Small Water Suppliers and Rural Communities
at Risk of Drought and Water Shortage Vulnerability
and
Recommendations and Guidance to Address the Planning Needs of these Communities

Appendices

California Department of Water Resources
Water Use Efficiency Branch

Appendix 1. Literature Review

County Drought Advisory Group

Project: Small Water Supplier and Rural Community Drought Risk and Water Shortage Planning

Literature Review

February 2019

Water Use and Efficiency Branch

California Department of Water Resources

This report was prepared under the supervision of DWR with the assistance of Greg Young of Tully & Young.

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Introduction

In May 2018, Governor Brown signed into law several new statutes intended to help make water conservation a California way of life. These statutes, developed and approved through Assembly Bill 1668 and Senate Bill 606, added Section 10609.42 to the California Water Code (CWC). This section instructs the California Department of Water Resources (DWR) to:

a) "[U]se available data to identify small water suppliers and rural communities that may be at risk of drought and water shortage vulnerability." [CWC 10609.42(a)], and
b) Develop for the Governor and Legislature "recommendations and guidance relating to the development and implementation of countywide drought and water shortage contingency plans to address the planning needs of small water suppliers and rural communities." [CWC 10609.42(b)]

Specifically, CWC 10609.42(b) directs DWR to include, but not be limited to, recommendations that address the following components:

1. Assessment of drought vulnerability.
2. Actions to reduce drought vulnerability.
3. Response, financing, and local communications and outreach planning efforts that may be implemented in times of drought.
4. Data needs and reporting.
5. Roles and responsibilities of interested parties and coordination with other relevant water management planning efforts.

To assist DWR with its required tasks, a literature review was conducted of several documents that may provide insight into small water supplier and rural community drought vulnerability. This report documents the findings of the literature review.

Selected Literature for Review

The selected literature reviewed is listed in Table 1 along with an indication as to its relevance or value for the two aforementioned DWR directives. The County Drought Advisory Group (CDAG), organized to assist DWR, contributed to the compilation of this list and represent some of the agencies or authors of the same. The selected literature represents a number of readily available documents that were topically relevant and reflective of recent drought circumstances experienced in California. Many of these sources focused on the availability and reliability of safe drinking water for disadvantaged communities, using the recent drought as a platform to highlight longer trending concerns regarding clean drinking water. It should be noted that because there are many interrelations between water shortage contingency planning and the issue of safe drinking water availability under all conditions, these literature sources provide conclusions and findings from a broader scope than the project with which DWR is tasked.

Methods

Each of the literature sources listed in Table 1 was reviewed and "highlighted" electronically. Various primary points, conclusions, data sources, and findings were highlighted during the review process for later assessment and revisiting. Primary information was copied from the electronic version of the sources into a spreadsheet for use in preparing this summary report.

Table 1 Literature Sources Reviewed for this Report

Ref #	Report Title	Report Source	Relvant for Development of CWC Section 10609.42					
			(a)	(b)(1)	(b)(2)	(b)(3)	(b)(4)	(b)(5)
1	Californians Without Safe Water and Sanitation: California Water Plan Update 2013	DWR (2013)	X	X		X		X
2	Measuring Progress Toward Universal Access to Water and Sanitation in California: Defining Goals, Indicators, and Performance Measures	Pacific Institute (2018)		X		X	X	X
3	Managing Drought in a Changing Climate: Four Essential Reforms	PPIC (2018)	X		X			X
4	The Struggle for Water Justice in California's San Joaquin Valley: A Focus on Disadvantaged Unincorporated Communities	UCD (2018)	X	X	X		X	
5	Drought Management and Climate Adaptation of Small, Self-Sufficient Drinking Water Systems in California	UCD (2018)	X	X	X	X	X	X
6	Bringing Water and Land Use Together: Final Report to the Community Foundation Water Initiative on the Equitable Integration of Water and Land Use	Local Gov Comm (2018)			X			X
7	Broadening understandings of drought: The climate vulnerability of farmworkers and rural communities in California	Univ of Arizona (2018)	X	X		X		
8	Making Water Conservation a California Way of Life: Implementing Executive Order B-37-16	DWR/SWRCB (2017)		X	X	X	X	X
9	Water Equity Science Shop (WESS) presentation on the domestic well community layer	CWC (2018)	X					
10	Water/Wastewater Utilities and Extreme Climate and Weather Events: Case Studies on Community Response, Lessons Learned, Adaptation, and Planning Needs for the Future (Project CC7C11)	WERF (2014)				X		X
11	Drought and Equity in California	Pacific Institute (2017)	X	X	X	X	X	X
12	Drought and Water Supply Vulnerability Contingency Planning	Comm. Water Center (2018)						
13	A Framework and Tool for Evaluating California's Progress in Achieving the Human Right to Water	OEHHA (2019)	X					
14	Drought Contingency Plan Template	IHS (2014)			X	X	X	
15	Basic & Urgent: Realizing the Human Right to Water & Sanitation for Californians Experiencing Homelessness	ELC/EJCW (2018)						

Findings

Many of the literature sources included foundational data derived from common State and federal data sources, though they were often from different points of time, used differently in analytical work, or simply presented in different formats. These same literature sources often had overlapping or similar conclusions and findings. The findings extracted from each source were reviewed to create a synthesized set of findings to give background information for breakout group discussions within the CDAG.

The synthesized findings reported by subject are:

SF1: **Funding and Financing:** Improve access to funding sources for drought planning and drought mitigation project implementation. Priorities should include streamlining the application processes to reduce the level of effort; modifying the threshold requirements to target disadvantaged communities, especially disadvantaged unincorporated communities (DUCs)[1] with at-risk drinking water sources or systems; defining "drought" as a qualifying emergency; and making funds available during non-drought periods to support advanced and proactive planning and solutions. Consider modifying the determination of "income" to assure at-risk DUCs are appropriately meeting qualification thresholds.
Study Findings: 1d, 1g, 2a, 3d, 4b, 5a, 5b, 5c, 12e, 11g, 12g

SF2: **Data and Tools:** Need for coordination among local, regional, State, and federal agencies to collaborate on a consistent set of indicators to help counties monitoring rural communities and small water systems vulnerable to droughts and water shortages. State managed and financed data collection, data management, and data storage, along with routine development, reporting, and dissemination of vulnerability mapping.
Study Findings: 1a, 1b, 2b, 2c, 2d, 2e, 4d, 4e, 5b, 6d, 7b, 8a, 8b, 11a, 11d, 11e, 12b

SF3: **Outreach and Education:** Need for financed creation and distribution of drought planning tools and templates, including educational outreach materials for use by small water systems and within rural communities. Education materials should target hard-to-reach water users such as renters, multi-unit housing occupants, and users with language barriers. Increase research for DUC oriented safe water solutions.
Study Findings: 4f, 5d, 5e, 5i, 11g, 12b

SF4: **Technical Assistance and Capacity Building:** Provide State-financed personnel and management resources to high-risk DUCs to facilitate planning, prevention, and mitigation for drought and water shortage vulnerabilities. Provide venues for local coordination and knowledge transfer. Include diverse expertise and representation (e.g., community advocates, local system operators, disadvantaged self-supplied or small water system users, large system operators).
Study Findings: 1f, 5f, 5h, 5i, 6e, 6f, 6g, 7a, 12a

SF5: **Regional Planning and Coordinated Communication:** Require responsible regional parties to demonstrate drought preparedness for all water users within defined boundaries (e.g., through Hazard Mitigation Plan, General Plan Updates, or stand-alone programs). Encourage development of drought

[1] A Disadvantaged Unincorporated Community (DUC) "means a fringe, island, or legacy community in which the median household income is 80 percent or less than the statewide median household income. California Government Code Section 65302.10(a)(2).

plans when not in the midst of a drought and perform monitoring and plan-updates on a routine basis — including communications with State, regional, and local agencies to assure data sharing.
Study Findings: 3a, 7b, 7c, 8b, 8c, 8d, 8e, 10a, 10b, 11b, 12a, 12d, 12f, 14a

SF6: **Land-use Plans:** Require land-use planning to address conditions of ongoing water shortage vulnerability (e.g., because of water quality or other factor), especially for disadvantaged communities. Encourage land use planning to limit the creation of or worsening of water shortage conditions for small water systems and rural communities. Include emphasis on water system infrastructure investments prior to new developments (e.g., consolidation, water system upgrades, or water system interties prior to land-use modifications). Improve county well permitting processes to recognize water limitations and vulnerabilities.
Study Findings: 3b, 3c, 4c, 5i, 6a, 6b, 6c, 6d, 6h, 11c

SF7: **Consolidation:** Emphasize consolidation of small water systems, especially those at risk of or already facing safe water concerns. When this is impractical, facilitate support from local urban water suppliers to provide technical expertise, emergency response, mutual aid, and service interties.
Study Findings: 1e, 4a, 5g, 11f

SF8: **Rate Restructuring:** Refine small water system billing to reduce financial impact of drought surcharges on low-income customers, while helping small water system operators obtain adequate revenues to assure stable operations during droughts (e.g., state funding sources, disadvantaged community rate-assistance funding).
Study Findings: 5i, 11g

SF9: **Human Right to Water:** Assure State, regional, and local land-planning and water supply and management entities continue to focus on implementing actions to achieve the policy goals within California Water Code Section 106.3 (AB 685).
Study Findings: 1c, 15a, 15b, 15c, 15d, 15e, 15f

DWR Action 1.

Identify Small Water Suppliers and Rural Communities Vulnerable to Droughts

As directed by CWC 10609.42(a), DWR shall identify small water suppliers and rural communities at risk of drought — using available data. The literature sources each include a variety of data obtained from several federal, State, regional, and local resources. Some of the cited literature references data sources or demonstrates data combinations and analyses that can aid this DWR directive. Data in the literature generally falls within five categories:

1. Water supply source — surface water or groundwater, or both.

2. Water provider — public water system or self-supplied domestic well.
3. Demographics.
4. Economics.
5. Source water quality.

While DWR will likely need to develop its own combination of these data categories, the data references cited in the literature provide a starting place. Data used to prepare graphics, tables, and maps presented in the various literature were copied into a master spreadsheet, referencing the dataset name, providing a link to the source data (as presented in the literature — though links were not validated), and indicating the dataset's primary owner. This information is summarized in Table 2.

Table 2 Referenced Data Sources from Cited Literature

Dataset name	Data source (report)	Organization (data owner)	Type of data	Coverage (statewide or specific region)
Communities that Rely on a Contaminated Groundwater Source for Drinking Water. 2013.	https://www.waterboards.ca.gov/water_issues/programs/gama/ab2222/docs/ab2222.pdf	State Water Resources Control Board (SWRCB)	census data	statewide
Population Estimates for Community Water Systems	June 2012 database (reported by each community water system)	California Department of Public Health (CDPH): Permits, Inspection, Compliance, Monitoring and Enforcement (PICME)	census data	statewide
Small Water Program Plan	http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Smallwatersystems.shtml.	California Department of Public Health (CDPH)	water use data	statewide
Groundwater Ambient Monitoring & Assessment Program – Private Domestic Well Project	http://www.waterboards.ca.gov/gama/domestic_well.shtml	SWRCB	water use data	select private wells, various counties
Groundwater Assessment and Protection Program – Salinas and Pajaro Valley Domestic Well Project 2012/2013 (Preliminary Results)	http://www.waterboards.ca.gov/centralcoast/water_issues/programs/gap/index.shtml#special_projects	Central Coast Regional Water Quality Control Board	water use data	Salinas and Pajaro Valley
Onsite Wastewater Treatment System	2012 policy	SWRCB	water use data	statewide
Sanitation Deficiency Construction Program	2012 program	Indian Health Services (IHS)	water use data	statewide
Addressing Nitrate in California's Drinking Water with a Focus on Tulare Lake Basin and Salinas Valley Groundwater	2012 Report to the Legislature	UC Davis	water use data	Tulare Lake Basin and Salinas Valley
Recommendations Addressing Nitrate in Groundwater	2013 Report to the Legislature	SWRCB	water use data	statewide
Report on New and Expanded Funding Sources to Address the Needs of Disadvantaged Communities in Unincorporated Areas that Do Not Have Safe Drinking Water	2013 Final Report to the Governor's Office http://www.waterboards.ca.gov/water_issues/programs/groundwater/docs/stakeholders/8132013_2_final_rep_new_expanded_funding.pdf	Governor's Drinking Water Stakeholder Group	economic data	statewide
Small Community Wastewater Strategy	2008 Report and Annual Updates	SWRCB	water use data	statewide
2013 Office of Federal Acknowledgement, Number of Petitioners by State. [Website].	http://www.bia.gov/cs/groups/xofa/documents/text/idc1-024416.pdf	Bureau of Indian Affairs (BIA)	census data	statewide
Technical, Managerial, and Financial (TMF) Criteria for Public Water Systems [Website]	http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/tmfcapacitydevelopment/2013/TMF%20Criteria%20May%202013.doc.	CDPH	water use data, economic data	statewide
Small Water System Program Goal, Implementation Plan.	http://www.cdph.ca.gov/certlic/drinkingwater/Documents/SWS/2013/Small%20Water%20System%20Implementation%20Plan.pdf	CDPH	water use data	statewide
2014 California Water Action Plan	http://resources.ca.gov/docs/california_water_action_plan/Final_California_Water_Action_Plan.pdf	California Natural Resources Agency, California Department of Food and Agriculture, California Environmental Protection Agency.	water use data	statewide
2014. Safeguarding California: Reducing Climate Risk - An update to the 2009 California Climate Adaptation Strategy.	http://resources.ca.gov/docs/climate/Final_Safeguarding_CA_Plan_July_31_2014.pdf.	California Natural Resources Agency	water use data	statewide
2013. Indian Entities Recognized and Eligible to Receive Services from the United States Bureau of Indian Affairs	http://www.gpo.gov/fdsys/pkg/FR-2013-05-06/pdf/2013-10649.pdf	Federal Register / Vol. 78, No. 87 / Monday, May 6, 2013 / Notices. Pages 26384 – 26389.	census data	statewide
2012. Agreements and Legislative Recommendations, Final Report to the Governor's Office.	http://www.waterboards.ca.gov/water_issues/programs/groundwater/docs/stakeholders/08202012_1_final_rep_to_gov.pdf.	Governor's Drinking Water Stakeholder Group	water use data, census data, economic data	statewide
2014. Data Collection and Management for Local and State Small Water Systems	http://www.waterboards.ca.gov/water_issues/programs/groundwater/docs/stakeholders/1142014_3_data_management_rep.pdf	Governor's Drinking Water Stakeholder Group	water use data	statewide
2012. Our Changing Climate 2012: Vulnerability & Adaptation to the Increasing Risks from Climate Change in California. A Summary Report on the Third Assessment from the California Climate Change Center. Support from California Energy Commission and California Natural Resources Agency.	http://www.energy.ca.gov/2012publications/CEC-500-2012-007/CEC-500-2012-007.pdf	California Climate Change Center, with support from California Energy Commission and California Natural Resources Agency.	water & economic data	statewide
2013c. Fifth Annual Update on Efforts to Assist Small and/or Disadvantaged Communities in Meeting Their Wastewater Needs.	http://www.waterboards.ca.gov/board_info/agendas/2013/oct/102213_4.pdf.	SWRCB	water & economic data	statewide
2012a. National Water Program 2012 Strategy: Response to Climate Change. EPA-850-K-12-004.	http://water.epa.gov/scitech/climatechange/upload/epa_2012_climate_water_strategy_full_report_final.pdf	United States Environmental Protection Agency (EPA), Office of Water.	water use data	nationwide
2012b. 2010 National Public Water Systems Compliance Report.	http://www2.epa.gov/sites/production/files/2014-04/documents/sdwacom2010.pdf	EPA	water use data	nationwide
2013. RTOC Strategic Plan 2012-2014 (Draft).	http://www.epa.gov/region9/tribal/rtoc/win13/pdf/2013-02-14-attach-c-rtocstrategic-plan-2012-2014-v01082013.pdf	EPA Region 9 Tribal Operations Committee	census data, economic data	EPA Region 9
2014. Indian Tribal Approvals. [Website].	http://water.epa.gov/scitech/swguidance/standards/wqslibrary/approvtable.cfm	EPA	census data, economic data	statewide
2012 Report. Place Matters for Health in the San Joaquin Valley: Ensuring Opportunities for Good Health for All.	https://www.fresnostate.edu/chhs/cvhpi/documents/cvhpi-jointcenter-sanjoac	Joint Center for Political and Economic Studies	census data, economic data	San Joaquin Valley
Social Vulnerability Analysis: A Comparison of Tools. February 2013.	http://www.iwr.usace.army.mil/Portals/70/docs/iwrreports/Social_Vulnerabilit	Alexandria, Virginia: Institute for Water Resources	economic data	nationwide
2015. Los Angeles County Community Water Systems: Atlas and Policy Guide. Supply Vulnerabilities, At-Risk Populations, Conservation Opportunities, Pricing Policies, and Customer Assistance Programs	http://innovation.luskin.ucla.edu/sites/default/files/Water_Atlas_0.pdf	Los Angeles: UCLA Luskin Center for Innovation	water & economic data	Los Angeles County
2010 Census: Households and Families	https://www.census.gov/programs-surveys/decennial-census/data/datasets.2010.html	United States Census Bureau	census data	nationwide

DWR Action 2.

Develop Guidance and Recommendations for the Legislature

A summary of each reviewed document that CDAG found was relevant to DWR's second directive [under CWC 10609.42(b)] is provided below. These summaries are not intended to capture the full range of a particular source's objectives and findings. Rather, the summaries provide the source's context (usually directly quoting a stated goal/purpose of the relevant study or report), and a list of findings reflecting the host of issues that need to be addressed for reducing drought vulnerability and impacts on small water systems and rural communities (again, that scope is broader than the scope of the project with which DWR is tasked).

Study 1:

Californians Without Safe Water and Sanitation: California Water Plan Update 2013
Jose Alarcon, Senior Engineer; Department of Water Resources (specific publication date unknown)

Context of the study:
"This report was prepared as part of the *California Water Plan Update 2013* process and is an update to the 2005 *Californians without Safe Water* report. It continues the dialogue regarding Californians without safe drinking water and/or adequate sanitation facilities and includes 14 recommendations toward ensuring that all Californians have safe drinking water and adequate sanitation facilities." (p. 1)

Relevant findings reported:
1a: State, regional, and local governments should coordinate to estimate the statewide total population without safe water, including those residing in areas served by a state small water system, local small water system, or private domestic well. [SF2]

1b: State, regional, and local governments, along with interested stakeholders, should coordinate to develop performance metrics and track the progress of achieving safe drinking water and sanitation for all Californians. Periodic progress reports should be prepared that show what improvements have been made and what additional actions are needed. [SF2]

1c: Ensure implementation of the policy goals within California Water Code Section 106.3 (AB 685), which states that every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes. [SF9]

1d: State government should remove barriers to local and regional funding for water projects conducted to support disadvantaged and environmental justice communities. [SF1]

1e: State government should provide incentives for the consolidation, acquisition, or improved management of small water systems. [SF7]

1f: SWRCB and other State agencies that provide funding to third-party technical assistance providers to assist small water and wastewater systems should allow tribal water and wastewater systems to be eligible to receive this technical assistance. [SF4]

1g: SWRCB and other State agencies should submit an endorsement letter to the U.S. Environmental Protection Agency and Congress supporting an increase in the funding allocation (currently at 2 percent) for the Safe Drinking Water Act Drinking Water Infrastructure Tribal Set-Aside and Clean Water Act Indian Set-Aside Programs. [SF1]

Study 2:

Measuring Progress Toward Universal Access to Water and Sanitation in California: Defining Goals, Indicators, and Performance Measures
Laura Feinstein; Pacific Institute (September 2018)

Context/goals/assumptions of the study:
"This report offers a unified framework on how to measure progress toward universal access to water and sanitation in California." (p. IV) "This report focuses on water and sanitation service in homes, including standard housing types, such as single-family and multi-family units; unconventional housing, such as RVs, vans, and boats; group residences, such as dormitories, Single Resident Occupancies (SROs), and homeless shelters." (p. 5)

Relevant Findings reported:
2a: Use the Eligibility for Customer Assistance Program (ECAP) metric described in "Ancillary Performance Indicators for Affordable Water and Sanitation" to qualify households for a water affordability assistance program. [SF1]

2b: Collect information on service disconnections that distinguishes between occupied and unoccupied residences. [SF2]

2c: Identify Public Water Systems that persistently fail to deliver water that meets Safe Drinking Water Act standards. [SF2]

2d: Adopt a single, consistent set of indicators and performance measures, and designate a single entity entrusted with regularly assessing those metrics. [SF2]

2e: Investigate quality of water delivered by Very Small [Water] Systems, i.e., domestic wells. [SF2]

Study 3:

Managing Drought in a Changing Climate: Four Essential Reforms
Jeffrey Mount (et al); Public Policy Institute of California (September 2018)

Context/goals/assumptions of the study:
"This report employs new and recently published climate change simulations, along with lessons learned from the latest drought, to examine California's capacity for adaptation to greater climate extremes and growing water scarcity.[2] We conclude that California will need new policies and strategic investments to reduce the social, economic, and environmental costs of dealing with droughts of the future.

We begin by examining the challenges of managing scarce water supplies in four key sectors during the drought: cities and suburbs, irrigated agriculture, rural communities, and freshwater ecosystems. Based on climate model projections, we then examine additional pressures that are likely to challenge water management in these sectors over the next several decades. We next recommend a suite of policy and management reforms in four areas: drought planning, water infrastructure and operations, water rights administration, and funding. Finally, we examine where California appears to be on the right path in preparing for future droughts and where difficult course corrections may be needed." (p. 5)

Relevant findings reported:
3a: Plan ahead. Stronger drought planning is critically important for urban water management, groundwater sustainability, safe drinking water in rural communities, and freshwater ecosystems. [SF5]

3b: Upgrade the water grid. California needs a comprehensive program to address above- and below-ground storage, conveyance, and operational challenges by mid-century, including repairing facilities that are broken, expanding conveyance and storage capacity, and modernizing and integrating operations. [SF6]

3c: Update water allocation rules. California should comprehensively update its water allocation governance. The goals should be to find equitable and efficient ways to allocate limited supplies among competing demands during dry times while promoting efforts to capture and store water during wet times. [SF6]

3d: Find the money. Reliable funding is crucial for adapting to climate change. New sources are needed to pay for necessary water-management investments and to fill funding gaps in the state's water system. [SF1]

Study 4:

Basic information

The Struggle for Water Justice in California's San Joaquin Valley: A Focus on Disadvantaged Unincorporated Communities
Jonathan London (et al); UC Davis: Center for Regional Change (February 2018)

Context/goals/assumptions of the study:
"Our report analyzes this situation in detail, and offers several recommendations to inform policy and advocacy on how to improve water access to these communities. To do so, we have used maps of DUCs, CWSs, and State Small Water Systems (SSWSs), as well as water quality reports, demographic data, and expert interviews. Together, these sources have helped us highlight gaps in the provision of safe and affordable drinking water.

Our main conclusion is that California's legislature, regulatory agencies, and water suppliers need to undertake more concerted and well-resourced efforts to ensure that the HRTW is ensured for all of the San Joaquin Valley's residents." (p. 9)

Relevant findings reported:
4a: Develop and strengthen consolidation and service extension mandates and incentives. [SF7]

4b: Create larger, more stable, more equitably distributed and coordinated sources of funding that focus on addressing historic patterns of inequitable access to resources. [SF1]

4c: Ensure that local governments comply with land use and annexation laws to address the legacies of discriminatory local planning practices. [SF6]

4d: Improve public access to data and planning tools, enhance existing data systems, and coordinate monitoring systems efforts. [SF2]

4e: Develop new publicly accessible data and mapping tools to improve local and regional planning. [SF2]

4f: Address Outstanding Research Needs. [SF3]

Study 5:

Basic information

Ekstrom, Julia A., Meghan R. Klasic, Amanda Fencl, Mark Lubell, Ezekiel Baker, Frances Einterz. (University of California, Davis). 2018. *Drought Management and Climate Adaptation among Small, Self-Sufficient Water Systems in California.* California's Fourth Climate Change Assessment, California Natural Resources Agency. Publication number: CCCA4-CNRA-2018-004.

Context/goals/assumptions of the study:
"The overarching goal of this project was to document small, self-sufficient system managers' perspectives, experiences, and needs for future drought resilience in the face of climate change and uncertainty. Small [Water] systems are those that serve fewer than 10,000 people, and self-sufficient system are those that do not receive any water from either of the major California water projects (State Water Project, Central Valley Project)." (p. 1)

Relevant findings reported:
5a: Small water systems need assistance..., and this likely requires different approaches than what is provided to larger systems. [SF1]

5b: Need better income surveys in rural areas to more accurately capture demographics of water system customers. [SF1] [SF2]

5c: Defining disadvantaged communities should be specific for drinking water sector (for purposes of financial assistance qualifications). [SF1]

5d: Need continued and improved outreach to and education of consumers about the value of water, the importance of conservation, and the potential repercussions of not conserving. [SF3]

5e: Need unified messaging (templates) to save staff time and resources and create a consistent message. [SF3]

5f: Need State financial support to increase staff capacity for small [water] systems. [SF4]

5g: Agreements between larger and smaller [water] systems to create more equitable distribution of financial and technical assistance. [SF7]

5h: Work with other smaller [water] systems to plan for extreme events. [SF4]

5i: Need ongoing water conservation outreach programs, rate restructuring, infrastructure updates, and maintaining working relationships among and between systems, non-governmental organizations, and the state government. [SF3] [SF4] [SF6] [SF8]

Study 6:

Bringing Water and Land Use Together: Final Report to the Community Foundation Water Initiative on the Equitable Integration of Water and Land Use
(author(s) unknown); Local Government Commission (October 2018)

Context/goals/assumptions of the study:
"Integrating water management and land-use planning emerged as a shared interest area among the Community Foundation Water Initiative members. The cohort commissioned this report to help identify and pursue opportunities at the intersection of integrated water management and land-use planning that advance equity, regional economic development, climate adaptation, housing and transportation planning.

Through this effort, the Community Foundation Water Initiative and its members are gaining a robust understanding of water management needs and opportunities for improved integration with land-use planning at local, regional and statewide levels. By advocating for and investing in efforts that effectively integrate water management and land-use planning, local community foundations will help make all of California's communities more equitable and resilient.

This report identifies strategies for community foundations and other local leaders to leverage the multiple benefits of an integrated, collaborative planning approach. These results benefit the project's community and agency stakeholders, and will have a "scaling up" effect to influence regional and statewide practices." (pp. 3–4)

Relevant findings reported:
<u>State Actions:</u>
6a: Prioritize infrastructure investments that support existing communities, especially underserved communities, before new development. [SF6]

6b: Ensure State and local investments are directed toward multi-solving through green infrastructure projects developed at local scales with robust community engagement. [SF6]

6c: Incentivize or require cross-sector, coordinated planning and management of land use, water, flood mitigation, and climate adaptation. [SF6]

6d: Require additional sophistication (better data and analytics) in growth projections and coordinated regional planning for both land-use planning and water-management agencies. [SF2] [SF6]

Regional Actions:
6e: Advocate for water access and affordability for community members facing disadvantages. [SF4]

6f: Provide venues for local leaders in both the water and land-use sectors to interact with one another (to build relationship, share ideas, and eventually collaborate). [SF4]

6g: Develop regional leaders in both the water and land-use sectors and provide opportunities for them to interact with one another. [SF4]

6h: Build local political will and understanding around water and land-use integration by convening and educating local leaders. [SF6]

Study 7:

Broadening understandings of drought: The climate vulnerability of farmworkers and rural communities in California
Christina Green; University of Arizona (August 2018)

Context/goals/assumptions of the study:
"This paper is organized as follows. Section 2 connects the literature on socioeconomic drought in agricultural systems in developed countries with the scholarship on climate vulnerability. Section 3 describes the study area and the case study of the 2012–2016 drought. Section 4 summarizes the methods for data collection, including semi-structured interviews and a household survey. In Section 5, data results on the impact of the drought on agricultural employment and well-being are presented. Section 6 discusses these results in the context of socio- economic drought and differential vulnerability. Finally, Section 7 concludes the paper with policy recommendations." (p. 1)

Relevant findings reported:
7a: Planning for future droughts improves with the coordination and participation of diverse experts with knowledge of local communities and different dimensions and scales of well-being. The response to the human impact of the drought in California required the coordination and engagement of government officials, community leaders, farmworker activists, and non-profits involved in water security, food security, health, and employment training. [SF4]

7b: Drought vulnerability is dynamic and changes with adaptation decisions made during a drought. Drought relief and planning needs continual assessments to consider the redistribution of drought risk given different adaptation decisions. [SF2] [SF5]

7c: Greater inclusion and representation of vulnerable groups in drought and water resource planning and management is needed. [SF5]

Study 8:

Making Water Conservation a California Way of Life: Implementing Executive Order B-37-16
California Department of Water Resources (DWR), State Water Resources Control Board (Water Board), California Department of Food and Agriculture (CDFA), California Public Utilities Commission (CPUC), and California Energy Commission (CEC); (April 2017)

Context/goals/assumptions of the study:
"The EO directs the California Department of Water Resources (DWR), State Water Resources Control Board (Water Board), California Department of Food and Agriculture (CDFA), California Public Utilities Commission (CPUC), and California Energy Commission (CEC) – collectively referred to as the "EO Agencies" – to summarize in a report a framework for implementing the EO and incorporating water conservation as a way of life for all Californians.

The framework described herein promotes efficient use of the State's water resources in all communities, whether conditions are wet or dry, and prepares the State for longer and more severe drought cycles that will mark our future. The EO directs DWR, the Water Board, and CPUC to develop methods to ensure compliance with the provisions of the EO, including technical and financial assistance, agency oversight, and enforcement action by the Water Board to address non-compliant water suppliers, if necessary." (p. 1-1)

Relevant findings reported:
8a: Reporting and Data Recording — Improved data collection, management, analysis, sharing, and transparency at all levels is foundational to the ability to plan. Data analysis will allow for better coordination among stakeholders and improve on both long-term actions as well as immediate responses to drought risks, especially in rural communities. [SF2]

8b: Communications Planning — Improved monitoring and communications among stakeholders, from the State, through the counties, and to the water suppliers and citizens. [SF2] [SF5]

8c: County Demonstration of Drought Planning — While some portion of a county's citizenry may be covered by an urban supplier's WSCP or a small supplier's drought plan (not required), there is nothing currently available to demonstrate that drought risk is being addressed for all county citizens. To address this need, counties may submit drought planning information to the EO Agencies through documents such as: [SF5]

1. Drought-specific protocols defined in a county (or multi-jurisdictional) hazard mitigation plan.
2. A county drought plan.

8d: Roles and Responsibilities — Defined State agency and county roles, responsibilities, and funding mechanisms. [SF5]

8e: Coordination — The EO agencies and the county, working with stakeholders, should coordinate with SGMA efforts to assure drought planning and responses are reflected in groundwater sustainability plans (where applicable). [SF5]

Study 9:

Presentation on the domestic well community layer
Community Water Center and Water Equity Science Shop (WESS) (September 2018)

Context/goals/assumptions of the study:
Presentation at workshop during technical advisory meeting for development of the Drinking Water Tool

Relevant findings reported:
[Note: this presentation is about data for understanding and defining vulnerability and does not report specific, written findings.]

Study 10:

Water/Wastewater Utilities and Extreme Climate and Weather Events: Case Studies on Community Response, Lessons Learned, Adaptation, and Planning Needs for the Future (Project CC7C11)
Lauren Fillmore (et al); Water Environment Research Foundation (2014)

Context/goals/assumptions of the study:
"Collaboratively with NOAA, U.S. EPA, and partner organizations, research was conducted at six local workshops, organized to include participants that experienced different types of extreme events throughout a river basin or watershed. The localities included: Apalachicola-Chattahoochee-Flint River Basin, Georgia; Central Texas; Lower Missouri River Basin, Kansas and Missouri; National Capital Area; Russian River Basin, California; Tidewater Area, Virginia." (Exec Summary)

Relevant findings reported:
10a: To build resilience, communities must embrace both emergency response and long-term preparedness. [SF5]

10b: The complex array of decisions needed to support resilience within a basin requires coordination across water service areas and jurisdictional boundaries. [SF5]

Study 11:

Drought and Equity in California
Laura Feinstein, Rapichan Phurisamban, Amanda Ford, Christine Tyler, Ayana Crawford; Pacific Institute (January 2017)

Context/goals/assumptions of the study:
"In this report, we examine three major impacts of the drought. The first two—shortages and price hikes—affected people's access to safe, affordable, adequate water in their homes. The third arena we investigate is salmon fishery performance during the drought, and how it affected commercial and tribal fishermen reliant on salmon for income, food, and cultural traditions. We selected these topics based on input from a diverse set of stakeholders. While we were unable to explore them in-depth in this report, the impact of drought on farmworkers, water quality, and subsistence fishermen (beyond the tribes we discuss in Section 3), are also critical issue areas that deserve further analysis.

Our goals were to synthesize available information from the state, media outlets, and non-governmental organizations (NGOs) and develop recommendations on how to mitigate the impacts of future droughts. This report is intended to provide information to community groups to advocate for their own interests, as well as to inform policymakers and other decision-makers interested in crafting more effective drought response strategies, particularly to address the needs of the state's most vulnerable communities." (p. 6)

Relevant findings reported:
11a: Establish a statewide, quantitative metric for measuring water supply reliability for public water systems. [SF2]

11b: Require water shortage contingency plans for all public water systems and establish regional plans for non-public systems. [SF5]

11c: Increase oversight of new private wells. [SF6]

11d: Systematically collect information on water shortages for public and non-public water systems. [SF2]

11e: Identify areas where private wells and other non-public water systems are likely to run dry in future droughts. [SF2]

11f: Identify areas where water system consolidation can resolve supply problems. [SF7]

11g: To reduce the inequitable impact of drought charges on low-income households, we recommend the following:

1. Ensure drought surcharges are not applied to basic water use, preferably by calculating household water budgets based on the number of people in a residence; [SF8]
2. Provide technical and financial assistance to water utilities, especially the smallest ones, to implement drought charges that do not unfairly burden low-income households; [SF1] [SF3]
3. Target water conservation and efficiency programs to low-income households by offering, for example, point-of-sale coupons, targeted education and outreach, and direct-install programs; [SF3] [SF8]
    a) Develop low-income rate assistance programs within current legal constraints and reform Proposition 218 to allow greater latitude in funding such programs; [SF8]
    b) Wherever possible, require meters and submeters to allow for more equitable drought charges based on volumetric water use; [SF8]
    c) Develop approaches that effectively target hard-to-reach customers, such as renters and residents of multi-unit buildings, for rate assistance and conservation programs. [SF3] [SF8]

Study 12:

Drought and Water Supply Vulnerability Contingency Planning
Maria Martinez (et al); Community Water Center (prepared by: Yale University) (March 2018)

Context/goals/assumptions of the study:
"This report offers recommendations to state and local water decision-makers to improve drought contingency and water supply vulnerability planning for small water systems and in rural, disadvantaged, and unincorporated communities across California. By examining drought contingency, preparedness, and response plans, this report highlights the need to shift drought management away from a reactionary model of responding to drought, and toward a proactive paradigm of drought preparedness that integrates an awareness of water supply vulnerability into all phases of water management. A selection of 16 drought contingency and water management plans were assessed for equity and inclusion based on five primary criteria that target DAC-specific needs and vulnerabilities (Figure 1)." (p. 6)

"This report examines and develops recommendations for drought contingency and water supply vulnerability planning in small water systems and for rural, disadvantaged, and unincorporated communities across California. We developed the recommendations by evaluating 16 local and regional drought contingency plans, conducting 45 interviews with agency and community representatives, and reviewing California's relevant drought and water- related policies." (p. 18)

Relevant findings reported:
12a: Move away from a "one size fits all" drought management strategy to a strategy prioritizing community needs, particularly in the state's disadvantaged communities. Identify and prioritize communities that have the highest water supply and drought vulnerability when allocating water resources and throughout the planning process. [SF5]

12b: Develop mapping and decision-support tools to empower State and local water policymakers with the information they need in order to support proactive drought and water supply vulnerability contingency planning and inform sound policymaking. [SF2] [SF3]

12c: Integrate and coordinate drought management systems in order to preserve institutional memory and build collaborative partnerships with stakeholders. [SF4]

12d: Improve and require drought contingency plans for disadvantaged communities by following the best practices detailed in section 4. [SF5]

12e: Include drought provisions in disaster fund measures, such as California Disaster Assistance Act, to include drought as a covered disaster under the statute's definition of "disaster," and lift strict constraints to ensure funding can be used for multi-benefit drought solutions. [SF1]

12f: Account for the impacts of climate change in drought and groundwater management and use drought mitigation and adaptation as a strategy to make communities resilient to changes in water supplies. Drought and other water supply crises should be viewed as an opportunity to improve the effectiveness of response plans and to enact permanent changes in water policy and water management. [SF5]

12g: Provide adequate funding to support drought and water supply contingency planning processes to ensure vulnerable communities have adequate resources to manage and respond to drought and water supply vulnerability. [SF1]

Study 13:

A Framework and Tool for Evaluating California's Progress in Achieving the Human Right to Water

Carolina Balazs (et al); Office of Environmental Health Hazard Assessment (January 2019)

Context/goals/assumptions of the study:

"Recently, the Board enlisted the expertise of the Office of Environmental Health Hazard Assessment (OEHHA) to develop a framework for evaluating the quality, accessibility, and affordability of the state's domestic water supply. Once populated with data, the framework described in this report can be used as a tool to track changes and needs across the state's community water systems and across the framework's three principal analytic components – water quality, accessibility, and affordability. This marks the first state-led effort to develop a conceptual framework and method for assessing the status of the state's water systems in the context of AB 685 and tracking progress in achieving the statute's broad policy goals. Other related efforts focus on one aspect of water service, or present results at a single point in time. This framework and tool will uniquely

offer information that can be viewed over time, at the state or system-level, across all three principal components of the State's human right to water." (p. 2)

Relevant findings reported:
This report provides a data framework for evaluating and tracking potentially vulnerable small water systems and rural communities. It is useful for DWR's first directive but does not provide findings useful for the second directive.

Study 14:

Drought Contingency Plan Template 03-24-2014-Final
Indian Health Service, California Area, Office of Environmental Health and Engineer (March 2014)

Context/goals/assumptions of the study:
"The Drought Contingency Plan (Plan) is a framework of forward-leaning planning for scenarios and objectives, managerial and technical actions, and potential response systems in order to prevent, or better respond to, a drought-related emergency or critical situation. The overall goal of the Plan, and the contingency planning process, is to facilitate rapid emergency response. The intention of the Plan is to be functional, flexible, and easy to implement, and also serve as a tool for maintaining control over the events or limiting the risk of loss of control. The Plan should be periodically updated." (p. 1)

Relevant findings reported:
14a: Document presents a template for use in developing a localized, small water system drought contingency plan, including triggering stages and response actions. [SF5]

Study 15:

Basic & Urgent: Realizing the Human Right to Water & Sanitation for Californians Experiencing Homelessness
Environmental Law Clinic at University of California Berkeley and Environmental Justice Coalition for Water (August 2018)

Context/goals/assumptions of the study:
"This report, prepared by the University of California Berkeley Environmental Law Clinic (ELC) for use in advocacy efforts by the Environmental Justice Coalition for Water (EJCW): (1) examines the lack of access to water and toilets faced by California's unsheltered residents; (2) explores existing efforts towards, barriers to, and opportunities for ensuring such access; and (3) recommends minimum standards for access to water and sanitation by homeless Californians. It also proposes policy and programmatic interventions for achieving those standards." (Executive Summary, p. i)

Relevant findings reported:
15a: Establish minimum State standards for access to water and sanitation and incentivize compliance. [SF9]

15b: Create municipal incentives for new developments to include publicly accessible drinking fountains and toilets. [SF9]

15c: Identify and pursue partnerships to expand non-encampment-tied services. [SF9]

15d: Ensure all public drinking fountains are operational, accessible, and remain in good repair. [SF9]

15e: Ensure all public toilets are operational, accessible, clean, safe, and in good repair. [SF9]

15f: Provide ongoing basic services (potable water, toilets, hand washing stations, showers) at all established encampments. [SF9]

Summary of the List of Findings

The findings extracted from each literature source were evaluated and synthesized to develop a set of common findings (see "Findings"). The relationship between each literature source and the synthesized findings are presented in Table 3. This can help CDAG return to specific literature sources and/or authors to quickly reference relevant ideas and detailed findings.

The synthesized findings can be useful when CDAG discusses elements to be considered when developing guidance relating to the development and implementation of countywide drought and water shortage contingency plans to address the planning needs of small water suppliers and rural communities

Table 3 Relationship of Literature Source and Synthesized Findings

		Findings								
		SF1	SF2	SF3	SF4	SF5	SF6	SF7	SF8	SF9
Literature Reviewed										
1	Californians w/o Safe Water (CA Water Plan 2013)	X	X		X		X	X		X
2	Measuring Progress (Pacific Institute 2018)	X	X							
3	Managing Drought (PPIC 2018)	X				X	X			
4	The Struggle for Water Justice (UCD 2018)	X	X	X			X	X		
5	Drought Management (UCD 2018)	X		X	X		X	X	X	
6	Bringing Water/Landuse Together (Local Gov Com 2018)				X		X			
7	Broadening Understanding of Drought (Univ of Ariz 2018)		X		X	X				
8	Making Water Conservation a Way of Life (DWR 2017)		X			X				
9	Drinking Water Vulnerability Tool PPT (WESS 2018)									
10	Enhancing Resiliency (WERF 2014)					X				
11	Drought and Equity in CA (Pacific Institute 2017)	X	X	X		X	X	X	X	
12	Drought and Water Supply Vulnerability (CWC 2018)	X	X	X	X	X				
13	A Framework/Tool for Evaluating Progress (OEHHA 2019)									
14	Drought Contingency Plan Template (IHS 2014)									
15	Basic & Urgent (ELC/EJCW 2018)					X				X

Summary of Findings	
SF1	Funding and Financing: Improve access to funding sources for drought planning and drought mitigation project implementation. Priorities should include streamlining the application processes to reduce the level of effort, modifying the threshold requirements to target disadvantaged communities, especially disadvantaged unincorporated communities (DUCs) with at-risk drinking water sources or systems, defining "drought" as a qualifying emergency, and making funds available during non-drought periods to support advanced and proactive planning and solutions. Consider modifying the determination of "income" to assure at-risk DUCs are appropriately meeting qualification thresholds.
SF2	Data and Tools: Need for coordination among local, regional, state and federal agencies to collaborate on a consistent set of indicators to help counties monitoring rural communities and small water systems vulnerable to droughts and water shortages. State-managed and financed data collection, data management, and data storage, along with routine development, reporting, and dissemination of vulnerability mapping.
SF3	Outreach and Education: Need for financed creation and distribution of drought planning tools and templates, including educational outreach materials for use by small water systems and within rural communities. Education materials should target hard-to-reach water users such as renters, multi-unit housing occupants, and users with language barriers. Increase research for DUC oriented safe water solutions.
SF4	Technical Assistance and Capacity Building: Provide state-financed personnel and management resources to high-risk DUCs to facilitate planning, prevention and mitigation for drought and water shortage vulnerabilities. Provide venues for local coordination and knowledge transfer. Include diverse expertise and representation (e.g. community advocates, local system operators, disadvantaged self-supplied or small water system users, large system operators.)
SF5	Regional Planning and Coordinated Communication: Require responsible regional parties to demonstrate drought preparedness for all water users within defined boundaries (e.g. through Hazard Mitigation Plan, General Plan Updates, or stand-alone programs). Encourage development of drought plans when not in the midst of a drought, and to perform monitoring and plan-updates on a routine basis – including communications with State, regional and local agencies to assure data sharing.
SF6	Land-use Plans: Require land-use planning to address conditions of on-going water shortage vulnerability (e.g. due to water quality or other factor), especially for disadvantaged communities. Encourage land use planning to limit the creation or worsening of water shortage conditions for small water systems and rural communities. Include emphasis on water system infrastructure investments prior to new developments (e.g. consolidation, water system upgrades, or water system interties prior to land-use modifications). Improve county well permitting processes to recognize water limitations and vulnerabilities.
SF7	Consolidation: Emphasize consolidation of small water systems, especially those at risk to or already facing safe water concerns. When impractical, facilitate support from local urban water suppliers to provide technical expertise, emergency response, mutual aid, and service interties.
SF8	Rate Restructuring: Refine small water system billing to reduce financial impact of drought surcharges on low-income customers, while helping small water system operators obtain adequate revenues to assure stable operations during droughts (e.g. state funding sources, disadvantaged community rate-assistance funding).
SF9	Human Right to Water: Assure state, regional, and local land-planning and water supply and management entities continue to focus on implementing actions to achieve the policy goals within California Water Code Section 106.3 (AB 685).

Exhibit 1

SF1: **Funding & Financing**: Improve access to funding sources for drought planning and drought mitigation project implementation. Priorities should include streamlining the application processes to reduce the level of effort, modifying the threshold requirements to target disadvantaged communities, especially disadvantaged unincorporated communities (DUCs)[2] with at-risk drinking water sources or systems, defining "drought" as a qualifying emergency, and making funds available during non-drought periods to support advanced and proactive planning and solutions. Consider modifying the determination of "income" to assure at-risk DUCs are appropriately meeting qualification thresholds.

Study Findings:

	Short Term
1d	State government should remove barriers to local and regional funding for water projects conducted to support disadvantaged and environmental justice communities.
1g	SWRCB and other State agencies should submit an endorsement letter to the U.S. Environmental Protection Agency and Congress supporting an increase in the funding allocation (currently at 2 percent) for the Safe Drinking Water Act Drinking Water Infrastructure Tribal Set-Aside and Clean Water Act Indian Set-Aside Programs.
2a	Use the Eligibility for Customer Assistance Program (ECAP) metric described in "Ancillary Performance Indicators for Affordable Water and Sanitation" to qualify households for a water affordability assistance program.
11g	(2) Provide technical and financial assistance to water utilities, especially the smallest ones, to implement drought charges that do not unfairly burden low-income households
12e	Include drought provisions in disaster fund measures, such as California Disaster Assistance Act, to include drought as a covered disaster under the statute's definition of "disaster," and lift strict constraints to ensure funding can be used for multi-benefit drought solutions.
	Long Term
3d	Find the money. Reliable funding is crucial for adapting to climate change. New sources are needed to pay for necessary water-management investments and to fill funding gaps in the state's water system.
4b	Create larger, more stable, more equitably distributed and coordinated sources of funding that focus on addressing historic patterns of inequitable access to resources.
5a	Small water systems need assistance...and this likely requires different approaches than what is provided to larger systems.
5b	Need better income surveys in rural areas to more accurately capture demographics of water system customers.
5c	Defining disadvantaged communities should be specific for drinking water sector (for purposes of financial assistance qualifications).
12g	Provide adequate funding to support drought and water supply contingency planning processes to ensure vulnerable communities have adequate resources to manage and respond to drought and water supply vulnerability.

[2] A Disadvantaged Unincorporated Community (DUC) "means a fringe, island, or legacy community in which the median household income is 80 percent or less than the statewide median household income. California Government Code Section 65302.10(a)(2).

SF2: **Data &Tools**: Need for coordination among local, regional, State and federal agencies to collaborate on a consistent set of indicators to help counties monitoring rural communities and small water systems vulnerable to droughts and water shortages. State-managed and financed data collection, data management, and data storage, along with routine development, reporting, and dissemination of vulnerability mapping.

Study Findings:

	Data
1a	State, regional, and local governments should coordinate to estimate the statewide total population without safe water including those residing in areas served by a State small water system, local small water system, or private domestic well.
1b	State, regional, and local governments, along with interested stakeholders, should coordinate to develop performance metrics and track the progress of achieving safe drinking water and sanitation for all Californians. Periodic progress reports should be prepared that show what improvements have been made and what additional actions are needed.
2b	Collect information on service disconnections that distinguishes between occupied and unoccupied residences.
2c	Identify Public Water Systems that persistently fail to deliver water that meets Safe Drinking Water Act standards.
2d	Adopt a single, consistent set of indicators and performance measures, and designate a single entity entrusted with regularly assessing those metrics.
2e	Investigate quality of water delivered by Very Small [Water] Systems, i.e., domestic wells.
5b	Need better income surveys in rural areas to more accurately capture demographics of water system customers.
6d	Require additional sophistication (better data and analytics) in growth projections and coordinated regional planning for both land-use planning and water-management agencies.
7b	Drought vulnerability is dynamic and changes with adaptation decisions made during a drought. Drought relief and planning needs continual assessments to consider the redistribution of drought risk given different adaptation decisions.
8a	Reporting and Data Recording – Improved data collection, management, analysis, sharing, and transparency at all levels is foundational to the ability to plan. Data analysis will allow for better coordination among stakeholders and improve on both long-term actions as well as immediate responses to drought risks, especially in rural communities.
11d	Systematically collect information on water shortages for public and non-public water systems.
11e	Identify areas where private wells and other non-public water systems are likely to run dry in future droughts.
	Tools
4d	Improve public access to data and planning tools, enhance existing data systems, and coordinate monitoring systems efforts.
4e	Develop new publicly accessible data and mapping tools to improve local and regional planning.
8b	Communications Planning – Improved monitoring and communications among stakeholders, from the State, through the counties, and to the water suppliers and citizens.
11a	Establish a statewide, quantitative metric for measuring water supply reliability for public water systems.
12b	Develop mapping and decision-support tools to empower State and local water policymakers with the information they need in order to support proactive contingency Drought and Water Supply Vulnerability Contingency planning and inform sound policymaking.

SF3: **Outreach & Education:** Need for financed creation and distribution of drought planning tools and templates, including educational outreach materials for use by small water systems and within rural communities. Education materials should target hard-to-reach water users such as renters, multi-unit housing occupants, and users with language barriers. Increase research for DUC oriented safe water solutions.

Study Findings:

4f	Address Outstanding Research Needs.
5d	Need continued and improved outreach to and education of consumers about the value of water, the importance of conservation, and the potential repercussions of not conserving.
5e	Need unified messaging (templates) to save staff time and resources and create a consistent message.
5i	Need ongoing water conservation outreach programs, rate restructuring, infrastructure updates, and maintaining working relationships among and between systems, non-governmental organizations, and the State government.
11g	To reduce the inequitable impact of drought charges on low-income households, we recommend the following: (2) Provide technical and financial assistance to water utilities, especially the smallest ones, to implement drought charges that do not unfairly burden low-income households; (3) Target water conservation and efficiency programs to low-income households by offering, for example, point-of-sale coupons, targeted education and outreach, and direct-install programs; (6) Develop approaches that effectively target hard-to-reach customers, such as renters and residents of multi-unit buildings, for rate assistance and conservation programs.
12b	Develop mapping and decision-support tools to empower State and local water policymakers with the information they need in order to support proactive contingency Drought and Water Supply Vulnerability Contingency planning and inform sound policymaking.

SF4: **Technical Assistance & Capacity Building**: Provide State-financed personnel and management resources to high-risk DUCs to facilitate planning, prevention and mitigation for drought and water shortage vulnerabilities. Provide venues for local coordination and knowledge transfer. Include diverse expertise and representation (e.g., community advocates, local system operators, disadvantaged self-supplied or small water system users, large system operators).

Study Findings:

	Technical Assistance
1f	SWRCB and other State agencies that provide funding to third-party technical assistance providers to assist small water and wastewater systems should allow tribal water and wastewater systems to be eligible to receive this technical assistance.
7a	Planning for future droughts improves with the coordination and participation of diverse experts with knowledge of local communities and different dimensions and scales of well-being. The response to the human impact of the drought in California required the coordination and engagement of government officials, community leaders, farmworker activists, and non-profits involved in water security, food security, health, and employment training.
5i	Need ongoing water conservation outreach programs, rate restructuring, infrastructure updates, and maintaining working relationships among and between systems, non-governmental organizations, and the State government.
6e	Advocate for water access and affordability for community members facing disadvantages.
	Capacity Building
5f	Need State financial support to increase staff capacity for small [water] systems.
5h	Work with other smaller [water] systems to plan for extreme events.
6f	Provide venues for local leaders in both the water and land-use sectors to interact with one another (to build relationship, share ideas, and eventually collaborate).
6g	Develop regional leaders in both the water and land-use sectors and provide opportunities for them to interact with one another.
12a	Move away from a “one size fits all” drought management strategy to a strategy prioritizing community needs, particularly in the State’s disadvantaged communities. Identify and prioritize communities that have the highest water supply and drought vulnerability when allocating water resources and throughout the planning process.

SF5: **Regional Planning and Coordinated Communication**: Require responsible regional parties to demonstrate drought preparedness for all water users within defined boundaries (e.g., through Hazard Mitigation Plan, General Plan Updates, or stand-alone programs). Encourage development of drought plans when not in the midst of a drought, and to perform monitoring and plan updates on a routine basis — including communications with State, regional and local agencies to assure data sharing.

Study Findings:

	Regional Planning
3a	Plan ahead. Stronger drought planning is critically important for urban water management, groundwater sustainability, safe drinking water in rural communities, and freshwater ecosystems.
7b	Drought vulnerability is dynamic and changes with adaptation decisions made during a drought. Drought relief and planning needs continual assessments to consider the redistribution of drought risk given different adaptation decisions.
7c	Greater inclusion and representation of vulnerable groups in drought and water resource planning and management is needed.
8c	County Demonstration of Drought Planning — While some portion of a county's citizenry may be covered by an urban supplier's WSCP or a small suppliers' drought plan (not required), there is nothing currently available to demonstrate that drought risk is being addressed for all county citizens. To address this need, counties may submit drought planning information to the EO Agencies through documents such as: Drought-specific protocols defined in a county (or multi-jurisdictional) Hazard Mitigation Plan. A County Drought Plan.
10a	To build resilience, communities must embrace both emergency response and long-term preparedness.
11b	Require water shortage contingency plans for all public water systems and establish regional plans for non-public systems.
12a	Move away from a "one size fits all" drought management strategy to a strategy prioritizing community needs, particularly in the state's disadvantaged communities. Identify and prioritize communities that have the highest water supply and drought vulnerability when allocating water resources and throughout the planning process.
14a	Document presents a template for use in developing a localized, small water system drought contingency plan, including triggering stages and response actions.
	Coordinated Communications
8b	Communications Planning — Improved monitoring and communications among stakeholders, from the State, through the counties, and to the water suppliers and citizens.
8d	Roles and Responsibilities — Defined State Agency and county roles, responsibilities, and funding mechanisms.
8e	Coordination — The EO Agencies and the county, working with stakeholders, should coordinate with SGMA efforts to assure drought planning and responses are reflected in Groundwater Sustainability Plans (where applicable).
10b	The complex array of decisions needed to support resilience within a basin requires coordination across water service areas and jurisdictional boundaries.
12d	Improve and require drought contingency plans for disadvantaged communities by following the best practices detailed in section 4.
12f	Account for the impacts of climate change in drought and groundwater management and use drought mitigation and adaptation as a strategy to make communities resilient to changes in water supplies. Drought and other water supply crises should be viewed as an opportunity to improve the effectiveness of response plans and to enact permanent changes in water policy and water management.

SF6: **Land-use Plans**: Require land-use planning to address conditions of on-going water shortage vulnerability (e.g., Because of water quality or other factor), especially for disadvantaged communities. Encourage land use planning to limit the creation or worsening of water shortage conditions for small water systems and rural communities. Include emphasis on water system infrastructure investments prior to new developments (e.g., consolidation, water system upgrades, or water system interties prior to land-use modifications). Improve county well permitting processes to recognize water limitations and vulnerabilities.

Study Findings:

	Land-use Plans
3c	Update water allocation rules. California should comprehensively update its water allocation governance. The goals should be to find equitable and efficient ways to allocate limited supplies among competing demands during dry times while promoting efforts to capture and store water during wet times.
4c	Ensure that local governments comply with land use and annexation laws to address the legacies of discriminatory local planning practices.
6a	Prioritize infrastructure investments that support existing communities, especially underserved communities, before new development.
6b	Ensure State and local investments are directed toward multi-solving through green infrastructure projects developed at local scales with robust community engagement.
6c	Incentivize or require cross-sector, coordinated planning and management of land use, water, flood mitigation and climate adaptation.
6d	Require additional sophistication (better data and analytics) in growth projections and coordinated regional planning for both land-use planning and water-management agencies.
6h	Build local political will and understanding around water and land-use integration by convening and educating local leaders.
	Infrastructure
3b	Upgrade the water grid. California needs a comprehensive program to address above- and below-ground storage, conveyance, and operational challenges by mid-century, including repairing facilities that are broken, expanding conveyance and storage capacity, and modernizing and integrating operations.
5i	Need ongoing water conservation outreach programs, rate restructuring, infrastructure updates, and maintaining working relationships among and between systems, non-governmental organizations, and the State government.
6a	Prioritize infrastructure investments that support existing communities, especially underserved communities, before new development.
11c	Increase oversight of new private wells.

SF7: **Consolidation**: Emphasize consolidation of small water systems, especially those at risk to or already facing safe water concerns. When impractical, facilitate support from local urban water suppliers to provide technical expertise, emergency response, mutual aid, and service interties.

Study Findings:

1e	State government should provide incentives for the consolidation, acquisition, or improved management of small water systems.
4a	Develop and strengthen consolidation and service extension mandates and incentives.
5g	Agreements between larger and smaller [water] systems to create more equitable distribution of financial and technical assistance.
11f	Identify areas where water system consolidation can resolve supply problems.

SF8: **Rate Restructuring**: Refine small water system billing to reduce financial impact of drought surcharges on low-income customers, while helping small water system operators obtain adequate revenues to assure stable operations during droughts (e.g., State funding sources, disadvantaged community rate-assistance funding).

Study Findings:

5i	Need ongoing water conservation outreach programs, rate restructuring, infrastructure updates, and maintaining working relationships among and between systems, non-governmental organizations, and the State government.
11g	To reduce the inequitable impact of drought charges on low-income households, we recommend the following: (1) Ensure drought surcharges are not applied to basic water use, preferably by calculating household water budgets based on the number of people in a residence; (3) Target water conservation and efficiency programs to low-income households by offering, for example, point-of-sale coupons, targeted education and outreach, and direct-install programs; (4) Develop low-income rate assistance programs within current legal constraints and reform Proposition 218 to allow greater latitude in funding such programs; (5) Wherever possible, require meters and submeters to allow for more equitable drought charges based on volumetric water use; (6) Develop approaches that effectively target hard-to-reach customers, such as renters and residents of multi-unit buildings, for rate assistance and conservation programs.

SF9: **Human Right to Water**: Assure State, regional, and local land-planning and water supply and management entities continue to focus on implementing actions to achieve the policy goals within California Water Code Section 106.3 (AB 685).

Study Findings:

1c	Ensure implementation of the policy goals within California Water Code Section 106.3 (AB 685), which states that every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes.
15a:	Establish minimum State standards for access to water and sanitation and incentivize compliance.
15b:	Create municipal incentives for new developments to include publicly accessible drinking fountains and toilets.
15c:	Identify and pursue partnerships to expand non-encampment-tied services.
15d:	Ensure all public drinking fountains are operational, accessible, and remain in good repair.
15e:	Ensure all public toilets are operational, accessible, clean, safe, and in good repair.
15f:	Provide ongoing basic services (potable water, toilets, hand washing stations, showers) at all established encampments.

Appendix 2
Drought and Water Shortage Risk Scoring: California's Small Water Supplier and Self-Supplied Communities

Prepared for

County Drought Advisory Group process
as partial fulfillment of Assembly Bill 1668

By

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1.0 Purpose

Water Code Division 6 Part 2.55 Section 8 Chapter 10 (Assembly Bill 1668) effectively requires California Department of Water Resources, in consultation with other agencies and an advisory group, to create a list of small water suppliers and "rural communities" that are at risk of drought and water shortage. This list must be shared with counties, Groundwater Sustainability Agencies (GSAs), other regional groups, and the public. This document describes the indicators, datasets, and methods used to construct this deliverable.

This is the first effort to systematically and holistically consider water shortage risk statewide of small water suppliers and self-supplied communities. The indicators and scoring methodology should be revised as better data become available and stakeholders evaluate the performance of the indicators, datasets used, and aggregation and ranking method used to aggregate and rank risk scores. Additionally, the scoring system should be adaptive, meaning that our understanding of what contributes to risk of drought and water shortage may evolve. This understanding may especially be informed by experiences gained while navigating responses to future droughts.

Coordination

DWR recognizes and is in communication with other state agencies and experts working on related efforts. These include the State Water Resources Control Board's (SWRCB) Needs Assessment, the California Office of Environmental Health Hazard Assessment's (OEHHA) metrics being developed to track the Human Right to Water, and Water Equity Science Shop at UC Berkeley in their development of geospatial datasets applicable to this project. Our effort creates a model of risk that is consistent with concepts, datasets, and metrics with these other efforts whenever possible. (The State Water Board received funding authorization to perform a Needs Analysis regarding the state of drinking water in California. The analysis must be completed by June 2021. See https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/needs.html. Three workshops will cover the main aspects of this assessment: public water systems, domestic wells, and cost analysis.)

2.0 Roadmap for Risk Scoring

The overall goal is to produce a list of what small water suppliers and 'rural communities' are at risk of drought and water shortage. To achieve this goal, we set four objectives to take us stepwise to achieving this goal.

- Objective 1. Identify factors that indicate a small water supplier and/or self-supplied community is at risk of drought and/or water shortage vulnerability.
- Objective 2. Develop measurable indicators for evaluating risk of water shortage and drought for small water suppliers and self-supplied households.
- Objective 3. Develop a scoring method to combine measurable indicators
- Objective 4. Calculate risk scores and generate profiles of risk and vulnerability for each county, GSA, and statewide.

3.0 Key Concepts and Approach

This section presents key concepts and definitions.

3.1 Units of Analysis

The final lists required by legislation must be in the form of listing small water suppliers and rural communities (referred to here as 'self-supplied communities'). Because the risk factors differ between these groups, we conducted an analysis of these separately and therefore construct separate lists.

- The unit of analysis used for small water suppliers is the service area boundary polygons available through the Water Boundary Tool.
- The unit of analysis for the self-supplied households is Census Block Groups (ACS 2012-2016 Tiger Shapefile). The Census Block Groups do not represent individual communities, but they do cover areas where population resides. Using this spatial unit for this analysis allows us to access demographic information that is otherwise not available.

3.2 Small Water Suppliers

'Small water suppliers' for this analysis are those publicly-regulated systems with fewer than 3,000 service connections and using fewer than 3,000 acre feet (AF). Those suppliers with 3,000 connections and/or use over 3,000AF are required to develop an Urban Water Management Plan, which includes a section on drought and water shortage contingency planning. Those small suppliers that are listed as participating in an Urban Water Management Plan were also excluded because they are expected to be covered by their Urban Water Management Plan.

The analysis includes those suppliers that have spatial boundaries of their service areas recorded in the Water Boundary Tool, as of May 23, 2019 (https://trackingcalifornia.org). The "State Small Systems" (SWRCB) with fewer than 15 service connections are considered under the self-supplied communities' analysis.

3.3 Self-Supplied Communities

This category of *self-supplied communities* intends to cover what is regarded as the "rural communities" in the legislation. This is intended to cover those households and others with domestically used water (dish washing, showering, drinking, etc.) on their own wells and surface water supplies. The unit of analysis for these communities is the US Census Block group, omitting those with zero population (according to ACS 2012-2016) and/or those that have no domestic wells recorded between 1970-2019 (based on data from the DWR Well Report Database, queried September 2019).

For the purpose of this risk and vulnerability assessment, this category also addresses communities served by water suppliers with fewer than 15 service connections, which are either local small (serving between 2–4 connections) state smalls (serving between 5–14 connections) or domestic wells (serving one connection).

3.4 Risk

Consistent with the IPCC's 2012 Special Report (Cardona et al. 2012) and its upcoming Sixth Assessment Report, *risk* is the combination of vulnerability and the extent of exposure to a hazardous event or conditions, including projected future hazards (IPCC 2017). Vulnerability, as described below, is the combination of sociological and structure factors that make it more or less likely for people to be harmed when they are exposed to a hazard. The treatment of risk as manifested both from environmental, natural conditions and human dimensions is consistent with scholarly work of disaster risk management as articulated by Wisner and colleagues: "The crucial point about understanding why disasters happen is that it is not only natural events that cause them. They are also the product of social, political, and economic environments… These two aspects – the natural and the social – cannot be separated from each other: to do so invites a failure to understand the additional burden of natural hazards, and it is unhelpful in both understanding disasters and doing something to prevent or mitigate them." (Wisner et al. 2003, p.4-5). The stakeholders in CDAG meetings agreed that risk is driven by both environmental events and conditions and social, political and economic factors, and supplier vulnerability, all of which is consistent with scientific literature on water shortage and scarcity (see Kummu et al. 2016; Mekonnen and Hoekstra 2016).

3.5 Exposure to Hazard

Exposure in this risk framework represents the degree to which a water supplier's service area and/or a community is exposed to various hazardous environmental conditions and events that could lead to drought and/or water shortage.

3.6 Vulnerability

Vulnerability is the propensity or predisposition to be adversely affected. Such predisposition constitutes an internal characteristic of the affected element, whereas exposure to a hazard is a condition or event to which the affected element (i.e., supplier) is subjected. In the field of disaster risk management, this includes the characteristics of a person or group and their situation that influences their capacity to anticipate, cope with, resist, and recover from the adverse effects of physical events (Wisner et al., 2004). For further reading on vulnerability, see "Key Concepts and Methods in Social Vulnerability and Adaptive Capacity." (https://www.fs.fed.us/rm/pubs/rmrs_gtr328.pdf) and Chapter 1 in Intergovernmental Panel on Climate Change Special Report on Extreme Events (Lavell et al. 2012). Vulnerability is commonly estimated by combining *sensitivity* and *capacity* of the supplier or community or other grouping of population or assets.

Sensitivity

Sensitivity is one of the two core sub-components to understand vulnerability. This is the likelihood of susceptibility of harm in an extreme event relating to drought and/or water shortage. This is often measured using characteristics of a population or a system. For this analysis, we represent sensitivity in Component 3 of the framework and it covers mostly physical vulnerability indicators.

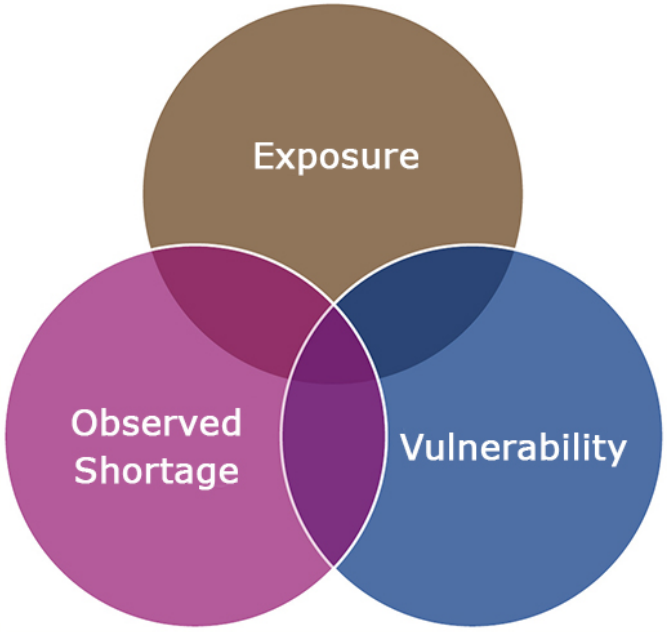
Adaptive Capacity

The *capacity* to adapt or cope is one of the two core sub-components necessary to understand vulnerability. This is the ability or potential of a system (or supplier, household, etc.) to respond successfully to climate variability and change and includes adjustments in both behavior and in resources and technologies. For this analysis, we represent capacity in *Component 4: Organizational Vulnerability* of the framework, which covers social and economic vulnerability indicators.

3.7 Risk and Vulnerability Framework

We developed a framework for examining risk using the risk and vulnerability concepts described in the Intergovernmental Panel on Climate Change IPCC (2012) and the World Risk Index (2018). Small suppliers and self-supplied households in California have varying degrees of exposure to hazardous events and conditions. We account for current and recent hazards as well as future hazards projected to occur with the changing climate (Exposure in Figure 1). Each also has a unique set of sensitivities and adaptive capacities that make it more or less vulnerable to this exposure (Vulnerability in Figure 1).

Figure 1 Indicators used to estimate each component of the risk framework (exposure, vulnerability, observed shortage)



3.8 Process for Development of Risk Indicators

Risk indicators were developed over several meetings with the CDAG and technical workgroups. Beginning in December 2018, the advisory group developed lists of factors that may affect the risk (via the exposure, sensitivity, and adaptive and coping capacity of a supplier or a household) of water shortage and drought. These lists were recorded and augmented with potential datasets that could be used to quantitatively indicate each factor. In the February 2019 CDAG meeting, participants and the project team staff collectively revised and prioritized the lists of factors and datasets for indicator development.

Two April 2019 CDAG technical workgroup meetings were hosted to collect further insights regarding what datasets are available and useful for representing the listed risk factors. A third workgroup meeting was held in September 2019 to review the status of the supplier analysis and discuss further details. During this meeting we shared a visualization of the initial scoreboard to show significant data gaps, as well as how the indicators were being combined to create a risk index. For all of the technical workgroup meetings, stakeholders attended in person and by call-in/webcast. These discussions were instrumental in providing detailed feedback on scoring methods and data sources.

Working closely with the advisory group and project team, we developed a series of 29 metrics to quantitatively indicate multiple dimensions of risk of water shortage and drought for small suppliers and 20 metrics for examined risk and vulnerability of self-supplied communities. Each metric is described below.

Each variable is normalized and/or rescaled to add multiple variables together for a composite score. necessary. Data manipulation process is described for each indicator below. First, we present indicators and the aggregation method of these for the small suppliers. Second, we present indicators and aggregation method used for the analysis of self-supplied communities.

4.0 Small Water Supplier Indicators and Scoring

4.1 Indicators

Exposure to Hazards

4.1.1 Climate Change

We use three indicators representing the spatial threats of climate change as it could impact water suppliers. These include temperature changes, wildfire, and salt-water intrusion (via sea level rise). These represent mid-century projections, consistent with DWR's vulnerability assessment (though projections on wildfire and drought are derived from the State's Fourth Assessment 2018 and sea level rise impacts are from University of Wyoming). Future analysis should include projections of precipitation and drought, as these become readily available. Details of each indicator used are presented in Table 1 and described in more detail below.

Table 1 Indicators of climate change impacts on water systems relevant to water shortage and/or drought (Component 1)

COMPONENT 1 – Climate Change	Metric	Data Source
SC1a – Projected Temperature Shift	Projected change in temperature by mid-century	*Pierce, Cayan Scripps UCSD, DWR*
SC1b - Projected Sea Level Rise	Presence of salt into coastal aquifers with projected 1 meter sea level rise	USGS, Befus Univ. Wyoming
SC1c - Projected Wildfire Risk	Projected acres burned from wildfire for each system boundary or community	Westerling UC Merced

Projected Future Hazard

SC1a. Projected Temperature Shift under Climate Change

Impact on risk: Increased temperatures could increase water supply demands from customers, evapotranspiration, and others thereby increasing the risk of drought and/or water shortage impacts on a supplier

Data source: Derived from the DWR Water Storage Investment Program climate change projections

What does it represent: The percentage of change in maximum temperature from historic range (1961-1990) to mid-century.

What do want it to indicate: Increased temperature as a pressure on demand

What does it represent: The percentage of change in maximum temperature from historic range (1961-1990) to mid-century.

What do want it to indicate: Increased temperature as a pressure on demand

Location of data: queried by DWR from the climate projections used in the Water Shortage Investment Program

Metric generated: Percent change in maximum temperature by mid-century

Notes: None.

SC1b. Projected Sea Level Rise Risk as Salt Water Intrusion in Coastal Groundwater

Impact on risk: Increases risk when exposed to current and future salt water intrusion

Data source: Kevin Befus, University of Wyoming – dataset in preparation for publication (as of August 2019)

What does it represent: 0,1 binary (0= no modelled exposure of service area to salt water intrusion in groundwater current or with 1 meter sea level rise; 1= yes, exposed to current or future salt water intrusion in coastal groundwater aquifer with up to 1m sea level rise)

What do want it to indicate: Risk to coastal salt water intrusion into unconfined coastal aquifers under sea level rise of 1 meter, representing a mid-century projection.

Location of data: Kevin Befus, University of Wyoming

Link: http://www.uwyo.edu/befushydro/

Notes: The exposure data (of which service areas are at risk to this indicator) were calculated using a shapefile developed and provided directly by Dr. Kevin Befus at University of Wyoming. This shapefile represents the modelled output of saltwater intrusion into unconfined coastal groundwater aquifers with sea level rise up to 1 meter. The modelled area indicates those with a fresh-saline groundwater interface that is <50 m deep (as you move inland, the interface gets deeper). The shapefiles were merged (by Befus) from present-day up until a sea level of 1 m above present day (using a bathtub type assignment of sea level, though also uses the LMSL tidal datum from NOAA's vdatum that is variable along the CA coast). This calculation is based on a steady-state (or equilibrium) groundwater model.

Metric generated: Spatial join of small water suppliers' service areas and/or Block groups intersect with the spatial extent of projected salt water intrusion

Associate analysis units to hazard index: Generated presence/absence data per service area boundary

SC1c. Projected Wildfire Risk under Climate Change

What: Projected (future) wildfire risk with climate change

Data source: Leroy Westerling, UC Merced

What does it represent: Projected risk of wildfire as influenced by climate change, representing acreage burned annually averaged across 2035-2064 periods from the average across 10 global climate models.

What do we want it to indicate: Varying degrees of risk to wildfire in mid-century for areas in California

Location of data: Westerling, UC Merced

Link: https://cal-adapt.org

Metric generated: Average acreage burned within in period of 2035-2064, RCP 8.5, Original data ranges from 0 to 100, rescaled to 0-1 for analysis.

4.1.2 Exposure to Current Environmental Conditions and Events

Current hazard is composed of three groups of risk factors: episodic stressors, source vulnerabilities, and source quality risks. Each group is composed of several indicators, and the two latter groups measured using data related to groundwater basins. These data are available for Bulletin 118 Basins (DWR 2019), which do not cover the entire state.

Table 2 Indicators of current or recent hazardous conditions and events (System -- Component 2, SC2)

COMPONENT 2 –Recent Conditions and Events	Metric	Data Source
SC2a – Current Wildfire Risk	Modelled current risk for each system (based on vegetation)	CalFire
SC2b - Drought Early Warning Forecast Water Year 2019	Annual Risk of Local Drought (precipitation)	PRISM OSU
SC2c - Fractured Rock Area	Fractured rock	DWR
SC2h - Projected population growth	Near term projected population growth rate	DWR
SC2i – Water Quality in Surrounding Basin	Water quality problems in surrounding basin	USGS GAMA

COMPONENT 2 –Recent Conditions and Events	Metric	Data Source
SC2d - Basin- Subsidence	Susceptibility to subsidence	DWR
SC2e - Basin- Salt	Salts documented in basin	DWR
SC2f - Critically Overdrafted	Critically overdrafted basin	DWR
SC2g - Chronic declining water levels	Declining groundwater levels	DWR
SC2j -Surrounding agricultural land use	Presence of irrigated agricultural in basin	DWR

Episodic Stressors

SC2a. Drought Early Warning Forecast Water Year 2019

What: Current Year's Early Warning for Risk of Local Drought (must be updated annually)

Data source: Oregon State University PRISM Climate Group

What does it represent: Current drought risk based on percent of average precipitation already received for first part of Water Year.

What do want it to indicate: Annual Forecasted Risk of Local Drought

Location of data: http://www.prism.oregonstate.edu

Metric to generate: Score those areas under 70% =1 (high risk); Score those areas over 70% = 0.

Notes: The level of precipitation received by the end of January is a good indication of how well the water year will be for a local supply. Those suppliers in areas that have received less than 70% of average precipitation by January 31st each year are considered 'at risk of drought' for that water year (Anderson DWR in prep). The metric used to indicate annual drought risk is percent of average precipitation received by January 31st in that water year. This needs to be updated annually. Because legislation requires this risk list be produced by January 2020, we use Water Year 2019 data.

The original PRISM precipitation is in raster (grid) format in GIS. We calculated the original PRISM data for the months of interest (Oct 1 2018 - Jan 31 2019, http://www.prism.oregonstate.edu/recent/) and divided by the average precipitation (reference to as '30-year normal' on website) between years 1981-2010 (provided by PRISM website, http://www.prism.oregonstate.edu/normals/). We used ArcGIS raster calculator for summing the months and then the division for the calculations. Then to associate the values in the grid to the service area polygons, we used the Spatial Analyst Tool Zonal Statistics (where the input zones were service area polygons).

SC2b. Wildfire as present threat to water shortage

What: Current Risk of Wildfire

Data source: CalFire

What does it represent: Fire Hazard Severity Zone maps for State Responsibility Areas in November 2007, as recognized by CalFire

What do want it to indicate: Severity of current wildfire risk

Location of data: https://osfm.fire.ca.gov/divisions/wildfire-prevention-planning-engineering/wildland-hazards-building-codes/fire-hazard-severity-zones-maps/

Metric to generate: rescaled to 0-1 scale with extreme severity as 1 (High=0.7; Moderate=0.3; Low=0)

Notes: Recoded, Done in SPSS

Source Vulnerabilities

Aquifer Characteristics

Fractured Rock – SC2c

- Indicated by areas not in alluvial groundwater basins as marked by Bulletin 118, developed by DWR North Regional Office as part of upcoming Bulletin 118.
- Scoring = 0/1 binary scale so that all areas outside of these basins are scored as 1 (high risk)
- Completed

SC2R. Groundwater Basin Vulnerability

What: Presence of one or more risks observed in the groundwater basin

Data source: Aggregated multiple risk factors from the SGMA basin prioritization dataset, including presence of subsidence in basin (SC2d), presence of salt in basin (SC2e), record of critically overdrafted basin (SC2f), record of chronic declining water levels (SC2g), and presence of irrigated agriculture (SC2j)

What does it represent: Groundwater basin vulnerability based on multiple risk factors.

What do we want it to indicate: A single score to represent one or more of the issues that commonly make a groundwater basin more vulnerable during a dry period.

Location of data: DWR

Metric to generate: Took the maximum score (0-1) of the recoded scores of the five combined factors that were associated to each small water supplier. Max score was used as the score to represent this aggregate indicator.

Notes: Complete.

SC2d. Presence of Subsidence in Basin

Impact on risk: Higher susceptibility = higher risk

Data source: SGMA 2019 Basin Prioritization

What does it represent: "Documented Impacts #7.b Subsidence Points"

What do want it to indicate: subsidence problems and risk

Location of data: DWR GIS server (source data)

Metric to generate: Recoded to 0,.5,1 from original points of 0,3,10, then associated to supplier boundaries with spatial join in ArcGIS

Notes: Completed. Incorporated as part of SC2R indicator.

SC2e. Presence of Salt in Basin

Impact on risk: Suppliers in basins with documented salt intrusion issues may have increased challenges of dealing with challenges of saline groundwater

Data source: SGMA 2019 Basin Prioritization

What does it represent: "Documented Impacts #7.c Salt Intrusion Points"

What do want it to indicate: Areas that have been documented to have problems with salt intrusion

Location of data: DWR

Metric to generate: Rescale SGMA points of 0 and 5 to our risk indicator scoring of 0 and 1.

Notes: Technical workgroup (SGMA) suggested alternative scaling, but don't see any other options besides binary. Completed. Incorporated as part of SC2R indicator.

SCf. Critically Overdrafted Basin

Impact on risk: If your local groundwater is in decline, this would increase your risk to water shortage and drought.

Datasource: B118 (Roy Hull, DWR)

What does it represent: Determinations of critically over drafted groundwater basin or not

What do want it to indicate: Local groundwater vulnerability

Location of data: DWR

Metric generated: Yes (1)/no (0) of whether area is in critical overdraft

Notes: Technical workgroup (SGMA) suggested alternative scaling, but only have binary for this so there is not other optional scaling. Completed. Incorporated as part of SC2R indicator.

SC2g. Chronic Declining Water Levels

Impact on risk: Declining level indicates surrounding increased risk

Data source: Documented Impacts #7.a - Declining GW levels Points

What does it represent: Groundwater level change in elevation 2011-2015

What do want it to indicate: Declining water levels in aquifer

Location of data: DWR

Metric to generate: Associate score of sub-basin to the supplier service boundaries.

Notes: This is included in addition to the overdraft indicator above because it is assumed that having this as more specific location data could be helpful to indicate more specific risk to water shortage during a drought. Incorporated as part of SC2R indicator.

SC2j. Presence of Irrigated Agriculture in Surrounding Basin

Impact on risk: May indicate competing demand on groundwater supplies, which could create higher risk for small suppliers during a drought or water shortage event.

What does it represent: Presence of irrigated agriculture in surrounding basin

What do want it to indicate: Competing demand on water use

Location of data: DWR

Metric generated: Associated rescaled score of sub-basin to the service areas of small water suppliers examined.

Notes: Complete. Incorporated as part of SC2R indicator.

SC2h. Population Growth Rate

Impact on risk: Increasing population growth rates in surrounding region could increase risk of water shortage

Data source: Vendor-derived US Census-based estimates

What does it represent: Population growth projected in service area

What do want it to indicate: Near future increasing water demands

Location of data: DWR

Metric generated: Rescaled population growth rate from vendor estimates by service area

Notes: None.

SC2i. Water Quality in Surrounding Basin

Impact on risk: Increased contamination = increased risk

Data source: GAMA USGS Priority Basin Project-derived (Deep Aquifer Assessment)

What does it represent: Potential risk of contaminants in surrounding groundwater (from deep aquifer of region)

What do want it to indicate: Potential risk of contaminants in groundwater

Location of data: DWR (USGS derived)

Metric generated: Calculated weighted percent of constituents past regulatory thresholds (1) or near thresholds (0.5)

Notes: Applies to deeper groundwater in established alluvial basins typically accessed by municipal supply wells.

4.2 Small Water Supplier Vulnerability

Several factors contribute to and indicate that a small supplier is more or less vulnerable to being affected by a water shortage and dry period. These are commonly divided and described using the concepts of "sensitivity" and "adaptive capacity", and in some instances including "coping capacity" (Füssel 2007; Fussel and Klein 2006; Wolf et al. 2013; McDowell et al. 2016). Vulnerability, as defined above in the introduction is a supplier's sensitivity to a dry period or water shortage and its ability to proactively adapt to make changes that would decrease or avoid the impacts. Additionally, vulnerability also represents it ability to cope when a dry period or shortage occurs. These factors naturally fell into physical infrastructure factors (sensitivity of a supplier) and organization factors (adaptive capacity of a supplier).

Infrastructure Vulnerability + Organizational Vulnerability = Vulnerability of Small System

4.2.1 Infrastructure Vulnerability Factors

Infrastructure Vulnerability factors associated with small water suppliers included five categories of variables: connectivity, supplier's infrastructure, portfolio redundancy, physical coping capacity, and historical source water conditions.

Table 3 List of indicators representing infrastructure vulnerability of small water suppliers, including metrics and datasets (Component 3)

COMPONENT 3 – Infrastructure Vulnerability	Metric	Data Source
SC3a - Interties	Presence of interties	SDWIS
SC3b – Emergency interties	Presence of emergency interties	SDWIS
SC3c - Baseline monitoring	Level of monitoring reported	eAR
SC3d – Customers metered	% system connections that have meters	eAR
SC3e - # Water Sources	Count of water sources	SDWIS derived
SC3f - # Source Types	Count of water source types	SDWIS derived
SC3g – Supplier Size	Service connections count	eAR
SC3i – Distribution Outage Record	Count of distribution problems of water outage	eAR
SC3j – Water Level Status	Levels of water source-recovering, steady, declining, blank	eAR

Connectivity

SC3a. Interties

Impact on risk: The more interties, the assumed lower risk of outage because they can potentially switch sources if needed

Data source: SDWIS

What does it represent: # interties

What do want it to indicate: Available water transfers

Location of data: SWRCB SDWIS

Metric to generate: Rescaled to binary for those with one or more intertie (0, low risk) and those with zero (1, high risk)

Notes: requested from SWRCB 6/13/19 SDWIS; received and processed. Completed

SC3b. Emergency Interties

Impact on risk: The more emergency interties, the assumed lower risk of outage because they can potentially switch sources if needed

Data source: SDWIS

What does it represent: # emergency interties

What do want it to indicate: Availability of emergency water

Location of data: SWRCB SDWIS

Metric generated: Recoded to binary, so that zero emergency interties is 1, and more than zero reported is marked as '0'. Those with no data are marked "null".

Notes: Completed

Supplier's Information Infrastructure

SC3c. Baseline monitoring

Impact on risk: Having baseline monitoring could decrease your risk because it indicates the capacity to observe declining levels

Data source: eAR 2017, columns "CONSERVATION Monitor Static" + "CONSERVATION Levels"

What does it represent: 0,1,2 scale (none, monitor static level, monitor pumping) reported in EAR

What do want it to indicate: Presence of baseline monitoring of source supply levels

Location of data: SWRCB, updated annually

Metric generated: -99= no data; 1 = no reported monitoring; 0.5= static monitoring only; 0= static and level monitoring in place.

Notes: Completed

SC3d. Customers Metered

Impact on risk: Absence of metering would increase risk to water shortage and drought because it makes it difficult to implement and monitor conservation measures than may be triggered to reduce customer demand.

Data source: eAR 2017 "T Potable UM"/"T Potable Total"

What does it represent: Proportion of system potable customers that have meters or not

What do want it to indicate: Whether customers and utility have ability to monitor consumption

Location of data: SWRCB SDWIS, updated annually

Metric generated: Proportion of potable connections unmetered (eAR 2017) (0-1 scalar)

Notes: Completed

SC3e. # Water Sources

Impact on risk: The fewer sources, the assumed higher risk

Data source: SDWIS

What does it represent: Number of water sources (Note: volume per source is not captured)

What do want it to indicate: Flexibility and diversity of supply

Location of data: SDWIS

Metric generated: Count of (sw intakes + wells + imported water sources); More than one water source =0 risk and single source type =1 (high risk).

Notes: Combined from SDWIS data. Recoded binary in SPSS.

SC3f. # Source Types

Impact on risk: Fewer source types is higher risk.

Data source: SDWIS

What does it represent: Count of source types (GW, SW, purchased)

What do want it to indicate: Number of source types as one indicator of supply portfolio diversity

Location of data: SDWIS

Metric generated: Count of total types of sources; More than one water source type =0 risk and single source type =1 (high risk).

Notes: Counts from SDWIS data by SWRCB DDW. Recoded binary in SPSS.

Physical Coping Capacity

SC3g. Supplier Size

Impact on risk: The number of service connections is used as a proxy for size of the water supplier. The larger the supplier's size, the assumed higher capacity in terms of the staff and budget of the supplier. Smaller size is higher risk.

Data source: SDWIS

What does it represent: service connections count

What do want it to indicate: The number of service connections is used as a proxy for size of the water supplier. The larger the supplier's size, the assumed higher capacity in terms of the staff and budget of the supplier.

Location of data: SDWIS

Metric generated: log10(service connections); normalized 0-1 using min as 0/max as 2999/range, then flipped scale so that lower number of service connections is higher risk, (i.e., closer to 1).

Notes: Complete.

SC3i. Distribution Outage Record

Impact on risk: Potentially increases risk

Data source: eAR 2017

What does it represent: Count of distribution problems of water outage

What do want it to indicate: Recent record of outages, may indicate infrastructure needs

Location of data: SWRCB

Metric generated: Rescaled min-max-range to 0-1, maintain NULL for no data

Notes: *Complete.*

SC3j. Water Level Status

Impact on risk: Declining levels of water supply indicate an elevated risk to drought and water shortage

Data source: eAR 2017

What does it represent: Self-reported levels of water sources (optional survey question) for water systems. Options for this survey question were 'declining', 'in recovery', or 'steady' and 'not applicable'.

What do want it to indicate: This seeks to indicate whether the water supply is at risk

Location of data: eAR 2017

Metric generated: Scored survey responses to Steady or not applicable as "0" (no risk), recovering as "0.5", declining as "1" (high risk) and no response as "null"

Notes: This is self-reported by the supplier themselves. This was an optional question and therefore will be underpopulated.

4.2.2 Organizational Vulnerability

Organizational vulnerability factors that can affect a supplier's risk to water shortage and drought covers three categories of variables: financial, organizational, and customer base (Table 4).

Table 4 Risk factors and datasets proposed to represent indicators of each factor of social vulnerability related to small water suppliers (Suppliers Component 4)

COMPONENT 4 – Organization Vulnerability	Metric	Data Source
SC4a – Rate Updated	Year rate structure was last updated	SWRCB
SC4b – Rate Type	Type of rate structured used by supplier. Survey question in eAR 2017 (flat base rate =1; other =0)	SWRCB
SC4d – Drought Preparedness Plan	Have drought plan or WSCP; year written or updated	SWRCB
SC4e - Customer Base Socio-Economics	Multiple population characteristics combined score	Private vendor data

Financial

SC4a. Rate Structure Update

This indicator serves to gauge the financial capacity of the supplier. The dataset available is from the electronic Annual Report (eAR), reporting the year the supplier last upgraded their rate structure.

Impact on risk: The more recent rate restructuring would be considering to lower financial risk of a supplier

Data source: eAR 2017

What does it represent: How many years it has been since the supplier last updated their rate structure

What do want it to indicate: Financial capacity to cope through drought

Location of data: SWRCB

Metric to generate: (Rate updated 2015-2019=0; Rate updated 2010-2014=0.25; Rate updated between 2003-2009=0.5; Rate updated prior to 2003=1)

Notes: Completed

SC4b. Rate Structure Type

Impact on risk: Those with rate structure other than flat base rates are considered to have higher capacity to cope financially during a dry period.

Data source: eAR 2017

What does it represent: Type of rate structure

What do want it to indicate: Financial capacity to cope through drought

Location of data: SWRCB

Metric to generate: Scored so that flat base rate =1; other =0

Notes: Completed

SC4c- eliminated via Advisory Group agreement (10/1/2019)

SC4d. Drought Preparedness Plan

Impact on risk: Having a drought or water shortage contingency plan reduces risk to drought and/or water shortage events.

Data source: eAR 2017, "CONSERVATION DPP Date"

What does it represent: Supplier reported to have a Drought Plan and what year it was written or updated: Drought Preparedness Plan, recoded years since DPP (eAR 2017) note we don't have record of who does not have a plan and cannot assume that no EAR response means no plan. Therefore, we use prior to 2004 to be high risk.

What do want it to indicate: having a recently updated drought preparedness plan indicates higher coping capacity.

Location of data: SWRCB, updated annually.

Metric to generate: Drought Preparedness Plan (DPP) developed before 2003; DPP developed between 2004-2014=0.5; DPP developed since 2015=1.

SC4e. Customer Base Socio-Economics

Impact on risk: Suppliers with customer bases that is considered socially vulnerable are considered to be at higher risk to drought and water shortage for two reasons: (1) the supplier may be especially restricted in making necessary rate structure changes (that would prevent financial impacts during droughts) if they could have major impacts on their customer base (ie., customer base cannot afford any increase in water bills); and (2) demographic and socioeconomic characteristics selected are known to be more impacted during emergencies and disasters, following Cutter et al. (2011) and Flanagan et al. 2011.

Data source: US Census, American Community Survey 2012-2016

What does it represent: Social vulnerability of estimated customer base, from a composite score of % poverty, mean household income (inverse), per capita income (inverse), % renter population, % education with high school degree or less only, %unemployed, %mobile homes, %group quarters, % of 5 or younger; %65yrs and older

What do want it to indicate: Social vulnerability of customer base

Location of data: US Census ACS/DWR Demographer by block groups, associated to service area polygons

Metric to generate: Social vulnerability score for each small water supplier aggregating estimates of each of the following measures listed in Table 5.

Notes: Completed. Other suggestion for improving this indicating in the future. Further delineation of Customer Base information into more specific factors (e.g., % State-wide MHI and Rate Affordability) will be considered for inclusion in future risk model updates. MHI data is available for water systems and rate affordability calculation would require knowledge of current water rates on an annual basis, all available information. % MHI could be an indicator of future rate increase tolerance and capacity for a specific water system.

Rate Affordability = indicator of how high current rates are indexed to EPA affordability criteria, and ability to fund future water system improvements to improve water system reliability in the future.

Table 5 Demographic and socioeconomic characteristics estimated to represent the customer base on the small supplier. Spatial analysis used to associate Census data to service area boundaries

Variable	Variable Names	Brief description of what variable is	Data Source
Per capita income 2016	PERCAP	Average per capita income for the all Block groups (BG) that intersected with the service areas	ACS 2012-2016
Mean household income	AvgMHI	Average Median Household Income (MHI) for the all BGs that intersected with the service areas	ACS 2012-2016
Percent persons 65 year of age or older	Q65yr	Percentage of population of 65 and older of all BGs that intersected with the service areas	ACS 2012-2016
Percent persons 5 year of age or younger	Q5y	Percentage of population of under 5 years age of all BGs that intersected with the service areas	ACS 2012-2016
Percent mobile homes	Qmobile	Percentage of mobile households of all BGs that intersected with the service areas	ACS 2012-2016
No vehicle available	NoVeh	Percentage of households with no vehicles of all BGs that intersected with the service areas	ACS 2012-2016
Percent persons with no high school diploma	Qedu	Percentage of population over 25 years age with no high school diploma of all BGs that intersected with the service areas	ACS 2012-2016
Percent population with single parent	Qparent	Percentage of population with single parent with children under 18 of all BGs that intersected with service areas	ACS 2012-2016
Percent population unemployed	Qunempl	Percentage of population of civilian unemployed of all BGs that intersected with the service areas	ACS 2012-2016

Variable	Variable Names	Brief description of what variable is	Data Source
Percent of population in group quarters	Qgroup	Percentage of all census Block population with Group Quarters (GQ) that intersected with the service areas	Census 2010

4.2.3 Record of Water Shortage

The final component seeks to capture those suppliers that have recently experienced shortage. The assumption is that without sufficient changes to the water sources or supplier, the supplier is likely to experience shortage again. We use three indicators to estimate the shortage record, though recognize each comes with substantial caveats. The State does not have complete record of what suppliers experienced shortage during the drought or otherwise, especially for suppliers that did not report occurrences. We therefore combine information from supplier-reports of shortage (an optional survey question), documented drought assistance provided, and suppliers that received compliance orders during the drought.

COMPONENT 5 – Recent Observed Shortage	Metric	Data Source
SC3h – Shortage: Self-reported projected	Supplier-reported projected shortage	eAR 2011-2018
SC3k – Shortage: Curtailment and Compliance Order	Systems under order of compliance for curtailment (2014) or building moratoriums	SWRCB
SC3L – Shortage: Drought Assistance Record	Systems that received drought assistance on record	SWRCB

SC3h. Shortage: Supplier-Reported Projected Shortage

Impact on risk: Assumed higher risk if a system has previously and recently self-reported a projected water shortage.

Data source: eAR 2011-2018

What does it represent: Presence of any reported projected shortage between 2011 and 2018.

What do want it to indicate: Water suppliers that experienced recent past shortages may indicate those that may have additional shortage problems in the future.

Location of data: eAR 2011-2018 projected water shortage (Conservation section in survey)

Metric generated: Binary score of "1" (at risk) if the supplier reported a projected shortage in any of the eAR 2011-2018 surveys. If they responded to that question with a "no" for any of the survey years, that system is marked as a '0' (no risk). If they did not respond to that question for any of the survey years, they are marked as "null".

Notes: Complete (JE 9/6/19). This is self-reported by the supplier themselves. This was an optional question and therefore will be underpopulated.

SC3k. Shortage: Curtailment and Compliance Order

Impact on risk: Suppliers with past record of curtailment order may be at risk of future curtailment

Data source: SWRCB

What does it represent: Water suppliers whose water sources during the last drought were impacted severely and were eligible for drought funds

What do want it to indicate: Water suppliers that experienced major impacts from the drought

Location of data: website

Metric generated: Binary score of "1" (at risk) if the supplier is listed as having received a compliance order from the SWRCB.

Notes: Complete

SC3L. Shortage: Drought Assistance Record

Impact on risk: Suppliers with record of severe impacts from drought may be at relatively higher risk in future droughts

Data source: SWRCB DFA

What does it represent: Record of drought assistance to supplier

What do want it to indicate: Water suppliers that experienced major impacts from the drought

Location of data: SWRCB DDW

Metric generated: Binary score of "1" (at risk) if the supplier is listed as receiving drought assistance funds.

Notes: Complete

4.3 Method of Aggregation for Scoring Small Suppliers

To aggregate the risk factor variables described above, all variables were rescaled 0-1, and then were combined with the variables in their respective component. We use a simple calculation that weights each variable within its given component of the framework. Then we aggregate the weighted component scores together. Weightings were developed based on feedback from CDAG, Division of Drinking Water District Engineers (SWRCB) and several others. This offers a transparent, repeatable and communicable method for calculating risk based on the many variables identified.

Equation for Small Water System Risk:

Supplier's Risk of Drought and Water Shortage for Small Water System Risk =

$$0.25\ x\ \mu(\mathrm{SC1a,b,c}) + 0.75\ \mathrm{x}\ \mu((\mathrm{SC2a,b,c,i,h}) + \mathrm{Max}(\mathrm{SC2d,e,f,g,j})) + 0.67\ \mathrm{x}\ \mu(\mathrm{SC3a,b,c,d,e,f,i,j}) + 0.33\ \mathrm{x}\ \mu(\mathrm{SC4ab,d,e,g}) + 0.33\ \mathrm{x}\ \mathrm{Max}(\mathrm{SC3h,k,l})$$

Exposure

Vulnerability

Observed Shortage

Where, all SC's value is scaled from 0 to 1, ordinal between 0 and 1, or binary 0 or 1.

Each group of variables is to be combined with the other groups' scores for that component (components are Exposure, Vulnerability, and Observed Shortage). Finally, the scores for each component will be added to create a risk score.

5.0 Self-Supplied Communities Risk Indicators and Scoring

All indicators were developed based on input we received and facilitated at advisory group in-person meetings and smaller web-based technical work group meeting. Development of metrics was taken directly from verbatim input we received during these meetings, as well as additional feedback received from the data stewards and groundwater engineers and climate scientists.

5.1 Indicators

Exposure to Hazard

Hazard risk factors seek to indicate the likelihood of the intensity, severity, duration, and frequency for water shortage and drought in a given area. For the purpose of this project, this includes risks based on modeled future projections with climate change (Component 1) and based on recent conditions and events (Component 2). These are then spatially analyzed to determine the extent to which each community is exposed to these hazards, as described below.

5.1.1 Climate Change

Also note, at this time, sufficient data does not exist to estimate numbers and locations of households on self-supplied *surface* water intakes, but this is recognized as a major data gap for future consideration.

Similar to following the method of attribution for the indicators used in the Small Water Supplier risk scoring, each indicator for the Self-Supplied Communities was attributed to the Block groups with one or more domestic well outside of service areas.

Table 6 Indicators of climate change impacts on water systems relevant to water shortage and/or drought (Component 1)

Risk Factor	Influence on Risk	Proposed Variable	Proposed metric (measure)	Dataset	Data Source	Data Availability
RC1a - Temperature Shift	Increases risk	Projected change in heat by mid-century	Projected change in max temperatures by mid-century (averaged across models)	Water Storage Investment Program	DWR	DWR WSIP
RC1b - Saline intrusion risk	Increases risk	Susceptibility to seawater intrusion --1 meter sea level rise into coastal aquifers	Spatial extent of projected SLR under RCP 8.5 by 2040 (1m) into coastal aquifers; spatial join with Block groups	University Wyoming, Kevin Befus saltwater intrusion into coastal aquifers from 1m SLR	*University of Wyoming (coordinated with USGS)*	*Can't post statewide original data until published*
RC1c - Wildfire risk	Increases risk	Projected severe or high severe risk for each system boundary or community	Projected area burned (averaged across all GCMs) by 2035-2064, RCP8.5; spatial join with Block groups	Westerling's wildfire projections from 4th Assessment, he queried dataset directly per our request	UC Merced	Posting to DWR portal when Westerling is ready

RC1a. Projected Heat Risk

Impact on risk: Increased temperatures could increase water supply demands from customers, evapotranspiration, and others thereby increasing the risk of drought and/or water shortage impacts on a supplier

Data source: Derived from the DWR Water Storage Investment Program climate change projections; see https://cwc.ca.gov/-/media/CWC-Website/Files/Documents/2017/WSIP/TechnicalReference.pdf

What does it represent: The percentage of change in maximum temperature from historic range (1961-1990) to mid-century

What do want it to indicate: Increased temperature as a pressure on demand

Location of data: WSIP DWR

Metric to generate:

Notes:

RC1b. Projected Wildfire

What: Projected (future) wildfire risk with climate change

Data source: Leroy Westerling, UC Merced

What does it represent: Projected risk of wildfire as influenced by climate change, representing acreage burned in 2035-2064 periods of the average across all global climate models for the entire state.

What do we want it to indicate: varying degrees of risk to wildfire in mid-century for areas in California

Location of data: Westerling, UC Merced

Link: https://cal-adapt.org

Metric to generate: Average acreage burned within in period of 2035-2064, RCP 8.5, Original data ranges from 0 to 100, rescaled using min/max to 0-1 for analysis.

Notes: Used Zonal Statistics as Table tool in ArcGIS to calculate mean acreage burned per Block Group (from Westerling's raster data). Adjusted the cell size in the raster calculator ('environment' menu in tool) to be 0.001 so that 13K Block groups were captured.

RC1c. Projected Salt Water Intrusion in Coastal Groundwater

Impact on risk: Increases risk when exposed to current and future salt water intrusion

Data source: Kevin Befus, University of Wyoming – dataset in preparation for publication (as of August 2019)

What does it represent: 0,1 binary (0= no modelled exposure of service area to salt water intrusion in groundwater current or with 1 meter sea level rise; 1= yes, exposed to current or future salt water intrusion in coastal groundwater aquifer with up to 1m sea level rise)

What do want it to indicate: Risk to coastal salt water intrusion into unconfined coastal aquifers under sea level rise of 1 meter, representing a mid-century projection.

Location of data: Kevin Befus, University of Wyoming

Link: http://www.uwyo.edu/befushydro/

Notes: The exposure data (of which service areas are at risk to this indicator) were calculated using a shapefile developed and provided directly by Dr. Kevin Befus at University of Wyoming. This shapefile represents the modelled output of saltwater intrusion into unconfined coastal groundwater aquifers with sea level rise up to 1 meter. The modelled area indicates those with a fresh-saline groundwater interface that is <50 m deep (as you move inland, the interface gets deeper). The shapefiles were merged (by Befus) from present-day up until a sea level of 1 m above present day (using a

bathtub type assignment of sea level, though also uses the LMSL tidal datum from NOAA's vdatum that is variable along the CA coast). This calculation is based on a steady-state (or equilibrium) groundwater model.

Metric generated: Spatial join of Block groups intersect with the spatial extent of projected salt water intrusion

Associate analysis units to hazard index: Generated presence/absence data per Block group polygon.

5.1.2 Exposure to Current Environmental Conditions and Events

Current hazard is composed of three groups of risk factors: episodic stressors, source vulnerabilities, and source quality risks. Each group is composed of several indicators, and the two latter groups measured using data related to groundwater basins. These data are available for Bulletin 118 Basins (DWR 2019), which do not cover the entire state.

Table 7 Indicators of current or recent hazardous conditions and events (Community – Component 2, SC2)

Group	Risk Factor	Indicator	Metric (measure)	Dataset	Data Source
Episodic	RC2a - Drought early warning	Annual Updated Early Drought Risk Warning	Less than 70% of average precipitation by January 31st for that water year = high risk of drought	Calculated percent of normal precipitation received by January 31st for that Water Year	PRISM OSU
	RC2b - Wildfire risk	Modelled current risk maximum for each Census Block Group	Use CalFire Scoring HAZ_CODE: Moderate (1)= .33; High (2)= .67; Very High (3) =1; no score =0 (no or low risk); Took max for each Census BG with spatial	CalFire Wildfire risk	CalFire

Group	Risk Factor	Indicator	Metric (measure)	Dataset	Data Source
			join in ArcGIS		
Environmental Conditions and Stressors	RC2c - Geology	Fractured Rock Area	Communities in Fractured Rock Areas (1) or not (0)	DWR per B118 upcoming 2020 update	DWR
	RC2h – Increasing water demand	Projected population growth	Census data estimates of growth rate between 2016 to 2021, estimated by service area	DWR/Private Vendor Census data estimates	DWR
	RC2i- Water quality in shallow aquifer	Domestic well water quality risk (includes areas outside of alluvial basins)	Indication of likelihood that groundwater likely accessed by domestic wells may contain concentrations of constituents above regulatory levels.	Division of Water Quality GAMA Groundwater Information System	SWRCB
Alluvial Basin Conditions	RC2d – Basin sub-sidence	Record of subsidence	Documented Impacts #7.b Subsidence Points; recoded to 0,.5,1 from original points of 0,3,10, then associated to Block groups	SGMA 2019 Basin Prioritization	DWR
	RC2e – Basin salt	Record of salts	Documented Impacts #7.c Salt Intrusion Points	SGMA 2019 Basin Prioritization	DWR

Group	Risk Factor	Indicator	Metric (measure)	Dataset	Data Source
Alluvial Basin Conditions	RC2f – Overdrafted basin	Critically overdrafted groundwater basin	Yes (1)/no (0) of whether area is in critical overdraft	SGMA 2019 Basin Prioritization	DWR
	RC2g - Chronic declining water levels	Declining groundwater levels	Documented Impacts #7.a - Declining GW levels Points	SGMA 2019 Basin Prioritization	DWR
	RC2j - Surround-ing land use	Presence of irrigated agriculture in surrounding basin	Irrigated Acres Priority Points	SGMA 2019 Basin Prioritization	DWR

Events and Environmental Conditions

RC2a. Drought Risk

What: Current Year's Early Warning for Risk of Local Drought (must be updated annually)

Data source: Oregon State University PRISM Climate Group

What does it represent: Current drought risk based on percent of average precipitation already received for first part of the current Water Year.

What do want it to indicate: Annual Forecasted Risk of Local Drought

Location of data: http://www.prism.oregonstate.edu

Metric to generate: Score those areas under 70% =1 (high risk);
Score those areas over 70% = 0.

Notes: The level of precipitation received by the end of January is a good indication of how well the water year will be for a local supply. Domestic wells can be sensitive to levels of annual precipitation in their region. Those with under 70% of average for their area by January 31st each year are considered 'at risk of drought' for that water year. The metric used to indicate annual drought risk is percent of average precipitation received by

January 31st in that water year. **This needs to be updated annually.** Because legislation requires this risk list be produced by January 2020, we will use Water Year 2019.

The original PRISM precipitation is in raster (grid) format in GIS. We calculated the original PRISM data for the months of interest (Oct 1 2018 - Jan 31 2019, http://www.prism.oregonstate.edu/recent/) and divided by the average precipitation (reference to as "30-year normal" on website) between years 1981-2010 (provided by PRISM website, http://www.prism.oregonstate.edu/normals/). We used ArcGIS raster calculator for summing the months and then the division for the calculations. Then to associate the values in the grid to the Census BG polygons, we used the Spatial Analyst Tool Zonal Statistics (where the input zones were service area polygons). Adjusted the cell size in the raster calculator ('environment' menu in tool) to be 0.0001 so that all Block groups were captured.

.00 = "Drought risk absence – Local precipitation by January, 31, 2019, wa above 70 percent of average precipitation."

1.00 = "Drought risk presence – Local precipitation was less than 70 percent average (of a water year).'

RC2b. Wildfire as present threat to water shortage

What: Current Risk of Wildfire

Data source: CalFire

What does it represent: Fire Hazard Severity Zone maps for State Responsibility Areas in November 2007, as recognized by CalFire

What do want it to indicate: Severity of current wildfire risk

Location of data: https://osfm.fire.ca.gov/divisions/wildfire-prevention-planning-engineering/wildland-hazards-building-codes/fire-hazard-severity-zones-maps/

Metric to generate: rescaled to 0-1 scale with extreme severity as 1. Category scores rescaled as follows: Moderate (1) = .33; High (2) = .67; Very High (3) =1; no score =0 (no or low risk).

Notes: This may be updated soon by CalFire

Source Environmental Conditions and Stressors

RC2c - Fractured rock area

- Indicated by areas not in alluvial groundwater basins as marked by Bulletin 118, developed by DWR North Regional Office as part of upcoming Bulletin 118.
- Scoring = 0/1 binary scale so that all areas outside of these basins are scored as 1 (high risk)
- Completed

RC2h - Population Growth in immediate region

Impact on risk: Increasing population growth rates in surrounding region could lead to increased demand and thereby increasing risk of water shortage

Data source: Census, private vendor for demographic data

What does it represent: Population growth projected between 2016-2021

What do want it to indicate: Near future increasing water demands

Location of data: DWR

Metric generated: Rescaled population growth rate from a proportion to 0-1

Notes:

Alluvial Basin Characteristics

RC2R. Groundwater Basin Vulnerability

What: Presence of one or more risks observed in the groundwater basin

Data source: Aggregated multiple risk factors from the SGMA basin prioritization dataset, including presence of subsidence in basin (RC2d), presence of salt in basin (RC2e), record of critically over drafted basin (RC2f), record of chronic declining water levels (RC2g), and presence of irrigated agriculture (RC2j)

What does it represent: Groundwater basin vulnerability based on multiple risk factors.

What do we want it to indicate: A single score to represent one or more of the issues that commonly make a groundwater basin more vulnerable during a dry period.

Location of data: DWR

Metric to generate: Took the maximum score (0-1) of the recoded scores of the five combined factors that were associated to each small water supplier. Max score was used as the score to represent this aggregate indicator.

Notes: Complete.

RC2d. Presence of Subsidence in Basin

Impact on risk: Higher susceptibility = higher risk

Data source: SGMA 2019 Basin Prioritization

What does it represent: "Documented Impacts #7.b Subsidence Points"

What do want it to indicate: subsidence problems and risk

Location of data: DWR GIS server

Metric to generate: recoded to 0,.5,1 from original points of 0,3,10, then associated to Block group

Notes: Completed. Incorporated as part of Alluvial Basin Conditions score.

RC2e. Presence of Salt in Basin

Impact on risk: Block Groups in basins with documented salt issues may have increased challenges of dealing with challenges of saline groundwater

Data source: SGMA 2019 Basin Prioritization

What does it represent: "Documented Impacts #7.c Salt Intrusion Points"

What do want it to indicate: areas that have been documented to have problems with salt in basin

Location of data: DWR

Metric to generate: rescale SGMA points of 0 and 5 to our risk indicator scoring of 0 and 1.

Notes: Technical workgroup (SGMA) suggested alternative scaling, but don't see any other options besides binary. Completed. Incorporated as part of Alluvial Basin Conditions score.

RC2f. Critically Overdrafted Basin

Impact on risk: If local groundwater is in decline, this would increase risk of water shortage and drought.

Data source: Phase 2 and 1 of SGMA Basin Prioritization

What does it represent: Determinations of critically over drafted groundwater basin or not

What do want it to indicate: Local groundwater vulnerability

Location of data: DWR Phase 2 update, combined with Phase 1

Metric generated: Yes (1)/no (0) of whether area is in critical overdraft

Notes: Technical workgroup (SGMA) suggested alternative scaling, but only have binary for this so there is not other optional scaling. Incorporated as part of Alluvial Basin Conditions score.

RC2g. Chronic Declining Water Levels

Impact on risk: Declining level indicates surrounding increased risk

Data source: Documented Impacts #7.a - Declining GW levels Points

What does it represent: Groundwater level change in elevation 2011-2015

What do want it to indicate: Declining water levels

Location of data: DWR

Metric to generate: Associated rescaled score of sub-basin to the Census BGs.

Notes: This is included in addition to the overdraft indicator above because it is assumed that having this as more specific location data could be helpful to indicate more specific risk to water shortage during a drought. Incorporated as part of Alluvial Basin Conditions score.

RC2j. Presence of irrigated agriculture in surrounding basin

Impact on risk: May indicate competing demand on groundwater supplies, which could create higher risk for small suppliers during a drought or water shortage event.

What does it represent: Presence of irrigated agriculture in surrounding basin

What do want it to indicate: Competing demand on water use

Location of data: DWR

Metric generated: Associated rescaled score of sub-basin to the Census BGs.

Notes: Complete. Incorporated as part of Alluvial Basin Conditions score.

RC2i. Source Water Quality Risk

Impact on risk: Presence of constituents at elevated concentration = increased risk

Data source: State Water Boards Division of Water Quality GAMA Groundwater Information System

What does it represent: Quality of groundwater likely accessed by domestic wells, based on the last 20 years of available data (from DDW, DWR, USGS, GAMA, and ILRP datasets) for each PLS section.

What do want it to indicate: Potential water quality problems in groundwater within the Census Block Group

Location of data: SWRCB

Metric generated: Five risk indices were developed for this metric: 1 (highest value) indicates an average historic or recent MCL exceedance for two or more constituents, 0.8 indicates an average historic or recent MCL exceedance for one constituent, 0.5 indicates historical average water quality between 0.5 and 1 times the MCL, and 0 indicates an historical average of less than 0.5 times the MCL for all constituents. -999 indicates where no data was available on water quality for that section.

Notes: Water quality data from Division of Water Quality at SWRCB. More detailed methodology involved in generating these risk indices will be posted to the Division of Drinking Water Needs Assessment website once complete.

5.2 Vulnerability of Self-Supplied Communities

We quantify vulnerability using a series of social and physical factors as they relate to groups of self-supplied residences. These groupings spatially are represented by US Census Block Groups. As done for the small water supplier vulnerability, self-supplied community vulnerability is quantified using three main components: (RC3) physical and (RC4) social vulnerability factors. Available data is sparse about households on their own supplies, so all information is estimated based on spatial associations to domestic wells within the Census Block Groups. No data was identified as readily available to represent those households that rely on private surface water intakes.

Note: As with the small water supplier assessment above, *vulnerability* is not a tangible, measurable concept; it is only relative as a comparison to others.

5.2.1 Physical Vulnerability

Physical vulnerability seeks to indicate the susceptibility of water shortage and drought for a self-supplied community. Two indicators developed using the depth of domestic wells compared to the depth of public wells are used to represent this component.

Table 8 Physical Vulnerability indicators for Self-Supplied Communities

Factor	Metric	Dataset	Data Source
RC3a - Well depth flag	Well-depth flag – if any portion of the groundwater unit(s) that intersect with the Census BG has relatively domestic wells, marked whole BG as '1' (high risk) (0,1)	Well Completion Reports, processed by GAMA SWRCB	OSWCR-DWR
RC3b – Well depth proportion	Proportion of Public Land Survey Sections in Block Group where the max depth of domestic wells is shallower than max of public wells (0-1)	Well Completion Reports, processed by GAMA SWRCB	OSWCR-DWR

RC3a - Shallow Depth of Domestic Wells Part 1

Impact on risk: Increased risk when domestic wells in the area are shallower than public supply wells

Data source: OSWCR DWR

What does it represent: Areas that could go out first, earlier than others during a dry year and are more shallow than public supplier wells in the surrounding area.

What do want it to indicate: higher risk when domestic wells are shallow

Location of data: DWR, processed by DWQ SWRCB group by Public Land Survey Section and then attributed to each groundwater unit. These groundwater units were then associated to Census Block groups for this analysis (by DWR).

Notes: Complete

RC3b - Shallow Depth of Domestic Wells Part 2

Impact on risk: Increased risk when wells are shallow, captures the proportion of area that is estimated as having shallower domestic wells (compared to public supply wells)

Data source: OSWCR DWR

What does it represent: Areas that could go out first, earlier than others during a dry year and are more shallow than public supplier wells in the surrounding area.

What do want it to indicate: Higher risk where domestic wells are shallower than public supplier wells, capturing extent of the risk

Location of data: DWR, processed by DWQ SWRCB group by PLS Section and then attributed to each groundwater unit. These groundwater units were then associated to Census BGs for this analysis (by DWR).

Notes: This is a proportion scale.

5.2.2 Socioeconomic Vulnerability

Social vulnerability factors associated with self-supplied communities includes 14 variables. The list of demographic variables selected to gauge social vulnerability of self-supplied communities is based on the CDAG input combined with Flanagan et al. (2011), a report written by several scientists at the Center for Disease Control to document its commonly used set of socio-economic population characteristics used to estimate social vulnerability. These population characteristics are the currently accessible factors they recommend using to calculate social vulnerability for disaster management, though we have omitted race and ethnicity factors given that these do not drive the population to be at higher risk. Race and ethnicity data can be offered as additional layer for post-scoring analysis given that they are characteristics of populations that often are exposed to higher risk.

Impact on risk: Demographic and socioeconomic characteristics examined are known to be more impacted during emergencies and disasters, following Cutter et al. (2003) and Flanagan et al. 2011.

Data source: US Census 2010 and American Community Survey 2012-2016

What does it represent: Social vulnerability of population within Census Block groups

What do want it to indicate: Social vulnerability of population within Census Block groups that may indicate households' varying capacity to manage their private water source when exposed to drought and shortage conditions.

Location of data: US Census/DWR Demographer

Metric to generate: Method of Center for Disease Control

Notes: Complete

Table 9 Indicators and datasets chosen to represent social factors (adaptive capacity) that contribute to increased risk to water shortage and drought for self-supplied communities

Variable	GIS Variable Names	Brief description of what variable is	Data Source
Per capita income 2016	PERCAP	Average per capita income for all block groups (BG)	ACS 2012-2016
Mean household income	AvgMHI	Average Median Household Income (MHI) for all BGs	ACS 2012-2016
Percent persons 65 year of age or older	Q65yr	Percentage of population of 65 and older of all BGs	ACS 2012-2016
Percent persons 17 year of age or younger	Q17yr	Percentage of population of under 17 years of all BGs	ACS 2012-2016
Percent persons 5 year of age or younger	Q5y	Percentage of population of under 5 years age of all BGs	ACS 2012-2016
Percent mobile homes	Qmobile	Percentage of mobile households of all BGs	ACS 2012-2016
No vehicle available	QnoVeh	Percentage of households with no vehicles of all BGs	ACS 2012-2016
Percent persons with no high school diploma	Qedu	Percentage of population over 25 years age with no high school diploma of all BGs	ACS 2012-2016
Percent population with single parent	Qparent	Percentage of population with single parent with children under 18 of all BGs	ACS 2012-2016
Percent population unemployed	Qunempl	Percentage of population of civilian unemployed of all BGs	ACS 2012-2016

Variable	GIS Variable Names	Brief description of what variable is	Data Source
Percent of population who speak English less than well	Qlang	Percentage of population who speak English less than well of all BGs	ACS 2012-2016
Percent of population in group quarters	Qgroup	Percentage of all census block population with Group Quarters (GQ)	Census 2010

Following the Center for Disease Control's method of calculating social vulnerability index, we used the following groupings of the socioeconomic variables.

Socioeconomic status:

- MHI
- Per capita income
- Percent under poverty level

Household composition and language (this is revised from Center Disease Control's method to account for not having disability data and not using race data):

- Percent 65 years and over
- Percent under 5 years
- Percent single parent households
- Percent of unemployment among employable age
- Percent without a high school degree among those over 25 years
- Percent of population who speak less English less than very well

Housing and transportation:

- Percent of households with no vehicle
- Percent living in group quarters
- Percent renters
- Percent living in mobile homes

The percentile ranking was calculated for each variable. Then these ranking were summed within each of their corresponding themes above. Then the percentile rank was calculated for each theme. Then the sum of the theme's percentile ranks was calculated to create an overall vulnerability score. This was rescaled using percentile rank to include as a variable in the Self-Supplied Communities Risk equation (see here for more information on this method (https://svi.cdc.gov/publications.html, and here: https://www.youtube.com/watch?v=REKFHOryflA&feature=youtu.be).

5.2.3 Record of Shortage

RC5a – Reported household outages on domestic well

Impact on risk: Increased risk in areas that have already experienced outages.

Data source: DWR https://mydrywatersupply.water.ca.gov/report/

What does it represent: Presence of one or more households with reported outages in Census BG (0,1)

What do want it to indicate: Areas that may experience outages again due to combinations of aquifer sensitivity/fluctuations and shallow wells.

Location of data: DWR, processed by DWQ SWRCB group by PLS Section and then attributed to each groundwater unit. These groundwater units were then associated to Census BGs for this analysis (by DWR).

Notes:

RC5b – Reported household outages on private well

Impact on risk: Increased risk in areas that have already experienced outages.

Data source: DWR https://mydrywatersupply.water.ca.gov/report/

What does it represent: Proportion of households with reported outages in Census BG (compared to total households in BG) (0-1 scalar)

What do want it to indicate: Areas that may proportionally experience outages again due to combinations of aquifer sensitivity/fluctuations and shallow wells.

Location of data: DWR Southern Regional Office

Notes: Complete

5.3 Method of Aggregation for Scoring Communities

To aggregate the risk factor variables described above, we use simple calculation that weights each variable within its given component of the framework. Then we aggregate the weighted component scores together. This offers a transparent, interpretable, and communicable method for calculating risk based on the many variables identified.

To combine variables, we use the method illustrated below. All variables are rescaled in 0-1 numbers, which then is combined with the variables in their respective component. Scales were adjusted when necessary so that all scales indicate higher risk on the higher end of the scale (1 is the highest, zero is the lowest). As described in Indicators Section above, each indicator has a different scoring done to make it applicable for this project.

Each group of variables is combined with the other groups' scores for that component (components are Exposure, Vulnerability, and Observed Shortage).

We examined 5,000 Census Block Groups, selecting those that had at least one domestic well drilled between 1970-2019 (from DWR Well Completion Reports) and had at least one household on record by the US Census. The following map indicates the spatial coverage of the analysis.

Equation for Self-Supplied (Rural) Community Risk:

Self-Supplied Community's Risk of Drought and Water Shortage =

$$0.25 \; x \; \mu(\text{RC1a, b, c}) + 0.75 \text{ x } \mu((\text{RC2a,b,c,i,h}) + \text{Max}(\text{RC2d,e,f,g,j})) + (\widehat{RC3a} + b) + \mu(\text{RC4a, b, c}) + 0.33 \text{ x } (\widehat{\text{RC5a}} + \text{b})$$

Exposure

Vulnerability

Observed Shortage

Where, all RC's value is scaled from 0 to 1, ordinal between 0 and 1, or binary 0 or 1.

Weighting

Two main weightings were considered to capture the CDAG's discussions. First, the scores were within each component. For example, based on the October 2019 CDAG meeting discussions and post-meeting written comments, the climate change indicators were weighted much lower than the current conditions indicators, decreasing the important of climate change factors on the final scores.

The second weighting considered involves the populations estimated use and assumed reliance on domestic wells. Preliminary exploratory analysis included that the sum of all three components were multiplied by a Domestic Well Reliance indicator. The purpose of this method was to de-emphasize the weighting of those Block groups with high exposure and high vulnerability, but that are almost entirely supplied by public water systems, are ranked low in the overall Self-Supplied Community Risk Score. However, such a weighting was determined to create a confusing and potentially misleading message about risk of drought and water shortage. Therefore, we offer the Domestic Well Count per Block Group with the final score, but not as part of it.

6.0 Variable Name and Description Table

The table below presents the name and brief description of each variable provided in the downloadable table of results for the small water suppliers risk scoring.

Table 10 Variable Names and Descriptions

Variable Name	Variable Description
County	County on record in which water supplier is located
pwsid	Public water system identification number
owner_type	Ownership Type
PWS_TYPE	Type of public water system
RES_SDWIS	Estimated residential population served
SystemName	Public water system name
TotalPop	Total population served
WATER_TYPE	Type of primary water source
SC1a_abs_ch	SC1a - averaged absolute projected max temperature change by mid-century
SC1a_heatAvg_percen	SC1a - averaged percent of projected max temperature change by mid-century
SC1aR_Qheatcc	SC1a - Projected change in temperature rescaled 0-1
SC1bR_saltwatergwSLR	SC1b - Projected severe or high severe risk for each system boundary or community rescaled 0-1
SC1cR_firecc	SC1c - Presence salt with 1 meter sea level rise into coastal aquifers rescaled 0-1
SC2aR_wildfire	SC2a - Modelled current risk for each system (based on vegetation)
SC2bR_DroughtForecast2019	SC2b- Annual Risk of Local Drought (precipitation-based by January 31 of current year's analysis)
SC2c_fractured	SC2c - Fractured rock (presence 1, absence 0)
newSC2cR_fra_sw	Fractured rock presence, weighted by surface water reliance (0.5) or groundwater (1)

Variable Name	Variable Description
SC2d_subsidence	SC2d - Susceptibility to subsidence
SC2e_salt	SC2e - Salts documented in basin
SC2f_overdraft	SC2f - Critically overdrafted basin
SC2g_gwlevel	SC2g - Declining groundwater levels
SC2h_Popgrowth_recodedpws2	SC2h - Near term projected population growth rate
rSC2Rbasindefgjxwatertype	Combined score with basin variables, weighted by primary water source type (SC2R – Groundwater Basin Vulnerability)
rSC2iR_gamawq_xwatertype	SC2i - Water quality flag weighted by primary water source type
rSC2jR_ag	SC2j - Presence of irrigated agricultural in basin
rSC3aR_intertie	SC3a - Available water transfers (presence of interties, rescaled 0-1)
rSC3bR_emergtie	SC3b - Availability of emergency water (presence of emergency interties, rescaled 0-1)
rSC3cR_monitor	SC3c - Baseline monitoring (level of monitoring reported, rescaled 0-1)
rSC3dR_qUnmeter	SC3d - Lack of metering (% system connections that have meters)
rSC3eR_singlesrc	SC3e - Number of sources
rSC3fR_srctype	SC3f - Number of source types
SC3_svc_connec	System size, number of service connections
rSC3g_servconn	SC3g - Supplier size rescaled 0-1
rSC3iR_distprob	SC3i - History of distribution problems
rSC3jR_watrSTATUS	SC3j - Current water supply levels
rSC3hR_short11to18	SC3h – Shortage: Self-reported projected shortage
rSC3kR_curtailorder2014	SC3L – Shortage: Systems under order of compliance for curtailment (2014) or building moratoriums
rSC3LR_droughtassist	SC3k – Shortage: Systems that received drought assistance
rSC4aR_yrssincerateupdate	SC4a - Upgraded rate structure, year updated
rSC4bR_ratetype	SC4b - Type of rate structure (Flat base rate or other)

Variable Name	Variable Description
rSC4dR_yrDPP	SC4d - Have drought plan or water shortage contingency plan, year written or updated
rSC4eR_demogcustomers	SC4e - Customer base socio-economics
PERCMISSING_vulnerability	Percent of missing indicators from the vulnerability indicators (Components 3 and 4)
Prank_onethirdshortageRISKTOTAL	Final Risk Score, 1-100 with 100 as highest risk; for assessment conducted in 2019

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Appendix 3
Drought and Water Shortage Risk Scoring: Risk Score Results of Small Water Suppliers

Prepared for

County *Drought* Advisory Group process
as partial fulfillment of Assembly Bill 1668

By
California Department of Water Resources

California Department of Water Resources
Water Use Efficiency Branch

March 2020

Appendix 3. Drought and Water Shortage Risk Score Results of Small Water Suppliers

CWC Section 10609.42(a) requires DWR, in consultation with other agencies and stakeholders, to identify small water suppliers and rural communities (areas of households on private supplies, also called "**self-supplied communities** in this report") that may be at **risk** of **drought** and **water shortage**. DWR must then notify counties and groundwater sustainability agencies (GSAs) of suppliers or communities that may be at risk within its jurisdiction and may make the information publicly accessible on the website.

This appendix presents results of calculating initial **risk** scores using existing statewide datasets and the newly developed tools to estimate **risk** of **drought** and **water shortage** for small water suppliers and **self-supplied communities**. The risk was assessed based on a multi-pronged definition; this offers valuable information beyond helping to prioritize which suppliers and communities need assistance. Further, delivering not only the aggregated risk scores, but also the disaggregated measures of **risk** to water suppliers, counties, groundwater sustainability agencies, integrated regional water management programs, the State Water Board, and other stakeholders can be valuable for planning, prioritizing and improving **drought** and **water shortage** resilience.

Risk scores were calculated for the following categories:

1. Small water suppliers including community and **noncommunity water systems** and tribal water systems (produced by the federal government [IHS]).
2. **Self-supplied communities**.

Recognizing that the risk assessment conducted as part of this project is based on available data and reflects a snapshot of drought and water shortage risk, it is recommended that this assessment is updated annually.

Map of suppliers examined for risk of drought and water shortage

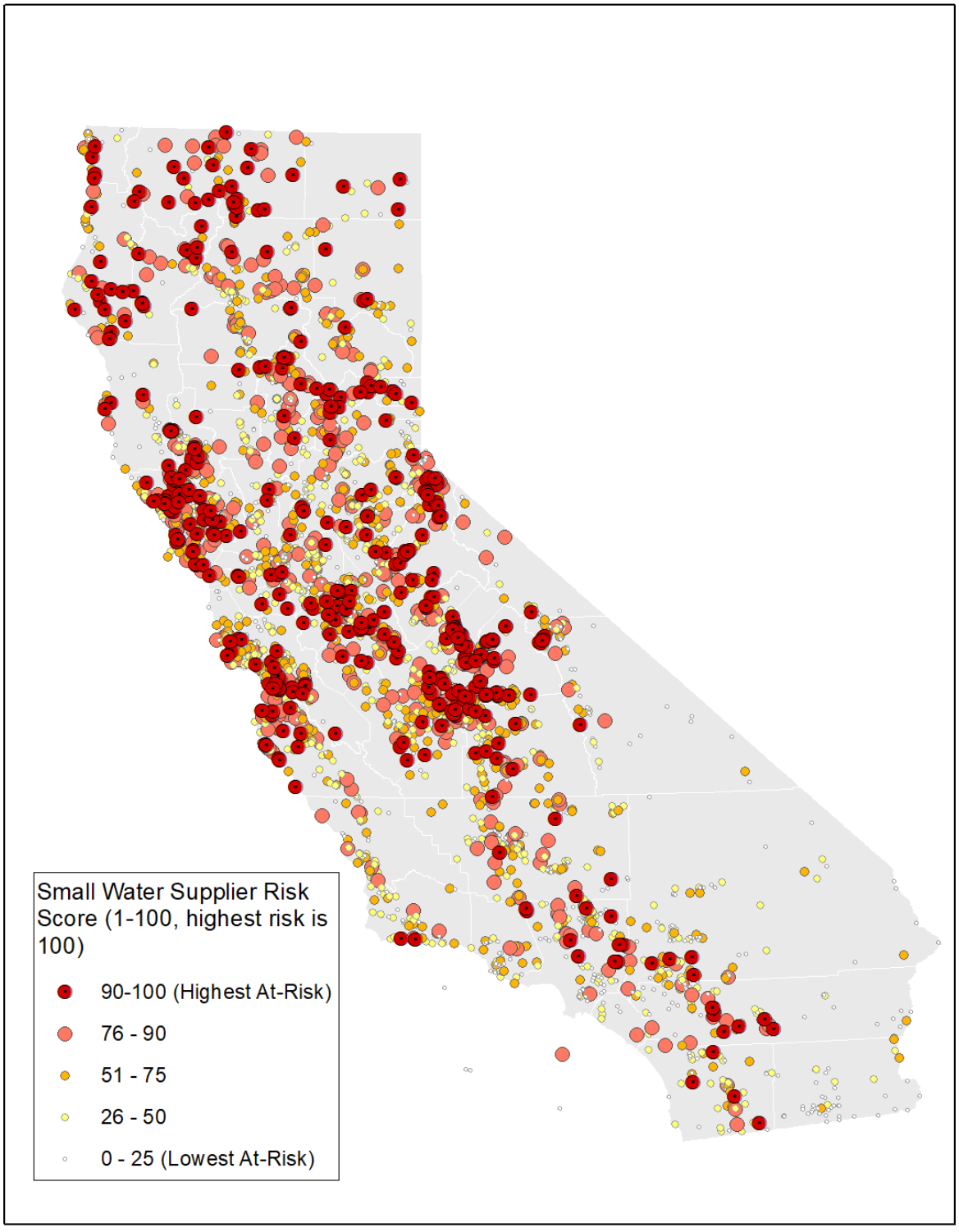


Figure 1. Map of suppliers examined for risk of drought and water shortage. Draft risk scores indicated by color ramp ranging from dark (high relative risk) to light (low relative risk).

For results of risk scores for each supplier examined, see the following links:

1. Table of suppliers, ordered by score or county (Available on request from droughtrisk@water.ca.gov)

Drought and Water Shortage Risk Support Tool: Small Water Suppliers

In creating a list of small suppliers and self-supplied communities at risk of drought and water shortage, the Department of Water Resources (DWR) with its Project Team and the County Drought Advisory Group recognized the value of the underlying data to evaluate drought and water shortage risk. The group agreed it would benefit suppliers and communities to be able to access specific information about their area relating to drought and water shortage risk. Understanding the factors driving the risk score can be helpful as small water suppliers develop their own drought plans. Therefore, in addition to developing a list of suppliers and self-supplied communities with a single scoring of risk, a planning support tool was developed for the water suppliers, counties, groundwater sustainability agencies (GSAs), and other stakeholders to access the information behind the supplier risk assessment. This tool offers a way to access the diverse suite of environmental, infrastructural, organizational, and socio-economic conditions that contribute to risk in their area.

The following link offers an interactive tool to allow interested parties to explore the indicators of risk for each small water supplier. Users may select a county, groundwater basin or other region of interest, or specific small water supplier examined to view the results of each of the 29 indicators examined as part of the drought and water shortage risk analysis.

Tool is accessible through the following link:

https://dwr.maps.arcgis.com/apps/MapSeries/index.html?appid=3353b370f7844f468ca16b8316fa3c7b

Appendix 4
Drought and Water Shortage Risk Scoring: Risk Score Results of Self-Supplied Communities

Prepared for

County *Drought* Advisory Group process
as partial fulfillment of Assembly Bill 1668

By
California Department of Water Resources

California Department of Water Resources
Water Use Efficiency Branch

March 2020

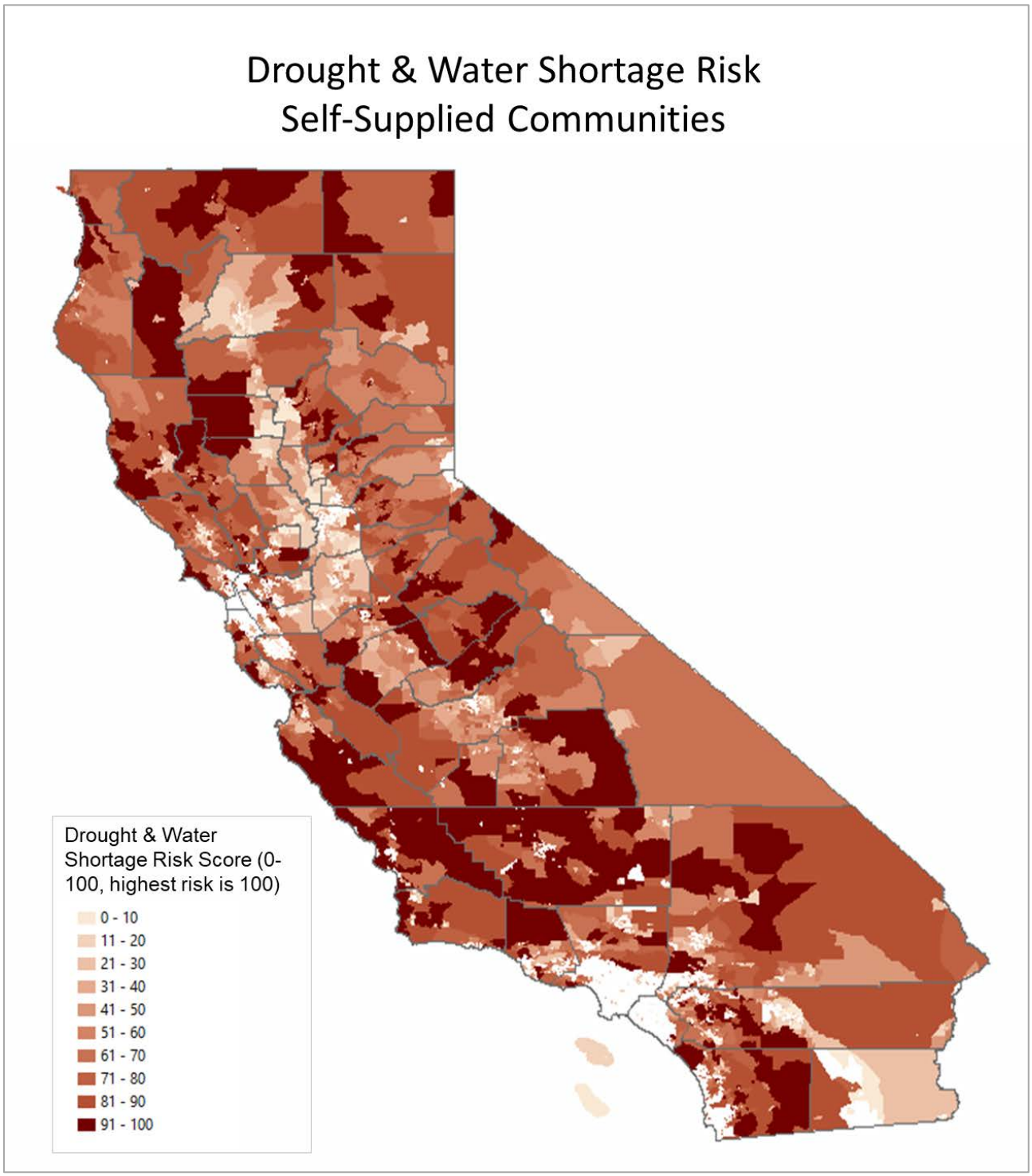
Appendix 4. Drought and Water Shortage Risk Score Results of Self-Supplied Communities

Water Code Division 6 Part 2.55 Section 8 Chapter 10 (Assembly Bill 1668) effectively requires California Department of Water Resources, in consultation with other agencies and an advisory group, to create a list of small water suppliers and "rural communities" that are at risk of drought and water shortage. This list must be shared with counties, Groundwater Sustainability Agencies (GSAs), other regional groups, and the public. This document presents the statewide results of the scoring for rural communities, referred to here and throughout as "self-supplied communities."

The unit of analysis for the self-supplied households is Census Block Groups (ACS 2012-2016 Tiger Shapefile). The Census Block Groups do not necessarily represent socially-defined communities, but they do cover areas where population resides. Using this spatial unit for this analysis allows us to access demographic information that is otherwise not available.

A table of the complete results of all communities examined, can be found here: https://water.ca.gov/Programs/Water-Use-And-Efficiency/Making-Conservation-a-California-Way-of-Life/County-Drought-Planning

Map of communities examined and their drought and water shortage risk scores is shown below.


Drought & Water Shortage Risk
Self-Supplied Communities
Drought & Water Shortage Risk Score (0-100, highest risk is 100)
0 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100

Drought and Water Shortage Risk Support Tool: Self-Supplied Communities

In creating a list of small suppliers and self-supplied communities at risk of drought and water shortage, the Project Team and CDAG agreed it would benefit suppliers and communities to be able to access specific information about their area relating to drought and water shortage risk. Therefore, in addition to developing a list of suppliers and self-supplied communities with a single scoring of risk, a planning support tool was developed for the public, GSAs, and counties. This tool offers a way to access the diverse suite of environmental, infrastructural, organizational, and socio-economic conditions that contribute to risk in their area.

The following link offers an interactive tool to allow interested parties to explore the indicators of risk for each self-supplied community (community). Users may select a county, groundwater basin or other region of interest to view the results of each of the 21 indicators examined as part of the drought and water shortage risk analysis for self-supplied communities. Communities with a record of one or more domestic well installed within the past 50 years are included in the analysis.

Tool is accessible through the following link:

https://dwr.maps.arcgis.com/apps/MapSeries/index.html?appid=3353b370f7844f468ca16b8316fa3c7b

Appendix 5
Proposed Draft Water Shortage Contingency Plan Components for Small Water System Serving 1,000 to 2,999 Service Connections

(Organized by AWWA M60 Manual Suggested Steps)

Prepared for

County Drought Advisory Group process
as partial fulfillment of Assembly Bill 1668

By

California Department of Water Resources

California Department of Water Resources
Water Use Efficiency Branch

March 2020

WSCP Component (AWWA M60, 2019)	Examples of CDAG Required Items
Step 1 Form a Water Shortage Response Team Select the Water Shortage Response Team Set Priorities Establish Schedules and Maintain Momentum Coordination, Cooperation, and Communications	Identify responsible staff for coordinating with Regional Water Planning Groups, drought task force. Identify events cause emergencies and contractors you will need. What are your goals/objectives for managing drought related problems and involve the public? Annually report progress and schedule Emergency Notification & Effective Communication, Chain of Command – Lines of Authority, Emergency Contact info. Coordinate with county/regional planning
Step 2. Forecast Supply in Relation to Demand Data Collection Data Analysis Is There a Predicted Shortage? Catastrophic Supply Interruptions	Summary inventory of water supply and demand, Water System background (sources), Describe what indicates drought conditions for your system Document previous water shortage conditions, drought scenarios, annual monthly usage Document your anticipated drought related problems and thought process to determine if a water shortage is imminent. Response Actions for Specific Events (Fire actions should be included). Document highest stage-minimum usage and connection moratorium

WSCP Component (AWWA M60, 2019)	Examples of CDAG Required Items
Step 3. Balance Supply and Demand and Assess Mitigation Options Supply Augmentation Methods Demand-Reduction Methods	Assess Supply & Demand, Mitigation Measures & Assessment Determine Long term mitigation measures- alternative water sources, improvements in supply Determine how to balance Supply and Demand
Step 4. Establish Triggering Levels Trigger Mechanisms	Drought Response Triggers
Step 5. Develop a Staged Demand-Reduction Program Criteria for Demand Reduction During a Water Shortage Establish Stages Measures Manages Customer Expectations	Criteria for Initiation and Termination of Drought Stages. Criteria for triggers. Triggers should be set at 10%, 25%, and 50%. Drought Response Stages Response actions Variances
Step 6. Adopt the Plan Involve the Community Prepare the Community Prepare a Revenue Program Formalize cooperation with local agencies in the region Review and finalize the plan	Declaration of Policy, Purpose, and Intent. Public involvement and outreach plan. Revenue & expenditure analysis, Urgency ordinance for surcharges

WSCP Component (AWWA M60, 2019)	Examples of CDAG Required Items
Step 7. Implement the Plan Essential Elements of Implementing a Water Shortage Plan Shortage Plan Public Information and media Program Drought Recovery and Water Shortage Plan Termination	Mechanism for determining actual water use reductions Public involvement and outreach plan Returning to Normal Operation, Criteria for Initiating and termination of drought response stages

Appendix 6
Proposed Draft Umbrella Water Shortage Contingency Plan Components

(Organized by Water Shortage Disaster Risk Management Phases and AWWA M60 Manual Suggested Steps)

Prepared for

County Drought Advisory Group process
as partial fulfillment of Assembly Bill 1668

By

California Department of Water Resources

California Department of Water Resources
Water Use Efficiency Branch

March 2020

Tables 1 and 2 discuss the four-phase model of disaster risk management aimed at improving the drought preparedness of small water suppliers and rural communities. These tables detail a seven-step plan that addresses drought and water shortage vulnerability and risk reduction.

Table 1 presents phases 1 and 2 and explains pre-disaster strategies to employ before a drought and during a water shortage. Table 2 presents phases 3 and 4 and explains post-disaster strategies to aid in recovering from a drought or a water shortage.

Figure 1 Disaster Risk Management Framework

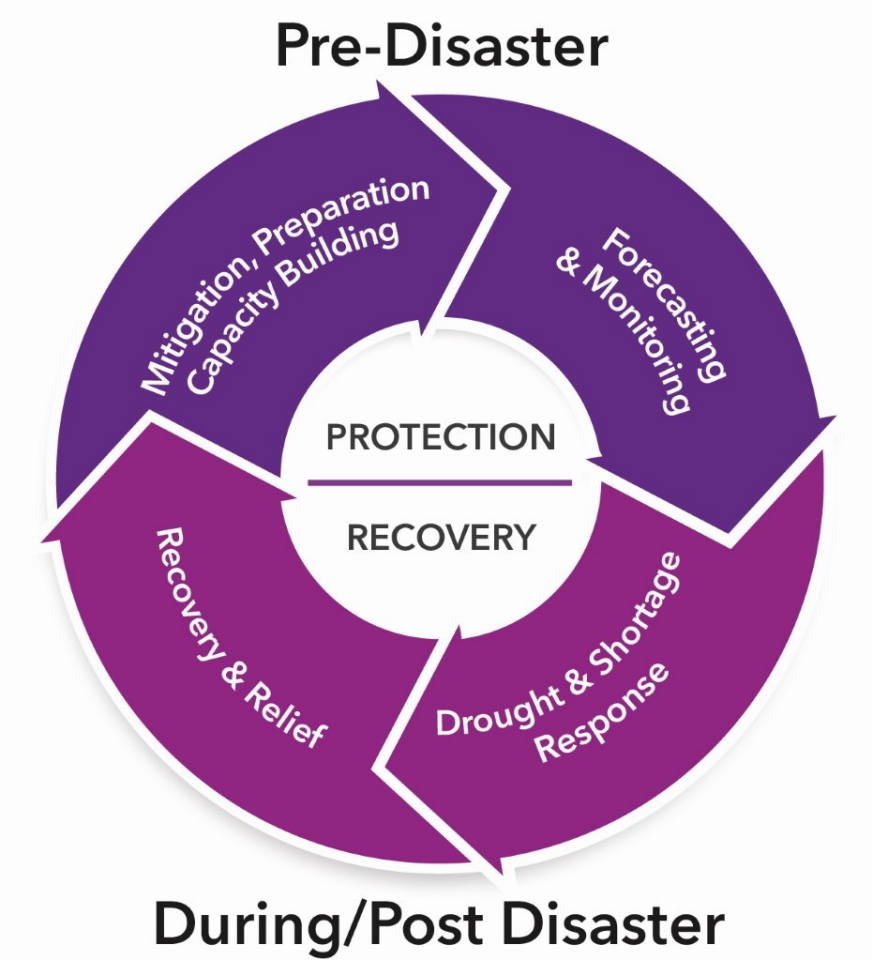


Table 1 presents phases 1 and 2 of the four phases in the disaster risk management framework. Both are pre-disaster phases. Phase 1 is a before-drought/water-shortage learning phase that includes risk assessment, risk reduction, improving coping capacity, and improving emergency and water shortage plans. Phase 2 is an ongoing phase that includes monitoring, forecasting, and tracking; improving science; and accounting for precipitation, water supply, or other changes.

Table 1 Pre-Disaster Phases 1 and 2

WSCP Component (AWWA M60, 2019)	**Before Drought / Water Shortage** **CDAG Requires (R) / Recommends (r)**	**Notes** **Phase 1: Preparation, Risk Reduction, and Capacity Building**	**Notes** **Phase 2: Forecasting and Monitoring**
Step 1: Form a Water Shortage Response Team			
Select the Water Shortage Response Team	R	Team and lead in lead entity with support from other entities. AWWA M60 Step 1	Monitoring & Forecasting activities already in place for implementing WSCP
Set Priorities	r	Based on vulnerability & risk analysis, economic, environmental factors, water efficiency	Plan already in place and key staff are aware for Step
Establish Schedules and Maintain Momentum	r	Start planning in advance	Monitoring protocols already in place
Coordination, Cooperation, and Communication	R	Coordinate with water suppliers, community, and among local, regional, state and federal agencies	Reporting protocols already in place
Step 2: Forecast Supply in Relation to Demand			
Data Collection	R	Compile data related to water resources groundwater allocations and surface water rights, water purchase agreements, available water supply and storage capacity, treatment flexibility, recycled water availability, assets, customer characteristics, seasonal demand profiles. Identify early warning systems.	Early warning systems identified in planning stage. Continue to collect data.
Data Analysis	R	Analyze scenarios: supply data analysis, water quality date analysis, water demand data analysis	Continue to collect and use data to analyze for your region and review for potential adaptations needed due to climate change.
Is There a Predicted Shortage?	R	Plan regional communication. Can wholesale suppliers, retail suppliers carryover storage?	Communication planned already
Catastrophic Supply Interruptions		Short-term and long-term planning, Join regional entities (CALWARN). Emergency Response Plan recommended. Be ready to move directly to highest stage actions.	Early warning systems identified in planning stage. Continue to collect data.

WSCP Component (AWWA M60, 2019)	**Before Drought / Water Shortage** **CDAG Requires (R) / Recommends (r)**	**Notes** **Phase 1: Preparation, Risk Reduction, and Capacity Building**	**Notes** **Phase 2: Forecasting and Monitoring**
Step 3: Balance Supply and Demand and Assess Mitigation Options			
Supply Augmentation Methods	R	AWWA M60 Table 3-1. (1) Leverage existing assets through existing system flexibility and infrastructure upgrades; (2) increase supplier water use efficiency; (3) expand water supply portfolio with new sources including recycled water; and (4) seek opportunities to collaborate with other agencies. Expand areas of use boundaries for emergency purposes, as needed.	Some are long term measures, these should be implemented prior to the drought and re-evaluated periodically to determine new information/projects that may be needed.
Demand-Reduction Methods	R	Plan demand reduction measures based on severity of the shortage and by stage.	Collect and analyze data related to demand reduction measures
Step 4 Establish Triggering Levels			
Trigger Mechanisms	R	Clearly define and document triggers-reservoir, groundwater levels, etc. See list AWWA M60 Pg 56. Use 3-5 stages. Plan exit strategy.	Monitoring & Forecasting already planned. Periodically, evaluate if adaptations to triggers are necessary based on new data.
Step 5: Develop a Staged Demand-Reduction Program			
Criteria for Demand Reduction During a Water Shortage		Criteria includes: timing (goals will be met?), magnitude of savings, season, costs	
Establish Stages	R	Based on triggers: 3-5	
Measures	r	Short and long term based on customer categories. See Table 5-3.	
Manage Customer Expectations		Implement system to answer community questions (call in phone line etc.)	

WSCP Component (AWWA M60, 2019)	**Before Drought / Water Shortage** **CDAG Requires (R) / Recommends (r)**	**Notes** **Phase 1: Preparation, Risk Reduction, and Capacity Building**	**Notes** **Phase 2: Forecasting and Monitoring**
Step 6: Adopt the Plan			
Involve the Community	r	Develop/Review and update the WSCP with public input	If adaptations are necessary, include community.
Prepare a Revenue Program		Plan for recovering expenses by considering raising water rates, imposing a water shortage surcharge (if legally allowable), include needed drought projects in hazard mitigation plans and seek funding sources from outside agencies, as appropriate.	Re-evaluate if modifications are needed based on new data.
Formalize cooperation with local agencies in the region		Prepare ordinances and interagency agreements for different levels of water shortage.	Re-evaluate if modifications are needed based on new data.
Review and finalize the plan		WSCP should go through formal public review process to minimize future objections when mandatory prohibitions are needed. Quickly adopt it formally.	Revise and reapprove if modifications are necessary.
Step 7: Implement the Plan			
Essential Elements of Implementing a Water Shortage Plan		1. Staff levels 2. Staff training and support 3. Office space 4. Equipment 5. Budget 6. Intra-office communication 7. Coordination with other agencies 8. Computer and billing format capabilities 9. Customer assistance 10. Customer appeals 11. Special-needs customers 12. Media contacts 13. Monitoring of actual use	Implement long-term projects

WSCP Component (AWWA M60, 2019)	Before Drought / Water Shortage CDAG Requires (R) / Recommends (r)	Notes Phase 1: Preparation, Risk Reduction, and Capacity Building	Notes Phase 2: Forecasting and Monitoring
Public Information and Media Program	r	Getting the public involved will require an expansion of an existing water conservation public education program. A vigorous public education program during a water shortage emergency is crucial for achieving substantial water-use reductions.	
Drought Recovery and Water Shortage Plan Termination			Monitoring indicates that a water system is capable of supporting unrestricted water demand for a sustained period of time.

Table 2 presents phases 3 and 4 of the four phases in the disaster risk management framework. Both are during-drought and post-disaster phases. Phase 3 an ongoing phase that includes monitoring, forecasting, and tracking; improving science; and accounting for precipitation, water supply, or other changes. Phase 4 a disaster response phase that includes communication, calling for assistance, and implementing emergency response procedures.

Table 2 During-Drought and Post-Disaster Phases 3 and 4

WSCP Component (AWWA M60, 2019)	During-Drought/ Post-Disaster CDAG Requires (R) / Recommends (r)	Notes Phase 3: Response	Notes Phase 4: Drought / Water Shortage Recovery
Step 1: Form a Water Shortage Response Team			
Select the Water Shortage Response Team	R	Same teams as planning stage implement WSCP	Team follows WSCP during implementation
Set Priorities	r	Plan already in place and public is familiar	Team reflects on actions taken and their effectiveness.
Establish Schedules and Maintain Momentum	r	Steps to implement WSCP already planned	
Coordination, Cooperation, and Communication	R	Essential staff roles laid out in WSCP, recent changes since last plan should be incorporated	

WSCP Component (AWWA M60, 2019)	**During-Drought/ Post-Disaster CDAG Requires (R) / Recommends (r)**	**Notes Phase 3: Response**	**Notes Phase 4: Drought / Water Shortage Recovery**
Step 2: Forecast Supply in Relation to Demand			
Data Collection	R	Data collected essential to track triggers, if any data found to be missing based on evaluation of the specific drought then this should be immediately collected.	Additional data collection during recovery
Data Analysis	R	Data analysis to track needed change to triggers based on actual drought	Notify public when water shortage is over
Is There a Predicted Shortage?	R	Actions by wholesale suppliers and retail suppliers. Regularly collect up-to-date data and share with other agencies, as needed.	Document lessons learned
Catastrophic Supply Interruptions		Use ERP and contact Local OES. Additional steps as necessary to secure interim water supplies.	Document lessons learned to revise WSCP and ERP. Coordinate with other agencies (FEMA, CALWARN, etc.) on reimbursement needs/responsibilities.
Step 3: Balance Supply and Demand and Assess Mitigation Options			
Supply Augmentation Methods	R	Water purchases, transfers and interconnections already planned—determine if actual drought requires other non-planned changes.	Offer Incentives for increased water use efficiency, irrigation system audits. Re-evaluate alternatives for future based on lessons learned.
Demand-Reduction Methods	R	Public Information campaign, Restrictions, exemptions, rationing, enforcement, education, feedback – adapted to actual drought, as necessary	Continue informing Public, positive feedback until no longer necessary.
Step 4 Establish Triggering Levels			
Trigger Mechanisms	R	Communicate triggers in Step 7 adapted as necessary based on actual drought	Communicate exit strategy in Step 7.
Step 5: Develop a Staged Demand-Reduction Program			
Criteria for Demand Reduction During a Water Shortage			

WSCP Component (AWWA M60, 2019)	**During-Drought/ Post-Disaster CDAG Requires (R) / Recommends (r)**	**Notes Phase 3: Response**	**Notes Phase 4: Drought / Water Shortage Recovery**
Establish Stages	R	Communicate monitoring data and stage information	
Measures	r	Evaluate water saved by measures	
Manage Customer Expectations		Implement system to respond to community questions	Communicate exit strategy, anticipate that drought impacts will last longer in some communities then others
Step 6: Adopt the Plan			
Involve the Community	r	Hold public meetings/events as needed based on actual drought impacts.	Document what worked and challenges faced based on actual drought experience for future plan modifications.
Prepare a Revenue Program		Begin documenting additional staff costs and resources needed. Re-evaluate based on actual drought impacts.	Summarize financial impact of drought and challenges faced based on actual drought experience for future plan modifications. Coordinate with other agencies (FEMA, CALWARN, etc.) on reimbursement needs/responsibilities.
Formalize cooperation with local agencies in the region		Interagency agreements confirmed in advance of response-determine if any additional agreements are necessary based on actual drought impacts	Toward the end of the drought is a good time to formalize any informal partnerships that were developed as a result of the drought or begin searching for additional funding for future droughts while it is still a high priority.
Review and finalize the plan		Contacting industry representatives ahead of time may gain their support	Make adaptations as necessary based on actual experiences.
Step 7: Implement the Plan			
Essential Elements of Implementing a Water Shortage Plan		Re-evaluate based on current drought scenario.	Re-evaluate based on lessons learned in drought scenario.
Public Information and Media Program	r	The lead entity also assumes a central role in publicizing the extent of the water shortage problem as well as in helping consumers conserve. Even voluntary programs have achieved significant reductions in water use where the public was well-informed and understood the need to conserve.	Re-evaluate based on lessons learned in drought scenario.

WSCP Component (AWWA M60, 2019)	**During-Drought/ Post-Disaster CDAG Requires (R) / Recommends (r)**	**Notes Phase 3: Response**	**Notes Phase 4: Drought / Water Shortage Recovery**
Drought Recovery and Water Shortage Plan Termination			Water shortage response team reflects on actions taken and their effectiveness. Track progress toward addressing vulnerabilities - Build on / update / improve DWR's list of vulnerable suppliers and communities within the umbrella area Publicize gratitude for the community's cooperation Restore water utility operations, organization, and services to pre-event levels Document the event and response, and compile records for future reference Collect cost accounting information, assess revenue losses and financial impact, and review deferred projects or programs Debrief staff to review effectiveness of actions, to identify the lessons learned, and to enhance response and recovery efforts in the future Complete a detailed evaluation of affected facilities and services to prepare an "after action" report, including lessons learned and recommended improvements Continue to maintain liaisons as needed with external agencies Plan to update the WSCP as needed.

Appendix 7. Water Shortage Contingency Plan Components for Tribal Water Systems

Drought Contingency Plan
Public Water System

Name of Tribe/Band

Address of Tribe/Band
P.O. Box XXX
City, California 95555

Name of Tribal Utility Department/Water Department

Address of Tribal Utility Department/Water Department
P.O. Box XXX
City, California 95555

Name of Tribal Public Water System

Public Water System ID Number: 1234567

Date [00/00/2014]

****

Background and instructions:

This document is a template for a drought contingency plan for a tribal public water system. The template covers a broad list of sections and topics with the aim of being applicable for a majority of the water systems. Because tribal water systems vary throughout the state (e.g. in complexity, water source, number of customers, etc.), it is recommended that the tribe edit and modify the template to best fit their specific situation and context, and only include those sections that are necessary.

This template was developed by the Indian Health Service, California Area, Office of Environmental Health and Engineer, and primarily based on reference information from the California Drought Contingency Plan (November 2010), the Texas Handbook for Drought Contingency Planning for Retail Public Water Suppliers (April 2005), and several existing drought contingency plans for cities in California.

Please contact your local IHS District Office for assistance with developing a drought contingency plan. Contact information can be located at:
http://www.ihs.gov/california/index.cfm/about-us/field-offices/

Sections with [_____] are intended to be edited with information specific to the tribe and/or public water system. The information in the bracket provides reasonable example values; however, it should be reviewed and modified as appropriate. For example: The water usage of [_____] [50 gpcd] [75 gpcd] [100 gpcd].

The text in green font provides background and instructions, and should be deleted in the final document.

****

Table of contents

****
Edit the following listing depending on whether relevant articles are contained within final edited section or not.
****

The Drought Contingency Plan contains the following sections:

1. Declaration of policy, purpose, and intent

1.1. General

In order to conserve the available water supply and protect the integrity of water supply facilities, with particular regard for domestic water use, sanitation, and fire protection, and to protect and preserve public health, welfare, and safety and minimize the adverse impacts of water supply shortage or other water supply emergency conditions, the [_____] [name of Tribe/Band] hereby adopts the following regulations and restrictions on the delivery and consumption of water through an ordinance/or resolution.

The Drought Contingency Plan (Plan) is a framework of forward-leaning planning for scenarios and objectives, managerial and technical actions, and potential response systems in order to prevent, or better respond to, a drought-related emergency or critical situation. The overall goal of the Plan, and the contingency planning process, is to facilitate rapid emergency response. The intention of the Plan is to be functional, flexible, and easy to implement, and also serve as a tool for maintaining control over the events or limiting the risk of loss of control. The Plan should be periodically updated.

The primary focus is placed on best management practices to manage water use demand, while evaluating options for alternative water supply sources. Water uses regulated or prohibited under the Plan are considered to be non-essential and continuation of such uses during times of water shortage or other emergency water supply condition are deemed to constitute a waste of water which subjects the offender(s) to penalties as defined in this Plan.

1.2. Water use priorities

The risks to public health from water shortages could be high and include issues of water quality, water quantity, sanitation, and hygiene for personal use and food preparation. As a result of this, the Plan establishes the following priorities for use in developing demand reduction programs and allocations during a water shortage emergency. Priorities for use of available water, from highest to lowest priority, are:

1. Health and safety: residential home interior uses, sanitation, and fire fighting
2. Commercial, industrial, and governmental: maintain jobs and economic base
3. Existing landscaping: especially trees and shrubs
4. New demand: projects without permits when shortage is declared

1.3. Application

The provisions of this Plan shall apply to all customers and property utilizing water provided by the public water system.

2. Drought task force

A drought task force was created by the Tribe/Band in order to develop this Plan and to assist in further developing and implementing effective drought monitoring, mitigation, and response actions. The drought task force consists of representatives from the following:

- [_____] [name of tribal office or official]

- Tribal administrator
- Tribal water/utility department
- Tribal environmental department
- Local tribal housing department entity
- Local fire chief
- Local police chief
- Critical water users, e.g. health clinics, schools

3. Authorization

The designated official listed below, or his/her designee, is hereby authorized and directed to implement the applicable provisions of this Plan upon determination that such implementation is necessary to protect public health, safety, and welfare. The designated official or his/her designee shall have the authority to initiate or terminate drought or other water supply emergency response measures as described in this Plan. The authorized designated official is: [_____] [name of authorized designated official] [tribal administrator] [tribal public works director] [tribal utility authority director]

4. Definitions

For the purposes of this Plan, the following definitions shall apply:

A. **Aesthetic water use:** water use for ornamental or decorative purposes such as fountains, reflecting pools, and water gardens.

B. **Commercial and institutional water use:** water use which is integral to the operations of commercial and non-profit establishments and governmental entities such as retail establishments, hotels and motels, restaurants, and office buildings. The term is also referred to as non-residential water use.

C. **Conservation:** those practices, techniques, and technologies that reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water or increase the recycling and reuse of water so that a supply is conserved and made available for future or alternative uses.

D. **Customer:** any person, company, or organization using water supplied by the public water system.

E. **Domestic water use:** water use for personal needs or for household or sanitary purposes such as drinking, bathing, heating, cooking, sanitation, or for cleaning a residence. The term is also referred to as residential water use.

F. **Drought level or stage:** severity of the drought conditions indicated by the impact and/or vulnerability triggering criteria for the water source and capacity to meet demand, and corresponding best management practices to mitigate impacts.

G. **Even number address:** street addresses, box numbers, or rural postal route numbers ending in 0, 2, 4, 6, or 8 and locations without addresses.

H. **Industrial water use:** the use of water in processes designed to convert materials of

lower value into forms having greater usability and value.

I. **Landscape irrigation use:** water used for the irrigation and maintenance of landscaped areas, whether publicly or privately owned, including residential and commercial lawns, gardens, golf courses, parks, and rights-of-way and medians.

J. **Non-essential water use:** water uses that are neither essential nor required for the protection of public, health, safety, and welfare.

K. **Non-residential water use:** the term is also referred to as commercial or institutional water use.

L. **Odd numbered address:** street addresses, box numbers, or rural postal route numbers ending in 1, 3, 5, 7, or 9.

M. **Public water system:** a system for the provision to the public of water for human consumption through pipes or other constructed conveyances. The term is also referred to as community water system.

N. **Residential water use:** the term is also referred to as domestic water use.

5. Previous water shortage conditions

Living in the western regions of the United States, the peoples of the [_____] [name of Tribe/Band] were accustomed to natural variations in climate cycles, and drought conditions have impacted the Tribe since before recorded history. Like other Native Americans living in this region, the Tribe moved seasonally between the ocean and the mountains, according to rainfall and temperature cycles. The ability to move tribal villages as necessary to be near water sources allowed our ancestors to adapt to periods of abundant rainfall and drought conditions. This cultural adaptability remains, however the physical ability to move tribal homes to new areas was removed when the Tribe was required to live on a reservation. This created new challenges, because the Tribe had to remain in one place and survive off of local water sources, regardless of whether rainfall was plentiful or limited.

Since the formation of the Reservation/Rancheria, the Tribe has been impacted many times by drought. During previous water shortages and droughts in [_____] [indicate year] [1987] [1992], the [_____] [name of Tribe/Band] experienced [_____] [indicate impacts experienced from the water shortage/drought] [declining groundwater levels] [reduced surface water flows] [loss of production capacity from the groundwater wells/surface water intake] [reduction in system pressures].

The water shortage conditions caused the [_____] [name of Tribe/Band] to implement the following response actions:

- [_____] [indicate any previous actions taken]
- [voluntary water use reduction]
- [mandatory water use reduction]
- [water allocations]
- [deepening groundwater wells]
- [use of alternative water sources]

6. Criteria for initiating and termination of drought response stages

The designated official shall monitor water supply on a periodic bases as determined by the severity of the drought, and determine when conditions warrant initiation or termination of each stage of the Plan based on the specified triggering criteria. The triggering criteria are based on public health risks (likelihood and impacts) and an analysis of the anticipated vulnerability of the water source under drought conditions, and system capacity limits.

7. Coordination with regional partners

The public water system(s) is in or adjacent to an area with other potential regional partners. As appropriate, this Plan will be provided to other regional partners for the purpose of effective and efficient planning and coordination of resources for drought emergency response. The regional partners for drought emergency response include:

A. [_____] [name of adjacent Tribe/Band]
B. [_____] [name of adjacent city or town]
C. [_____] [name of adjacent water district/utility]
D. [_____] [name of local county Office of Emergency Services (OES)]

8. Public involvement

Opportunities for public input in the Plan were provided by the methods including:

- Holding a public meeting to accept input on the Plan
- Making the Plan available on the official tribal Website
- Providing the Plan to anyone requesting a copy
- Accepting comments on the Plan at a designated office

9. Public education and notification

Community outreach, education, and notification about the Plan will include information about the conditions under which each stage is to be initiated or terminated, the drought response measures to be implemented in each stage, and the specific actions required of the public.

The more severe the water shortage, the more vigorous the public information campaign will need to be. Any public communications strategy undertaken in connection with a water shortage should contain the following fundamental attributes:

- **Timely:** Information should be disseminated well in advance of voluntary or mandatory actions that are to take effect, repeated often, and updated at regular intervals.

- **Credible:** Information should strive to be clear, professional, consistent, straight forward, reasoned, and honest to build trust and community support.

- **Multi-modal:** Information should be made available to the public using a variety of methods; for example using the internet, newsletters, radio, and public meetings.

- **Open:** The public water system will actively listen to, engage, and involve its customers, solicit feedback, address identified concerns, and respond to public input in a manner that is respectful, appreciative, welcome to creative solutions, and acknowledges each individual's sacrifice, inconvenience, and contribution to the solution.

- **Coordinated:** The public water system should collaborate with other Tribal departments and other impacted entities to ensure that the community as a whole has a synchronized and coordinated approach.

- **Action oriented:** Information should always contain positive action steps people can take to help foster a spirit of cooperation and create an overall atmosphere that encourages the people to conserve water for the public good.

A valuable technique in communication is to have a prepared and concise public message for each stage of the water shortage as described in the Plan. These statements are included within the response action for each stage, and intended to help communications be consistent, stay on message, and set the tone for subsequent communications through the duration of the incident.

There are various methods to carry out communications and public outreach. The designated official will consider the following techniques and methods to notify the public:

- Announcement at public events and meetings
- Presentations and open forums at community meetings
- Publication in a newspaper of general circulation
- Press releases using other local media; e.g. television, radio, E-mail
- Direct mail to each customer; e.g. utility bill inserts
- Telephone hotline
- Public service announcements
- Signs posted in public places; e.g. posting a bulletin at the tribal offices
- Take-home fliers/posters at schools, churches, libraries, grocery stores
- Public information booths at events
- Outdoor signs
- Drought response center
- Announcements on the official tribal Website
- Notifying other tribal offices, departments, schools, and other agencies as appropriate

The designated official will notify the following individuals or agencies:

- Tribal chairperson and members of the tribal council
- Tribal water utility board
- Tribal environmental department
- Local tribal housing department entity
- Local fire chief
- Local police chief
- Critical water users, e.g. health clinics, schools
- County Office of Emergency Services (OES) director
- Indian Health Service District/Field Office
- Other Federal entities; e.g. BIA, BOR, EPA

10. Summary inventory of water supply and demand

10.1. Water supply

The public water system is currently supplied by water source(s) including [_____] [description of the water sources] [groundwater] [surface water] [system intertie with local water

district] [imported water].

A brief description of each source is provided in the Table below. A detailed description of each water source is provided in the Appendix, and includes [groundwater: well depth, pump depth, seasonal static water levels, seasonal dynamic/pumping water levels, well drilling logs] [surface water: supply, water allocation, seasonal limitations] [system intertie with local water district: supply, seasonal limitations] [imported water: supply, seasonal limitations].

While production from specific water supply source will often vary year to year, due to a variety of factors, it is anticipated that during a drought condition, the water supply would drastically change in quantity and quality.

Table 1: Estimated minimum water supply

Water supply source	**Estimated minimum water supply [indicate units] [gallons per day] [acre-feet per day]**
Source no. 1	
Source no. 2	
Source no. 3	
Total all sources	

10.2. Water demand

The public water system has a current water demand from uses including [_____] [description of the water demand uses] [residential] [non-residential including commercial, schools, tribal offices, health clinics] [irrigation].

A brief description of each water use demand is provided in the Table below. A detailed description of each water use demand is provided in the Appendix, and includes [average demand] [seasonal peak demands] [special/critical use demands; e.g. health clinics].

Table 2: Average water use demand

Customer type	**Number of connections**	**Total water demand [indicate units] [gallons per day] [acre-feet per day]**
Residential		
Non-residential		
Irrigation		
Total all demands		

The average water demand is based on a use of:

- [_____] [average water usage for each customer type]
- [_____] [650 gpd per residential connection]
- [_____] [7,000 gpd for high school]
- [_____] [5,000 gpd for health clinic]
- [_____] [3,000 gpd for all other non-residential connections including tribal offices]
- [_____] [2,000 gpd for all irrigation]

In addition, actual water use data for the wintertime (e.g. January and February) has been utilized to evaluate the water use allotments for the most restrictive stages. Wintertime water

use is considered to be more representative of actual minimum domestic water use because it consists primarily of domestic uses, as exterior water use is likely to be minimal during this time of year (e.g. limited use for lawn irrigation, swimming pools, etc.).

The wintertime water use was found to range from approximately [_____] to [_____] [indicate approximate range of wintertime per capita water usage] [40 to 95 gpcd].

11. Determining if a water shortage is imminent

In normal or wet years when the water supply outlook is favorable, there is generally sufficient supply to meet the existing demand. However, after an unusually dry winter or period of consecutive dry years, there is an increased likelihood the water supply would not meet the demand. It is critical during this situation to undertake an analysis of whether water supplies will be deficient relative to the estimated water needs for the coming dry season. If possible, the analysis should be performed before the end of the rainy season in time to decide appropriate actions and to provide adequate notice to the public. There is a chance that late winter rains will change the water supply outlook, and therefore, the situation often remains dynamic through the end of April.

Generally, the period of May 1 to October 31 is considered the critical period for the purpose of defining the degree of water supply shortfall and for selecting the appropriate demand reduction strategy and goals. During this period is often when water supply availability is the lowest and water demand is the highest, potentially creating a summer water supply shortage situation.

There may often be no single criterion, trigger, or definition that is used to determine if a water shortage exists. The determination of a water shortfall involves consideration of all the relevant factors listed in the Plan which generally involve both the water supply and demand. Generally, forecasting water supplies available from all potential sources (e.g. surface water and ground water sources) may involve a range of certainty due to the availability of historic information and variance in weather patterns and subsurface conditions. Using the best available information, the designated official will determine the degree of the water shortfall following a three-step process, which includes:

1. Develop a monthly forecast of water supply available from all sources.
2. Compare the water supply available to the anticipated water demand.
3. Evaluate whether the available water supply is adequate to meet the demand over the projected time period of dry weather conditions, and any anticipated water shortfall. Implement any water shortage/drought response actions as necessary.

12. Triggering criteria and stages of action

One of the key elements of the Plan is a framework of incremental or staged triggering criteria for the drought severity and corresponding response actions. Each stage is triggered by an anticipated or actual water shortage condition, and each stage has several triggering criteria. The triggering criteria described below are based on an analysis of the vulnerability of the water source under anticipated drought conditions and system capacity limits. The drought condition stage, water shortage triggering criteria, and corresponding demand reduction goals are presented in the Table below.

Table 3: Level of water shortage, triggering criteria, and demand reduction goals

Stage Level	Stage title	Water shortage condition and triggering criteria	Demand reduction goal	Program type
1	Normal	Abnormally dry, minor shortage: 0-10%	10%	Voluntary
2	Alert	Moderate shortage: 10-25%	25%	Mandatory
3	Warning	Severe drought: 25-35%	35%	Mandatory
4	Critical	Extreme drought: 35-50%	50%	Mandatory
5	Emergency	Exceptional drought: over 50%	Over 50%	Mandatory

A water shortage may trigger any stage of response actions and include best management practices for supply management and demand reduction. The designated official will determine the most appropriate stage to implement based on actual conditions at the time of the event. Successive stages of response actions will be declared only after exhausting efforts to make a prior stage successful.

In some cases it may be necessary for the designated official to immediately implement an advanced stage of the Plan. This may occur due to information that indicates likely increased severity in the drought conditions (e.g. to serve as a preemptive action) or when the health and safety of the community are at an increased risk. The response actions are designed to be flexible so that there is an appropriate response to the specific situation occurring at a particular time. The conditions that may trigger specific stages of the Plan are specified below.

****

Examples of triggering criteria and conditions for each drought level or stage are provided below. One or a combination of such criteria must be defined for each drought stage, but usually not all will apply. It is recommended to review, edit, and modify the list for those triggering criteria that best fit the specific situation and context, and only include those that are necessary. Select only those appropriate to the public water system. The example values in the brackets are reasonable for each drought level/stage; however, they should be reviewed and modified as appropriate.

****

12.1. Stage 1: Minor/abnormally dry conditions (Normal)

The triggering criteria and conditions for this drought level or stage include:

- Annually, beginning on [_____] through [_____] [list duration] [for example: March 1 through November 1].
- State Governor or local authority issues a drought declaration at Level/Stage 1.
- When the water supply available to the public water system is equal to or less than [_____] [list amount] [acre-fee, percentage of storage, etc.].
- When the water supply available to the public water system is reduced by [_____] [list percentage] [10%] of the long-term average.
- Pursuant to requirements specified in the wholesale water purchase contract with [_____] [name of wholesale water supplier], notification is received requesting initiation of a drought stage.

- When flows in the [_____] [list name of stream or river] are equal to or less than [_____] [cubic feet per second].

- When the one-year change in the static water level in the well(s) indicates a downward trend and the change in the depth of static water level exceeds [_____] [indicate depth in feet] [for example: 2 feet].

- When the one-year change in the specific capacity of the well(s), defined as the yield of the well divided by drawdown (expressed in units of gpm/ft), decreases by [_____] [indicate percentage difference] [10%] percent of the original specific capacity of the well(s).

- When total water source yield is unable to meet the water demand averaged over each person at [_____] [indicate volume per person per day] [for example: 200 gallons per person day].

- When total daily water demand equals or exceeds [_____] [indicate volume per day] [for example: 55,000 gallons per day] for [_____] [indicate number of days] [for example, 3] consecutive days based on a safe operating capacity of the water supply facilities.

- A combination of the above mentioned circumstances reduces the public water system's overall water supply or production capabilities by [_____] [list percentage] [10%] or more.

12.2. Stage 2: Moderate conditions (Alert)

The triggering criteria and conditions for this drought level or stage include:

- State Governor or local authority issues a drought declaration at Level/Stage 2.

- When the water supply available to the public water system is equal to or less than [_____] [list amount] [acre-fee, percentage of storage, etc.].

- When the water supply available to the public water system is reduced by [_____] [list percentage] [25%] of the long-term average.

- Pursuant to requirements specified in the wholesale water purchase contract with [_____] [name of wholesale water supplier], notification is received requesting initiation of a drought stage.

- When flows in the [_____] [list name of stream or river] are equal to or less than [_____] [cubic feet per second].

- When the one-year change in the static water level in the well(s) indicates a downward trend and the change in the depth of static water level exceeds [_____] [indicate depth in feet] [for example: 3 feet].

- When the one-year change in the specific capacity of the well(s), defined as the yield of the well divided by drawdown (expressed in units of gpm/ft), decreases by [_____]

[indicate percentage difference] [25%] percent of the original specific capacity of the well(s).

- When total water source yield is unable to meet the water demand averaged over each person at [_____] [indicate volume per person per day] [for example: 100 gallons per person day].

- When total daily water demand equals or exceeds [_____] [indicate volume per day] [for example: 62,500 gallons per day] for [_____] [indicate number of days] [for example, 3] consecutive days based on a safe operating capacity of the water supply facilities.

- A combination of the above mentioned circumstances reduces the public water system's overall water supply or production capabilities by [_____] [list percentage] [25%] or more.

12.3. Stage 3: Severe conditions (Warning)

The triggering criteria and conditions for this drought level or stage include:

- State Governor or local authority issues a drought declaration at Level/Stage 3.

- When the water supply available to the public water system is equal to or less than [_____] [list amount] [acre-fee, percentage of storage, etc.].

- When the water supply available to the public water system is reduced by [_____] [list percentage] [35%] of the long-term average.

- Pursuant to requirements specified in the wholesale water purchase contract with [_____] [name of wholesale water supplier], notification is received requesting initiation of a drought stage.

- When flows in the [_____] [list name of stream or river] are equal to or less than [_____] [cubic feet per second].

- When the one-year change in the static water level in the well(s) indicates a downward trend and the change in the depth of static water level exceeds [_____] [indicate depth in feet] [for example: 5 feet].

- When the one-year change in the specific capacity of the well(s), defined as the yield of the well divided by drawdown (expressed in units of gpm/ft), decreases by [_____] [indicate percentage difference] [35%] percent of the original specific capacity of the well(s).

- When total water source yield is unable to meet the water demand averaged over each person at [_____] [indicate volume per person per day] [for example: 75 gallons per person day].

- When total daily water demand equals or exceeds [_____] [indicate volume per day] [for example: 67,500 gallons per day] for [_____] [indicate number of days] [for example, 3] consecutive days based on a safe operating capacity of the water supply

facilities.

- A combination of the above mentioned circumstances reduces the public water system's overall water supply or production capabilities by [_____] [list percentage] [35%] or more.

12.4. Stage 4: Extreme conditions (Critical)

The triggering criteria and conditions for this drought level or stage include:

- State Governor or local authority issues a drought declaration at Level/Stage 4.

- When the water supply available to the public water system is equal to or less than [_____] [list amount] [acre-fee, percentage of storage, etc.].

- When the water supply available to the public water system is reduced by [_____] [list percentage] [50%] of the long-term average.

- Pursuant to requirements specified in the wholesale water purchase contract with [_____] [name of wholesale water supplier], notification is received requesting initiation of a drought stage.

- When flows in the [_____] [list name of stream or river] are equal to or less than [_____] [cubic feet per second].

- When the one-year change in the static water level in the well(s) indicates a downward trend and the change in the depth of static water level exceeds [_____] [indicate depth in feet] [for example: 10 feet].

- When the one-year change in the specific capacity of the well(s), defined as the yield of the well divided by drawdown (expressed in units of gpm/ft), decreases by [_____] [indicate percentage difference] [50%] percent of the original specific capacity of the well(s).

- When total water source yield is unable to meet the water demand averaged over each person at [_____] [indicate volume per person per day] [for example: 50 gallons per person day].

- When total daily water demand equals or exceeds [_____] [indicate volume per day] [for example: 75,000 gallons per day] for [_____] [indicate number of days] [for example, 3] consecutive days based on a safe operating capacity of the water supply facilities.

- A combination of the above mentioned circumstances reduces the public water system's overall water supply or production capabilities by [_____] [list percentage] [50%] or more.

12.5. Stage 5: Exceptional conditions (Emergency)

The triggering criteria and conditions for this drought level or stage include:

- State Governor or local authority issues a drought declaration at Level/Stage 5.

- When the water supply available to the public water system is equal to or less than [_____] [list amount] [acre-fee, percentage of storage, etc.].

- When the water supply available to the public water system is reduced by [_____] [list percentage] [over 50%] of the long-term average.

- Pursuant to requirements specified in the wholesale water purchase contract with [_____] [name of wholesale water supplier], notification is received requesting initiation of a drought stage.

- When flows in the [_____] [list name of stream or river] are equal to or less than [_____] [cubic feet per second].

- When the one-year change in the static water level in the well(s) indicates a downward trend and the change in the depth of static water level exceeds [_____] [indicate depth in feet] [for example: over 10 feet].

- When the one-year change in the specific capacity of the well(s), defined as the yield of the well divided by drawdown (expressed in units of gpm/ft), decreases by [_____] [indicate percentage difference] [over 50%] percent of the original specific capacity of the well(s).

- When total water source yield is unable to meet the water demand averaged over each person at [_____] [indicate volume per person per day] [for example: 25 gallons per person day].

- When total daily water demand equals or exceeds [_____] [indicate volume per day] [for example: 87,500 gallons per day] for [_____] [indicate number of days] [for example, 3] consecutive days based on a safe operating capacity of the water supply facilities.

- A combination of the above mentioned circumstances reduces the public water system's overall water supply or production capabilities by [_____] [list percentage] [over 50%] or more.

13. Response actions

The Plan provides stages of response actions to manage and mitigate the impacts indicated by each triggering criteria and condition. The response actions provide for a combination of best management practices for both water supply management and reduction in water demand. The response approaches are designed to be flexible so that there is an appropriate action to the specific drought situation occurring at a particular time.

The response actions included in each stage are cumulative, meaning that if Stage 2 is implemented than all of the measures in Stage 1 and 2 shall be implemented. Likewise, if ultimately Stage 5 is implemented, all of the measures in Stages 1, 2, 3, and 4 shall be implemented as well.

A brief description of the response actions for each stage of the Plan are specified below.

****
Examples of response actions for each drought stage are provided below. It is recommended to review, edit, and modify the list of response actions for each stage in order that they best fit the specific situation and context, and only include those that are necessary. Select only those appropriate to the public water system. The example values in the brackets are reasonable for each drought level/stage; however, they should be reviewed and modified as appropriate.
****

13.1. Stage 1 response actions

13.1.1. Target and public message

Target: Achieve a **voluntary** reduction of [_____] [indicate percentage] [10%] of total daily water demand.

Public message: *Due to abnormally dry conditions this winter, we are asking all customers to voluntarily cut back on water use by [10%] in order to stretch the available water supply. The water users should stop using water for non-essential purposes and conserve where possible in case the dry period continues through the year. If everyone cooperates and the water supplies are not impacted anymore, we may avoid more stringent water restrictions. Wasting water hurts everyone.*

13.1.2. Communication, coordination, and planning

Communication, coordination, and planning activities include:

A. Initiate public information outreach campaign to:
   - Prepare and distribute educational information
   - Notify customers of the water shortage, the need to conserve water, and the importance of significant water use reductions
   - Notify customers with large landscapes of irrigation restrictions
   - Provide customers with practical information on ways to improve water use efficiency
   - Implement customer meter reading program
   - Request customers to reduce their water use by the percentage listed above

B. Notify Federal (e.g. FEMA, BOR, BIA, IHS, EPA, etc.), State, and Local (County) entities.

C. Begin initial evaluation of potential temporary and/or long-term needs for infrastructure improvements and funding opportunities.

13.1.3. Supply management best management practices

Best management practices for supply management include:

A. Reduce flushing of water mains.

B. Initiate leak detection and repair program.

C. Develop program for water waste patrols; hire and train staff.

D. Initiate use of reclaimed water for non-potable purposes.

13.1.4. Demand reduction best management practices

Best management practices for demand reduction include:

A. Water customers are requested to voluntarily limit the irrigation of landscaped areas to two days a week. Sundays and Thursdays for customers in service area(s) [_____] [indicate name of service area or sub-community A] [or with a street address ending in an even number (0, 2, 4, 6 or 8)]. Saturdays and Wednesdays for customers in service area(s) [_____] [indicate name of service area or sub-community B] [or with a street address ending in an odd number (1, 3, 5, 7 or 9)]. Irrigate landscapes only between the hours of 12:00 midnight to 10:00 A.M. and 8:00 P.M. to 12:00 midnight on designated watering days.

B. Water customers are requested to practice water conservation and to minimize or discontinue water use for non-essential purposes including:
   1. Willfully or negligently wasting water;
   2. Irrigation or sprinkling systems and devices that are not properly designed, installed, maintained, and operated to prevent wastage of water;
   3. Irrigation or sprinkling of any yard, ground, premise, or vegetation unless the watering device is controlled by an automatic shut-off device, or a person is in immediate attendance of the hose or watering device;
   4. Irrigation or sprinkling of lawns for a period that exceeds 15 minutes per station at one time, or a total of 30 minutes per station during a 24 hour day, if water is applied either through a sprinkler system or through a hose with or without a sprinkler device;
   5. Irrigation or sprinkling of landscape areas, including parks, athletic fields, and golf courses, except otherwise provided under this Plan;
   6. Use of water to wash down any sidewalks, walkways, driveways, parking lots, basketball courts, or other hard-surfaced areas;
   7. Use of water for dust control;
   8. Use of water to wash down buildings or structures for purposes other than immediate fire protection;
   9. Flushing gutters or permitting water to run or accumulate in any gutter or street;
   10. Use of water to fill, refill, or add to any indoor or outdoor swimming pools or Jacuzzi-type pools;
   11. Use of water in a fountain or pond for aesthetic or scenic purposes except where necessary to support aquatic life or where such fountains or ponds are equipped with a recirculation system;
   12. Installing or replacing an air-conditioning systems (including portable systems) without a water conservation device which is properly maintained;
   13. Failure to repair a controllable leak(s) or faulty water fixture(s) within a reasonable period time; and
   14. Use of water from hydrants for construction purposes without a permit or any other purposes other than firefighting.

13.2. Stage 2 response actions

13.2.1. Target and public message

Target: Achieve a **mandatory** reduction of [_____] [indicate percentage] [25%] of total daily

water demand.

Public message: *It is necessary to impose mandatory restrictions on water use to ensure that throughout the duration of this water shortage an adequate supply of water is maintained for public health and safety purposes. Our overall goal is to reduce water use by [25%], which can be achieved if everyone cuts back their outdoor watering and other non-essential uses. We are relying on cooperation and support of all water users to abide by all restrictions and to reach this goal. Otherwise, the shortage could deteriorate into a more serious emergency that requires household water allocations to avoid depleting that available water supply.*

13.2.2. Communication, coordination, and planning

Communication, coordination, and planning activities include:

A. Increase public information outreach campaign to:
   - Notify customers of the mandatory reductions
   - Notify customers of the water shortage, the need to conserve water, and the importance of significant water use reductions
   - Generate publicity about customers demonstrating significant water savings
   - Consult with major customers to develop conservation plans
   - Publicize weekly water consumption graph/data

B. Identify priorities for water supplies.

C. Begin to coordinate with Federal (e.g. FEMA, BOR, BIA, IHS, EPA, etc.), State, and Local (County) entities and in particular the County Office of Emergency Services (OES).

D. Initiate evaluation and plan for potential temporary and/or long-term needs for infrastructure improvements and funding opportunities (e.g. FEMA, BOR, BIA, IHS, EPA, USDA/RD, State, etc.).

E. Develop strategy to mitigate revenue losses.

13.2.3. Supply management best management practices

Best management practices for supply management include:

A. Discontinue flushing of water mains; for emergency purposes only.

B. Intensify leak detection and repair program.

C. Intensify program for water waste patrols.

D. Use of reclaimed water for non-potable purposes.

E. Plan for use of an alternative water source(s).

13.2.4. Demand reduction best management practices

Best management practices for demand reduction include:

A. Water customers are required to limit the irrigation of landscaped areas to two days a week. Sundays and Thursdays for customers in service area(s) [_____] [indicate

name of service area or sub-community A] [or with a street address ending in an even number (0, 2, 4, 6 or 8)]. Saturdays and Wednesdays for customers in service area(s) [_____] [indicate name of service area or sub-community B] [or with a street address ending in an odd number (1, 3, 5, 7 or 9)]. Irrigate landscapes with hose-end sprinklers or automatic irrigation systems, and only between the hours of 12:00 midnight to 10:00 A.M. and 8:00 P.M. to 12:00 midnight on designated watering days.

B. Use of water to wash any motor vehicle, motorbike, boat, trailer, or other vehicle is prohibited except on designated watering days between the hours of 12:00 midnight and 10:00 A.M. and between 8:00 P.M. and 12:00 midnight. Such washing, when allowed, shall be done with a hand-held bucket or a hand-held hose equipped with a positive shutoff nozzle for quick rinses. Vehicle washing may be done at any time on the immediate premises of a commercial car wash or commercial service station. Further, such washing may be exempted from these regulations if the health, safety, and welfare of the public are contingent upon frequent vehicle cleansing, such as garbage trucks and vehicles used to transport food and perishables.

C. Use of water from hydrants shall be limited to firefighting related activities, or other activities necessary to maintain public health, safety, and welfare, except that use of water from designated fire hydrants for construction purposes may be allowed under special permit from the public water system.

D. All restaurants are prohibited from serving water to patrons except upon request of the patron.

E. Water customers are mandated to practice water conservation and to minimize or discontinue water use for non-essential purposes. Prohibitions include:
   1. Willfully or negligently wasting water;
   2. Irrigation or sprinkling systems and devices that are not properly designed, installed, maintained, and operated to prevent wastage of water;
   3. Irrigation or sprinkling of any yard, ground, premise, or vegetation unless the watering device is controlled by an automatic shut-off device, or a person is in immediate attendance of the hose or watering device;
   4. Irrigation or sprinkling of lawns for a period that exceeds 15 minutes per station at one time, or a total of 30 minutes per station during a 24 hour day, if water is applied either through a sprinkler system or through a hose with or without a sprinkler device;
   5. Irrigation or sprinkling of landscape areas, including parks, athletic fields, and golf courses, except otherwise provided under this Plan;
   6. Use of water to wash down any sidewalks, walkways, driveways, parking lots, basketball courts, or other hard-surfaced areas;
   7. Use of water for dust control;
   8. Use of water to wash down buildings or structures for purposes other than immediate fire protection;
   9. Flushing gutters or permitting water to run or accumulate in any gutter or street;
   10. Use of water to fill, refill, or add to any indoor or outdoor swimming pools or Jacuzzi-type pools;
   11. Use of water in a fountain or pond for aesthetic or scenic purposes except where necessary to support aquatic life or where such fountains or ponds are equipped with a recirculation system;
   12. Installing or replacing an air-conditioning systems (including portable systems)

without a water conservation device which is properly maintained;
13. Failure to repair a controllable leak(s) or faulty water fixture(s) within a reasonable period time; and
14. Use of water from hydrants for construction purposes without a permit or any other purposes other than firefighting.

13.3. Stage 3 response actions

13.3.1. Target and public message

Target: Achieve a **mandatory** reduction of [_____] [indicate percentage] [35%] of total daily water demand.

Public message: *The Tribe faces a serious water shortage emergency due to prolonged drought. To conserve the available water supply for the greatest public benefit while minimizing impacts on our local economy, it has become necessary to institute a water allocation program for all residential customers. Our goal is to reduce system water demand by [35%]. While water allocation amounts are adequate for normal domestic needs, significant cuts to outdoor water use may be necessary to remain within set allocations. All customers are urgently asked to make every effort to conserve water and abide by watering restrictions or face further reductions in water allotments.*

13.3.2. Communication, coordination, and planning

Communication, coordination, and planning activities include:

A. Intensify and expand public information outreach campaign to:
   - Notify customers of the water use allocations
   - Inform customers of ban on open burning
   - Expand and strengthen water conservation education, activities, and programs

B. Identify priorities for water supplies.

C. Coordinate with Federal, State, and Local (County) entities, and in particular, the County Office of Emergency Services (OES), and any mutual aid assistance.

D. Coordinate with local health directors to assess public health treats and take appropriate actions.

E. Provide regular situational reports to Federal entities and County OES.

F. Deploy temporary and/or long-term infrastructure improvements for water supply augmentation such as emergency interconnection, rehabilitation of existing water wells, construction of new water wells, re-confirm arrangements for water hauling etc.

G. Invoke ban on open burning.

H. Increase customer service training for staff.

I. Review and adopt enforcement rates and appeals board to process requests for exceptions.

13.3.3. Supply management best management practices

Best management practices for supply management include:

A. Discontinue flushing of water mains; for emergency purposes only.

B. Intensify leak detection and repair program.

C. Intensify and expand program for water waste patrols; e.g. increase staff.

D. Use of reclaimed water for non-potable purposes.

E. Use of an alternative water source(s).

13.3.4. Demand reduction best management practices

Best management practices for demand reduction include:

A. Implement Stage 3 water consumption allocations for all customers (see Table 4).

B. Water customers are required to limit the irrigation of landscaped areas to one day a week. Sundays for customers in service area(s) [_____] [indicate name of service area or sub-community A] [or with a street address ending in an even number (0, 2, 4, 6 or 8)]. Saturdays for customers in service area(s) [_____] [indicate name of service area or sub-community B] [or with a street address ending in an odd number (1, 3, 5, 7 or 9)]. Irrigate landscapes with hand-held hoses, hand-held buckets, drip irrigation, or permanently installed automatic sprinkler system only. The use of hose-end sprinklers is prohibited at all times. Irrigation is limited to the hours of 12:00 midnight and 10:00 A.M. and between 8 P.M. and 12:00 midnight only.

C. Use of water to wash any motor vehicle, motorbike, boat, trailer, or other vehicle is prohibited.

D. The watering of golf course tees is prohibited unless the golf course utilizes a water source other than that provided by the public water system.

E. The use of water for construction purposes from designated fire hydrants under special permit is to be discontinued.

13.4. Stage 4 response actions

13.4.1. Target and public message

Target: Achieve a **mandatory** reduction of [_____] [indicate percentage] [50%] of total daily water demand.

Public message: *Due to continuing deterioration and scarcity of the available water supply, all customers are subject to reduced water allocations. The current water shortage has become very severe. We must all continue to conserve water to the maximum extent possible and strive to maintain water use within our established water allocation limits as long as the drought endures in order to prevent a water crisis.*

13.4.2. Communication, coordination, and planning

Communication, coordination, and planning activities include:

A. Continue to intensify public information outreach campaign to:
   - Notify customers of the water use allocations
   - Publicize daily water consumption graph/data
   - Open a centralized drought public outreach position for issues on conservation, water use allocations, etc.
   - Set-up and/or confirm emergency notification lists for high priority water users including health clinics, schools, stores and restaurants, and other large or critical users

B. Identify priorities for water supplies.

C. Coordinate with Federal, State, and Local (County) entities, and in particular, the County Office of Emergency Services (OES), and any mutual aid assistance.

D. Coordinate with local health directors to assess public health treats and take appropriate actions.

E. Provide regular situational reports to Federal entities and County OES.

F. Continue use of water supply augmentation measures such as emergency interconnection, use of existing water wells, use of new water wells, water hauling etc.

G. Continue ban on open burning.

H. Plan with local partners for potential movement of vulnerable populations out of areas with limited or no water supply.

13.4.3. Supply management best management practices

Best management practices for supply management include:

A. Discontinue flushing of water mains; for emergency purposes only.

B. Intensify leak detection and repair program.

C. Intensify program for water waste patrols and consider expansion to 24/7 with additional staff if necessary.

D. Use of reclaimed water for non-potable purposes.

E. Use of an alternative water source(s).

13.4.4. Demand reduction best management practices

Best management practices for demand reduction include:

A. Implement Stage 4 water consumption allocations for all customers (see Table 4).

B. Irrigation of landscaped areas is prohibited.

C. Use of water to wash any motor vehicle, motorbike, boat, trailer, or other vehicle is prohibited.

D. The watering of golf course tees is prohibited.

E. No application for new, additional, expanded, or increased-in-size water service connections, meters, service lines, pipeline extensions, mains, or water service facilities of any kind shall be approved, and time limits for approval of such applications are hereby suspended for such time as the drought response stage.

13.5. Stage 5 response actions

13.5.1. Target and public message

Target: Achieve a **mandatory** reduction of [_____] [indicate percentage] [over 50%] of total daily water demand.

Public message: *The Tribe is confronted with a critical water shortage emergency of unprecedented proportions. At this time, there exists barely enough drinking water for the most essential human health, sanitation, and safety needs. As a result, all outdoor water use is prohibited. We understand the hardship this extraordinary condition poses to every customer, and we appreciate the sacrifices people are making to ensure that water system does not run dry. Everyone is urgently requested to do whatever necessary to maintain water use within or below their allotted amount.*

13.5.2. Communication, coordination, and planning

Communication, coordination, and planning activities include:

A. Continue to intensify public information outreach campaign to:
- Notify customers of the water use allocations
- Notify customers of public water points; e.g. for bottled water or portable water storage tanks
- Notify vulnerable populations of potential movement/relocations

B. Identify priorities for water supplies.

C. Coordinate with Federal, State, and Local (County) entities, and in particular, the County Office of Emergency Services (OES), and any mutual aid assistance.

D. Coordinate with local health directors to monitor and assess public health treats and take appropriate actions.

E. Provide regular situational reports to Federal entities and County OES.

F. Continue use of water supply augmentation measures such as emergency interconnection, use of existing water wells, use of new water wells, water hauling etc.

G. Continue ban on open burning.

H. Plan with local partners for monitoring and potential movement of vulnerable populations out of areas with limited or no water supply.

13.5.3. Supply management best management practices

Best management practices for supply management include:

A. Discontinue flushing of water mains; for emergency purposes only.

B. Intensify leak detection and repair program.

C. Intensify program for water waste patrols.

D. Use of reclaimed water for non-potable purposes.

E. Use of an alternative water source(s).

13.5.4. Demand reduction best management practices

Best management practices for demand reduction include:

A. Implement Stage 5 water consumption allocations for all customers (see Table 4).

B. Water use reduced to health and safety needs only. All other uses are prohibited.

14. Water use allocations

14.1. General

In the event that water shortage conditions threaten public health, safety, and welfare, the designated official is authorized to allocate water according to the following water allocation plan in the Table listed below.

Table 4: Stage water use allocations

Customer/connection type	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Residential	Normal or 200 gpcd	Normal or 100 gpcd	75 gpcd	50 gpcd	25 gpcd
Commercial/institutional	Normal	90% of average	85% of average	65% of average	50% of average
Landscape irrigation	Normal	90% of average	50% of average	0% of average	0% of average

Note: gallons per capita per day is gpcd

The residential water use allocations are based on water use priorities for health and safety and were calculated based on minimum domestic uses including drinking, cooking, personal washing, sanitation, and washing clothes. In addition, these water uses have been compared to actual data, in particular during the wintertime period. The Table below provides a more detailed presentation of the basis for the residential water uses and requirements for Stage 4, 5, and rationing water allocations.

Table 5: Stage 4, 5, and rationing residential water use allocations requirements

Residential water uses	Stage 4 requirements (gpcd)	Stage 5 requirements (gpcd)	Rationing requirements (gpcd)
Drinking	2.5	2.5	2.5
Cooking	5.0	2.5	2.0
Personal washing	15.0	12.5	7.5
Sanitation	5.0	2.5	1.5
Washing clothes	2.5	2.5	1.5
Cleaning home	5.0	2.5	0
Growing food/garden	15.0	0	0
Total	50	25	15

Residential customers may have some livestock, and will be entitled to an allocation to meet the needs of the animals. Residential customers with livestock should follow water conservation practices including repairing leaks, dripping faucets, practice of filling water tubs and tanks, and cleaning floors and equipment. The Table below provides a list of daily water needs of some common animals.

Table 6: Water needs for farm animals

Type of animal	Daily water requirements (gallons per day)
Horse	12
Cow	20-45
Beef animal	8-12
Swine/pig	3-5
Sheep/goats	2-4
Poultry/fowl (per 100)	8-15

14.2. Residential customer single-family

The allocation to residential water customers residing in a single-family dwelling shall be based on the persons per household at the level given in Table 4. A “household” means the residential premises served by the customer’s water service line and/or water meter. Persons per household include only those persons currently physically residing at the premises and expected to reside there for the entire billing period. It shall be assumed that a particular customer’s household is comprised of two (2) persons unless the customer notifies the designated official of a greater number of persons per household.

It shall be the customer’s responsibility to go to the office of the designated official to complete and sign the necessary form claiming more than two (2) persons per household. New customers may claim more persons per household at the time of applying for water service on the form prescribed by the designated official. When the number of persons per household increases so as to place the customer in a different allocation category, the customer may notify the designated official and the change will be implemented in the next practicable billing period. If the number of persons in a household is reduced, the customer shall notify the designated official in writing within two (2) days. In prescribing the method for claiming more than two (2) persons per household, the designated official shall adopt methods to insure the accuracy of the claim. Any person who knowingly, recklessly, or with negligence falsely reports the number of

persons in a household or fails to timely notify the designated official of a reduction in the number of person in a household shall be fined not less than [_____] [indicate amount] [$50].

****
Example surcharges for metered customers. Review and modify as appropriate.
****

Residential water customers shall pay the following surcharges:

- For the first 1,000 gallons over allocation: [_____] [indicate amount] [$5].
- For the second 1,000 gallons over allocation: [_____] [indicate amount] [$10].
- For the third 1,000 gallons over allocation: [_____] [indicate amount] [$15].
- For each additional 1,000 gallons over allocation: [_____] [indicate amount] [$5].

Surcharges shall be cumulative.

14.3. Residential customer master-metered multi-family

The allocation to a customer billed from a master meter which jointly measures water to multiple permanent residential dwelling units (e.g. apartments, mobile homes) shall be allocated based on [_____] [indicate number of persons] [2] persons in each dwelling unit per month. It shall be assumed that such a customer's meter serves two dwelling units unless the customer notifies the designated official of a greater number on a form prescribed by the designated official. It shall be the customer's responsibility to go to the office of the designated official to complete and sign the form claiming more than [_____] [indicate number of dwellings] [2] dwellings. A dwelling unit may be claimed under this provision whether it is occupied or not. New customers may claim more dwelling units at the time of applying for water service on the form prescribed by the designated official. If the number of dwelling units served by a master meter is reduced, the customer shall notify the designated official in writing within two (2) days. In prescribing the method for claiming more than [_____] [indicate number of dwellings] [2] dwelling units, the designated official shall adopt methods to insure the accuracy of the claim. Any person who knowingly, recklessly, or with negligence falsely reports the number of dwelling units served by a master meter or fails to timely notify the designated official of a reduction in the number of person in a household shall be fined not less than [_____] [indicate amount] [$50].

****
Example surcharges for metered customers. Review and modify as appropriate.
****

Customers billed from a master meter under this provision shall pay the following monthly surcharges:

- For 1,000 gallons over allocation up through 1,000 gallons for each dwelling unit: [_____] [indicate amount] [$5].
- Thereafter, for each additional 1,000 gallons over allocation up through a second 1,000 gallons for each dwelling unit: [_____] [indicate amount] [$10].
- Thereafter, for each additional 1,000 gallons over allocation up through a third 1,000 gallons for each dwelling unit: [_____] [indicate amount] [$15].
- Thereafter for each additional 1,000 gallons over allocation: [_____] [indicate amount] [$5].

Surcharges shall be cumulative.

14.4. Commercial customers

A monthly water allocation shall be established by the designated official, or his/her designee, for each non-residential commercial customer. The non-residential customer's allocation shall be based on Table 4, and the customer's usage for corresponding month's billing period for the previous 12 months. If the customer's billing history is shorter than 12 months, the monthly average for the period for which there is a record shall be used for any monthly period for which no history exists.

The designated official shall give his/her best effort to see that notice of each non-residential customer's allocation is mailed to such customer. If, however, a customer does not receive such notice, it shall be the customer's responsibility to contact the designated official to determine the allocation. Upon request of the customer or at the initiative of the designated official, the allocation may be reduced or increased if, (1) the designated period does not accurately reflect the customer's normal water usage, (2) one non-residential customer agrees to transfer part of its allocation to another non-residential customer, or (3) other objective evidence demonstrates that the designated allocation is inaccurate under present conditions. A customer may appeal an allocation to the designated official.

****
Example surcharges for metered customers. Review and modify as appropriate.
****

Non-residential commercial customers shall pay the following surcharges:

Customers whose allocation is [_____] [indicate number of gallons] [10,000] or less per month:

- For the first 1,000 gallons over allocation: [_____] [indicate amount] [$20] per thousand gallons
- For the second 1,000 gallons over allocation: [_____] [indicate amount] [$30] per thousand gallons
- For the third 1,000 gallons over allocation: [_____] [indicate amount] [$40] per thousand gallons
- For each additional 1,000 gallons over allocation: [_____] [indicate amount] [$20] per thousand gallons

Customers whose allocation is [_____] [indicate number of gallons] [10,000] or more per month:

- For the first 1,000 gallons over allocation: [_____] [indicate amount] [$40] per thousand gallons
- For the second 1,000 gallons over allocation: [_____] [indicate amount] [$60] per thousand gallons
- For the third 1,000 gallons over allocation: [_____] [indicate amount] [$80] per thousand gallons
- For each additional 1,000 gallons over allocation: [_____] [indicate amount] [$40] per thousand gallons

The surcharges shall be cumulative.

15. Enforcement

This Plan is designed to place the responsibility for managing the water resources during a water shortage emergency on the entire community. Care has been taken in the design of the Plan not to penalize any customer who has undertaken good-faith and diligent measures to conserve water. However, for the protection of the water resources and ability to provide sufficient water for public health and safety priorities, enforcement and penalties are required for those customers who knowingly or intentionally use water in a manner contrary to the Plan.

Enforcement provisions include the following:

A. No person shall knowingly or intentionally allow the use of water from the public water system for any purpose in a manner contrary to any provision of this Plan, or in an amount in excess of that permitted by the drought response stage in effect at the time pursuant to action taken by the designated official in accordance with provisions of this Plan.

B. Any person who violates this Plan shall be fined:
    1. For the first incident, the fee shall be deferred for customers who attend a course in water conservation. The deferral shall be conditioned upon the customer's successful completion of a water conservation course provided by the authorized designated official and the customer not having an additional incident of water wastage within a one-year period. The deferred fee shall be collected if a second incident of water wastage occurs within a one-year period.

    2. For the second incident, the fee shall be not less than [_____] [indicate amount] [$50]. Each day that one or more of the provisions in this Plan is violated shall constitute a separate offense.

    3. If a person is convicted of a third incident or more distinct violations of this Plan within a one-year period, the designated official shall, upon due notice to the customer, be authorized to:
        i. Require the customer to repair any defects in the water system of such customer within 14 days of notice;

        ii. Installation by the designated official of flow restrictors or termination of water service for exterior use;

        iii. Termination of all water service to a customer unless in the opinion of the designated official such termination would result in an unreasonable risk to the health and safety of the persons;

        iv. Services discontinued under such circumstances shall be restored only upon payment of a re-connection charge, hereby established at [_____] [indicate amount] [$50], and any other costs incurred by the public water system in discontinuing service. In addition, suitable assurance must be given to the designated official that the same action shall not be repeated while the Plan is in effect. Compliance with this plan may also be sought through injunctive relief in the [_____] [indicate

tribal entity] [tribal council, tribal court, etc.].

v. Compliance with this plan may also be sought through injunctive relief in the [_____] [indicate tribal entity] [tribal council, tribal court, etc.].

C. Any person, including a person classified as a water customer of the public water system, in apparent control of the property where a violation occurs or originates shall be presumed to be the violator, and proof that the violation occurred on the person's property shall constitute a rebuttable presumption that the person in apparent control of the property committed the violation, but any such person shall have the right to show that he/she did not commit the violation. Parents shall be presumed to be responsible for violations of their minor children and proof that a violation, committed by a child, occurred on property within the parents' control shall constitute a rebuttable presumption that the parent committed the violation, but any such parent may be excused if he/she proves that he/she had previously directed the child not to use the water as it was used in violation of this Plan and that the parent could not have reasonably known of the violation.

D. Any employee of the public water system, police officer, or other designated official, may issue a citation to a person he/she reasonably believes to be in violation of this Plan. Service of the citation shall be complete upon delivery of the citation to the alleged violator, to an agent or employee of a violator, or to a person over 14 years of age who is a member of the violator's immediate family or is a resident of the violator's residence.

****

Consider adding for systems with no or limited residential water meters. Modify as appropriate to the customers metered and billing structure.

****

E. Because there are currently no and/or a limited number of single-family residential customers with a meter and are billed for water use based on a monthly flat rate, no penalties can be assessed for excessive water use based on a metered volume of water. However, enforcement of violations of the Plan will be made based on other factors including visual observations of irrigation practices, water used for washing vehicles, dust control, and other acts of negligently wasting water.

16. Variances

The designated official may in writing grant temporary variance for existing water uses otherwise prohibited under this Plan if it is determined that failure to grant such variance would cause an emergency condition adversely affecting the health, sanitation, or fire protection for the public or the person requesting such variance and if one or more of the following conditions are met:

- Compliance with this Plan cannot be technically accomplished during the duration of the water supply shortage or other condition for which the Plan is in effect, and
- Alternative methods can be implemented which will achieve the same level of reduction in water use.

Persons requesting an exemption from the provisions of this Plan shall file a petition for variance with the public water system within 5 days after the Plan or a particular drought

response stage has been invoked. All petitions for variances shall be reviewed by the designated official and shall include the following:

A. Name and address of the petitioner(s).
B. Purpose of water use.
C. Specific provision(s) of the Plan from which the petitioner is requesting relief.
D. Detailed statement as to how the specific provision of the Plan adversely affects the petitioner or what damage or harm will occur to the petitioner or others if petitioner complies with this Plan.
E. Description of the relief requested.
F. Period of time for which the variance is sought.
G. Alternative water use restrictions or other measures the petitioner is taking or proposes to take to meet the intent of this Plan and the compliance date.
H. Other pertinent information.

Variances granted by the public water system shall be subject to the following conditions, unless waived or modified by the designated official:

- Variances granted shall include a timetable for compliance.
- Variances granted shall expire when the Plan is no longer in effect, unless the petitioner has failed to meet specified requirements.

No variance shall be retroactive or otherwise justify any violation of this Plan occurring prior to the issuance of the variance.

17. Revenue and expenditure analysis

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An example of a revenue and expenditure analysis as a result of the response actions is provided below. It is recommended to review, edit, and modify in order that it best fits the specific situation and context.

****

17.1. Potential revenue impacts

The public water system's revenues from water use charges are derived from customers and uses including [_____] [description of the customers and water demand uses] [residential] [non-residential including commercial, schools, tribal offices, health clinics] [irrigation]. Water service to the customers is [not] billed and is [not] based on [_____] [description of the rate structure] [metered rate] [flat rate] [no charge]. Therefore, as customer water use decreases based on the mandatory restrictions and water allocations, the revenue would [_____] [description of the impact to the revenue as the customers use less water] [decrease] [remain the same with limited change].

[In the future, all customers will be metered and billed based on a metered usage rate. As the transition occurs, the public water system may become potentially more vulnerable to revenue impacts during periods when water use is reduced.]

17.2. Potential expenditure impacts

During a water shortage and activation of this Plan, the expenditures for water-related services may be impacted. Expenditures may increase based on numerous factors including:

- Increased water conservation program costs to implement, monitor, and enforce new or more intensive activities.
- Increased staffing costs for operation and maintenance of facilities to ensure efficient operation of available facilities
- Increased costs for acquisition of alternative water supplies and associated facilities including [_____] [description of the additional costs for alternative water supplies] [interconnection use agreements] [purchase of additional water] [water hauling services].
- Increased costs for groundwater pumping, if additional groundwater pumping is needed to compensate for decreased surface water supplies or if more energy is required because of increased pumping lifts associated with decreasing groundwater levels.

With assumed increases in certain expenditures, overall water expenditures may increase during the various stages of the Plan. These increases in expenditures, coupled with reductions in revenue [for metered rate customers], could potentially impact the public water system's budget and financial status.

17.3. Proposed measures to overcome revenue and expenditure impacts

Measures that may be implemented to overcome revenue and expenditure impacts include:

- Water rate increases; and
- Development and use of reserve funds.

18. Mechanism for determining actual water use reductions

The system's water production from [_____] [description of the water source(s)] [ground water wells] [surface water] is continuously monitored by [_____] [description of the system to measure water production] [totalizing flow meter] [SCADA system].

During Stage 1 or Stage 2, daily water production figures will be reported to the designated official. The designated official will then compare the weekly production to the target weekly production and verify that the reduction goal is being achieved. Weekly reports would then be forwarded to the Drought Task Force and [_____] [name of tribal office or official] [Tribal council] [Tribal administrator]. If the reduction goals are not met, the designated official will notify the Drought Task Force and consider potential corrective actions; e.g. implementation of additional water use restrictions.

During Stage 3 or Stage 4, the procedure would remain the same, with the addition of a daily report being provided to the Drought Task Force and other required Tribal entities.

During Stage 5, the procedure would remain the same, with the addition of an hourly or on-demand report being provided to the Drought Task Force and other required Tribal entities.

19. Drought scenario

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An example drought scenario is provided below. It is recommended to review, edit, and modify the list of conditions and response actions in order that they best fit the specific situation and context, and only include those that are necessary. Select only those appropriate to the public water system.

****

For contingency planning purposes, the drought scenario and assumptions include the following:

A. Drought conditions with below-normal precipitation and snowpack levels have adversely impacted water sources.

B. Drought conditions progress from abnormally dry to [_____] [list anticipated drought conditions will reach] [moderate] [severe] [extreme] [exceptional/emergency] conditions through the year with severity increasing into fall (September/October).

C. Water source(s) capacity reduced by [_____] [list anticipated reduction in capacity] [minimal impact at up to 10%][moderate impact at 10 to 25%] [severe impact at 25 to 35%] [critical impact at 35 to 50%] [exceptional/emergency impact at over 50%].

D. Anticipated available water source(s) capacity after reductions from drought will be [_____] [list anticipated remaining water source capacity after reduction from drought] [for example: 10,000 gpd].

E. During the peak drought conditions, the anticipated water demand level and corresponding water use allocation will be at [_____] [list the anticipated water demand reduction/allocation level/stage] [level 1] [level 2] [level 3] [level 4] [level 5].

F. Based on the anticipated drought level, the total water demand, including anticipated water use reductions, will be [_____] [list the anticipated water demand including any water reductions from allocations and conservation] [for example: 20,000 gpd].

G. Existing alternative water source(s) include [_____] [description of the existing alternative water sources] [back-up wells] [irrigation wells] [spring sources] [system intertie with local water district] [agreement for imported water]. [Include in the Appendix specific information on the existing alternative water sources including location, capacity, water quality, agreements, etc.].

H. New feasible alternative water sources that could be completed within a reasonable timeframe include [_____] [description of the new feasible alternative water sources] [back-up wells] [irrigation wells] [spring sources] [system intertie with local water district] [agreement for imported water]. [Include in the Appendix specific information on the proposed new alternative water sources including location, conceptual design, cost estimate, capacity, water quality, agreements, permits, etc.].

I. Likelihood of alternative water sources (existing and/or new, if any), in combination with current water supply reduced by the drought, could fully meet the anticipated water demand is [_____] [list anticipated likelihood of total water sources being able to meet demand during the drought] [likely] [unlikely].

J. Duration of reduced water supply is anticipated to be [_____] [list anticipated duration] [14 days] [30 days] [45 days] [60 days] [90 days].

K. [_____] [list other specific site conditions, context, or assumptions for the scenario].

APPENDIX:

Example Resolution forming a Drought Task Force

Example Resolution adopting a Drought Contingency Plan

Other possible items to include:

A. Information on water sources; e.g. well logs, test pumps, river flows
B. Information on water sources; e.g. historic water use demands, pumphouse meter readings
C. List of high priority customer contacts for emergency notification including health clinics, schools, stores and restaurants, and other large or critical users
D. List of important contacts for tribal offices
E. List of important contacts for Federal, State, and Local (County) entities, and in particular, the County Office of Emergency Services (OES)
F. Example monthly water supply and water demand monitoring report
G. Copies of water agreements with vendors for hauling
H. Copies of water agreements with utilities for interconnections
I. Conceptual design/cost estimate for alternative water sources
J. Copies of applicable tribal ordinances and laws

[_____] [name of Tribe/Band]

EXAMPLE RESOLUTION FOR FORMING A DROUGHT TASK FORCE

Resolution No. [_____]
Date [_____]

WHEREAS, the [_____] [name of Tribe/Band] is a federally recognized Tribe governing itself according to a Constitution and By-laws; and

WHEREAS, the [_____] [name of Tribe/Band] is experiencing drought conditions along with other areas of the State of California; and

WHEREAS, the [_____] [name of Tribe/Band] recognizes that the amount of water available to the public water systems and its water customers is limited and subject to depletion during periods of extended drought; and

WHEREAS, the [_____] [name of Tribe/Band] desires to develop a Drought Contingency Plan in partnership with other federal and local agencies; and

WHEREAS, a critical part of managing and mitigating the impacts of a drought are initial contingency planning and to have competent staff identified that are assigned to work on this important issue; and

THEREFORE BE IT RESOLVED, that [_____] [name of Tribe/Band] desires to create the Drought Task Force, a subcommittee of the [_____] [name of tribal entity] [Tribal Water Board], that will be comprised of staff from [_____] [name of tribal office or official] [Tribal administrator] [Tribal water/utility department] [Tribal environmental department] [Local tribal housing department entity] [Local fire chief] [Local police chief] [Critical water users, e.g. health clinics, schools], and staff deemed necessary to carry out the duties to develop a Drought Contingency Plan; and

BE IT FURTHER RESOLVED, that the Drought Task Force will report to the [_____] [name of tribal entity] [Tribal Water Board], and the will keep the Tribal Council informed of the current drought conditions; and

BE IT FURTHER RESOLVED, that Drought Contingency Plan developed and recommended by the Drought Task Force will be presented to the Tribal Council for review and approval.

CERTIFICATION

This is to certify that the above resolution was duly adopted at a Tribal Council meeting of the [_____] [name of Tribe/Band] on [_____] [date], and will be ratified at the next General Council Meeting. The Resolution was adopted by a vote of: [_____] [names of Tribal Council members]

[_____] [name of Tribe/Band]

EXAMPLE RESOLUTION FOR ADOPTION OF A DROUGHT CONTINGENCY PLAN

Resolution No. [_____]
Date [_____]

WHEREAS, the [_____] [name of Tribe/Band] is a federally recognized Tribe governing itself according to a Constitution and By-laws; and

WHEREAS, the [_____] [name of Tribe/Band] is experiencing drought conditions along with other areas of the State of California; and

WHEREAS, the [_____] [name of Tribe/Band] recognizes that the amount of water available to the public water systems and its water customers is limited and subject to depletion during periods of extended drought; and

WHEREAS, the Drought Task Force has developed a Drought Contingency Plan; and

WHEREAS, as authorized under the Constitution and By-laws, and in the best interests of the Tribal members and all water system customers, the [_____] [name of Tribe/Band deems it expedient and necessary to establish certain rules and policies for the orderly and efficient management of limited water supplies during drought emergencies;

THEREFORE BE IT RESOLVED, that the Drought Contingency Plan attached hereto as Exhibit "A" and made part hereof for all purposes be, and the same is hereby, adopted as the official policy of the [_____] [name of Tribe/Band]; and

BE IT FURTHER RESOLVED, that [_____] [indicate title of designated official] [tribal administrator] [tribal public works director] [tribal utility authority director] is hereby directed to implement, administer, and enforce the Drought Contingency Plan; and

BE IT FURTHER RESOLVED, that the Drought Task Force consisting of its current membership, and other staff deemed necessary to carry out the duties detailed in the Drought Contingency Plan, shall remain in effect to assist and support the implementation of the Drought Contingency Plan; and

BE IT FURTHER RESOLVED, that the Drought Task Force will report to the [_____] [name of tribal entity] [Tribal Water Board], and the [_____] [indicate title of designated official] will keep the Tribal Council informed of the current drought conditions.

CERTIFICATION

This is to certify that the above resolution was duly adopted at a Tribal Council meeting of the [_____] [name of Tribe/Band] on [_____] [date], and will be ratified at the next General Council Meeting. The Resolution was adopted by a vote of: [_____] [names of Tribal Council members]

Appendix 8
General Funding and Financing Issues

Prepared for
County *Drought* Advisory Group process
as partial fulfillment of Assembly Bill 1668

By
California Department of Water Resources

California Department of Water Resources
Water Use Efficiency Branch
March 2020

Appendix 8. General Funding and Financing Issues

Feedback from CDAG made it clear that funding and financing is key for small water system and rural community water shortage contingency planning. The funding issues are not specific to this project but were raised by CDAG:

- The state should establish a transparent process for prioritizing, allocating and coordinating state drought relief funding.
- The state should provide block grants so that multiple systems with similar needs can collaborate to complete a single application.
- The state should provide incentives to urban water systems to assist small water systems to support implementation of the human right to water
- The state should provide additional technical and financial assistance for systems to conduct a feasibility analysis related to consolidation when applying for funding. The state should implement an advanced funding regime such as the Advanced Payment of Grant Funds applicable currently to IRWM projects (California Water Code Chapter 7, Section 10551).
- For small water systems between 15 and 200 service connections, , the state should reimburse for interest and loan fees related to gap, or bridge, financing for cash flow purposes during capital construction projects. The issue that comes up is that state payments can take two to three months to arrive, putting the small water system/district/grantee in a position of being 60 or more days late paying invoices, no matter how diligent they are about preparing claims for reimbursement and getting the funds out the door once received. So, they go get a revolving cash flow loan (bridge loan) to keep the money flowing. It's a common practice. Loans don't come for free, though, so loan origination fees and interest are charged. Most funding programs have been declining to cover this expense (especially bond-funded programs).
- For small water systems between 15 and 200 connections, where debt burden is a contributing factor to unaffordable water rates, the state should consider using available funding to refinance or forgive existing debt (state, federal or private) that was incurred for purposes that correspond to current funding eligibility guidelines. Long-term debt (thirty to forty years) can carry interest rates that are quite high in comparison to today's rates. In small water systems where the debt burden is spread over so few customers, decades-old debt can be the factor preventing the water system from providing safe water at affordable rates. When financial review reveals that a small water system's financial solvency is inhibited by old, expensive debt (or, perhaps by debt incurred in desperation, in response to an emergency), the simplest (and quite

possibly the cheapest) way to resolve their affordability problems may simply be to erase the problematic debt.

- The state should continue to offer principal forgiveness as a financing option for small, severely disadvantaged communities and expand principal forgiveness as a financing option for small disadvantaged communities. The current SWRCB Intended Use Plan, which is subject to revision every year, provides for 100% grant/principal forgiveness for small severely disadvantaged communities in any case, and for small disadvantaged communities (DACs) who pay more than 1.5% of their median household income to water rates. This is a generous funding plan but the concern is that small DACs might be forced to raise their rates for no other reason than to access state grant/principal forgiveness funds while under Proposition 218, water systems cannot charge more than it costs them to deliver the service.
- The state should pre-approve work plans for small systems to ensure that funding can be disbursed quickly
- State funding should be tailored, streamlined and expedited for small agencies. A significant amount of funding designated to support small water systems, but these systems often do not have the capacity to go through the funding process.
- The state should fully fund a technical assistance program focused on ensuring equitable implementation of these recommendations for small water suppliers in disadvantaged communities.
- When providing funding to urban water systems, the state should include incentives to assist small water systems to support implementation of the human right to water.
- The state should promote creation of a bridge for urban water systems to help small water systems access further funding. The State should develop and maintain a list of large water systems and professionals who would voluntarily be willing to provide operational and technical assistance. Consideration should be given to give continuing education units for water operators for help such as for developing plans or increasing operational knowledge.
- The state should incorporate CDAG funding recommendations into the Resiliency Portfolio, authorized through Governor's Executive Order N-10-19.
- The state should identify funding mechanisms for the SSWSs, which can be a challenging issue for those water systems that are privately-owned.
- The state should make funding applications consistent across agencies, especially with regards to requirements for technical reports, income surveys, etc.
- Counties should work with IRWM groups to secure funding from State and federal government for rural communities

- The state should fully fund a technical assistance program focused on ensuring equitable implementation of these recommendations in domestic well communities and other small and rural communities (including unincorporated communities).
- The State should support an increase in federal appropriations to State Revolving Funds, which will increase funding availability for small water systems and Tribal water systems to address critical infrastructure needs and bolster system resiliency if drought conditions occur. The federal funds appropriated annually for Drinking Water and Clean Water State Revolving Funds (SRF) include a small (approximately 2%) Tribal set-aside for Tribal drinking water and wastewater infrastructure funding. This Tribal funding is administered by federal EPA. Any increase to the SRF appropriations would result in an increase in Tribal funding available. These funds are used to improve infrastructure and implicitly, could be used to increase redundancy, resiliency and capacity during drought conditions.
- The state should improve Tribal access to State funding by removing or otherwise addressing the barrier of requirements for waivers of sovereign rights by Tribes in funding programs. It is recognized that any State requirements of a waiver of Tribal sovereignty as a condition of accepting State funding is a major barrier to its ability to assist Tribes. We recommend eliminating those requirements whenever possible. In cases when they cannot be waived, we recommend the option of working with a federal agency (e.g. IHS) or a technical assistance provider (e.g. RCAC) as a partner / funding pass-through to allow State assistance to be provided to Tribes without the sovereignty waiver requirement.
- The state should improve Tribal access to state funding by re-routing funding through federal partners, like the IHS, or other organizations, like the California Rural Water Association (Cal Rural). In cases when there cannot be a waiver of Tribal sovereignty, the state should allow the option of working with a federal agency (e.g. IHS) or a technical assistance provider (e.g. RCAC) as a partner / funding pass-through to allow State assistance to be provided to Tribes without the sovereignty waiver requirement.
- The state should help information flow freely by giving Tribes various options for who to report through so that they may work with entities with which they have built trust.
- Tribes will have the option of reporting through the Indian Health Service (IHS). If at any point in the future, a Tribe does not wish to report through IHS, the Tribe should approach the State and request the ability to report in the same manner as other small water suppliers or rural communities.