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C/CAG City/County Association of Governments of San Mateo County

OneWatershed Framework Report

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CA Governor's Office of Land Use and Climate Innovation

As communities in California experience more frequent, prolonged, and severe impacts from climate change, communities and governments at all scales are developing strategies and implementing actions to build a climate- resilient future. However, many jurisdictions, especially under-resourced communities in California, lack the capacity, tools, guidance, and resources to effectively prepare for climate impacts. The APGP addresses this capacity gap by providing funding to help fill planning needs, providing communities with the resources to identify climate resilience priorities, and supporting the development of climate resilience projects across the state. The APGP enables communities to climate risk and adaptation considerations into planning activities and prepare for climate readiness and resilience in the long term.

The APGP is an initiative of the Integrated Climate Adaptation and Resiliency Program (ICARP) housed within the Governor's Office of Planning and Research. ICARP advances statewide climate adaptation and resilience by coordinating investments, partnerships and climate science to ensure people, natural systems, and the built environment are protected, prepared, and thrive in the face of climate change. Through direct and equity-focused investments and resources, ICARP helps build climate adapted and equitable communities in California, with a focus on solutions that both address the impacts of climate change and reduce greenhouse gas emissions. ICARP works to advance these priorities across all levels of government by developing actionable science and research; providing guidance, tools, and technical assistance; and administering climate resilience-focused grant programs. Learn more: https://opr.ca.gov/climate/icarp/

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ACRONYMS AND ABBREVIATIONS

°F	degrees Fahrenheit
BAWSCA	Bay Area Water Supply & Conservation Agency
BCDC	San Francisco Bay Conservation and Development Commission
C/CAG	City/County Association of Governments
Cal OES	California Governor's Office of Emergency Services
Caltrans	California Department of Transportation
CBO	community-based organization
CNRA	California Natural Resources Agency
CRC	Climate Resilient Communities
DWR	Department of Water Resources
GCM	Global Climate Model
GSA	Groundwater Sustainability Agency
ICARP	Integrated Climate Adaptation and Resilience Program
ISG	Individual Supply Guarantee
LTVA	*Long-Term Vulnerability Assessment and Adaptation Plan*
mgd	million gallons per day
MS4	municipal separate storm sewer system
NPDES	National Pollutant Discharge Elimination System
RCP	Representative Concentration Pathway
RSB	Resilient San Bruno
RSAP	Regional Shoreline Adaptation Plan
SF RWS	San Francisco Regional Water System
SFEI	San Francisco Estuary Institute
SFPUC	San Francisco Public Utilities Commission
SGMA	Sustainable Groundwater Management Act
SLR	Sea Level Rise
SPUR	San Francisco Bay Area Planning and Urban Research Association
TAC	Technical Advisory Committee
USGS	United States Geological Survey
UWMP	Urban Water Management Plan

VA	voluntary agreement
WSCP	Water Shortage Contingency Plan

EXECUTIVE SUMMARY

E.1. Introduction

In 2023, the City/County Association of Governments of San Mateo County (C/CAG) received a grant from the California Integrated Climate Adaptation and Resilience Program (ICARP) Adaptation Planning Grant Program to develop and pilot the *OneWatershed Climate Resilience Framework* (OneWatershed Framework or Project), an equitable climate adaptation approach focused on integrated watershed management. The ICARP-funded project is led through a collaborative partnership of agencies and community partners, including C/CAG, Climate Resilient Communities (CRC), OneShoreline, City of San Bruno, County of San Mateo Sustainability Department, City of South San Francisco's South San Francisco-San Bruno Regional Water Quality Control Plant, and the Bay Area Water Supply & Conservation Agency (BAWSCA).

E.2. Background

San Mateo County is at risk from several categories of climate hazards that have significant consequences for watershed infrastructure and resources. The OneWatershed Framework leverages the definitions and approaches in the California Adaptation Planning Guide (California Governor's Office of Emergency Services [Cal OES] 2020). Cal OES defines *"a **hazard** [as] an event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, damage to the environment, interruption of business, or other types of harm or loss. A **climate hazard** is a dangerous or potentially dangerous condition created by the effects of the local climate."* The OneWatershed Framework focuses on specific climate hazards for which studies have already been completed and identified as high priority for Bay Area regional planning, for example: sea level rise, drought, extreme precipitation, extreme heat, and wildfire.

E.3. OneWatershed Framework

The OneWatershed Framework is intended to support the collaborative efforts of San Mateo County (County) agencies and interested parties, working across jurisdictions/organizations and watershed boundaries to achieve long-term and strategic climate resilience. The OneWatershed Framework is designed to employ a community co-creation approach to listen to the lived experiences of community members and weigh this input along with available quantitative on climate hazard exposure data and projections. A key goal of the approach is to identify the infrastructure that is most in need of updates per input from local communities, and develop a suite of multi-benefit projects that address the climate resilience and regulatory needs of multiple water infrastructure sectors and can be funded through innovative partnership approaches. The OneWatershed Framework is intended to be used on a longer-term basis to advance equitable watershed-based climate resilience in San Mateo County.

This OneWatershed Framework has been developed through the ICARP grant funding awarded to C/CAG and Project partners. A portion of the grant funding was directly awarded to CRC as the project community-based organization (CBO), and the remainder was contracted with a technical Consultant Team. Several groups were formed to support the development of the

OneWatershed Framework, including the Project Management Team, which leads the project; the Technical Advisory Committee; the Equity Priority Group, comprised of community-based organizations, non-profits, and interested County residents; and the Resilient San Bruno Team (RSB), which is the local Climate Change Community Team[1] made up of motivated and interested residents and/or community organization representatives from the San Bruno Creek Watershed. These groups and representatives were engaged throughout the development of the OneWatershed Framework through interactive meetings and review and comments on project deliverables.

The OneWatershed Framework defines a stepwise process that has been designed to be used on a watershed-basis for any watershed in San Mateo County. The process is intended to result in hyper-local watershed-specific Climate Resilience Plans that leverage Countywide tools but are guided by the lived experiences and priorities of the local community. The approach is illustrated in Figure E-1.

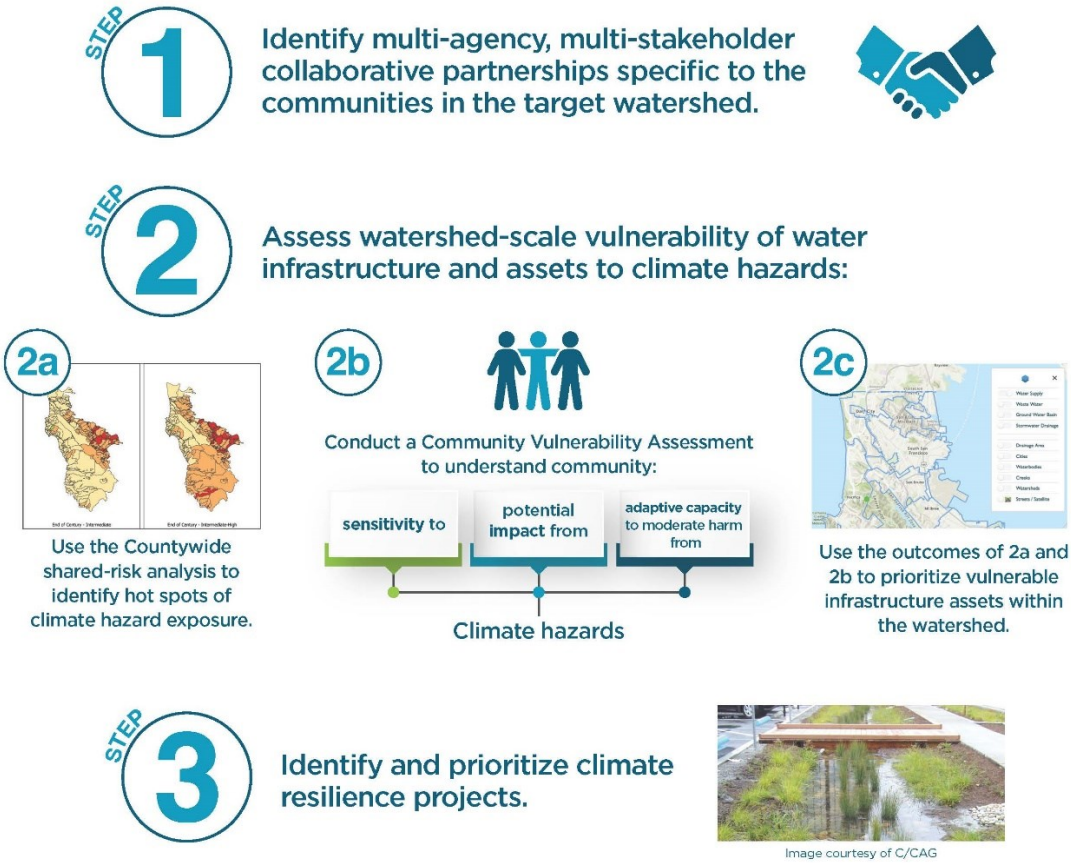

Image courtesy of C/CAG

[1] Climate Change Community Teams include local community-based organizations, religious leaders, youth leaders, and those interested in advancing climate change adaptation and action at the local level.

Figure E-1: OneWatershed Framework Process

Geospatial information system (GIS) data used for this analysis have been compiled in the OneWatershed Web Viewer. The data and Web Viewer are described in the OneWatershed Data Inventory attached to this Report (Appendix B). To complete the watershed-specific steps 2b and 2c of the OneWatershed Framework process, separate watershed-specific data should be compiled, including OneWatershed asset information, localized and/or asset-specific climate exposure or consequence projections, and existing plans across all OneWatershed infrastructure network sectors, including but not limited to stormwater capital improvement program projects; water supply infrastructure plans; wastewater infrastructure plans; green stormwater infrastructure plans; climate action plans; other climate resilience plans; creek and stream plans; pedestrian/bike, safe routes to school, or other transportation plans; development plans, etc.

E.4. Climate Hazard Exposure Assessment

A Countywide data-driven assessment of climate hazard exposure for OneWatershed infrastructure networks was conducted to support individual watershed-scale Climate Resilience Plans. The results of this analysis are intended to be used to support Step 2a of the OneWatershed process, i.e., ***Assess watershed-scale vulnerability of OneWatershed infrastructure and assets to climate hazards.*** This climate hazard exposure analysis examined the location and relative magnitude of climate hazards in relation to OneWatershed infrastructure networks in San Mateo County based on existing studies and reports. Climate hazards examined included: Sea Level Rise, Extreme Heat, Extreme Precipitation, Hydrologic Drought, and Wildfire. Climate hazard exposure was assessed using previously established studies and methods. An exposure score of "low," "moderate," or "high" was identified geospatially for each OneWatershed infrastructure network category based on the relative magnitude of exposure to the associated climate hazard.

A geospatial analysis was conducted to assess climate hazard exposure for four future climate scenarios for each OneWatershed infrastructure network category on a unit basis across San Mateo County. OneWatershed infrastructure network unit boundaries are defined as: Water supply service areas; Wastewater collection and treatment plant service areas; Stormwater catchments; and Groundwater basins. For each applicable OneWatershed infrastructure category, an exposure level (i.e., low, moderate, high) was assigned for each climate hazard category. The levels were assigned to infrastructure network units countywide based on the co-located geospatial climate hazard data.

E.5. Community Vulnerability Assessment Approach

The OneWatershed Framework incorporates a pilot Community Vulnerability Assessment which gathers information from community members and will be led by CRC. The results of this assessment are intended to be used to support Step 2b and 2c of the OneWatershed process, i.e., ***Assess watershed-scale vulnerability of OneWatershed infrastructure and assets to climate hazards.***

The Community Vulnerability Assessment is designed to compile experiential ("lived experience") data from residents living in frontline communities. The data collected is intended to identify what resources are currently being used to prevent climate impacts, recover from climate impacts, and what resources are needed that could improve prevention or recovery.

These components can be used to understand community sensitivity to climate hazard exposure, potential impacts from climate hazards, and the community's current adaptive capacity, as well as the gap between potential community impacts and adaptive capacity. All this information is compiled into a Community Vulnerability Assessment report.

E.6. Climate Resilience Projects

The OneWatershed Framework is ultimately designed to identify a variety of cross-water sector, cross-agency/partner climate resilience projects that could reduce priority vulnerabilities and increase resilience on a watershed-scale (Step 3 of the OneWatershed Framework process). These projects could include new projects or already-planned projects that have been identified through other planning processes. Longer-term, the Climate Resilience Plans developed through the OneWatershed Framework (including the San Bruno Creek pilot, which will be completed by early 2026) can be used to prioritize implementation of climate resilience projects across the County.

E.7. Pilot Application to San Bruno Creek Watershed

In 2025, the Project will pilot the OneWatershed Framework in the San Bruno Creek watershed. Step 1, identify multi-agency, multi-stakeholder collaborative, has been initiated, through the establishment of the Resilient San Bruno Team, working collaboratively with the PMT. Beginning in early 2025, the Project will initiate Step 2, ***Assess watershed-scale vulnerability of OneWatershed infrastructure and assets to climate hazards,*** resulting in a prioritized list of vulnerable OneWatershed infrastructure network assets. To address these vulnerabilities, the Project will then complete ***Step 3, identify and prioritize climate resilience projects.*** In close coordination with the Resilient San Bruno Team, the PMT and the Consultant Team will identify potential climate resilience projects that could address prioritized vulnerabilities within the watershed. These projects will be prioritized to maximize the climate hazard resilience benefits provided, in alignment with community priorities.

E.8. OneWatershed Dashboard

The OneWatershed Dashboard (https://web.paradigmh2o.com/smc-gi-tracking-qa/onewatershed) is a web-based tracking and visualization tool that has been developed to facilitate development of watershed-specific Climate Resilience Plans. The Dashboard leverages output from the climate hazard exposure assessment to summarize climate exposure risks based on geographic location of OneWatershed infrastructure network assets. The Dashboard will also be used to document community vulnerability assessment findings and identify OneWatershed Climate Resilience projects. The Dashboard and integrated visualization tools can be used for future watershed-scale climate resilience planning efforts.

1. INTRODUCTION

In 2023, the City/County Association of Governments of San Mateo County (C/CAG) received a grant from the California Integrated Climate Adaptation and Resilience Program (ICARP) Adaptation Planning Grant Program to develop and pilot the *OneWatershed Climate Resilience Framework* (OneWatershed Framework or Project), an equitable climate adaptation approach focused on integrated watershed management. The ICARP-funded project is led through a collaborative partnership of agencies and community partners, including C/CAG, Climate Resilient Communities (CRC), OneShoreline, City of San Bruno, County of San Mateo Sustainability Department, City of South San Francisco's South San Francisco-San Bruno Regional Water Quality Control Plant, and the Bay Area Water Supply & Conservation Agency (BAWSCA).

In collaboration with the project partners, C/CAG is developing the OneWatershed Framework as a method to assess the regional and shared risk of climate change to water infrastructure and resources (sewer, water, and stormwater) and to establish a cross-sectoral institutional foundation to build adaptive capacity to climate hazards for the most vulnerable communities through climate-resilience-focused programs, policies, and green and/or grey infrastructure projects. The OneWatershed Framework is intended to be a model that can be applied to watersheds throughout San Mateo County. As part of the Project, the OneWatershed Framework will be piloted in the San Bruno Creek watershed.

This OneWatershed Framework Report conceptually defines the goals, processes, data analyses, and stakeholder communication and outreach strategies that can be used to understand and assess the shared-risk of climate hazards for water infrastructure at the watershed scale and develop and advance climate resilience projects to reduce climate impacts and establish equitable and sustained funding cost frameworks. This report is organized as follows:

- Section 2 provides relevant background information for the OneWatershed Framework.
- Section 3 describes the objectives of the OneWatershed Framework, the development of the framework, the framework components, and OneWatershed data.
- Section 4 details the countywide climate hazard exposure approach and results.
- Section 5 describes the community vulnerability assessment approach.
- Section 6 introduces climate resilience projects, programs, and policies.
- Section 7 summarizes the proposed approach for the San Bruno Creek Watershed pilot application of the OneWatershed Framework.
- Section 8 describes the OneWatershed Dashboard.
- Section 9 includes document references.

2. BACKGROUND

2.1 Climate Risks to Communities in San Mateo County

San Mateo County is at risk from several categories of climate hazards that have significant consequences for watershed infrastructure and resources. San Mateo County has the highest population of any county in California living in projected sea level rise inundation areas, with an estimated $39.1 billion in assets at risk to flooding in the next 50 to 100 years (reference). In addition to public infrastructure, nearly 30,000 homes and 3,000 commercial parcels in San Mateo County are vulnerable to the impacts of sea level rise, including potential displacement and job loss (San Mateo County Office of Sustainability 2018). The county's location, bounded by the Pacific Ocean to the west and the San Francisco Bay to the east, makes it especially vulnerable to extreme rainfall through atmospheric river events, high tides/storm surge, and sea level rise, which place strain on the County's infrastructure and impact communities. In 2023, a number of communities in San Mateo County experienced unprecedented wet weather events, and portions of the County received more than four inches of rain in a single storm[2], causing major property flooding, road closures, and even deaths (Bay City News 2023). Communities in San Mateo County are anticipated to face additional severe climate risks in the coming decades, including coastal flooding and erosion, with especially significant erosion on the Pacific Coast side of the County; upland flooding from increasing extreme precipitation events (C/CAG 2021); wildfire, with an eight-fold increase in probability of a large fire occurring in the County by 2070 (Climate Ready San Mateo County, "Wildfire"); increased water stress due to drought, with two major droughts in the County spanning nine out of eleven consecutive years (between January 2012 and December 2022) with record-high heat and low precipitation (*Statesman Journal* 2024); and increased urban heat (Climate Ready San Mateo County, "Extreme Heat"), especially in the highly urbanized communities along the bayshore.

These climate hazards have and will cause direct damage, including harm to natural and built assets, adverse consequences to wildlife and ecosystems, and groundwater depletion, as well as indirect damage, such as a decrease in public safety, community equity, and economic vitality. In many cases, climate risks may be compounded with cascading effects due to the County's geography and inter-related infrastructure dependencies. For example, runoff-generated flooding in a tidally influenced location, could trigger cascading disruptions to critical services in an expanded area upstream, including transportation networks, water delivery and treatment processes, and energy infrastructure.

To support the overall and parallel resilience planning efforts in San Mateo County and align with state guidance, the OneWatershed Framework leverages the definitions and approaches in the California Adaptation Planning Guide (California Governor's Office of Emergency Services [Cal OES] 2020). This includes definitions relating to the consequences of climate change. Key definitions from Cal OES (2020) include:

[2] Approximately equivalent to a 25-year, 24-hour event per NOAA Atlas 14 for Bayside San Mateo County (4.4 inches).

> ***Climate change*** *refers to a change in the climate that can be identified by changes in the mean and/or variability of its properties and that persists for an extended period, typically decades or longer.*[4]
>
> *A* ***climate change effect*** *is any consequence, generally a negative one, that is caused by climate change.*
>
> *A* ***hazard*** *is an event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, damage to the environment, interruption of business, or other types of harm or loss. A* ***climate hazard*** *is a dangerous or potentially dangerous condition created by the effects of the local climate.*

The OneWatershed Framework focuses on specific climate hazards for which studies have already been completed. Climate hazards include, for example: sea level rise, drought, extreme precipitation, extreme heat, and wildfire.

2.2 Vulnerable Communities

Underserved and vulnerable communities in San Mateo County are at disproportionate risk of exposure to climate hazards and the resulting consequences. As seen in recent years, the pendulum swing between extreme heat and drought followed by torrential atmospheric river events causes "climate impact whiplash" to communities across San Mateo County. The most vulnerable communities in the County, including underserved communities and those neighborhoods identified as disadvantaged per state and federal classifications, experience many of the greatest impacts. This is often due to being in low-lying coastal or Bayside areas where aged, undersized, and/or underfunded water, sewer, and storm drain systems are at a higher risk of failure during large storms. These consequences are expected to increase with projected future changes in precipitation.

San Mateo County has greater income inequality than any other county in California, with underserved climate-vulnerable communities located within minutes of some of the wealthiest communities in the country. The County of San Mateo has enacted several measures to address the County's equity gap. This includes the development of the County Equity Framework (County Equity Framework | County of San Mateo, CA) that includes adopted resolutions and an ordinance to address equity challenges in the County, with a stated aim "*to create a strong, diverse, and equitable county where all people feel a deep sense of belonging and are empowered to voice their needs and manifest their aspirations."* The County of San Mateo also has a Recovery Initiative (SMC Recovery Initiative | County of San Mateo, CA), which "*is a collaboration among local government agencies, nongovernment organizations, private partners, and residents to promote inclusive recovery and leverage the collective capacity of the whole community to build a more equitable, healthy, and connected San Mateo County."*

Additional details about San Mateo County communities and the San Bruno Creek community, where the OneWatershed Framework will be piloted, are provided in the engagement plan included as Appendix A.

2.3 OneWatershed Infrastructure Networks

San Mateo County is served by several different infrastructure networks and water resources that are potentially vulnerable to climate hazards. To address the overlapping risk of climate change to water infrastructure and resources—focusing on the most vulnerable communities—the OneWatershed Framework focuses on the infrastructure networks summarized in Table 1, which are referred to as "OneWatershed infrastructure networks" throughout this document.

Table 1: OneWatershed Infrastructure Networks

Category	Infrastructure[1]	Water Resource of Focus
Water Supply	Reservoirs, supply lines, turnouts, interties, storage tanks, treatment plants	Water Supply Sources
Wastewater Services	Private laterals, sewer main pipes, lift stations, wet wells and detention facilities, treatment plants, recycled water distribution system	Sanitation and Recycled Water
Stormwater Drainage System	Inlets, storm drain pipes, pump stations, channels, detention facilities, outfalls, stormwater treatment assets (e.g., green stormwater infrastructure)	Receiving Waters
Groundwater Basins	Private and public wells, pumps, treatment equipment	Groundwater

[1] Represents major classes of infrastructure, not intended to include all infrastructure classes.

2.4 Regulatory Requirements

San Mateo County, C/CAG member agencies, water suppliers, wastewater collection and treatment providers, and groundwater basins are subject to myriad regulatory requirements. These regulatory systems may provide barriers or in some cases may incentivize collaborative projects that could address the consequences of climate change to water infrastructure and resources. These regulations include:

- Water Supply
  - The California Safe Drinking Water Act establishes drinking water standards for public water systems (e.g., primary and secondary Maximum Contaminant Levels [MCLs]).
- Wastewater

    - Wastewater treatment plants are regulated under the federal Clean Water Act and are permitted to discharge treated water effluent in accordance with individual National Pollutant Discharge Elimination System (NPDES) Permits, which regulate the types and amounts of pollutants that can be discharged into receiving waters.

- Stormwater
    - The California Regional Water Quality Control Board San Francisco Bay Region Municipal Regional Stormwater NPDES Permit (R2-2022-0018), which C/CAG member agencies are subject to. Other entities within San Mateo County are also subject to other NPDES permits, including the Phase II Small Municipal Separate Storm Sewer System (MS4) Permit (Order WQ 2013-0001-DWQ, as amended) for entities including school districts and universities; the Caltrans MS4 Permit (Statewide Stormwater Permit Order 2022-0003-DWQ) for highways; and varying Industrial General Permits and Waste Discharge Requirements for other industrial facilities.
    - The State Water Resources Control Board is currently drafting regulations for the onsite treatment and reuse of non-potable water (SBDDW-22-001) (State Water Resources Control Board 2024).
- Groundwater
    - In California, the Sustainable Groundwater Management Act (SGMA) was passed in 2014 and established a new structure for managing California's groundwater resources at the local level by local agencies. SGMA required Groundwater Sustainability Agencies (GSAs) to form in the State's high- and medium-priority basins and subbasins by June 30, 2017. The Water Code states that a GSA shall produce Groundwater Sustainability Plan to sustainably manage these subbasins. San Mateo County includes nine SGMA basins, but none are listed as high- or medium priority (California Department of Water Resources [DWR] n.d.).
    - The construction of new private groundwater wells is regulated by San Mateo County Environmental Health Services via the Water Well Ordinance (No. 4023, 2001). After the initial permit is granted, the long-term maintenance of the well, including water quality, is typically the responsibility of the owner. In March of 2024, the California DWR published *Groundwater Well Permitting: Observations and Analysis of Executive Orders N-7-22 and N-3-23*, which included policy recommendations for future well permitting, such as not issuing new groundwater well permits in medium- or high-priority basins without GSA approval.

These regulatory requirements must be considered for any climate resilience mitigation measures that may be implemented.

2.5 Climate Adaptation and Resilience

Cal OES (2020) describes climate adaptation planning as follows:

Climate adaptation planning allows communities to identify ways that they might be harmed by future conditions, including those unique to their communities, and to prepare for these conditions before they happen.

The Adaptation Planning Process, as illustrated by Cal OES (2020), is included in Figure 1 below.

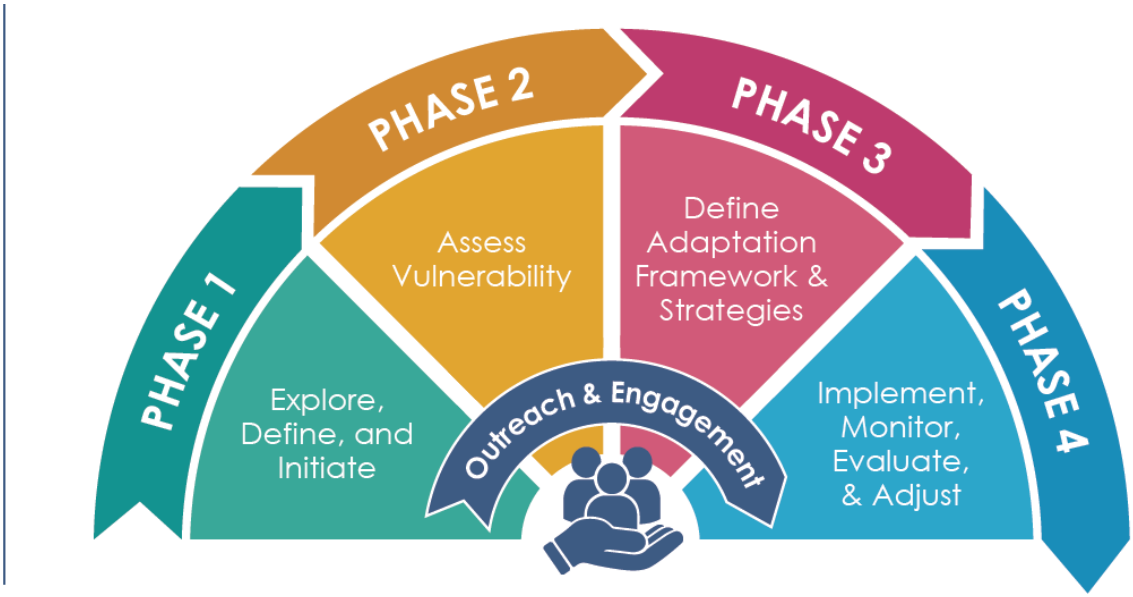

Figure 1: Adaptation Planning Process (Cal OES 2020)

Key definitions from Cal OES (2020) have been included below to orient the OneWatershed Framework approach around resilience, understanding climate vulnerability, and developing mitigation approaches that can reduce climate impacts:

> ***Resilience*** *is the "capacity of any entity—an individual, a community, an organization, or a natural system—to prepare for disruptions, to recover from shocks and stresses, and to adapt and grow from a disruptive experience." Adaptation actions contribute to resilience, which is a desired outcome or state of being.*
>
> ***Mitigation*** *is an act or sustained actions to reduce, eliminate, or avoid negative impacts or effects.* ***Hazard mitigation*** *is a sustained action taken to reduce or eliminate the long-term risk to human life and property through actions that reduce hazard, exposure, and vulnerability. Hazard mitigation can be one component of climate change adaptation.* ***Climate change mitigation,*** *also referred to as Greenhouse Gas (****GHG) mitigation*** *or* ***GHG reduction****, refers to actions to reduce GHG emissions to reduce the severity of climate change.*
>
> ***Vulnerability*** *is the exposure of human life and property to damage from natural and human-made hazards. Climate vulnerability describes the degree to which*

natural, built, and human systems are at risk of exposure to climate change impacts. Differences in exposure, sensitivity, and adaptive capacity affect an individual's or community's vulnerability to climate change. Vulnerability can increase because of physical (built and environmental), social, political, and/or economic factor(s). Vulnerability is considered a function of exposure, sensitivity, and adaptive capacity.

***Exposure** is the presence of people, infrastructure, natural systems, and economic, cultural, and social resources in areas that are subject to harm.*

***Sensitivity** is the degree to which a species, natural system, or community, government, and other associated systems would be affected by changing climate conditions.*

***Impact** is a specific negative result of a climate change effect, generally on a particular population or asset. Impact is often determined by the combination of exposure and sensitivity. For example, if the effect of climate change is that droughts are likely to become more frequent and severe, a potential impact to farmers is that less water could be available for irrigation.*

***Adaptive capacity** is the "combination of the strengths, attributes, and resources available to an individual, community, society, or organization that can be used to prepare for and undertake actions to reduce adverse impacts [or] moderate harm or [to] exploit beneficial opportunities." Simply stated, it is the ability to adjust to potential damage, to take advantage of opportunities, or to respond to consequences.*

***Risk** is the potential for damage or loss created by a hazardous condition that affects populations or community assets. For example, a freeway in an area that can experience flooding can be labeled as "at risk" of flooding. Sometimes a level of risk will be assigned, which can be either qualitative or quantitative (e.g., a house that faces a "high risk" from wildfires, or a community that faces a 30 percent chance of a major earthquake in the next 40 years). (Cal OES 2020)*

The vulnerability assessment steps included in Cal OES (2020) bring together these definitions to illustrate the process to assess and understand climate vulnerability for communities (see Figure 2).

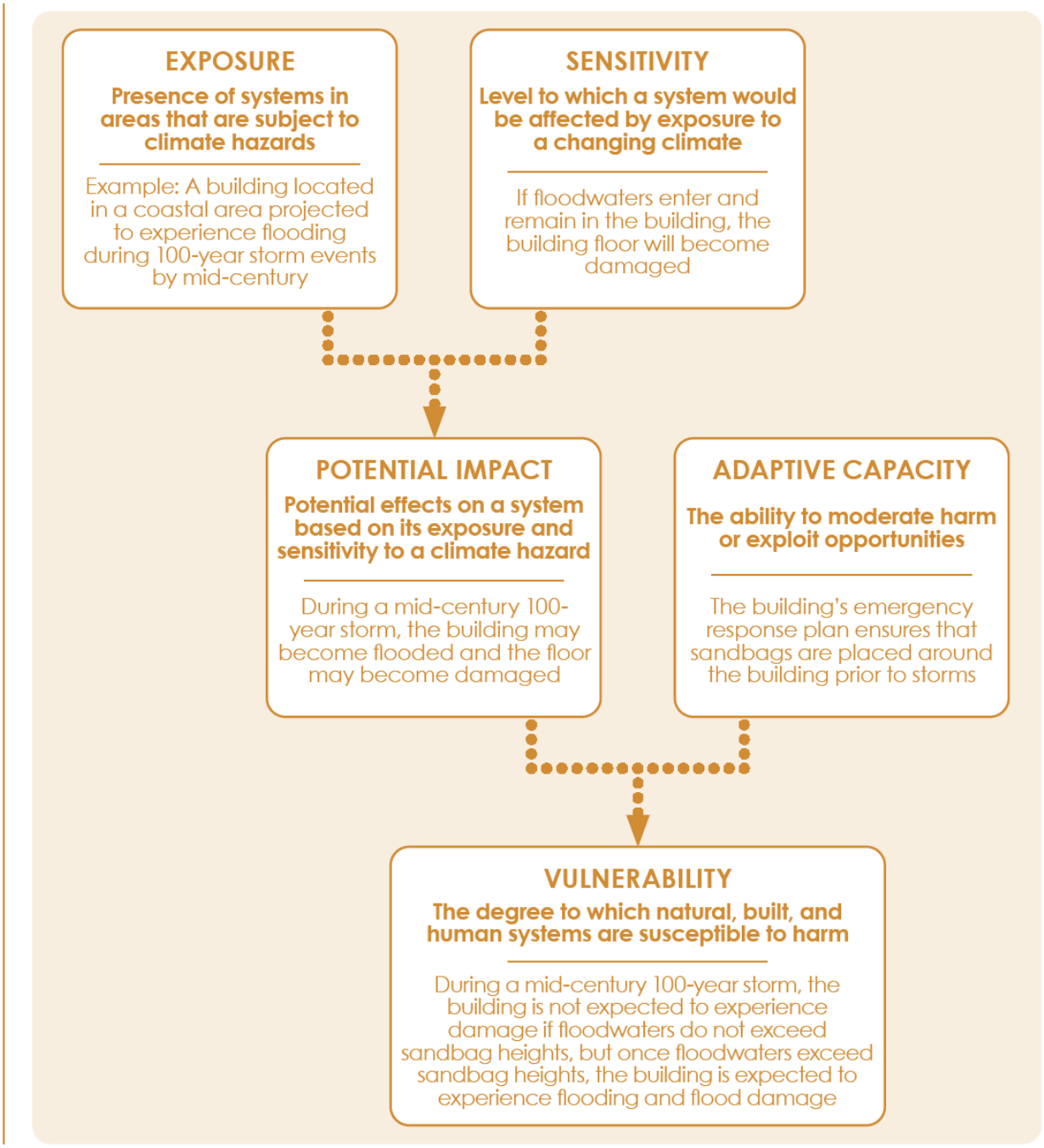

Figure 2: Vulnerability Assessment Steps (Figure 10 of Cal OES 2020)

3. ONEWATERSHED FRAMEWORK

3.1 Objectives

The OneWatershed Framework is intended to support the collaborative efforts of San Mateo County (County) agencies and interested parties, working across jurisdictions/organizations and watershed boundaries to achieve long-term and strategic climate resilience. The approach is a countywide integrated water infrastructure and resource management strategy designed to address the overlapping climate risks to community infrastructure from multiple interrelated hazards, especially flooding, sea level rise, heat, drought, and emergent groundwater conditions. The OneWatershed Framework is designed to employ a community co-creation approach to listen to the lived experiences of community members and weigh this input along with available quantitative on climate hazard exposure data and projections. This engagement model empowers communities to identify local climate-related concerns affecting their most vulnerable residents, infrastructure, and geographic areas, and work together to represent local concerns in larger-scale, collaborative climate resilience solutions across the County's watersheds.

The OneWatershed Framework builds from, and integrates with, several previously completed studies and programs. C/CAG, its member agencies and other partnering agencies and organizations in San Mateo County have completed substantial planning to identify infrastructure solutions that can reduce flooding impacts, improve water quality, and provide other co-benefits**.** Through several countywide studies,[3] C/CAG found that a greater quantity of drainage areas could be treated more cost-effectively through a collaborative, regional-scale stormwater management approach. C/CAG further investigated a more regional approach to sustainable stormwater management in its Advancing Regional-Scale Stormwater Management Project (Flows to Bay 2024), funded through a California Natural Resources Agency grant and developed with input from many of the Program collaborators in this proposal.

The OneWatershed Framework extends these efforts by providing a process and an institutional basis to further identify and prioritize multi-benefit stormwater capture and other water resilience infrastructure projects that could begin to address the cumulative consequences of climate change on water infrastructure and resources. In this way, the OneWatershed Framework creates a unifying lens through which shared-risk is the focal point for evaluating potential project opportunities. Climate hazard exposure, combined with the knowledge of the local community experiencing climate hazards, will be the driver for implementing projects that can also help meet stormwater management goals and integrate with or provide other water infrastructure and resource benefits.

There are a series of longstanding institutional and financial constraints that hinder climate resilience in San Mateo County:

[3] See the *Stormwater Resource Plan for San Mateo County* (San Mateo Countywide Water Pollution Prevention Program [SMCWPPP] 2017), the *PCBs and Mercury Total Maximum Daily Load (TMDL) Control Measure Implementation Plan and Reasonable Assurance Analysis (RAA) for San Mateo County* (SMCWPPP 2020b).

- Aged, degraded, and unfit drainage infrastructure to handle projected flood risk and water quality concerns under current conditions and future climate scenarios
- Ongoing fragmentation among watershed, water quality, climate resilience and other infrastructure planning and implementation among County agencies and other implementation partners
- Lack of dedicated funding due to state constraints on property related fees to support much needed storm drain improvements, water quality and climate resilience infrastructure
- Competing regulatory mandates to address stormwater quality goals that do not always support resilience goals

The OneWatershed Framework is intended to promote collaborative partnerships that can begin to address these challenges. A key goal of the approach is to identify the infrastructure that is most in need of updates per input from local communities, and develop a suite of multi-benefit projects that address the climate resilience and regulatory needs of multiple water infrastructure sectors and can be funded through innovative partnership approaches.

The OneWatershed Framework is intended to be used on a longer-term basis to advance equitable watershed-based climate resilience in San Mateo County. The longer-term vision is that this is rolled out in watersheds across the County to identify a variety of climate resilience and adaptation efforts that could be implemented at different scales and for different stakeholders/partners.

3.2 Development

This OneWatershed Framework has been developed through the ICARP grant funding awarded to C/CAG and Project partners. A portion of the grant funding was directly awarded to Climate Resilient Communities (CRC) as the project community-based organization (CBO), and the remainder was contracted with a technical consultant team led by Geosyntec Consultants, Inc. and supported by Paradigm Environmental, Hazen, Craig Communications, EOA, Inc., with technical advising from Carollo.

The following groups were formed to support the development of the OneWatershed Framework:

1. The Project Management Team, which leads the project and is made up of C/CAG, CRC, OneShoreline, City of San Bruno, County of San Mateo Office of Sustainability, City of South San Francisco's South San Francisco-San Bruno Regional Water Quality Control Plan, and BAWSCA; and
2. The Technical Advisory Committee (TAC), which includes County agencies, regional partners, and other interested parties with technical knowledge of climate resilience, water, and/or emergency planning.

The OneWatershed Framework development has also been informed by two groups focused on equity and outreach, led by CRC, including:

1. The Equity Priority Group, comprised of community-based organizations, non-profits, and interested County residents; and
2. The Resilient San Bruno Team (RSB), which is the local Climate Change Community Team[4] made up of motivated and interested residents and/or community organization representatives from the San Bruno Creek Watershed, with a focus in the highly impacted Belle Air neighborhood.

These groups and representatives were engaged throughout the development of the OneWatershed Framework through interactive meetings and review and comments on project deliverables. The engagement plan developed for the OneWatershed Framework, including the individuals who participated in each group,is provided as Appendix A.

Several resources were reviewed as part of the development of the OneWatershed Framework, many of which are cited throughout this document. To guide the overall thinking behind the approach, studies reviewed included:

- *The California Adaptation Planning Guide* (Cal OES 2020)
- *Draft California Climate Adaptation Strategy* (California Natural Resources Agency [CNRA] 2024)
- Racial Equity Impact & Implementation Guide (City of Oakland 2020)
- *Caltrans Climate Change Vulnerability Assessment Statewide Summary Report* (Caltrans 2024)
- Climate Resilience Framework Recommendations Report (City of Toronto 2019)
- Sonoma Water Climate Adaptation Plan (Sonoma Water 2021)

3.3 Process

The OneWatershed Framework defines a stepwise process that has been designed to be used on a watershed-basis for any watershed in San Mateo County. The process is intended to result in hyper-local watershed-specific Climate Resilience Plans that leverage Countywide tools but are guided by the lived experiences and priorities of the local community. The approach is illustrated in Figure 3.

[4] Climate Change Community Teams include local community-based organizations, religious leaders, youth leaders, and those interested in advancing climate change adaptation and action at the local level. Climate Change Community Teams are hyperlocal and focused on addressing climate justice issues in their neighborhoods. The Climate Change Community Teams are freestanding community organizing infrastructure intended to become a group that builds expertise over time.

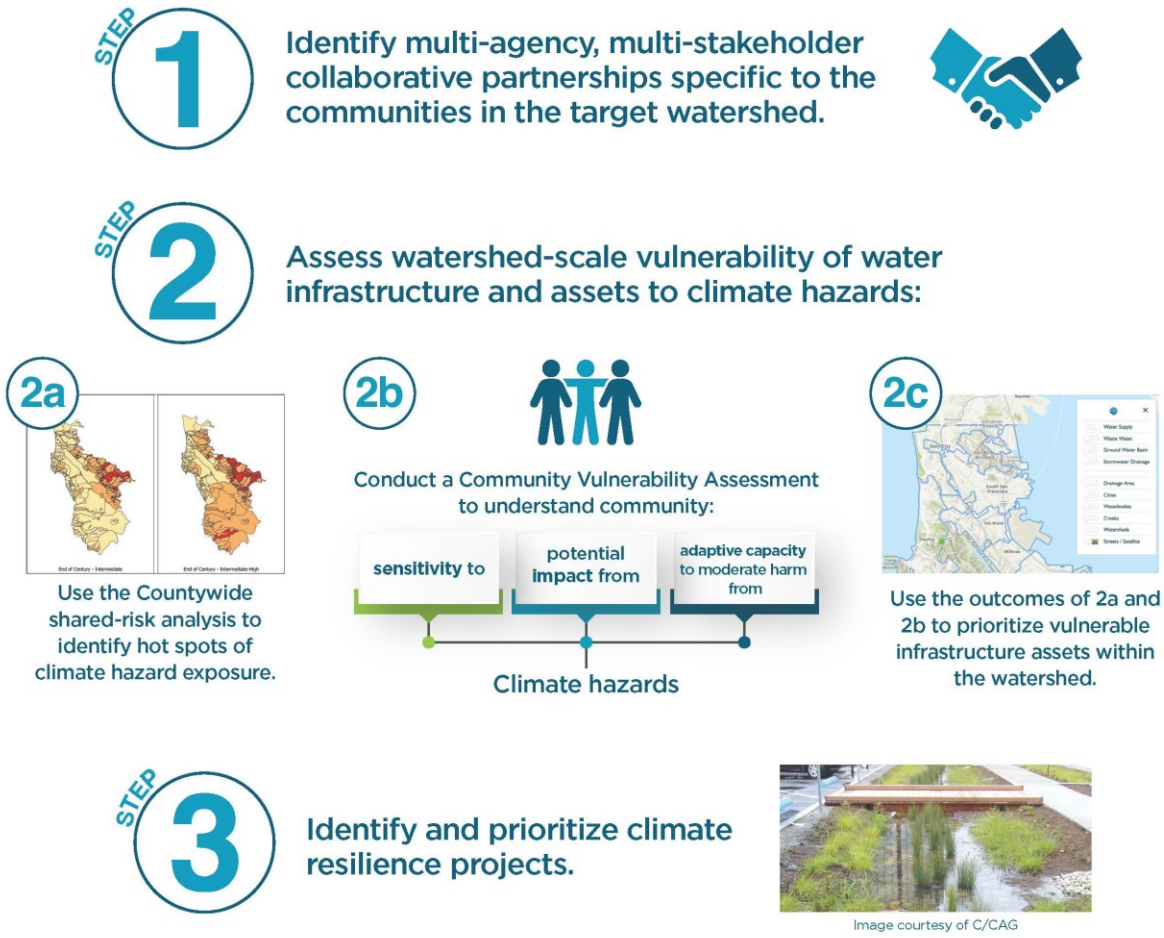

Figure 3: OneWatershed Framework Process

Step 2, "assess watershed-scale vulnerability of water infrastructure and assets to climate hazards" corresponds with "Phase 2 – Assess Vulnerability" and Step 3, "identify and prioritize climate resilience projects" initiates "Phase 3 – Define Adaptation Framework and Strategies" of the adaptation planning process defined by the Cal OES (2020) (see Figure 1). Substantial initial studies and exploration of climate hazards have been conducted throughout San Mateo County (i.e., "Phase 1 – Define, Explore, and Initiate" of the Cal OES process shown in Figure 1), and the OneWatershed Framework is intended to build upon those efforts.

Step 1: Identify multi-agency, multi-stakeholder collaborative partnerships specific to the communities in the target watershed. When implemented at the watershed scale, the OneWatershed Framework requires the combined collaboration of local jurisdictions, water and wastewater agencies, groundwater managers, CBOs, and residents. Establishing these partnerships is a critical first step for implementing the OneWatershed Framework.

Step 2: Assess watershed-scale vulnerability of OneWatershed infrastructure and assets to climate hazards. Following Cal OES (2020) (see Figure 2), watershed-scale vulnerability is assessed through a multi-step process:

2a: Use the results of a Countywide climate hazard exposure analysis (see Section 4) to identify "hot spots" of increased exposure to climate hazards within a watershed area.

2b: Conduct a Community Vulnerability Assessment (see Section 6) to understand the **sensitivity** of the watershed-based community to exposure to climate hazards, the resulting **potential impact** or **consequence** from climate hazards, and the existing **adaptive capacity** to moderate harm posed by climate hazards.

2c: Use the outcomes of steps 2a and 2b to identify vulnerable locations, resources, infrastructure and assets within the watershed and identify the specific OneWatershed assets and resources that are co-located with, serve, or rely on these areas, resources, and assets. Refine vulnerable OneWatershed asset exposure to climate hazards with asset-specific data and localized climate hazard projections, as available.

Step 3: Identify and prioritize climate resilience projects. Through community engagement, ideally led in collaboration with local agencies and a Climate Change Community Team (or an analogous community-based organization) located within the watershed, prioritize vulnerable OneWatershed assets within the watershed. Identify climate resilience projects that could address prioritized vulnerabilities within the watershed (see Section 8).

The outcomes of these steps are to be captured in a watershed specific Climate Resilience Plan that identifies climate resilience projects prioritized for implementation within the watershed.

3.4 Data

3.4.1 Countywide Data

Step 2a references the Countywide climate hazard exposure analysis completed as part of the Framework development. Geospatial information system (GIS) data used for this analysis includes OneWatershed infrastructure network data, including stormwater infrastructure (e.g., storm drains, catchments, outfalls, watershed boundaries), groundwater resources (e.g., groundwater basins), wastewater infrastructure (e.g., wastewater treatment facilities), water reclamation facilities, water supply infrastructure (e.g., reservoirs, dams), as well as data relating to social vulnerability (e.g., disadvantaged/underserved communities), and climate hazards (e.g., extreme heat, hazard data, erosion hazard, sea level rise, etc.). The data have been compiled in the OneWatershed Web Viewer. The data and Web Viewer are described in the OneWatershed Data Inventory attached to this Report (Appendix B).

3.4.2 Watershed-Scale Data

To complete the watershed-specific steps 2b and 2c of the OneWatershed Framework process, separate watershed-specific data should be compiled. Data compiled at the watershed-scale should include but not be limited to:

- More detailed OneWatershed asset information, including locations of assets, sizes, elevations, components, and other aspects.
- More localized and/or asset-specific climate exposure or consequence projections, if hyper-local studies have been conducted or are available.
- Existing plans across all OneWatershed infrastructure network sectors, including but not limited to stormwater capital improvement program projects; water supply infrastructure plans; wastewater infrastructure plans; green stormwater infrastructure plans; climate action plans; other climate resilience plans; creek and stream plans; pedestrian/bike, safe routes to school, or other transportation plans; development plans, etc.

4. CLIMATE HAZARD EXPOSURE ASSESSMENT

4.1 Overview

A Countywide data-driven assessment of climate hazard exposure for OneWatershed infrastructure networks was conducted to support individual watershed-scale Climate Resilience Plans. The results of this analysis are intended to be used to support Step 2a of the OneWatershed process, i.e., ***Assess watershed-scale vulnerability of OneWatershed infrastructure and assets to climate hazards.*** This climate hazard exposure analysis examined the location and relative magnitude of climate hazards in relation to OneWatershed infrastructure networks in San Mateo County based on existing studies and reports. Climate hazards examined include:

- Sea Level Rise
- Extreme Heat
- Extreme Precipitation
- Hydrologic Drought
- Wildfire

Community assets (e.g., roadways, electric/natural gas utilities, and parcels) are served by several different OneWatershed infrastructure networks that are potentially vulnerable to climate hazards. To assess the overall OneWatershed climate hazard exposure for a specific location, the approach geospatially calculated the climate hazard exposure for the four infrastructure categories (i.e., stormwater/flood, water supply, sanitary sewer, groundwater wells) independently. A climate hazard exposure score was assigned based on the magnitude of the projected climate hazard exposure. The combination of exposure scores across all OneWatershed infrastructure networks and climate hazards is referred to as the "shared-risk" for individual assets and communities. The assessment examines climate hazard exposure geospatially at a OneWatershed infrastructure network unit scale for a consistent set of climate change scenarios. OneWatershed infrastructure network unit boundaries for water supply and wastewater were set at the service area boundaries. Catchments were used to define OneWatershed infrastructure network unit boundaries for stormwater, and groundwater basin delineations for groundwater. These OneWatershed infrastructure network unit boundaries are provided in the OneWatershed Web Viewer.

The ultimate climate change-related vulnerability of an asset is dependent on the sensitivity to the hazard, adaptive capacity of the asset, and the consequence of the exposure (e.g., whether an asset will be damaged due to flooding when exposed to inundation from sea level rise). At the Countywide level, there is currently insufficient data and information to accurately assess consequences for all assets and climate hazards. Understanding community sensitivity and resulting impacts or consequences resulting from exposure to climate hazards, as well as existing adaptive capacity, are explored through the Community Vulnerability Assessments (see Section 5) that are completed during watershed-scale application of the OneWatershed Framework (i.e., through the development of watershed-scale OneWatershed Climate Resilience Plans).

Section 4.2 includes details of how climate hazard exposure was assessed for the selected OneWatershed infrastructure networks. Section 4.3 describes the results of the climate hazard exposure assessment.

4.2 Assessment

Climate hazard exposure was assessed using previously established studies and methods. An exposure score of "low," "moderate," or "high" was identified geospatially for each OneWatershed infrastructure network category based on the relative magnitude of exposure to the associated climate hazard. These scores are intended to identify areas throughout the County that are more likely to be exposed to climate hazards. The subsections below provide details about the data sources referenced to assess each climate hazard and how exposure scores of low, medium, or high are defined for each climate hazard.

Four emissions scenarios have been examined for climate hazard exposure, based on the recommendations of California Sea Level Rise Guidance: 2024 Science and Policy Update and included in the DRAFT San Francisco Bay Conservation and Development Commission (BCDC) Regional Shoreline Adaptation Plan (RSAP) Guidelines (BCDC 2024), as shown in Table 1 below. The identified OneWatershed Climate Scenarios in the table were applied to each climate hazard.

Table 2: OneWatershed Climate Scenarios (based on California 2024 scenarios for sea level rise)

Time Frame	Emissions Scenario	California Sea Level Rise Scenario	OneWatershed Climate Scenario
2050	Intermediate	0.8 feet (9.6 inches)	Mid-Century – Intermediate
2100	Intermediate	3.1 feet (37 inches)	End of Century – Intermediate
2100	Intermediate-High	4.9 feet (59 inches)	End of Century – Intermediate-High
2100	High	6.6 feet (79 inches)	End of Century – High

4.2.1 Sea Level Rise

Sea level rise caused by climate change is a major threat to community infrastructure. Infrastructure flooded from surface inundation or groundwater intrusion due to sea level rise may be acutely damaged or corroded over time and may not operate properly or negatively affect water quality. Flooding and groundwater intrusion also creates challenges to properly maintain infrastructure so that it operates over the long-term as designed and under changing conditions.

The County of San Mateo completed a Sea Level Rise Vulnerability Assessment in 2018 (San Mateo County 2018) and South Coast Sea Level Rise Vulnerability Assessment in 2022 (San Mateo County et al. 2022). The 2018 Sea Level Rise Vulnerability Assessment used a baseline scenario ("present-day" 1 percent annual chance coastal storm), a mid-level scenario (3.3 feet of sea level rise combined with a 1 percent annual chance coastal storm), a high-end scenario (6.6 feet of sea level rise combined with a 1 percent annual chance coastal storm), and a coastal

erosion scenario. The San Mateo County Sea Level Rise Vulnerability Sea Level Rise Exposure Analysis states:

> To determine the level of exposure of an asset: If an asset has already experienced surface flooding, ground water intrusion, or would be affected with less than 12 inches of sea level rise, exposure is considered 'high.' If an asset is expected to be inundated with sea level increases between 12 and 36 inches, exposure is 'moderate.' Finally, if an asset is unlikely to be inundated until sea level rises more than 36 inches, exposure is considered 'low.'

The County's SLR vulnerability assessments also evaluated the vulnerability (in terms of exposure/sensitivity/adaptive capacity) for a number of spatially explicit asset datapoints across the county for a single climate hazard. To effectively estimate shared climate hazard exposure at a countywide scale to different water sector assets and for multiple climate hazard categories, the OneWatershed shared-risk approach examined flooding exposure resulting from inundation or emergent groundwater for the static OneWatershed climate scenarios. While there are geospatial projections available for rising subsurface groundwater in the Bay Area (i.e., groundwater less than 6 feet below ground surface), there is currently insufficient data and information to understand what level of exposure might contribute to an increased level of climate impact or consequence. As described in SFEI (2022), there are many areas along the Bay margin that currently experience groundwater levels less than 6 feet below surface and have been designed to operate in this environment without consequence. Rising groundwater will introduce many challenges, including increasing the likelihood of flooding during winter storms and other subsurface impacts including increased liquefaction risk, contaminant mobilization, and damage to critical infrastructure, such as sewer systems, drinking water pipes, roads, and building foundations (San Francisco Bay Area Planning and Urban Research Association [SPUR] 2024). Proposed exposure levels for sea level rise and groundwater intrusion flooding exposure are provided in Table 2.

Table 3: OneWatershed Sea Level Rise/Groundwater Intrusion Flooding Exposure Score

Hazard	Low	Moderate	High
Inundation or Groundwater Intrusion	0% of area inundated	Up to 10% of area inundated	Greater than 10% of area inundated

As described above, the OneWatershed Framework uses the State's recommended sea level rise scenarios (OPC 2024; BCDC 2024; Sweet et al., 2022) to align with the recently adopted State guidance and new State requirements for Bayshore communities to have a San Francisco Bay Shoreline Resiliency Plan in place by January 1, 2034 (per Senate Bill 272 and described in BCDC 2024). The geospatial data corresponding to the sea level rise scenarios were obtained from BCDC's Online Mapping Platform (BCDC 2021). County of San Mateo Sea Level Rise Vulnerability Assessments (San Mateo County 2018, San Mateo County et al. 2022) were be used for comparison. The relationship between the sea level rise scenarios for both sources is included in Table 3. Maps of groundwater rise are available from the San Francisco Estuary Institute (SFEI) for specific sea-level rise scenarios (SFEI 2022).

Table 4: Sea Level Rise Scenarios Used Corresponding to OneWatershed Climate Scenarios

OneWatershed Climate Scenario	California (2024) SLR Scenario[1]	Corresponding SMC SLR Assessment Scenario[2]	Corresponding SFEI Groundwater Depth under Future SLR Conditions Scenario[3]
Mid-Century – Intermediate	0.8 feet (9.6 inches)	Not Assessed	12 inches
End of Century – Intermediate	3.1 feet (37 inches)	3.3 feet of SLR	36 inches
End of Century – Intermediate-High	4.9 feet (59 inches)	Not Assessed	66 inches
End of Century – High	6.6 feet (79 inches)	6.6 feet of SLR	77 inches

Blue highlighted cells indicate SLR values used in the analysis. The other studies are shown for reference.

[1] California sea level rise scenarios must combine SLR plus the Mean Higher High Water (MHHW) plus the 1% annual chance coastal storm surge.

[2] The San Mateo County Vulnerability Assessment used SLR plus the historic 1% annual chance coastal flood.

[3] For California (2024) scenarios, the corresponding shallow groundwater scenario should be "depth to groundwater for a rise at the Bay equal to the amount of sea level rise".

4.2.2 Extreme Heat

Extreme heat is an increasingly serious climate hazard with cascading consequences. Extreme heat negatively impacts communities, especially vulnerable populations and reduces the ability of workers to perform work tasks, resulting in lost labor time for water infrastructure operations. Extreme heat increases electricity use, and can result in interruptions to electricity service, which can have consequences for water infrastructure and other municipal operations that communities depend upon. Extreme heat also causes physical impacts to infrastructure and buildings, including water-related infrastructure and resources. Extreme heat can also cause environmental and water quality impacts to receiving waters.

San Mateo County's Climate Resilience "Extreme Heat" webpage defines high heat days as days exceeding 85 degrees Fahrenheit (°F). Based on the legend provided on the webpage, lower exposure areas are those with 10 or less high-heat days. Medium exposure areas are those with approximately 11 to 40 high-heat days, and high exposure areas are those with greater than 40 high-heat days per year.

San Mateo County has an Extreme Heat Dashboard, which provides projections of days exceeding a selected temperature threshold. This data were used to estimate heat-related exposure for the identified climate scenarios. These exposure levels are applied to all infrastructure categories geospatially.

Table 5: OneWatershed Extreme Heat Exposure Levels

Hazard	Low	Moderate	High
High Heat Days[1]	10 days or fewer per year	11–40 days	40+ days per year

[1] Defined as days exceeding a temperature threshold of 85°F.

A summary of the climate projections used for extreme heat is summarized in Table 6 below. The San Mateo County analysis was conducted based on specific carbon emissions scenarios, or representative concentration pathways (RCPs). This analysis matched the RCPs and ranges analyzed to the associated OneWatershed Climate scenarios as possible given available analyses and information. The planning horizon available from the San Mateo County Extreme Heat Dashboard is 2056 – 2085, which was used for the OneWatershed End of Century scenarios.

Table 6: Extreme Heat Scenarios Used Corresponding to OneWatershed Climate Scenarios

OneWatershed Climate Scenario	San Mateo County Extreme Heat Dashboard Scenarios[1]
Mid-Century – Intermediate	Year Range 2040–2049, Carbon Pathway RCP 4.5
End of Century – Intermediate	Year Range 2056–2085, Carbon Pathway RCP 4.5
End of Century – Intermediate-High	Year Range 2056–2085, Carbon Pathway Average of RCP 4.5 and RCP 8.5
End of Century – High	Year Range 2056–2085, Carbon Pathway RCP 8.5

[1] Temperature threshold of 85 °F and Average of Climate Models. Carbon Pathway RCP refers to the Representative Concentration Pathway, which relate to the future carbon emissions scenario used in the model.

4.2.3 Extreme Precipitation

Extreme precipitation occurs when rainfall substantially exceeds what is typical based on available historical records and/or projections from historical data. In California, extreme precipitation is typically associated with multi-day atmospheric river events. Precipitation projections used as input to modeling from C/CAG's San Mateo Countywide Sustainable Streets Master Plan (C/CAG 2021), which leverages a suite of 10 climate models from Cal-Adapt (Cal-Adapt 2024), were used to evaluate and identify areas projected to have the highest increase in future precipitation. Cal-Adapt uses several methods to define an extreme event. In San Mateo County, all methods classify the extreme event as a 50% annual chance storm (also referred to as the 2-year storm, a large storm that historically occurs every other year) or greater. Storm drain infrastructure is constructed to specific design standards that correspond to historic return frequencies (e.g., the 10% annual chance storm (i.e., 10-year event) or the 4% annual chance storm (i.e., 25-year event). When historically large storms become significantly larger due to climate change, storm drain infrastructure no longer performs per its design standard and can cause more frequent flooding within the storm drain catchments and communities it services.

For this analysis, exposure to extreme precipitation was estimated relative to precipitation increases due to climate change for a standard recurrence interval. The 10-year storm was used as the reference for evaluating extreme precipitation exposure due to its relevancy to storm drain infrastructure, as many storm drains in the County were sized for the historical 10-year storm. Extreme precipitation exposure was evaluated by relative change in storm intensity for the 10-year storm. Table 7 shows the proposed exposure levels for extreme precipitation. A projected increase in precipitation depth for the 10-year storm of less than 10% is considered low exposure. A projected increase of 10-25% is considered moderate exposure. A projected increase of over 25% is considered high exposure. These exposure levels are applicable for all asset

categories. The projected increase is applied from the Cal-Adapt model grids to each asset category's unit boundaries using an area-weighted average.

Table 7: OneWatershed Extreme Precipitation Exposure Levels

Hazard	Low	Moderate	High
Projected Increase in the 10-year Storm	Less than 10%	10–25%	Greater than 25%

To estimate the projected percent increase for the identified OneWatershed Climate Scenarios, exposure is evaluated for two emission scenarios (RCP4.5 and RCP8.5) and a mid-century and end-of-century period. The End of Century – Intermediate-High scenario is calculated from the average of the two emission scenarios. The OneWatershed Scenarios and the proposed corresponding extreme precipitation scenarios from Cal-Adapt (2024) are presented in Table 8.

Table 8: Extreme Precipitation Scenarios Used Corresponding to OneWatershed Climate Scenarios

OneWatershed Climate Scenario	Cal-Adapt Extreme Precipitation Scenario[1]
Mid-Century – Intermediate	RCP4.5 (2034-2064)
End of Century – Intermediate	RCP4.5 (2069-2099)
End of Century – Intermediate-High	Average of RCP 4.5 + RCP 8.5 (2069-2099)
End of Century – High	RCP8.5 (2069-2099)

[1] Median of Climate Models.

4.2.4 Drought

Droughts are periods with less rainfall than average, and when extended, can lead to shortages in surface water supplies that may rely on a certain amount of rainfall per year. Studies have demonstrated that more frequent, longer, and drier droughts are possible with climate change, as compared to historical periods. Drought exposure was measured and scored relative to water supply impacts in San Mateo County, specifically related to projected water supply shortages under climate change conditions. Water supply shortages were measured as the difference between projected demand and projected supply availability under climate change conditions.[5] Thresholds of water supply shortages are proposed to be directly related to DWR's standard Water Shortage Contingency Plan (WSCP) stages identified in Table 9 below.

[5] External factors affecting water supply availability, such as future infrastructure investments and regulatory conditions are assumed to be held constant to current conditions.

Table 9: Linkage Between DWR WSCP Stages and Proposed OneWatershed Drought Exposure Level

WSCP Stage	Level of Water Supply Shortage	OneWatershed Exposure Level
Stage 1	0%–10%	Low
Stage 2	10%–20%	
Stage 3	20%–30%	Moderate
Stage 4	30%–40%	
Stage 5	40%–50%	High
Stage 6	>50%	

Data sources used to estimate future water supply shortages within San Mateo County included data and context from San Francisco Public Utilities Commission's (SFPUC's) *Long-Term Vulnerability Assessment and Adaptation Plan* (LTVA) (Francois et al. 2021), 2020 Urban Water Management Plans (UWMPs) for water suppliers in the County, and the United States Geological Survey (USGS) Basin Characterization Model (Flint and Flint 2014) in Table 10.

Table 10: Overview of Data Sources for the Proposed OneWatershed Drought Exposure

Data Source	Quantitative Information Provided	Potential Application	Discussion
SFPUC Long-Term Vulnerability Assessment (LTVA)	Projected imported and local water supply availability from the San Francisco Regional Water System (SF RWS) under climate change conditions	Leverage estimates of imported water available and impacts to the inflow in local SFPUC-owned reservoirs in San Mateo County (e.g., Crystal Springs Reservoir) under climate change conditions.	The vast majority of San Mateo County's population is served imported water from the SF RWS. For many water suppliers in the County, water from the SF RWS is the only water supply source.
2020 UWMPs	Projected water demands and conceptual/ quantitative impacts of climate change on future water supply availability	Leverage water demand projections and quantitative impacts on water supply availability for estimating future water supply shortages.	UWMPs provide discussion on climate change related risks to water supply and demands, which could augment or supplement the most recent estimates of SFPUC's Long-Term Vulnerability Assessment
USGS Basin Characterization Model	Projected groundwater balance for California under 18 climate change projections.	Leverage estimates of groundwater recharge and water deficit under climate change conditions.	Data could be most useful in estimating impacts to water suppliers in the County who are not connected to the SF RWS.

Notes:
USGS: United States Geological Survey
UWMP: Urban Water Management Plan

In San Mateo County, 16 water agencies, containing 90% of the county's population, purchase water primarily from SFPUC and are represented by the Bay Area Water Supply & Conservation Agency (BAWSCA). Based on water production volume data from 2023, 95% of the water supply to San Mateo County's BAWSCA member agencies came from the SF RWS, while 5% consisted of local groundwater and surface water supply.

In 2021, SFPUC partnered with The Water Research Foundation and University of Massachusetts Hydrosystems Research Group to publish the LTVA, which assessed how climate change and other external factors could affect SFPUC's ability to meet level of service goals for both retail and wholesale customers over the next 50 years (2020 – 2070). The study used CMIP5-based global climate model (GCM) projections to evaluate the potential range of climate impacts on the three SFPUC watershed regions (Upcountry, East Bay, and Peninsula) under different emissions scenarios (RCPs). The GCM projections were analyzed for temperature and precipitation changes around the 2040 and 2070 periods using a 30-year averaging interval for each. The RCP8.5 emissions scenario[6] was selected to allow for an assessment of the outer bounds of RWS impacts by 2070, and the study noted that the different assumptions of each RCP tended to result in "similar climate projections to mid-century [i.e. from 2020 – 2050]". Downscaled GCM climate data was input into hydrologic models developed for each of the three RWS regions, which in turn generated climate change-adjusted simulations of streamflow into each RWS reservoir. The LTVA used the hydrologic model output to inform a water system operations model of the SFPUC retail and wholesale supply system. Four demand[7] and 1,360 climate[8] scenarios were modeled over a 2021-2070 simulation period to evaluate water supply shortages.

The analysis below and values in Table 11 are a deterministic distillation of the LTVA work. The LTVA 2040 and 2070 RCP8.5 outputs provide comparable climate factors to the 'Mid-Century Intermediate' and 'End-of-Century High' bookend scenarios, respectively, and the results below reflect conditions of the median climate change projections of +2°C warming by 2040 and + 4°C by 2070 with no change in mean annual precipitation. The 265-million-gallon-per-day (mgd) demand (+15% of the LTVA baseline) scenario was chosen for both scenarios as they reflect SFPUC's retail demand nearing buildout (i.e., 2045 retail demand projection from the SFPUC 2020 UWMP) and the BAWSCA agencies' Individual Supply Guarantees from SFPUC, which cannot be exceeded. This reflects an expected upper limit of RWS systemwide demands.

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[6] The LTVA study considered four RCPs from the Inter-Governmental Panel on Climate Change Fifth Assessment Report labeled as RCP2.6, RCP4.5, RCP6, and RCP8.5, after a possible range of radiative forcing values in the year 2100.

[7] The baseline demands scenario (226 mgd) is consistent with SFPUC RWS fiscal year 2012–2013 records (the year prior to the 2014-2016 statewide drought). Additional demand scenarios increased the baseline demands by +15%, +30%, and +45% (265 mgd, 300 mgd, and 334 mgd, respectively).

[8] To reflect the full plausible range of projections without regard to likelihood, 8 temperature scenarios ranging from +0 °C to +7 °C, and 17 precipitation scenarios ranging from -40% to 40% change from the historical baseline (1986 to 2005) were applied to 10 climate realizations (9 stochastic and 1 historical). Changes to mean annual temperature and precipitation were applied uniformly across seasons and regions.

Results of the LTVA median climate projections at 265 mgd demands found that the maximum annual SFPUC systemwide supply deficit across the scenarios was 97 thousand acre-feet (TAF) in 2040 (equivalent to 36% rationing) and 100 TAF in 2070 RCP8.5 (equivalent to 37% rationing). The median climate projection resulted in a 10% frequency of systemwide rationing of 20% or greater by 2040 and an 11% frequency of systemwide rationing of 20% or greater by 2070 RCP8.5. The SFPUC 2020 Water Shortage Contingency Plan outlines a Water Shortage Allocation Plan (WSAP) to allocate water between the retail and wholesale customers collectively. The WSAP notes that when a system-wide reduction in water use above 15% is required, the collective wholesale customers' share of the available RWS supply is 64.5%.[9] This leads to a maximum annual reduction in aggregate SFPUC wholesaler supply of 42% by 2040 and 43% by 2070 RCP8.5. The wholesale supply reduction is then passed through a Tier 2 allocation formula for distribution among wholesale agencies[10]. Given the minimal variation in median climate factors (only +2°C change between 2040 and 2070, with no assumed change to mean annual precipitation) and no change in demand between the two bookend scenarios, the approximate maximum annual supply shortage and shortage frequency similarly does not vary significantly. It can be assumed that values for both shortage and shortage frequency in the 'End-of-Century Intermediate' and 'End-of-Century Intermediate-High' scenarios would fall within this range.

Table 11: Summary of SF RWS Imported Water Supply Impacts to BAWSCA Agencies at Median Climate Change Projections and 265 mgd Systemwide Demand

One-Watershed Scenario	Representative year + RCP Scenarios	Comparable LTVA Scenario	Approximate Maximum Modeled Shortage	Approximate Frequency of Shortage ≥ 20%	One-Watershed Score
Mid-Century – Intermediate	2040–2049, RCP 4.5	2040	42%	10%	High
End-of-Century – Intermediate	2056–2085, RCP 4.5	N/A*	42.5% *	10.5% *	High
End-of-Century – Intermediate-High	2056–2085, Average of RCP 4.5 + RCP 8.5	N/A*	42.5% *	10.5% *	High
End of Century – High	2056–2085, RCP 8.5	2070 RCP8.5	43%	11%	High

Notes:

[9] Note that while the SFPUC Water Shortage Contingency Plan (Appendix K of SFPUC 2020) does not define allocation between retail and wholesale customers above RWS shortage levels of 20%, application of the 16-20% allocation to shortage levels greater than 20% is typically assumed for SFPUC's planning purposes.

[10] The Tier 2 formula is largely dependent on the Individual Supply Guarantee (ISG) contractual volumes of the BAWSCA member agencies. Since net wholesale demands were modeled as the sum of BAWSCA member ISGs for this analysis, the combined San Mateo BAWSCA member agencies' reductions can be assumed to equal the aggregate SFPUC wholesale supply reductions.

* The SFPUC LTVA study did not provide comparable surrogate scenarios for the 'End-of-Century Intermediate' and the 'End-of-Century Intermediate-High' scenarios. These placeholder values represent the average of the bookend scenarios, as the climate factors outlined in these intermediate scenarios fall between the ranges.
BAWSCA: Bay Area Water Supply & Conservation Agency
LTVA: *Long-Term Vulnerability Assessment and Adaptation Plan*
mgd: million gallons per day
RCP: Representative Concentration Pathway
SF RWS: San Francisco Regional Water System

The LTVA study did not provide detailed statistics regarding local groundwater and surface water sources to BAWSCA agencies in San Mateo County. However, given the small percentage of total supply, it can be assumed that the impact of climate change to local water sources will not significantly alter the total supply reliability to San Mateo BAWSCA agencies.

Beyond the climate change concerns discussed above, regulatory requirements from the Bay-Delta Plan are anticipated to have an outsized impact on future SFPUC water supply reliability, which would directly affect San Mateo County's BAWSCA agencies. As discussed in SFPUC's 2020 UWMP, full implementation of the San Francisco Bay/Sacramento-San Joaquin Delta Estuary Water Quality Control Plan (Bay-Delta Plan) and its 2018 amendments establishing flow objectives on three San Joaquin River tributaries would "severely impact SFPUC's water supply" by increasing systemwide shortages during hydrologic drought. Notably, SFPUC's 2020 UWMP projected a maximum annual shortage of 54% for wholesalers by 2045, or approximately 11% higher than under the LTVA climate change scenario 2070 RCP8.5. Currently, the California Natural Resources Agency and water users in the Bay-Delta watershed (including SFPUC) are working to establish voluntary agreements (VAs) to mitigate the water supply impacts from the Bay-Delta Plan while protecting environmental interests. These VA negotiations are still underway and the outcome for SFPUC's long-term supply reliability to wholesalers remains uncertain.

4.2.5 Wildfire

Wildfire poses risks to communities through impacts to air quality and to infrastructure through damage and loss and can impact water quality of water resources. CalFire has assigned current wildfire risk for areas across San Mateo County through their website "Fire Hazard Severity Zones in State Responsibility Area" (CalFire 2023). CalFire ranks wildfire hazard within their responsibility area as moderate, high, and very high. CalFire has also identified wildland-urban interface zones that may be at risk of the adjacent wildfire threats from influence areas (ArcGIS n.d.) with similarly categorized risk.

Projected changes in climate change-related wildfire have not been analyzed on a smaller spatial scale, so there is insufficient data that predicts increased exposure to wildfire on a census-block by census-block basis, for example. However, a joint study by the USGS and several universities (Gao et al. 2021) found that wildfire risk in San Mateo County could increase by 30% by the end

of the century (2070–2099)[11]. **Error! Reference source not found.** shows the criteria used to determine wildfire exposure across all asset categories.

Table 12: OneWatershed Wildfire Exposure Levels

Hazard	Low	Moderate	High
Wildfire	Areas **outside** of CalFire influence, wildland-urban interface, intermix areas, and local "moderate" exposure and "high" exposure areas[1]	CalFire designated "moderate" areas and adjacent wildland-urban interface and intermix areas and local "moderate" exposure areas[1]	CalFire designated "high" and "very high" areas and adjacent wildland-urban interface and intermix areas and local "high" exposure areas[1]

[1] Where local data is available.

Without currently available detailed projections, these exposure levels were used for all OneWatershed climate scenarios to estimate wildfire climate hazard exposure at a countywide scale.

4.3 Application to OneWatershed Infrastructure Networks

A geospatial analysis was conducted to assess climate hazard exposure for each climate scenario for each OneWatershed infrastructure network category on a unit basis across San Mateo County. OneWatershed infrastructure network unit boundaries are defined as:

1. Water supply service areas
2. Wastewater collection and treatment plant service areas
3. Stormwater catchments
4. Groundwater basins

For each applicable OneWatershed infrastructure category, an exposure level (i.e., low, moderate, high) was assigned for each climate hazard category per the exposure level definitions defined in Section **Error! Reference source not found.**. The levels were assigned to infrastructure network units countywide based on the co-located geospatial climate hazard data summarized in Section **Error! Reference source not found.**. The resulting climate hazard exposure for each asset category and each climate hazard are available through the OneWatershed Dashboard (https://web.paradigmh2o.com/smc-gi-tracking-qa/onewatershed) for each climate scenario, as shown in the screenshot below:

[11] Percent change in fire probability for coastal California mountains as compared to historical baseline conditions.

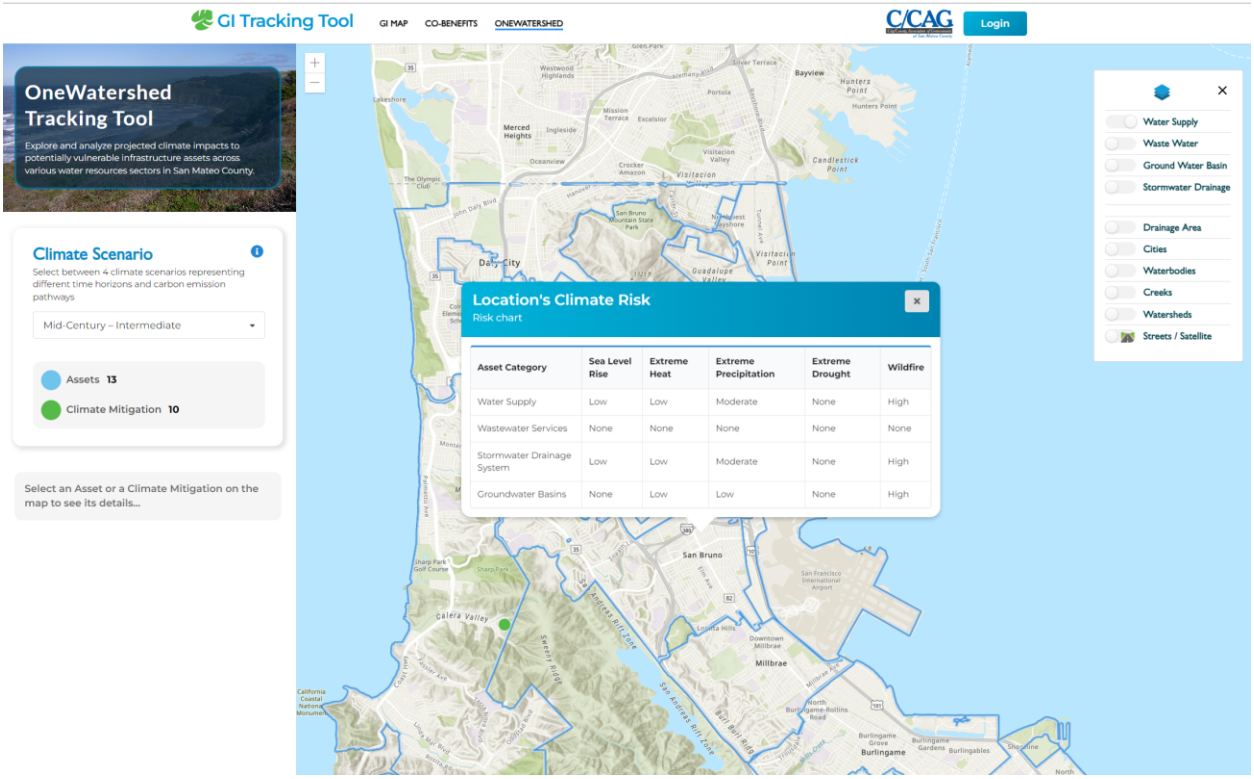


Figure 4: Example Climate Hazard Exposure Summary for Location

Additionally, a heat map showing climate hazard exposure shared-risk, which averages all climate hazard exposure levels across all water infrastructure categories, was developed for each climate scenario to provide a visual reference to locations that may be "hot spots" for climate exposure, see Figure 5.

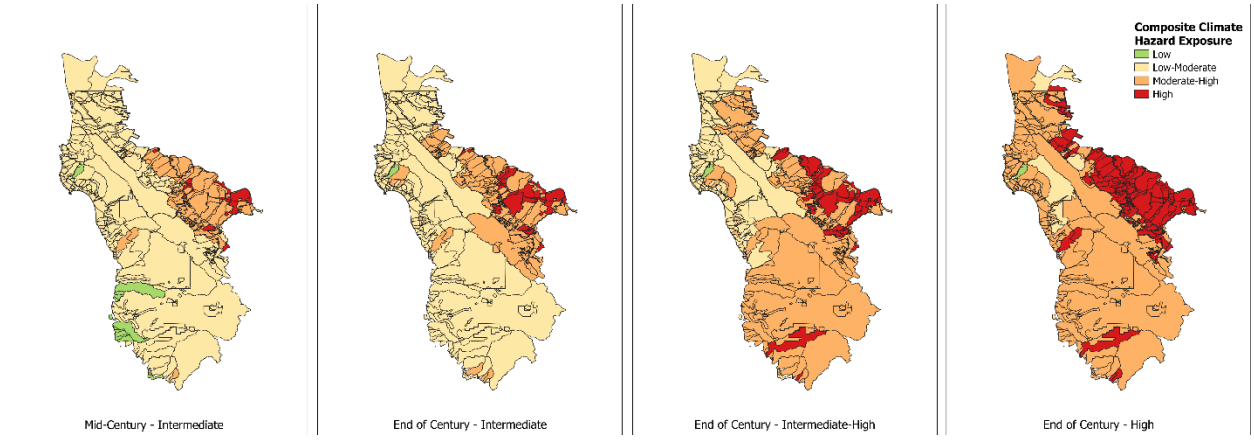


Figure 5: Climate Hazard Exposure for OneWatershed Climate Scenarios

This layer is provided in the OneWatershed Dashboard for all areas within the County.

5. COMMUNITY VULNERABILITY ASSESSMENT APPROACH

The OneWatershed Framework incorporates a Community Vulnerability Assessment which gathers information from community members. The results of this assessment are intended to be used to support Step 2b and 2c of the OneWatershed process, i.e., ***Assess watershed-scale vulnerability of OneWatershed infrastructure and assets to climate hazards.***

The Community Vulnerability Assessment is designed to compile experiential ("lived experience") data from residents living in frontline communities. The data collected is intended to identify what resources are currently being used to prevent climate impacts, recover from climate impacts, and what resources are needed that could improve prevention or recovery. These components can be used to understand community sensitivity to climate hazard exposure, potential impacts from climate hazards, and the community's current adaptive capacity, as well as the gap between potential community impacts and adaptive capacity. All this information is compiled into a Community Vulnerability Assessment report.

Project team member CRC has developed a plan for the Community Vulnerability Assessment conducted for the pilot OneWatershed Framework application in the San Bruno Creek Watershed (Appendix C). This is intended to serve as a model for how future Community Vulnerability Assessments can be completed for watershed-specific applications of the OneWatershed Framework. The plan includes several community-wide workshops specifically designed to gather the data described above, and crucially, relies on information gathered through working closely with the Resilient San Bruno team, which is the local Climate Change Community team for the watershed. The community-wide workshops are proposed include the following topics, and will be presented in English and separately in a highly concentrated linguistic group in a language other than English:

1. Workshops#1 and #2: Facilitators will present information on climate hazards compiled through the Countywide climate shared-risk analysis and experiential data collected from the Resilient San Bruno team. Facilitators will provide a survey to collect data from workshop participants as well as their family, friends, and colleagues within the watershed.
2. Focus Groups #1 and #2: Facilitators will invite participants into breakout groups, in which guiding questions will be asked to understand the resources community members use to prepare for and recover from climate impacts. Attendees will be asked to prioritize resources they wish were available to them following in depth breakout discussions.
3. Workshops#3 and #4: Return findings of the Community Vulnerability Assessment and overall Climate Resilience Plan to the community and describe how data collected through workshops and focus groups will be used, how the community can access it, and gain recommendations on how the community hopes the input they provided is used.

Notably, extensive outreach has already been completed in the San Bruno Creek Watershed.

The Community Vulnerability Assessment will explore climate impacts, but may not necessarily focus on OneWatershed infrastructure categories in particular, as this may narrow the scope of workshops and discussions and/or make participation less accessible to certain stakeholders. Data collected through the Community Vulnerability Assessment is translated to OneWatershed infrastructure through the overall OneWatershed process at the watershed scale.

6. CLIMATE RESILIENCE PROJECTS

The OneWatershed Framework is ultimately designed to identify a variety of cross-water sector, cross-agency/partner climate resilience projects that could reduce priority vulnerabilities and increase resilience on a watershed-scale (Step 3 of the OneWatershed Framework process). These projects could include new projects or already-planned projects that have been identified through other planning processes, including but not limited to utility master plans, green infrastructure and long-term stormwater plans, climate adaptation plans, transportation and pedestrian plans, shoreline adaptation projects, local hazard mitigation plans, etc. These projects could be refined or used as-is to match key vulnerabilities or realize co-benefits. Several existing resources could inform what these solutions look like, including but not limited to:

- The *Climate Resilience Resources Guide* for green stormwater infrastructure (Green Infrastructure Leadership Exchange and Geosyntec Consultants, Inc. 2023)
- *Implementing Green Stormwater Infrastructure on Schoolyards* (Green Infrastructure Leadership Exchange 2019)
- Resilience Playbook Website (Greenbelt Alliance 2020)
- Water supply plans, including the 2023 Drinking Water Needs Assessment (California State Water Resources Control Board 2023); California's Water Supply Strategy (CNRA et al. 2022); or California Water Plan Update (CNRA et al. 2023)
- Complete Cleanup of Contaminated Sites on the San Francisco Shoreline Statement (San Franciso Bay Shoreline Contamination Cleanup Coalition N.d.)

Longer-term, the Climate Resilience Plans developed through the OneWatershed Framework (including the San Bruno Creek pilot, which will be completed by early 2026) can be used to prioritize implementation of climate resilience projects across the County. Critical to the next implementation phase is development of a funding and delivery strategy that could support full design, installation, and ongoing operations and maintenance of climate resilience projects. These funding and delivery strategies may build upon previous work conducted by C/CAG, including funding options outlined in Advancing Regional-Scale Stormwater Management Projects and the Regional Collaborative Program *Interim MOU-Based Regional Collaborative Program Summary Report* (C/CAG 2023). The Regional Collaborative Program is intended to enable jurisdictions within the County to co-fund the implementation and maintenance of regional multi-benefit stormwater capture projects and regional-scale implementation of green stormwater infrastructure projects. Projects identified for implementation through the OneWatershed Framework approach could be funded through the Regional Collaboration Program as well as a range of other funding sources targeting other water sectors.

7. PILOT APPLICATION TO SAN BRUNO CREEK WATERSHED

In 2025, the Project will pilot the OneWatershed Framework in the San Bruno Creek watershed . Step 1, identify multi-agency, multi-stakeholder collaborative, has been initiatied, as follows:

- ***Step 1: Identify multi-agency, multi-stakeholder collaborative partnerships.*** In the San Bruno Creek watershed, this group is the Resilient San Bruno Team, working collaboratively with the PMT. CRC established the Resilient San Bruno Team in early 2024 and the group has been meeting monthly to discuss a range of community resilience topics.

Beginning in early 2025, the Project will initiate step 2.

- ***Step 2: Assess watershed-scale vulnerability of OneWatershed infrastructure and assets to climate hazards.***
  - 2a: Using the Countywide results, maps of hot spot areas will be compiled and provided to CRC for use in the San Bruno Creek Watershed Community Vulnerability Assessment.
  - 2b: CRC will complete the Community Vulnerability Assessment provided in Appendix C.
  - 2c: San Bruno Creek Watershed specific data, such as that listed in section 3.4.2, will be gathered to fine tune prioritization of key vulnerable assets and record this through the OneWatershed Dashboard. Within the watershed of interest, detailed assessment for water supply could use modeling tools, such as BAWSCA's Water System & Supply Model, to aid in the quantification of water supply shortages under climate change. This detailed modeling effort could incorporate decreased SFPUC supply availability due to climate change, along with local supply sources and future demand levels at the individual agency scale. Within a modeling approach, the USGS Basin characterization Model could be leveraged to provide insights into groundwater recharge estimates under climate change for watersheds where local groundwater is used as a source of supply.

- ***Step 3: Identify and prioritize climate resilience projects.*** In close coordination with the Resilient San Bruno Team, the PMT and the Consultant Team will identify potential climate resilience projects that could address prioritized vulnerabilities within the watershed. These projects will be prioritized to maximize the climate hazard resilience benefits provided, in alignment with community priorities. For the San Bruno pilot, watershed-based plans will be referenced to compile previously identified project opportunities will include but not be limited to:
  - *City of San Bruno Green Infrastructure Plan* (City of San Bruno 2019)
  - *Draft City of San Bruno Climate Action Plan* (City of San Bruno 2012)
  - *City of San Bruno Storm Drain Master Plan* (City of San Bruno 2014)
  - *San Bruno Creek/Colma Creek Resiliency Study* (SFO 2015)

- *City of San Bruno Walk 'n Bike Plan* (City of San Bruno 2016)
- *The San Francisco Estuary Institute's San Francisco Bay Shoreline Adaptation Atlas* (SFEI & SPUR 2019)
- *San Mateo County Stormwater Resource Plan* (SMCWPPP 2017)
- *Advancing Regional-Scale Stormwater Management in San Mateo County* (SMCWPPP 2022)

Steps 1 – 3 and the 10% concept design will be summarized in the San Bruno Creek Watershed Climate Resilience Plan.

8. ONEWATERSHED DASHBOARD

The OneWatershed Dashboard (https://web.paradigmh2o.com/smc-gi-tracking-qa/onewatershed) is a web-based tracking and visualization tool that has been developed to facilitate development of watershed-specific Climate Resilience Plans. The Dashboard leverages output from the climate hazard exposure assessment to summarize climate exposure based on geographic location of OneWatershed assets. The Dashboard will also be used to document community vulnerability assessment findings and identify OneWatershed Climate Resilience projects. The Dashboard and integrated visualization tools can be used for future watershed-scale climate resilience planning efforts.

The primary user interface of the Dashboard is a web map (see web page in Figure 6) that displays locations of OneWatershed assets and the OneWatershed infrastructure network unit boundaries, along with the climate exposure layers resulting from the climate hazard exposure shared-risk analysis. The map will allow a user to visualize the location of assets in relation to the climate hazard layers. Additionally, clicking on an asset results in a popup showing a basic description and a button to access additional asset and climate hazard exposure information.

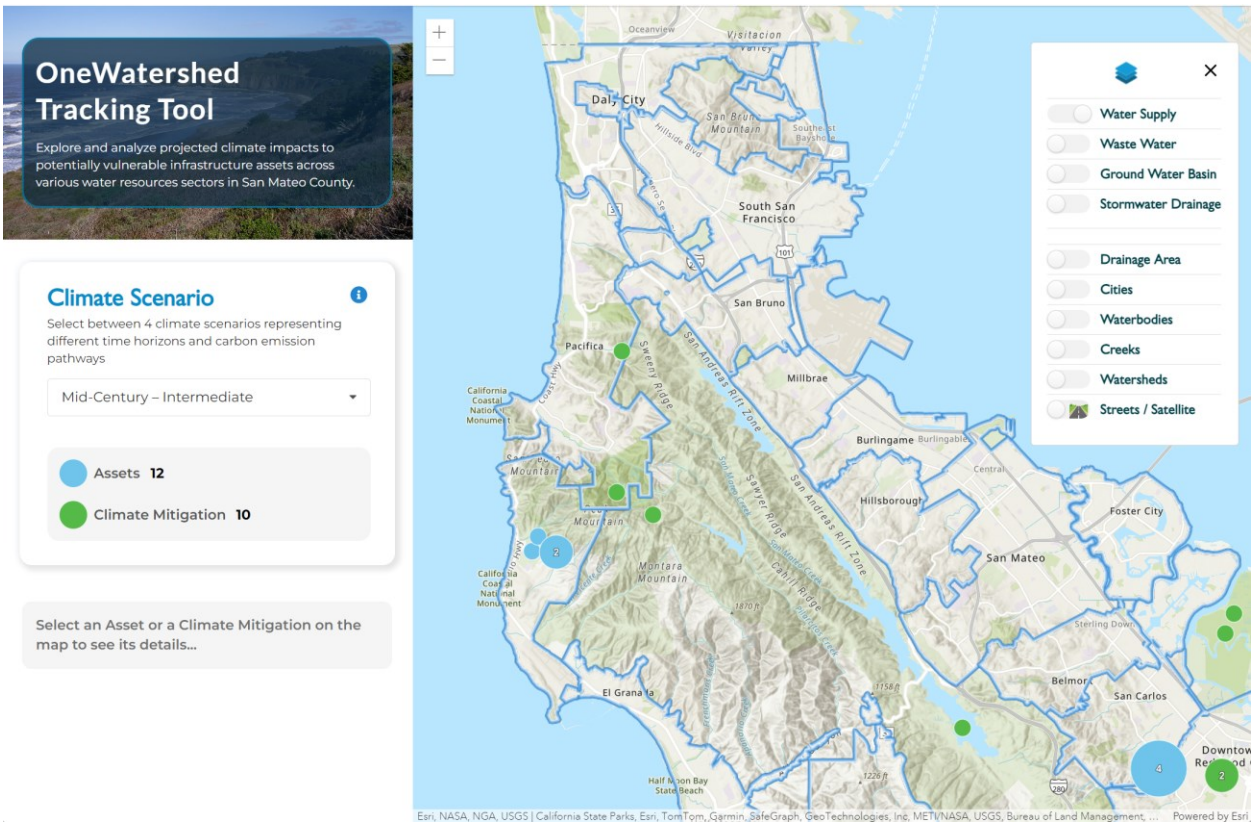
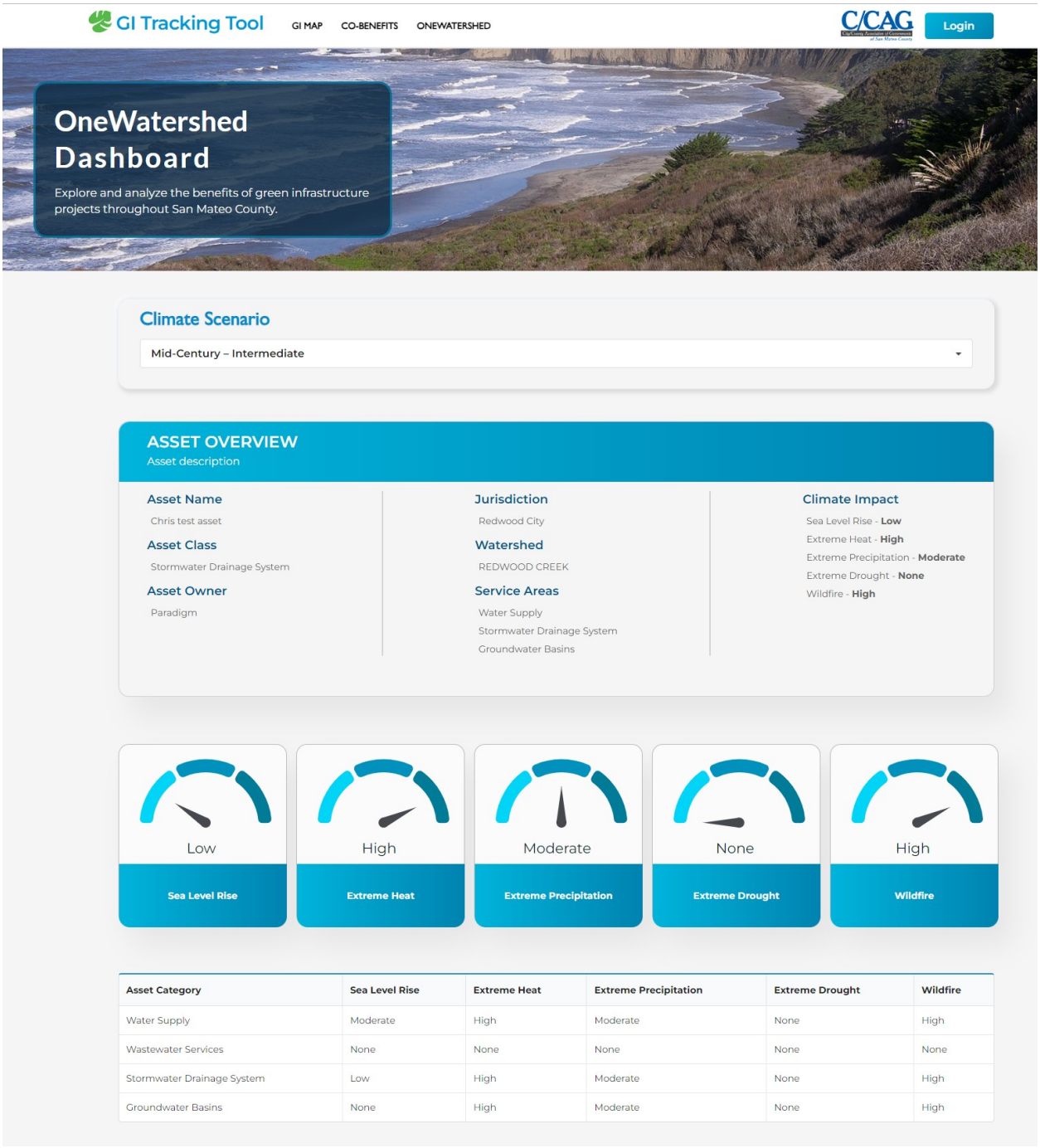


Figure 6: OneWatershed Dashboard primary user mapping interface

Clicking on an asset and the resulting button for more information directs the user to a separate web page for that asset (the web page is shown in Figure 7). When an asset is added to the Dashboard, the tool generates a unique URL that can be easily shared with other agencies for

planning purposes. The web page shows more information about an asset, including type of water infrastructure or water resource, as well as a summary of its climate hazard exposure associated with its location in relation to the climate hazard layers.



Asset Category	Sea Level Rise	Extreme Heat	Extreme Precipitation	Extreme Drought	Wildfire
Water Supply	Moderate	High	Moderate	None	High
Wastewater Services	None	None	None	None	None
Stormwater Drainage System	Low	High	Moderate	None	High
Groundwater Basins	None	High	Moderate	None	High

Figure 7: Asset-Specific Climate Hazard Exposure Shared-risk Summary Interface

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APPENDIX A

San Mateo County OneWatershed Climate Resilience Framework and San Bruno Creek Watershed Climate Resilience Plan Community Engagement Plan

APPENDIX B
OneWatershed Data Inventory

APPENDIX C

Community Vulnerability Assessment – Short Term Plan for San Bruno