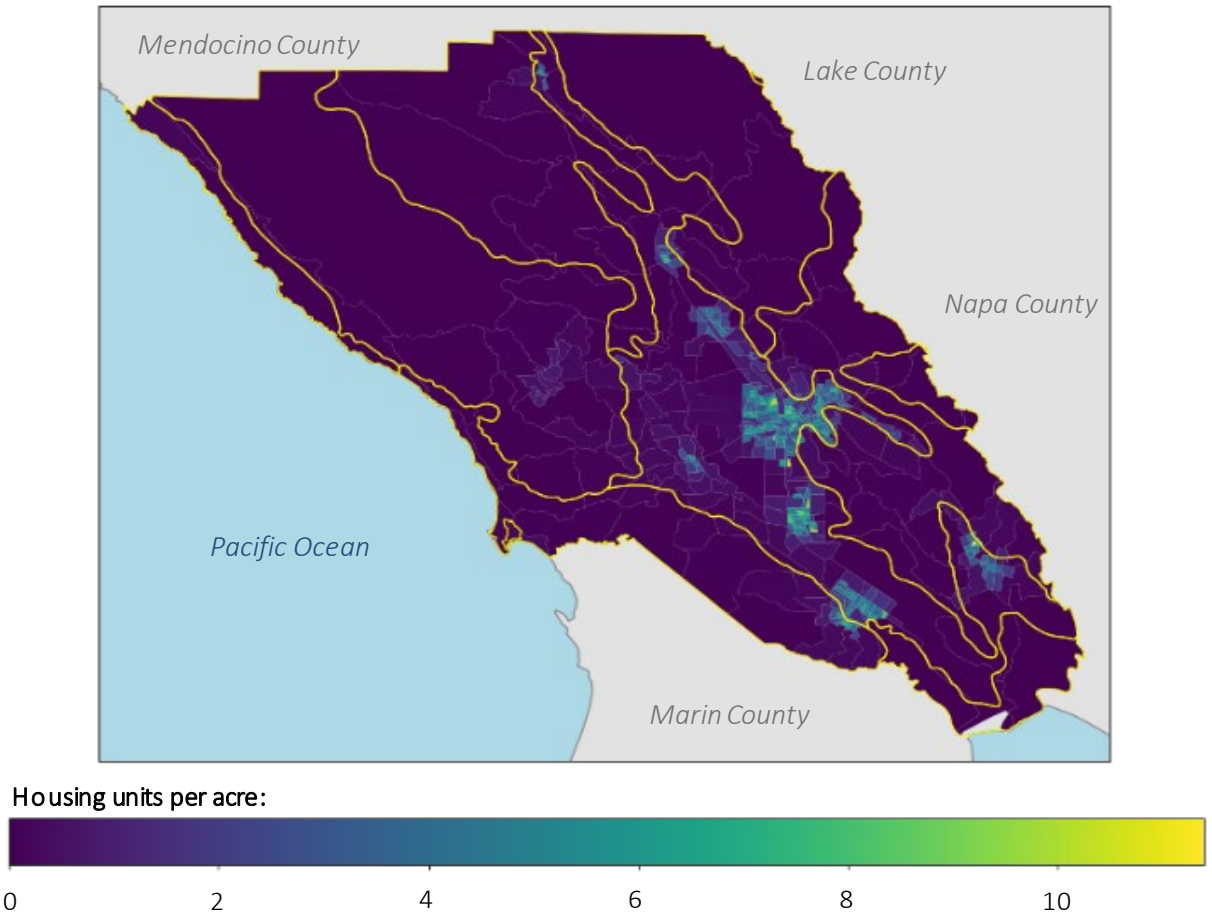


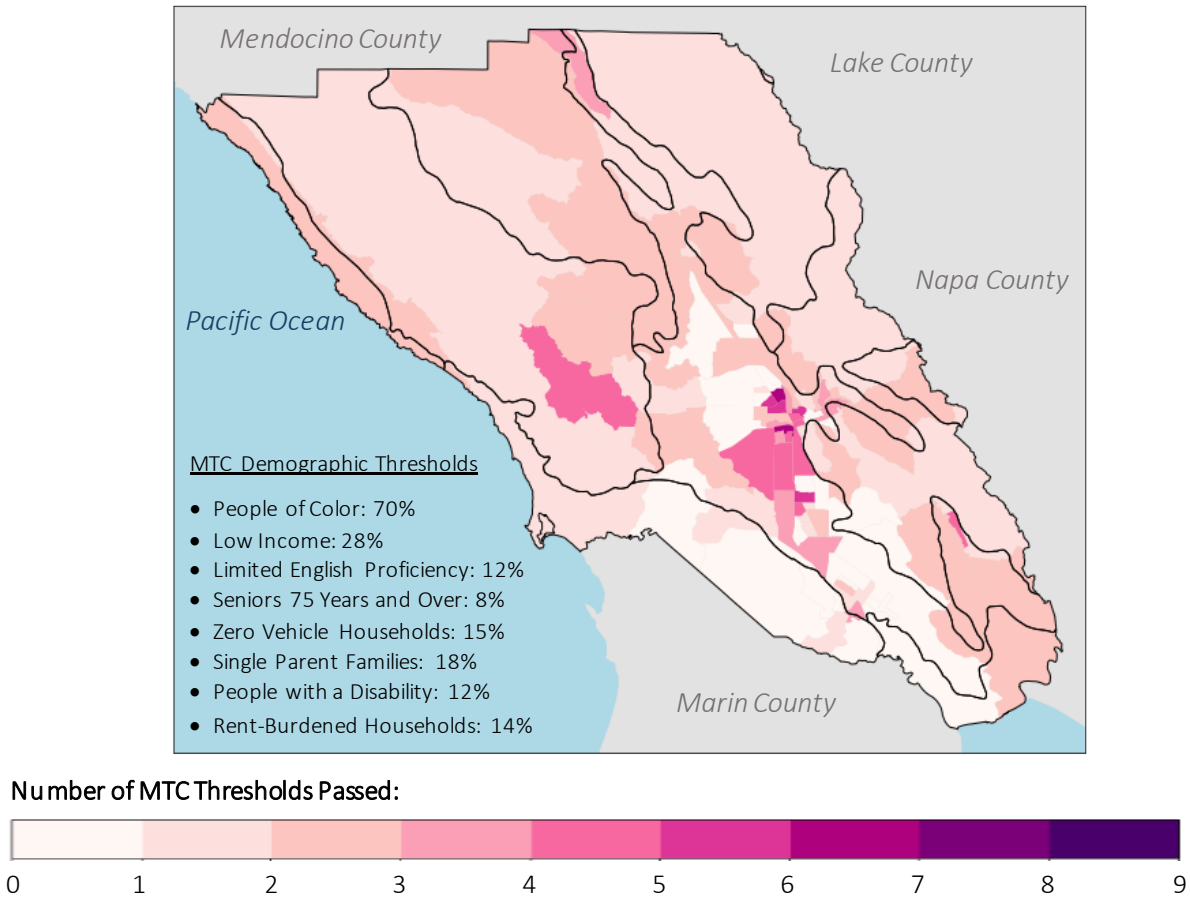
Figure 6 shows the land use designations for Sonoma County, with cities shown in gray and ecoregion borders in black. This map shows several notable patterns, including the cluster of cities in the valley around the major infrastructure and utility systems, as well as the large amount of land zoned for resources and rural development. The General Plan describes the "Resources and Rural Development" zoning category as allowing "very low density residential development, protection for timberlands, geothermal production, aggregate resource production, protection of natural resource lands, hazard overlay zone to reduce intensive development, accommodate agricultural uses and protect against growth in areas with inadequate public services" (Sonoma County, 2021a). Land-intensive and land-extensive agriculture are also predominant uses (land-intensive agriculture has high yields per acre; land-extensive agriculture has low yields per acre and mostly consists of grazing). Other common uses include public lands and rural residential use.

Figure 7. Housing density by census block group. Census data collected from the American Community Survey 2020.



Data from the 2020 American Community Survey show a very similar pattern to the land use designations described above and an urban growth boundary that has largely succeeded in limiting denser development to the cities within Sonoma County. Assessing the population by census block also shows a similar pattern, with no significant differences in density (see Figure 7). This pattern of residential density is helpful for determining the project types most suitable or needed in different parts of Sonoma County, as well as assessing what is at risk from current and future climate hazards. For example, larger, landscape-scale climate resilience strategies will likely be a better fit for areas in the northern and western portions of the county, as well as along portions of the eastern border with Napa and Lake Counties. Corridors, expanded greenbelts, and green infrastructure will likely be a better fit for the areas in the Napa–Sonoma–Russian River Valleys ecoregion.

Figure 8. MTC Equity Priority Communities by census tract. Each census tract value corresponds to the number of community attributes that pass threshold demographic statistics.



To understand the demographic characteristics in Sonoma County, particularly those characteristics that make people and communities more at risk from climate and hazard events, the project team used the MTC Equity Priority Community data and Measure for America's Portrait of Sonoma County (Measure of America, 2021). Given what is known about the disproportionate effect of climate and non-climate hazards on marginalized and underserved communities, it is important to consider this information to ensure that risks are reduced and benefits accrue to those whom current and future climate risks are likeliest to affect. A 2021 report by the U.S. EPA found that four demographic characteristics—income, educational attainment, race and ethnicity, and age—are disproportionately exposed to and harmed by the highest impacts of climate change (U.S. EPA, 2021).

The MTC Equity Priority Community data include information on people with low incomes, seniors over 75 years old, people of color, people with disabilities, limited English proficiency, zero-vehicle households, single-parent families, and rent-burdened households. MTC determined thresholds for each demographic factor by calculating the mean concentration of each factor plus half a standard deviation (Metropolitan Transportation Commission, 2021). MTC defined Equity Priority Community census tracts in two ways: 1) concentration of people of color and low-income households beyond the defined threshold or 2) concentration of low-income households beyond the defined threshold plus concentration of three more additional demographic factors beyond the thresholds.

Census tracts throughout Sonoma County have several of the characteristics tracked in Equity Priority Community data, including people over 75 and people with disabilities. Several other characteristics are

found in multiple tracts: single-parent families, low income, and limited English proficiency. About 15 tracts in the county pass four or more thresholds (Metropolitan Transportation Commission, 2021). These census tracts appear darker in Figure 8.

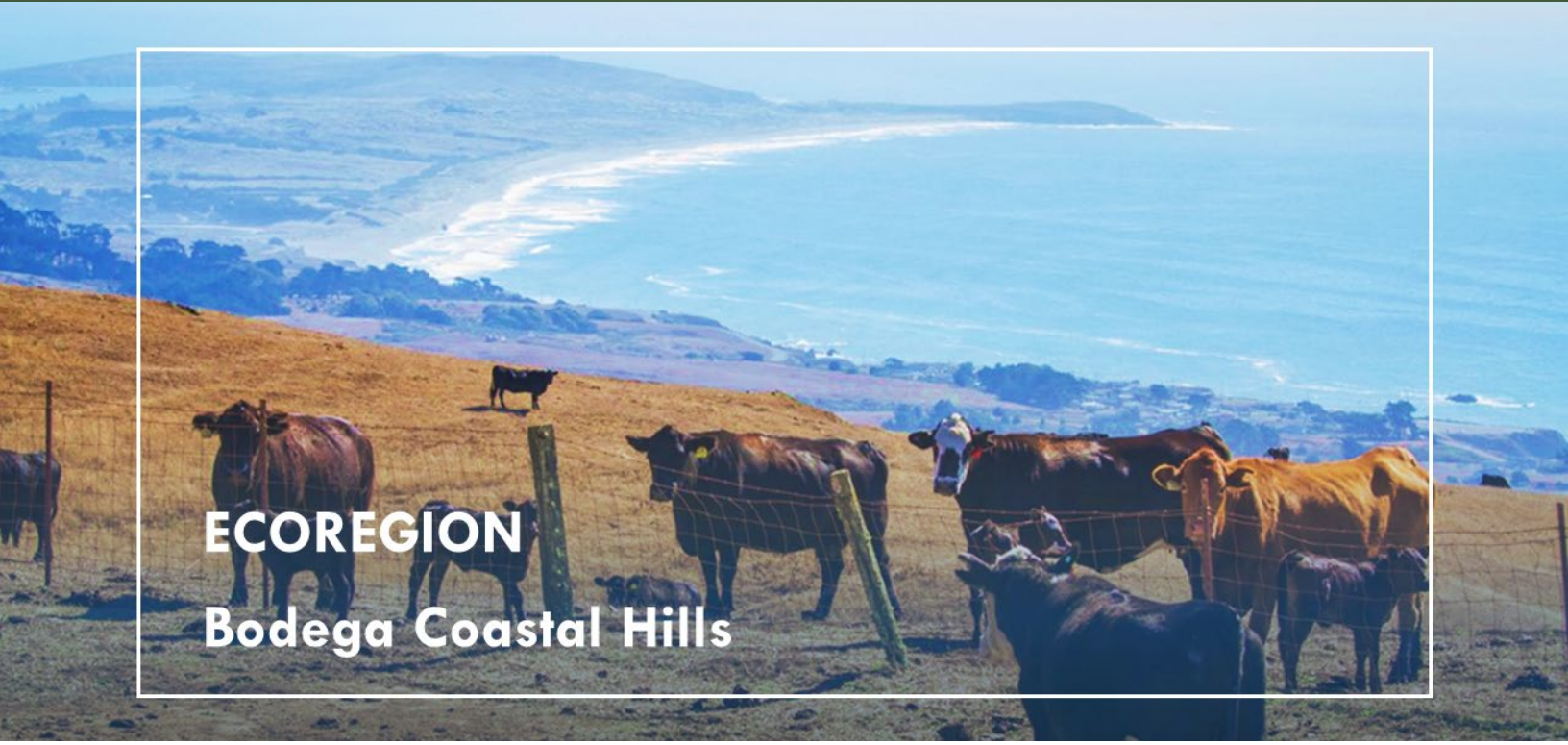
The Portrait of Sonoma data map life expectancy, education, median earnings, and high rent burden by census tract. Overall, the report found that the county's average life expectancy is 82.2 years, 37.8 percent of people there have at least a bachelor's degree, median earnings are $40,531, and 52% of renters face a high rent burden (Measure of America, 2021). Within each of these overall percentages, the report found significant disparities by race and ethnicity and geography. While not surprising, this finding gives the County two factors—race and ethnicity and geography—around which to assess climate benefits and burdens when implementing the Lands Strategy.

The project team used the data from both MTC and the Portrait of Sonoma County within the ecoregions to develop project concepts, as well as in the system-wide recommendations and the implementation and decision-making framework.

II. Ecoregion Summaries and Findings

This section provides an overview of the nine ecoregions within Sonoma County, along with information on their unique or extraordinary qualities, land use, demographics, critical assets, climate change, and resilience indicators. In addition, there is a summary of findings and list of recommended projects by ecoregion in Appendix A.

For a breakdown of exposure of each ecoregion to each hazard see Table 9 at the end of this section.



ECOREGION
Bodega Coastal Hills

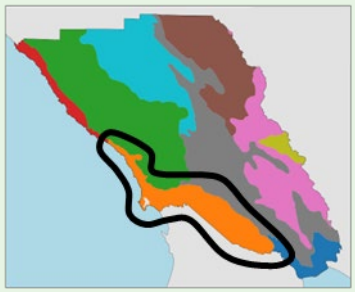
Acreage: 89,798

Cities/towns: Petaluma (portion), Bodega Bay, Jenner

Percent of lands protected: 23%

Population: ~43,700

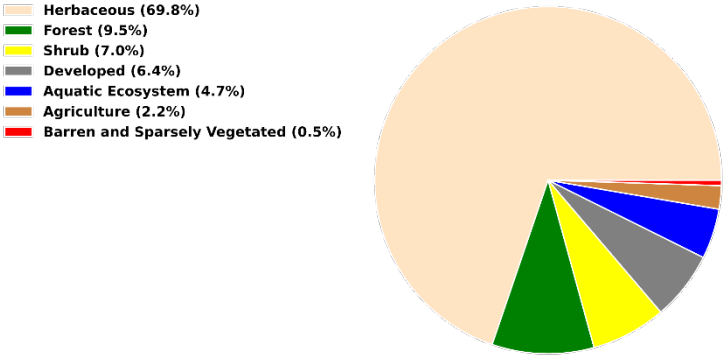
Number of households: ~20,400



OVERVIEW

The Bodega Coastal Hills ecoregion extends along the southwest margin of Sonoma County and north along the Pacific Coast. This ecoregion is primarily composed of herbaceous/grassland natural communities (70%), the majority of which are used as range and pastureland. It historically supported one of the largest coastal prairie expanses in California, which have largely transitioned to introduced annual and perennial grasses as a result of over a century of intensive agricultural use (Amme, 2008). Today, the rolling hillsides primarily support small, multi-generational pasture-based dairy farms, livestock ranches, and low-density rural communities (see **Error! Reference source not found.**). Farming and ranching practices contribute to the preservation of large tracts of land, including many areas that are under conservation easement with Ag + Open Space and land trusts. The Pacific coastline extends from Bodega Bay north to the mouth of the Russian River and is characterized by sheer coastal cliffs, secluded coves, offshore islets, and rocky crags that support a thriving

Figure 9. Vegetation types in the Bodega Coastal Hills ecoregion.



recreation- and tourism-based economy, as well as commercial fishing and mariculture. Public lands, including Sonoma Coast State Park, and open spaces support remnant coastal prairie and coastal scrub natural communities. Portions of the ecoregion fall within the California coastal zone, which restricts land development and protects productive resource lands (Sonoma County, 2001).

Three primary watersheds overlap with the ecoregion: the Russian River watershed to the north and the Bodega Unit (consisting of Salmon Creek and Americano Creek) to the south and extending east. The Estero Americano estuary and its main tributary Americano Creek form the Sonoma–Marin border. This tidal estuary and the surrounding landscape provide important habitat for hundreds of fish and wildlife species and is largely undeveloped due to a unique continuity of primarily private land ownership (Hickey et al., 2007). Flows supporting Americano Creek and Salmon Creek are highly seasonal and are fed by small ephemeral and intermittent streams that course through agricultural lands, leading to significant nutrient pollution and water quality issues throughout the watersheds (California Coastal Commission, 2019; Hickey et al., 2007). The Russian River, Bodega Headland, and Estero Americano are designated as Critical Coastal Areas (CCAs) by the California Coastal Commission. The CCA program was developed to foster collaboration among stakeholders and government agencies to improve efforts to protect high-resource-value coastal waters from polluted runoff (California Coastal Commission, 2019). The Russian River watershed drains nearly 1,500 square miles of lands and provides the primary water source for the County. The mouth of the river opens into the Russian River Estuary near the coastal village of Jenner. The estuary closes periodically throughout the year due to a sandbar, which builds inward during low flow periods. Sonoma Water mechanically breaches the sandbar to alleviate upstream flooding impacts (ESA, 2021).

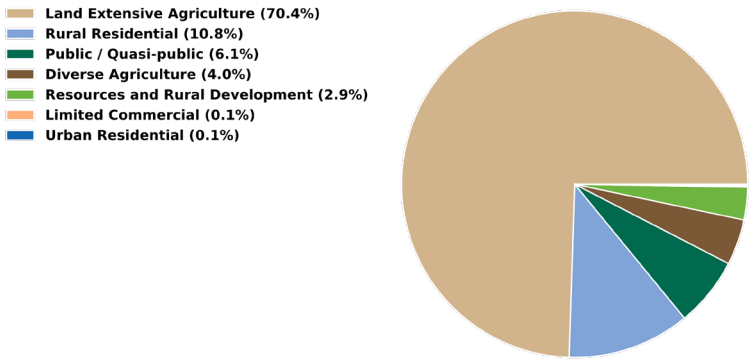
UNIQUE OR EXTRAORDINARY QUALITIES

The Estero Americano tidal estuary provides important habitat for a wide range of birds and wildlife species. The California Department of Fish and Wildlife classifies it as a state marine recreational management area, a designation that restricts certain uses and protects marine life and their habitats (California Department of Fish and Wildlife, 2016). Sonoma Coast State Park, near the northwest corner of the ecoregion, permanently protects several beaches, rock bluffs, and headlands. Salmon Creek forms a lagoon as the mouth closes with sand; the sandy beach provides vital nesting habitat for the federally listed snowy plover (California State Parks, 2022). The Vital Lands Initiative maps extensive areas of priority wetlands associated with Bodega Bay, the Estero Americano estuary, and the Salmon Creek lagoon (Ag + Open Space, 2021a). Roughly 23% of lands within this ecoregion are permanently protected as public lands or through conservation easement, and much of the ecoregion is classified as a priority area/critical linkage for wildlife habitat and movement (Ag + Open Space, 2021a).

LAND USE

Much of the land in this ecoregion is zoned for Land Extensive Agriculture (70% of total lands), which permits low-production agricultural uses and single-family residential dwellings and farm dwellings (see **Error! Reference source not found.**). A smaller portion of Land Extensive Agriculture zoned lands allow mixed agriculture and residential uses, including mixed crops and farm animals permitted jointly

Figure 10. Land use types in the Bodega Coastal Hills ecoregion.



with rural residential use, and diverse agriculture, where small-acreage intensive farming and part-time farming predominate.

The western edge of the City of Petaluma falls within the east corner of the ecoregion, which is bounded by rural residential/low density housing. The coastline supports extensive public/protected lands and interspersed rural residential, including the village of Bodega Bay (Permit Sonoma, 2021a).

EQUITY AND COMMUNITY DEMOGRAPHIC CHARACTERISTICS

The Bodega Coastal Hills ecoregion spans several census tracts, some of which have population characteristics that may make them more vulnerable to climate hazards:

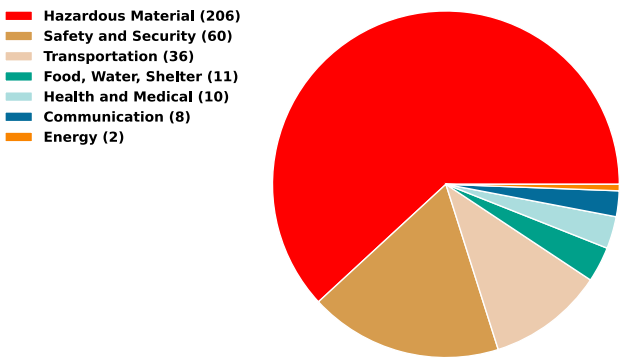
- **Census tract including the town of Bodega.** The population's demographic factors are beyond thresholds for disability (Metropolitan Transportation Commission, 2021).
- **Census tract to the west of Rohnert Park.** The population's demographic factors are beyond thresholds for disability (Metropolitan Transportation Commission, 2021).
- **Census tract that includes the town of Jenner.** This census tract scores lower than the county-wide average on key indicators of wellbeing identified in the Portrait of Sonoma County: 5.30 on the human development index compared to 6.19 (out of 10); 5.81 on education index compared to the county average of 5.85 (out of 10); 79.9-year life expectancy compared to 82.2 years; and $31,946 in median personal earnings compared to $40,531 (Measure of America, 2021).

OTHER CRITICAL ASSETS

Community infrastructure: The Sonoma HMP lists a number of critical assets in the ecoregion, including schools, fire stations, health services facilities, government buildings, and commercial industry (Permit Sonoma, 2021b). See Figure 11.

Agriculture and working lands: This ecoregion has several prominent dairy farms. The Vital Lands Initiative classifies much of the ecoregion as priority grazing land based on overall/total land within a single ownership, zoning designation, and vegetation cover (Ag + Open Space, 2021a).

Figure 11. Critical assets in the Bodega Coastal Hills ecoregion.



Protected areas and parks: Sonoma Coast State Park extends along the shoreline of the ecoregion and includes a diversity of protected natural areas/habitats, beaches, dunes, nearshore marine habitats, recreation areas, and campgrounds. The Bodega Marine Reserve and associated marine laboratory is a research, teaching, and conservation area supporting high biodiversity (University of California Davis, 2021). Helen Putnam Regional Park and Scott Ranch are located just outside the western edge of Petaluma, also placing them within this ecoregion.

Roads: Highway 1, a critical transportation corridor, runs south to north along the coastline and connects Sonoma and Marin Counties.

Groundwater basins: Bodega Bay.

Priority streams, creeks, estuaries: Russian River watershed, Salmon Creek and Americano Creek, Estero Americano, Americano Creek.

POSSIBLE CLIMATE CHANGE EFFECTS

Pole Mountain in the Bodega Coastal Hills.

The primary climate impacts that threaten natural and human communities in the Bodega Coastal Hills ecoregion are sea level rise, higher-intensity coastal storms, and altered temperature ranges/gradients. Further inland, impacts on natural communities and agricultural lands due to changes in the frequency and intensity of floods and droughts are anticipated to increase. Rising atmospheric carbon dioxide may lead to increased productivity of grasslands but may also increase the pervasiveness of parasites and diseases (Sonoma County, 2001). Water quality issues are prevalent and are likely to be exacerbated by climate-related impacts, including drought, water supply issues, and flooding. Along the coastline, sea level rise and storm impacts are anticipated to lead to significant impacts on human infrastructure and natural communities; the Bodega Bay Vulnerability Assessment projects a loss of 59–99% of marinas, 28–76% of county roads, 53% of coastal wetlands, 1–14% of residential areas (Permit Sonoma, 2019). Wildfire risk is low to moderate throughout most of the region; ember load is typically low (Sonoma County et al., 2021). Climate modeling predicts significant decreases in groundwater recharge, which may lead to future impacts on aquifers (Micheli et al., 2018).

RESILIENCE INDICATORS

The following resilience indicators are most applicable to this ecoregion (see Appendix F for a full list of indicators applicable throughout the county), given landscape and community characteristics. (These measures of resilience can be improved through key projects described in the next section.)

Landscape indicators

- *Ecosystem health and biodiversity*
  - Various stream corridors, intact coastal grasslands/shrublands, and coastal lagoons and estuaries supporting biodiversity and native species.
  - Lack of anthropogenic stream barriers at or upstream of the mouths of streams running into the Pacific Ocean, offering important habitat for coastal species.
- *Land coverage*
  - Habitat connectivity, attributed to minimal, low-impact development and expansive landscape continuity associated with predominantly rangeland agricultural land uses and land conservation agreements/public lands (which make up roughly 23% of the ecoregion).
- *Habitat quality and condition*
  - Biodiversity and native species supported by various stream corridors, intact coastal grasslands/shrublands, and coastal lagoons and estuaries.
- *Land management*
  - Regenerative farming or ecologically based farming practices, which can increase carbon sequestration.

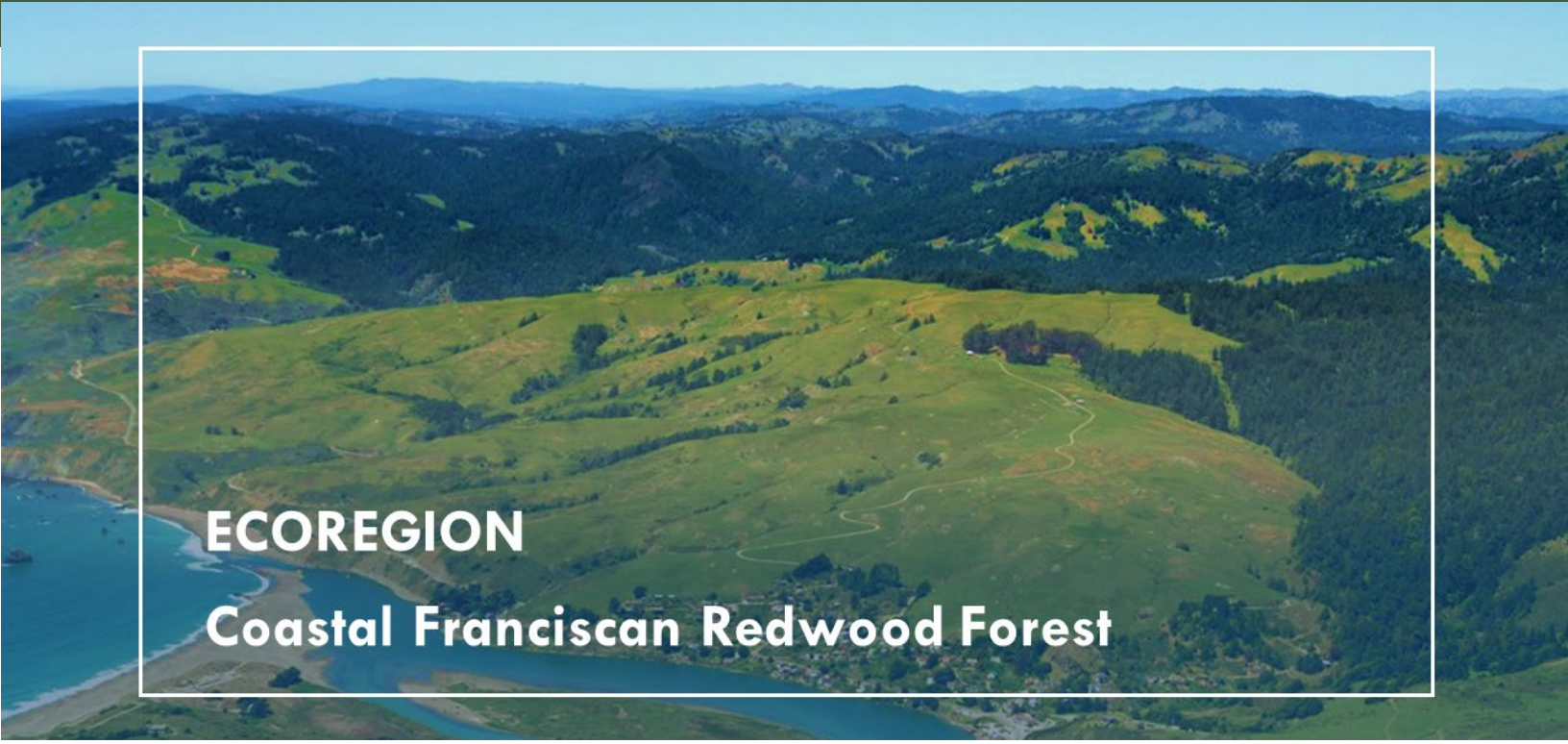
Major Climate Hazards in the Bodega Coastal Hills Ecoregion

Sea level rise and storms

Changing temperature range

Social and community indicators

- *Management, ownership, and capacity*
  - Partnership with RCDs on rangeland/agricultural practices and opportunities.
- *Socioeconomic benefits*
  - Contribution of natural and working lands to the county's economy and employment (offered by the large farming/ranching industry in this ecoregion).
  - High tourism levels, supported by coastal communities and small farms.
- *Proximity and access*
  - Access to resources, food, water, healthcare, and other critical services in rural communities are offered by local farms/suppliers, and proximity to Petaluma.
  - Equitable access to healthful, nutritious, fresh food from local farms and suppliers.



ECOREGION

Coastal Franciscan Redwood Forest

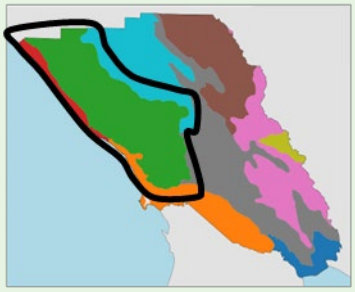
Acreage: 243,527

Cities/towns: Forestville, Guerneville, Monte Rio, Occidental

Percent of lands protected: 24%

Population: ~22,900

Number of households: ~15,700

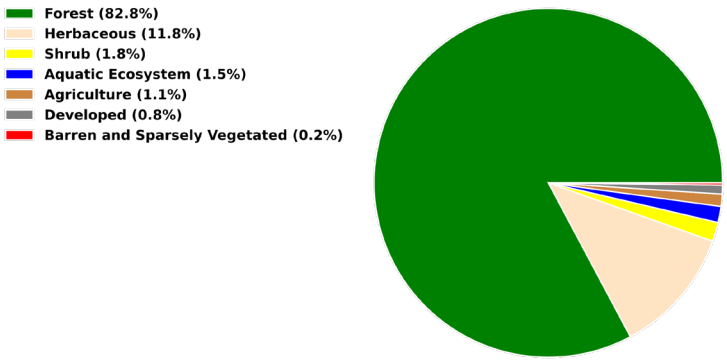


OVERVIEW

The Coastal Franciscan Redwood Forest ecoregion stretches from Buckeye Forest and the Mendocino County line in the north down to Guerneville and Armstrong Redwood State Natural Reserve in the south. It is oriented north–south, just inland of Sonoma's coastline. The ecoregion is characterized by a mix of conifers, including redwood and hardwood forests. According to Griffith et al. (2016), the ecoregion is characterized by a mix of conifers (including redwood) and hardwood forests. There are coast live oaks and grassland savannas intermixed in denser forest. The western side of the ecoregion receives more fog and contains more redwoods. Runoff is rapid and streams are dry by late summer; there are no natural lakes.

Dominant vegetation in this ecoregion includes redwood forest (covering 32% of the ecoregion); Douglas fir(covering 19%); and California annual and perennial grasslands (covering 9%). Redwoods and Douglas fir are a fire-adapted species, with older trees better able to survive fires (California Native Plant Society, n.d.). A high-level summary of vegetation types in the ecoregion is provided in Figure 12.

Figure 12. Vegetation types in the Coastal Franciscan Redwood Forest ecoregion.



Soil moisture regimes in this region are primarily 1) udic (a humid or subhumid climate where crops can be grown with irrigation), ustic (a semiarid climate where crop irrigation is required most years), and xeric (moist, cool winters and dry, warm summers that define Mediterranean climates) (G. E. Griffith et al., 2016; Owens et al., n.d.).

UNIQUE OR EXTRAORDINARY QUALITIES

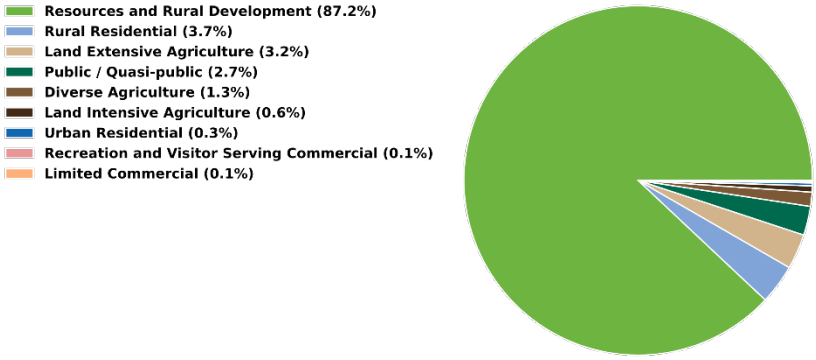
The Cedars (USGS).

This ecoregion includes some particularly unique ecosystems, including a 9-square-mile area called The Cedars that contains Sargent cypress and large expanses of serpentine rock. The Cedars provides a transitional habitat corridor between inland and coastal old-growth redwoods (Hirst, 2007). Additionally, redwood forests, especially old-growth redwoods, are rare and extremely important. The diversity in age and size of some redwood forests in Sonoma County, such as Howlett Forest, is especially noteworthy, as those forests provide important habitat for a variety of plant and animal species, including the northern spotted owl and pileated woodpecker, both of which are endangered due to habitat loss from logging. Howlett Forest, along the Mendocino border, is protected through a conservation easement for old-growth forests in the county (Ag + Open Space, 2021a). It contains old-growth redwood and mixed-age Douglas fir forest in addition to nearly six miles of healthy riparian corridors that are part of the headwaters to the Gualala River. Coast redwoods also provide important ecosystem services such as air and water quality improvement and carbon sequestration. The ecoregion also includes Buckeye Forest, a nearly 20,000 acre protected area where sustainable forestry is practiced (Ag + Open Space, n.d.).

LAND USE

Eighty-seven percent of this ecoregion is zoned for resources and rural development, which permits low residential development as well as agriculture and other industries that rely on natural resources.[3] This zoning limits development in areas without adequate public services. Another key land use is land-extensive agriculture (covering about 3% of ecoregion)

Figure 13. Land use types in the Coastal Franciscan Redwood Forest ecoregion.



[3] The zoning categorization for resources and rural development is for "protection of lands needed for commercial timber production, geothermal production, aggregate resources production; lands needed for protection of watershed, fish and wildlife habitat, biotic resources, and for agricultural production activities that are not subject to all of the policies contained in the agricultural resources element of the General Plan. The resources and rural development district is also intended to allow very low density residential development and recreational and visitor-serving uses where compatible with resource use and available public services" (Sonoma County Permit and Resource Management Department, 2020).

(see Figure 13). Agricultural lands are dispersed across the ecoregion, with clusters to the south of Annapolis, around the middle of the ecoregion around Guerneville, and further south toward Tannery Creek Reserve.

Zoning for rural residential covers about 4% of this zone. Rural residential areas are primarily along the towns of the lower Russian River (Permit Sonoma, 2021a).

EQUITY AND COMMUNITY DEMOGRAPHIC CHARACTERISTICS

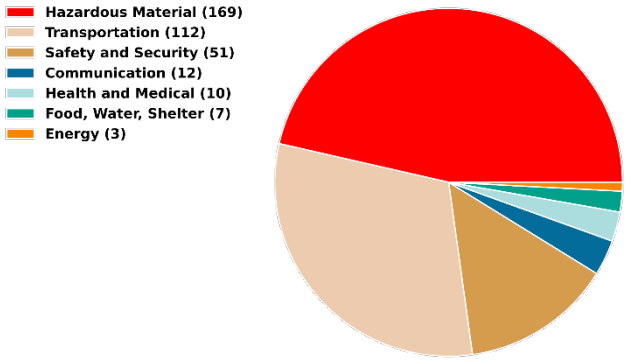
The communities within the census tract that stretches from southern Guerneville northwest to Cazadero have demographic characteristics that may make it challenging for them to prepare for, respond to, and recover from major hazard impacts. This is particularly concerning given that these communities are in a high fire and flood risk area. The MTC data define this area as an Equity Priority Community. The population's demographic factors are beyond thresholds for single-parent family structure, low income, disabilities, and rent burden (Metropolitan Transportation Commission, 2021). This census tract also scores lower than the county-wide average on key indicators of wellbeing: 4.91 on the human development index compared to 6.19 (out of 10); 79.5-year life expectancy compared to 82.2 years; 5.32 on education index compared to 5.85 (out of 10); and $29,654 in median personal earnings compared to $40,531 (Measure of America, 2021). Land use management planning and resilience planning should be done in close coordination with communities to get their input on new projects and programs.

OTHER CRITICAL ASSETS

Community infrastructure: Examples of major facilities include Annapolis Landfill, Annapolis electric substation, Russian River Fire Station (Guerneville), Saint Hubbert's Hall shelter, Guerneville Transfer Station. See Figure 14.

Protected areas and parks: Buckeye Forest, Howlett Forest, Armstrong Redwoods State Natural Reserve, Thelma Doelger Wildlife Preserve and Sanctuary, Jenner Headlands, Willow Creek Conservation Easement and State Park, Pryor Ranch, Soda Springs Reserve, Guerneville River Park, Sunset Beach County Park.

Figure 14. Critical assets in the Coastal Franciscan Redwood Forest Ecoregion.



Roads: Stewarts Point–Skaggs Springs Road, Mohrhardt Ridge Road, Fort Ross Road, Sweetwater Springs Road, River Road, CA-16–Pocket Canyon Highway.

Groundwater basins: Annapolis Ohlson Ranch Formation Highlands (Ag + Open Space, 2021a).

Priority streams, creeks, estuaries: Russian and Gualala Rivers and Armstrong, Willow, and Cazadero Austin creeks (along with many other feeder creeks) provide important habitat for salmonids, specifically coho salmon and steelhead (Ag + Open Space, 2021a).

POSSIBLE CLIMATE CHANGE EFFECTS

Natural and working lands and communities in the Coastal Franciscan Redwood Forest Ecoregion face high flood and wildfire risks. Thirty percent of the ecoregion is in a high-fire-risk zone, with the highest fire risk areas in the southern part of the ecoregion, on the north side of the Russian River, and south and east of Bohemian Grove. CAL FIRE identified the stretch of the Russian River from Duncan Mills to Rio Dell and lands along the western edge of the ecoregion (close to the coast) as priority landscape for restoring pest- and drought-damaged forest areas to restore ecosystem health and reduce wildfire threat (CAL FIRE Fire Resources Assessment Programs, n.d.).

Major Climate Hazards in the Coastal Franciscan Redwood Forest Ecoregion

Wildfire

Riverine flooding

Much of the ecoregion's population lives along this Russian River corridor, which has overtopped its banks 38 times since 1940. To address repeated damage to homes, the County started a program in 1995 to help homeowners raise their first floors (Rogers, 2019).

This stretch of the lower Russian River includes communities with demographic characteristics that make them most vulnerable to climate hazards and related disruptions. They may be affected the most by hazards and have the hardest time recovering from displacement, property damage, and job interruptions. Flood risk and housing cost burden are inextricably tied here, as the most affordable housing in the area is within the floodplain (Callahan, 2019).

In addition, riparian habitat and indicator species in the lower Russian River, like salmonids, can be harmed by low flow periods during drought, which can lead to streamflow impairments and cause salmonid smolts to become trapped and die (Russian River Coho Water Resources Partnership, 2022).

Vegetation in this ecoregion will likely face drought stress (climatic water deficit, or CWD) into the future, though drought stress is expected to be less severe here than in ecoregions farther inland. The CLN2.0 team estimated vegetation vulnerability to drought for the Bay Area by determining proximity of vegetation to the climatic "comfort zone" boundary for CLN2.0 vegetation targets based on CWD. This analysis identified the majority of vegetation in this ecoregion in the low and medium drought stress categories (Conservation Lands Network 2.0, 2019).

RESILIENCE INDICATORS

The following resilience indicators (see Appendix F for a full list of indicators) are most applicable to this ecoregion, given landscape and community characteristics. (These measures of resilience can be improved through key projects described in the next section).

Landscape indicators

- *Ecosystem health and biodiversity*
    - High diversity of endemic and native species. This ecoregion includes many of the county's stands of old-growth redwoods and stands of redwoods and Douglas fir with complex structures, meaning a diversity of size. These forests support unique canopy communities and contain some of the world's largest stores of carbon (Bay Area Council, 2019).

- *Land coverage*
    - Acreage and linear miles of protected riparian corridors. Since the early 2000s, there have been intensive efforts to conserve lands adjacent to the Russian River corridor, restore habitat, and remove barriers to fish passage (Ag + Open Space, 2021a).
    - Habitat continuity provides opportunities for wildlife migration and movement.
- *Land management*
    - High carbon sequestration potential in redwoods. Research indicates that forest sequestration can be increased through management practices.

Social and community indicators

- *Management, ownership, and capacity*
    - Prescribed burn associations, cooperative burning, and fire training for everyday people. This is important because the ecoregion includes high-fire-risk zones and is dominated by private lands.
- *Socioeconomic benefits*
    - For workers (e.g., loggers, heavy equipment operators, forest field staff, vegetation managers), health, safety, and ability to make a living wage and access housing in the community where they work.
    - Tourism levels and equitable distribution of tourism dollars.
- *Proximity and access*
    - Access to resources, food, water, healthcare, and other critical services in rural communities.
- *Equity and community demographic indicators*
    - Housing cost burden: Russian River communities are highly rent burdened. Projects must consider impacts on rents.

ECOREGION
Bay Flats

Acreage: 31,772

Cities/towns: Petaluma

Percent of lands protected: 45%

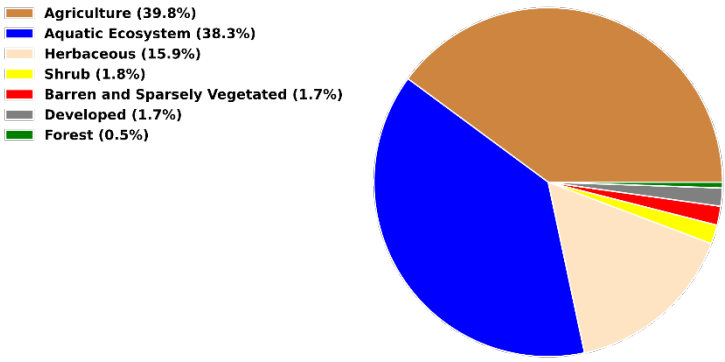
Population: ~5,200

Number of households: ~2,000

OVERVIEW

The Bay Flats ecoregion comprises historical baylands and remnant freshwater and brackish tidal marsh habitats and encompasses just over 28,000 acres (roughly 3% of the county). These lands, often called the Sonoma Baylands, once consisted of a diverse mosaic of tidal and seasonal wetlands and tidal flats (San Francisco Estuary Institute, 1998). Large millennial tidal wetlands no longer occur within this ecoregion, and remaining wetlands consist of centennial and newly restored marsh (San Francisco Bay Restoration Authority, 2022). Under current conditions, aquatic natural communities, including wetlands and open waters, make up nearly 40% of the total land cover. Much of the remaining landscape is diked to support agricultural uses, including irrigated pasture/managed hayfields (see Figure 15).

Figure 15. Vegetation types in the Bay Flats ecoregion.



The general topography of this ecoregion is flat, with elevation ranging from below sea level to about 10 feet. Significant areas of the ecoregion fall within subtidal elevation ranges, though many areas are not exposed to the tides due to hydrologic disconnections such as levees and berms (San Francisco Estuary Institute, 2019). The underlying

geology and soils are composed mainly of Quaternary bay fill (G. E. Griffith et al., 2016) and the primary geography is influenced by two converging watersheds, Petaluma and Sonoma Creek, which form wide alluvial valleys (San Francisco Estuary Institute, 2019).

The Bay Flats ecoregion is the focus of multiple recent and ongoing restoration planning and implementation efforts, including the Sears Point Wetland Restoration Project, the Sonoma Creek Baylands Strategy, the Petaluma River Adaptation and Resilience Plan, and the proposed State Route 37 Sea Level Adaptation Study (California Wetlands Monitoring Workgroup, 2022). Further, 45% of the land that currently supports tidal/aquatic habitats or agricultural use is under conservation easement or other permanent protection.

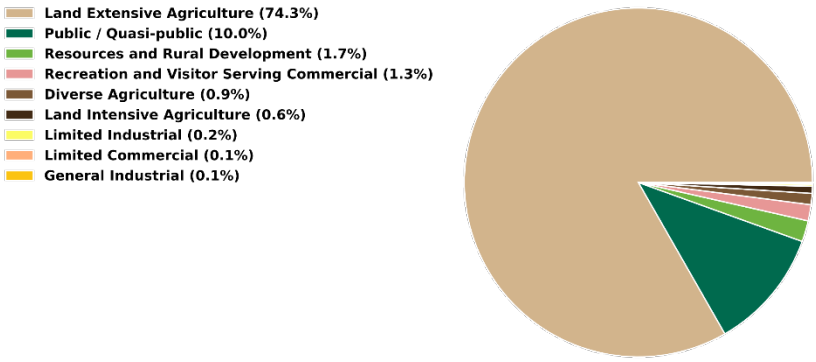
UNIQUE OR EXTRAORDINARY QUALITIES

The Bay Flats ecoregion provides migratory habitat for hundreds of species of birds, fish, and wildlife, including the federally listed Ridgeway's rail and salt marsh harvest mouse (U.S. Fish and Wildlife Service, 2013). A portion of the San Pablo Bay National Wildlife Refuge falls within the ecoregion, supporting the largest wintering population of canvasbacks (*Aythya valisineria*) on the West Coast. The Skaggs Island/Haire Ranch property was acquired by the Sonoma Land Trust in 2013 to restore the diked baylands to a diverse mosaic of tidal habitats and seasonal wetlands as part of the Sonoma Creek Baylands Strategy. The Sonoma Land Trust and partners completed restoration in 2018 and installed new water control structures, a pump station, and transplanted tule to provide habitat for ducks and marsh birds. The Tolay Creek Restoration Project restored and rehabilitated historical tidal wetlands from previously converted agricultural lands and has shown promising progress in accreting sediment to stay on pace with projected sea level rise (Takekawa et al., 2014).

LAND USE

Primary land uses include agriculture/diked lands (23,900 acres, 75% of total lands) and public lands (3,600 acres, 11% of total lands) (see Figure 16). Of the agricultural lands (mostly zoned as land-extensive), the majority are intensively managed hayfields and grazing lands. There is relatively limited development directly along the shoreline, potentially allowing for wetlands to migrate with sea level rise.

Figure 16. Land use types in the Bay Flats ecoregion.



EQUITY AND COMMUNITY DEMOGRAPHIC CHARACTERISTICS

The Bay Flats ecoregion spans the southern tip of two census tracts. The western tract does not pass any thresholds defined within MTC's Equity Priority Communities. The eastern tract is beyond the Equity Priority Communities thresholds for people over 75 years old (Metropolitan Transportation Commission, 2021).

The western census tract also scores higher than the county average on all key indicators of wellbeing identified in the Portrait of Sonoma County: 6.71 on the human development index compared to 6.1 (out

of 10); 82.9-year life expectancy compared to 82.2 years; $46.633 in median personal earnings compared to $40,531; and 6.16 on education index compared to the county average of 5.85 (out of 10) (Measure of America, 2021).

The eastern census tract also scores higher than the county average on all key indicators of wellbeing: 6.43 on the human development index compared to 6.1 (out of 10); 83.8-year life expectancy compared to 82.2 years; $38,036 in median personal earnings compared to $40,531; and 6.35 on education index compared to the county average of 5.85 (out of 10) (Measure of America, 2021)

OTHER CRITICAL ASSETS

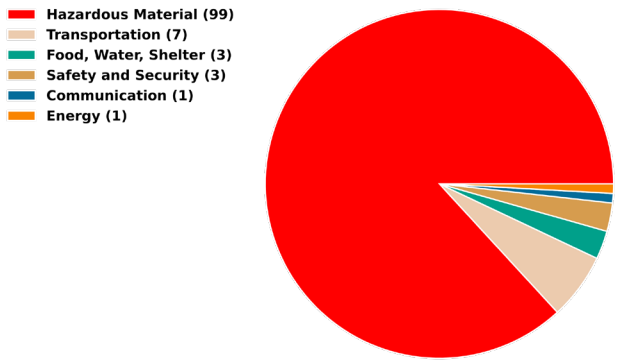
Community infrastructure: The northern part of the ecoregion has several wastewater treatment facilities. See Figure 17.

Agriculture and working lands: Irrigated pasture/managed hayfields.

Protected areas and parks: San Pablo Bay National Wildlife Refuge, Skaggs Island/Haire Ranch, Tolay Creek Restoration Project.

Roads: Highway 37, which traverses east–west through the ecoregion, is a critical transportation corridor that links U.S. Route 101 in Novato to Interstate 80 in Vallejo.

Figure 17. Critical assets in the Bay Flats ecoregion.



Groundwater basins: Two important groundwater basins, Sonoma Valley and Petaluma Valley, provide vital supplemental water for the City of Petaluma, City of Sonoma, and Valley of the Moon Water District; they serve as the primary water source for agriculture and rural land users (Sonoma Water, 2019).

Priority streams, creeks, estuaries: Multiple waterways drain to San Pablo Bay, including the Petaluma River, Sonoma Creek, Tolay Creek, and Novato Creek, which are collectively contained with the Petaluma and Sonoma Creek watersheds.

POSSIBLE CLIMATE CHANGE EFFECTS

Sea level rise and associated flooding are the dominant climate risks in this ecoregion. Under a future sea level rise scenario of 2.5 feet, 44% of the ecoregion is expected to be inundated without adaptation action (exposure analysis based on data from (Barnard et al., 2019). However, there are large stretches of land adjacent to existing tidal wetland at the right elevation for marsh migration. This presents important opportunities to adapt to sea level rise (San Francisco Estuary Institute & SPUR, 2019).

Major Climate Hazards in the Bay Flats Ecoregion

- Sea level rise and storms
- Flooding

The Sonoma Baylands are also expected to be affected by rising air and water temperatures, which may increase estuarine organisms' susceptibility to disease, parasites, and blooms of harmful algae. In addition, drought can create hypersaline conditions that may be hard for mid- to high marsh plants to tolerate (San Francisco Bay Area Wetlands Ecosystem Goals Project, 2016).

RESILIENCE INDICATORS

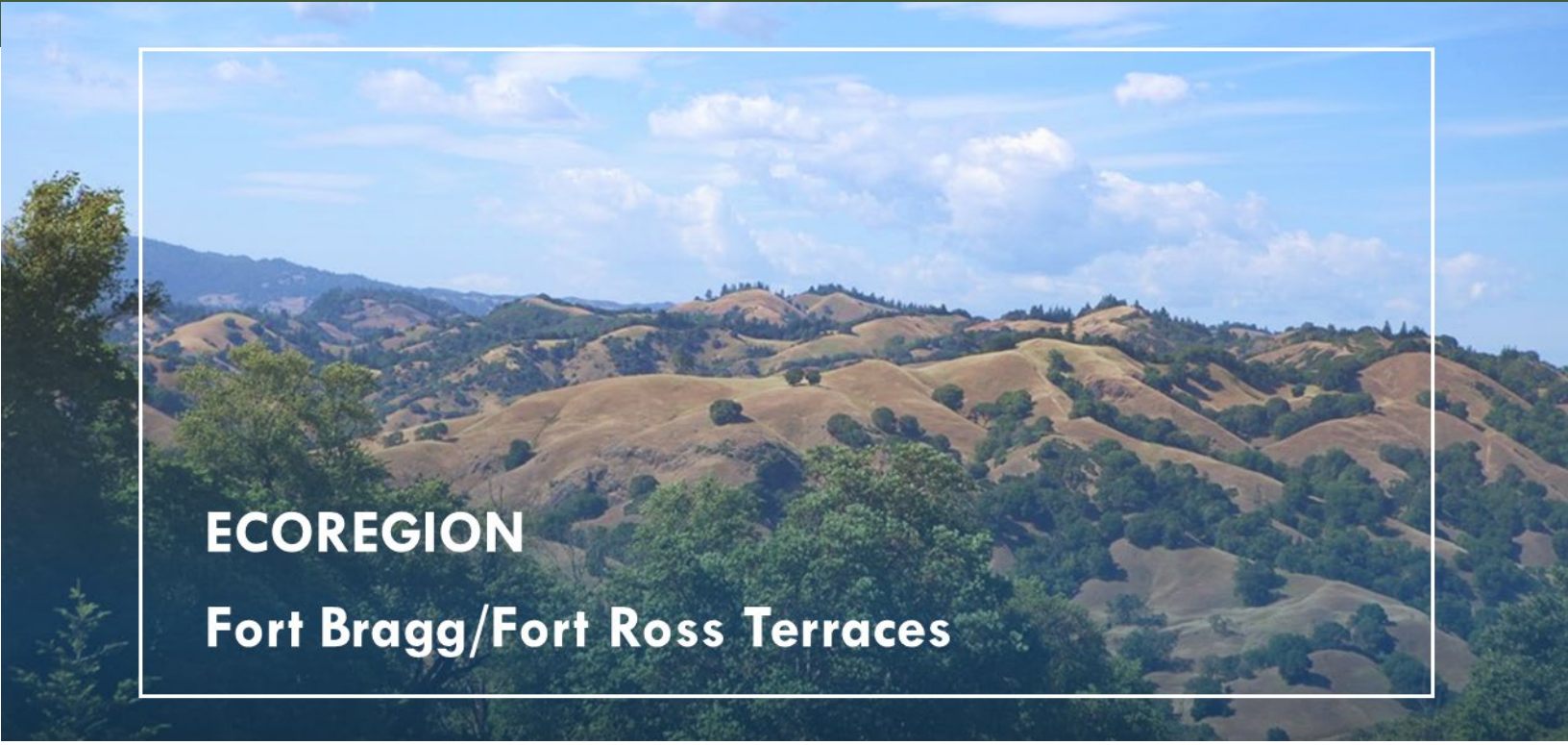
The following resilience indicators (see Appendix F for a full list of indicators) are most applicable to this ecoregion, given landscape and community characteristics. (These measures of resilience can be improved through key projects described in the next section.)

Landscape indicators

- *Land coverage*
  - Habitat continuity, providing opportunities for wildlife migration and movement.
  - Full range of tidal habitats, including intertidal mudflat, low marsh, mid-marsh, high marsh, transition zone, and upland habitats.
  - Tidal marsh migration opportunities on lands currently managed/diked for agricultural uses.
  - Limited development within the coastal zone, allowing opportunities to move existing structures and infrastructure out of high-risk zones.
- *Land management*
  - Carbon sequestration potential. Wetlands have high carbon sequestration potential. Carbon sequestration potential in tidal marshes in the San Francisco Bay region are estimated to sequester between 150 and 850 grams of carbon dioxide per square meter each year (Callaway et al., 2012). Sequestration can be maintained or increased through conservation, restoration, and management.
  - Storm surge protection provided by current/remnant tidal marsh and intertidal mudflats (Speers et al., 2015).

Social and community indicators

- *Management, ownership, and capacity*
  - Capacity for ongoing monitoring, maintenance, and adaptive management. Long-term wetlands monitoring is important for adaptive management.
- *Proximity and access*
  - Equitable access to parks and open spaces and job opportunities. Wetlands can also serve as key recreation sites and access must be provided equitably.
  - Provision of green corridors and connections (wetlands), as well as buffers, to provide access to nature and protection and relief from sea level rise and storms.



ECOREGION

Fort Bragg/Fort Ross Terraces

Acreage: 24,037

Cities/towns: None

Percent of lands protected: 34%

Population: ~2,300

Number of households: ~2,700

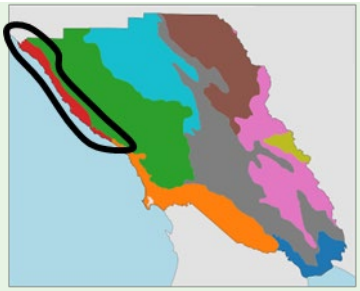
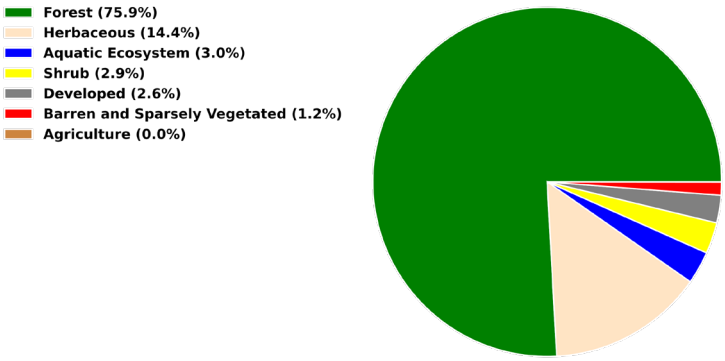


Figure 18. Vegetation types in the Fort Bragg/Fort Ross Terraces ecoregion.



The Fort Bragg/Fort Ross Terraces ecoregion contains the northern coastal part of the county and is formed by an elevated coastal plain above the Pacific Ocean that transitions to the Coastal Franciscan Redwood Forest to the east. The southern edge of the ecoregion is marked by the Russian River, while the northern edge is formed by the Gualala River. Forest habitat, consisting mainly of coast redwood (32% total cover), dominates the vegetated land cover. This ecoregion also supports the county's only stands of coastal bishop pine—noteworthy as a native, drought-tolerant species with restricted range, found mainly along the California coast. See Figure 18 for an overview of the vegetation types found in this ecoregion.

The coastline of the ecoregion is perched above the Pacific Ocean and is relatively flat; some areas are deeply dissected, forming steep ravines. Elevations range from sea level at the coast to 1,300 feet on inland hillslopes. The temperature range throughout the year is generally small and summer fog is common (G. E. Griffith et al., 2016). The Gualala River forms the divide between Sonoma and Mendocino Counties and drains extensive forestlands that have been under timber production since the turn of the

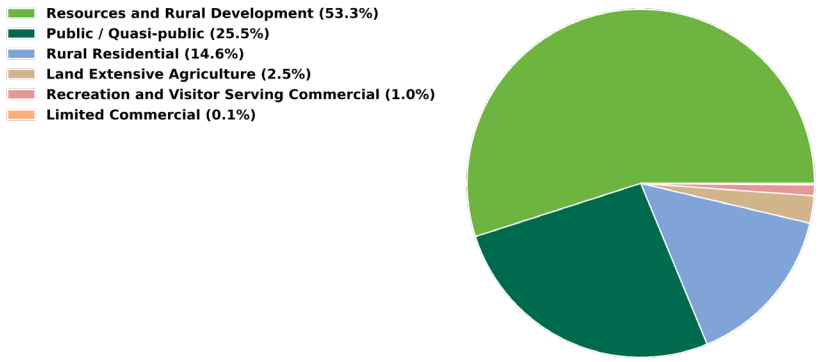
past century (Gualala River Watershed Council, 2022). The river is on the Clean Water Act 303(d) list for impaired water due to excessive sedimentation and high temperatures (North Coast Regional Water Quality Control Board, 2022).

UNIQUE OR EXTRAORDINARY QUALITIES

Over 34% of this ecoregion is protected as public lands or under conservation easement. State parks, including Salt Point State Park and Fort Ross State Historic Park, account for the majority of protected lands; other lands are managed by Sonoma County Regional Parks and land trusts. These lands provide contiguous habitat linkages between coastal habitats and inland forest and protect vital habitat for native and imperiled species such as the bishop pine, pygmy Cyprus, and California huckleberry. Salt Point State Park supports a rare and unique pygmy forest, which occur only on old elevated marine terraces (California Native Plant Society, 2022). The Kashia Coastal Reserve preserves coastal resources and the ancestral lands of the Kashia Band of Pomo Indians; the reserve is jointly owned by the Kashia[4] and protects important cultural sites while also providing an opportunity for public education about the history and practices of native people (Trust for Public Land, 2022).

LAND USE

Figure 19. Land use types in the Fort Bragg/Fort Ross Terraces ecoregion.



Significant portions of land are zoned for resources and rural development (see Figure 19), and 38% of total land cover in the ecoregion is zoned for timber production. Rural residential lands (15% of total lands) are generally associated with Sea Ranch, an unincorporated community, and timber cover. Residential communities are generally low-density and overall human population numbers in this ecoregion are low. Much of the ecoregion falls within California's coastal zone.

EQUITY AND COMMUNITY DEMOGRAPHIC CHARACTERISTICS

The population's demographic factors are beyond thresholds for disability and population of 75 years old (Metropolitan Transportation Commission, 2021). This census tract scores higher than the county-wide average on some key indicators of wellbeing: 6.6 on the human development index compared to 6.19 (out of 10) and 9.64 on education index compared to the county average of 5.85 (out of 10). This census tract scores lower than the county average on other key indicators of wellbeing: 81.8-year life expectancy compared to 82.2 years and $29,494 in median personal earnings compared to $40,531 (Measure of America, 2021).

[4] Ag + Open Space purchased a conservation easement and trail easement on the property.

OTHER CRITICAL ASSETS

Community infrastructure: Small businesses/commercial industry, two fire stations, a post office, a small single-strip airport in Sea Ranch (Permit Sonoma, 2021b). See Figure 20.

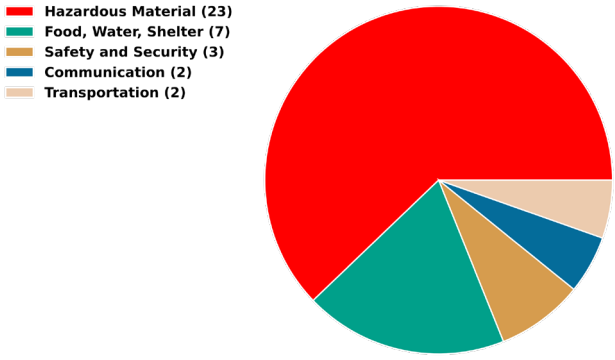
Protected areas and parks: Salt Point State Park, Fort Ross State Historic Park, Kashia Coastal Reserve, Stewarts Point conservation easement, Gualala Point Regional Park, Stillwater Cove Regional Park, Kruse Rhododendron State Natural Reserve.

Roads: Highway 1, which runs south to north, is the primary transportation corridor and connects Sonoma and Mendocino Counties.

Groundwater basins: No priority basins.

Priority streams, creeks, estuaries: Gualala River.

Figure 20. Critical assets in the Fort Bragg/Fort Ross Terraces ecoregion.



POSSIBLE CLIMATE CHANGE EFFECTS

Cliffs dominate the coastline of the ecoregion, offering communities, development, and clifftop habitats some protection from rising seas. While there is risk of cliff failure, this stretch of coast has not to date been identified as one of the state's highest cliff failure areas (Young, 2018). There are also beaches in this region, primarily within coves. Under a sea level rise scenario of 2.5 feet, beaches like Pebble, Walk On, Dune Drift, Shell, Olson, Black Point, and Fish Mill Cove are expected to be regularly inundated without adaptation action (Barnard et al., 2014). Changes in offshore conditions are anticipated to lead to changes in ecosystem dynamics and species composition, as is currently evident in loss of sea kelp along the Northern California coastline (Bailey & Minkiewicz, 2019).

Major Climate Hazards in the Fort Bragg/Fort Ross Terraces Ecoregion

Sea level rise and storms

RESILIENCE INDICATORS

The following resilience indicators (see Appendix F for a full list of indicators) are most applicable to this ecoregion, given landscape and community characteristics. (These measures of resilience can be improved through key projects described in the next section.)

Landscape indicators

- *Land coverage*
  - Habitat continuity and connectivity, providing opportunities for wildlife movement between coastal and inland habitats and opportunities for lateral range shift.
  - Protected lands constituting a significant portion of the ecoregion (with an accompanying need to ensure the long-term management and protection of diverse ecosystems).
  - Limited development within the coastal zone, allowing opportunities to move existing structures and infrastructure out of high-risk zones.
- *Habitat quality and condition*
  - Elevation and type of shoreline.

- *Ecosystem health and biodiversity*
    - Adaptive species including significant cover by coast redwood, a species known for its ability to recover rapidly from disturbance and for its high wildfire fire resistance (Ramage et al., 2010).
- *Land management*
    - Watershed management/coordination programs, developed and implemented for the Russian River and Gualala Watersheds. Climate adaptation measures have been incorporated into programs: for example, the Gualala Watershed Council received grant funds to develop a flow bank program to respond to drought conditions in the watershed (Gualala River Watershed Council, 2022).
    - Acres of risk reduction.

Social and community indicators

- *Management, ownership, and capacity*
    - Capacity and access for broad participation in scoping, planning, design, and implementation of the Lands Strategy. Resilience strategies, such as projects to relocate infrastructure, require broad participation.
- *Socioeconomic benefits*
    - Tourism levels and equitable distribution of tourism dollars.

ECOREGION

Napa–Sonoma–Russian River Valleys

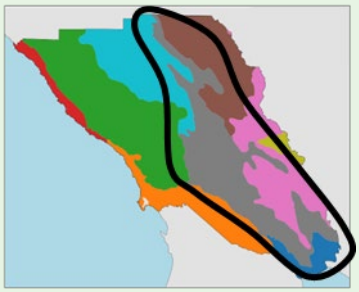
Acreage: 223,194

Cities/towns: Boyes Hot Springs, Fetters Hot Springs–Agua Caliente, Glen Ellen, Larkfield-Wikiup, Santa Rosa, Sonoma, Temelec, Petaluma, Cloverdale, Healdsburg, Windsor, Sebastopol, Rohnert Park, Cotati, Kenwood

Percent of lands protected: 9%

Population: ~464,500

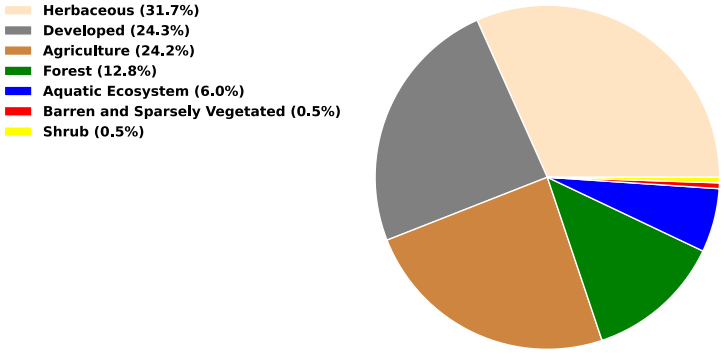
Number of households: ~187,900



OVERVIEW

The Napa–Sonoma–Russian River Valleys ecoregion is in the middle of Sonoma County, stretching from the Mendocino County line in the north down to the Bay Flats ecoregion. Napa–Sonoma–Russian River Valleys forms a natural corridor for U.S. 101 through the county and includes all of its major cities. Due to this, it is the most developed ecoregion in the county (about a quarter of its area is developed), but it is also characterized by grasslands (31%) and agriculture (24%) (see Figure 21). Many of Sonoma County's large fires burned parts of this ecoregion, including the 2017 Nuns and Tubbs Fires, the 2019 Kincade Fire, and the 2020 Glass Fire.

Figure 21. Vegetation types in the Napa–Sonoma–Russian River Valleys ecoregion.



The California annual and perennial grassland macro group (32%) is the predominant vegetation type in the ecoregion, though coastal live oak forest and woodlands are interspersed throughout the ecoregion (3%), especially along the western edge.

UNIQUE OR EXTRAORDINARY QUALITIES

Most of the county parks in Sonoma County are located in this ecoregion, including Crane Creek and Tolay Lake Regional Parks and part of Spring Lake Regional Park. The Russian River flows through the northern and central parts of the ecoregion, discharging an average of 1,600,000 acre-feet of water annually (based on the 1940–2011 average) (Mendocino County Resource Conservation District, 2012). The Russian River provides important habitat for aquatic and terrestrial plant and animal species, both common and endangered. These include Chinook salmon, California king snakes, western pond turtles, bobcats, river otters, great blue herons, and many more (Russian Riverkeeper, n.d.). The Russian River's eastern fork, also provides water to Lake Mendocino, one of the main reservoirs for Sonoma County (U.S. Geological Survey, 2018a). The Laguna de Santa Rosa, the largest freshwater wetland complex in northern California, is major tributary to the Russian River. It provides biodiversity, water quality, and flood control benefits to Russian River communities. The area serves an important Pacific flyway stopover area for migratory birds (Laguna de Santa Rosa Foundation, n.d.).

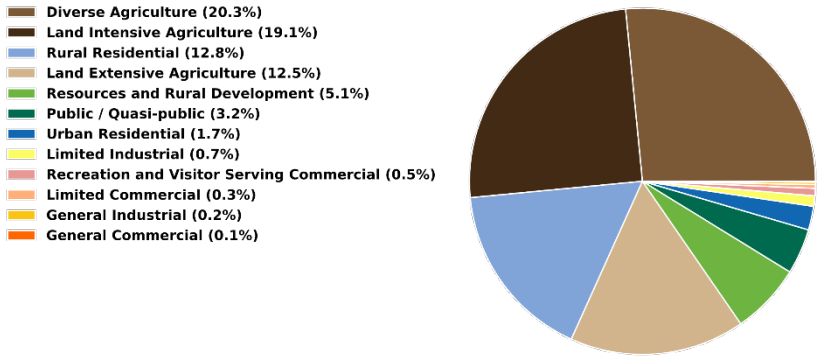
The Sonoma Valley and Sonoma Creek watershed drain into the San Francisco Bay marshlands. The valley is comprised of forests, grasslands, and vineyards. The creek is home to steelhead trout, Chinook salmon, and California freshwater shrimp. The 2017 Sonoma Valley fires impacted the watershed, leading to emergency watershed protection efforts to keep ask and debris out of the watershed (Sonoma Ecology Center, n.d.).

The Petaluma River is another vitally important waterway and riparian corridor that flows through this ecoregion. It is home to more than 500 species of birds, mammals, fish, and insects. Multiple parks are sited along the river (including Shollenberger, Alman Marsh, and Ellis Creek Water Recycling Facility wetlands parks) and are designated Ramsar sites[5] and birding hot spots (Shribbs, 2021). Petaluma's upper river region remains largely undeveloped and has over 100 acres of floodplain and more than 10 acres of wetlands. As 98% of the Petaluma Valley's seasonal wetlands have been lost, preserving these areas to allow for them to adapt to future climate conditions and to continue to serve a role in carbon sequestration is vital (Baumgarten et al., 2018). These wetlands also provide high value habitat for diverse species, including the gray fox and red shouldered hawk. Prioritizing conservation of the Petaluma River and surrounding riparian habitats as open space will protect sensitive habitat, enable continued carbon storage, and provide flood, fire, and heat protection for future generations of native species and human populations.

[5] Ramsar sites are wetlands designated to be of international importance, especially those providing waterfowl habitat, under the Ramsar Convention, an intergovernmental environmental treaty established in 1971 by the United Nations Educational, Scientific and Cultural Organization (UNESCO).

LAND USE

Figure 22. Land use types in the Napa–Sonoma–Russian River Valleys ecoregion.



Agricultural zoning makes up the predominant land use type in the ecoregion by far, with over half of the region zoned for agricultural use (Figure 22**Error! Reference source not found.**). A majority of this agricultural zoning is used by vineyards, covering 19% of the region. In fact, most of Sonoma County's vineyards are concentrated in the Napa–Sonoma–Russian River Valleys ecoregion and are an important part of the county's economy. According to Sonoma County Vintners, one in four Sonoma County jobs is in the wine industry, which generates over $9.2 billion per year from the U.S. retail value of wines produced and from wine tourism (Sonoma County Vintners, n.d.).

As in many parts of California, the cities in this ecoregion have expanded into the wildland–urban interface, where fire risk is great. Infill development will allow these urban areas to grow while limiting fire risk (Council of Infill Builders, 2018).

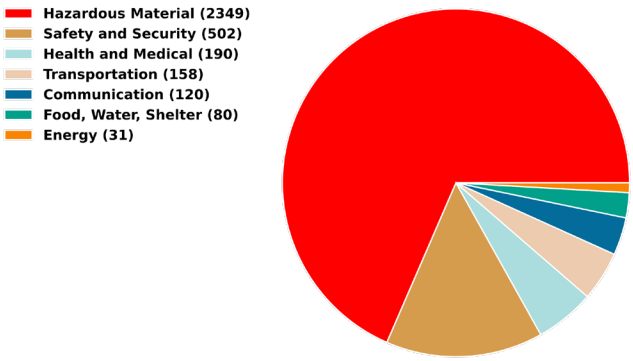
EQUITY AND COMMUNITY DEMOGRAPHIC CHARACTERISTICS

All the county's main cities are in this ecoregion, including Santa Rosa and Petaluma. The communities within census tracts in central and southern Santa Rosa have demographic characteristics that may make it challenging for them to prepare for, respond to, and recover from major hazard impacts. This is particularly concerning given that communities in southern Santa Rosa census tracts are within floodplains. This ecoregion includes about a dozen Equity Priority Communities, following the MTC definition. The populations of most of these tracts are beyond thresholds for low income, disabilities, and rent burden (Metropolitan Transportation Commission, 2021). The tract to the southwest of the U.S. 101 and CA 12 interchange includes a population above the defined threshold for percent people of color, another factor in identifying Equity Priority Communities (Metropolitan Transportation Commission, 2021). This census tracts around Sonoma also score lower than the rest of the county average on the human development index, which combines key indicators of wellbeing, including life expectancy, education, and earnings (Measure of America, 2021). Land use management and resilience planning should be done in close coordination with communities to get their input on new projects and programs.

OTHER CRITICAL ASSETS

Community infrastructure: The ecoregion contains a huge range of important community assets and infrastructure. Examples include Sonoma County Airport, Sonoma State University, Santa Rosa Memorial Hospital, County and Municipal offices, Healdsburg Senior Center (which also serves as an emergency shelter). See Figure 23.

Figure 23. Critical assets in the Napa–Sonoma–Russian River Valleys ecoregion.



Protected areas and parks: Examples include Tolay Lake Regional Park, Crane Creek Regional Park, Ragle Ranch Park, Spring Lake Park, Riverfront Regional Park, Cloverdale River Park, Maxwell Farms Regional Park, and Sonoma State Historic Park.

Roads: U.S. 101, CA 12, CA 116, Bodega Highway, River Road, Windsor Road, Old Redwood Highway, Alexander Valley Road, Dry Creek Road, many others.

Groundwater basins: Santa Rosa, Alexander Valley, Wilson Grove Formation Highlands, Petaluma Valley.

Priority rivers and streams: Russian River, Petaluma River, Big Sulfur Creek, Laguna Santa Rosa, Dry Creek, Mark West Creek, Santa Rosa Creek, Sonoma Creek.

POSSIBLE CLIMATE CHANGE EFFECTS

Napa–Sonoma–Russian River Valleys has a lower wildfire risk than other ecoregions in the county. That said, communities in the valley are heavily affected by forest and fire management in rural areas to the east. In hot, dry, high winds (generally blowing from east to west), fire can quickly spread vast distances. Reducing available fuels and active management for forest health can limit the speed and intensity of fires. It is important to be aware of the high fire risk in areas adjacent to this region and invest in resilient forest management in those areas (Fire Safe Sonoma, 2019; State of California, 2021a).

Major Climate Hazards in the Napa–Sonoma–Russian River Valleys Ecoregion

- Wildfire
- Extreme temperatures

Changing precipitation patterns will affect this ecoregion. Though projections of annual precipitation volume and trajectory vary, they indicate that there will be changes in the timing and amount of rain that falls during individual rainfall events (U.S. Geological Survey, 2018b). Increases in intensity and/or frequency in rainfall will have major effects on this ecoregion. The Petaluma River already floods during multi-day storms because of the insufficient stormwater system. The City of Santa Rosa's Laguna Treatment Plant has flooded during several storms and some housing has been developed in the Laguna De Santa Rosa floodplain (Permit Sonoma, 2021b).

Additionally, by 2070, average minimum annual temperatures in the ecoregion are expected to increase by over 6 degrees Fahrenheit in Santa Rosa, the largest increase in the county, under a hot, low rainfall scenario. The temperature increase is likely largest in Santa Rosa due to the urban heat island effect, in which temperatures in densely urban areas are higher than in the surrounding countryside. Minimum temperatures, which usually occur at night, are important to track during summer months, as the most serious health impacts of a heat wave are often associated with high temperatures at night (Sarofim et

al., 2016). If the air stays too warm at night, it is harder for the human body to cool and regulate itself, which is especially a concern for residents without air conditioning units.

RESILIENCE INDICATORS

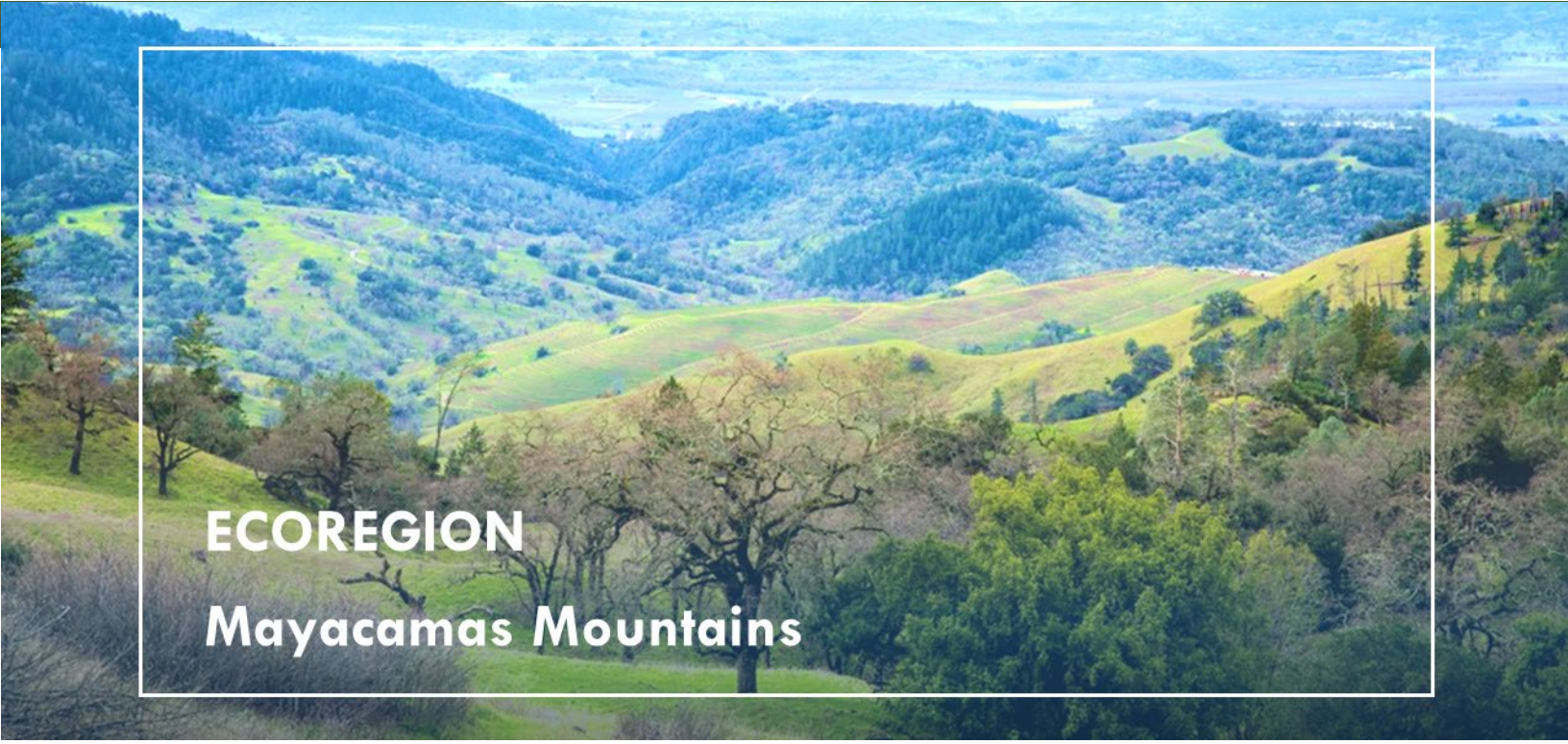
The following resilience indicators (see Appendix F for a full list of indicators) are most applicable to this ecoregion, given landscape and community characteristics. (These measures of resilience can be improved through key projects described in the next section.)

Landscape indicators

- *Land coverage*
  - Acreage and continuity of wetlands.
- *Habitat quality and condition*
  - Acreage and distribution of water resources, permeable soils, and recharge zones.
  - Acreage and diversity of working lands using climate-resilient practices.
- *Land management*
  - Acreage and diversity of working lands using climate-resilient practices.
  - Climate adaptation measures integrated in watershed management programs.

Social and community indicators

- *Management, ownership, and capacity*
  - Prescribed burn associations, cooperative burning, and fire training for everyday people.
  - Incorporation of traditional ecological knowledge and tribal expertise into management.
- *Socioeconomic benefits*
  - Contribution of natural and working lands to the county's economy and employment.
- *Proximity and access*
  - Proximity to green spaces and green infrastructure within the county's developed lands to underserved and under-resourced communities.



ECOREGION

Mayacamas Mountains

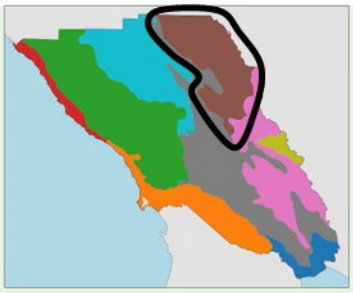
Acreage: 128,342

Cities/towns: Healdsburg, Larkfield-Wikiup, Windsor

Percent of lands protected: 21%

Population: ~16,700

Number of households: ~7,700

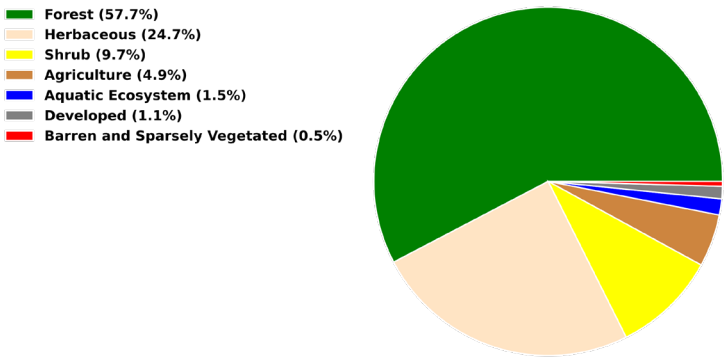


OVERVIEW

The Mayacamas Mountains ecoregion is in the northeast corner of the county. The western edge of the ecoregion includes the Alexander Valley and small portions of the outer edge of Windsor, Healdsburg, and Larkfield-Wikiup. The Mayacamas Mountains themselves are an interior coastal range reaching over 3,600 feet in elevation (e.g., for example, Pine Mountain at 3,614 feet). The ecoregion has annual grasslands and montane hardwoods at low elevations and mixed chaparral at higher elevations. There are also some blue oak woodlands, patches of Sargent or McNab cypress, and scattered Douglas fir in this part of the county.

Dominant vegetation in this ecoregion includes California annual and perennial grassland (25% of land area), coast live oak woodland and forest (9% of land area), and several additional oak woodlands alliances, each dominated by a different oak species (coast live oak, blue oak, Oregon white oak, California black oak, valley oak, interior live oak) (collectively 9% of land area). See Figure 24 for more information on vegetation types.

Figure 24. Vegetation types in the Mayacamas Mountains ecoregion.



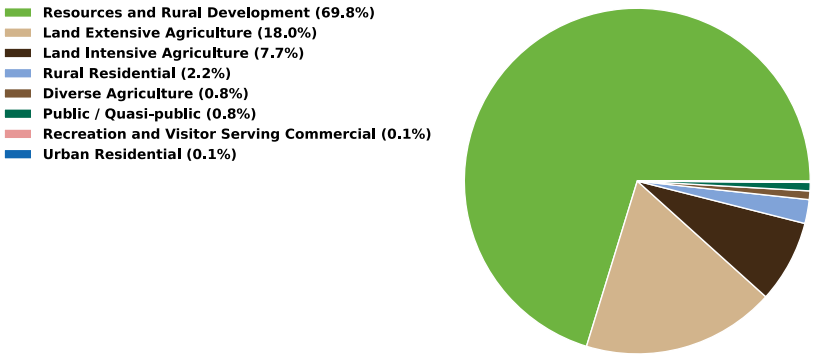
Many oak woodlands have been lost to development, but the remaining ones still play an important cultural and ecological role. They contain some of the highest plant and animal diversity in California (Myers et al., 2000) and provide local shade and cooling. Oaks store more atmospheric carbon than other common landscaping trees, and many oak species are resilient to drought. In the Mayacamas Mountains, valley oak, coast live oak, and blue oak are expected to persist in a changing climate (Climate Ready North Bay, 2015). They can tolerate low- and medium-intensity fire (but not high-intensity fires) (Ag + Open Space, 2021a).

UNIQUE OR EXTRAORDINARY QUALITIES

The Vital Lands Initiative identified the highest concentration of priority hardwoods countywide (as determined by rarity of species) in the northeast corner of this ecoregion. Most of the land in this ecoregion was identified as a priority area for wildlife habitat and movement (Ag + Open Space, 2021a). This ecoregion includes Modini Mayacamas Preserves, which is part of 12,600 acres of continuously protected land. The preserve includes a working cattle ranch and has several pristine creeks.

LAND USE

Figure 25. Land use types in the Mayacamas Mountains ecoregion.



Seventy percent of the Mayacamas Mountains ecoregion is zoned for resources and rural development (see Figure 25). Resources and rural development areas protect lands needed for 1) timber production, geothermal production, and aggregate resources production (e.g., mining of sand and gravel deposits); 2) watershed, fish and wildlife habitat, and biological resources; and 3) agricultural production (specifically agriculture not subject to the General Plan). Other major land uses include land-extensive agriculture (18% of land area) and land-intensive agriculture (8% of land area). Agriculture is concentrated in the Alexander Valley, with grazing lands in adjacent foothills.

EQUITY AND COMMUITY DEMOGRAPHIC CHARACTERISTICS

The Mayacamas Mountains region spans two census tracts. One larger tract covers the majority of the ecoregion. A second, smaller tract covers northeastern Healdsburg.

The population of the larger tract has demographic factors are beyond thresholds for people over 75 years old (Metropolitan Transportation Commission, 2021). This census tract scores higher than the county average on some key indicators of wellbeing identified in the Portrait of Sonoma County: 6.46 on the human development index compared to 6.19; 85.9-year life expectancy compared to 82.2 years; and $44,280 in median personal earnings compared to $40,531 (Measure of America, 2021). It scores lower than the county average on another key indicator: 4.5 on education index compared to the county average of 5.85 (Measure of America, 2021).

The population of the smaller census tract (northeastern Healdsburg) has demographic factors beyond thresholds for people over 75 years old and disability (Metropolitan Transportation Commission, 2021). This census tract scores higher than the county average on one key indicator of wellbeing identified in the

Portrait of Sonoma County: $42,060 in median personal earnings compared to $40,531 (Measure of America, 2021). It scores lower than the county average on other key indicators: 5.87 on the human development index compared to 6.19; 79.4-year life expectancy compared to 82.2 years; and 5.80 on education index compared to the county average of 5.85 (Measure of America, 2021).

OTHER CRITICAL ASSETS

Community infrastructure: Coldwater Creek Geothermal Facility, Aldin Geothermal Power Plant and Steamfield. See Figure 26.

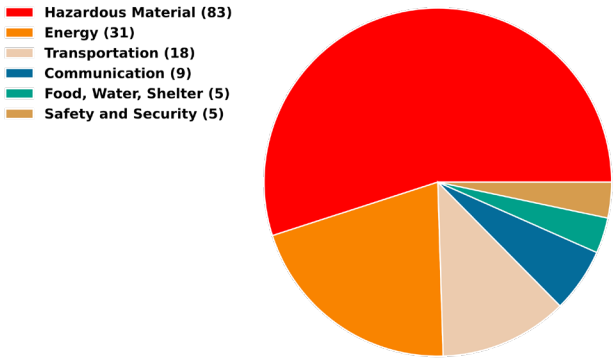
Protected areas and parks: Modini Mayacamas, Klesko Ranch, Santa Angelina conservation easement, Shiloh Ranch Regional Park.

Roads: CA 128, Geysers Road, Chalk Hill Road.

Groundwater basins: Alexander Valley.

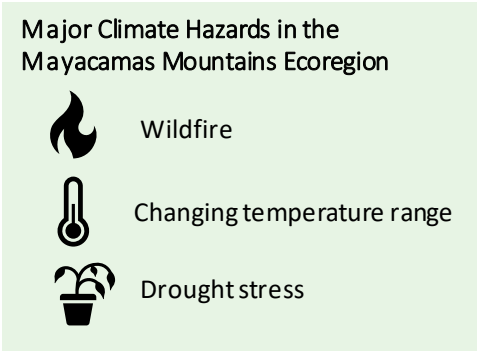
Priority streams, creeks, estuaries: Little Sulfur Creek, Russian River, Squaw Creek, Maacama Creek.

Figure 26. Critical assets in the Mayacamas Mountains ecoregion.



POSSIBLE CLIMATE CHANGE EFFECTS

Natural and working lands and communities in the Mayacamas Mountains ecoregion are expected to be affected by growing wildfire risk, increasing temperatures, and increasing drought stress. Sixteen percent of the ecoregion is in a high-fire-risk zone. CAL FIRE has identified priority hardwood areas (as identified in the Vital Lands Initiative) in the northeastern corner of the ecoregion as a priority for 1) restoring pest- and drought-damaged forests and 2) restoring forest ecosystem services damaged by wildfire (CAL FIRE Fire Resources Assessment Programs, n.d.). Loss of these hardwoods results in loss of carbon storage and biodiversity.



The western edge of this ecoregion (in the Alexander Valley) already has the highest average annual temperature in the county. As temperatures rise across the county as whole, this area will continue to be among the hottest. Climatic water deficit, an indicator of drought stress, is higher in the inland county across climate scenarios, particularly this on western side of the Alexander Valley.

RESILIENCE INDICATORS

The following resilience indicators (see Appendix F for a full list of indicators) are most applicable to this ecoregion, given landscape and community characteristics. (These measures of resilience can be improved through key projects described in the next section.)

Landscape indicators

- *Ecosystem health and biodiversity*
    - Presence/lack of anthropogenic stream barriers. The Mayacamas Preserves include creeks with intact riparian zones. They serve as the headwaters of Maacama Creek.

    - High diversity of endemic and native species. This ecoregion supports various alliances of oak woodlands, which support some of the highest plant and animal diversity in California.
- *Land management*
    - Acreage and diversity of working lands using climate-resilient practices.

Social and community indicators

- *Management, ownership, and capacity*
    - Prescribed burn associations, cooperative burning, and fire training for everyday people.
    - Incorporation of traditional ecological knowledge and tribal expertise into management.
- *Socioeconomic benefits*
    - Contribution of natural and working lands to the county's economy and employment.

ECOREGION

Napa–Sonoma–Lake Volcanic Highlands

Acreage: 124,653

Cities/towns: Fetters Hot Springs–Agua Caliente, Larkfield-Wikiup, Santa Rosa, Sonoma, Temelec

Percent of lands protected: 9%

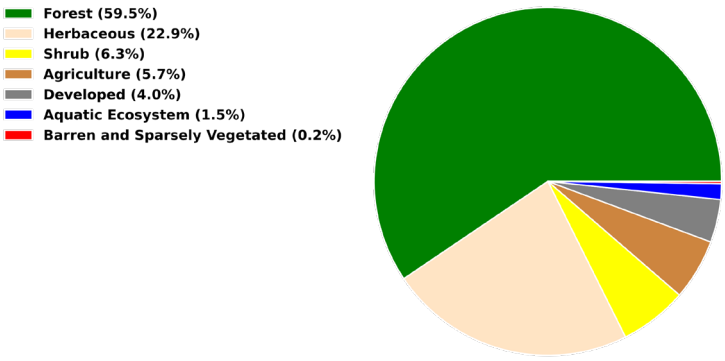
Population: ~73,800

Number of households: ~33,900

OVERVIEW

The Napa–Sonoma–Lake Volcanic Highlands ecoregion is defined by volcanic terrain (specifically, the Tertiary volcanic geology present in Napa and Sonoma Counties). Elevations here range from 500 feet in the south to 4,300 feet on Mount Saint Helena. The ecoregion approximately follows the eastern edge of the county and encompasses the outer boundaries of Santa Rosa (around Taylor Mountain Regional Park and Open Space Preserve), Petaluma (the Petaluma reservoir), the City of Sonoma (Montini Open Space Preserve), and the smaller communities of Temelec, Fetters Hot Springs–Agua Caliente, and Larkfield-Wikiup. The ecoregion encompasses most of the small towns of Boyes Hot Springs and Glen Ellen. It is characterized by mixed chaparral, mixed hardwoods, and some Douglas fir and cypress (G. E. Griffith et al., 2016). Soils in this ecoregion are mostly

Figure 27. Vegetation types in the Napa–Sonoma–Lake Volcanic Highlands ecoregion.



xeric, meaning that winters are moist and cool, and summers are warm and dry—conditions that define a Mediterranean climate.

Coast Live Oaks, Sonoma County.

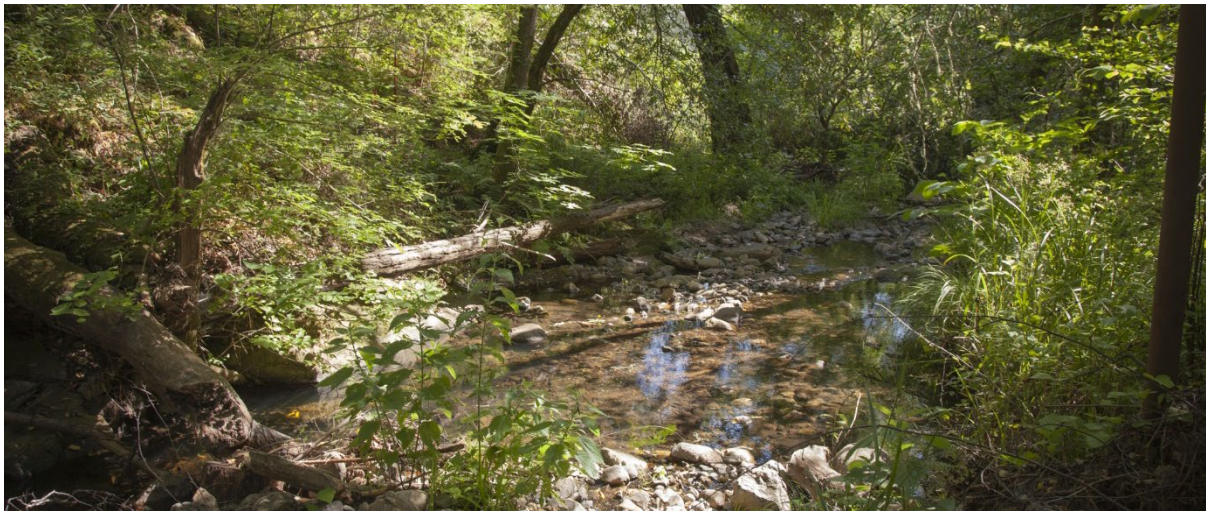
Dominant vegetation alliances in this ecoregion include California annual and perennial grassland (23% of ecoregion acreage); Douglas fir forest and woodland (13% of ecoregion acreage); coast live oak woodland and forest (9% of ecoregion acreage); and several other oak woodlands, each dominated by a different oak species (coast live oak, blue oak, Oregon white oak, California black oak, valley oak, interior live oak) (collectively 9% of land area) (Figure 27). As noted in the Mayacamas Mountain ecoregion summary, oaks play an important cultural and ecological role in Sonoma County, supporting high biodiversity and providing a range of ecosystem services including shade/cooling and carbon sequestration.

UNIQUE OR EXTRAORDINARY QUALITIES

As this ecoregion follows the outer boundaries of Santa Rosa, the City of Sonoma, Rohnert Park, and several smaller towns, several of the working lands and preserves function as important greenbelts, providing a buffer from wildland fires and serving as sites for agriculture, grazing, and/or recreation (Ag + Open Space, 2021a).

The Nuns, Glass, and Tubbs Fires all burned within this ecoregion. As such, sites like Calabazas Creek Regional Park and Open Space Preserve (which burned in the 2017 Nuns Fire) are currently undergoing regrowth. It is being managed to build fire resiliency and remove invasive species during this regrowth process (Ag + Open Space, 2021a).

This ecoregion is also home to the Pepperwood Preserve. Its springs, marshes, vernal pools, and ponds create habitat for a wild variety of species. Most of the preserve drains into the Santa Rosa Valley groundwater basin. The preserve is vital to species migration and movement and provides important breeding and rearing habitat (Pepperwood Preserve, n.d.).

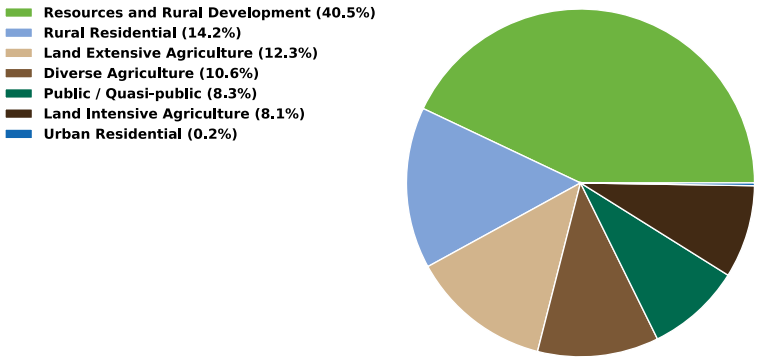


Calabazas Creek, Sonoma County.

LAND USE

Forty percent of Napa–Sonoma–Lake Volcanic Highlands is zoned for resources and rural development, 25% is agriculture, and 14% is rural residential (other land uses are listed in Figure 28). This ecoregion includes a number of parks and protected areas adjacent to cities that are designated as greenbelts.

Figure 28. Land use types in the Napa–Sonoma–Lake Volcanic Highlands ecoregion.



EQUITY AND COMMUNITY DEMOGRAPHIC CHARACTERISTICS

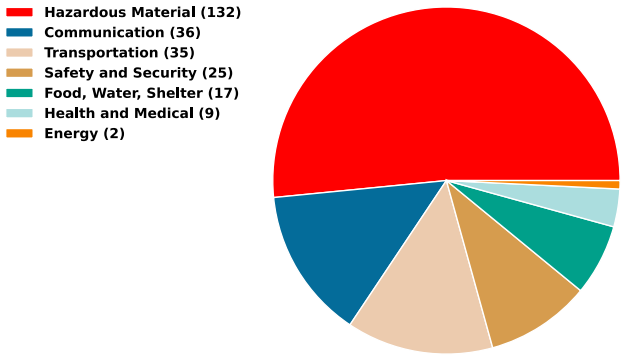
Several census tracts around Santa Rosa (to the east of Taylor Mountain; from Trione-Annadell State Park to the Napa border) and to the west of the City of Sonoma are above MTC's threshold for demographic factors that may make it harder for those communities to respond to and recover from a disaster: people over 75 and disability (Metropolitan Transportation Commission, 2021). Nearly all census tracts score higher than the county average on key indicators of wellbeing studied in the Portrait of Sonoma effort (Measure of America, 2021). One exception is the small area north of the City of Sonoma at Boyes Hot Springs, which scored lower than the county average for human development index, educational attainment, income and life expectancy. In addition, the ecoregion is directly adjacent to communities in Santa Rosa and Rohnert Park that are more vulnerable to climate stress, disruptions, and natural disasters based on the MTC and Portrait of Sonoma definitions (Measure of America, 2021; Metropolitan Transportation Commission, 2021).

OTHER CRITICAL ASSETS

Community infrastructure: Mayacama Ranch Wastewater Treatment Facility, Knight Valley Fire Station, Mayacamas Fire Station (examples). See Figure 29 for more details.

Protected areas and parks: Taylor Mountain Regional Park and Open Space Preserve, Geary Ranch, Fairfield-Osborn Preserve, North Sonoma Mountain Regional Park and Open Space Preserve, Morelli, Calabazas Creek Regional Park and Open Space Preserve, Mark West Creek Regional Park and Open Space Preserve, Safari West, Pepperwood Preserve (Ag + Open Space, 2021a).

Figure 29. Critical assets in the Napa–Sonoma–Lake Volcanic Highlands ecoregion.



Roads: Sonoma Highway (CA 12), Grange Road, Calistoga Road, St. Helena Road, CA 128.

Groundwater basins: Kenwood Valley.

Priority streams, creeks, estuaries: Willow Brook Creek, Santa Rosa Creek, Mark West Creek, Mill Creek, Porter Creek (Ag + Open Space, 2021a).

POSSIBLE CLIMATE CHANGE EFFECTS

Wildfire risk is the biggest concern for this ecoregion, with more than half of the land area in a high-fire-risk zone (Sonoma County et al., 2021). This is especially concerning because wildfires may spread to populated urban areas to the west, including communities in Santa Rosa and Rohnert Park that may be most vulnerable to hazards (as indicated by equity and community demographics). High winds, which escalate fire risk, generally blow from east to west in the region. As a result, fire risk in this ecoregion affects communities in this ecoregion and beyond. Reducing fuels available and actively managing to increase forest health can limit fire risk as well as the speed and intensity of fires (Fire Safe Sonoma, 2019; State of California, 2021a).

Major Climate Hazards in the Napa–Sonoma–Lake Volcanic Highlands Ecoregion

Wildfire

Changing temperature range

High heat is also a concern for communities, with most portions of the ecoregion expected to be 5.5–6.5 degrees Fahrenheit warmer during the 2040 to 2069 period than the historic baseline.

RESILIENCE INDICATORS

The following resilience indicators (see Appendix F for a full list of indicators) are most applicable to this ecoregion, given landscape and community characteristics. (These measures of resilience can be improved through key projects described in the next section.)

Landscape indicators

- *Ecosystem health and biodiversity*
  - Absence of nuisance species, pests, and disease.
  - High diversity of endemic and native species. This ecoregion supports various alliance of oak woodlands, which support some of the highest plant and animal diversity in California.
  - Post-fire disturbance/succession.
- *Land coverage*
  - Acreage and distribution of protected land.
- *Land management*
  - Acreage and diversity of fuels treatment and management projects.
  - Carbon sequestration potential.

Social and community indicators

- *Management, ownership, and capacity*
  - Prescribed burn associations, cooperative burning, and fire training for everyday people.
  - Capacity for ongoing monitoring, maintenance, and adaptive management.
- *Socioeconomic benefits*
  - Implementation of community-based processes to strengthen capacity and increased participation (e.g., workforce development, access to green jobs, technical assistance).

ECOREGION

North Coast Range Eastern Slopes

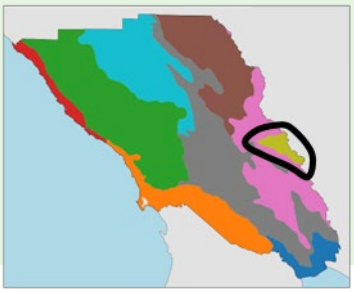
Acreage: 13,106

Cities/towns: None

Percent of lands protected: 54%

Population: ~5,100

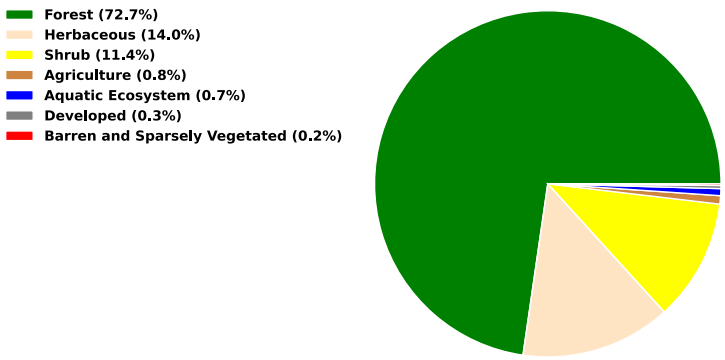
Number of households: ~2,800



OVERVIEW

The North Coast Range Eastern Slopes ecoregion extends from the eastern edge of Sonoma County into Napa County. The ecoregion is north of the City of Sonoma and east of the City of Santa Rosa. Its topographic, soil, climate, and geologic conditions are characterized by higher elevations than the surrounding area, sedimentary rocks, serpentine soils, and soil moisture regimes that support temperate hardwood forests and include a moderate to high water content on the north facing slopes of the ecoregion (udic) and soils more typical of Mediterranean climates with dry and wet cycles that support shrublands and chapparal (xeric). The soil temperature in the ecoregion ranges from 8 to 15 degrees Celsius. The vegetation and habitat in the ecoregion (see Figure 30) is predominately forest: more specifically, chaparral on the ridges, oak and fir woodland along the meadows, and redwood forest around Sonoma Creek. It also has shrublands and grasslands and a significant number of creeks, including the headwaters for Sonoma Creek as well as Salt Creek and Santa Rosa Creek. The habitat supports a

Figure 30. Vegetation types in the North Coast Range Eastern Slopes ecoregion.



diversity of native plants and animals including madrone, California lilacs, toyon, California laurel, bobcats, gray foxes, and many species of birds.

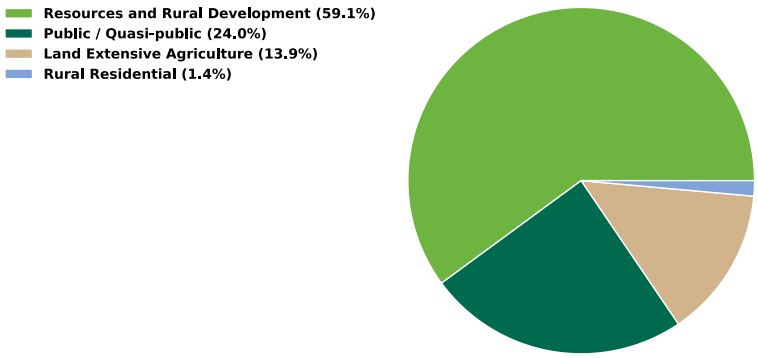
UNIQUE OR EXTRAORDINARY QUALITIES

Stream in Hood Mountain Regional Park.

The ecoregion contains two significant parks in the area, Sugarloaf Ridge State Park and Hood Mountain Regional Park. Sugarloaf Ridge State Park contains the headwaters of Sonoma Creek and the Robert Ferguson Observatory (California Department of Parks and Recreation, n.d.). Hood Mountain Regional Park contains the headwaters of Santa Rosa Creek and more than 19 miles of trails, the longest trail system in the regional park system (Sonoma County Regional Parks, n.d.). With the headwaters of two major creeks, significant open spaces and trails, native habitat, and the southern end of the Mayacamas Mountain range, this ecoregion has a number of extraordinary places important for the health and welfare of Sonoma County's people, biodiversity, clean water, and climate resilience.

LAND USE

Figure 31. Land use types in the North Coast Range Eastern Slopes ecoregion.



The primary land uses in the ecoregion are resources and rural development, public/quasi-public use, and land-extensive agriculture. There is also a small amount of rural residential use at the western edge of the ecoregion. These uses reflect the significant amount of parkland in the area (shown in dark green in Figure 31), the presence of low-production-per-acre agricultural uses due to climate and soil conditions and surrounding uses and infrastructure (shown in tan), rural residential at very low densities (shown in light blue), and natural resource protection and possible use (shown in light green). Most of the categories, except for parkland, allow rural residential uses from 20 to 320 units per acre (Sonoma County Permit and Resource Management Department, 2020).

EQUITY AND COMMUNITY DEMOGRAPHIC CHARACTERISTICS

As described above, the ecoregion has very low-density, rural residential development, which results in a small population. The Portrait of Sonoma data and maps show that the area has a fairly high life expectancy of 80 to 81 years, is in the middle of the range for housing cost burden and overall standard of living, and has a fairly high level of education; the ecoregion does contain an area with the lowest-level standard of living and another area that has a mid-range standard of living (Measure of America, 2021).

The ecoregion exceeds the MTC Equity Priority Communities thresholds for people over 75 years old and disability (Metropolitan Transportation Commission, 2021).

OTHER CRITICAL ASSETS

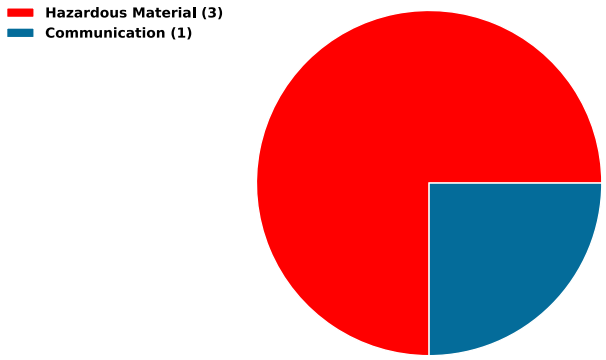
Priority streams: Headwaters for Sonoma Creek, Salt Creek and Santa Rosa Creek.

Protected areas and parks: Sugarloaf Ridge State Park, Hood Mountain Regional Park, the Robert Ferguson Observatory.

Roads: Major access roads of Adobe Canyon and Pythian Roads east of CA 12.

See Figure 32 for more information.

Figure 32. Critical assets in the North Coast Range Eastern Slope ecoregion.



POSSIBLE CLIMATE CHANGE EFFECTS

The most significant risk within the ecoregion is wildfire. Most of the ecoregion's land area—58%—is in the very high and extreme risk categories. In fact, the area has burned multiple times in recent years, with over 90 percent of Sugarloaf Ridge State Park being burned over three years from the 2017 Nuns Fire and the 2020 Glass Fire. Hood Mountain Regional Park suffered similar damage from both fires.

Major Climate Hazards in the North Coast Range Eastern Slopes Ecoregion

- Wildfire
- Changing temperature range

The border between Sonoma and Napa Counties has some of the highest-rated wildfire risk within either county and the land uses, topography, and vegetation types make the area harder to protect if wildfires ignite. Though the landscape in the ecoregion is known to be adaptive and resilient to wildfire, it is not adapted to fires at this frequency and intensity. Many of the species, if healthy, are resilient to wildfire (indeed, some species need periodic, small-scale burns), but they are all at great risk if not managed or restored to reduce conditions that lead to greater vulnerability. Recent fires have occurred with three years of each other and been both large and intense. A common pattern for the fires is to travel over the ridge from Napa into the more populated cities and towns to the west. The risks from these large and intense fires also include damage to the headwaters of two major creeks, the Sonoma and Santa Rosa. While some vegetation and habitat will return after fires, depending on the intensity and return period of wildfire, some will struggle to return—particularly the chaparral and shrubland, which may return as non-native grassland. Other, more unique species may struggle to re-populate. Another consideration is the rural nature of the area and the limited roadway access—also risks for both evacuation and fire response. With demographic characteristics that include people over 75 and those with disabilities, evacuation of such an area should be well designed in advance.

Post-Fire Conditions in Hood Mountain Regional Park (Sonoma County Parks).

While there is no flood risk within the ecoregion itself, there is flood risk associated with several of the creeks that have their headwaters in the ecoregion. Extreme

precipitation could result in flooding in the lower reaches of the watersheds of both Sonoma and Santa Rosa Creeks, creating flooding at the baylands for Sonoma Creek and the City of Santa Rosa for Santa Rosa Creek. If the riparian corridors are healthy, they can slow and store the water in the upper watershed, which could reduce the flooding in the lower watershed. If they are not healthy, the flood risk in the lower watershed could increase, as well as the risk of debris flows. This is particularly true if the area has burned recently.

The eastern region of the county is expected to experience the largest increase in average minimum temperature from the historical baseline. This increase could result in a threshold being met that shifts soil temperature from moderate to high, which could affect the vegetation and species the region supports. Native chaparral communities could shift to non-native grassland, and forest health could be affected. Species may also shift to higher elevations as conditions change.

RESILIENCE INDICATORS

The following resilience indicators (see Appendix F for a full list of indicators) are most applicable to this ecoregion, given landscape and community characteristics. (These measures of resilience can be improved through key projects described in the next section.)

Landscape indicators

- *Ecosystem health and biodiversity*
  - Post-fire disturbance/succession.
- *Land coverage*
  - Connectivity of protected lands.
  - Topographic and biological diversity.
  - Acreage of different forest stand types (oak woodland, riparian, redwood/Douglas fir, pine).
- *Habitat quality and condition*
  - Water access and storage. This area holds the headwaters of several creeks.

Social and community indicators

- *Management, ownership, and capacity*
  - Support for diverse organizations and individuals to own, manage, and steward land.
- *Socioeconomic benefits*
  - Implementation of community-based processes to strengthen capacity and increased participation (e.g., workforce development, access to green jobs, technical assistance).

ECOREGION

Sonoma–Mendocino Mixed Forest

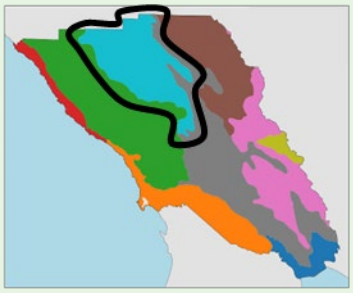
Acreage: 138,883

Cities/towns: Cloverdale

Percent of lands protected: 29%

Population: ~10,500

Number of households: ~5,300

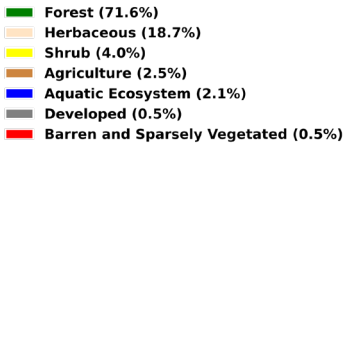


OVERVIEW

The Sonoma–Mendocino Mixed Forest ecoregion stretches from the Mendocino border down to Black Mountain, to the west of Windsor. It includes Lake Sonoma, which is an important resource for drinking water and recreation in the county. Lake Sonoma and most streams in this ecoregion drain into the Russian River to the east of the ecoregion. Lake Sonoma provides water to 600,000 people in Sonoma and Marin Counties (Ag + Open Space, 2017).

The ecoregion is defined by mixed hardwood forest, including tanoak, black oak, madrone, Oregon white oak, Douglas fir, and a few stands of redwoods. Forest covers 72% of the ecoregion. Among the forests are annual grasslands and chaparral (G. E. Griffith et al., 2016). Dominant vegetation includes California annual and perennial grasslands (covering 19% of the ecoregion), Oregon white oak woodland and forest (covering 13%), and Douglas fir forest and woodland (covering 12%). Oregon white oaks and

Figure 33. Vegetation types in the Sonoma–Mendocino Mixed Forest ecoregion.



Douglas fir are well adapted to low- to moderate-severity fires (California Native Plant Society, n.d.). See Figure 33 for a high-level summary of vegetation types in the ecoregion.

The geology consists of sandstone and shale, in addition to some metasedimentary rock (G. E. Griffith et al., 2016). The Vital Lands Initiative identified Alderglen Springs and Peña Creek as priority streams, in part because they provide salmonid habitat (Ag + Open Space, 2021a). Dry Creek is home to endangered coho salmon and threated Chinook salmon and steelhead (Sonoma Water, n.d.).

In the eastern edge of the ecoregion, closer to the Russian River (where there are population centers and land-intensive agriculture), average temperatures are warmer and wildfire risk higher than in Sonoma's Pacific coastal ecoregions. The western side of the ecoregion is cooler and receives higher annual precipitation than central and southern regions (U.S. Geological Survey, 2018b).

UNIQUE OR EXTRAORDINARY QUALITIES

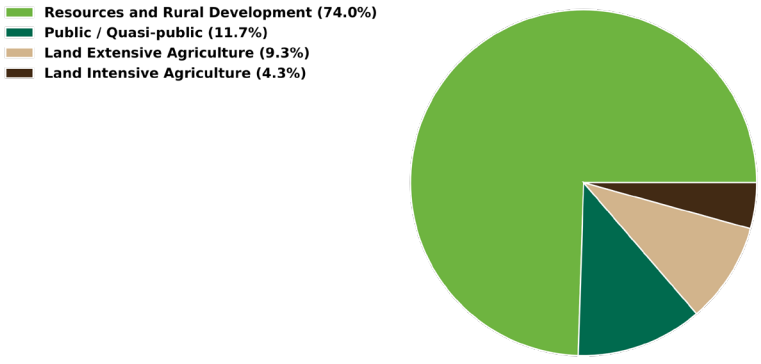
Cooley Ranch, which includes 19,000 acres of protected lands including old-growth redwoods and oak forests, vineyards, creeks, and riparian habitat, is an important natural asset that extends into Mendocino County. The fact that this preserve spans two counties points to the importance of managing lands based on watershed boundaries, rather than jurisdictional boundaries. As noted above, Colley Ranch protects 25% of the Dry Creek watershed, which drains into Lake Sonoma (Ag + Open Space, 2021a). By limiting development and implementing sustainable land management practices, this conservation effort supports healthy water quality for the county's water supply system (Ag + Open Space, 2017).

To the south of Cooley Ranch is another important protected area, Gloeckner Turner Ranch, which includes Oregon white oak and mixed hardwood forest, chaparral, Douglas fir and redwood forest, riparian woodlands, and grasslands (Ag + Open Space, 2021a). The area is an important wildlife corridor and protects headwaters of the Dry Creek River, which feeds into Lake Sonoma. Limited vineyards and continued cattle grazing are allowed, with best management practices in place to protect watersheds and natural resources.

LAND USE

There is very limited residential development in this area. Much of the ecoregion (74%) is zoned for resources and rural development (Permit Sonoma, 2021a) (Figure 34). The area around Lake Sonoma is public/quasi-public, serving as a drinking water reservoir and recreation area. There is also limited agriculture in this ecoregion, with 9% of land zoned for land-extensive agriculture and 4% zoned for land-intensive agriculture. With Gloeckner Turner Ranch (3,000 acres) and Cooley Ranch (19,000 acres), the northern ecoregion has large expanses of protected lands.

Figure 34. Land use types in the Sonoma–Mendocino Mixed Forest ecoregion.



EQUITY AND COMMUNITY DEMOGRAPHIC CHARACTERISTICS

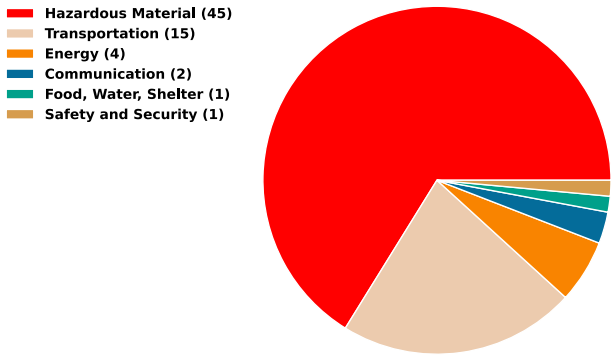
This ecoregion has a small, rural population. The West Cloverdale census tract, just to the west of Cloverdale, scores lower than the county average on key indicators of wellbeing: 5.93 on the human

development index compared to 6.19 (out of 10); 81.4-year life expectancy compared to 82.2 years; 5.66 on education index compared to 5.85 (out of 10); and ~$39,000 in median personal earnings compared to $40,531 (Measure of America, 2021). According to MTC's analysis of Equity Priority Communities, the population's demographic factors are beyond thresholds for disability and people over 75 years old ((Metropolitan Transportation Commission, 2021). Land use management and resilience planning in this area needs to consider factors that may make it difficult for a community to plan for and recover from hazards.

OTHER CRITICAL ASSETS

Groundwater basins: Snow Creek and Smith Creek (adjacent to Colley Ranch), Fall Creek (south of Lake Sonoma), and the Peña Creek area (at the southern end of the ecoregion) are important groundwater basins and recharge areas in the ecoregion (Ag + Open Space, 2021a). See Figure 35.

Figure 35. Critical assets in the Sonoma–Mendocino Mixed Forest ecoregion.



Priority streams: Alderglen Springs, Peña Creek, Dry Creek (Ag + Open Space, 2021a).

Protected areas and parks: Cooley Ranch, Gloeckner Turner Ranch, Porterfield Creek Trails Open Space Preserve, Lake Sonoma Yorty Creek Recreation Area, Lake Sonoma Recreation Area, Warm Spring Recreation Area.

Roads: CA 28, Stewarts Point–Skaggs Spring Road, Dutcher Creek Road.

Major facilities: Lake Sonoma, U.S. Army Corps of Engineers Lake Sonoma Waste, Warm Spring Dam.

POSSIBLE CLIMATE CHANGE EFFECTS

Major Climate Hazards in the Sonoma-Mendocino Mixed Forest Ecoregion

- Wildfire
- Drought stress
- Changing temperature range

The Sonoma–Mendocino Mixed Forest ecoregion will likely be most affected by growing wildfire risk, increasing temperatures, and increasing drought stress. Twenty-three percent of the ecoregion is currently in a high-fire-risk area, with the highest fire risk on the eastern side along the Russian River valley (and closer to residential and urban development). CAL FIRE has identified the area surrounding and to the north of Lake Sonoma as mid-priority watershed for treatments to reduce wildfire risk to forest ecosystem services (CAL FIRE Fire Resources Assessment Programs, n.d.). Fires in the watershed could affect Lake Sonoma water quality, so fire and associated runoff must be carefully managed.

Ag + Open Space has identified hardwood forests to the east of Lake Sonoma as a management and conservation priority. Conservation of hardwoods is important for maintaining carbon storage.

The eastern side of the ecoregion is in the county's current highest average annual temperature area. As temperature increases across the county as a whole (as projected by all climate scenarios), this area will continue to get hotter. The hottest parts of the county are co-located with intensive agriculture areas. Increasing air temperatures lead to higher water temperatures, which are harmful to sensitive salmon and steelhead in the ecoregion's creeks. Higher temperatures can also increase the frequency of harmful

algal blooms in the Russian River watershed (California Northcoast Regional Water Quality Control Board, 2017).

Under all climate scenarios, drought stress (climatic water deficit) increases with time. Work by the Conservation Lands Network on Vegetation Vulnerability to Drought indicates that vegetation along the Russian River valley side of the ecoregion is vulnerable under current conditions, whereas Cooley Ranch includes some areas where vegetation has low vulnerability to drought (Bay Area Council, 2019).

RESILIENCE INDICATORS

The following resilience indicators (see Appendix F for a full list of indicators) are most applicable to this ecoregion, given landscape and community characteristics. (These measures of resilience can be improved through key projects described in the next section.)

Landscape indicators

- *Land coverage*
  - Acreage and distribution of protected land. This ecoregion includes Cooley Ranch, with 19,000 acres of protected lands, representing the largest land acquisition to date by Ag + Open Space (Ag + Open Space, 2021a).
- *Habitat quality and condition*
  - Habitat continuity and connectivity provide opportunities for wildlife movement between Cooley Ranch, Gloeckner Turner Ranch, Lake Sonoma, and surrounding forests.
- *Land management*
  - Acreage of agricultural land stewarded using climate-resilient practices. Gloeckner Turner Ranch, for example, follows grazing practices that protect riparian areas.
  - Acreage and linear miles of protected riparian corridors. Watershed management/coordination programs have been developed and implemented for the Russian River watershed.

Social and community indicators

- *Management, ownership, and capacity*
  - Support for diverse organizations and individuals to own, manage, and steward land—public, private, or tribal.
- *Proximity and access*
  - Access to resources, food, water, healthcare, and other critical services in rural communities.

III. Hazard Exposure by Ecoregion

The sections above summarize climate change effects by ecoregion. Table 9 below provides a summary breakdown of exposure of each ecoregion to each hazard.

Table 9. Percent of ecoregion affected by each hazard. Colors mark a range from most affected (red) to least affected (green).

Ecoregion	High Fire Risk (%)[1]	Flood Awareness + FEMA 100 Year flood[2] (%)	High Landslide Risk[3] (%)	75 cm Sea Level Rise[4] (%)	75 cm Sea Level Rise + 100-Year Storm[5] (%)	200 cm Sea Level Rise[6] (%)
Bodega Coastal Hills	29.0	4.0	44.7	1.0	1.4	1.4
Coastal Franciscan Redwood Forest	20.5	3.3	82.9	0.2	0.3	0.2
Bay Flats	0.7	89.0	2.2	44.3	66.0	89.5
Fort Bragg/Fort Ross Terraces	0.0	4.8	22.0	1.1	1.4	1.4
Napa–Sonoma–Russian River Valleys	11.6	14.4	12.1	0.1	0.1	0.5
Mayacamas Mountains	16.2	2.5	73.4	0.0	0.0	0.0
Napa–Sonoma–Lake Volcanic Highlands	51.3	1.7	66.4	0.0	0.0	0.0
North Coast Range Eastern Slopes	58.2	0.9	87.0	0.0	0.0	0.0
Sonoma–Mendocino Mixed Forest	22.5	1.2	74.9	0.0	0.0	0.0

[1] Sonoma County et al. (2021)

[2] Ag + Open Space (2021b) and FEMA (2021)

[3] California Department of Conservation and California Geological Survey (2020)

[4] Barnard et al. (2014)

[5] Barnard et al. (2014)

[6] Barnard et al. (2014)

6. PROJECT PLANNING, DESIGN, AND IMPLEMENTATION

To enable County agencies and their partners to plan, design and implement future resilience-related projects, this chapter contains project development guidance. The recommendations outlined throughout this chapter will help ensure that projects consider sustainability, biodiversity, equity, risk reduction, inclusive engagement, alignment with other County efforts, and improved ecological and community health. To support project implementation, this chapter also highlights funding and financing strategies and sources, in addition to matching them with relevant project types. This section is intended as guidance and is not meant to replace or add to any prioritization and decision-making processes already in place at County agencies. The considerations detailed within the chapter, however, could help support or bolster existing prioritization processes—or develop new ones—if desired by the County and its partners.

I. Project Design Guidance

To identify critical issues to consider in project development, the project team worked closely with the TAC and IAG to identify priorities and scenarios and refine a clear set of criteria that could guide project design. The guidance adheres to the following principles:

1. **Transparent and easy to implement, understand, and communicate** based on established goals, principles, and objectives.
2. **Based on assessment findings** regarding risks and consequences.
3. **Incorporates physical climate and social landscape resilience indicators** to assess and inform project decisions.
4. **Supports decisions** in the near, mid, and long term and easy to update.
5. **Drives alternatives** that clearly reduce climate risks to the County and include environmental, social, and economic benefits.
6. **Clearly identifies benefits and trade-offs** regarding potential alternatives and actions.
7. **Aligns and is consistent** with other County or related decision-making processes.
8. **Prioritizes projects with multiple benefits** for strengthened climate resilience of the natural and working lands system.

The main components of the guidance include screening and performance criteria. The screening criteria (Table 10) are intended to be used at the early planning stages of project design to ensure projects include components that consider the key priorities described throughout the Lands Strategy. While not every project can be designed to meet all screening criteria, projects should be planned and designed to meet as many of the screening criteria as possible. The performance criteria (Table 11) are designed for use toward the end of project design to assess how well each project addresses a more limited and measurable set of key criteria. In combination, the screening and performance criteria will support the development of comprehensive, strategic, and aligned projects that advance a resilient, sustainable, and equitable approach, as well as provide the County with a way of measuring progress on the issues covered by the criteria. It is recommended that the County work with public and private partners to apply this guidance in way that results in projects that build climate resilience in the natural and working lands, while providing the desired ecological and community outcomes and consistency across project design and implementation.

Table 10. Screening criteria.

Category	Screening Criteria
Ecology, equity, and environment	• Supports biodiversity • Conserves critical habitat • Provides equitable access to safe and healthy lands and natural resource benefits • Provides equitable access to underserved communities • Provides urban greening/green infrastructure in underserved communities • Identifies disproportionate impacts and addresses them • Manages agricultural lands to support ecosystem function and resilience • Improves local, sustainable food sources and food access • Improves air quality • Improves water quantity and quality • Furthers tribal access and engagement • Prioritizes tribal cultural resources and cultural properties • Conserves and manages assets for carbon and methane reduction • Reduces risk from extreme events and climate impacts
Economy, just transition, and jobs	• Increases adaptive capacity of natural and working lands to support farming, as well as tourism • Increases resilience to mobility corridors, job centers, and critical infrastructure • Protects the physical health and wellbeing of farmworkers, especially during extreme events • Protects job security of farmworkers, including during extreme events • Provides job training, access to ownership, opportunity to participate in climate economy • Creates new well-paid job opportunities
Governance	• Aligns with County of Sonoma (or other organizational) priorities • Includes a wide range of partnerships, including with community members, community-based organizations, and workers • Is consistent with federal and state priorities and funding programs
Innovation	• Builds new capacity or relationships • Implements pilot or small-scale projects to identify new approaches • Includes creative design/implementation
Feasibility/Best practices	• Has broad support • Is technically sound • Meets current policies and regulations

Table 11. Performance criteria.

Category	Performance Criteria
Improves resilience	• Conserves/manages/restores resilient areas • Improves resilience of vulnerable areas • Contributes to biodiversity/ecosystem health • Demonstrates adaptability (redundancy) • Promotes connectivity and corridors • Conserves/manages/restores aquatic and riparian resources • Conserves/manages/restores habitat

Category	Performance Criteria
Reduces GHGs	• Reduces greenhouse gas emissions • Increases carbon sequestration and storage
Reduces risk to adjacent uses	• Reduces climate risk(s) to critical ecological and community assets • Includes climate resilient management practices • Coordinates with adjacent land use/management
Reduces risk to adjacent communities	• Provides resilience of underserved and marginalized communities and community members • Increases resilience of communities, workers, and critical county community assets such as transportation, utilities, hospitals, schools, etc.
Cost	• Justified based on the scope and scale of benefits and funding sources • Has additional associated benefits • Distributes benefits equitably

II. Funding and Financing Strategies

The County's efforts to strengthen the resilience of its natural and working landscape system dovetails well with a similar focus at the state level to build resilience of California's natural and working lands to prepare for the escalation of climate change impacts. For instance, the Draft California 2030 Natural and Working Lands Climate Change Implementation Plan and the Draft Pathways to 30x30 document outline actions for building resilience through state-supported and state-funded efforts. These efforts are and will be implemented through programs at the California Department of Food and Agriculture, California Environmental Protection Agency, California Strategic Growth Council, and the California Natural Resources Agency, and the various departments within it (State of California, 2019). (See the sections below for more details on state funding opportunities.)

This Lands Strategy will allow the County to align its efforts with those at the state level and position itself to receive funding from opportunities that arise through new state programs and funding mechanisms. Finding funding to support the projects that the County and its partners will implement based on this Lands Strategy is critical to ensuring actions that will promote natural and working land resilience and strengthen the ability of these lands to build countywide resilience, buffer the effects of climate change, and support community wellbeing. The sections below outline a range of funding and financing strategies the County can consider using to fund implementation of resilience and adaptation projects within the county. The funding database in Appendix D identifies funding sources and opportunities, such as public and private grant programs and state bond opportunities, which could also support resilience and adaptation projects within the county.

Federal, State, Private, and Local Funding and Financing Strategies

There are a number of funding strategies that align with the County's resilience goals and the projects identified in this strategy. To secure comprehensive funding for identified and future projects, there are a variety of funding strategies that other agencies such as Sonoma Water and the city and county of San Francisco have identified and that the County could consider for implementation. The sections below provide additional details on these strategies, which include fees, debt and credit tools, value capture, and more.

Direct Fees

- **Property taxes.** With voter approval, the County could enact a local property tax increment or a "special tax" that could enable a specific source of funding for specific projects. This would be dependent on voter approval (Seawall Finance Work Group, 2017).
- **Tourism taxes.** Sonoma County is a popular tourism destination and attracted over 10 million visitors in 2019. Developing a Hotel Assessment District or increasing a general transient occupancy tax dedicated to support certain projects or a fund for general resilience projects could help create long-term, sustainable revenue to support conservation, management, and restoration actions within the county (Seawall Finance Work Group, 2017).
- **Community Facilities District.** The County could consider creating a Community Facilities District for financing public improvement or resilience projects that would provide direct benefits to the communities in the district (Seawall Finance Work Group, 2017). Community Facilities Districts are special tax districts that provide a method of financing public improvement projects when no other funding sources are available.
- **Public benefit funds.** These funds could be created through minor surcharges on utility bills to customers. This strategy could be primarily used to fund energy efficiency or renewable energy projects or programs (Center for Climate and Energy Solutions, 2019).
- **Transfer fee funds.** These funds could be included as a percentage of a real estate transaction price if transfer of property ownership occurs. Community preservation funds are an example of this type of fund and are tax programs implemented by states or counties to fund public improvement projects (Sonoma Water, 2021b).
- **User fees.** The County could set user fees enacted through toll roads, toll bridges, or public transit to fund improvements to infrastructure systems (e.g., roads, bridges, public transit) (Sonoma Water, 2021b).

Debt Tools

- **General obligation bonds.** These bonds are municipal bonds provide state or local governments with funding sources for non-revenue-generating projects such as construction of public schools or highways. These bonds can be established through moderate property tax increases, subject to voter approval (Seawall Finance Work Group, 2017).
- **Revenue bonds.** These bonds are often used to finance municipal projects that will generate revenue for the municipality. For example, a water and sewer system bond could be repaid by way of user fees to the system customers (Sonoma Water, 2021b).
- **Green bonds.** Green bonds are primarily used to finance projects that will have a positive impact on the environment, such as ecosystem restoration or carbon sequestration projects (Climate Bonds Initiative, 2014).

Value Capture Mechanisms

- **Improvement districts.** These districts are formed in a specific geographic area where property owners decide to pay an assessment to fund a specific improvement project from which they owners will benefit directly (Sonoma Water, 2021b).

Federal, State, and Private Funding Opportunities

In addition to the funding and financing strategies discussed above, there are many additional funding opportunities available through an array of public and private programs and grant funding. The discussion below provides a brief overview of some key funding opportunities that are highly aligned with the Lands Strategy. A full list of the identified opportunities is available in Appendix D.

Federal Opportunities

Recent federal initiatives, most notably President Biden's $1.2 trillion bipartisan infrastructure law (Infrastructure Investment and Jobs Act), include approximately $550 billion in federal funding for improvements to roads and bridges, water infrastructure, climate resilience, and more. The Infrastructure Act enables close to $50 billion for resilience and western water infrastructure. This section of funding focuses on efforts to improve resilience to droughts, floods, and wildfires while also investing in "weatherization" (The White House, 2021). The federal government has directed federal agencies such as the United States Department of Agriculture (USDA) Forest Service, the USDA Natural Resources Conservation Service, and the Federal Emergency Management Agency (FEMA) to undertake climate resilience projects that would enable funding to flow through these agencies to state and local agencies. The discussion below highlights a few federal agencies with relevant funding opportunities, with a full list identified relevant federal opportunities in Appendix D:

- **FEMA.** The Building Resilience Infrastructure and Communities (BRIC) program supports communities by providing funding for states, local communities, tribes, and territories to undertake hazard mitigation projects to reduce risk from natural disasters (FEMA, 2022). Since its inception in 2020, the BRIC program has expanded to offer increased funding assistance to states and local communities and had $1 billion available for distribution in Fiscal Year 2021. Additional FEMA programs to consider include the Flood Mitigation Assistance program, Hazard Mitigation Grant Program, and the Hazard Mitigation Post-Fire Grant Program.
    - In June 2021, FEMA awarded a $37 million grant to the County to mitigate wildfire risk to life, property, and the environment. Activities funded by this grant will include vegetation management and fuels reduction projects in Sonoma County. Some funding will also support private property owners to undertake fuels reduction and land management projects to reduce wildfire risk while enhancing environmental function (Sonoma County, 2021b).
- **U.S. Department of the Interior Bureau of Land Management.** There are $25 million available through the Bureau of Land Management's California Fuels Management and Community Fire Assistance program. Grants through this program fund activities such as community wildfire education, planning and implementing fuels treatment and strategies to reduce wildfire impact, and strategies to protect communities and infrastructure or restore or enhance forests and rangelands to reduce wildfire risk.
- **USDA Natural Resource Conservation Service.** There are $618 million in grants available over five years, including $500M for Watershed and Flood Prevention operations and $118 for Watershed Rehabilitation programs.

State Opportunities

In response to recent devastating wildfires, ongoing extreme drought conditions, and other events related to climate change, the state of California has recently developed multiple important climate resilience and climate change adaptation strategies. With the development of these strategies and with recent budget surpluses, many important funding opportunities have emerged, and additional funding to support these strategies is expected to be available in the coming years. Some of these state-level funding opportunities include:

- **California Department of Food and Agriculture.** The Healthy Soils Incentives program encourages California farmers and ranchers to "implement conservation management practices that sequester carbon, reduce atmospheric greenhouse gases, and improve soil health" (California Department of Food and Agriculture, 2022).
- **California Climate Investments:** The State uses proceeds from cap-and-trade auctions to invest in greenhouse gas emissions reductions, improve public health and the environment, and provide meaningful benefits to the most disadvantaged communities, under-resourced communities, and low-income households. There are over 70 programs under the California Climate Investment program that are administered by over 20 state agencies. Example programs include a sustainable transportation and equity project, coastal resilience planning, climate smart agriculture technical assistance, and a fire prevention grants program.
- **2021 State Climate Package:** In September 2021, Governor Gavin Newsom signed 24 bills totaling over $15 billion to support efforts focused on building climate resilience, preparing for drought and wildfires, promoting sustainable agriculture, and other sustainability and resilience investments (State of California, 2021b). $15 billion from the 2021 State Climate Package is broken down into specific categories of funding packages, including:
    - *Wildfire and Forest Resilience*. This $1.5 billion package to support comprehensive forest and wildfire resilience strategies across the state builds on an April 2021 funding package.
    - *Climate-Smart Agriculture*. Provides $1.1 billion over two years to promote healthy soil management, livestock methane reduction efforts, and funding for replacing outdated agricultural equipment to reduce emissions. The package also includes investments in technical assistance and incentives for developing farm conservation management plans, as well as supporting expanded access to healthy food in public institutions and nonprofits.
    - *Water and Drought Resilience*. Provides $5.2 billion over three years to support drought response and long-term water resilience, including emergency drought relief and drinking water and wastewater infrastructure with a focus on small and disadvantaged communities. This package also includes support for implementing the Sustainable Groundwater Management Act to improve the security and quality of water supplies.

2021 State Budget included initial funding to support the State's work towards implementing the Pathways to 30x30 Strategy, highlighted in the box below.

Released in April 2022, the Pathways to 30x30 Strategy lays out priority actions to advance biodiversity conservation and elevate "the role of nature in the fight against climate change." While specific funding sources have not yet been identified, the strategy outlines actions for securing funding such as:

- Aligning state funding with conservation activities identified in the strategy.
- Establishing a working group of philanthropic and industry organizations to coordinate funding.
- Establishing processes for leveraging conservation investments.
- Exploring innovative financing mechanisms for multi-benefit conservation and restoration projects, including program-related investments, the New Market Tax Credits program, revenue-raising techniques, and other impact-investing mechanisms.

California's 2021 state budget included significant funding to jumpstart progress on 30x30 activities. For example, the 2021–2022 budget included $786 million for nature-based solutions, $600 million for coastal resilience projects, $645 million for habitat restoration projects, and $105 million for wildlife corridors and fish passage projects. The 2021 budget package builds on the 2021 early action package, which allocated funding to the Climate Package discussed above. These allocations have great potential to advance the 30x30 Strategy. Additionally, the strategy highlights the importance of conserving natural and working lands to promote carbon sequestration and implementing nature-based solutions that promote multiple conservation and resilience benefits, which align with the goals of the County's Lands Strategy.

Philanthropic Opportunities

A review of other regional and state climate adaptation and conservation plans, as well as funding strategies for other county-level entities, identified many private funding opportunities, primarily for foundations with environmental missions. These funding opportunities will likely be most suited for supporting smaller scale projects that require one-time funding support. These opportunities are detailed in Appendix D, and a brief overview of the most promising opportunities is below:

- **National Fish and Wildlife Foundation**. The National Coastal Resilience Fund provides grants for restoring, building, and strengthening natural infrastructure to protect coastal communities and enhance habitat for fish and wildlife. Grants are available for conservation and restoration projects that restore or enhance natural features such as coastal marshes and wetlands to minimize the impacts of storms and other coastal hazards. The National Fish and Wildlife Foundation will award approximately $140 million in grants in 2022. See the 2022 Request for Proposals for more information.
- **Gordon and Betty Moore Foundation.** The Gordon and Betty Moore Foundation's Bay Area Conservation Program provides grant funding to conserve Bay Area resources through property acquisition, natural resource use, and conservation financing. Specific strategies include:
    - Prioritizing land acquisition and conservation easements grounded in science-based regional conservation planning.
    - Supporting initial stewardship to deliver real, durable conservation outcomes.
    - Coordinating with partners across the region to foster effective collaboration among stakeholders.
    - Developing the most effective conservation finance structures to maximize the impact of funding and ensure financial sustainability.

Priority Funding Sources for Identified Project Types

Appendix A of this Lands Strategy describes various project types ranging from acquisition of lands for conservation to on-the-ground restoration work. Table 12 matches project types identified in the strategy to specific funding sources or opportunities. Appendix D also outlines the topical priorities for each

identified funding source to provide further detail on applicability of each funding source to projects or project types.

Table 12. Project types and potential funding sources to support them.

	Conservation Projects	Land Management Strategies	Restoration	Program Development	Planning and Policy Development	Technical Assistance, Training, Education and Outreach
CAL FIRE	X	X				X
California Climate Investments	X	X	X			X
California Department of Conservation	X	X	X		X	X
California State Coastal Conservancy		X	X	X		X
California Strategic Growth Council and the California Department of Conservation	X	X				X
California Wildlife Conservation Board	X		X			
Gordon and Betty Moore Foundation	X					
National Fish and Wildlife Foundation			X		X	
Resources Legacy Fund	X		X		X	X
USDA Natural Resources Conservation Service, Regional Conservation Partnership Program	X	X				

III. Framework for Ongoing Decision-Making, Engagement, and Implementation

A critical component of the success of the Lands Strategy will be the ongoing engagement and participation of County agencies, public and private partners, local Native American tribes, community members and organizations, and regional, state, and federal partners. Given the necessary scale and the timeframe of actions recommended in the Lands Strategy, it is important that the County develop an approach for broad engagement and encourage participation in each step of project design process. The following are engagement and participation principles that the County and its partners could consider when developing projects:

- **Co-creation:** Engagement has a clear purpose, defined opportunities, shared decision-making and outcomes. Early opportunities are provided to co-create and shape goals, objectives, and desired outcomes.
- **Inclusivity:** Barriers to participation are eliminated by engaging with stakeholders and communities in their spaces, at their invitation. Any engagement hosted by the County or its partners is welcoming, includes childcare, offers different ways and times to participate, and provides clear objectives for the engagement.
- **Knowledge sharing:** Opportunities for trust and capacity building are incorporated in all meetings and engagements. All types of expertise are recognized, and identified goals, objectives, and priorities include a range of perspectives and expertise.
- **Empowerment:** Engagement includes multiple sectors and scales and is designed to be collaborative and strategic. Community and local organizations are provided resources and are empowered to lead engagement in their communities and with their constituents and stakeholders.
- **Partnership:** New partnerships are built and sustained through ongoing engagement and participation at each stage in the project planning, design, and implementation process. Public, private, and non-profit partnerships are built to advance projects focused on specific geographic or issue areas, such as the design of a trail segment or resilient community corridor in a neighborhood.
- **Accountability:** Engagement includes the development of goals and criteria to allow for progress to be measured both quantitatively (e.g., acres of riparian corridor restored) and qualitatively (e.g., increased access to green spaces).
- **Multi-scale collaboration:** Partnerships with other scales of government, such as local Native American tribes, the region, the State of California, and the federal agencies are necessary to advance the actions of the Lands Strategy and the priorities identified by the engagement with Sonoma County stakeholders and communities.

Broad and sustained engagement, outreach, education, and new and stronger partnerships are necessary given the scale of change required to improve natural and working land resilience in a way that protects ecological and community health and safety in the near, mid, and long term. Siloed, single issue or single agency approaches will not be able to achieve the objectives of the Lands Strategy. The County of Sonoma has an opportunity to not only transform its landscape, but to educate, engage, and empower partners in the private, public, and non-profit sectors, and the community to join in the effort.

IV. Lands Strategy Implementation

For the Lands Strategy to result in actions that will increase the climate resilience of the natural and working lands, the agencies and organizations responsible for climate, open spaces, parks, agricultural lands, and ecology must work together during all phases of implementation. The following County departments, agencies, and organizations will need to lead and partner on most projects detailed in the Lands Strategy, and it is recommended that each should begin to strengthen their partnerships and act across jurisdictional boundaries.

County Departments

CLIMATE ACTION AND RESILIENCY DIVISION (CARD)

CARD was created by the County of Sonoma in 2021 to coordinate the County's approach to climate action and resilience, ensure that the County meets the climate goals of its Strategic Plan, and assist the Board of Supervisors with distributing County resources towards climate mitigation and adaptation actions. The County is working to meet targets established by Climate Change Action Resolution No. 18-0166 which was adopted by the Board of Supervisors in 2018. This resolution states that the County will work toward the RCPA target to reduce greenhouse gas emissions by 40% below 1990 levels by 2030 and 80% below 1990 levels by 2050. The resolution also commits the County to continued work to increase the health and resilience of social, natural, and built resources to withstand the impacts of climate change.

CARD partnered with Ag + Open Space to oversee the development of the Lands Strategy and could continue to play a coordinating roll in planning and program efforts. CARD is also well-positioned to identify and pursue potential funding and financing strategies and design and advance community engagement. Finally, CARD could play a leading role in developing partnerships at the county, regional, state, and federal scale, including with local Native America tribes, on climate resilient practices, conservation of tribal ecological resources, and advancing tribal ecological knowledge.

REGIONAL PARKS

Sonoma County Regional Parks manages and maintains more than 50 parks and beaches, from the mountains in the eastern portion of the county to the shorelines to the south and the west. Included in this portfolio are wildlands and an environmental education center, as well as sports fields, miles of trails, campgrounds, and a marina. Regional Parks has made a commitment to social equity to ensure that all residents have equitable access to the benefits parks provide, access to involvement in developing park services, and they are also investing in projects that address identified disparities. Given Regional Parks' responsibly in the development, management, and maintenance of parks and trails across the county, it will play a critical role on many of the recommended projects in the Lands Strategy. Many of these recommendations can occur on existing parklands with additional resources, partners, and support. Potential projects and actions that could occur on parklands include the restoration and management of natural lands to improvement climate resilience, as well as actions that can increase the resilience of developed lands—such as resilient community corridors, green infrastructure, urban stream restoration, and resilient buffers. In many cases, these projects can be paired with the completion of the County's trails system and the objective of equitable access to parks and their benefits. Additionally, Regional Parks could partner with Ag + Open Space and Sonoma Water to coordinate conservation strategies and management practices across

jurisdictional boundaries and continue to implement land management strategies to support carbon sequestration and storage, water, and soil health.

PERMIT SONOMA

Permit Sonoma is the land use planning and permitting department for the County of Sonoma and covers areas such as code enforcement, engineering and construction, fire prevention and hazardous materials, natural resources, and planning. Permit Sonoma develops, administers, and maintains many of the long-range plans for land use, neighborhood planning, hazard mitigation, and bicycle and pedestrian trails. Implementation of actions recommended by the Lands Strategy will be necessary for the County to achieve the goals in the resolution and fulfill Permit Sonoma's role in developing area plans, long-range planning documents, regulations, zoning, and overseeing the Hazard Mitigation Plan. Permit Sonoma will play a key role in the design and implementation of the policy and land use approaches necessary to reduce development in the wildland urban interface, conservation of natural and working lands projects for carbon sequestration and climate resilience, in addition to guiding residential development densities to support affordable housing goals near transit services within the developed lands of the county.

Other Agencies and Organizations

SONOMA WATER

Given the importance of water to Sonoma County's ecological, agricultural, and community health—as well as their mitigation and sequestration potential—Sonoma Water will play a critical role in climate resilience actions throughout the county. For instance, Sonoma Water could assist with actions related to conserving and restoring headwaters and advancing a watershed approach to climate resilience, in addition to partnering projects to conserve and restore riparian corridors. Sonoma Water adopted its Sonoma Water Climate Adaptation Plan, which includes actions that could advance the climate resilience of the natural and working lands. Partnering with other County agencies and organizations, such as Ag + Open Space, will increase opportunities to design multi-benefit projects that conserve and restore water resources, implement management practices to increase water storage and soil health, and undertake strategic landscape scale improvements that reduce risks and improve resilience for water supply and quality in the natural and working lands.

AG + OPEN SPACE

Ag + Open Space describes its mission as permanently protecting the diverse agricultural, natural resource, and scenic open space lands of Sonoma County for future generations. Ag + Open Space recently adopted the Vital Lands Initiative which identifies a range of conservation priorities throughout the county that if pursued, would also have significant benefits for climate resilience, adaptation, and mitigation. Ag + Open Space partnered with CARD to oversee the development of the Lands Strategy and has a significant role to play in strengthened partnerships throughout the county to pursue the actions identified in the strategy. Given Ag + Open Space's mission and role within the county, it is most suited to lead on conservation and management strategies for both agricultural and natural lands, to partner on program support for regenerative agricultural practices, and work with the local Native American tribes to pursue shared land stewardship strategies that promote climate resilience.

REGIONAL CLIMATE PROTECTION AUTHORITY (RCPA)

The RCPA coordinates climate efforts among Sonoma County's cities and multiple agencies. This coordination includes supporting collaboration, goal setting, combining resources, formalizing partnerships, and helping integrate Sonoma County's climate work across sectors, scales, and issue areas. The initial primary focus of the RCPA was to lower emissions, but it also has supported climate adaptation activities through the development of efforts such as Climate Ready Sonoma County: Climate Hazards and Vulnerabilities. The RCPA's greenhouse gas goals include reducing greenhouse gas emissions by 40% below 1990 levels by 2030 and 80% below 1990 levels by 2050. The implementation of actions recommended by the Lands Strategy to increase the carbon sequestration and storage of the natural and working lands will be a necessary component to meet these greenhouse gas emission reduction goals. The RCPA's role as a coordinator on climate work within and outside of the county make them a natural partner in the implementation of the Lands Strategy. The Lands Strategy can only be successful if there is robust coordination, collaboration, and formalized partnerships among County agencies and organizations and a clear alignment with regional, state, and federal climate funding and policy initiatives. Based on its role, experience, and climate objectives, the participation of the RCPA would contribute significantly to the successful coordination and implementation of the Lands Strategy.

NATIVE AMERICAN TRIBES

Sonoma County has several active local Native American tribes, including the Cloverdale Rancheria of Pomo Indians, the Kashia Band of Pomo Indians, the Dry Creek Rancheria of Pomo Indians, the Lytton Band of Pomo Indians, and the Federated Indians of Graton Rancheria. Each of these tribes has traditional ecological knowledge (TEK, sometimes also referred to as tribal cultural knowledge) and practices that can benefit land conservation, restoration, and management decisions. Many of the local Native American tribes have been engaged in projects and initiatives for Sonoma County's natural and working lands. The local Native American tribes also have tribal cultural resources, tribal cultural properties, and manage their own lands. These assets and functions are important to consider when planning, designing, and implementing the Lands Strategy. Early and ongoing engagement (as described earlier in Chapter 2) on all aspects of Lands Strategy implementation (including projects implemented, open space designations, and more) will ensure that the local Native American tribes benefit from the projects and programs, in addition to helping leverage the vast knowledge the tribes have of their lands and resources to benefit the projects.

The County prioritizes involving local Native American tribes as key partners in County natural and working lands efforts, and identifying tribes as leads and partners on conservation, management, restoration, and education projects where appropriate. The County will work closely with the tribes to determine feasible, clear, long-term, and mutually agreed upon co-management governance structures and arrangements that will strive for consensus-based decision-making on the managed resources that recognize adaptive management, TEK, and sustainable practices. During collaboration and co-management, the County should maintain the confidentiality of sensitive cultural information and shared traditional ecological knowledge to ensure protection of valuable cultural resources. Finally, the County should work to ensure adequate funding is available to support both tribal co-management partners and their local counterparts.

RESOURCE CONSERVATION DISTRICTS (RCDS)

RCDs are established by California law as special districts for the purposes of soil and water conservation, the control of runoff, the prevention and control of soil erosion, watershed management, the protection of water quality and water reclamation, the development of storage and distribution of water, and the treatment of each acre of land according to its needs. RCDs develop voluntary programs to advance conservation and land management in partnership with the communities they serve. Within Sonoma County there are two RCDs: the Sonoma Resource Conservation District and the Gold Ridge Resource Conservation District. Both RCDs respond to pressing natural resource issues by assisting landowners in being part of the solution. As non-regulatory special districts, they help individuals protect the public trust on private land. Sonoma County's RCDs frequently work together to support Sonoma County communities, farmers, ranchers, and others to improve resource conservation and management through technical assistance, financial assistance, education, and other tools. With the experience that RCDs have in working across public and private landowners and managers, developing voluntary programs, and building and maintaining relationships with the community, the RCDs are an important resource and potential lead on some of the recommendations included in the Lands Strategy. Many of the RCD's current projects and programs include actions that will increase climate resilience, including carbon sequestration and storage, soil and water health, assistance to private landowners to improve land conservation and management practices, and the formation and strengthening of cross-jurisdictional partnerships.

Summary

No single agency or organization can advance the Lands Strategy on its own; partnerships—including among County agencies, as well as public-private partnerships that help leverage the vast knowledge of landowners, nonprofits, and others working throughout the county—are necessary to design and implement the recommended landscape and watershed scale actions that must occur across jurisdictional and ownership boundaries. Fortunately, Sonoma benefits from the knowledge, expertise, and capacity of many agencies that have been working on issues related to the natural and working lands, including climate resilience. Through partnership and coordination, needed agency- and organization-specific climate resilience actions could be planned, designed, and implemented across jurisdictional and ownership boundaries, thus enabling them to address multiple issues and objectives. For more detail on the recommendations on leads and partners, as well as specific phases and actions for each project concept, please see Appendix A.

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8. APPENDICES

Appendix A: Project Concepts

Note that the sections below of Lands Strategy detail and recommend potential project concepts for the County to consider. Please note, however, that some of the project components, such as potential leads, potential partners, and funding sources may not be exhaustive and should be refined as part of implementation.

Project Concept A: Advance Climate Resilient Agricultural Practices

ECOREGIONS

Bodega Coastal Hills

Coastal Franciscan Redwood Forest

Fort Bragg/Fort Ross Terraces

Sonoma-Mendocino Mixed Forest

Mayacamas Mountains

Napa-Sonoma-Lake Volcanic Highlands

North Coast Eastern Slopes

Bay Flats

Napa-Sonoma-Russian River Valleys

PROJECT TYPES

Management

Conservation

Carbon Sequestration

Policy and Program Development

TARGET RESOURCES

Agricultural lands– Croplands, Vineyards, Grazing

PROJECT TIMELINE

Near- to mid-term

POTENTIAL LEADS

Ag + Open Space (conservation)

RCDs (regenerative agriculture)

POTENTIAL PARTNERS

Sonoma County Farm Bureau

FUNDING STRATEGIES

Conservation Easements

Conservation Banks

Carbon Banking

FUNDING SOURCES

USDA-NRCS RCCP, USDA Conservation Innovation Grants, Restore California Zero Footprint, CDFA Healthy Soils Program

PROJECT OBJECTIVES (WHY)

Agricultural lands—which include croplands, vineyards, and grazing lands—make up a large percentage of the Sonoma's land area. Climate resilient agricultural practices, often known as regenerative agricultural, have the potential to reduce greenhouse gas emissions, increase carbon sequestration and storage, increase biodiversity and biological productivity of the land, and provide risk reduction for the entire county from wildfire, flood, heat, erosion, and drought. While the amount of carbon sequestration and storage varies by local conditions, the regenerative practices applied to the land, and the crops grown, it has been well-established that using regenerative practices provides significant climate benefits. For lands using regenerative practices, estimates of potential carbon sequestration and storage range from 25 to 60 tons of carbon per acre. Overall, regenerative agricultural practices have been identified as having the potential to contribute from five to 10% of the carbon removal needed to meet the current greenhouse gas objectives worldwide (Paustian et al., 2020). Additionally, regenerative practices improve soil health, reduce water usage, reduce air and water pollution, and provide agricultural land the ability to adapt and respond to changing conditions over time (Rodale Institute, n.d.). Other benefits include reducing the greenhouse gas emissions from agricultural uses, increasing the benefits of agricultural lands (which in turn can reduce the risk of land conversion), and providing farmers with access to new resources and sources of funding and financing.

IDENTIFYING SUITABLE LOCATIONS (WHERE)

All of Sonoma County's croplands, vineyards, and grazing lands are suitable locations for the application of regenerative agricultural practices. Within Sonoma County's ecoregions, those that have the largest percentage of agricultural lands are in the River Valleys, Bodega Coastal Hills, Bay Flats, and the Volcanic Highlands.

DESCRIPTION (HOW)

The objective of this project is to shift Sonoma County's agricultural lands to regenerative practices. To do this, the County could scale up the current support for these practices, promote conservation of

agricultural lands, and design a program that provides a range of technical assistance, financial support, peer-to-peer learning, grant assistance, and a single location for these services to be found.

Design Sonoma County Regenerative Agricultural Program – As part of the proposed Climate Resilient Lands Working Group led by the County, design a program that could be supported or co-led by partners such as Ag + Open Space (who could lead the conservation efforts), RCDs, UC Cooperative Extension, Community Alliance with Family Farmers (CAFF) land trusts, and others that support farmers shifting from traditional to regenerative practices. This may include support from the County to coordinate among partners, assure synergy between County climate goals and partner activities, and build capacity within existing programs. A subcommittee of farmers and grazers could be formed to advise on the needs of the end users.

Identify funding and financing for program and actions – There are several funding and financing strategies that have been identified to support regenerative agriculture. The challenge is that many are small grants that farmers cannot rely on in the long-term and do not compensate them for the value of their contribution over time. Another significant challenge is that many funding programs do not adequately support the costs of technical assistance, outreach, and education that are essential to implementing regenerative agriculture practices. The Working Group could focus on strategies that provide long-term support and provide a way for farmers to receive compensation for the climate and land benefits that are being provided on their lands. Current tools that could be adapted for this purpose include conservation easements, conservation banks, carbon banks, and tax incentives.

Program principles –

- Reduce soil disturbance.
- Promote continuous vegetative cover.
- Restore health and biodiversity to soils.
- As feasible, reduce irrigation by increasing the water storage potential of the soils.
- Reduce or minimize reliance on pesticides.
- Bring back natural processes to agricultural lands and increase adaptability (Teal & Burkart, 2022).

Program components – The program could include support for the following strategies:

- No till, cover crops, perennials, diversity.
- Hedgerows, windbreaks, trees.
- Crop and grazing rotations.
- Grass cover for waterways to filter and slow water.
- Integration of animals to support natural processes such as pest control, invasives removal, and fertilizer.
- Compost and organic waste for soil health (Rodale Institute, n.d.).

IMPLEMENTATION (WHO)

The County and partners could be the initial implementers of the program, with strong leadership by the RCDs, who are already involved in many similar efforts, and Ag + Open Space, who could help lead the conservation efforts. Participation from farmers and ranchers is essential to get practices implemented on the ground and ensure that the program is user-friendly and supports the needs of the end users. If successful, the implementation of the program and the implementation of the actions will be a partnership between the County and other organizations already implementing this work (e.g., the RCDs),

the farmers and grazers, and others who support the program through funding, technical assistance, or other contributions.

BENEFITS

Reduces risks from: Climate hazards, land conversion, traditional farming practices, climate risks to agricultural lands such as drought and wildfire.

Provides benefits: Carbon sequestration and storage, water quality, soil health, water supply, biodiversity, air quality, farmworker health, food security, small farm support, capacity building, habitat.

INDICATORS

This project concept will increase key aspects of resilience as specified by the following indicators:

Landscape: Controllable levels of nuisance species, pests, and disease. Maintenance of current patterns of biodiversity. Presence and condition of annual and perennial crops. Grazing practices that provide buffers against climate hazards. Acreage and diversity of working lands using climate resilient practices. Acreage of land devoted to food production using regenerative practices. Enhanced ecological and hydrologic conditions and processes across landscapes, watersheds, and groundwater basins. Carbon sequestration potential. Acres of risk reduction. Number of landowners using climate resilient management practices (including grazing, croplands and vineyards practices, and timber practices).

Social: Condition and management of resources, including presence of adaptive management strategies for working lands and communities (dairy, vineyard, crop, and grazing lands). Inclusion of small farmers in program development and design to ensure compatibility with needs. Strengthened partnership with RCDs to identify needs and opportunities of agricultural producers. Support for diverse organizations and individuals to own, manage, and steward land. Support for small farmers to implement climate resilient agricultural practices and shift to regenerative and ecological practices (e.g., through technical assistance, grant writing support, peer-to-peer learning, financial resources). Health, safety, and capacity of workers.

Project Concept B: Advancing Resilient Rangeland Management

ECOREGIONS

Bodega Coastal Hills

Coastal Franciscan Redwood Forest

Fort Bragg/Fort Ross Terraces

Sonoma-Mendocino Mixed Forest

Mayacamas Mountains

Napa-Sonoma Lake Volcanic Highlands

North Coast Eastern Slopes

Bay Flats

Napa-Sonoma-Russian River Valleys

PROJECT TYPES

Management

Conservation

Monitoring

TARGET RESOURCES

Rangelands

PROJECT TIMELINE

Program Development

Identify Lands and Partners

Implement Actions

POTENTIAL LEADS

Land Trusts, RCDs, County, private landowners, UCCE, Ag + Open Space

POTENTIAL PARTNERS

RCDs (in leads as well), Sonoma Ecology Center

FUNDING SOURCES

Gordon and Betty Moore Foundation, USDA-NRCS, CDFA-Healthy Soils Program

PROJECT OBJECTIVES (WHY)

Rangelands offer both socio-economic and ecological benefits and therefore, require an integrated management approach to enhance resilience for the entire system—much like the agricultural lands system they are part of and as detailed in Project Concept A. Rangeland management for climate resilience is designed to identify stressors to the system, integrate measures to reduce greenhouse gas emissions and increase carbon storage, and implement actions that improve the sustainability of resources (water, plants, soils, livestock, wildlife) in response to current and future climate risks. The goal is to build resilience into rangelands through land stewardship to ensure long-term sustainability of land uses and resources.

IDENTIFYING SUITABLE LOCATIONS (WHERE)

Appropriate management actions and decisions should be guided by evaluating current conditions and understanding ongoing and future risks. This can be directed by monitoring data (in situ, surveys, or remote), productivity reports, and land manager input. Two core metrics can be used to evaluate lands: 1) rangelands that currently exhibit signs of degradation, including low plant biomass during peak growing season, water quality issues, poor soil health, and poor or declining agricultural productivity, and 2) rangelands that fall within critical wildlife corridors, support headwater streams/first order tributaries, and/or are prime farmlands or contribute significantly to the local heritage/economy.

DESCRIPTION (HOW)

Project implementation should focus on addressing landscape stressors (causes of degradation) and improving system-wide resilience. Successful implementation will require that the County support capacity building of existing organizations and efforts on this front and in doing so, help connect landowners and managers with the tools and resources needed to effectively carry out actions.

Phase 1 – Program Development (1-2 years)

Private landowners and land managers may be interested in adopting climate resilience land management practices but need a straightforward pathway that provides technical assistance, financial resources, and training to support them. The County should work with existing partners engaged in similar efforts and identify opportunities to strengthen and support program implementation through partnership and development of a user-friendly information portal, outreach and engagement workshops, and County sponsored pilot projects.

Phase 2 – Identify Priority Lands and Engage with Willing Landowners (2-5 years)

Through the Vital Lands Initiative, the County is identifying priority lands – including rangelands – for land conservation. Rangelands currently owned by the County, in addition to future acquisitions should be managed to improve upon climate resilience benefits. Additional incentives can be offered by the County and/or other conservation easement holders for integration and implementation of climate resilient management practices into long-term management plans. Additionally, other willing landowners interesting in improving climate resilience of their lands can be reached through public workshops and outreach efforts led by partner organizations or the County.

Phase 3 – Implement Actions (4-20 years)

The approach for developing and implementing management practices to increase climate resilience of rangelands should be flexible and adaptive to prepare for and adjust to changing factors and conditions. Further, given the potential diversity of needs and resources on rangelands, actions should be selected that consider the variability of the system. USDA Northwest Climate Hub offer a range of climate driven management actions (Peterson et al., 2019; USDA, 2022a). Example actions include the following:

- *Grazing Exclosures/Nutrient Buffers* – limiting livestock access to streams/riparian areas to reduce streambank erosion and encourage re-establishment or actively implement enhancement and/or restoration of riparian areas. Riparian buffers work to mitigate overland nutrient inputs to improve water quality and stabilize streambanks. Improved riparian health can lead to increased carbon sequestration potential in soils and in vegetation biomass.
- *Regenerative Grazing* – close management of livestock density and duration of grazing; develop a regenerative grazing roadmap that incorporates redundancy and flexibility based on seasonal and annual conditions, which may include prescribed stocking rates and adjusted rates in response to drought conditions and low vegetation biomass, species rotation grazing, planting cover crops, and infrastructure upgrades. Such practices can be effective in reducing invasive species encroachment, encouraging recruitment by native perennial grasses adapted to grazing regimes, and increasing carbon sequestration potential. Improved soil health can lead to higher land productivity.
- *Routine Monitoring and Adaptive Management* – monitoring the efficacy of early management strategies on improving or maintaining water, vegetation, and soil health; may include collection of soils for analysis, vegetation health assessments, water quality sampling, and habitat use surveys. Management actions (ongoing and new) are adjusted in response to monitoring results.

IMPLEMENTATION (WHO)

Rangelands in the County are overwhelming owned by private landowners; however, Ag + Open Space through its conservation easement program and through development of a rangeland management program can work with willing landowners to explore opportunities and secure funds and grants to develop and implement property specific regenerative agricultural practices. New conservation easement

management plans should incorporate specific actions that prescribe climate-smart regenerative practices. Additionally, landowners that are not part of the conservation easement program can work with the existing network of partners in the county to plan and implement regenerative practices.

BENEFITS

Reduces risks from: drought, invasive plants/pests, water quality issues.

Provides benefits to: water quality, habitat quality and condition, agricultural land production, natural resources, food security, agricultural resources, water.

INDICATORS

This project concept will increase key aspects of resiliency as specified by the following indicators:

Landscape: Presence and condition of annual and perennial crops/climate resilient grazing practices, soil water holding capacity, Acreage and diversity of working lands using climate resilient practices, Acreage of land devoted to food production using regenerative practices.

Social: Capacity for ongoing monitoring, maintenance, and adaptive management; condition and management of resources, including presence of adaptive management strategies for working lands and communities (dairy, vineyard, crop, and grazing lands).

CASE STUDY

Stemple Creek Ranch

The 1,000-acre family-owned cattle ranch in Marin County worked with the Marin Carbon Project to develop regenerative agriculture techniques, including application of compost and compost tea on grazing lands, reseeding with perennial grasses, rotational grazing, fencing off stream corridors, and planting trees and grasses. These investments have resulted in improved soil organic matter retention, which contributes to higher rates of carbon sequestration, improved water absorption and retention, and protection of stream health (Marin Carbon Project, n.d.). The Marin Carbon Project received funding from the California Coastal Commission, California State Parks Bond, Marin Agricultural Land Trust, USDA Natural Resources Conservation Service, Rahr Foundation, and Hog Island Oyster Company (Marin Carbon Project, 2022).

As Part of The Marin Carbon Project, Land Managers Apply Compost to Grazing Lands to Increase Soil Organic Content (Marin Carbon Project).

Project Concept C: Climate Resilient Forest Conservation & Management

ECOREGIONS

Bodega Coastal Hills

Coastal Franciscan Redwood Forest

Fort Bragg/Fort Ross Terraces

Sonoma-Mendocino Mixed Forest

Mayacamas Mountains

Napa-Sonoma-Lake Volcanic Highlands

North Coast Eastern Slopes

Bay Flats

Napa-Sonoma-Russian River Valleys

PROJECT OBJECTIVES (WHY)

Forests cover about half of the county's land area. Climate resilient forest management represent of the county's greatest opportunities to boost carbon sequestration, biodiversity, watershed and stream health, and risk of catastrophic fires. In addition, improved forest health can reduce impacts of floods, extreme precipitation, and extreme heat. In Sonoma County, large areas of forest in the county are privately held (most oak woodlands and 68% of coniferous forest are on private parcels. Many of those parcels are less than 50 acres (Fire Safe Sonoma, 2019). As such, a key objective is widespread participation of forest landowners in resilient forest management practices.

IDENTIFYING SUITABLE LOCATIONS (WHERE)

Locations in need of improved forest management can also be identified based on fuels build-up, vegetation density, presence of pests, and risks facing native species (E. Griffith & Jasperse, 2021). Sites for resilient forest conservation and management can be further prioritized based on the overlap of opportunities for wildlife movement, biodiversity conservation, and habitat migration (vertical and lateral), as well as adjacency to protected areas. This issue of adjacency is key as resilient forest management should be approached a regional scale to realize maximum benefits. Finally, when it comes to protecting cities and communities from fire and heat, it is important to focus attention within the wildland urban interface (Fire Safe Sonoma, 2019).

DESCRIPTION (HOW)

Strategies to conserve forest include conservation easements, purchase of forest lands, and expansion of forest-based carbon offsets (Kovner, 2016). Conservation alone is unlikely to realize all benefits. In addition, active and adaptive management of forests is required, through activities such as:

- Ecologically appropriate thinning (described further in the "Fuels Treatment and Post-Fire Lands & Waters Restoration" Project Concept)

PROJECT TYPES

Management

Conservation

Carbon Sequestration

Monitoring

TARGET RESOURCES

Forests

PROJECT TIMELINE

Program Development

Initiation

Implementation

POTENTIAL LEADS

Ag + Open Space

POTENTIAL PARTNERS

Firesafe Sonoma, Forest Conservation Working Group, Private landowners, RCDs, tribes, Save the Redwoods League, The Conservation Fund, CalFire

FUNDING STRATEGIES

Conservation Easements

Carbon Banking

Grants – Community Facilities Districts

FUNDING SOURCES

California Forest Improvement Program, Bureau of Land Management

- Control of insect and disease outbreaks by pruning, otherwise removing infested material, and/or herbicide treatment (Jones, 2021)
- Prescribed burns
- Restoration of burned areas
- Reduction in density and diversification of species (United States Department of Agriculture, 2018)
- Forest health monitoring (State of California, 2021a), particularly following treatments and including post-vegetation management analyses to determine the effectiveness of treatment in meeting wildfire risk reduction and carbon sequestration objectives
- Understory or overstory planting

These management activities support increased resilience to drought, pest invasion, and fire, among other climate impacts.

There are a wide range of county, state, and federal agencies, non-profits, and community groups working to increase adoption of resilient forest management practices on public and private lands. Ag + Open Space works to limits forest harvest and encourages enhanced forest management. Another example, the Sonoma County Forest Conservation Working Group educates landowners about active forest management, linking landowners with funding, resources, and landowner associations (Sonoma County Forest Conservation Working Group, n.d.). These kinds of resources are essential. In addition, County leadership is needed to ensure that forest management work in individual parcels is integrated into an ecosystem-wide approach to land management that considers broader issues of sensitive, wildlife migration corridors, and insect management across public and private lands.

IMPLEMENTATION (WHO)

Once priority forest lands for conservation are identified by the County or other program leads, steps can be taken to safeguard permanent protection via easements or outright purchase. For instance, Ag + Open Space could serve as the lead for conservation efforts that limit forest harvest and encourage enhanced forest management. Ag + Open Space could work with the County and other partners to ensure active and resilient management of all forestlands (protected and private) by developing a forest management program and strategy that follows an ecosystem-wide approach (Sonoma County et al., 2012). Such a program will ensure that County-owned lands and adjacent private lands are aligned in supporting broader forest health goals. Naturally, such a program will work with Sonoma County Forest Conservation Working Group, Fire Safe Sonoma, and others to ensure that private landowners are actively engaged, resourced, and funded to carry out the appropriate forest management activities. All partners should work together during both program implementation, as well as subsequent monitoring and assessment to determine the efficacy of new forest conservation and management practices and policies.

BENEFITS

Reduces risks from: wildfires, extreme precipitation, extreme heat, drought, and habitat loss.

Provides benefits: carbon sequestration, watershed and stream health, habitat quality and quantity, species movement and habitat shifts, biodiversity, conservation of endemic species, sensitive resources and culturally significant resources.

INDICATORS

This project concept will increase key aspects of resiliency as specified by the following indicators:

Landscape: Habitat continuity and connectivity; climate resilient management practices; carbon sequestration potential; diversity of endemic and native species; topographic diversity.

Social: Job creation as forest management requires a variety of jobs (e.g., forester, field technicians, environmental planners). Through local training, forest management activities can generate local jobs. Such training can be focused on low-income communities in the county.

CASE STUDY

Sonoma Valley Wildlands Collaborative

The Sonoma Valley Wildlands Collaborative provides an example of a collaborative of conservation organizations and land management agencies moving towards as ecosystem-wide approach to forest management and fire risk management. Collaborative members collectively manage 18,000 acres (across 11 parks and preserves) in the Sonoma Valley. The collaborative is working with CAL FIRE to develop a strategy for vegetation management and fire risk reduction in the wildland-urban interface of the Sonoma Valley. The strategy will look at forest and open space management at a landscape-scale and supporting ecosystem health (Sonoma Valley Wildlands Collaborative, 2020).

Sugarloaf Ridge State Park (Lisa Williams).

Project Concept D: Conserve and Restore Areas for Biodiversity

ECOREGIONS

Bodega Coastal Hills

Coastal Franciscan Redwood Forest

Fort Bragg/Fort Ross Terraces

Sonoma-Mendocino Mixed Forest

Mayacamas Mountains

Napa-Sonoma-Lake Volcanic Highlands

North Coast Eastern Slopes

Bay Flats

Napa-Sonoma-Russian River Valleys

PROJECT TYPES

Management

Conservation

Restoration

Carbon Sequestration

TARGET RESOURCES

All natural and working lands

PROJECT TIMELINE

Near- to long-term

POTENTIAL LEADS

Ag + Open Space, Regional Parks, Sonoma Water

POTENTIAL PARTNERS

RCDs, Land Trusts

FUNDING STRATEGIES

Conservation Easements

Conservation Banks

Carbon Banking

FUNDING SOURCES

Gordon and Betty Moore Foundation, California State Coastal Conservancy, NFWF

PROJECT OBJECTIVES (WHY)

Without strategies implemented to reduce climate impacts and provide opportunities for adaptation, climate change is projected to have significant impacts on the biodiversity within Sonoma County. Climate change is frequently cited as one of the most significant drivers of biodiversity loss, with effects that include significant reductions in certain species, horizontal and vertical shifts in habitat, life cycle changes, and development of traits that can cause increased inter-species competition (Convention on Biological Diversity, 2010). However, if biodiversity is conserved, it can help strengthen resilience to climate change. The presence of healthy and biodiverse lands, waters, and soils provide many climate benefits including carbon sequestration, as well as risk reduction from flooding, heat, drought, wildfire, flooding, and extreme precipitation. In recognition of the importance of biodiversity to climate, the European Union is making biodiversity one of its main climate resilience strategies. The European Commission's Biodiversity Strategy for 2030 identifies many of the same actions as the Lands Strategy, including a larger network of protected areas, a prioritization on restoration, and developing long-term financing options to support biodiversity efforts (European Commission, n.d.).

IDENTIFYING SUITABLE LOCATIONS (WHERE)

Conserving, restoring, and managing lands, waters, and soils to preserve and enhance biodiversity could be a priority across all Sonoma County's natural and working lands. Given the scale of the projected climate impacts and the presence of current stressors such as pollution, development, and non-native species, it is necessary to conserve and restore biodiversity across all ecoregions and land types, including parks, open spaces, wetlands, forests, riparian corridors, agricultural lands, trail systems, and green infrastructure.

DESCRIPTION (HOW)

To conserve, restore, and manage natural and working lands to increase biodiversity and the climate resilience benefits associated with biodiversity, the County could:

Reduce existing stressors such as pollution, development, land conversion, non-native species, fragmentation of conserved lands, and poor land management practices.

Promote widespread adoption and application of conservation and sustainable management and use of natural and working lands, including increasing the size, topography, and connectivity of conserved areas and expanding the use of regenerative agricultural practices.

Support adaptive management through increasing the capacity of the County and its partners to monitor and evaluate changes and act prior to ecosystem collapse.

Harness and use the power of biodiversity to reduce climate risks to social, ecological, and economic resources in the county. For example:

- Conservation, restoration, and management of uplands, wetlands, and floodplains reduce flood risk, increase water quality and quantity, and allow for significant carbon sequestration potential.
- Conservation, restoration, and management of forests reduce wildfire risks, stabilize land, regulate water flows, and sequester carbon.
- Regenerative agricultural practices reduce climate risks from drought, wildfire, and extreme precipitation, as well provide for carbon sequestration and storage. These strategies also support the adaptability of agricultural uses to respond to climate change (U.S. Climate Resilience Toolkit, 2021).

IMPLEMENTATION (WHO)

The lead for this action should be Ag + Open Space with support from Regional Parks, Sonoma Water, other land trusts, and the resource conservation districts.

BENEFITS

Reduces risks from: Climate hazards including wildfire, flooding, heat, drought, extreme precipitation, erosion, loss of biodiversity and ecosystem health, fragmentation, loss of native species and habitats.

Provides benefits: Native species, habitats, ecosystem and community health, adaptability of natural and agricultural lands, water quality and quantity, connectivity, topographic and climatic diversity.

INDICATORS

This project concept will increase key aspects of resilience as specified by the following indicators:

Landscape: Acreage of regulated and protected land within a property (e.g., forestland acres with exclusion zones, riparian buffers, Northern Spotted Owl core areas). Acreage and continuity of wetlands (freshwater and coastal). Acreage and distribution of water resources, permeable soils, and recharge zones. Presence of biodiversity and native species. Acreage of agricultural land stewarded using climate-resilient practices. Number of landowners using climate resilient management practices.

Social: Support for small farmers to implement climate resilient agricultural practices and shift to regenerative and ecological practices. Provision of green corridors and connections, as well as buffers, to provide access to nature and protection and relief from climate hazards. Proximity of natural resource benefits to underserved and under-resourced communities. Proximity to green spaces and green infrastructure within the County's developed lands to underserved and under-resourced communities.

Project Concept E: Conserve and Restore Headlands, Coasts, and Baylands

ECOREGIONS

Bodega Coastal Hills

Coastal Franciscan Redwood Forest

Fort Bragg/Fort Ross Terraces

Sonoma-Mendocino Mixed Forest

Mayacamas Mountains

Napa-Sonoma-Lake Volcanic Highlands

North Coast Eastern Slopes

Bay Flats

Napa-Sonoma-Russian River Valleys

PROJECT TYPES

Conservation

Restoration

TARGET RESOURCES

River and stream headlands, coastal and Bayland shorelines, intertidal, and upland zones

PROJECT TIMELINE

Near- and mid-term

POTENTIAL LEADS

Ag + Open Space, Sonoma Water, Regional Parks

POTENTIAL PARTNERS

Land Trusts, Resource Conservation Districts, Permit Sonoma

FUNDING STRATEGIES

Conservation Easements

Carbon Banking

FUNDING SOURCES

Gordon and Betty Moore Foundation, California State Coastal Conservancy, Caltrans, FEMA

PROJECT OBJECTIVES (WHY)

The ability of Sonoma County's natural and working lands to be resilient and adaptable to climate change will depend on several factors. One of the most critical and important factors will be the availability of clean water. Additionally, the county's water sources must be supported by watershed conservation, management, and restoration that protects the headlands and restores and conserves the connections between these systems and the coasts and Baylands. Without appropriate conservation and protection of water resources, then the soils, the lands, the habitats, and the opportunities to reduce climate risks and increase carbon sequestration will not be available. Conserving, restoring, and managing the county's watersheds and natural water system will provide a much better chance for water to stay present in the natural and working lands.

IDENTIFYING SUITABLE LOCATIONS (WHERE)

The Lands Strategy identifies several ecoregions that contain headlands for some of the county's most significant rivers and creeks. The Bayland and coastal systems are also identified as a critical component of this system and a healthy headland to Bay and coast system would reduce flood risk throughout the system, provide space and sediment for the shoreline to gain elevation to keep up with sea level rise, and reduce erosion by providing for a slower and more natural release of waters from the headlands. Additionally, removing existing and reducing additional encroachments that impair the natural functions of the system will be a critical to the success of this project.

DESCRIPTION (HOW)

Project implementation should prioritize the conservation and restoration of the rivers and creeks that feed the coasts and Baylands, as well as the network of smaller rivers and creeks downstream of these larger systems.

Conserve headlands, Baylands, and coastal areas – Ag + Open Space, Sonoma Water, Regional Parks, and land trusts should coordinate on a strategy to conserve areas large enough to provide for the health of

these systems and to allow them to adapt to changing conditions due to climate change impacts such as drought, extreme precipitation, sea level rise, heat, and fire.

Restore and manage based on local conditions including climate effects – Headlands, coastal areas, and Baylands could be restored and managed to reduce erosion, connect the systems to uplands, remove non-native species and reduce fuel loads, re-introduce native species and natural hydrologic conditions where they are absent, and provide a restored and conserved buffer that provides space for the natural adaptation and migration of these systems.

Reduce existing and potential encroachments – Some of Sonoma's headlands, coastal areas, and Baylands have encroachments that impair the ability of the natural system to respond and adapt to changing conditions and increase flood and fire risk, reduce the ability the systems to supply water to the surrounding soils and vegetation, and increase the risks to the system from drought and erosion. Encroaching land uses and non-native species reduce the management and restoration options available. Land use strategies, conservation easements, buyouts from willing sellers, and restoration and management strategies are approaches that can be used to reduce existing and new encroachments into these critical systems.

IMPLEMENTATION (WHO)

Ag + Open Space, Sonoma Water, and Regional Parks have lands and existing plans that would support them leading this action. Potential partners include the land trusts in the county, Permit Sonoma, and the RCDs.

BENEFITS

Reduces risks from: Flood, fire, extreme precipitation, drought, high heat, and secondary effects of erosion and water quality.

Provides benefits: Contributes to biodiversity and ecosystem health, conserves critical habitat, water quality and quantity, increases opportunities for adaptation and range shifts, conserves and manages assets for carbon sequestration and storage, conserves, manages and restores resilient and vulnerable areas.

INDICATORS

This project concept will increase key aspects of resiliency as specified by the following indicators:

Landscape: Maintenance of current patterns of biodiversity, presence of multiple migration pathways for native plants and animal species to adapt to climate change, addresses encroachment into aquatic systems, acreage and continuity of wetlands, acreage and distribution of water resources, permeable soils, and recharge zones, topographic and climate diversity, conservation of upland transition zone, carbon sequestration potential, water access and storage.

Social: Increased capacity for management of resources and presence of adaptive management strategies, reduced risk to downstream communities from flooding, erosion, drought, and wildfire.

Sonoma Creek Baylands Strategy

Baylands in Sonoma County

Led by the Sonoma Land Trust, the Sonoma Creek Baylands Strategy is a planning project to develop and implement landscape scale restoration and flood risk reduction, as well as promote public access to, Lower Sonoma Creek where it enters the San Pablo Baylands portion of the San Francisco Estuary. The resulting plan included analysis of the hydrodynamic, geomorphic, and ecological conditions of the area and identified a range of alternatives, all of which considered the system, climate impacts, climate risk reduction, and opportunities to provide community access and benefits while conserving and restoring this critical aquatic system.

Project Concept F:
Create Sonoma Climate Resilient Lands Working Group

ECOREGIONS

Bodega Coastal Hills

Coastal Franciscan Redwood Forest

Fort Bragg/Fort Ross Terraces

Sonoma-Mendocino Mixed Forest

Mayacamas Mountains

Napa-Sonoma-Lake Volcanic Highlands

North Coast Eastern Slopes

Bay Flats

Napa-Sonoma-Russian River Valleys

PROJECT TYPES

Governance and Partnerships

TARGET RESOURCES

All

PROJECT TIMELINE

Near-term and ongoing

POTENTIAL LEADS

CARD, RCPA

POTENTIAL PARTNERS

Sonoma Water, Ag + Open Space, Permit Sonoma, Regional Parks, tribes, RCDs, UCCE, CAFF, land trusts or Sonoma Land Trust

FUNDING STRATEGIES

Membership fees

FUNDING SOURCES

County sources, foundation funding, State funding

PROJECT OBJECTIVES (WHY)

A clear finding of the Lands Strategy is that Sonoma County has a significant number of agencies, organizations, and efforts that are addressing aspects of climate change and natural and working lands. A significant benefit of the Lands Strategy was the engagement with the TAC and the IAG, as well as the initiation of engagement with local Native American tribes and organizations representing marginalized communities. This engagement provided a collaborative space for representatives with diverse expertise, perspectives, and priorities to work together, learn from each other, and identify shared goals and objectives. The success and power of this engagement demonstrated the need for ongoing engagement by a similar group of representatives throughout the implementation of the Lands Strategy. This working group could support and champion the implementation of the Lands Strategy and develop a countywide vision and actions to achieve climate resilience for Sonoma County's natural and working lands in a way that is just, equitable, and sustainable.

IDENTIFYING SUITABLE LOCATIONS (WHERE)

The Sonoma County Climate Resilient Lands Strategy Working Group would work at the countywide scale.

DESCRIPTION (HOW)

The development and implementation of a countywide Lands Strategy Working Group would require the following actions:

Identify lead agency – A countywide agency is needed to take the lead on designing and implementing the working group, setting meeting dates, drafting agendas, producing meeting materials, ensuring actions are advanced, and supporting the working group. The best candidates for this role are either CARD, a co-lead on the Lands Strategy, or the RCPA, who serves a lead on many climate change initiatives within the county. Strong partners could include Sonoma Water, Ag + Open Space, Permit Sonoma, U.C. Cooperative Extension (UCCE), and the Community Alliance with Family Farmers (CAFF). Another option would be to rotate leads among key county agencies and organizations among a core group with shared responsibility.

Hire or identify a coordinator – Successful collaboratives have a coordinator that has time dedicated to advancing the collaborative's objectives and actions. To ensure that the working group does not become an organization that reports out on individual agency actions but is advancing joint, collaborative work, a coordinator will be necessary. The role of the coordinator will not only include administrative tasks such as meeting agendas, notes, and material, but will advance priority actions of the working group between meetings and represent the working group and the County at regional and statewide levels. This coordinator could work on grant proposals, seek funding for priority initiatives, and work to close research and data gaps.

Identify participating agencies and organizations – The lead agency could begin with the membership of the Land Strategy's TAC and IAG, as well as representatives from other organizations who were engaged during the effort. The working group could include a range of expertise, perspectives, and priorities, with representatives such small farmers, local Native American tribes, the scientists and researchers, community organizations, farmworkers, and others from a wide range of sectors. Additionally, the working group will seek to financially compensate participating entities that do not have baseline funding to support their participation.

Sustainable funding – Many climate change initiatives identify collaboration and coordination as one of the most significant barriers to advancing climate work. The challenge is not only the scope and scale of the problem, which crosses sector and jurisdictional boundaries, but also a lack of funding sources for ongoing and sustained partnerships across these boundaries. The best collaboratives are funded by a stable funding source, but many are initiated with grants or project dollars and stabilize funding over time. The lead agency and its key partners should identify funding sources, which could include a membership fee model, funding from a foundation, a core group of agencies including it within their budgets, or a request that the region or the state fund county climate collaboratives designed to advance key state priorities such as the Natural and Working Lands Strategy and the 30 x 30 Initiative.

Design purpose and objectives – Building off the Lands Strategy, the initial meetings should affirm and revise as necessary the Land Strategy's definition, goals, and objectives, as well as the priorities and recommendations. The initial meetings should also identify additional research needs, pilot projects, engagement and communications strategies, and priority grants and funding opportunities to pursue within the next two to three years. From the initial meetings, the working group should have a roadmap of actions that will be taken both collectively and by individual agencies and organizations to advance the priority countywide goals, objectives, and actions. Opportunities for broader community engagement and communication should also be identified, and participants can regularly engage their constituents to share progress and obtain input.

IMPLEMENTATION (WHO)

As described above, the design and implementation of the Lands Strategy Working Group is best filled by a countywide agency or organization that currently has a broad role in climate adaptation and mitigation. Currently, CARD or the RCPA are the two most likely leads, with key potential partners being Sonoma Water, Ag + Open Space, Regional Parks, and Permit Sonoma.

BENEFITS

Reduces risks from: Uncoordinated actions, lack of support for climate initiatives, ineffective communication, and engagement with public, inability to advance action on priority projects due to lack resources, persistent gaps in research and data, lack of countywide, landscape scale progress.

Provides benefits: Capacity building, shared and strategic vision, increases awareness and understanding of the interconnected nature of the issue, success in identifying and securing funding and financing for priority strategies, increased efficiency of County resources, success in advancing priority actions that contribute to countywide resilience that is measurable and broadly supported, increased communication and engagement with the public on how the County is advancing climate resilience.

INDICATORS

This project concept will increase key aspects of resilience as specified by the following indicators:

Landscape: Indirectly the creation of the Lands Strategy Working Group would advance many landscape indicators as projects from the Lands Strategy were implemented and funding was secured for countywide actions.

Social: Capacity and access for broad participation in scoping, planning, design, and implementation of the Strategy. Capacity for ongoing monitoring, maintenance, and adaptive management. Strengthened partnership with Resource Conservation Districts to identify needs and opportunities of small farms. Increased partnerships between the local Native American tribes and the County.

Project Concept G: Develop and Implement Strategic Vision

ECOREGIONS

Bodega Coastal Hills

Coastal Franciscan Redwood Forest

Fort Bragg/Fort Ross Terraces

Sonoma-Mendocino Mixed Forest

Mayacamas Mountains

Napa-Sonoma-Lake Volcanic Highlands

North Coast Eastern Slopes

Bay Flats

Napa-Sonoma-Russian River Valleys

PROJECT TYPES

Planning and Program Development

TARGET RESOURCES

All

PROJECT TIMELINE

Near-term

POTENTIAL LEADS

CARD, RCPA

POTENTIAL PARTNERS

Ag + Open Space, Regional Parks, Sonoma Water, Permit Sonoma, Resource Conservation Districts, Tribes, land trusts or Sonoma Land Trust (my preference is to include Sonoma Land Trust in lieu of "land trusts" throughout

FUNDING STRATEGIES

County/local funding source

FUNDING SOURCES

State Coastal Conservancy

PROJECT OBJECTIVES (WHY)

Sonoma County has several agencies, organizations, and initiatives that work on climate change, the natural and working lands, and hazard-specific issues. There are also several climate related plans and studies and topical reports and research, as well as a range of working groups and committees. As part of the scoping and engagement for the Lands Strategy, these efforts were reviewed for relevance and the agencies and organizations were engaged in the process to develop the Lands Strategy. The findings from this work included a need for better coordination and alignment and an opportunity to develop a strategic vision among the key County and special district agencies and organizations. An important outcome of this collaboration would be the development of a strategic, countywide vision for the natural and working lands that includes prioritization of multi-benefit climate resilience projects that can be planned, designed, and implemented in partnership. While this Lands Strategy includes a range of recommendations on project concepts, priorities, and general locations, the strategic vision would go further, providing detail on timing, location, a prioritization process, and coordination on project leads, project partners, and project engagement approaches.

IDENTIFYING SUITABLE LOCATIONS (WHERE)

This project is a planning project that would include the whole of Sonoma County and identify the timing, locations, and lead for high priority actions identified in the Lands Strategy including forest restoration and conservation, regenerative agriculture support and assistance, restoration of grasslands, and other similar priority projects.

DESCRIPTION (HOW)

Development of a countywide strategic vision should include the following steps:

Identify Core Agency and Organization Partners – Include the key agencies and organizations in Sonoma County that oversee efforts on climate change, the natural and working lands, and water and agricultural resources. Based on the assessment for the strategy, the participation should include CARD, Sonoma

Water, Regional Parks, RCPA, Ag + Open Space, Permit Sonoma, RCDs, and the local Native American tribes.

Build from Existing Documents – Based on the findings and recommendations from this Lands Strategy, the Vital Lands Initiative, Sonoma Water's Climate Adaptation Plan, and input on priorities from Regional Parks, the RCDs, the local Native American tribes, and others, develop a countywide set of priority projects that draws from these existing documents and the input received from participating agencies and organizations.

Design Strategic Vision – Design a strategic vision that prioritizes natural and working lands projects that advance climate resilience, climate hazard risk reduction, carbon sequestration and storage, and areas of high biodiversity and under resourced and marginalized communities. Design a technical document that is geographically specific, identifies leads and partners for each priority project, and includes a high-level estimate of cost for each project.

Implement Strategic Vision – Develop a prioritized list of projects, leads, funding sources, and timing for each priority project.

IMPLEMENTATION (WHO)

Sonoma County agencies and organizations that oversee climate initiatives, natural and working lands, water resources, and agricultural and soil resources.

BENEFITS

Reduces risks from: all hazards. Like this Lands Strategy, the strategic vision would include climate resilience from all hazards as well as carbon sequestration and storage.

Provides benefits: to all natural and working lands categories, but more importantly, to the entire county by prioritizing countywide and landscape scale projects at a scale that would provide broad climate benefits to all parts of Sonoma County.

INDICATORS

This project concept will increase key aspects of resiliency as specified by the following indicators:

Landscape: Ecosystem health and biodiversity, land coverage, land management, and habitat quality and condition.

Social: Capacity and access for broad participation in implementing the Lands Strategy, development of shared decision-making frameworks with tribal partners, strengthened partnerships with RCDs, equitable access to climate resilient benefits.

Project Concept H:
Fuels Treatment and Post-Fire Lands & Waters Restoration

ECOREGIONS

Bodega Coastal Hills

Coastal Franciscan Redwood Forest

Fort Bragg/Fort Ross Terraces

Sonoma-Mendocino Mixed Forest

Mayacamas Mountains

Napa-Sonoma-Lake Volcanic Highlands

North Coast Eastern Slopes

Bay Flats

Napa-Sonoma-Russian River Valleys

PROJECT OBJECTIVES (WHY)

Fuels management aims to reduce the risk of catastrophic fire in the county and limit fire impacts to people, communities, and the environment (CAL FIRE, n.d.). As part of a broader climate-resilient land management program, fuels management can increase ecological health of land and water. Post-fire lands and waters restoration aims to reduce risk of erosion, debris flows, flooding, and polluted water (all of which are more likely to occur on a burned landscape. In addition, post-fire recovery plans aim to support ecosystem health and reduce intensity of future fires (Ag + Open Space, 2022).

IDENTIFYING SUITABLE LOCATIONS (WHERE)

Fuels management and treatment is especially important in the wildland-urban interface (e.g., Napa-Sonoma-Lake Volcanic Highlands) and in open space adjacent to all communities in the county to limit impacts of fire on people, property, and infrastructure. Resources such as Sonoma County Wildfire Fuel Mapper can help determine where fuels management is needed most. Post-fire restoration focuses on restoring ecological health of areas that have recently burned, largely contained with Mayacamas Mountain, Napa-Sonoma-Lake Volcanic Highlands, and Sonoma-Mendocino Mixed Forest, North Coast Eastern Slopes, and Napa-Sonoma-Russian River Valleys Ecoregions.

PROJECT TYPES

Management

Carbon Sequestration

Monitoring

TARGET RESOURCES

All lands and waters

PROJECT TIMELINE

Assessment

Recommendations

Expand Programs

POTENTIAL LEADS

County, Firesafe Sonoma, Watershed Collaborative, RCDs

POTENTIAL PARTNERS

Private Landowners Sonoma Ecology Center, Tribes, Pepperwood

FUNDING STRATEGIES

Transfer fee funds

Improvement District Grants

FUNDING SOURCES

2021 State Climate Package, Bureau of Land Management, NFWF

DESCRIPTION (HOW)

Fuels treatment is a key component of the Climate Resilient Forest Conservation & Management Project Concept (Concept 6) with a specific focus on wildfire risk reduction. Fuels treatment activities are focused on reducing a buildup of flammable vegetation and may include: prescribed burns, thinning, pruning, chipping, grazing, and removal of ladder fuels (USDA, 2022b). Fuels treatments should be designed to increase the ecological health of a landscape. For example, thinning can increase forest health and resilience to drought by reducing competition for water (Jones, 2021).

In the aftermath of a fire, runoff from burned landscapes can increase risk of erosion, debris flows, and flooding. In addition, runoff can pollute watersheds, negatively impacting sensitive species (like steelhead and coho) and potable water supply (Kovner, 2020; Pierce et al., n.d.). Post-fire restoration is designed to limit this damaging impact. Key activities in a post-fire recovery and restoration plan may include burned tree care; erosion control; reseeding (limited to areas that burned very hot); foster wildlife recovery (e.g., removing unnecessary fences, installing nest boxes); monitoring ecosystem health; managing invasive species; removal of toxic ash and debris; and fuels treatment in adjacent areas. A land restoration expert should be consulted before implementing most of these activities. All fuels treatment projects should be paired with robust post-implementation monitoring, which will help determine the effectiveness of different treatments in meeting wildfire risk reduction goals.

IMPLEMENTATION (WHO)

Sonoma County's resilient lands and waters management is unique in California in that it requires engaging, educating, supporting, and funding the many landowners of small parcels to conduct ecosystem-scale activities. The RCDs and other groups provide many guidance documents, tool kits, resources, and grants to small-land owners to manage vegetation, treat fuels and restore burned lands. Ag + Open Space, the County, RCDs, and CAL FIRE could benefit from a joint assessment of how their guides, grants, and toolkits have impacted on-the-ground implementation of fuels treatment and post-fire restoration on private properties and the lands they directly manage. Such an approach could guide development of future programs and funding programs. All future programs and practices should be monitored and assessed to verify their efficacy toward addressing climate resilience goals.

BENEFITS

Reduces risks from: wildfire, including secondary impacts of erosion, debris flows, flooding, and polluted water.

Provides benefits: Maintenance of carbon storage; watershed and stream health; habitat quality and quantity, biodiversity, sensitive resources, culturally significant resources.

INDICATORS

This project concept will increase key aspects of resiliency as specified by the following indicators:

Landscape: Climate resilient management practices; carbon sequestration potential (storage maintained with reduced fire risk and intensity); acreage and diversity of fuels treatment and management projects; acres of risk reduction.

Social: Participation of prescribed burn associations, cooperative burning, and fire training of everyday citizens; increased partnerships between the local Native American tribes and the County; incorporation of traditional ecological knowledge and tribal expertise into management decisions; contribution of natural and working lands to the County's economy and employment.

CASE STUDY

Conservation Corps North Bay

Many of the activities described above require consultation with experts and work crews to implement the specific activities decided. Conservation Corps North Bay provides skilled crews to implement some of these activities, such as habitat restoration and erosion control design and installation, and hazardous tree removal. The non-profit organization trains youth in practical skills that will support living-wage careers in natural resource management (Conservation Corps North Bay, n.d.). This work support resilience goals as well as goals to contribute to the local economy.

Fire Managers Using Prescribed Fire on the Landscape (USFWS).

Project Concept 1:
Enhancing Groundwater Resources

ECOREGIONS

Bodega Coastal Hills

Coastal Franciscan Redwood Forest

Fort Bragg/Fort Ross Terraces

Sonoma-Mendocino Mixed Forest

Mayacamas Mountains

Napa-Sonoma-Lake Volcanic Highlands

North Coast Eastern Slopes

Bay Flats

Napa-Sonoma-Russian River Valleys

PROJECT TYPES

Enhancement

Carbon Farming

Land Management

TARGET RESOURCES

Groundwater

Floodplains

PROJECT TIMELINE

Evaluate needs/priorities

Pilot Projects

Engage Landowners

Implement Policies

POTENTIAL LEADS

County, Private Landowners, GSAs

POTENTIAL PARTNERS

Land Trusts, Sonoma Water

FUNDING STRATEGIES

Sonoma Water - GSAs

FUNDING SOURCES

State Water Resources Control Board, Department of Water Resources, NRCS-RCCP

PROJECT OBJECTIVES (WHY)

The Sonoma County agricultural economy and rural residents rely on reliable and clean sources of groundwater for drinking water, irrigation, and general use. There are roughly 45,000 water wells distributed throughout the county, the most per capita of any county in California (Sonoma County, 2022). Climate related stressors on water resources are impacting availability and quality of groundwater throughout the county. The Sustainable Groundwater Management Act requires the formation of Groundwater Sustainability Agencies (GSAs) to achieve groundwater sustainability by 2042. Three basins in the county are under GSA authority: Santa Rosa Plain, Petaluma Valley, and Sonoma Valley. Groundwater Sustainability Plans (GSPs) have been developed, which identify Sustainable Management criteria, future projections of groundwater conditions, and management actions. Recent action by the three GSAs will impose a regulatory fee for well usage within the GSAs (Press Democrat, 2022). The remaining basins in the county are not subject to GSA oversight. Additional sustainability measures are needed to maintain reliable and safe groundwater supplies within and outside of GSA jurisdictions.

IDENTIFYING SUITABLE LOCATIONS (WHERE)

Groundwater usage within GSA boundaries is managed under existing GSPs; however, all groundwater/well dependent users may implement land management actions to improve groundwater recharge potential. High priority basins can be identified using online tools and resources available by the Department of Water Resources(Department of Water Resources, 2022a, 2022b). Specific focus for pilot projects may be implemented on lands identified within below normal water budget values that rely on irrigation for high water depend crops, well users reporting dry conditions, and lands within basins that rely primarily on groundwater supplies. For example, the Wilson Grove Formation Highlands Groundwater Basin receives 74% of water supply from groundwater and land users within the Bodega Bay Area rely entirely on groundwater supplies (California Department of Water Resources, 2022a). Review existing and ongoing studies to help identify suitable groundwater recharge projects, such as the Sonoma Valley Groundwater Recharge Potential Mapping Project developed by the Sonoma Ecology Center (Sesser et al., 2011).

DESCRIPTION (HOW)

Collaborative multi-benefit projects and actions to improve natural groundwater recharge may include all or some of the following actions:

Floodplain Enhancement – allowing sufficient room for floodplain recharge through removal or relocation of flood control berms and levees, combined with riparian/wetland enhancement on floodplains to *slow the water down.* Floodplain vegetation can reduce the magnitude of floods by reducing water velocity and improve groundwater recharge within the hyporheic zone.

Create Recharge Basins – to capture larger floodwater overflow within floodplains during high flow events or excess runoff during heavy rains. Additional measures can be employed to improve water quality as water infiltrates into the ground (University of California, Santa Cruz, 2018).

Managed Vegetation Transitions – studies suggest that conversion of grasslands to shrub/tree dominated landscapes may increase/improve groundwater recharge (Schreiner-McGraw et al., 2020). Shrub and woody plant encroachment onto grassland systems may occur in response to certain climate change conditions (warmer/drier); therefore, proactive enhancement actions to preserve essential grassland habitat while allowing or facilitating conversions in locations with higher overland flow rates, natural basins, and within or bordering floodplains to encourage groundwater recharge (Bagne et al., 2012).

On-Farm Recharge – managed aquifer recharge practice in which growers flood farmlands during wet/high water years to recharge and store water in underground aquifers (California Department of Water Resources, 2022c).

Soil Carbon Projects – application of compost, reduced tillage, and/or maintenance of plant cover to improve soil infiltration and water holding capacity. Reports indicate that a 1% increase in soil organic matter on 200 acres could yield an increase in water holding capacity by 200 acre-inches or 16.7 acre-feet (Sequoia Riverlands Trust, 2017).

Water/Landscape Efficiency Requirements – new developments and/or well permit applications outside of an existing GSA should require similar water/landscape efficiency and conservation plans.

Stormwater Recapture Requirements – include measures within Stormwater Pollution Protection Plans and/or other Municipal Separate Storm Sewer System (or known as MS4) requirements that encourage groundwater recharge in addition to water quality protection via green infrastructure, riparian buffer/restoration requirements, use of native seed for revegetation, vegetated swales, and tree/shrub planting.

Decision Support Tool – development to assessment of recharge scenarios, identify priority areas, and evaluate effectiveness of actions.

Groundwater Banking – modeled after pilot efforts led by Sonoma Water (Sonoma Water, 2022), groundwater banking or Aquifer Storage and Recovery (or known as ASR) stores surface water underground during wet periods to increase groundwater levels.

IMPLEMENTATION (WHO)

Collaborative efforts led by the County and in close collaboration with the GSAs, as well as through engagement with agricultural landowners and rural residents to identify priority, need, and funding opportunities to support multi-benefit water recharge projects.

BENEFITS

Reduces risks from: drought, water supply shortages, water quality degradation, flooding.

Provides benefits for: rural residents, agricultural uses, water security, wildlife habitat.

INDICATORS

This project concept will increase key aspects of resiliency as specified by the following indicators:

Landscape: soil water holding capacity, acreage and distribution of water resources, permeable soils, and recharge zones, water access and storage.

Social: condition and management of resources, including presence of adaptive management strategies for working lands and communities.

CASE STUDY

Kaweah Oaks Preserve in Tulare County is owned and managed by the Sequoia Riverlands Trust. The Sequoia Riverlands Trust, which is part of a Groundwater Collaborative, has initiated multiple land management practices on the preserve, including a Carbon Farm Pilot study, recharge basins, and a floodwater banking project (Sequoia Riverlands Trust, 2017). This program has served as an educational opportunity for local students, citizens, and land managers and pilot project for other land mangers exploring these types of practices.

Project Concept J: Increase Coordination with Local Native American Tribes

ECOREGIONS

Bodega Coastal Hills

Coastal Franciscan Redwood Forest

Fort Bragg/Fort Ross Terraces

Sonoma-Mendocino Mixed Forest

Mayacamas Mountains

Napa-Sonoma-Lake Volcanic Highlands

North Coast Eastern Slopes

Bay Flats

Napa-Sonoma-Russian River Valleys

PROJECT OBJECTIVES (WHY)

Sonoma County's local Native American tribes are land stewards, managers, owners, and experts in the county's native species, ecological trends, and adaptation opportunities. The presence of so many tribes and tribal lands in Sonoma County is a resource that the county can use to build climate resilience. Local Native American tribes can also act as a co-managers and partners that can contribute to climate resilience solutions and an important community whose vulnerabilities must be considered when planning and prioritizing climate resilient actions. Many agencies and organizations frequently work with the tribes on climate issues. Tribes have also been adapting to climate conditions and working on projects in Sonoma County to address climate risks to their communities and cultural and land resources. Formalizing and strengthening this coordination are necessary if the County wants to realize its climate resilience goals.

IDENTIFYING SUITABLE LOCATIONS (WHERE)

As a governance and partnership project, this project concept applies to the entire county.

DESCRIPTION (HOW)

Encourage ongoing tribal engagement on climate resilience – It would be beneficial for the County to dedicate funds to support its staff engaging in climate resilience focused consultation with interested tribes. This engagement would not be about a specific project or a program but more broadly on climate resilience and vulnerability. The County recognizes that individual tribes in Sonoma County are culturally and politically distinct. In conducting tribal engagement, the County may take into consideration the traditional and cultural affiliation of tribes to specific lands. An ongoing, quarterly meeting between local Native American tribal representatives and County agencies would ensure that planning, design, and implementation could be done in close coordination with the tribes and that tribal priorities and expertise are included at the earliest stages of project development or inform the development of a project or program. Currently, formal consultation processes are designed around specific projects or programs, missing the important stage of determining what becomes a project and what issues to prioritize. In a listening session held by the State of California's Office of Environmental Health Hazard Assessment

PROJECT TYPES

Governance and Partnerships

TARGET RESOURCES

All with focus on tribal lands, tribal cultural resources, and tribal cultural properties

PROJECT TIMELINE

Near-term and ongoing

POTENTIAL LEADS

CARD, RCPA, County agencies, Ag + Open Space

POTENTIAL PARTNERS

Local Native American tribes

FUNDING SOURCES

County funds

Tribal Colleges Extension

Tribal Climate Resilience Annual Awards Program

BIA Tribal Climate Resilience

Tribal Government Challenge Planning Grant

(OEHHA) held in May 2021, tribal representatives that included the Federated Indians of Graton Rancheria and the Kashia Band of Pomo Indians, Northern California tribes described frustration with the current approach to climate work, which often excludes tribes based on issues agencies determine need a formal consultation or what the tribal interests are in the issues (California Office of Environmental Health Hazard Assessment, 2021). The tribes explained that they have broad expertise and interest in climate resilience and vulnerability and that they should be a key partner in this work. Additionally, tribal representatives have highlighted opportunities for the County to work closely with the local Native American tribes to determine long-term co-management governance structures and arrangements that will promote equal decision-making on climate resilience issues and be oriented toward durable management.

Include tribal expertise in project and program planning, design, and implementation – Sonoma County local Native American tribes have been adapting to conditions in the county for centuries and continue to work closely in the landscape and with native species. They own, steward, and manage land and have been identifying the vulnerabilities caused by climate change for decades. Tribes are often one of the first communities to see the changes and look for the wholistic causes of that change, including management practices recommended by non-native agency representatives. While several Sonoma County local Native American tribes have received grant funding for specific projects, programs, or geographic sites, the County lacks a common space to work together or act as co-managers with local tribes more broadly on climate resilience and vulnerability. Grant funded projects—such as the one led by the Dry Creek Rancheria Band of Pomo Indians to develop fire management practice for their lands, or the project led by the Federated Indians of Graton Rancheria to conduct vulnerability assessment and develop adaptation for at risk cultural sites along the Sonoma County coast—will always be important. However, site and issue specific projects are insufficient to meet the greater need for coordination, capacity building, and joint work that needs to be done between the County and the tribes (Bureau of Indian Affairs, 2021).

Identify tribal priorities for climate action – As part of the ongoing climate resilience engagement and collaboration between the Local Native American tribes and the County, the quarterly meetings should include the identification of tribal priorities. The tribal priorities that participating tribes identified in the engagement for the Lands Strategy included protecting tribal cultural resources, tribal cultural lands, and reducing risk to the infrastructure and utilities that the tribes rely on, particularly during emergencies.

Secure funding for engagement and climate resilience actions – The County will need to identify adequate resources to support the ongoing engagement and tribal participation. This should be done with the understanding that the different local tribes have varying levels of available resources and capacity to dedicate to this engagement and participation, which should be addressed to ensure equitable access to participation for all local tribes. Additionally, the County and the tribes can use the ongoing consultation sessions to explore sources of funding and financing to advance joint priorities. Tools such as the Tribal Climate Change Guide can provide a range of funding options for a variety of projects (University of Oregon, n.d.). Seeking grants together for joint projects or to fund this ongoing engagement, as well as identifying financing approaches at the county scale will increase the capacity and trust among the group.

Include tribal experts and voices in climate resilience panels, presentations, and other climate resilience activities. – One of the most significant benefits of increasing coordination between the local Native American tribes and the County is to bring tribal expertise into County climate resilience work more broadly. The expertise of the tribes can be included as part of the consultations. Adding tribal representation to County efforts focused on resilience will ensure that this expertise will inform climate resilience activities and will contribute to the identification of new opportunities.

IMPLEMENTATION (WHO)

The County agencies that lead climate adaptation and mitigation efforts are the most appropriate to lead the quarterly climate resilience engagements. While other project and issue specific consultations will still be necessary and led by other agencies and organizations, this broad and ongoing consultation is likely most appropriately led by CARD or RCPA. Additional partners include Sonoma Water, Regional Parks, Ag + Open Space, and the RCDs.

BENEFITS

Reduces risks from: Uncoordinated actions, loss of tribal cultural resources, loss of tribal cultural lands, lack of data and information from those with deep expertise, lack of support for climate projects.

Provides benefits: Ecological understanding, ability to work jointly, capacity building, climate action with broad support, for tribal lands and communities, countywide, and watershed scale resilience across jurisdictional boundaries, native species.

INDICATORS

This project concept will increase key aspects of resiliency as specified by the following indicators:

Landscape: Number of landowners using climate resilient management practices (including grazing, croplands and vineyards practices, and timber practices). Presence of biodiversity and native species. Acres of risk reduction. Increased carbon sequestration potential of land. Presence/distribution of native species/species richness.

Social: Development of shared decision-making frameworks with tribal partners to identify tribal cultural properties and resources, as well as other conservation priorities and strategies. Support for diverse organizations and individuals to own, manage, and steward land. Capacity and access for broad participation in scoping, planning, design, and implementation of climate projects. Capacity for ongoing monitoring, maintenance, and adaptive management.

CASE STUDY

Kashia Coastal Reserve

Kashia Coastal Reserve, Sonoma County (Sonoma County Regional Parks)

The Kashia Band of Pomo Indians owns and manages the Kashia Coastal Reserve. The Reserve includes over 700 acres in a conservation easement, as well as a trail easement for a new segment of the California Coastal Trail to be implemented by Sonoma County Regional Parks. The purchase and transfer of the Reserve included the participation of many agencies and organizations, including Ag + Open Space, the Gordon and Betty Moore Foundation, the California Coastal Conservancy, the Trust for Public Land and others. The realization of the Kashia Coastal Reserve is an example of what can happen when County agencies and organizations and tribal representatives work together to advance joint priorities and identify and secure the resources to do so (Martinez, 2015).

Project Concept K: Land Conservation for Climate Resilience

ECOREGIONS

Bodega Coastal Hills

Coastal Franciscan Redwood Forest

Fort Bragg/Fort Ross Terraces

Sonoma-Mendocino Mixed Forest

Mayacamas Mountains

Napa-Sonoma Lake Volcanic Highlands

North Coast Eastern Slopes

Bay Flats

Napa-Sonoma-Russian River Valleys

PROJECT OBJECTIVES (WHY)

Creating connected landscapes that secure critical migration and movement corridors, offer opportunities for range shifts, and sustain biodiversity will be essential to ensuring the long-term sustainability of natural resources. Climate-smart land conservation through strategic land acquisitions and/or conservation easements will be essential to protecting resilient natural and working lands. Further, land conservation practices will keep the County on tract in meeting State's goal in conserving 30 percent of lands by 2030.

IDENTIFYING SUITABLE LOCATIONS (WHERE)

The Conservation Lands Network maps significant areas of Sonoma County as "Areas Essential to Conservation Goals." Building upon prior work completed for the region and County, including prioritization efforts under the Vital Lands Initiate will provide a foundation for mapping lands not currently protected as public lands or through conservation easements. These efforts can be taken one step further through evaluation of critical resource characteristics, identification of resilient land indicators, and coordination and partnership with local and regional stakeholders.

DESCRIPTION (HOW)

Project implementation should focus identifying lands that form connected landscapes, habitat redundancy, and can accommodate range/habitat shifts. In this case, *bigger is better,* and *landscape diversity* is key. The County of Sonoma currently has a framework in place for proactive land conservation through the Vital Lands Initiative. Strategies and criteria for prioritizing land conservation should be refocused to foster landscape connectivity and resilience. Identified lands should support all or of many of the following:

Large/Intact Natural Landscapes – larger tracts of land are likely to support greater topographic, geologic, and soil diversity that can accommodate habitat/range shifts for native species and provide climate refugia (Vernon, 2020).

PROJECT TYPES

Management

Conservation

Carbon Sequestration

TARGET RESOURCES

Undeveloped natural and working lands

PROJECT TIMELINE

Identify Lands

Evaluate Conservation Strategies

Coordinate Efforts

POTENTIAL LEADS

Ag + Open Space

POTENTIAL PARTNERS

RCDs, tribes, Land Trusts, County, private landowners

FUNDING STRATEGIES

Conservation Easements
Conservation Banks

Carbon Banking

FUNDING SOURCES

Gordon and Betty Moore Foundation, USDA-NRCS RCCP

Habitat Corridors/Connectivity – opportunities to connect lands currently under conservation easement/permanent protected lands and/or lands within critical movement corridors (Bay Area Council, 2019). Landscape connectivity facilitates species dispersal and lateral range shifts for plants and animals (Littlefield et al., 2017).

Range Edges and Critical Habitat – accommodate species range shifts at edges of known geographic distributions; conserve lands that abut or support critical habitat designations, including stream corridors.

Carbon Sequestration Potential – lands that currently support natural systems that currently or have potential for high rates of carbon sequestration – including forested lands, landscape mosaics supporting wetlands/riparian habitats, and intact perennial grasslands.

IMPLEMENTATION (WHO)

Once lands are identified by the County or other program leads, steps can be taken to safeguard permanent protection via easements or outright purchase. Willing landowners can earn significant tax benefits; acquisitions can benefit the great public by providing expanded access to outdoor lands; conservation banking programs can garner substantial funds for long-term management and maintenance. Successful implementation should incorporate coordinated efforts with local stakeholders, including tribes and land trusts, in addition to forming partnerships with bordering counties, aligning with state efforts, and capitalizing on federal programs.

BENEFITS

Reduces risks from: temperature/precipitation shifts and habitat loss.

Provides benefits: habitat quality and quantity, species movement and habitat shifts, community access to natural lands, biodiversity, endemic species, sensitive resources, culturally significant resources.

INDICATORS

This project concept will increase key aspects of resiliency as specified by the following indicators:

Landscape: Maintenance of current patterns of biodiversity; migration pathways for animals and plant species in the face of increasing temperatures and rising sea levels; acreage and distribution of protected land; presence of habitat connectivity and corridors; topographic diversity; redundancy of habitat and types.

Social: Development of shared decision-making frameworks with tribal partners to identify tribal cultural properties and resources, as well as other conservation priorities and strategies; Support for diverse organizations and individuals to own, manage, and steward land.

CASE STUDY

Fitzsimmons Ranch Acquisition

Sonoma Land Trust acquired the 200-acre Fitzsimmons Ranch property, located within the Mayacamas Mountains, which joins the property to the surrounding Hood Mountain Regional Park. This property falls within a critical wildlife movement corridor that connects Point Reyes to the interior mountains of Lake and Napa counties. The property supports varied topography and diverse and unique natural resources, including rare serpentine communities (Sonoma Land Trust, 2022). The acquisition was made possible through private donations and funding support from the Gordon and Betty Moore Foundation.

Fitzsimmons Ranch (Sonoma Land Trust).

Project Concept L: Nature Based Approaches to Shoreline Management

ECOREGIONS

Bodega Coastal Hills

Coastal Franciscan Redwood Forest

Fort Bragg/Fort Ross Terraces

Sonoma-Mendocino Mixed Forest

Mayacamas Mountains

Napa-Sonoma-Lake Volcanic Highlands

North Coast Eastern Slopes

Bay Flats

Napa-Sonoma-Russian River Valleys

PROJECT TYPES

Shoreline Protection

Conservation

Carbon Sequestration

TARGET RESOURCES

Groundwater, Streams, Riparian Corridors

PROJECT TIMELINE

Identify High Risk Locations

Evaluate Long Term Solutions

Implement Actions

Acquire Properties

POTENTIAL LEADS

County, Land Trusts, Private Landowners

POTENTIAL PARTNERS

Sonoma Water, Groundwater Basin Authorities

FUNDING SOURCES

CDFW-watershed restoration grants (Proposition 1), CDFW – rivers and streams (prop 68), IRWMP

PROJECT OBJECTIVES (WHY)

The County of Sonoma is bounded to the west by the Pacific Ocean and to the south by San Pablo Bay – these coastlines are projected to experience 1.1 to 2.7 feet of sea level rise in addition to increasing frequency and intensities of coastal storms (see Chapter 3). Proactive and reactive measures to improve coastal resilience through nature-based approaches, structural approaches, and policy strategies will protect critical infrastructure, vulnerable communities, and coastal resources.

IDENTIFYING SUITABLE LOCATIONS (WHERE)

Planning now to mitigate against risks associated with sea level rise and coastal storms will require identifying vulnerable locations based on existing indications of susceptibility (significant erosion, flooding, salinity intrusion) and anticipated risk (exposure). The impacts of sea level rise and coastline erosion are already presenting challenges, including threatening key transportation corridors and private residences. Use of predictive modeling and vulnerability assessments should be combined with boots-on-the-ground conversations with coastal community members and organizations. The 2021 Draft Local Coastal Plan includes a vulnerability assessment for Bodega Bay, which identifies multiple areas as potentially at high risk to shoreline erosion and/or directly by sea-level rise including SubAreas 6 (High Cliffs/Muniz-Jenner), 8 (Pacific View/Willow Creek), and 9 (State Beach/Bodega Bay) (Permit Sonoma, 2019). A similar assessment should be implemented for all coastal communities along the Sonoma Coastline. The Bay Shoreline Adaptation Plan offers nature-based measures for shoreline adaptation for the San Pablo Bay shoreline (San Francisco Estuary Institute, 2019).

DESCRIPTION (HOW)

Prioritization of shoreline protection measures should focus on addressing near-term high-risk locations and identifying long-term solutions.

Living Shorelines/Green Infrastructure/Habitat Restoration and Conservation – green/nature-based techniques to stabilize highly erodible shorelines using vegetation (low initial cost, high management

effort), edging (low initial cost; higher management effort), and living reefs/submerged aquatic vegetation (higher initial cost; lower management effort) (SAGE, 2015). These measures can be employed to protect natural landscapes – including on State Park Lands, reserves, coastal headlands and nearshore habitats, where protection of critical infrastructure is not a priority. Conservation and restoration of coastal wetland habitats protect the shoreline from erosion and flood surges.

Infrastructure Upgrades – identify road crossings, culverts, and stormwater outlets that are contributing to shoreline erosion, soil instability, and/or overland runoff. Implement structural measures (upgrades), relocation, removal/reducing impervious surfaces, redirecting flows, and/or capturing runoff.

Engineered Structural Measures – hardened shoreline structures in locations where shoreline erosion/flooding/wave action poses risks to critical infrastructure, including road corridors with limited opportunities for relocation/realignment, important historic and cultural sites, and essential structures that cannot be relocated. Harden structures may include bulkheads, revetments, and seawalls.

Policy Measures – Sonoma County Local Coastal Program limits development in areas identified as high risk for coastal erosion and encourages relocation of existing at-risk properties over placement of shoreline protection structures. Integrate programs/policy for voluntary buyouts for high-risk properties/properties repeatedly damaged by storms/erosion/coastal flooding. Flood hazard zones in coastal areas should be redesignated to match the projected expansion of flooding frequency and extent. Wetland setbacks for development should be expanded to account for projected sea-level rise, allowing for inland migration of coastal/tidal wetland habitats.

IMPLEMENTATION (WHO)

Coordinated efforts led by the County with private landowners, business owners, the California Department of Transportation, the California Coastal Commission, and land managers (parks, land trusts, etc.) will be necessary first step in understanding risks and existing planning frameworks. Community engagement should be implemented early in the planning process.

BENEFITS

Reduces risks from: sea level rise, coastal storms, tidal surges, coastal erosion.

Provides benefits: local/coastal economies and communities, coastal tourism, coastal habitats, nearshore habitats, infrastructure, historic, cultural, and natural resources.

INDICATORS

This project concept will increase key aspects of resiliency as specified by the following indicators:

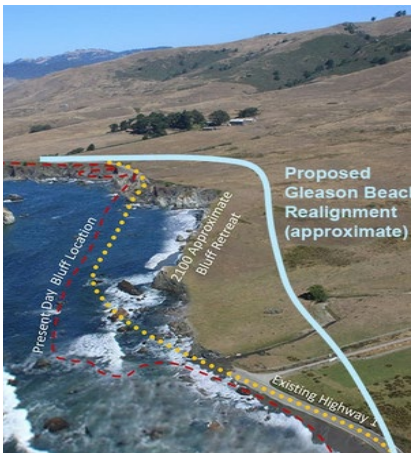
Landscape: Elevation and type of shoreline, acres of risk reduction.

Social: Support for diverse organizations and individuals to own, manage, and steward land; contribution of natural and working lands to the County's economy and employment; tourism levels.

CASE STUDY

Gleason Beach Realignment

Gleason Beach is situated along the Sonoma coastline between Bodega Bay and the Russian River and is adjacent to Highway 1. Caltrans has been implementing emergency repairs to Highway 1 since the early 2000s. This project involves the realignment of a half-mile stretch of Highway 1 and improvements and restoration on Scotty Creek, including daylighting the stream at its mouth and removing a culvert that proposed a barrier to listed fish species (Caltrans, 2022).



Gleason Beach Realignment (Gleason Beach, California (Highway 1) Road Realignment Project | Adaptation Clearinghouse)

Project Concept M: Resilient Buffer Zones

ECOREGIONS

Bodega Coastal Hills

Coastal Franciscan Redwood Forest

Fort Bragg/Fort Ross Terraces

Sonoma-Mendocino Mixed Forest

Mayacamas Mountains

Napa-Sonoma-Lake Volcanic Highlands

North Coast Eastern Slopes

Bay Flats

Napa-Sonoma-Russian River Valleys

PROJECT OBJECTIVES (WHY)

Sonoma County has effectively applied land use strategies to reduce growth in the rural parts of the county and in areas that lack sufficient infrastructure to support higher density development. These land use strategies include urban growth boundaries, rural and resource development zoning, and conservation easements and purchases. The resulting land use pattern is a more densely developed valley that runs north to south through the middle of the county and surrounding natural lands, open spaces, and agricultural uses with rural residential densities throughout. This pattern of development provides the county with the opportunity to establish a network of Resilient Buffer Zones in the wildland urban interface to reduce wildfire risk and provide other climate resilience and ecological benefits to the county. Research conducted using the Town of Paradise as a case study has indicated that fire buffers—areas of reduced fire fuel that could include areas such as green space or community parklands—are effective zones of wildfire defense and could significantly decrease losses from wildfire and are as effective as zones of wildfire defense that are required for individual homes. This research estimates that using both wildfire buffer zones and codes and clearing requirements for individual residences could convert a one in 100-year loss level into a much rarer one in 350-year loss level (The Nature Conservancy & MarshMcLennan, 2021). Additionally, climate resilient buffers can reduce development in the wildland-urban interface and allow for a broader range of risk reduction strategies, such as controlled burns and a reduction of utilities and infrastructure that have been the source of past wildfire events.

PROJECT TYPES

Management

Conservation

Nature based approaches

Carbon Sequestration

TARGET RESOURCES

Urban wildland interface, areas at risk from wildfire, development lands

PROJECT TIMELINE

Near-to mid-term

POTENTIAL LEADS

Regional Parks, Permit Sonoma

POTENTIAL PARTNERS

Sonoma County Fire District, Sonoma Water, Ag + Open Space, CARD, tribes

FUNDING STRATEGIES

Conservation Easements
Conservation Banks

Carbon Banking

Fees, Taxes

FUNDING SOURCES

CAL Fire, USDA, NFWF, California Firesafe Council, CDFW, CNRA

IDENTIFYING SUITABLE LOCATIONS (WHERE)

The primary ecoregions where climate resilient corridors should be prioritized are in the Napa-Sonoma-Russian River Valleys, the North Coast Eastern Slopes, and the Napa-Sonoma-Lake Volcanic Highlands. Greenbelt Alliance has conducted research and written a white paper that recommends the following related to the locations for climate resilient buffers:

- Select areas that will serve as strategic locations for wildfire defense and are between wildlands and developed areas.
- Place wildfire resistant buffers surrounding developed lands and inside community spaces.
- Use buffers to guide development out of the wildland urban interface and into the developed areas.
- Manage lands for wildfire resilience, biodiversity, and the provision of community green spaces (Greenbelt Alliance, 2021).

DESCRIPTION (HOW)

County agencies including Regional Parks, local fire districts, Permit Sonoma, and others should identify strategic locations for buffers that can serve as areas for wildfire defense, as separations that are managed to reduce fuel load and resist wildfire, and as areas to increase access to improve biodiversity and access to open spaces.

Identify existing trails, open spaces, recreational green spaces, and agricultural lands that can contribute to the network of climate resilient buffers – Regional Parks, Ag + Open Space, land trusts, and others who own, conserve, and/or manage land should work together to identify existing spaces that can be managed to serve as climate resilient buffers.

Identify gaps and critical locations for additional buffers – Based on current and projected wildfire risk, past fire behavior, and land use patterns, determine if there are critical locations where resilient buffers should be expanded or added to reduce risk and increase wildfire resilience.

Design climate resilient buffers handbook – Based on findings from past fires and recent research into the significant risk reduction benefits of wildfire risk reduction buffers, develop a handbook that includes guidance on management strategies to reduce fuel loads and create wildfire resistant landscapes. These spaces can also provide water and soil benefits, space for grazing, and increase community access to open spaces. The handbook could also include recommendations regarding how to limit new development (residential or commercial) in high fire hazard areas.

Identify funding and financing strategies and land use policies – Determine a range of approaches including managing current parks and open spaces to serve as climate resilience buffers. These approaches could include identifying priority locations for conservation easements or purchase, developing zoning that identifies climate resilient buffers and allowable land uses and management practices, identifying incentives and funds to retrofit and relocate structures in high fire hazard areas, and determining funding and financing strategies to enable broad implementation of these buffer zones throughout areas at risk within the county.

IMPLEMENTATION (WHO)

Regional Parks, Permit Sonoma, local fire districts, Sonoma Water, and Ag + Open Space should work together to design the climate resilient buffers network, secure funding, and prioritize implementation based on fire risk, assets at risk, strategic locations for staging fire defense, and need for more robust fire management strategies.

BENEFITS

Reduces risks from: Wildfires, heat, drought.

Provides benefits: Public health and safety, water quality, water and soil health, biodiversity, critical assets and communities at risk from wildfires, wildfire management.

INDICATORS

This project concept will increase key aspects of resiliency as specified by the following indicators:

Landscape: Presence of multiple migration pathways for animals and plant species in the face of increasing temperatures and rising sea levels. Soil water holding capacity. Acreage and distribution of protected land. Acreage and distribution of water resources, permeable soils, and recharge zones. Topographic diversity. Enhanced ecological and hydrologic conditions and processes across landscapes, watersheds, and groundwater basins. Acreage and diversity of fuels treatment and management projects Acres of fire suppressed areas (with consideration of historic fire return intervals). Carbon sequestration potential. Acres of risk reduction

Social: Provision of green corridors and connections, as well as buffers, to provide access to nature and protection and relief from climate hazards. Proximity of natural resource benefits to underserved and under-resourced communities. Proximity to green spaces and green infrastructure within the County's developed lands to underserved and under-resourced communities.

Project Concept N: Resilient Community Corridors

ECOREGIONS

Bodega Coastal Hills

Coastal Franciscan Redwood Forest

Fort Bragg/Fort Ross Terraces

Sonoma-Mendocino Mixed Forest

Mayacamas Mountains

Napa-Sonoma-Lake Volcanic Highlands

North Coast Eastern Slopes

Bay Flats

Napa-Sonoma-Russian River Valleys

PROJECT TYPES

Restoration

Program Development

Nature Based Approaches

Carbon Sequestration

TARGET RESOURCES

Developed lands, marginalized communities, areas vulnerable to climate risks

PROJECT TIMELINE

Near-to mid-term

POTENTIAL LEADS

Regional Parks, Permit Sonoma, CARD, RCPA

POTENTIAL PARTNERS

Ag + Open Space, Sonoma Water, tribes, private landowners, businesses, community groups

FUNDING STRATEGIES

Easements, fees, taxes, tourism

FUNDING SOURCES

State Coastal Conservancy, CAL fire, CCI, Urban Waters Small Grants

PROJECT OBJECTIVES (WHY)

The Resilient Community Corridors project is intended to extend the climate resilient qualities found in Sonoma County's natural lands into underserved communities with less access to green spaces. The project will also serve as an opportunity to connect open spaces and parks, improve movement, and reduce risks from fire, flood, and heat in the urbanized parts of the county. Finally, the project would fill gaps in the system of open spaces where developed lands create a barrier to biodiversity, wildlife movement, and adaptive capacity. Corridors that include urban forests, restored urban creeks, trails, and green infrastructure are effective strategies to reduce climate hazards and sequester carbon, and provide significant health, economic, and ecological benefits to the environment and the community.

IDENTIFYING SUITABLE LOCATIONS (WHERE)

The project would be located within the developed parts of the county, primarily within the Napa-Sonoma-Russian River Valleys ecoregion. The specific locations for the Resilient Community Corridors would include areas with marginalized communities with less access to natural areas and climate resilient resources; areas at risk from wildfire, heat, and flood; areas adjacent to rivers and streams; areas that present current barriers to wildlife movement; and planned trail locations. Resilient Community Corridors can leverage and bolster efforts to complete the Bay Trail and Ridge Trail.

DESCRIPTION (HOW)

Project implementation could include the following steps:

Identify Resilient Community Corridors locations – Determine the ideal system by using county-wide plans as a baseline to identify priority riparian and creek corridors; trail corridors; areas that lack trees and green spaces; areas at high risk from flooding, wildfire, and heat; marginalized and or vulnerable communities; and gaps in wildlife corridor and natural areas.

Engage the community and stakeholders to refine location and develop countywide design – Hold a series of community and stakeholder meetings throughout the county to share the draft Resilient Community Corridor system, location, purpose, and characteristics. The characteristics of the corridor system segments would include native landscape, climate resilient community gardens, traditional green infrastructure for storm water purposes, green roofs, rain gardens, and riparian corridor improvements. The system would also include opportunities for conducting tree planting, improving bike and pedestrian access and paths, creating community parkland and resilience hubs, promoting tribal ecological knowledge and practices, and educating and engage the surrounding community on climate resilience and biodiversity. The project could also include job training to provide local jobs to implement the corridors and volunteer programs to partner with the County to maintain them. The outcome would be a countywide plan for a network of corridors to benefit both the communities that are currently most vulnerable to climate hazards such as flooding.

Design segments – Upon the completion of the countywide system and characteristics, community meetings could be held to refine the design of segments. Collaboration with countywide agencies and organizations could help ensure key objectives for climate resilience and county priorities are met.

Identify funding and financing strategies – Throughout project planning and design, funding and financing strategies could be identified based on the location, characteristics, and benefits of the system and the segments. It is unlikely that one source of funding would be found to complete the whole system but finding resources on a segment-by-segment basis would be possible and sources could include funds to complete the county's trail network, grants for urban forestry, public/private partnerships with local businesses and landowners, and funding for green infrastructure to reduce climate risks.

Implement Resilient Community Corridor Segments – Once planning and design of the system is complete, the implementation of segments can proceed upon securing funding and financing and refinement and approval for segments. The systemwide plan may include prioritization of segments based on criteria such as the potential for risk reduction, the population that will benefit from improved access to open spaces and climate resilience benefits, or the desire to complete a trail segment or wildlife corridor.

IMPLEMENTATION (WHO)

While the Resilient Community Corridors system could be overseen and managed by one countywide agency or organization, the corridor segments could be implemented more broadly by public and private partners. Implementation could also be shared through public/private partnerships that increase capacity and participation in building countywide climate resilience.

BENEFITS

Reduces risks from: Climate risks including wildfire, flooding, heat, extreme precipitation, and risks to marginalized communities, critical assets, natural resources, and fragmentation of natural lands.

Provides benefits: Recreation, equitable and expanded access to natural and open spaces, water quality, air quality, wildlife movement, pedestrian and bicycle access, carbon sequestration, greenhouse gas emission reductions, healthy soils.

INDICATORS

This project concept will increase key aspects of resiliency as specified by the following indicators:

Landscape: Migration pathways, soil water holding capacity, acreage of permeable soils and recharge zones, acreage of protected riparian corridors, presence of habitat connectivity and corridors, topographic diversity, enhanced ecological and hydrologic conditions and processes, topographic and climatic diversity, presence of climate resilient land management practices, acres of risk reduction.

Social: Access for broad participation in climate work, incorporation of traditional ecological knowledge and management, support for diverse organizations and individuals to own, manage, and steward land, contribution to economy and employment, tourism benefits, equitable access to parks and open spaces, provision of green corridors and buffers for access to nature and risk reduction from flood, fire, and heat, proximity of green infrastructure and green spaces to underserved communities.

Project Concept Q: Restore Streams and Riparian Corridors

ECOREGIONS

Bodega Coastal Hills

Coastal Franciscan Redwood Forest

Fort Bragg/Fort Ross Terraces

Sonoma-Mendocino Mixed Forest

Mayacamas Mountains

Napa-Sonoma-Lake Volcanic Highlands

North Coast Eastern Slopes

Bay Flats

Napa-Sonoma-Russian River Valleys

PROJECT OBJECTIVES (WHY)

Sonoma County is traversed by the Russian, Gualala, and Petaluma Rivers and the network of dozens of major and minor streams that feed them. Restoration of these streams and their riparian corridors can help achieve a wide range of objectives (and often many objectives at once), including but not limited to:

- Reduced peak flows. Stream-side trees and grasses can slow floodwaters.
- Improved water quality. Riparian corridors clean water for drinking and clean and cool in-stream flows that support endemic and threated species like coho and steelhead salmon.
- Disrupt spread of wildfire. Moisture in a health riparian area can limit spread of fire wildfire (U.S. Forest Service, n.d.)
- Wildlife corridors. Provide a haven and passage for wildlife movement, especially during a wildfire or landslide.
- Cool microclimate. Create cool microclimate for wildlife and people (streamside recreation areas that provide an escape from hot urban environments) (National Research Council, 2002).
- Carbon sequestration. Tree canopies and vegetated banks that make up a health riparian corridor sequester above and below ground carbon (Dybala et al., 2019).

IDENTIFYING SUITABLE LOCATIONS (WHERE)

The Vital Lands Initiative provides a starting place for prioritizing riparian areas and streams based dominance of native riparian habitat and presence of salmonids and freshwater shrimp in-stream (Ag + Open Space, 2021c). Additional recommendations for prioritizing restoration areas are identified in strategic planning or visioning projects, such as the Upper Sonoma Creek Restoration Vision, Laguna de Santa Rosa Master Restoration Plan, Petaluma Valley Historical Hydrology and Ecology Study, and draft Sonoma Creek Watershed Enhancement Plan. Additional study is required to identify which restoration sites (defined individually or at watershed/sub-watershed) can maximize the resiliency benefits described here.

PROJECT TYPES

Partnerships

Management

Restoration

Monitoring

TARGET RESOURCES

Streams, Riparian Corridors, Watersheds

PROJECT TIMELINE

Assessment

Recommendations

Expand Partnerships & Programs

POTENTIAL LEADS

RCDs, Watershed Associations, County, Sonoma Water NCRP, Ag + Open Space, land trusts

POTENTIAL PARTNERS

Private landowners, Sonoma Ecology Center

FUNDING STRATEGIES

Green/watershed resilience bonds, grants, direct fees

FUNDING SOURCES

2021 State Climate Package, California Wildlife Conservation Board

DESCRIPTION (HOW)

Restoration of rivers and riparian areas includes a wide range of activities, including, but not limited to:

- Working with adjacent land managers to reduce pesticide use
- Repairing eroded banks
- Revegetating riparian corridors and conducting invasive weed control
- Upgrading storm drains
- Managing sediment
- Restoring seasonal wetlands
- Stream monitoring (Heller, 2017)
- Developing and implementing best management practices for grazing and agriculture practices in the vicinity of riparian areas.
- Volunteer engagement
- Installing fish passage (Sotoyome Resource Conservation District & Gold Ridge Resource Conservation District, n.d.)

Sonoma Water, RCDs, Sonoma Ecology Center, Ag + Open Space, Russian River Watershed Association, Confluence, NCRP, and many other institutions are involved designing and implementing a diverse set of riparian restoration and stream health projects throughout the County. The County and partners can further support riparian and stream restoration efforts by ensuring that these riparian restoration efforts are well-integrated with broader watershed management (a systems-scale approach) (Klapproth & Johnson, 2009) and climate resilience efforts given the large impact that roads, development, agriculture, grazing, drought, and wildfires can have on riparian health.

For example, California Forward (2019) developed a report for California Department of Water Resources on collaborative management of the Russian River watershed, recognized the long history of successful partnerships in the watershed on land management, water quality, and endangered species recovery. In addition, the report recommends expanded efforts to develop a shared vision and encourage collective action for the future watershed management, suggesting next steps such as continuing to expand project monitoring and "identify regulatory innovations and enhancements". The County, State, and partner groups have an opportunity to clarify the vision for the watershed, clarify governance structures, map and track projects to date, and expand engagement of local Native American tribes, the public, and key interest groups (California Forward, 2019). While the needs of each of the county's watershed differ, integration of restoration efforts and systems planning can improve resilience of all county watersheds.

IMPLEMENTATION (WHO)

As noted above, riparian restoration, stream health, and systems-scale watershed management are carried out by Sonoma Water, RCDs, Sonoma Ecology Center, Ag + Open Space, Russian River Watershed Association, Confluence, NCRP, and many other institutions. The County can further support these efforts by supporting watershed governance and visioning, filling project tracking and monitoring gaps, engaging elected officials, and supporting development of innovative funding approaches, such as a watershed resilience fund. This work can move restoration from small projects to watershed-scale restoration efforts, maximizing benefits.

BENEFITS

Reduces risks from: wildfires, extreme precipitation, extreme heat, and flooding.

Provides benefits: biodiversity, recreation areas, nutrient cycling, cool microclimates, and water quality improvements (National Research Council, 2002; U.S. Forest Service, n.d.).

INDICATORS

This project concept will increase key aspects of resiliency as specified by the following indicators:

Landscape: Presence/distribution of native species/species richness; presence/lack of anthropogenic stream barriers; acreage and linear miles of protected riparian corridors; acreage and diversity of working lands using climate resilient practices; carbon sequestration potential.

Social: Capacity and access for broad participation in scoping, planning, design and implementation of the Strategy; capacity for ongoing monitoring, maintenance, and adaptive management; increased partnerships between the tribes and the County; equitable access to parks and open spaces.

CASE STUDY

Ebabais Creek Riparian Restoration Project

The Gold Ridge RCD, the local Conservation Corps North Bay, and Point Blue Conservation Science's environmental education program (i.e., the Students and Teachers Restoring A Watershed Program or STRAW) are collaborating with a family dairy in the southwestern county to restore 1,800 ft of riparian habitat on Ebabais Creek. The project will improve water quality and allow for wildlife movement. The project includes carbon farming—through prescribed grazing and rangeland compost application to increase carbon capture (Gold Ridge Resource Conservation District et al., 2022; Hart, 2020).

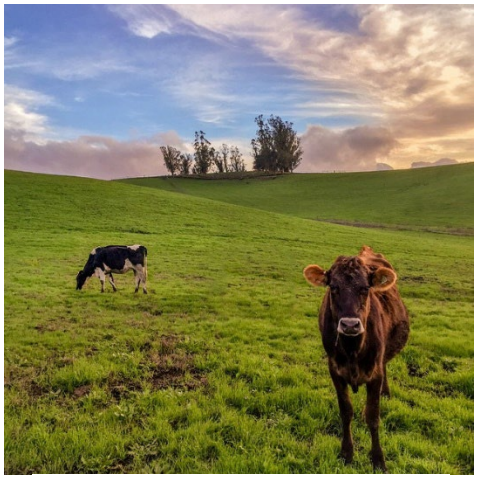


Photo Credit: Peter Alfred Hess.

Project Concept P:
Tidal Marsh Conservation, Restoration, and Sediment Supply

ECOREGIONS

Bodega Coastal Hills

Coastal Franciscan Redwood Forest

Fort Bragg/Fort Ross Terraces

Sonoma-Mendocino Mixed Forest

Mayacamas Mountains

Napa-Sonoma-Lake Volcanic Highlands

North Coast Eastern Slopes

Bay Flats

Napa-Sonoma-Russian River Valleys

PROJECT TYPES

Restoration

Conservation

Carbon Sequestration

TARGET RESOURCES

Tidal Marsh

Coastal Habitats

PROJECT TIMELINE

Synthesis and Alignment

Acquisitions and Conservation

Restoration and Planning

Monitoring and Assessment

POTENTIAL LEADS

County, land trusts, RCDs

POTENTIAL PARTNERS

Sonoma Water, CALTRANS, California Coastal Commission, Ag + Open Space

FUNDING STRATEGIES

SFBJV, sales tax

FUNDING SOURCES

NFWF, NOAA, CA State Parks, USFWS, California Coastal Commission, CDFW

PROJECT OBJECTIVES (WHY)

Sea level rise projections demonstrate a substantial need to plan for increasing threats to natural resources, working lands, communities, and critical infrastructure. Tidal marsh systems provide many benefits, including flood risk management (ESA & PWA, 2013), and are capable of adapting to rising seas when given suitable pathways for inland/horizontal migration and/or vertically accretion. Without proactive actions, existing tidal marsh systems are vulnerable to degradation and climate risk reduction benefits will be lost. Multiple regional planning efforts, including the Sonoma Creek Baylands Strategy (Sonoma Land Trust & San Francisco Bay Restoration Authority, 2020) and the San Francisco Bay Joint Venture (San Francisco Bay Joint Venture, 2022) partnership, identify project prioritization criteria and feasibility considerations for coordinating acquisition, protection, and restoration of bayland and coastal habitats, which align with recommendations and restoration goals offered by the Baylands Ecosystem Habitat Goals Project (San Francisco Bay Area Wetlands Ecosystem Goals Project, 2015).

IDENTIFYING SUITABLE LOCATIONS (WHERE)

Lands currently diked for agriculture are at high risk for flooding/saltwater intrusion and are not likely to sustain current land use practices in the future. These lands can be acquired to allow gradual transition or proactively restored in collaboration with regional efforts. Review of existing and ongoing efforts on EcoAtlas can assist with identifying current gaps and opportunities to develop partnerships with project leads (California Wetlands Monitoring Workgroup, 2022).

DESCRIPTION (HOW)

Tidal marsh restoration projects require significant time investments to move a project through planning, design, permitting, and construction. Further, tidal marsh habitat succession typically occurs over long-time scales and is influenced by numerous external factors, meaning that certain project benefits may be dynamic or not realized for many years after construction is complete. Therefore, a phased approach

should be employed that includes conservation of habitats that currently provide resilient ecological and human community benefits and planning/restoration action to increase bayland/coastal resilience based on future scenarios.

Phase 1 – Synthesis of Existing Work and Strategic Alignment: This phase involves review of existing restoration and conservation efforts and regional plans/strategies to identify gaps and opportunities to support protection and restoration of resilient tidal systems. For the North Bay Subregion, the Baylands Ecosystem Goals highlight a need to restore contiguous tidal habitats in the Napa-Sonoma Marsh, reconnect major tributaries (Napa River, Sonoma Creek, Novato Creek, Tolay Creek, and Petaluma River) to existing tidal systems, and to elevate Highway 37 to improve water and sediment exchanges (San Francisco Bay Area Wetlands Ecosystem Goals Project, 2015).

Phase 2 - Strategic Acquisitions/Conservation: The Baylands within Sonoma County are nearly entirely undeveloped and offer significant opportunities for conservation and restoration. Acquisitions of diked wetlands that once supported tidal marsh habitats and agricultural lands from willing landowners will provide opportunities for immediate restoration actions (marsh and transition zone) and to support future marsh migration. Along the coastline, efforts should focus on conservation of lands adjacent to tidal lagoons (for example, along the Estero Americano) and extant salt marshes adjacent to private lands.

Phase 3 – Restoration and Watershed Planning: Initial restoration efforts within the Bayland can be focused on removal or relocation of levees/barriers to tidal exchange to allow natural accretion and marsh development as well as opportunities to expand upon current/ongoing tidal marsh restoration efforts. These measures should be implemented in conjunction with watershed planning efforts that reconnect streams with marshes (San Francisco Bay Area Wetlands Ecosystem Goals Project, 2015) and to support adequate sediment supplies and in collaboration with proposed infrastructure upgrades (e.g., Highway 37 realignment, Sonoma Creek and Tolay Creek bridge improvements, railroad upgrades). Along the coastline, planning efforts have been primarily limited to individual watershed management and enhancement efforts (e.g., Salmon Creek, Russian River, Estero Americano, Gualala River). Salt marsh habitats are generally limited along the Sonoma coastline and are primarily associated with tidal lagoons and within Bodega Bay. Coastline restoration and enhancement efforts can be focused on coastal dunes, tidal lagoons, and intertidal habitats and as described under Project Concept #3 – Nature Based Approaches to Shoreline Management.

Phase 4 – Monitoring and Adaptive Management: A robust and coordinated monitoring program and adaptive management strategy should accompany restoration and enhancement actions to understand ambient changes and effects of implemented actions. Data from monitoring efforts should be made widely available to encourage input and feedback from regional experts and stakeholders.

IMPLEMENTATION (WHO)

Land managers – including the County, land trusts, RCDs, California Audubon Society, State Parks, Ducks Unlimited, and U.S. Fish and Wildlife Service with the support of planning and regulatory agencies including San Francisco Bay Joint Venture, Association of Bay Area Governments, California Coastal Commission, Bay Conservation and Development Commission, and U.S. Army Corps of Engineers.

BENEFITS

Reduces risks from: sea level rise, flooding, storm surges.

Provides benefits for: coastal and bayland communities and infrastructure, wildlife habitat, carbon sequestration.

INDICATORS

This project concept will increase key aspects of resiliency as specified by the following indicators:

Landscape: acreage and continuity of wetlands, acreage and distribution of protected land, presence of habitat connectivity and transition areas, redundancy of habitat and land types.

Social: condition and management of resources, including presence of adaptive management strategies for working lands and communities.

CASE STUDY

Tolay Creek/Lower Tubbs Island Restoration

Tolay Creek flows into San Pablo Bay between Sonoma Creek and the Petaluma River at Tubbs Island. Collaborative efforts involving the San Pablo Bay National Wildlife Refuge, California Department of Fish and Game, California Audubon Society, and Ducks Unlimited have resulted in restoration efforts to increase tidal flow in lower Tolay Creek, improve water quality, and restore subtidal habitat, tidal marsh, and transition zone habitats at Tubbs Island. These efforts have resulted in improved hydrologic connection between marsh areas and has benefited numerous wildlife species, including multiple endangered and threatened species (Audubon California, 2022; Takekawa et al., 2004). These efforts were supported by funding from Conoco-Phillips, Shell Oil Company Mitigation Funds, California State Coastal Conservancy, U.S. EPA, and CALFED Bay-Delta Program.

Project Concept Q: Urban Streams and Wetland Restoration

ECOREGIONS

Bodega Coastal Hills

Coastal Franciscan Redwood Forest

Fort Bragg/Fort Ross Terraces

Sonoma-Mendocino Mixed Forest

Mayacamas Mountains

Napa-Sonoma-Lake Volcanic Highlands

North Coast Eastern Slopes

Bay Flats

Napa-Sonoma-Russian River Valleys

PROJECT OBJECTIVES (WHY)

Urban stream and wetland restoration projects have the same objectives of stream and wetland restoration elsewhere: restore native plants, create wildlife corridors and habitat, reduce peak flows, disrupt spread of wildfires, sequester carbon, and create outdoor recreation opportunities (National Research Council, 2002; U.S. Forest Service, n.d.). Implementation of these projects in or near urban areas is unique in that a) there may be more channelization and barriers to contend with; and b) projects can directly impact the lives of greater numbers of community members.

Developed/urbanized areas in the county are concentrated in the Napa-Sonoma-Russian River Valleys Ecoregion which cuts through the middle of the county (running north-south). Without streams and wetlands and other habitat corridors running through urban areas, wildlife faces a significant barrier to east-west movement and migration (Sonoma Land Trust, 2014).

IDENTIFYING SUITABLE LOCATIONS (WHERE)

Restoration sites selection should be driven by a strategic, system-wide approach to land use and restoration planning. For example, the many partners involved with Laguna de Santa Rosa (or Laguna) are currently going through such a process (San Francisco Estuary Institute, 2020). The Laguna, which drains a watershed including parts of Windsor, Santa Rosa, Rohnert Park, Cotati, Forestville, and Sebastopol, is one of the largest freshwater wetland complexes in California and supports biodiverse wildlife and a flourishing agriculture.

Through a collaborative process and engagement with landowners, a "Restoration Vision for the Laguna de Santa Rosa" was published in 2020. A restoration plan driven by this vision is in progress. The plan will provide steps to accomplish near-term restoration targets, drawing on project concept developed through visioning (San Francisco Estuary Institute, 2020). Such a process will allow partners to strategically select sites and projects that build toward defined targets and multiply ecological benefits.

Directly within urban centers, initial areas of focus often include streams that have been buried, heavily modified or channelized in order to create more riparian habitat and create more open space and areas for recreation in cities (Bay Area Council, 2019).

PROJECT TYPES

Partnerships

Management

Restoration

Monitoring

TARGET RESOURCES

Streams, Riparian Corridors, Watersheds

PROJECT TIMELINE

Assessment

Recommendations

Expand Partnerships & Programs

POTENTIAL LEADS

RCDs, Watershed Associations, County, Sonoma Water NCRP

POTENTIAL PARTNERS

Private landowners, Sonoma Ecology Center, Ag + Open Space

FUNDING STRATEGIES

Green/watershed resilience bonds, grants, direct fees

FUNDING SOURCES

2021 State Climate Package, California Wildlife Conservation

DESCRIPTION (HOW)

Upon identifying priority sites for restoration, urban stream and wetland restoration can include:

- On-the-ground restoration like repairing eroded banks and conducting invasive weed control.
- Designing recreation areas adjacent to streams for community benefit (Permit Sonoma, n.d.).
- Developing and implementing policy measures to protect riparian corridors: or example, Sonoma County has a Riparian Corridor Combining Zone designed to enhance stream health.
- Collaborating with utilities to enhance stream health: for example, a bridge or culvert replacement project can be designed to encourage stream health.

IMPLEMENTATION (WHO)

Coordinated efforts across Sonoma Water, RCDs, Sonoma Ecology Center, Ag + Open Space, cities, and many other organizations working on urban stream restoration are needed to ensure a system-wide approach to stream and wetland planning. An important role for the County may be supporting projects being developed across city lines and into the unincorporated county.

BENEFITS

Reduces risks from: wildfires, extreme precipitation, extreme heat, and flooding.

Provides benefits: biodiversity, recreation areas, nutrient cycling, cool microclimates, carbon sequestration and water quality improvements (National Research Council, 2002; U.S. Forest Service, n.d.).

INDICATORS

This project concept will increase key aspects of resiliency as specified by the following indicators:

Landscape: Presence/distribution of native species/species richness; presence/lack of anthropogenic stream barriers; acreage and linear miles of protected riparian corridors; acreage and diversity of working lands using climate resilient practices; carbon sequestration potential.

Social: Capacity and access for broad participation in scoping, planning, design and implementation of the Strategy; capacity for ongoing monitoring, maintenance, and adaptive management; equitable access to parks and open spaces; proximity of natural resource benefits to underserved and under-resourced communities; support for diverse organizations and individuals to own, manage, and steward land.

CASE STUDY

Lower Colgan Creek Restoration Project

The City of Santa Rosa is working to restore 1.3-mile portion of Lower Colgan Creek in southwest Santa Rosa. Restoration of the flood control (including extensive riparian plantings) has included expansion of the floodplain, increased sinuosity, and native plantings, among other features. When complete, the project will result in improved flood protection (to 100-year flood protection), increased groundwater recharge, and improved habitat. The project will also provide recreational benefits as the final phase of the project will include development of bicycle and pedestrian paths near regional transportation facilities. Schools

Scientists Studying Water Quality (Todd Harless, USFWS).

along the creek have been engaged in restoration efforts, with students assist with clean ups and plant care (City of Santa Rosa, n.d.).

Appendix B: Sonoma Strategy Public Engagement Meetings—Meeting Agendas

Technical Advisory Committee Meeting #1 Agenda

Technical Advisory Committee
Meeting #1
Process Agenda: December 16, 2021
12:00–1:30 p.m. PT

Meeting Purpose:

- Provide an overview of the project and role of Technical Advisory Committee
- Confirm group membership and representation
- Discuss draft "natural and working lands resilience" definition
- Identify existing data to inform the Plan
- Identify data and information gaps to developing resilience actions

Time (PT)	Agenda Item
12:00—12:10 p.m.	**Meeting welcome and introduction to the Natural and Working Lands Resilience Action Plan (Sonoma County)** ● *Meeting welcome (Sonoma County)* ● *Overview of Plan rationale and purpose*
12:10—12:40 p.m.	**Overview of project and role of Technical Advisory Committee (Lindy Lowe)** ● *Overview of the project and ERG team* ● *Technical Advisory Committee role and introductions* ● *Share TAC meeting frequency and topics* ● *Summary of Draft Plan Components*
12:40—12:55 p.m.	**Natural and working lands resilience definition (Diana Pietri)** ● *Overview of definitions from existing efforts* ● *Draft definition for the project and Plan* ● *Refine and revise draft definition*
12:55—1:20 p.m.	**Existing data sources and information (Diana Pietri and Elizabeth Weathers)** ● *Overview of existing documents reviewed and current gaps* ● *Discussion surrounding additional sources to add and review for topics of 1) Equity and climate justice; 2) funding and financing; 3) natural area resilience; and 4) other sector resilience.*
1:20—1:30 p.m.	**Wrap up and next steps (Lindy Lowe and Sonoma County)** ● *Review homework for the group* ● *Discuss purpose of next meeting* ● *Meeting logistics*

Technical Advisory Committee Meeting #2 Agenda

Technical Advisory Committee Meeting #2

Agenda: January 25, 2022
3:00–4:30 p.m. PT

Meeting Purpose:

- Provide updates on project progress
- Review and discuss changes to "natural and working landscape system climate resilience" definition and goals
- Review climate hazards and assets
- Discuss draft indicators
- Review climate and asset data

Time (PT)	Agenda Item
3:00—3:10 pm	**Meeting welcome and review agenda (Lindy Lowe)** • *Meeting welcome* • *Review of agenda*
3:10—3:20 p.m.	**Updates on project progress (Lindy Lowe)** • *Meetings held since last TAC meeting* • *Further definition of climate hazards, included assets* • *Draft climate resilience indicators*
3:20—3:30 p.m.	**Revisions to natural and working landscape system climate resilience definition and goals (Eliza Berry)** • *Recap of feedback received on definition and goals* • *Review of revised definition and goals* • *Final discussion of definition and goals*
3:30—3:45 p.m.	**Review climate hazards and data to be included in the project (AnnaClaire Marley/Esa Crumb)** • *Climate hazards* • *Data sources and gaps*
3:45—4:05 p.m.	**Share draft assets to be included in the project (AnnaClaire Marley/Esa Crumb)** • *Natural and working landscape system assets* • *Critical community assets*
4:05—4:25 p.m.	**Climate resilience indicators (Lindy Lowe)** • *Natural and working landscape system indicators* • *Components of the system indicators* • *Community and equity indicators*
4:25—4:30 p.m.	**Wrap up** • *Questions or comments?* • *Next steps and upcoming meetings*

Technical Advisory Committee Meeting #3 Agenda

Technical Advisory Committee Meeting #3

Agenda: February 16, 2022
2:30–4:00 p.m. PT

Meeting Purpose:

- Finalize resilience definition and goals
- Finalize climate hazards, assets, and indicators
- Share progress on climate assessment and analysis
- Discuss draft evaluation criteria and prioritization framework

Time (PT)	Agenda Item
2:30—2:40 pm	**Meeting welcome and review agenda (Lindy Lowe)** • *Meeting welcome* • *Review of agenda*
2:40—2:50 p.m.	**Finalize resilience definition and goals (Diana Pietri)** • *Updates made to revised definition based on TAC and IAG feedback* • *Final discussion of definition and goals*
2:50—3:05 p.m.	**Finalize climate hazards, assets, and indicators (Diana Pietri)** • *Recap of feedback received on hazards, assets, and indicators* • *Review of revised assets and indicators* • *Review and discussion of newly added priority communities and equity and community benefit indicators*
3:05—3:30 p.m.	**Share progress on climate assessment and analysis (AnnaClaire Marley/Esa Crumb)** • *Current status of assessment and findings* • *Data gaps and questions for TAC* • *Questions and discussion*
3:30—3:50 p.m.	**Discuss draft evaluation criteria, priorities, and prioritization framework (Lindy Lowe)** • *Initial evaluation criteria and how they will be used* • *Description of prioritization framework and its proposed application* • *Questions and discussion*
3:50—4:00 p.m.	**Wrap up (Lindy Lowe)** • *Questions or comments?* • *Next steps and upcoming meetings*

Implementation Advisory Committee Meeting #1 Agenda

Implementation Advisory Group
Meeting #1

Agenda: January 27, 2022
3:30 – 5:00 pm PT

Meeting Purpose:

- Provide an overview of the project, progress to-date, and the role of the Implementation Advisory Group
- Confirm group membership and representation
- Discuss "natural and working landscape system resilience" definition and goals
- Identify existing processes and plans that are relevant to the Plan
- Consider the opportunities and challenges to leverage, integrate, and align existing work
- Identify opportunities and challenges to identify new or existing funding sources

Time (PT)	Agenda Item
3:30—3:40 p.m.	**Meeting welcome and introduction to the Natural and Working Landscape System Climate Resilience Plan (County of Sonoma and Lindy Lowe)** ● *Meeting welcome (County of Sonoma)* ● *Overview of Plan rationale and purpose (Lindy Lowe)*
3:40—4:10 p.m.	**Overview of project and role of Implementation Advisory Group (Lindy Lowe)** ● *Overview of the project and ERG team* ● *Implementation Advisory Group role and introductions* ● *Share Implementation Advisory Group meeting frequency and topics* ● *Summary of Draft Plan components*
4:10—4:25 p.m.	**Natural and working landscape system climate resilience definition and goals (Diana Pietri)** ● *Overview of definitions from existing efforts* ● *Draft definition for the project and Plan, including feedback from the Technical Advisory Committee and changes made* ● *Refinement and revision of draft definition*
4:25—4:50 p.m.	**Existing processes and plan (Diana Pietri and Elizabeth Weathers)** ● *Overview of existing plans and processes reviewed* ● *Identification of additional relevant processes and plans* ● *Discussion of opportunities for alignment of work* ● *Discussion of potential new and existing funding opportunities*
4:50—5:00 p.m.	**Wrap up and next steps (Lindy Lowe and County of Sonoma)** ● *Any questions or comments?* ● *Discuss purpose of next meeting and recap schedule*

Joint Technical Advisory Committee/Implementation Advisory Group Meeting #1 Agenda

Implementation Advisory Group/Technical Advisory Committee Meeting #3/4

Agenda: March 17, 2022
3:30–5:00 p.m. PT

Meeting Purpose:

- Share and discuss revised indicators and screening and performance criteria
- Review decision-making and prioritization process
- Discuss updated zones and project types

Time (PT)	Agenda Item
3:30—3:40 pm	**Meeting welcome and review agenda (Lindy Lowe)** • *Meeting welcome* • *Review of agenda*
3:40—4:00 p.m.	**Discuss and finalize indicators and screening and performance criteria (Diana Pietri)** • *Recap of feedback received* • *Updates made based on TAC and IAG feedback*
4:00—4:15 p.m.	**Share updated identification of zones and locations (AnnaClaire Marley)** • *Overview of zones approach* • *Updated zone types and locations*
4:15—4:30 p.m.	**Discuss potential project types and zones (Lindy Lowe)** • *Example project types and zones* • *Questions and discussion*
4:30—4:50 p.m.	**Discuss prioritization framework (Lindy Lowe)** • *Proposed approach for screening criteria* • *Description of prioritization framework and its proposed application* • *Questions and discussion*
4:50—5:00 p.m.	**Wrap up (Lindy Lowe)** • *Questions or comments?* • *Next steps and upcoming meetings*

Joint Technical Advisory Committee/Implementation Advisory Group Meeting #2 Agenda

Implementation Advisory Group/Technical Advisory Committee Meeting #2

Agenda: May 9, 2022
2:00–4:00 p.m. PT

Meeting Purpose:

- Share updates on draft Sonoma County Climate Resilient Lands Strategy development.
- Discuss opportunities and challenges.
- Discuss countywide and system-scale recommendations for advancing climate resilience in the natural and working lands.
- Discuss overarching findings and recommended projects for each ecoregion.

Time (PT)	Agenda Item
2:00—2:10 p.m.	**Meeting welcome and review agenda (Lindy Lowe)** • *Meeting welcome* • *Review of agenda*
2:10—2:50 p.m.	**Discuss opportunities, challenges, and system-scale recommendations (Lindy Lowe)** • *Recap of opportunities, challenges, and system-scale recommendations presented in the Strategy* • *Group discussion and questions*
2:50—3:50 p.m.	**Discuss overarching findings and recommended projects for each ecoregion (Esa Crumb and Lindy Lowe)** • *Presentation of ecoregions, findings, and ecoregion scale recommendations* • *Group discussion and questions*
3:50—4:00 p.m.	**Wrap up (Lindy Lowe)** • *Questions or comments?* • *Next steps for finalizing and sharing the Strategy*

Appendix C: List of Documents Reviewed

The following table lists existing documents reviewed for the development of Lands Strategy.

Document Title	Author/Publisher
Adapting to Rising Tides Bay Area: Regional Sea Level Rise and Adaptation Study	San Francisco Bay Conservation and Development Commission
Basin Characterization Model	U.S. Geological Survey California Water Science Center
Biodiversity Action Plan for Sonoma County	Community Foundation Sonoma County, Sonoma County Water Agency
California Climate Adaptation Strategy	California Natural Resource Agency
Caltrans Climate Change Resources	Climate Change Branch of Caltrans' Division of Transportation Planning
Carbon Inventory Estimates for the North Coast Resource Partnership	North Coast Resource Partnership
Climate Action Through Conservation	Ag + Open Space
Climate and Natural Resources Analyses and Planning for the North Coast Resource Partnership	North Coast Resource Partnership
Climate Ready North Bay	California Landscape Conservation Partnership
Defining Vulnerable Communities in the Context of Climate Adaptation	California Governor's Office of Planning and Research
Financing the Future Working Group	San Francisco Bay Conservation and Development Commission
Fire Safe Sonoma	Fire Safe Sonoma
Health Action: 2020 Action Plan	Sonoma County
Healthy Lands & Healthy Economies	Ag + Open Space
House Agriculture Build Back Better Act	House Agriculture Committee
In Sonoma County 'Regenerative Agriculture' Is the Next Big Thing	New York Times
Living in a Fire-Adapted Landscape: Priorities for Resiliency	Ag + Open Space
Morgan Stanley Carbon Sequestration	Morgan Stanley
Natural and Working Lands Climate Smart Strategy	California Natural Resources Agency
Office of Planning and Research Adaptation Financing Guide	Office of Planning and Research
Plan Bay Area	Metropolitan Transportation Commission and Association of Bay Area Governments
Preliminary Designation of Disadvantaged Communities Pursuant to Senate Bill 535	California Environmental Protection Agency
Roadmap for Climate Resilience in Sonoma County	North Bay Climate Adaptation Initiative
San Francisco Bay Shoreline Adaptation Atlas - Working with Nature to Plan for Sea Level Rise Using Operational Landscape Units	San Francisco Estuary Institute and San Francisco Bay Area Planning and Urban Research Association

Document Title	Author/Publisher
Seawall Financing Working Group	City and County of San Francisco
Seeding Capital Policy Solutions to Accelerate Investment in Nature-Based Climate Action	Berkeley Law, University of California, Los Angeles School of Law, and Bank of America
SoCo Adapts	Sonoma County
Sonoma Climate Mobilization Strategy	Sonoma County Regional Climate Protection Authority
Sonoma County Five-Year Strategic Plan 2021-2026	Sonoma County
Sonoma County Hazard Mitigation Plan	Permit Sonoma
Sonoma Resilient Landscapes	Resilient Landscapes Coalition
Sonoma Water Climate Adaptation Plan	Sonoma Water
Sonoma Water Climate Vulnerability Assessment and Adaptation Work Plan 2015	Sonoma Water
Sonoma Water Potential Funding Sources	Sonoma Water
The Baylands and Climate Change, Baylands Ecosystem Habitat Goals Science Update 2015	California Coastal Conservancy
The Vital Lands Initiative	Ag + Open Space
Update to the California Communities Environmental Health Screening Tool: CalEnviroScreen 4.0, Public Review Draft	CalEPA

Appendix D: Potential Funding Sources and Opportunities

The database identifies funding sources and opportunities, such as public and private grant programs and state bond opportunities, which could also support resilience and adaptation projects within the county.

Appendix D: Funding Opportunities

Funder Name	Program	Sector	Website	General Topical Priorities	Relevant Granting Priority Areas	Proposal Process, Requirements, and Timing	Grant Amount	Primary Name and Contact Information
CalFire	Wildfire Prevention Grants Program	Government - Federal	https://www.fire.ca.gov/grants/wildfire-prevention-grants/	The three qualifying projects and activities include those related to hazardous fuels reduction, wildfire prevention planning, and wildfire prevention education.	Wildfire	2022 funding closed	• $514 million over 5 years for hazardous fuels reduction projects • $500 million over 5 years for Community Defense Grants • $88 million over 5 years for State Fire Assistance Grants.	fpgrants@fire.ca.gov cnrgrants@fire.ca.gov (Northern Region Contact) Diane Carpenter (916) 224-8442 Adriana Negrea (916) 462-0055 Shaiyal Kumar (916) 204-0073
California Air Resources Board - GHG Reduction Fund/ Cap-and-Trade Program	Multiple programs	Government - State	https://ww2.arb.ca.gov/sites/default/files/2019-06/draft-nwl-ip-040419.pdf	Emission Reduction and other specific programs: • Natural Resources & Waste Diversion • Climate Adaptation and Resiliency • Climate Ready Program and Climate Adaptation • Healthy Soils • Training and Work Experience • Urban Greening • Wetlands and Watershed Restoration	Sea level rise and storm surge, climate adaptation and resilience, healthy soils, urban greening, wetlands and watershed restoration	*Program dependent*	*Program dependent*	Rajinder Sahota Branch Chief RSahota@arb.ca.gov Richard Corey Executive Officer rcorey@arb.ca.gov
California Coastal Commission	Local Coast Program (LCP) Local Assistance Grant Program	Government - State	https://documents.coastal.ca.gov/assets/lcp/grants/LCPGrantProgramDetails_AdoptedOct2021.pdf https://www.coastal.ca.gov/lcp/grants/#:~:text=The%20LCP%20Local%20Assistance,level%20rise%20and%20climate%20change.	• The Local Coast Program (LCP) Local Assistance Grant Program provides funds to support local governments in completing or updating LCPs consistent with the California Coastal Act, with special emphasis on planning for sea level rise and climate change. • Grant-funded work has included the completion of sea level rise vulnerability assessments, technical studies, economic analyses, adaptation planning and reports, public outreach and engagement, and LCP policy development.	Sea level rise and storm surge, disadvantaged communities and environmental justice, community and/or ecosystem resilience	Round 7 funds for competitive grants is now closed. Join mailing list fo future competitive grants:https://www.coastal.ca.gov/signup/ Non-competitive grants are reviewed and awarded on a rolling basis	Targeted grants: up to $100,000	Brittney Cozzolino (Sonoma, Marin, San Francisco, San Mateo, and Orange counties), brittney.cozzolino@coastal.ca.gov general email: LCPGrantProgram@coastal.ca.gov
California Department of Conservation	Working Lands and Riparian Corridors Program	Government - State	https://www.conservation.ca.gov/dlrp/grant-programs/Pages/Working-Lands-and-Riparian-Corridors-Program.aspx	• Protection, restoration, and enhance working lands and riparian corridors through conservation easements and restoration projects and agricultural lands. • Riparian corridor restoration and conservation, Local and regional planning grants, Land trust capacity grants	Agriculture and working lands, open space and public lands	Most recent grants were awarded in February 2022. 2020 Riparian Corridor Restoration and Conservation grant was awarded to Sonoma RCD for Sonoma Mountain Stormwater Management and Rainwater Storage	$4 million total.	mlrp@conservation.ca.gov
California Department of Fish and Wildlife	Wetlands Restoration for Greenhouse Gas Reductions Program	Government - State	https://www.wildlife.ca.gov/Conservation/Watersheds/Greenhouse-Gas-Reduction	•GHG reductions in wetlands and watersheds •Provide co-benefits to fish and wildlife habitat •Provide co-benefits to water quality and quantity	GHG reductions in wetlands and watersheds, water quality and habitat benefits	Most recent round of funding was awarded in December 2019	$11.35 million granted to seven projects.	Matt Wells CDFW Watershed Restoration Grants Branch (916) 445-1285 matt.wells@wildlife.ca.gov

Funder Name	Program	Sector	Website	General Topical Priorities	Relevant Granting Priority Areas	Proposal Process, Requirements, and Timing	Grant Amount	Primary Name and Contact Information
California Department of Fish and Wildlife - Office of Spill Prevention and Response	Environmental Enhancement Fund Grant Program	Government - State	https://www.wildlife.ca.gov/OSPR/Science/Environmental-Enhancement-Fund/About	Awards grants nonprofits, cities, counties, cities and counties, districts, state agencies, and departments. An enhancement project acquires habitat for preservation, or improves habitat quality and ecosystem function above baseline conditions, is located within or immediately adjacent to waters of the state, has measurable outcomes within a predetermined timeframe, is designed to acquire, restore, or improve habitat or restore ecosystem function, or both, to benefit fish and wildlife.	Habitat preservation, habitat improvement, community and/or ecosystem resilience	Grant proposals and applications were due on March 30, 2022. 2022 selections will be announced in summer 2022.	Total amount awarded to all grantees in a single year is typically $250,000, but can be more or less.	Daniel Orr Environmental Enhancement Fund Grant Coordinator Daniel.Orr@wildlife.ca.gov (916) 445-4325
California Department of Fish and Wildlife - Prop 1	Watershed Restoration Grant Program, and the Delta Water Quality and Ecosystem Restoration Grant Program, collectively named Restoration Grant Program.	Government - State	https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=183720&inline	Watershed restoration and protection projects of statewide importance	Wildfire, sea level rise and storm surge, riverine flooding and extreme precipitation, water quality, community and/or ecosystem resilience, ish and wildlife improvement	2022 Prop 1 Solicitation is now closed. Application deadline March 4, 2022.	Approximately $143 total granted.	Matt Wells CDFW Watershed Restoration Grants Branch (916) 445-1285 matt.wells@wildlife.ca.gov watershedgrants@wildlife.ca.gov
California Department of Fish and Wildlife - Prop 68	Rivers and Streams Grants, Southern Steelhead Grants, Fish and Wildlife Improvement Grants	Government - State	https://wildlife.ca.gov/Conservation/Watersheds/Prop-68	Rivers and streams; Southern Steelhead; Fish and wildlife improvement; Funds planning, implementation and acquisition projects	Fish and wildlife improvement	2022 Prop 1/68 Restoration Grants solicitations are now closed. Application deadline March 4, 2022.	Approximately $6 million for Prop 68 Rivers and Streams Restoration Grants.	Matt Wells CDFW Watershed Restoration Grants Branch (916) 445-1285 matt.wells@wildlife.ca.gov
California Department of Food and Agriculture (CDFA)	Healthy Soils Incentives Program	Government - State	https://www.cdfa.ca.gov/oefi/healthysoils/incentivesprogram.html	Helping California growers and ranchers implement conservation management practices that sequester carbon, reduce atmospheric greenhouse gases (GHGs), and improve soil health.	Agriculture and working lands, carbon sequestration, GHG reduction, soil improvement	2021 funding closed, no date for next round of funding	Up to $67.5M available for 2022 funding	*Not readily available*
California Department of Transportation (CALTRANS) -	Active Transportation Program	Government - State	http://www.catc.ca.gov/programs/atp/	Since its inception, the Active Transportation Program has funded over 700 active transportation projects across the state benefitting both urban and rural areas. More than 200 of the funded projects are Safe Routes to Schools projects and programs that encourage a healthy and active lifestyle throughout students' lives. In addition, every cycle has seen more than 85% of funds going towards projects that will benefit disadvantaged communities throughout the state.	Building bicycle/pedestrian paths, installation of bike racks, and payments for other projects or programs that make walking or biking easier, safer and more convenient.	Deadline June 15, 2022.	ATP cycle 6 is expected to include about $650M.	Karl Anderson Funding Policy and Programs Phone (415) 778-6645 kanderson@bayareametro.gov

Funder Name	Program	Sector	Website	General Topical Priorities	Relevant Granting Priority Areas	Proposal Process, Requirements, and Timing	Grant Amount	Primary Name and Contact Information
California Department of Water Resources	Integrated Regional Water Management (IRWMP) grant programs	Government - State	https://water.ca.gov/Work-With-Us/Grants-And-Loans/IRWM-Grant-Programs https://water.ca.gov/Work-With-Us/Grants-And-Loans/IRWM-Grant-Programs/Proposition-1/Implementation-Grants	Funding is intended to improve regional water self-reliance security and adapt to the effects on water supply arising out of climate change. Specifically, the purpose is to assist water infrastructure systems in adapting to climate change; provide incentives for water agencies throughout each watershed to collaborate in managing the region's water resources and set regional priorities for water infrastructure; and improve regional water self-reliance, while reducing reliance on the Sacramento-San Joaquin Delta.	Disadvantaged communities and environmental justice, planning, implementation	Round 2 Grant solicitation (for 2022 projects) is now closed.	$192 million total	
California Department of Water Resources	Water- Energy Grant Program	Government - State	https://water.ca.gov/Work-With-Us/Grants-And-Loans/Water-Energy-Grant-Programs	•Commercial Water Efficiency or Institutional Water Efficiency Programs •Residential Water Efficiency Programs that benefit Disadvantaged Communities •Projects that reduce greenhouse gas, reduce water and reduce energy use •Only projects with water conservation measures that also save energy	Water efficiency programs	*There are no open solicitations at this time. Projects funded in the 2014 and 2016 solicitations are in progress.*		Leslie Pierce Program Manager at California Department of Water Resources Leslie.Pierce@water.ca.gov (916) 651-9251
California Department of Water Resources - Prop 1	Multiple	Government - State	https://www.waterboards.ca.gov/water_issues/programs/grants_loans/proposition1.html	Help water infrastructure systems adapt to climate change, including, but not limited to: •sea-level rise •Provide incentives for water agencies throughout each watershed to collaborate in managing the region's water resources and setting regional priorities for water infrastructure •Improve regional water self-reliance consistent with section 85021 (Reduce reliance on the Delta)	Small community wastewater, water recycling, dringing water, stormwater, groundwater	*Not listed--varies by program*	Varies based on program. Funding amounts range from $200 million to $800 million.	Kamyar Guivetchi, P.E.Manager Statewide Integrated Water Management Kamyar.Guivetchi@water.ca.gov Zaffar Eusuff Program Manager Muzaffar.Eusuff@water.ca.gov Mark Cowin Director Mark.Cowin@water.ca.gov Ted Daum Theodore.Daum@water.ca.gov
California Department of Water Resources - Urban Streams Restoration	Urban Streams Restoration	Government - State	https://water.ca.gov/Programs/Integrated-Regional-Water-Management/Urban-Streams-Restoration-Program	Projects include: stream cleanups, bank stabilization projects, revegetation efforts, recontouring of channels to improve floodplain function, occasional acquisition of strategic floodplain properties or easements.	Riverine flooding and extreme precipitation	Public comment period closes on Monday March. Following the review of public comments, the Final Guidelines and proposal solicitation will be released.	$1M (available funds per project)	For Riverine Stewardship Program A, Marc Commandatore, Program Manager, Riverine Stewardship Program angelo.commandatore@water.ca.gov Jim Long, Supervisor, Riverine Stewardship Program jim.long@water.ca.gov RSO@water.ca.gov

Funder Name	Program	Sector	Website	General Topical Priorities	Relevant Granting Priority Areas	Proposal Process, Requirements, and Timing	Grant Amount	Primary Name and Contact Information
California Natural Resources Agency - (RA)	Environmental Enhancement and Mitigation Grant Program	Government - State	https://resources.ca.gov/-/media/CNRA-Website/Files/grants/EEM/2022-Final-EEM-Guidelines.pdf https://resources.ca.gov/grants/environmental-enhancement-and-mitigation-eem/	EEM projects must contribute to mitigation of the environmental effects of transportation facilities.	Mitigation of effects of transportation	Proposals must be submitted before 5 PM PST on June 3, 2022.	Grants for individual projects generally limited to $500,000 each. $7 million in total available eachyear	eemcoordinator@resources.ca.gov
California Natural Resources Agency: Recreational Trails and Greenways Grant Program		Government - State	https://www.grants.ca.gov/grants/recreational-trails-and-greenways-grant-program/	Funding to provide nonmotorized infrastructure development and enhancements that promote new or alternate access to parks, waterways, outdoor recreational pursuits and forested or other natural environments to encourage health related active transportation and opportunities for Californians to reconnect with nature.	Promoting access to parks, waterways, outdoor recreation, and natural environments, disadvantaged communities and environmental justice	solicitation out summer 2019 (deadline for application) Deadline for first application October 11, 2019 , awards announced in fall 2020, period of performance is 2 years, so there is likely another round of funding coming in 2022		Contact: Polly Escovedo polly.escovedo@resources.ca.gov (916) 653-2812
California State Coastal Conservancy	Prop 68 SF Bay Area Conservancy Program Climate Adaptation Funds; Coastal Stories Grant Program; Wildfire Resilience Request for Proposals; Explore the Coast Grants	Government - State	https://scc.ca.gov/grants/	•Water Sustainability •Protect and Enhance Anadromous Fish Habitat •Wetland Restoration •Urban Greening • Projects that use natural infrastructure and provide multiple benefits will be prioritized	Sea level rise and storm surge, drought, disadvantaged communities and environmental justice, improve and protect coastal and rural economies, agricultural viability, wildlife corridors, or habitat; develop future recreational opportunities	• Prop 68 Climate Ready, rolling pre-applications accepted from January 1,2021 • Wildfire Resilience, pre-applications accepted on a rolling basis • Explore the Coast Grants. Applications due March 11, 2022 The Conservancy accepts grant applications on an ongoing basis for projects that benefit public access, natural resources, working lands, and climate resiliency on the California coast.	No maximum, the Conservancy will base the size of awards on project needs, benefits and competing demands for existing funding. (exception: $50,000 is the maximum amount for the Conservancy's Explore the Coast Grants)	Moira McEnespy San Francisco Bay Area: Nine Bay Area Counties, excluding the coastside of Sonoma, Marin, and San Mateo Counties: matt.gerhart@scc.ca.gov
California State Parks	Regional Park Program	Government - State	https://www.parks.ca.gov/?page_id=29940	Create, expand, or improve regional parks and regional park facilities. Eligible projects: Acquisition for new or enhance public access and use; Development to create or renovate; trails, with preference given to multiuse over single-use trails; Regional sports complexes; Visitor and interpretive facilities; Other types of recreation and support facilities in regional parks	Regional parks	Application deadline January 20, 2022.	$23,125,000 total available for 2022	Megan Harrison, megan.harrison@parks.ca.gov, (916) 661-1719

Funder Name	Program	Sector	Website	General Topical Priorities	Relevant Granting Priority Areas	Proposal Process, Requirements, and Timing	Grant Amount	Primary Name and Contact Information
California State Parks	Recreational Trails Program	Government - State	https://www.parks.ca.gov/?page_id=24324	The RTP provides funds annually for recreation trails and trails-related projects.	Transportation and recreation trails	Proposal deadline is April 7, 2022.	Non-motorized: $1.7M available Motorized: $1.7M available	Non-motorized: Megan Harrison, megan.harrison@parks.ca.gov, (916) 661-1719 Motorized: Ethan Mathes, ethan.mathes@parks.ca.gov, (916) 215-8074
California State Parks	Statewide Park Development and Community Revitalization Program	Government - State	http://www.parks.ca.gov/?page_id=29939	Projects must create or renovate at least one recreation feature such as an aquatic center, dog park, outdoor gym exercise equipment. Projects may also include major support amenities such as restroom building, parking lot, landscape or lighting that will be constructed throughout the park.	Regional parks, disadvantaged communities and environmental justice	Most recent application deadline:March 12, 2021.	$548.3 million in grants announced for 2022.	parks.ca.gov/?page_id=29939 CA Department of Parks and Recreation Office of Grants and Local Services (916) 653-7423
California Strategic Growth Council and the California Department of Conservation	The Sustainable Agricultural Lands Conservation (SALC) Program	Government - State	http://sgc.ca.gov/programs/salc/	SALC Program Guidelines serve as the basis for this year's SALC Program Request for Grant Applications (Round 5 RFGA), and cover planning grants and Agricultural Conservation Acquisition grants	Agriculture and working lands	Acquisition pre-proposals due June 1, 2022 Planning pre-proposals due July 1, 2022. All applications due September 8, 2022.	No cap for easements grants; $250,00 cap for planning grants	Louise Bedsworth Executive Director of CA Strategic Growth Council louise.bedsworth@sgc.ca.gov
California Wildlife Conservation Board	California Streamflow Enhancement Program	Government - State	https://www.wcb.ca.gov/Programs/Stream-Flow-Enhancement	Water Quality, Supply and Infrastructure Improvement Act provides funding to implement the three objectives of the California Water Action Plan: 1. More reliable water supplies 2. Restoration of important species and habitat 3. More resilient and sustainably managed water resources system that can better withstand inevitable and unforeseen pressures in the coming decades.	Reliable and resilient water supplies, habitat restoration and species protection	*Not readily available*	Prop 1 authorized the Legislature to appropriate $200 million to the Wildlife Conservation Board 2021 SB 170 allocated $100 million dollars from the state general fund to the WCS to fund projects to enhance streamflow	Aaron Haiman (916) 926-8835 wcbstreamflow@wildlife.ca.gov
California Wildlife Conservation Board	Land Acquisition Program	Government - State	https://wcb.ca.gov/Programs/Acquisitions	•Land acquisition •Property evaluation in partnership with CDFW	Land acquisition for conservation and habitat protection	Projects are accepted on a continuous basis if they are in an existing LAE or CAPP. Please contact John Walsh at (916) 322-9461 for further information.		Joseph Navari joseph.navari@wildlife.ca.gov

Funder Name	Program	Sector	Website	General Topical Priorities	Relevant Granting Priority Areas	Proposal Process, Requirements, and Timing	Grant Amount	Primary Name and Contact Information
California Wildlife Conservation Board	Regional Conservation Investment Strategies (RCISs); Mitigation Credit Agreements (MCAs)	Government - State	https://www.wildlife.ca.gov/conservation/planning/regional-conservation	RCISs: Voluntary, non-regulatory, non-binding conservation assessment that includes information and analyses relating to the conservation of focal species, their associated habitats, and the conservation status of the RCIS land base. MCAs: Developed under an approved RCIS, developed in collaboration with CDFW to create mitigation credits by implementing the conservation or habitat enhancement actions identified in an RCIS. MCAs create credits that can be used as compensatory mitigation for impacts under CEQA, CA ESA, and the Lake and Streambed Alteration program.	Wildlife	*Not readily available*		Wildlife Conservation Board Ron Unger RCIS@wildlife.ca.gov (916) 653-3779 CDFW Manager, Landscape Conservation Planning Program rcis@wildlife.ca.gov 916-653-3779
California Wildlife Conservation Board (WCB)	General grant	Government - State	https://wcb.ca.gov/	All projects shall provide one or more of the benefits identified in WCB's Strategic Plan. Projects should also contribute to the State's priorities such as protecting biodiversity, increasing climate resilience, providing access for all, and expanding nature-based solutions through initiatives such as the Pathways to 30x30 document that identifies a goal of protecting 30 percent of California's land and coastal waters by 2030.	Climate change resilience, conserving or enhancing working lands, protecting or enhancing biodiversity	Webinar held on April 6, 2022 to discuss the new WCB General Grant Guidelines. Webinar will be recorded and posted to the WCB website. Pre application not yet available https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=199421&inline	*Funding to be announced*	Shannon Lucas, Manager, Restoration and Development shannon.lucas@wildlife.ca.gov
Federal Emergency Management Agency	Building Resilient Infrastructure and Communities; HMGP Post Fire Grants; Hazard Mitigation Grant Program	Government - Federal	https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities	BRIC program guiding principles are supporting communities through capability and capacity-building; encouraging and enabling innovation; promoting partnerships; enabling large projects; maintain flexibility; and providing consistency.		BRIC opened on September 30, 2021 and closed on Jan 28, 2022.	$700 million available in FY 2020 grants.	California Office of Emergency Services Jennifer L. Hogan jennifer.hogan@caloes.ca.gov (916) 328-7450
National Fish and Wildlife Foundation	National Coastal Resilience Fund (NCRF)	Government - Federal	https://www.nfwf.org/coastalresilience/Pages/home.aspx	The National Coastal Resilience Fund restores, increases and strengthens natural infrastructure to protect coastal communities while also enhancing habitats for fish and wildlife. Regional focus aims to reduce impact of coastal flooding, improve water quality, recreational opportunities, and enhance ecological integrity.	Sea level rise and storm surge, riverine flooding and extreme precipitation, nature-based solutions to enhance resilience of coastal communities and ecosystems	Pre-proposal due date April 21, 2022 *Full proposals are by invite only, must submit pre-proposal and then be invited to apply.* Full proposal invitations: End of May 2022 Full proposals due: Thursday, June 30, 2022	Varies, $140M total available for 2022	Jessica Grannis, Program Director, Coastal Resilience jessica.grannis@nfwf.org Arielle Mion, Program Manager, Coastal Resilience Arielle.Mion@NFWF.ORG

Funder Name	Program	Sector	Website	General Topical Priorities	Relevant Granting Priority Areas	Proposal Process, Requirements, and Timing	Grant Amount	Primary Name and Contact Information
NOAA Coastal and Marine Habitat Restoration Grants	Coastal and Marine Habitat Restoration Grants	Government - Federal	https://www.fisheries.noaa.gov/grant/coastal-and-marine-habitat-restoration-grants	• Community-based Restoration Program funding. Habitat restoration and protection; sustainable fisheries; community based restoration projects,	Restoration projects using a habitat-based approach to rebuild productive and sustainable fisheries, contribute to the recovery and conservation of protected resources, promote healthy ecosystems, and yield community and economic benefits	Most recent round of funding closed in April 2020. Award Period is 1-3 years. *Applicants should apply through the www.Grants.gov website. A complete standard NOAA financial assistance application package should be submitted in accordance with the guidelines in the Federal Funding Opportunity announcement posted to www.Grants.gov. Each application must include the application forms from the SF-424 form family.*	$75,000 to $3 million	Natalie McLenaghan Marine Habitat Restoration Specialist, Office of Habitat Conservation Natalie.McLenaghan@noaa.gov
North Coast Resource Partnership	Regional Forest and Fire Capacity Planning	Regional Partnership	https://northcoastresourcepartnership.org/ncrp-regional-forest-planning/	Promote and support collaborative planning and implementation of wildfire resiliency and forest health protection, management, and restoration efforts at the landscape or watershed level. Coordinate and integrate management of wildfire resiliency and forest health protection, management, and restoration efforts at the regional scale. Identify, prioritize, and implement forestry and wildfire protection projects that meet regional and statewide public safety, ecosystem, and public resource goals, and that are consistent with the Forest Carbon Plan.	Wildfire	Most recent grants were announced in 2021. Grant term is through 2025	$8.88 million available for 3 grants (North Coast Region)	Jenny DiStefano jenny.e.distefano@conservation.ca.gov
Resources Legacy Fund	California coastal program; Land-sea connection (LSC); San Francisco Bay Area Conservation	Private Foundation	https://resourceslegacyfund.org/programs/	LSC program supports high-value, on-the-ground conservation efforts to reduce impacts to watershed health across a range of issues, with focused investments related to cannabis cultivation, agricultural practices, and urban runoff/stormwater San Francisco Bay Area Conservation supports wetlands restoration around the Bay with a focus on building a diverse constituency to support equitable, long-term funding and government policies for Bay restoration and flood improvements including the effective implementation of Measure AA.	Sea level rise and storm surge, disadvantaged communities and environmental justice	Must be invited to submit a proposal, after invitation one can go through the online portal https://resourceslegacyfund.org/grantees/	Varies	Julie Turrini Director/Attorney, Lands, Rivers, and Communities JTurrini@resourceslegacyfund.org or Jocelyn Herbert Program Manager/Attorney JHerbert@resourceslegacyfund.org
United States Department of Agriculture, Natural Resources Conservation Service	Regional Conservation Partnership Program	Government - Federal	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/rcpp/	• Helping partners, ag producers, and private landowners address local and regional natural resource challenges • Land management/ land improvement practices • Land rentals • Entity-held easements • United States-held easements • Public works/ watersheds	Agriculture and working lands	Proposal Deadline is April 13, 2022.	NCRS will invest up to $225 million in RCPP Classic and RCPP alternative Funding arrangement projects for 2022. • RCPP has $300M to invest annually	For more information, please contact RCPP@usda.gov

Funder Name	Program	Sector	Website	General Topical Priorities	Relevant Granting Priority Areas	Proposal Process, Requirements, and Timing	Grant Amount	Primary Name and Contact Information
United States Department of the Interior Bureau of Land Management	California Fuels Management and Community Fire Assistance Program	Government - Federal	https://www.grants.gov/custom/viewOppDetails.jsp?oppId=339261#relatedDocumentsTab	Accomplish fuels management activities on federal and non-federal land; Develop and implement fire education, training, and/or community action plans/programs; Conduct Community Wildfire Protection Plans (CWPPs), community wildfire assessments, and planning activities; Expand community capability to enhance local employment opportunities; Develop and implement short and long-term monitoring and maintenance plans for hazardous fuels reduction, community fire education and training, and community action ptorgrams	Wilfire			
NFWF and federal agencies	America the Beautiful Challenge 2022		https://www.nfwf.org/programs/america-beautiful-challenge/america-beautiful-challenge-2022-request-proposals					

Appendix E: Climate Hazard Projections

Temperature Projections

By 2040, the average maximum temperature in Sonoma County is expected to increase by an average of about 2.4°F under both a hot and low rainfall scenario (MIROC RCP 8.5) (see Figure 36) and a warm and high rainfall scenario (CNRM RCP 8.5) (see Figure 37). However, by the end of this century, the average maximum temperature in Sonoma County is expected to increase by about 9.9°F on average (ranging from 9.2°F—10.8°F) under a hot and low rainfall scenario compared to historic temperatures. Under a warm and high rainfall scenario, average temperatures are expected to increase about 6.8°F (ranging from 6.3°F —7.8°F). In both scenarios, the Fort Brag/Fort Ross terraces are expected to experience the largest increase in temperature from the historic baseline.

The average minimum temperature in Sonoma County is expected to increase by an average of about 2.7°F under both a hot and low rainfall scenario and a warm and high rainfall scenario. However, by the end of this century, the average maximum temperature in Sonoma County is expected to increase by about 9.4°F on average under a hot and low rainfall scenario compared to historic temperatures. Under a warm and high rainfall scenario, average temperatures are expected to increase about 7.2°F. In both scenarios, the southeast region of the county is expected to experience the largest increase in average minimum temperature from the historic baseline, such as in the Napa–Sonoma–Lake Volcanic Highlands ecoregion.

Figure 36. Average annual maximum temperature 2040-2069 change from historical average under MIROC RCP 8.5 (hot, low rainfall scenario).

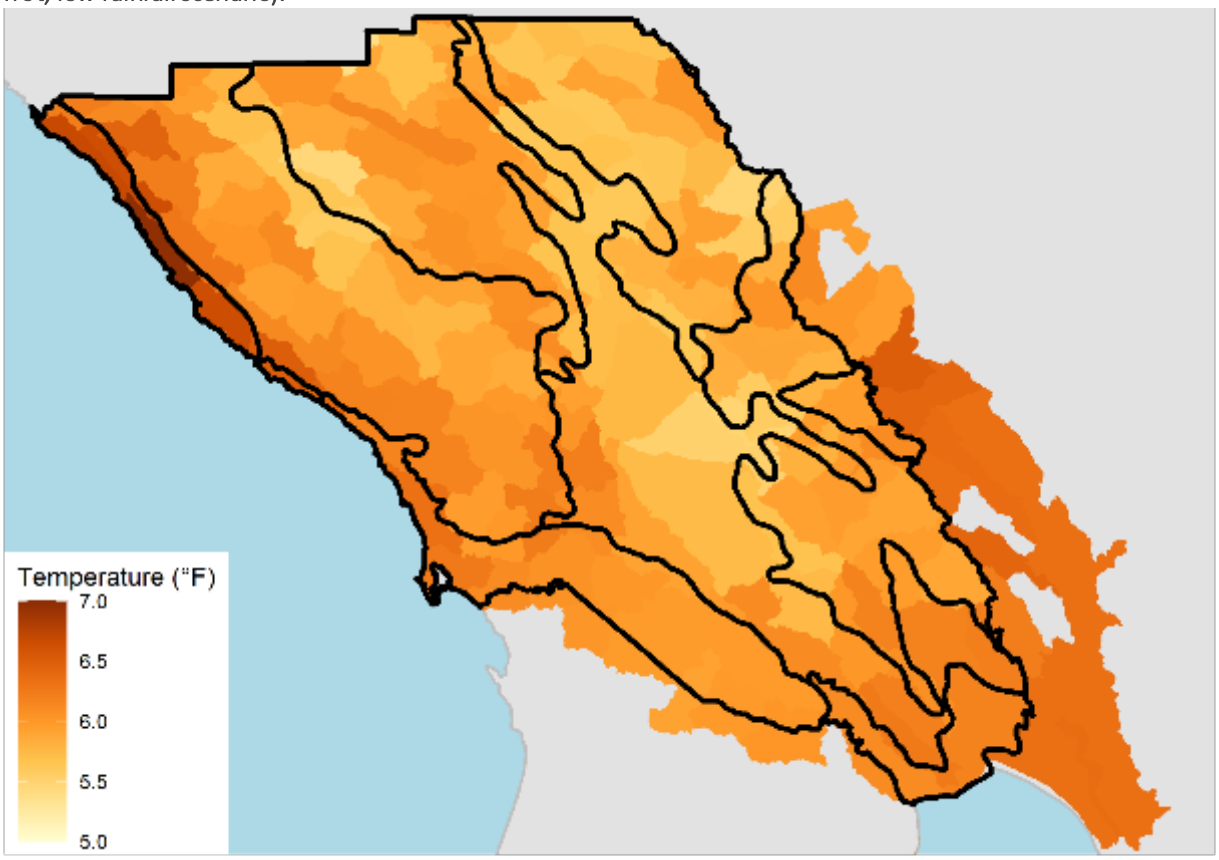
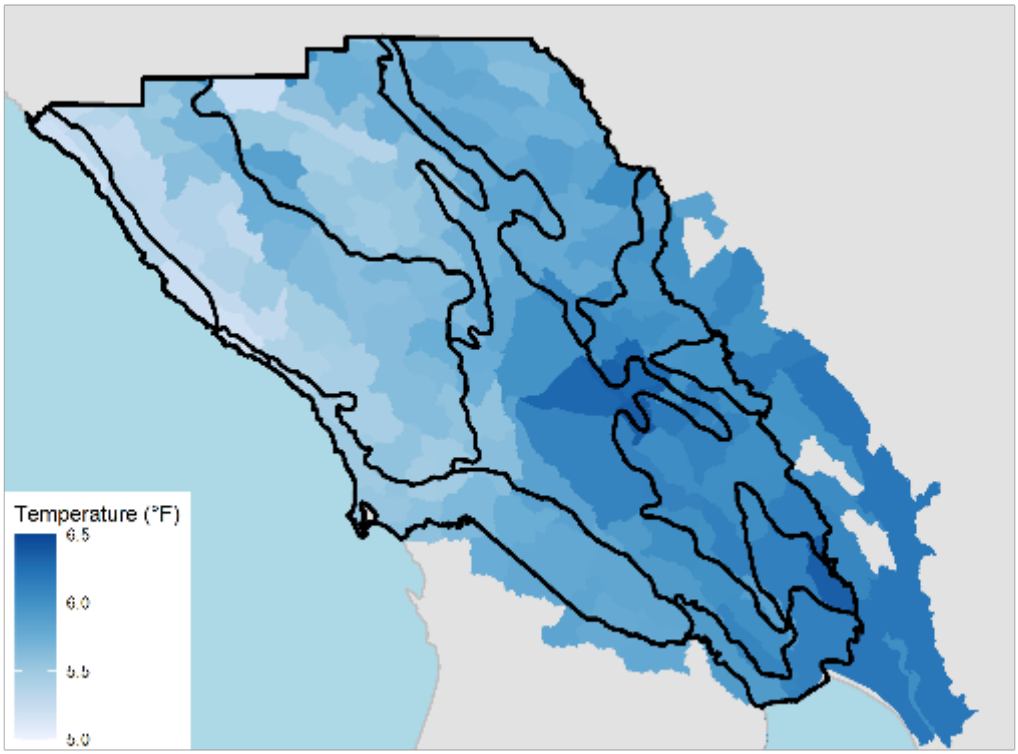


Figure 37. Average annual minimum temperature 2040-2069 change from historical average under MIROC RCP 8.5 (hot, low rainfall scenario).

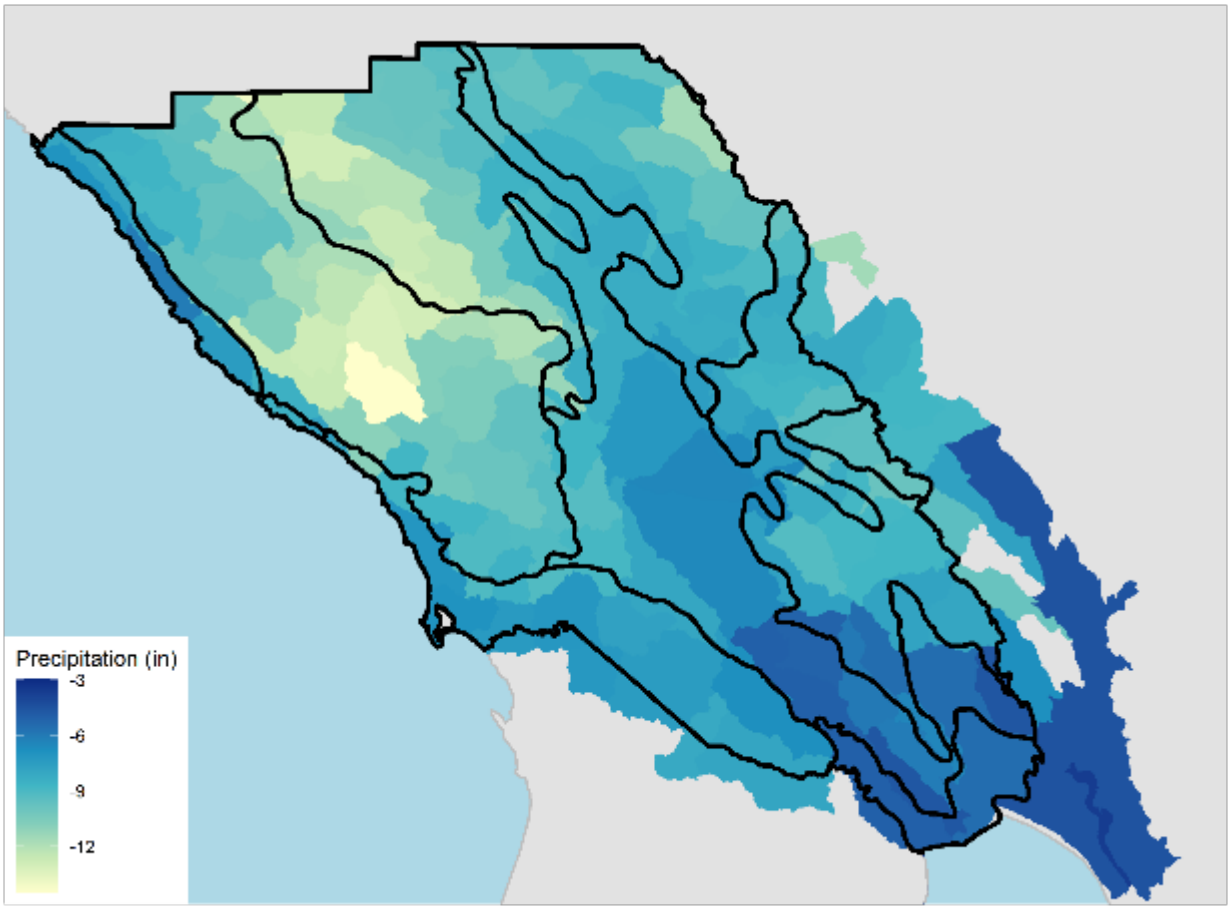


Precipitation and Flood Projections

As shown in Figure 38, the hot, low rainfall scenario (MIROC) indicated that average annual precipitation will decline over the century.

Under both a warm and high rainfall scenario and a hot and low rainfall scenario, the Coastal Franciscan Redwoods ecoregion generally is expected to receive the highest amount of precipitation, while the Bay Flats ecoregion is expected to experience some of lowest precipitation in the county. By 2040, average annual rainfall is projected to increase by an average of 12.6 in or decrease by an average of 1.9 inches under a warm and high rainfall scenario and a hot and low rainfall scenario, respectively. By 2069, under a hot and low rainfall scenario, the northern part of the county is expected to experience the biggest decrease in precipitation while the southern portion is expected to experience the smallest decrease (Figure 38). By the end of the century, this large difference in projected rainfall is expected to increase to 16.9 in or decrease by 9.6 in under the two different climate scenarios.

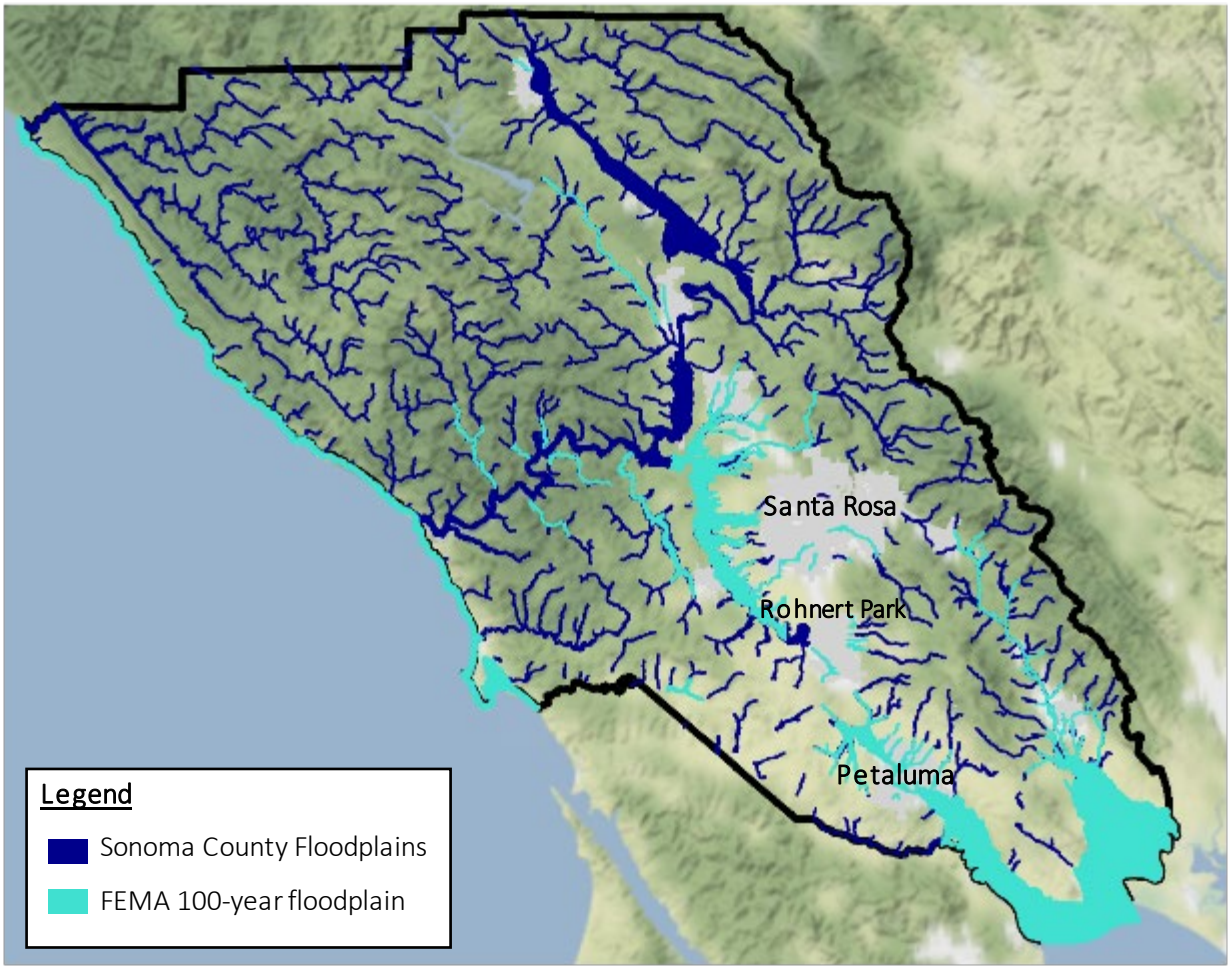
Figure 38. Average total annual precipitation 2040-2069 change from historical average under MIROC RCP 8.5 (hot, low rainfall scenario).



The models agree in their projections of more frequent atmospheric rivers with occasional increases in storm intensity (Cornwall et al., 2016; Micheli et al., 2018). As such, increased flood extent and flood frequency are also expected. Details of future flows and inundation areas are difficult to project over decades, given that most rain in the county arrives in thin, difficult to anticipate bands (i.e., atmospheric rivers). Instead of utilizing future flood projections, we have provided the best available, current flood maps in the county: FEMA's 100-year flood zone and Sonoma County Flood Awareness Areas (see Figure 39 on the next page). The Sonoma County Flood Awareness data includes channels and floodplains for functional riparian areas in which stream catchment areas are over 500 acres (Permit Sonoma, 2021c). For purposes of considering flood risk, floodplains are mapped below (and channels are excluded).

These maps estimate current flood risk based on historical data. They should be viewed with the understanding that 1) such floods will occur more often over the century and 2) floods may exceed the flood zones shown.

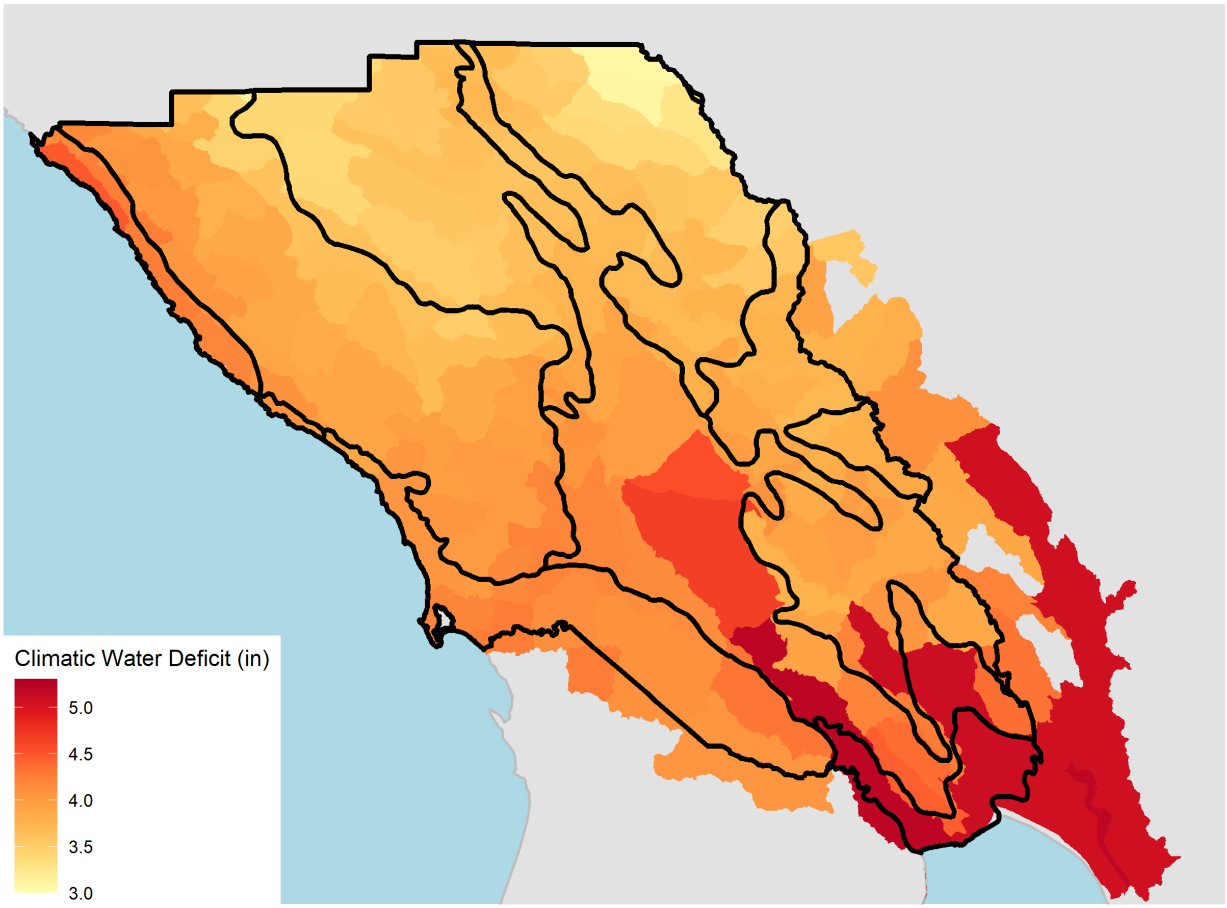
Figure 39. Floodplains from Sonoma County Flood Awareness Areas and FEMA's 100-year flood zone.



Drought Projections

Projected changes in frequency and intensity of precipitation and projected increases in surface temperature will lead to increases in drought severity and duration. There are several metrics for drought stress, with climatic water deficit (CWD) proving especially useful by integrating joint effects of temperature, available rainfall, and watershed structure. CWD takes into account rainfall, air temperature, topography, and soil structure to estimate how much more water the landscape could have used in the absence of drought conditions (Micheli et al., 2016; North Coast Resource Partnership, 2020; Sonoma Water, 2021a). All models evaluated under the NCRP point to increasing CWD over time, with outputs of two models provided in Figure 40.

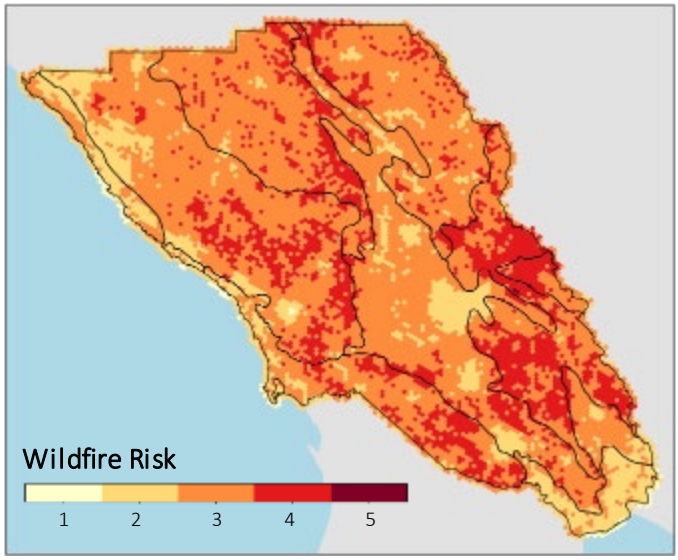
Figure 40. Average total annual climatic water deficit 2040-2069 change from historical average under MIROC RCP 8.5 (hot, low rainfall scenario).



These two climate scenarios show CWD growing over time, with CWD particularly extreme under a hot, low rainfall scenario (MIROC RCP 8.5). In both cases, CWD is more extreme inland than on the coast, meaning inland lands are more vulnerable to drought conditions. This trend is consistent regardless of land use category (Micheli et al., 2018).

Wildfire projections

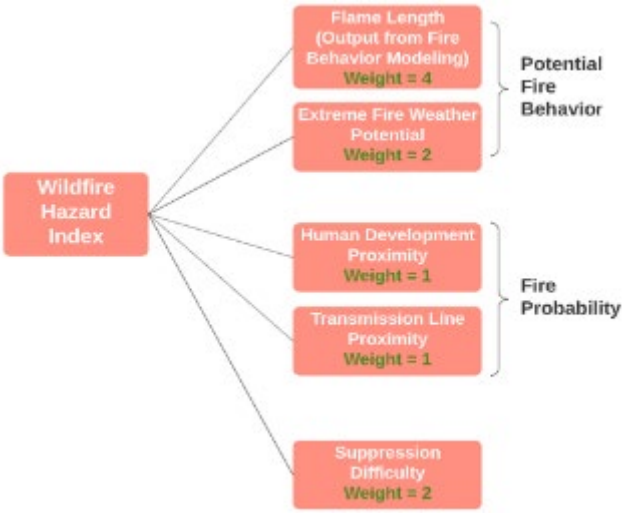
Figure 41. Wildfire Risk Index across Sonoma County.



In considering wildfire risk across the county, our team focused on the Sonoma County Wildfire Risk Index which models predicted wildfire risk, classifying pixels on a five-point scale ranging from "low risk" to "extreme risk" as mapped in Figure 41. One of the key inputs to the model is the Sonoma County Wildfire Hazard Index, which is summarized in **Error! Reference source not found.**. The Risk Index also includes inputs such as an ember load index, structure density, and road network rank. Please see the Sonoma County Wildfire Risk Index Story Map for additional details on the index and its inputs.

The North Coast Range Eastern Slopes and Napa–Sonoma–Lake Volcanic Highlands ecoregions contain the highest proportions (58 and 51% respectively) of total acres in the very high (class 4) and extreme risk (class 5) areas. Both ecoregions are mostly forested and covered by the resources and rural development land use type. Fire risk is lower along the coast and San Pablo Bay than inland areas. The Napa–Sonoma–Russian River Valleys ecoregion stands out in having lower fire risk than the mountainous/hilly areas to its east and west. The ecoregion is predominately characterized by development and agriculture, which contributes to its lower wildfire risk.

Figure 42. Sonoma County Wildfire Hazard Index Inputs. The Wildfire Hazard Index is one of the inputs to the Wildfire Risk Index. Credit: County of Sonoma, 2021.

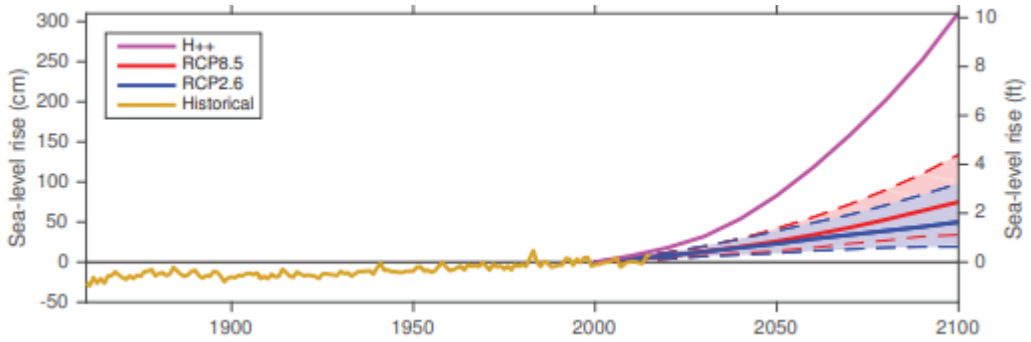


The Sonoma County Wildfire Risk Index addresses current fire hazards and does not project them into the future. There are several challenges to projecting future fire risk, such as the challenge of predicting ignition from lightning and human activities and modeling of "fire weather" conditions and fuels accumulation (Micheli et al., 2018). Various efforts have been made to project wildfire risk in the state, including a recent effort by Park et al. (2021) . However, the data created from this model only has fire projections up until 2016. Until more data becomes available this may be the best fire model to use for the County. For the time being, the Sonoma County Wildfire Risk Index provides an important starting point for considering fire risk as it contains the most Sonoma-specific inputs, and its outputs are high resolution. It is understood that existing fire risk across the county will increase over time, following a similar relative risk distribution (Micheli et al., 2018; Thomas et al., 20018; Westerling, 2018). As such, we can review Sonoma County Wildfire Risk Index and assume the fire risk shown will increase over time without major changes in land management and vegetation management.

Sea Level Rise and Storm Projections

This document investigated sea level rise and storm projections that align with the State of California's Sea Level Rise Guidance (Ocean Protection Council, 2018). California's Ocean Protection Council (OPC) Sea Level Rise Policy Guidance provides a range of sea level rise projections linked to different emissions scenarios[6] and differing probabilities of exceedance (Ocean Protection Council, 2018) as depicted in Figure 43 below. The guidance calls on coastal planners and local government to consider a range of sea level rise projections to account for uncertainty in the projections and consider varying consequences of adopting a single projection (i.e., if one assumes a lower sea level rise projection, what will the consequence be for a critical asset?). The document recommends that coastal planning decisions consider the impact of storms on top of sea level rise. Coastal planners and communities will be faced with decisions on whether to recommend managed retreat. Sonoma county has a unique opportunity to demonstrate migration and managed retreat due to large number of public lands.

Figure 43. Relative sea level at the San Francisco tide gauge (source: Griggs et.al., 2017).



For the purposes of this strategy, we have selected planning scenarios and identified alignment with the best available sea level rise inundation mapping for Sonoma County along San Francisco Bay, Sonoma's Pacific coast, and the Russian River (outputs of the U.S. Geological Survey's Coastal Storm Modeling System [or CoSMoS]) (Barnard et al., 2019). The key CoSMoS inundation map scenarios applied are: 2.5 and 6.6 ft of sea level rise and with and without a 100-year storm. Alignment between these scenarios and the State Guidance are summarized in Table 13. For project-specific planning efforts, managers may need to consider additional or different scenarios.

[6] As a reminder, RCP 8.5 is the high or business as usual emissions scenario. RCP 2.6 is the low emissions scenario (aggressive emissions reduction). It is considered extremely unlikely given current global emission trends. RCP 4.5 (not pictured) is more moderate emissions reduction. The H++ scenario graphed here in an extreme scenario that assumes rapid ice sheet melt. The probability of this occurrence is not known.

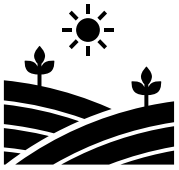
Table 13. Alignment between state sea level rise guidance and CoSMoS scenarios.

Comparing CA State Sea Level Rise Guidance to COSMOS scenarios (subset of scenarios) for San Francisco Tide Gauge			1-in-200 Chance	H++
			Medium-High Risk Aversion	Extreme Risk Aversion
2050	State Guidance (high emissions)	MHHW+	1.9 ft	2.7 ft
	COSMOS Equivalent Mapped	MHHW+	--	It
			--	2.5 ft + 100-yr storm
2060	State Guidance (high emissions)	MHHW+	2.6 ft	3.9 ft
	COSMOS Equivalent Mapped	MHHW+	2.5 ft	--
	Sea Level Rise + 100-year storm	MHHW+	2.5 ft + 100-yr storm	--
2080	State Guidance (high emissions)	MHHW+	4.5 ft	6.6 ft
	COSMOS Equivalent Mapped	MHHW+	--	6.6 ft
2100	State Guidance (high emissions)	MHHW+	6.9 ft	10.2 ft
	COSMOS Equivalent Mapped	MHHW+	6.6 ft	--
	Sea Level Rise + 100-year storm	MHHW+	6.6 ft + 100-yr storm	--

Appendix F: Indicators of Resilience

To measure progress being made on climate resilience, is it critical for the Lands Strategy to include a clear set of landscape-scale indicators that will allow the County to understand changes that are occurring on the landscape and the location, and types of benefits being achieved by projects advanced from this Strategy. Indicators—defined within this strategy as quantitative or qualitative qualities or system traits that describe condition or performance—are also essential to defining a decision-making process that it can be used to select and prioritize projects. To support ongoing measurement of progress toward the goals and objectives of the Strategy, the County, the TAC, and the IAG, as well as others who were engaged in the development of the Lands Strategy identified indicators related to three major categories: physical climate resilience, social climate resilience, and equity and community benefits. The sections that follow provide more detail regarding these three sets of indicators.

I. Climate Resilience Landscape Indicators



Physical climate resilience indicators will help the County assess changes across its natural and working landscape system. From indicators that will measure the condition of the lands (e.g., presence and distribution of native species, annual and perennial crops) to those that will evaluate cover and connectivity of protected land, these indicators will help the County understand how the landscape is responding to changing conditions, stressors, and extreme events. Table 14 below describes the indicators that the agencies within the county could use to assess the climate resilience of its natural and working lands at the landscape scale.

Table 14. Climate resilience landscape indicators.

Indicator Category	Indicators
Ecosystem health and biodiversity	• Absence of nuisance species, pests, and disease • Maintenance of current patterns of biodiversity • Presence of multiple migration pathways for animals and plant species in the face of increasing temperatures and rising sea levels • Native plant and animal dominance • Pollinator presence • Post-fire disturbance/succession • Presence and condition of annual and perennial crops/climate-resilient grazing practices • Presence/distribution of native species/species richness • Presence/lack of anthropogenic stream barriers • Soil water holding capacity
Land coverage	• Acreage and continuity of wetlands (freshwater and coastal) • Acreage and distribution of protected land • Acreage and distribution of water resources, permeable soils, and recharge zones • Acreage and linear miles of protected riparian corridors • Acreage of different forest stand types (oak woodland, riparian, redwood/Douglas fir, pine) • Acreage of forestland by age and late seral forest characteristics • Acreage of regulated and protected land within a property (e.g., forestland acres with exclusion zones, riparian buffers, Northern Spotted Owl core areas)

Indicator Category	Indicators
	• Acreage and diversity of working lands using climate-resilient practices • Acreage of land devoted to food production using regenerative practices • Topographic diversity
Habitat quality and condition	• Acreage, age, and diversity of forest land • Elevation and type of shoreline, presence of upland transition zone • Enhanced ecological and hydrologic conditions and processes across landscapes, watersheds, and groundwater basins • Quantity or acreage of restored watersheds • Presence of biodiversity and native species • Topographic suitability of land for cropping, grazing by a diversity of animals; forest restoration and recovery; and fuels management projects • Topographic and climatic diversity • Water access and storage
Land management	• Acreage and diversity of fuels treatment and management projects Acres of fire suppressed areas (with consideration of historic fire return intervals) • Acreage of forest treatments by silviculture type • Carbon sequestration potential • Acres of risk reduction • Acreage of agricultural land stewarded using climate-resilient practices (e.g., practices that increase water retention, increase soil nutrients, decrease erosion, promote plant health and resilience to climate impacts, encourage native pollinators, etc.) • Diversity of production on agricultural lands • Food system diversity • Number of landowners using climate-resilient management practices (including grazing, croplands and vineyards practices, and timber practices)

II. Social Resilience Indicators

This set of indicators will help the County track how projects implemented under this Strategy are influencing the conditions of residents, workers, and visitors in the county, as well as assessing some of the socioeconomic aspects of the county's natural and working lands. Through indicators related to land ownership, access and proximity to natural resources, workforce capacity, exposure to risk of the workforce, and more, these indicators could allow organizations working on climate resilience throughout the county to think about how to design and adaptively manage projects to ensure meet its goals of providing critical and equitably distributed social functions and benefits to the county's residents, particularly underserved and under-resourced communities. Table 15 below provides more details regarding these indicators.

Table 15. Social resilience indicators.

Indicator Category	Indicators
Management, ownership, and capacity	• Capacity and access for broad participation in scoping, planning, design and implementation of the Strategy • Capacity for ongoing monitoring, maintenance, and adaptive management

Indicator Category	Indicators
	• Condition and management of resources, including presence of adaptive management strategies for working lands and communities (dairy, vineyard, crop, and grazing lands) • Inclusion of small farmers in program development and design to ensure compatibility with needs • Development of shared decision-making frameworks with tribal partners to identify tribal cultural properties and resources, as well as other conservation priorities and strategies • Incorporation of traditional ecological knowledge and tribal expertise into management • Increased partnerships between the local Native American tribes and the County • Land ownership and management—public, private, tribal • Ongoing, meaningful consultation and engagement with local Native American tribes regarding resilience priorities and actions related to advancing the Strategy • Participation of prescribed burn associations, cooperative burning, and fire training for everyday people • Strengthened partnership with RCDs to identify needs and opportunities of small farms • Support for diverse organizations and individuals to own, manage, and steward land • Support for small farmers to implement climate-resilient agricultural practices and shift to regenerative and ecological practices (e.g., through technical assistance, grant writing support, peer-to-peer learning, financial resources)
Socioeconomic benefits	• Contribution of natural and working lands to the County's economy and employment • Contribution of natural and working lands to tribal economies and employment • Health, safety, and capacity of workers (e.g., loggers, heavy equipment operators, and forest field staff and vegetation managers) to make a living wage and access housing in the community they work • Health and capacity of workforce/number of workers • Health, safety, and capacity of tribal communities • Implementation of community-based processes to strengthen capacity and increased participation (e.g., workforce development, access to green jobs, technical assistance) • Protection of workers to climate hazards (e.g., worker exposure to wildfire smoke, heat, and chemicals) • Prioritization and protection of tribal cultural resources and properties • Tourism levels
Proximity and access	• Access to resources, food, water, healthcare, and other critical services in rural communities • Equitable access to healthful, nutritious, fresh food (ideally locally grown for increased resilience to disruption, maximum nutrition, and local economic benefit) • Equitable access to parks and open spaces and jobs opportunities • Prioritization and protection of access (ingress and egress) to tribal lands through state and county roads during disasters

Indicator Category	Indicators
	• Provision of green corridors and connections, as well as buffers, to provide access to nature and protection and relief from climate hazards • Proximity of natural resource benefits to underserved and under-resourced communities • Proximity to green spaces and green infrastructure within the County's developed lands to underserved and under-resourced communities

III. Equity and Community Demographic Indicators

This set of demographic indicators will help monitor the composition of communities in the county that could benefit from natural and working lands. These demographic indicators could allow those using this Lands Strategy to advance projects that will result in benefits to underserved and under-resourced communities. The equity and community indicators below are drawn from A Portrait of Sonoma County 2021, California Air Resources Board's California Climate Investments Priority Populations, CalEnviroScreen 4.0's demographic characteristics, and MTC's Equity Priority Communities. Indicators include:

- Age (under 5 and over 75)
- Asthma
- Cardiovascular disease
- Education
- Employment type
- Gender
- Homelessness
- Housing cost burden
- Housing crowding
- Income/poverty
- Life expectancy
- Limited English Proficiency/Linguistic Isolation
- Low birth weight
- People with a disability
- Race and ethnicity
- Single parent families
- Transportation cost burden
- Unemployment
- Zero-vehicle household