California Water Service
CLIMATE CHANGE RISK ASSESSMENT & ADAPTATION FRAMEWORK
EXECUTIVE SUMMARY

April 2022

Background and Purpose

Climate change poses a risk to the reliability and resilience of essential services, such as the provision of safe and affordable water. California Water Service already faces climate risks — wildfire, increasing temperatures, sea level rise, flooding, and drought — and seeks to address these risks by identifying them and taking action.

This current Study is an expansion of Cal Water's 2016 Study *Potential Climate Change Impacts on the Water Supplies of California Water Service.* In December 2020, Cal Water completed Phase 1 of this project. The resulting *Climate Change-Water Resource Monitoring and Adaptation Plan* provides a baseline understanding of changes to climate in areas relevant to Cal Water's system. In Phase 2 of this project, *Climate Change Risk Assessment & Adaptation Framework*, Cal Water conducted a Study to (1) identify and prioritize climate-driven risks to Cal Water's supply reliability, operations, and assets, and (2) project and assess changes to the supply of and demand for Cal Water resources.

This Study is intended to assist in understanding climate change risk across all Cal Water's districts, spanning its future supply availability as well as its key operations and assets. The Study identifies primary risks to Cal Water across all districts as well as the top risks to individual districts.

Using this Study and the Adaptation Framework, Cal Water can continuously monitor and address the following:

- Immediate risks given near-term threat and low risk tolerance
- Actions to take when a trigger is reached (e.g., when information becomes available or there is external opportunity for an adaptation strategy)
- District-specific risks requiring targeted management attention
- Risks to disadvantaged and vulnerable communities

Policy Context

Various state agencies have, and are expected to, develop requirements for water utilities to incorporate climate change adaptation into their planning and operations, including conducting vulnerability assessments as a starting point. This Study is designed to address requirements of these policies. These policy frameworks and requirements include:

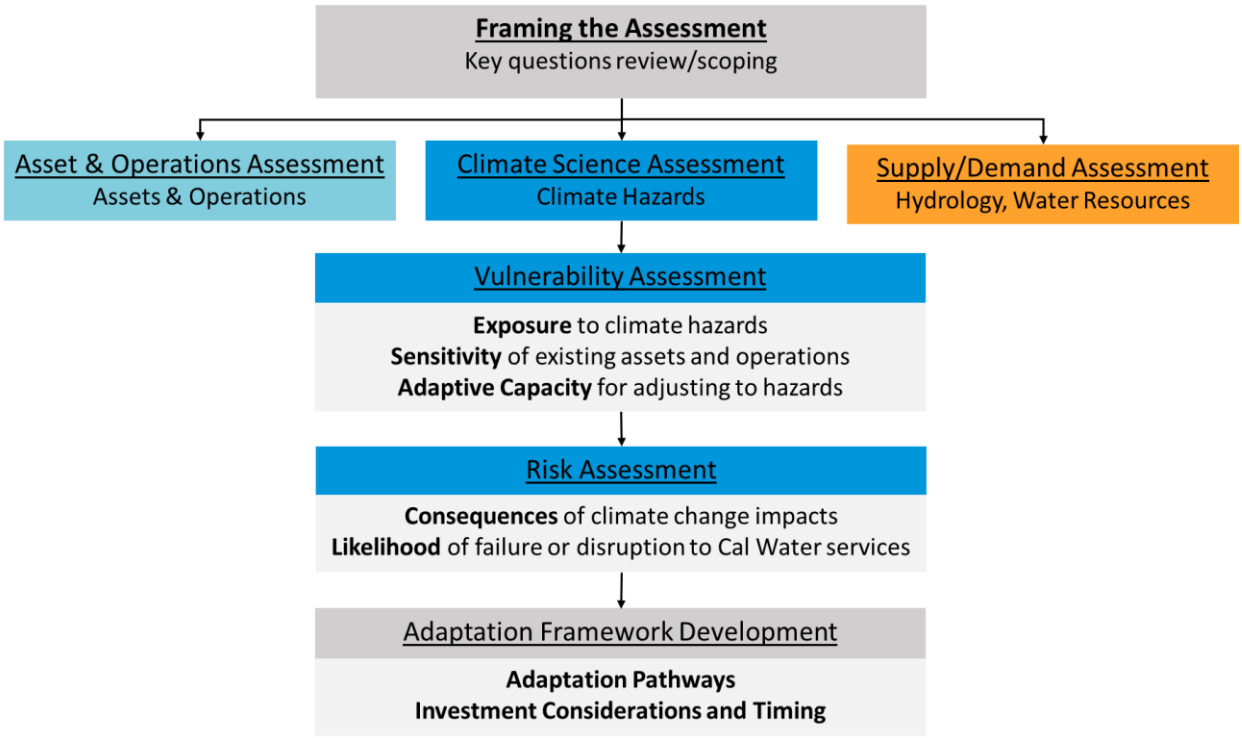
1. The California Public Utilities Commission (CPUC) Order Instituting Rulemaking (OIR) R.18-04-019 to Consider Strategies and Guidance for Climate Change Adaptation (2020). The deadline for finalizing requirements for Phase II, expected to apply to water utilities, has been extended to December 2022.
2. The California Coastal Commission (CCC) Critical Infrastructure at Risk: Sea Level Rise Planning Guidance for California's Coastal Zone (Draft, November 2021).

3. The California Natural Resources Agency (CNRA) 2021 Climate Adaptation Strategy (Draft, October 2021).
4. The 2020 Water Resilience Portfolio in response to Governor's Executive Order N-10-19.
5. The State Water Resources Control Board's 2017 Comprehensive Response to Climate Change.
6. The Task Force on Climate-Related Financial Disclosures (TCFD) from the Financial Stability Board recommend that organizations describe the climate-related risks and opportunities the organization has identified over the short, medium, and long term. Furthermore, it recommends that asset managers describe how climate-related risks and opportunities are factored into relevant products or investment strategies.

Methodology

The Study follows three steps that are common in the risk assessment stages of adaptation planning: framing the assessment, conducting the vulnerability assessment, and carrying out the risk evaluation (Figure 1). Finally, the Study team developed an adaptation framework to identify the structure for Cal Water's order of operations for addressing key risks.

Figure 1: Vulnerability assessment methodology



Framing the Assessment

To determine how Cal Water may be impacted by climate change, the Study team reviewed literature, conducted a workshop with subject matter experts within Cal Water to identify

potential effects on critical system components, and developed a sensitivity inventory with potential risks highlighted by literature or Cal Water experts.

Vulnerability Assessment

The Study team sought to understand the relationships between climate hazards, climate indicators available in climate science, and Cal Water's system and key functions. To do this, the Study team carried out a science-based vulnerability assessment looking at climate change impacts under two different scenarios (Representative Concentration Pathway [RCP] 4.5 and 8.5[1]) that span over the early, mid, and late century.

The assets and operations vulnerability assessment draws from the framework put forth in the 2020 California Adaptation Planning Guide, which includes three key elements of vulnerability: exposure, sensitivity, and adaptive capacity. Exposure refers to systems, populations, or assets in areas that make them subject to direct harm; sensitivity is the degree to which a system may be impacted; and adaptive capacity is the ability to prepare for and respond to potential consequences or opportunities.

The supply vulnerability assessment focused on incorporating existing supply studies, where available, along with watershed-level climate projections developed for this assessment, which consider the exposure and sensitivity of district supplies to climate change.

Risk Assessment

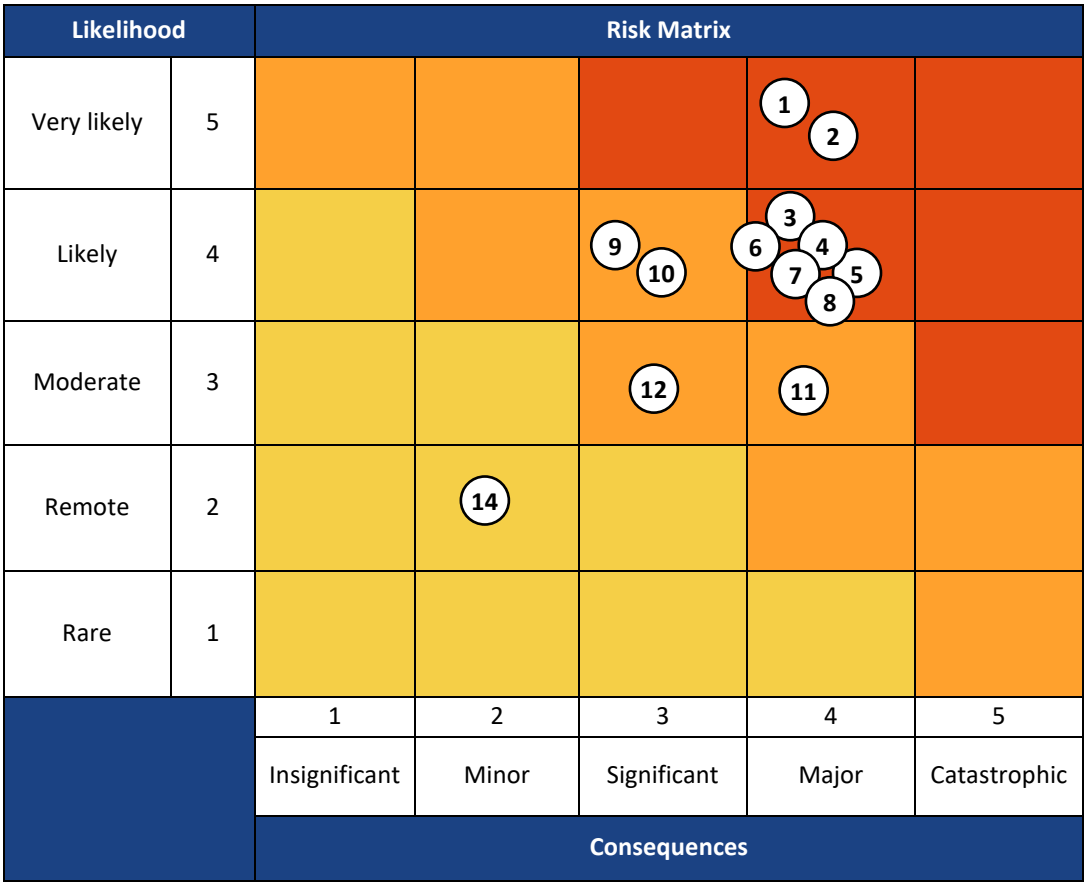
Based on vulnerabilities to supply and demand, operations, and assets, the Study team developed a collection of risk statements that describe the potential damage or disruption to Cal Water's system. The Study team ranked each risk statement based on the scenario's likelihood and consequences to Cal Water's system. Likelihood refers to the chance, absent any intervention, that the risk will result in asset/operational failure or disruption to services, while consequence refers to the magnitude of the effect on Cal Water's system.

Findings

The Study team developed fourteen risk statements based on the highest-scoring supply reliability, assets, and operations vulnerabilities, which are compared to each other based on likelihood and consequence ratings as shown in the risk matrix (Figure 2).

[1] Representative Concentration Pathway (RCP) scenarios are greenhouse gas concentration trajectories adopted by the IPCC for its Fifth Assessment Report in 2014. RCP 4.5 represents an intermediate scenario that considers global greenhouse gas mitigation measures, while RCP 8.5 represents a higher-emissions scenario in which emissions continue to rise throughout the 21st century.

Figure 2: Risk matrix

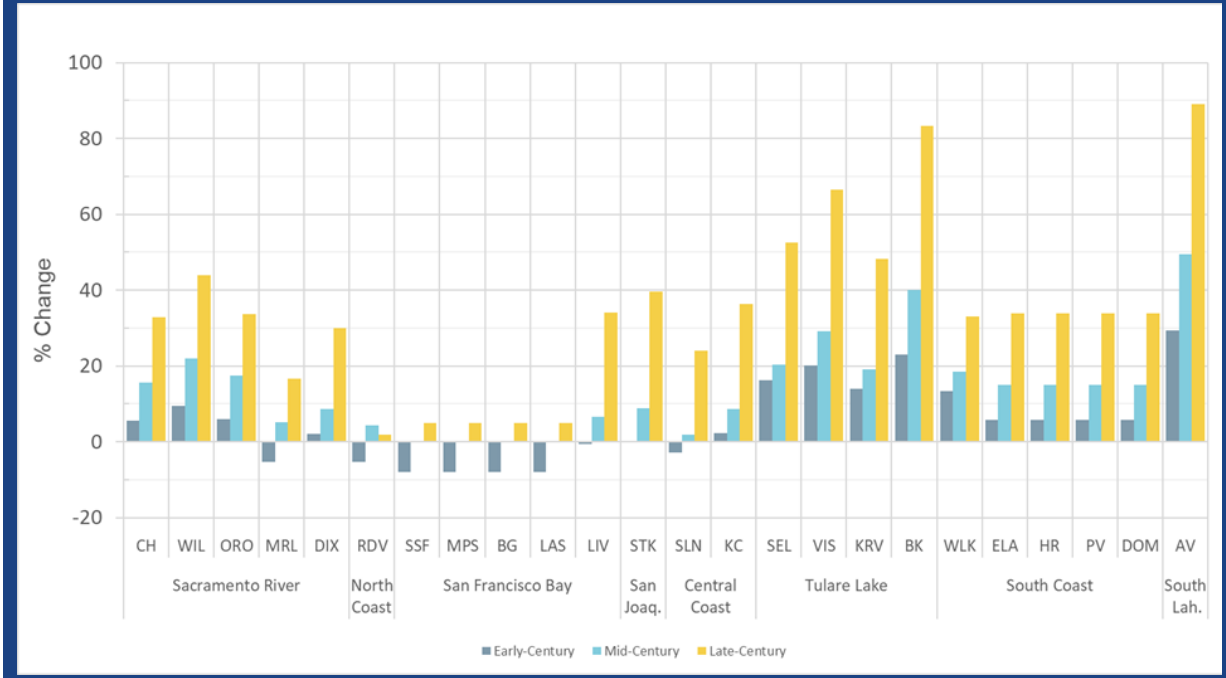


These risks, ranked with the most likely and consequential statements near the top, include (as numbered in Figure 2):

1. **Operations:** Water quality will decrease due to high temperatures and low rainfall, which could increase algal blooms, cyanotoxins, sediments, and eutrophication, increasing water treatment costs and potentially impacting supply availability.
2. **Operations:** Water quality will be impacted by increased wildfire risk and frequency of intense rainfall, resulting in greater quantities of debris and pollutants that enter waterways after fire events. This may disrupt operations, increase water treatment costs, and reduce water available for distribution.
3. **Supply Reliability:** Annual State Water Project (SWP) deliveries are likely to decrease in average years and be eliminated in the driest years.
4. **Supply Reliability:** Groundwater recharge is expected to decrease in some basins, which could limit sustainable yield from groundwater basins and lead to supply shortages.

5. **Supply Reliability:** Decreased surface water supply availability is expected due to longer, more severe, and more frequent droughts, leading to potential supply shortages.

Figure 3: Percent change in average drought duration months (using 12-month SPEI).

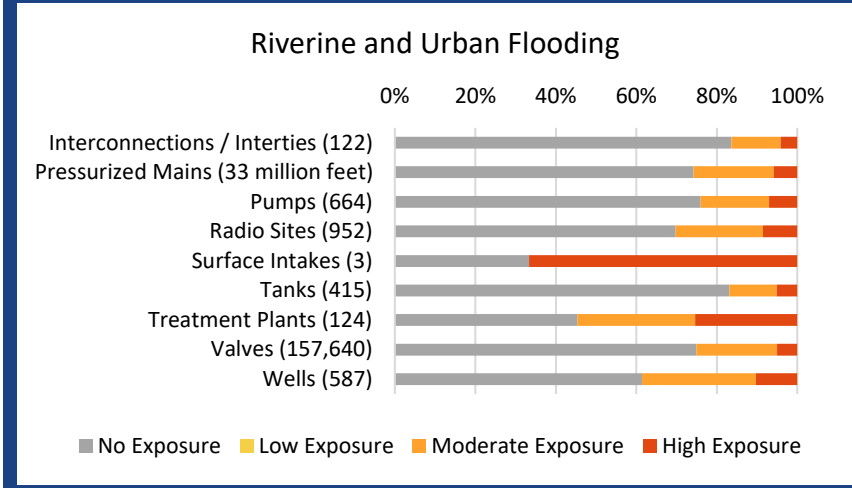


Highlight: Risk Statement #5

Increased drought duration and intensity could lead to supply shortages. The SPEI (a drought index) for each district shows that while drought duration is generally expected to increase throughout the state, the Tulare Lake region is likely to experience the greatest increases in drought duration while the San Francisco Bay region is likely to experience the least increase in drought duration (Figure 3).

6. **Operations:** Worker health and safety will be endangered due to wildfire.
7. **Assets:** More frequent and severe riverine and urban flooding can result in service disruption and infrastructure damage due to loss of access to assets, damage to electrical components, long recovery time from disruption, and difficulty in moving or replacing fixed assets.

Figure 4: Percentage of assets exposed to riverine and urban flooding.



Highlight: Risk Statement #7

Riverine and urban flooding poses a high risk to assets. Flooding could result in loss of access to assets, damage to electrical components, long recovery time from disruption, and difficulty in moving or replacing fixed assets that are damaged or at-risk to flooding.

8. **Assets:** Increased wildfire risk could affect all of Cal Water's asset types.
9. **Supply Reliability:** Outdoor demands will increase due to increased evapotranspiration (ET) and longer, more frequent, and more severe droughts, leading to potential shortages and/or challenges to operations.
10. **Operations:** Natural snowpack storage may decrease due to declining snowpack due to temperature increases, leading to overall reduced supply and forcing Cal Water (or reservoir managers) to adjust reservoir storage facilities and operations to adapt to decreased surface flows.
11. **Assets:** Sea level rise can result in permanent inundation of several asset types, especially pressurized mains.
12. **Assets:** Rising groundwater due to sea level rise may affect wells and treatment facilities through flooding or causing saltwater intrusion in wells, affecting operations, water quality, or preventing access to facilities.
13. **Assets:** Subsidence may damage wells, valves, and treatment plants and increase leakage at joints.
14. **Operations:** High temperatures may impact safety and productivity of workers.

Disadvantaged Vulnerable Communities (DVCs)

Disadvantaged Vulnerable Communities (DVCs) are communities that have been identified as being the most vulnerable to climate change under the Phase 1 decision of the California Public Utilities Commission's (CPUC) 2020 Order Instituting Rulemaking (OIR) to Consider Strategies and Guidance for Climate Change Adaptation. DVCs often face disproportionate levels of

exposure to climate hazards and have a lower capacity to adapt to these hazards. The CPUC's 2020 OIR requires that California utilities companies devote special attention to DVCs in climate adaptation and resilience planning.

DVC criteria, as defined by the CPUC, are as follows:

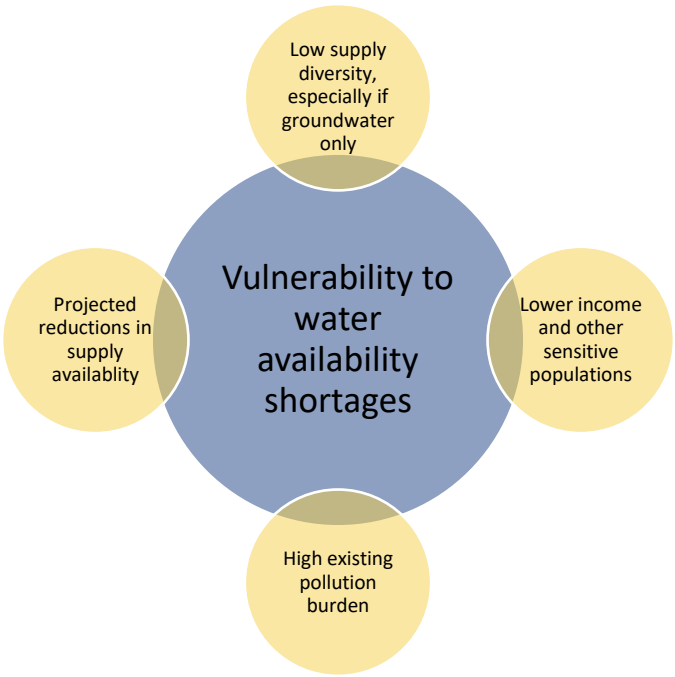
- 25% highest scoring census tracts according to CalEnviroScreen;
- All tribal lands;
- Census tracts with median household incomes less than 60% of state median income;
- Census tracts that score in the highest 5% of Pollution Burden[2] within CalEnviroScreen, but do not receive an overall CalEnviroScreen score due to unreliable public health and socioeconomic data.

DVCs may experience disproportionate impacts from climate-driven changes to water resources and face challenges in preparing for and recovering from events that affect water supplies, such as water contamination and water shortages. Districts that serve vulnerable communities and rely on only one supply of water are particularly vulnerable to the impacts of climate change.

In total, approximately 732,000 residents from 16 Cal Water districts live in disadvantaged and vulnerable communities. The Study team identified the districts with the highest number of customers living in DVCs and lowest supply diversity to determine which DVCs are most at risk. Figure 5 shows the social and physical factors contributing to that risk.

[2] Pollution Burden compiles the potential exposure to pollutants and adverse effects caused by pollution, which includes but is not limited to water pollution (California Office of Environmental Health Hazard Assessment (OEHHA), 2021).

Figure 5: Factors contributing to community vulnerability to water availability shortages



Addressing Climate Risks

Existing Efforts

Cal Water is currently carrying out programs that address some of the climate risks identified in this Study. These existing efforts include:

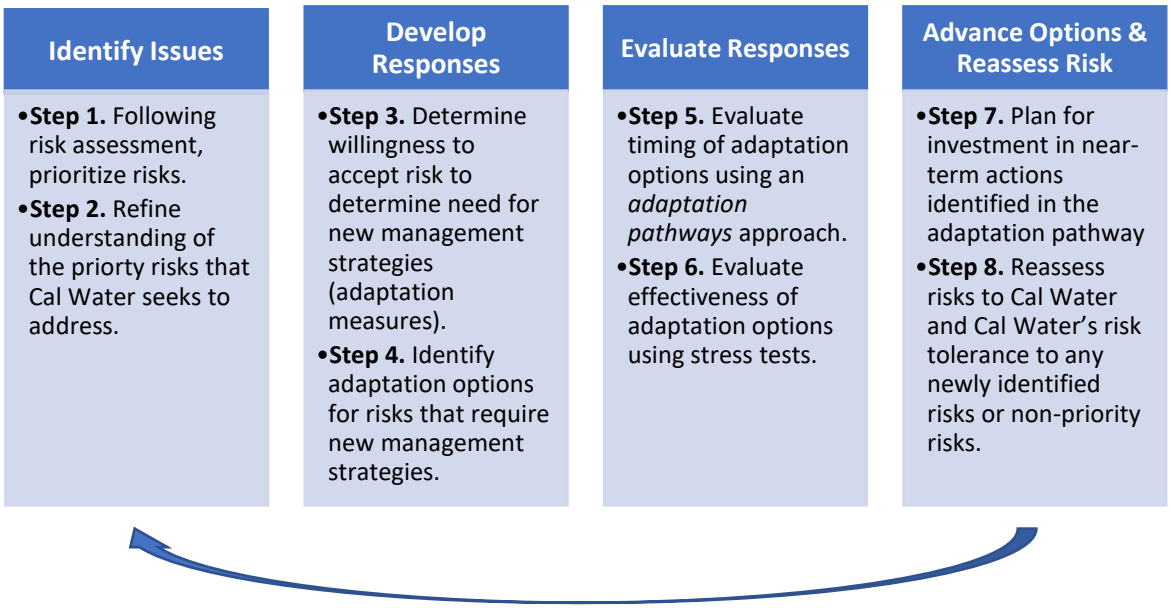
- Wildfire preparation and Wildfire Risk Assessment – Infrastructure projects and upgrades to increase reliability in the event of a wildfire and prevent loss of power at key facilities, along with protections for worker safety.
- Treatment plant analysis – Systematic review of climate change risks driven by wildfires, droughts, intense rainstorms, or excessive agricultural nutrient loads.
- Long-term demand model update – Improvements in modeling for more effective management of water resources, including the addition of evapotranspiration, and updating climate projection inputs.

Adaptation Framework

An adaptation framework is provided to assist Cal Water in incorporating the outcomes of this study into further analysis of investment decision making over time.

The primary steps of the adaptation framework are summarized below in Figure 6.

Figure 6: The Adaptation Framework follows 8 steps and is an iterative process for adaptation planning



The departments primarily affected by climate risks include Water Resource Sustainability; Water Quality; Operations; and Engineering. District Management will be affected by specific vulnerabilities in each individual district.

Cal Water will need to address vulnerabilities exacerbated by climate change to prepare its systems for continued operation and to continue to meet established level-of-service goals. Worsening climate conditions may change the historical balance between supply and demand and increase management requirements of assets and operations. Adaptation investments should be developed and evaluated for major identified risks and resiliency potential. Given that supply availability is dictated by many factors outside of Cal Water's control, it may be important for Cal Water to seek adaptation measures in collaboration with wholesalers and state and federal water management agencies.

Next Steps

The Study team recommends these seven next steps toward the development of adaptation responses:

1. Initiate robust adaptation planning using the framework described in Section 6, *Framework to Identify and Prioritize Adaptation Strategies*.
2. Refine asset vulnerabilities by cataloging local asset characteristics through site specific evaluations. This can support adaptation strategy development for individual assets.
3. Re-evaluate climate vulnerability and risk as new climate projections or datasets become available to identify additional system stressors and adaptation needs.

4. Conduct focused assessment (e.g., stress testing) of top risks from this assessment and their respective adaptation strategies. The study team recommended developing a pilot study for specific hazards in a single district.
5. In conjunction with the above, define metrics for conducting performance evaluation under climate change for key risks and refine metrics for exposure based on asset design and attributes.
6. Consider approaches to integrating downscaled climate projections into local resource reliability planning.
7. Prepare a plan for engagement with disadvantaged vulnerable communities identified in this assessment to prioritize and address vulnerabilities within Cal Water's locus of control.

Conclusion

Cal Water faces climate change risks that, if not addressed, may damage its assets and disrupt its operations and services. Highly likely and consequential risks include decreased water quality, reduced supply reliability from decreased groundwater and surface water availability, endangered worker health and safety due to wildfire, and damage to assets from riverine and urban flooding and wildfire. Disadvantaged vulnerable communities, particularly those with low supply diversity, are especially vulnerable to climate risks that threaten Cal Water's system.

While it is already carrying out efforts to address climate change risks, Cal Water will need to invest in additional climate adaptation efforts to continue reliable operations and meet its service goals. As climate impacts continue to affect the water sector, Cal Water will proactively incorporate climate change considerations into its planning and decision-making processes.