Draft Final White Paper Discussion On:

Identification of Risk Assessment 2.0 Indicators for Public Water Systems

July 16, 2020

Table of Contents

Executive Summary

The State Water Resources Control Board (State Water Board) is developing Risk Assessment methodologies for identifying "at-risk" public water systems, tribal water systems, state small water systems, and domestic wells in order to assist with prioritization of Safe and Affordable Drinking Water Fund allocations in the State Water Board's Fund Expenditure Plan. **This white paper focuses on the first step of developing a Risk Assessment for public water systems (with a focus on systems with 3,300 or less service connections): the identification of potential risk indicators and the development of a transparent Risk Indicator Evaluation Tool.**

The State Water Board, in partnership with the University of California, Los Angeles (UCLA), is seeking stakeholder feedback and recommendations on risk indicators being considered for inclusion in Version 2.0 of the Risk Assessment for public water systems. Version 1.0 of the Risk Assessment utilized 14 risk indicators. In response to public feedback from its April 17, 2020 webinar workshop, the State Water Board and UCLA have identified over 100 potential risk indicators that may help predict the probability of a water system's failure to deliver safe drinking water. A concerted effort was made to identify potential indicators that measure accessibility, affordability, and TMF capacity (technical, managerial, and financial) based on their criticality as it relates to a system's ability to remain in compliance with safe drinking water standards. This effort includes full consideration of risk indicators identified in complementary efforts conducted by the Office of Environmental Health Hazard Assessment, the Department of Water Resources, and the California Public Utilities Commission.

The State Water Board is also seeking public feedback on a draft Risk Indicator Evaluation Tool which will be used to assess the applicability and fitness of the identified potential risk indicators for inclusion in Version 2.0 of the Risk Assessment.

The State Water Board is committed to engaging the public and key stakeholder groups to solicit feedback and recommendations as it develops its Needs Assessment methodologies (Risk Assessment, Affordability Assessment, and Cost Assessment). The State Water Board will continue to host public webinar workshops to provide opportunities for stakeholders to learn about and contribute to the State Water Board's efforts to develop a more robust Risk Assessments for public water systems, state small water systems, tribal water systems, and domestic wells.

Introduction

In 2016, the California State Water Resources Control Board (State Water Board) adopted a Human Right to Water Resolution making the Human Right to Water[1] (HR2W), as defined in Assembly Bill 685[2], a primary consideration and priority across

[1] Human Right to Water
https://www.waterboards.ca.gov/water_issues/programs/hr2w/
[2] Assembly Bill 685
https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201120120AB685

all of the state and regional boards' programs. The HR2W recognizes that "every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking and sanitary purposes."

In 2019, to advance the goals of the HR2W, California passed Senate Bill 200[3] (SB 200) which enabled the State Water Board to establish the Safe and Affordable Funding for Equity and Resilience (SAFER) Program[4]. SB 200 established a set of tools, funding sources, and regulatory authorities the State Water Board can harness through the SAFER Program to help struggling water systems sustainably and affordably provide safe drinking water to their customers.

Foremost among the tools created under SB 200 is the Safe and Affordable Drinking Water Fund[5]. The Fund provides up to $130 million per year through 2030 to enable the State Water Board to develop and implement sustainable solutions for underperforming drinking water systems. The annual Fund Expenditure Plan prioritizes projects for funding, documents past and planned expenditures, and is "based on data and analysis drawn from the drinking water Needs Assessment" (Health and Safety Code §116769).

FY 2020-21 Fund Expenditure Plan
The FY 2020-21 Fund Expenditure Plan does not utilize the Risk Assessment methodologies or results from the efforts detailed in this white paper. The State Water Board intends to incorporate the results of this effort into the next iteration of the Fund Expenditure Plan for FY 2021-22 after the Needs Assessment methodologies have been more fully developed through a stakeholder-driven process.

About the Needs Assessment

The State Water Board's Needs Assessment consists of three core components:

- **Risk Assessment**: Identifying public water systems (with a focus on systems with 3,300 or less service connections),[6] tribal water systems,[7] state small

[3] Senate Bill 200
https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201920200SB200
[4] SAFER Program
https://www.waterboards.ca.gov/safer/
[5] Safe and Affordable Drinking Water Fund
https://www.waterboards.ca.gov/water_issues/programs/grants_loans/sustainable_water_solutions/safer.html
[6] "Public Water System" means a system for the provision to the public of water for human consumption through pipes or other constructed conveyances that has 15 or more service connections or regularly serves at least 25 individuals daily at least 60 days out of the year. A PWS includes any collection, pretreatment, treatment, storage, and distribution facilities under control of the operator of the system that are used primarily in connection with the system; any collection or pretreatment storage facilities not under the control of the operator that are used primarily in connection with the system; and any water system that treats water on behalf of one or more public water systems for the purpose of rendering it safe for human consumption. (Health & Saf. Code, § 116275, subd. (h).)
[7] "Tribal water systems" means federally recognized California Native American Tribes, and non-federally recognized Native American Tribes on the contact list maintained by the Native American Heritage Commission for the purposes of Chapter 905 of the Statutes of 2004. (Health & Saf. Code, § 116766, subd. (c)(1).) Drinking water systems for

water systems,[8] and regions where domestic wells[9] consistently fail or are at-risk of failing to provide adequate[10] safe drinking water.

- **Cost Assessment:** Determining the costs related to the implementation of interim and/or emergency measures and longer-term solutions for systems in violation and at-risk systems. Solutions may include, but are not limited to, water partnerships, physical and managerial consolidations, administrators, treatment facility additions or upgrades, distribution system repairs or replacement, and/or point of use/point of entry treatment. The cost assessment also includes the identification of available funding sources and the funding gaps that may exist to support interim and long-term solutions.

- **Affordability Assessment:** Identifying community water systems that serve disadvantaged communities[11] that must charge their customers' fees which exceed the affordability threshold established by the State Water Board in order to provide adequate safe drinking water.

Figure 1: Needs Assessment Components

The State Water Board's Needs Analysis Unit in the Division of Drinking Water is leading the implementation of the Needs Assessment in coordination with the Division

federally recognized tribes fall under the regulatory jurisdiction of the United States Environmental Protection Agency (USEPA), while non-federally recognized tribes are currently under the jurisdiction of the State Water Board.

[8] "State small water system" means a system for the provision of piped water to the public for human consumption that serves at least five, but not more than 14, service connections and does not regularly serve drinking water to more than an average of 25 individuals daily for more than 60 days out of the year. (Health & Saf. Code, § 116275, subd. (n).)

[9] "Domestic well" means a groundwater well used to supply water for the domestic needs of an individual residence or a water system that is not a public water system and that has no more than four service connections. (Health & Saf. Code, § 116681, subd. (g).)

[10] "Adequate supply" means sufficient water to meet residents' health and safety needs at all times. (Health & Saf. Code, § 116681, subd. (a).)

[11] "Disadvantaged community" or "DAC" means the entire service area of a community water system, or a community therein, in which the median household income is less than 80 percent of the statewide annual median household income level. (Health & Saf. Code, § 116275, subd. (aa).) See separate definition of 'GGRF Disadvantaged Community'.

of Water Quality (DWQ) and Division of Financial Assistance (DFA). The University of California, Los Angeles (UCLA) was contracted (agreement term: 09.01.2019 through 03.31.2021) to support the initial development of Needs Assessment methodologies for the Risk Assessment and Cost Assessment. Although it is important to note, the contract with UCLA was written and scoped prior to passage of SB 200 and was originally designed to conduct a one-time Needs Assessment. Three State Water Board workshops hosted in early 2019 informed the original scope of the UCLA contract.[12] [13]

Overall, the Needs Assessment contract with UCLA consists of two core Elements:

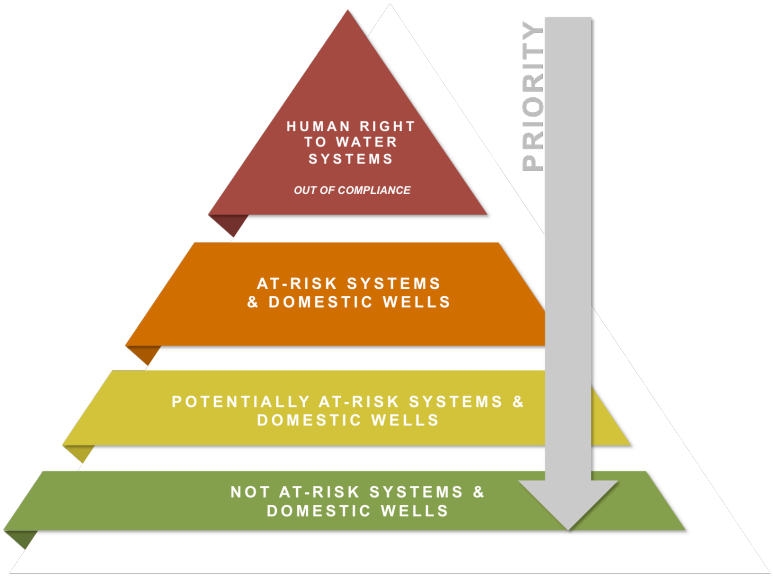
- **Identification of Public Water Systems in Violation or At-Risk**: focuses primarily on developing and evaluating risk indicators for community water systems up to 3,300 connections and non-transient non-community water systems, due to the large number of historical violations associated with these smaller systems.

- **Cost Analysis for Interim and Long-Term Solutions**: developing a model to estimate the costs related to both necessary interim and/or emergency measures and longer-term solutions to bring systems into compliance and address the challenges faced by at-risk systems. This Element also includes the identification of available funding sources and the funding gaps that may exist to support interim and long-term solutions.

These two UCLA Contract Elements of the Needs Assessment are providing the SAFER Program with foundational methodologies for evaluating drinking water risk for public water systems and domestic well users, and estimating the cost to ameliorate these challenges. Moving forward, the Needs Analysis Unit will be conducting the Needs Assessment annually to support the implementation of the SAFER Program. The results of the Needs Assessment will be used to prioritize public water systems, tribal water systems, state small water systems, and domestic wells for funding in the Safe and Affordable Drinking Water Fund Expenditure Plan; direct State Water Board technical assistance; and to develop strategies for implementing interim and long-term solutions.

[12] Key Participants: Rural Community Assistance Corporation; CA Rural Water Association; UC Davis, UCLA; UC Berkeley; Pacific Institute; Office of Environmental Health Hazard Assessment; and many more
[13] Drinking Water Quality Needs Assessment
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/needs.html

Figure 2: SAFER Prioritization of Risk Assessment Results



Risk Assessment for Public Water Systems

The goals of the Risk Assessment component of the Needs Assessment are: 1) to identify public water systems, tribal water systems, state small water systems and domestic wells in need of potential assistance or intervention before they fail to provide adequate and safe drinking water; and 2) to assist DFA in prioritizing those systems for targeted technical and financial assistance to advance long-term solutions in the Fund Expenditure Plan in order to prevent additional Californians from receiving unsafe or inadequate water supply in the future.

The Needs Analysis Unit and UCLA are collaborating to develop the Risk Assessment methodology for public water systems. **This White Paper focuses on the methodology for the Risk Assessment for public water systems (with a focus on systems with 3,300 or less service connections).**

Risk Assessment Methodologies for Tribal Water Systems, State Small Water Systems, and Domestic Wells

Tribal Water Systems
The Needs Analysis Unit is working in coordination with the State Water Board's Office of Public Participation to collect data and develop a Risk Assessment methodology for State and Federal tribal water systems located in California.

State Small Water Systems & Domestic Wells
The State Water Board's DWQ's Groundwater Ambient Monitoring and Assessment Program (GAMA) Unit is leading the effort to develop the Risk Assessment methodology for state small water systems and domestic wells that is

focused on groundwater quality. This effort will be accomplished through the mapping of aquifers that are used as a source of drinking water that are at high risk of containing contaminants that exceed primary drinking water standards.

DWQ's GAMA Unit has published a Draft White Paper[14] for public feedback and Needs Assessment Domestic Well Water Quality Tool[15], detailing the development of the Risk Assessment methodology for state small water systems and domestic wells. The GAMA Unit is hosting a public webinar workshop on July 22, 2020 from 1:00 - 3:00 pm to solicit stakeholder feedback on technical aspects regarding the development of the Aquifer Risk Map that will identify aquifers likely to be used by state small water systems and domestic wells that are at high risk of exceeding primary drinking water standards.

The State Water Board will be identifying opportunities to coordinate and integrate this effort with the implementation of the Sustainable Groundwater Management Act[16] and the Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) Program.[17]

Risk Assessment Components

The Risk Assessment methodology for **public water systems** (with a focus on systems with 3,300 or less service connections) incorporates three critical components:

- **Risk Indicators**: quantifiable measurements of key data that allow the State Water Board to assess the probability of a water system's failure to deliver safe drinking water. Risk indicators that measure accessibility, affordability, and TMF capacity will be incorporated based on their criticality as it relates to a system's ability to remain in compliance with safe drinking water standards.

- **Risk Thresholds**: the levels, points, or values associated with a risk indicator that delineates when a water system is more at-risk of failing.

- **Weighting and/or Scoring**: the application of a value or weight to each risk indicator – as certain risk indicators may be deemed more critical than others. The application of weights to risk indicators allows the State Water Board to assess all the risk indicators together in a combined Risk Assessment score.

[14] Draft GAMA Needs Assessment White Paper 021420
https://gispublic.waterboards.ca.gov/portal/home/item.html?id=0e7fe8d490ef45fb826ab3ad86db5409
[15] Needs Assessment Domestic Well Water Quality Tool
https://gispublic.waterboards.ca.gov/portal/apps/webappviewer/index.html?id=292dd4434c9c4c1ab8291b94a91cee85
[16] Sustainable Groundwater Management Act
https://www.waterboards.ca.gov/water_issues/programs/gmp/sgma.html
[17] Central Valley Salinity Alternatives for Long-Term Sustainability Program
https://www.waterboards.ca.gov/centralvalley/water_issues/salinity/

The Risk Assessment methodology will evolve over time to incorporate additional and better quality data; evidence from targeted research to support existing/new risk indicators and thresholds; experience from implementing the SAFER Program; and further input from the Board and public.

Risk Assessment Version 1.0

The determination of exact risk indicators, thresholds, comparative weightings and overall system scoring for Risk Assessment 1.0 were specified in the original scope of work in the contract between the State Water Board and UCLA, and carried out by UCLA exactly as specified in the contract. Risk Assessment 1.0 focused on evaluating the 14 risk indicators (Table 1) for community water systems with up to 3,300 service connections as well as non-transient non-community water systems which exclusively serve schools, due to the large number of historical violations associated with these systems. The total number of systems evaluated was 2,841. Full methods and results of Risk Assessment 1.0 are detailed in Appendix A and a summary of the results are shown below in Table 2.

Table 1: Risk Assessment 1.0 Risk Indicators (see Appendix B for more details)

Risk Indicator	Definition	Data Source(s)	Risk Threshold
Water Outages	Proportion of unplanned outage per capita per year excluding the ones caused by exogenic factors such as natural disaster, power outages, *etc.*	SWRCB-eAR	Top decile
Waterborne Illness[18]: Current and Historical	The total number of reported customer complaints of waterborne illness per customer either confirmed by the system or with no test results refuting the responsibility of the water system.	SWRCB-eAR	One or more incident
Lead and Copper	Exceedance of lead or copper Action Level (lead: 0.015 mg/L copper: 1.3 mg/L).	SWRCB-SDWIS	One or more incident
Extensive Treatment Required	The number of occurrences that meet the following conditions: - Groundwater source concentration exceeding a primary maximum contaminant level (MCL);	SWRCB-SDWIS	One or more of these conditions

[18] This does not reflect the current California's regulatory definition for Waterborne Microbial Disease Outbreak (California Code of Regulation § 64651.91) or Federal's regulatory definition for Waterborne Disease Outbreak (40 Code of Federal Regulation § 141.2).

Risk Indicator	Definition	Data Source(s)	Risk Threshold
	- Groundwater source concentration three times above secondary MCL; - Surface water quality necessitating a surface water treatment plan.		
Active Standing with California Secretary of State Status Requirements	Non-compliance with active status requirements using water systems' entity names.	Secretary of State website	Inactive standing
Single Groundwater Source	Reliance on a single groundwater well source.	SWRCB-SDWIS	Single groundwater source
Absence of Customer-Level Meters	Lacking individual customer-level water meters.	SWRCB-eAR	Less than 50% metered
Monitoring and Reporting Violations	The number of monitoring and reporting violations per California Safe Drinking Water Act (SDWA).	SWRCB-SDWIS	One or more occurrence
Bacteriological Violations or E. coli	Presence of bacteriological violations in an active source or evidence of presence of E. coli in an active source within the past three years.	SWRCB-SDWIS	One or more occurrence
Operator Certification Violations	Failure to have an appropriately certified water treatment or distribution operator.	SWRCB-eAR	Insufficient number of treatment or distribution operators at the levels required by the regulation
Disadvantaged Community[19] Status	Identified as located within a disadvantaged community.	SWRCB-eAR	Benefited from a DAC fee reduction
Location in a High Priority Groundwater Basin	Service area located within the boundaries of one or more high priority groundwater basins.	DWR-SGMA	At least 50% of the service area
Treatment Technique Violations	Treatment technique violation per the regulatory requirements.	SWRCB-SDWIS	One or more violations

[19] This does not directly reflect the current California's statutory definition for Disadvantaged Community (California Water Code § 79505.5, subd. (a).) but was based on available data.

Table 2: Results of 1.0 Risk Assessment

Risk Category	In Violation	At-Risk	Potentially At-Risk	Not At-Risk
Number of systems	328	1,293	744	476
% of those evaluated	12%	45%	26%	17%

With the passage of SB 200 and timing limitations of Version 1.0 (see Appendix A), UCLA and the State Water Board began developing the next iteration of the Risk Assessment Version 2.0. The development of Risk Assessment 2.0 will be a stakeholder-driven process and the methodology and data supporting it will be transparent and accessible to the public. Stakeholder input will be put into practice before the Risk Assessment directly informs any state policy or funding decisions. UCLA will be supporting the State Water Board in developing Version 2.0 by March 2021.

Risk Assessment Version 2.0

On April 17, 2020, the State Water Board and UCLA hosted a public webinar workshop to introduce the results of Risk Assessment 1.0 and solicit public feedback and recommendations for the next version (Version 2.0) of the Risk Assessment.

Key stakeholder recommendations for Risk Assessment 2.0 included:

- Expanding the Risk Assessment to more clearly align with the HR2W goals.
- Expanding the list of evaluated risk indicators that fall within the following four categories: water quality, accessibility, affordability, and TMF.
- Refining the setting of risk indicator thresholds and considering tiered thresholds.
- Further considering the weighting and scoring between risk indicators to better capture their criticality as they relate to a system's ability to remain in compliance with drinking water standards.
- Determining how to apply a more robust risk assessment to state small water systems and domestic wells.

Version 2.0 Risk Indicator Categories

In response to public feedback from the April 17, 2020 webinar workshop, the State Water Board focused on further identifying potential risk indicators that align with the three fundamental components of the HR2W (i.e., water quality, accessibility, and affordability), and has extended its search to incorporate technical, managerial, and financial (TMF) capacity indicators as well. The following risk indicator category definitions were developed to guide the identification of new potential indicators for Risk Assessment 2.0.

- **Water Quality**: Risk indicators that correspond to California SDWA water quality requirements; measure current water quality and trends to identify likelihood of future compliance with water quality and treatment technique regulatory requirements; and measure frequency and duration of exposure to drinking water contaminants.

- **Accessibility**: Risk indicators that impact a system's ability to deliver safe, sufficient, and continuous drinking water to meet public health needs. These indicators may measure risks impacting a system's quality and quantity of source water; reliability and volume of its delivery/distribution; and ability of customers to access safe drinking water.

- **Affordability**: Risk indicators that measure the capacity of and burden placed on households and the customer base as a whole to supply the revenue necessary for a system to pay for necessary capital, operations, and maintenance expenses to deliver accessible, safe drinking water.

- **Technical, Managerial, and Financial (TMF) Capacity**: Risk indicators that measure a system's technical, managerial, and financial capacity to plan for, achieve, and maintain long term compliance with drinking water standards, thereby ensuring the quality and adequacy of the water supply. These three areas of capacity are interrelated:

    - **Technical Capacity**: Indicators that measure the physical ability of a system to effectively treat and deliver safe drinking water.

    - **Managerial Capacity**: Indicators that measure a water system's ability to conduct its affairs in a manner enabling it to achieve and maintain compliance with the California SDWA requirements while maintaining best practices in accountability and interactions with customers and regulatory agencies.

    - **Financial Capacity**: Indicators that measure a system's ability to generate sufficient revenue, maintain creditworthiness, and manage funds through budgeting, accounting and other methods of fiscal control.

Identification of Potential Version 2.0 Risk Indicators

UCLA and the State Water Board initiated a concerted research effort to identify additional potential risk indicators for Risk Assessment 2.0 that align with the categories defined above. This effort included identifying risk indicators utilized in complementary efforts conducted by other California state agencies, as well as additional indicators that are recognized by the water sector and its advocates to be key measures of water system resiliency.

Alignment with Other State Agency Efforts

Multiple other California state agencies have recently begun assessing different aspects of drinking water systems' risks and performance with respect to the HR2W. These agencies include the Department of Water Resources (DWR), the Office of Environmental Health Hazard Assessment (OEHHA) and the California Public Utilities Commission (CPUC). Both State Water Board staff and the UCLA team have engaged in discussions with staff from each of these agencies to avoid duplication of efforts and

ensure the most productive long-term statewide assessment of water system risks possible.

To that end, all indicators or metrics utilized by OEHHA, DWR, and CPUC to measure or assess "risk" or "affordability" in the efforts described below have been incorporated into the list of potential risk indicators for the Risk Assessment 2.0 (see Tables 3 through 6). These indicators will be evaluated by the State Water Board and UCLA using the Risk Indicator Evaluation Tool (see page 30). As the Water Board's Needs Analysis Unit undertakes its Risk Assessment on an ongoing basis, any updates or recurring efforts by these agencies will continue to be taken into account.

Office of Environmental Health Hazard Assessment

The State Water Board, as part of its efforts to achieve the HR2W, contracted OEHHA (07.01.2018 - 06.30.2020) to develop a framework for evaluating the adequacy of the State's drinking water supply. The HR2W Risk Assessment and Data Tool developed by OEHHA is designed to assess a baseline from which to comprehensively track challenges that individual California community water systems face in drinking water provision and progress in achieving HR2W over time. This Tool comprises three categories for assessing the risk to achieve the overall adequacy of the provision of waters - Water Quality, Accessibility, and Affordability - along with the corresponding indicators established for their evaluation.

Based on expert, interagency, and public input, OEHHA developed a total of 13 indicators, metrics, and respective scoring/weighting methodologies to examine the water system's deficiencies, vulnerabilities, and/or capacities in terms of compliance with drinking water standards (7 indicators), physical and institutional vulnerability of water supply (3 indicators), and affordability to pay for the water bills (3 indicators). The draft full report and web tool – which will be finalized in 2020 – can be found at the OEHHA's website.[20]

The State Water Board will continue to coordinate and consult with OEHHA staff on the development of Risk Assessment 2.0. All of the risk indicators identified and utilized by OEHHA's HR2W Risk Assessment and Data Tool have been incorporated into the list of potential risk indicators for the Risk Assessment 2.0 (see Tables 3 through 6). These indicators will be evaluated by the State Water Board and UCLA using the Risk Indicator Evaluation Tool (see page 30) and presented to the public for feedback.

Department of Water Resources

Staff from DWR have also been consulted regarding potential synergies between State Water Board Needs Analysis Unit work and the Disadvantaged Community

[20] OEHHA's HR2W Risk Assessment and Data Tool
https://oehha.ca.gov/water/report/human-right-water-california

Involvement Program in DWR's Integrated Regional Water Management (IRWM) planning efforts. In addition, synergies were explored between the Needs Analysis Unit work and DWR's report and tool which was published in 2020, titled "Drought and Water Shortage Risk Scoring – California's Small Water Supplier and Self-Supplied Communities"[21]

IRWM

As of the writing of this white paper, not all IRWM regions have completed their needs assessments and reported them back to DWR. Thus, they are not yet available for statewide analysis efforts such as the State Water Board's Risk Assessment. Even more importantly, each IRWM Needs Assessment is, by the program's design, customized in terms of exact topic area, data collection and analysis approach by stakeholders in each region. Accordingly, uniform statewide data points will not be available through this effort.

Drought and Water Shortage Risk Scoring Tool

As directed by Water Code Section 10609.42, DWR's Drought and Water Shortage Risk Scoring Tool aims to identify small water suppliers and rural communities that are potentially at-risk of drought and water shortage vulnerability. This tool creates an aggregated, weighted risk score for each supplier and community which is calculated using indicators derived from data that captures different dimensions of exposure to hazards, vulnerability, and observed supply shortages. Indicators were selected through a series of workgroup meetings involving the County Drought Advisory Group and other stakeholders.[22]

For small water suppliers, DWR calculated risk scores using 29 indicators[23] across the following categories: exposure to climate change (3 indicators),

[21] Drought and Water Shortage Risk Scoring Report and Tool
https://water.ca.gov/Programs/Water-Use-And-Efficiency/Making-Conservation-a-California-Way-of-Life/County-Drought-Planning

[22] DWR Countywide Drought and Water Shortage Contingency Plans Website
https://water.ca.gov/Programs/Water-Use-And-Efficiency/Making-Conservation-a-California-Way-of-Life/County-Drought-Planning
"Appendix 2 Drought and Water Shortage Risk Scoring: California's Small Water Supplier and Self-Supplied Communities" (March 2020)
https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Water-Use-And-Efficiency/County-Drought-Advisory-Group/Files/CDAG-Appendix-2--Scoring-Method-Draft.pdf?la=en&hash=4533D3CFCC811064FBBAADF6C2B83169C1A90CCE

[23] Among those 29 indicators, the following four indicators are not included in the list of the potential risk indicators for this white paper because they are related to Domestic Wells, not Public Water Systems. They will be considered for a more in-depth Risk Assessment for Domestic Wells.

Risk Indicator	Definition
Shallow Depth of Domestic Wells: Presence	Presence of any portion of groundwater unit(s) where the max. depth of domestic wells is shallower than max. of public wells in the surrounding area.
Shallow Depth of Domestic Wells: Proportion	Proportion of area where the max. depth of domestic wells is shallower than max. of public wells
Reported Household Outages on Domestic Wells	Presence of one or more households with reported outages in Census Block Groups.

exposure to recent conditions and events (10 indicators), infrastructure vulnerability (8 indicators), organization vulnerability (5 indicators), and recent observed shortage (3 indicators).[24] For self-supplied communities, risk scores were calculated using 31 indicators across the following categories: climate change risk (3 indicators), exposure to current conditions and event risk (10 indicators), physical vulnerability (2 indicators), social vulnerability (14 indicators), and water shortage record (2 indicators).

DWR's methodology for analyzing risk does not define thresholds whereby certain small water suppliers and self-supplied communities are considered "at risk" of drought and water shortage and others are not. Instead, the methodology inherently recognizes that all communities in California face some risk of drought and water shortage and thus provides a tool to calculate the ***relative risk*** of these suppliers and communities.

The State Water Board has incorporated all of these indicators into the list of potential risk indicators for the Risk Assessment 2.0 (see Tables 3 through 6). These indicators will be evaluated by the State Water Board and UCLA using the Risk Indicator Evaluation Tool (see page 30).

California Public Utilities Commission

The State Water Board is also exploring the potential synergies between the State Water Board's Needs Assessment work and an ongoing CPUC's proceeding on affordability. On July 23, 2018, the CPUC issued R.18-07-006,[25] an Order Instituting Rulemaking to Develop Methods to Assess the Affordability Impacts of Utility Rate Requests and Commission Proceedings. On November 19, CPUC issued a Scoping Memo and Ruling[26] that covers identification and definition of affordability criteria for CPUC-jurisdictional utility services, methods and processes for assessing affordability impacts across CPUC proceedings and utility services, and other utility services affordability issues.

The CPUC formed a staff working group from their Water, Energy, and Communications Divisions, with the goal of developing a framework that would allow the CPUC to assess the affordability of public utility rates across utility types and services. In January 2020 CPUC released a staff proposal for an Affordability Metrics Framework.[27] This Framework develops a method for

Reported Household Outages on Private Wells	Proportion of households with reported outages in Census Block Groups

[24] One socio-economic indicator was composed of 12 base indicators.
[25] Order Instituting Rulemaking to Develop Methods to Assess the Affordability Impacts of Utility Rate Requests and Commission Proceedings
https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M218/K186/218186836.PDF
[26] Assigned Commissioner's Scoping Memo and Ruling
https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M240/K635/240635632.PDF
[27] Affordability Metrics Framework Staff Proposal
https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M325/K620/325620620.PDF

calculating the affordability of a predetermined essential service quantity to determine the impact of utility rates on a household.

The Framework proposes three affordability metrics:

- **Hours at Minimum Wage (HM)** describes essential service bills in terms of worked hours required to pay for them. It provides an illustration of the impact on daily lives of low-wage ratepayers compared to the dollar amount alone.

- The **Socioeconomic Vulnerability Index** describes the relative socioeconomic characteristics of communities—in terms of poverty, unemployment, educational attainment, linguistic isolation, and percent of income spent on housing—to quantify how the same rate impact may affect one community's ability to pay more than another's.

- The **Affordability Ratio (AR)** describes the impact an essential service bill has on a household budget; that is, the percent of income that is spent on each type of essential utility service after housing and the remaining essential utility services are considered.

The State Water Board has incorporated all three of these metrics into the list of potential risk indicators for the Risk Assessment 2.0 (see Table 5). These indicators will be evaluated by the State Water Board and UCLA using the Risk Indicator Evaluation Tool (see page 30).

Potential Risk Indicators for Risk Assessment 2.0

Approximately 170 risk indicators were reviewed by the State Water Board based on risk factors prepared by various national, state and educational agencies. The following tables (Tables 3 through 6) summarize the potential Version 2.0 risk indicators for each of risk indicator category identified for California water systems by the State Water Board and UCLA from this research. **The State Water Board is seeking public feedback on this list before these risk indicators are assessed using the Risk Indicator Evaluation Tool described in the following section.**

Potential Water Quality Risk Indicators

Table 3 includes a draft list of potential risk indicators that correspond to California SDWA water quality requirements. These indicators measure current water quality and trends to identify compliance with water quality and treatment technique regulatory requirements, as well as frequency and duration of exposure to drinking water contaminants.

Table 3: Potential Water Quality Risk Indicators (25 Potential Risk Indicators)

Risk Indicator	Definition	Data Source(s)	Current Utilization
Waterborne Illness: Historical	The total number of reported customer complaints of waterborne illness per customer in the past two years either confirmed by the system or with no test results refuting the responsibility of the water system.[28]	SWRCB-eAR	Risk Assessment 1.0
Waterborne Illness: Current	The total number of reported customer complaints of waterborne illness per customer in the most recent reporting year confirmed by sampling.	SWRCB-eAR	Risk Assessment 1.0
Extensive Treatment Required	The number of occurrences that meet the following conditions: - Groundwater source concentration exceeding a primary maximum contaminant level (MCL); - Groundwater source concentration three times above secondary MCL; - Surface water quality necessitating a surface water treatment plant.	SWRCB	Risk Assessment 1.0
Frequency of Bacteriological Violations (Total Coliform)	Presence of bacteriological violations incurred in the past three years.	SWRCB-SDWIS	Risk Assessment 1.0
E. coli	Evidence of E. coli or E. coli violation in the past two years.	SWRCB-SDWIS	Risk Assessment 1.0
Treatment Technique Violations	Treatment technique violation per the regulatory requirements incurred in the past 12 months (may include this such as surface water treatment plant failures, etc.).	SWRCB-SDWIS	Risk Assessment 1.0
Lead and Copper	Exceedance of lead or copper Action Level (lead: 0.015 mg/L copper: 1.3 mg/L) in the past 12 months	SWRCB-SDWIS	Risk Assessment 1.0 “in-violation”
High Potential Exposure (HPE)	The number of contaminants whose annual average concentration exceeds the drinking water standard (MCL or AL) plus one count added if the system has at least one total coliform MCL	SWRCB-SDWIS	OEHHA HR2W Tool

[28] Please refer to Appendix B for more information.

Risk Indicator	Definition	Data Source(s)	Current Utilization
	exceedance during one 9-year compliance cycle.		
Presence of Acute Contaminant: HPE	The total number of acute contaminants[29] that have a HPE.	SWRCB-SDWIS	OEHHA HR2W Tool
Maximum Duration of HPE	Selection of the maximum duration of HPE across all contaminants (*i.e.*, select the highest value among the total number of years of HPE for each contaminant and total number of years of total coliform MCL violations).	SWRCB-SDWIS	OEHHA HR2W Tool
Data Availability	Determining if the water system has the minimum number of samples per monitoring frequency requirements for each contaminant.	SWRCB-SDWIS	OEHHA HR2W Tool
Non-Compliance with Primary Drinking Water Standard	The total number of contaminants with at least one MCL violation during one 9-year compliance cycle at source level.	SWRCB-SDWIS	OEHHA HR2W Tool
Presence of Acute Contaminants: MCL Violation	The total number of acute contaminants[1] with any of MCL violations.	SWRCB-SDWIS	OEHHA HR2W Tool
Max. Duration of Non-compliance	Selection of the max. duration of non-compliance across all contaminants (*i.e.*, select the highest value among the total number of years with at least one MCL violation for each contaminant).	SWRCB-SDWIS	OEHHA HR2W Tool
Presence of Water Quality Trends Toward MCL	Presence of regulated contaminant(s), especially those attributable to anthropogenic causes, that are detected at or greater than 80% of MCL in the Water Board's SDWIS database over the past decade.	SWRCB-EDT Library	
Frequency of Water Quality Trends Toward MCL	Frequency of when regulated contaminant(s), especially those attributable to anthropogenic causes, are detected at or greater than 80% of MCL in the Water Board's SDWIS database over the past decade.	SWRCB-EDT Library	

[29] Nitrate, nitrite, or total nitrate and nitrite, perchlorate, and E. coli/fecal coliform, per California Public Notification Rule (California Code of Regulation § 64463.1, subd. (a).), defined as contaminants that have the potential for adverse effects on human health as a result of short-term exposure.

Risk Indicator	Definition	Data Source(s)	Current Utilization
Current Water Quality Greater than 50% for Acute Contaminants	The drinking water contains greater than 50% of MCL of any acute contaminant.	SWRCB-SDWIS	
Past presence on the HR2W list	Number of times the system was on the HR2W list over the last 4 years.	SWRCB-SDWIS	
Average duration on HR2W list	The average amount of time the system was on the HR2W list over the last 4 years.	SWRCB-SDWIS	
Proximity to Septic System for the Public Water System Source	The minimum distance from the public water system source water and a septic system.	SWRCB-Sanitary Survey; County records	
Proximity of Untreated Public Water System Source to Surface Water (river, stream, *etc.*).	The distance from the untreated public water system source may result in bacteriological contamination of the source during certain periods or events.	SWRCB-Sanitary Survey	
Compliance with Well Construction Standards	Compliance with California Code of Regulations Section 64560.	SWRCB-Sanitary Survey	
Emerging Contaminants	Presence of emerging contaminants with an established public health goal.	SWRCB-SDWIS	
Potential Contamination Hazards	Presence of nearby sources of contamination or active releases.	SWRCB-GeoTracker[30]; DWSAP[31]	
Source water Protection Zones	Compliance with California Code of Regulations Section 64560. Demonstrate a 50-foot radius around site to protect source.	SWRCB-Sanitary Survey	

Potential Accessibility Risk Indicators

Table 4 includes potential risk indicators that measure a system's ability to deliver safe, sufficient, and continuous drinking water to meet public health needs. These indicators may measure risks impacting a system's quality and quantity of source water; reliability and volume of its delivery/distribution; and ability of customers to access safe drinking water.

[30] State Water Board GeoTracker webpage
https://www.waterboards.ca.gov/ust/electronic_submittal/about.html
[31] Drinking Water Source Assessment and Protection
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/DWSAP.html

Table 4: Potential Accessibility Risk Indicators (36 Potential Risk Indicators)

Risk Indicator	Definition	Data Source(s)	Current Utilization
Water Outages: Public Water System	Presence of substantial unplanned water outages in the past 5 years.	SWRCB-eAR	Risk Assessment 1.0; DWR Water Shortage Risk Tool
Location In a High Priority Groundwater Basin	Service area located within the boundaries of one or more SGMA high priority groundwater basins.	DWR-SGMA	Risk Assessment 1.0
Single Groundwater Source	Reliance on a single groundwater well source.	SWRCB-SDWIS	Risk Assessment 1.0
Water Source Type/ Number	Water system's water source type (groundwater and surface water) and the total number of available sources.	SWRCB-SDWIS	OEHHA HR2W Tool
Water System Size/ Socioeconomic Status of the Community	Water system size by service connection number and community's DAC/ SDAC status as defined in California Water Code §79505.5(a) & §13476.	US Census ACS; SWRCB-SDWIS; SWRCB-SABL[32]	OEHHA HR2W Tool; Risk Assessment 1.0 embedded in methodology
Temperature Shift	Projected change in maximum temperature by mid-century.	DWR-WSIP[33]	DWR Water Shortage Risk Tool
Saline Intrusion: Projected	Exposure of service area to salt water intrusion into coastal groundwater aquifers determined by projected 1-meter sea level rise.	Calculated using a shapefile provided by Univ. of Wyoming (coordinated with USGS)	DWR Water Shortage Risk Tool
Wildfire Risk: Projected	Projected area burned from wildfire.	Univ. of California, Merced-Wildfire Projection	DWR Water Shortage Risk Tool
Wildfire Risk: Current	Current risk maximum for each Census Block Group using CalFire score.	CalFire-Fire Hazard Severity Zone Maps	DWR Water Shortage Risk Tool

[32] Service Area Boundaries Layers
[33] Water Storage Investment Program

Risk Indicator	Definition	Data Source(s)	Current Utilization
Drought Early Warning	Less than 70% of average precipitation by January 31st for the current water year.	OSU-PRISM	DWR Water Shortage Risk Tool
Communities in Fractured Rock Areas	Areas not in alluvial groundwater basins as marked by Bulletin 118.	DWR-Bulletin 118	DWR Water Shortage Risk Tool
Projected Population Growth	Projected 5-year term population growth rate.	DWR	DWR Water Shortage Risk Tool
Water Quality in Surrounding Basin	Indication of potential groundwater contaminants exceeding regulatory standard accessed by domestic wells based on the last 20 years of available data.	SWRCB-DWQ-GAMA GIS	DWR Water Shortage Risk Tool
Subsidence in Basin	Indication of inelastic subsidence evaluated to the extent data are available (back in time as far as possible) as detailed in the 2019 SGMA Basin Prioritization report.[34] In many cases the time frames were six to ten years for current conditions and 20 years or more for historical analyses.	DWR-SGMA Basin Prioritization	DWR Water Shortage Risk Tool
Salt in Basin	Indication of saline intrusion evaluated by reviewing available data published over the last 20 years as detailed in the 2019 SGMA Basin Prioritization report.	DWR-SGMA Basin Prioritization	DWR Water Shortage Risk Tool
Overdrafted Basin	Indication of critically overdrafted groundwater basin evaluated by reviewing available data published over the last 20 years as detailed in the 2019 SGMA Basin Prioritization report.	DWR-SGMA Basin Prioritization	DWR Water Shortage Risk Tool
Chronic Declining Water Levels	Indication of groundwater level declining evaluated by reviewing groundwater level data published over the last 20 years as detailed in the 2019 SGMA Basin Prioritization report.	DWR-SGMA Basin Prioritization	DWR Water Shortage Risk Tool
Surrounding Agricultural Land Use	Presence of irrigated agriculture in the surrounding basin (irrigated acreage)	DWR-SGMA Basin Prioritization	DWR Water Shortage Risk Tool

[34] Sustainable Groundwater Management Act 2019 Prioritization
https://og-production-open-data-cnra-892364687672.s3.amazonaws.com/resources/ffafd27b-5e7e-4db3-b846-e7b3cb5c614c/sgma_bp_process_document.pdf?Signature=4USbxU7j5IbdBTX19Xdfns%2BaYWA%3D&Expires=1594275104&AWSAccessKeyId=AKIAJJIENTAPKHZMIPXQ

Risk Indicator	Definition	Data Source(s)	Current Utilization
Interties	Presence of interties.	SWRCB-SDWIS	DWR Water Shortage Risk Tool
Emergency Interties	Presence of emergency interties.	SWRCB-SDWIS	DWR Water Shortage Risk Tool
Baseline Monitoring	Presence of baseline monitoring of source supply levels.	SWRCB-eAR	DWR Water Shortage Risk Tool
Water Source Number	Total number of available water sources including surface water, wells, and imported water.	SWRCB-SDWIS	DWR Water Shortage Risk Tool
Water Source Types	Total number of water source types.	SWRCB-SDWIS	DWR Water Shortage Risk Tool
Supplier Size	Service connections count as a proxy for the size of the water supplier.	SWRCB-SDWIS	DWR Water Shortage Risk Tool
Water Level Status	Self-reported levels of water source: recovering, steady, declining, blank.	SWRCB-eAR	DWR Water Shortage Risk Tool
Water Shortage: Projected	Presence of any self-reported projected water shortage.	SWRCB-eAR	DWR Water Shortage Risk Tool
Water Shortage: Curtailment and Compliance Order	Water systems under order of compliance for curtailment or building moratoriums.	SWRCB-enforcement record review	DWR Water Shortage Risk Tool
Water Shortage: Drought Assistance Record	Water systems that received drought assistance determined by record of drought assistance to suppliers.	SWRCB-DFA	DWR Water Shortage Risk Tool
Water Production for 55 Gallon Per Capita Per Day	Sufficiency of monthly water production using 100% as the main threshold.	SWRCB-Sanitary Survey	
History of Past Water Shortages	Presence of historical water shortage.	SWRCB; IHS[35]	
Backup Power Supply	Does the water system have backup power available during power outages to ensure reliable water service?	SWRCB-eAR	
Distribution System Pressure	Does the water system maintain sufficient pressure throughout the distribution system?	SWRCB-eAR/Sanitary Survey	
Water Rights / Water Allocations	Does the water system have sufficient water rights and/or	SWRCB-eWRIMS[36];	

[35] Indian Health Service
[36] Electronic Water Rights Information Management System (eWRIMS),

Risk Indicator	Definition	Data Source(s)	Current Utilization
	allocations to meet projected demand?	adjudicated basin data; SGMA GSPs[37]	
Water Loss	Percentage of non-revenue produced water (water loss).	Not currently available	
Adequate Water Storage Capacity	Compliance with California Code of Regulations Section 64552	SWRCB-eAR/Sanitary Survey	
Water Conservation Plan	Does the water system have a water conservation plan?	SWRCB-Sanitary Survey	

Potential Affordability Risk Indicators

Table 5 includes potential risk indicators that measure the capacity of households and the customer base as a whole to supply the revenue necessary for a system to pay for necessary capital, operations, and maintenance expenses.

Table 5: Potential Affordability Risk Indicators (22 Potential Risk Indicators)

Risk Indicator	Definition	Data Source(s)	Current Utilization
Population Growth: Historical	Population Change in the past eight to ten years.	US Census-ACS	UNC Financial Dashboard
Percent of Median Household Income (%MHI)[38]	6-CCF Water Rates divided by water service area MHI.	SWRCB-eAR; SWRCB-SABL; US Census-ACS	OEHHA HR2W Tool; SWRCB-FEP 2020/21; UNC Financial Dashboard
Percent of Community Poverty Threshold (% CPT)[38]	6-CCF Water Rates divided by water service area community poverty threshold.	SWRCB-eAR; SWRCB-SABL; PPIC-CPT[39]	OEHHA HR2W Tool
Percent of Deep Poverty Income (% DP)[38]	6-CCF Water Rates divided by water service area deep poverty income (*i.e.*, 50% of community poverty threshold).	SWRCB-eAR; SWRCB-SABL; PPIC-CPT	OEHHA HR2W Tool
Per Capita Income	Average per capita income for water service area.	US Census-ACS	DWR Water Shortage Risk Tool
Average Median Household Income	Average Median Household Income for water service area.	US Census-ACS	DWR Water Shortage Risk Tool

[37] Groundwater Sustainability Plans (GSPs)
[38] *Public Preview Draft* California Office of Environmental Health Hazard Assessment: Achieving the Human Right to Water In California: An Assessment of the State's Community Water Systems. August 2019 https://oehha.ca.gov/media/downloads/water/report/achievinghr2w08192019.pdf
[39] Public Policy Institute of California-California County Poverty Thresholds, 2015 https://www.ppic.org/interactive/california-poverty-rates-by-county/

Risk Indicator	Definition	Data Source(s)	Current Utilization
Percentage of Poverty (% Poverty)	Percentage of serving population living at or under the water service area poverty income.	US Census-ACS	DWR Water Shortage Risk Tool
Demographic and Socioeconomic Characteristics of Customer Base	Aggregating estimates of each of the following: Percentage of population over 65 years old; under 17 years old; under 5 years old; over 25 years old with no high school diploma; unemployed among employable age; who speaks English less than well; single parent households with children under 18 years old; households with no vehicle; mobile households; renter households; living in Group Quarters	US Census-ACS	DWR Water Shortage Risk Tool
Household Burden Indicator (HBI)[40]	Average Water Rates divided by 20th percentile household income for water service area.	US Census-ACS	UNC Financial Dashboard; Recommended by national water associations to US EPA
Poverty Prevalence Indicator (PPI)[5]	Percentage of serving population under 200% of the Federal Poverty Level.	US Census-ACS	Recommended by national water associations to US EPA
Affordability Ratio (AR_{20})	Average Water Rates divided by 20th percentile household income (discretionary after excluding costs for housing, food, healthcare, energy and taxes) for water service areas.	SWRCB-eAR; US Census-ACS; HUD; Healthcare.gov; Housing costs from local sources (*e.g.* craigslist); USDA; IRS	CPUC Framework recommendation; Recommended by national water associations to US EPA
WARi®[5]	Weighted average residential index: Census Tract-level water rates divided by Census Tract-level MHI, then multiplied by % households. For Service Area WARi, sum across Census	SWRCB-eAR; US Census-ACS	Recommended by national water associations to US EPA

[40] Developing a New Framework for Household Affordability and Financial Capability Assessment in the Water Sector. April 2019 https://www.awwa.org/Portals/0/AWWA/ETS/Resources/DevelopingNewFrameworkForAffordability.pdf?ver=2020-02-03-090519-813

Risk Indicator	Definition	Data Source(s)	Current Utilization
	Tracts divided by total households.		
Extreme Water Bill	6-CCF Water Rates divided by State average Water Rate.	SWRCB-eAR	SWRCB AB-401 report
% Shut-Offs	Percentage of residential customer base with service shut-offs due to nonpayment.	SWRCB-eAR	
Duration of Shut-Offs	Median duration of the shut-offs.	SWRCB-eAR	
Hours at Minimum Wage to Pay Water Bill	6-CCF Water Rates divided by minimum hourly wage of water service area.	SWRCB-eAR; UC Berkeley Labor Center	CPUC recommendation; UNC Financial Dashboard
Socioeconomic Vulnerability Index	The relative socioeconomic characteristics of communities - in terms of poverty, unemployment, educational attainment, linguistic isolation, and percent of income spent on housing - to quantify how the same rate impact may affect one community's ability to pay more than another's.	OEHHA-CalEnviroScreen	CPUC Framework recommendation
Households Delinquent in Paying Bills	Total number of accounts that missed one or more bill payment.	SWRCB-eAR	Recommended by national water associations to US EPA
Households Below the Living Wage	Percentage of households earning below the living wage.	US Census-ACS	Recommended by national water associations to US EPA
Shelter Cost	Percentage of households spending more than 30% of income on shelter.	HUD Fair Market Rent; US Census-ACS	Recommended by national water associations to US EPA
Households Receiving Public Assistance	Percentage of households receiving public assistance.	US Census-ACS	UNC Financial Dashboard
Customers receiving Water Bill Payment Assistance	Percentage of customers receiving water bill payment assistance from the water system's customer assistance programs.	SWRCB-eAR	

Potential TMF Risk Indicators

Table 6 includes potential risk indicators that measure a system's TMF capacity to plan for, achieve, and maintain long term compliance with drinking water standards, thereby ensuring the quality and adequacy of the water supply.

Table 6: Potential TMF Capacity Risk Indicators (35 Potential Risk Indicators)

Risk Indicator	Definition	Data Source(s)	Current Utilization
Active Standing with California Secretary of State (SoS) Status Requirements	Not in active standing with the California Secretary of State, or failure to maintain an active board as an allowable business entity authorized to provide drinking water under the California Corporations Code.	Secretary of State website	Risk Assessment 1.0
Operator Certification Violations	Failure to have an appropriately certified water treatment or distribution operator.	SWRCB-enforcement records (or eAR for future work)	Risk Assessment 1.0
Disadvantaged Community[41] Status	Water service area's MHI is less than 80% of the Statewide MHI.	SWRCB-SDWIS; US Census ACS; SWRCB-SABL[42]	Risk Assessment 1.0
Monitoring and Reporting Violations	The total number of monitoring and reporting violations for particular contaminants and treatment techniques during one 9-year compliance cycle.	SWRCB-SDWIS	Risk Assessment 1.0; OEHHA HR2W Tool
Customers Metered	Percentage of service connections that have meters.	SWRCB-eAR	DWR Water Shortage Risk Tool
Absence of Customer-Level Meters	Lacking individual customer-level water meters. (Representing both water loss awareness and potential for unknown bacteriological intrusion via leaking pipes.)	SWRCB-eAR	Risk Assessment 1.0
Updated Rate Structure	Year rate structure was last updated.	SWRCB-eAR	DWR Water Shortage Risk Tool
Rate Structure: Type	Type of rate structures used by water system.	SWRCB-eAR	DWR Water Shortage Risk Tool
Drought Preparedness Plan (DPP)/ Water	Presence of a DPP or WSCP and year written or updated.	SWRCB-eAR	DWR Water Shortage Risk Tool

[41] As defined in California Water Code § 79505.5
[42] Service Area Boundaries Layers

Risk Indicator	Definition	Data Source(s)	Current Utilization
Shortage Contingency Plan (WSCP)			
Operating Ratio with Depreciation	Operating revenue divided by operating expenses including depreciation.	Water System's Financial Statements; Form I-990 for MWCs; CPUC Annual Report for IOUs; California State Controller's Office for Cities and SDs[43]	UNC Financial Dashboard[44]
Adjusted Operating Ratio	Operating revenue divided by operating expenses including depreciation plus calculated reserves	Water System's Financial Statements; Form I-990 for MWCs; CPUC Annual Report for IOUs; California State Controller's Office for Cities and SDs	UNC Financial Dashboard (not for California)
Non-Capital (simple) Operating Ratio	Operating revenue divided by operating costs excluding depreciation.	Water System's Financial Statements; Form I-990 for MWCs; CPUC Annual Report for IOUs; California State Controller's Office for Cities and SDs	UNC Financial Dashboard
Revenue Collection Per Connection	Operating revenues divided by total number of service connections.	Water System's Financial Statements; Form I-990 for MWCs; CPUC Annual Report for IOUs;	UNC Financial Dashboard

[43] MWCs: Mutual Water Companies
IOUs: Investor Owned Utilities
SDs: Special Districts

[44] For all systems water systems with less than 3300 connections

Risk Indicator	Definition	Data Source(s)	Current Utilization
		California State Controller's Office for Cities and SDs; SWRCB-eAR	
Operating and Maintenance (O&M) Expenditure Per Connection	Operating expenditures divided by total service connection.	Water System's Financial Statements; Form I-990 for MWCs; CPUC Annual Report for IOUs; California State Controller's Office for Cities and SDs; SWRCB-eAR	
Days Cash on Hand	The number of days the system can pay its daily operations and maintenance costs before running out of its unrestricted cash save-up (*i.e.*, unrestricted cash & investments divided by per day operating expenses excluding depreciation)	Water System's Financial Statements; Form I-990 for MWCs; CPUC Annual Report for IOUs; California State Controller's Office for Cities and SDs	UNC Financial Dashboard
Asset Depreciation	Accumulated infrastructure depreciation expense divided by total depreciable assets	Water Systems' Financial Statements	UNC Financial Dashboard (not for California)
Debt to Equity Ratio	Total long-term debt divided by total net assets	Water Systems' Financial Statements	UNC Financial Dashboard (not for California)
Outstanding Water Bill	Sum of uncollected residential water bills at the end of the most recent year.	SWRCB-eAR	
Dedicated Fund/ Account for Revenues and Expenses	Does the water system have a protected enterprise fund or dedicated fund/account for system revenues and expenditures (no excessive non-service related transfers to a city or county's general fund or corporate parent from the water system)?	Not currently available	

Risk Indicator	Definition	Data Source(s)	Current Utilization
Line of Credit with Financial Institution	Does the water system have a line of credit or an established borrower/lender relationship with a financial institution for financing needs?	Not currently available	
Debt Service Coverage Ratio	The ratio of operating income available to debt servicing for interest, principal and lease payments (*i.e.*, operating revenues minus operating expenses excluding depreciation divided by principal plus interest payment on long-term debt).	Not currently available	UNC Financial Dashboard (not for California)
Current Ratio	Liquidity ratio that measures whether a water system has enough resources to meet its short-term obligations by comparing a water system's current assets to its current liabilities (*i.e.*, unrestricted current assets excluding inventories and prepaid items divided by current liabilities).	Not currently available	UNC Financial Dashboard (not for California)
Emergency Response Plan (ERP)	Does the water system ERP properly outline procedures/responsibilities to respond to emergencies and up to date?	SWRCB-Sanitary Survey	
Capital Improvement Plan (CIP)	Does the water system have a CIP adequately prepared and updated?	SWRCB-Sanitary Survey (in some cases)	
Asset Management Plan (AMP)	Does the water system have an AMP adequately prepared and updated?	SWRCB-Sanitary Survey (in some cases)	
Member of CalWARN or Alternative Mutual Aid Agreement	Is the system a current member of CalWARN Mutual Aid and Assistance Program?	CalWARN; SWRCB-Sanitary Survey	
Insurance Coverage	Does the water system have insurance coverage (i.e. property insurance, management liability, workers comp. etc.)	Not currently available	
Full-Time Operator	Does the water system have a full-time operator?	Not currently available	
Number of Staff Per Connection	The number of water system employees divided by the number of customer connections (usually	Not currently available	The International Benchmarking

Risk Indicator	Definition	Data Source(s)	Current Utilization
	expressed in thousands of connections)		Network of the World Bank
Operator Training	Total number of hours training per operator	Drinking Water Operator Certification Program (DWOCP)[45]	
Employee Turnover	Frequency of the loss of workforce over time caused by employee departure, including resignations, layoffs, terminations, retirements, location transfers, *etc*.	Not currently available	
Cross Connection Control/ Backflow Prevention	Does the water system have an active cross connection control/ backflow prevention program in place and properly implemented?	SWRCB-eAR and Sanitary Survey	
Number of Service Connections	Total number of customer service connections of the water system.	SWRCB-SDWIS	
Maintaining a Full Board (organization)	Does the water system maintain a governing board which actively meets in accordance with best practices for the governance type/legal entity status of the system?	Not currently available	
Training of Board Members	Have the water system's board members completed board training? (Mutual water companies are required to complete training as detailed in California Health and Safety Code § 116755 subd. (a))	RCAC Records; Sanitary Survey Results	

Draft Risk Indicator Evaluation Tool

The State Water Board is seeking public feedback on a draft Risk Indicator Evaluation Tool which will be used to determine the most appropriate risk indicators, drawn from the lists above as well as stakeholder input, for inclusion in Risk Assessment 2.0. The draft Evaluation Tool consists of two steps, the evaluation of risk indicator applicability and the fitness of the required data associated with each risk indicator, for example data quality and availability.

Step 1 Applicability

This step will evaluate whether a relatively strong relationship exists between a potential risk indicator and a water system's ability to provide adequate and safe drinking water.

[45] The Drinking Water Operator Certification Program
https://www.waterboards.ca.gov/drinking_water/certlic/occupations/DWopcert.html

Evaluation Scoring Criteria for Step 1:

- **Excellent**: Evidence-driven
- **Good**: Water sector recognized
- **Fair**: Some water sector debate over relationship
- **Poor**: Neither evidence-based nor water sector recognized

Step 2 Fitness

This step will evaluate whether the required data for each risk indicator meets the following criteria:

Criteria 1: Coverage

This criterion evaluates whether the data associated with the risk indicator is available for a sufficient number of California public water systems.

Draft Coverage scores proposed for feedback are:

- **Good**: 90% or more
- **Fair**: 65% - 90%
- **Poor**: Below 65%

The State Water Board will also be conducting a thorough review of strategies employed to account for missing data for individual indicators, including those undertaken by DWR and OEHHA in their CDAG and H2RW screenings.

Criteria 2: Availability

This criterion evaluates whether the data associated with the risk indicator is updated and available on a recurring basis in order to support the State Water Board's annual Risk Assessment data requirements.

Draft Availability scores proposed for feedback are:

- **Good**: Updated annually or more frequently
- **Fair**: Updated less than annually but at least every three years
- **Poor**: Updated less than every three years

Criteria 3: Accuracy/Quality

This criterion evaluates whether the data associated with the risk indicator reasonably or accurately reflects what the data is meant to measure and/or illustrate. High-quality data is accurate, correctly reported, valid, and consistent.

Draft Accuracy/Quality scores proposed for feedback are:

- **Good**: Credible source, correctly reported
- **Fair**: Credible source, fairly correctly reported
- **Poor**: Dubious source, extensive incorrect reporting

Step 3 Combined Evaluation

The Evaluation Tool will combine the evaluations from Steps 1 and 2 to determine if the State Water Board should consider the risk indicator for inclusion in Risk Assessment 2.0.

- **Yes**: Step 1 results must be Excellent or Good; and Step 2 results must be Good for all three criteria.
- **Maybe**: Step 1 results may be Good or Fair; and Step 2 results may be Good or Fair for all three criteria.
- **No**: Step 1 results are Fair or Poor; and Step 2 results are Fair or Poor for all three criteria.
- **Future**: Step 1 results are Excellent or Good, and Step 2 results are Fair and Poor. These will be retained for consideration for future iterations to see if data fitness scores improve.

Final Indicator Inclusion Determination

The State Water Board will utilize public feedback from the July 22, 2020 webinar workshop to refine and finalize the Evaluation Tool. The State Water Board and UCLA will then use the Evaluation Tool to evaluate the list of potential risk indicators. The results of the evaluation will be made public for feedback prior to determining the final list of the risk indicators for inclusion on Risk Assessment 2.0.

It is anticipated that there may be multiple risk indicators that will score well using the Evaluation Tool, but measure the same or similar phenomena. For these risk indicators, UCLA and the State Water Board will conduct a thorough analysis of the indicator options and present the results of the analysis to the public for feedback on which should be included in the final Risk Assessment 2.0 methodology.

The results of the risk indicator evaluation will also likely identify some risk indicators that score highly on the applicability test, but poorly on the data fitness test. The State Water Board will use this information and public feedback to develop a long-term data strategy to improve its datasets. Improved datasets will support the development of more robust iterations of Risk Assessment methodologies in the years to come.

Example Draft Evaluation Tool Results for Version 1.0 Risk Indicators

Table 7 demonstrates how the draft Evaluation Tool may be used to evaluate potential risk indicators for inclusion in Risk Assessment 2.0. The final evaluation results may vary depending on public feedback received on the draft Evaluation Tool.

Table 7: DRAFT Evaluation Tool Results for Version 1.0 Risk Indicators

Risk Indicator	STEP 1	STEP 2			Potential Inclusion in Version 2.0?
	Applicability	Data Coverage	Data Availability	Data Accuracy/ Quality	
Water outages	Good	Good	Fair	Poor	Maybe
Lead and Copper	Good	Good	Good	Good	Yes
Bacteriological violations or E. coli[46]	Good	Good	Good	Good	Yes
Waterborne illness: current or historical[47]	Excellent	Good	Poor	Poor	Future
Extensive treatment required	Good	Good	Good	Good	Yes
Active standing with California Secretary of State (SoS) status requirements	Good	Poor	Fair	Poor	No
Single groundwater source	Good	Good	Good	Good	Yes
Absence of customer-level meters	Fair	Good	Good	Good	Maybe
Monitoring and reporting violations	Good	Good	Good	Good	Yes
Operator certification violations	Good	Good	Good	Good	Yes

[46] For Version 2.0 total coliform violations and E. coli will be separated out into two separate risk indicators because it is recognized that their applicability and state fitness are different.
[47] Data quality in Version 1.0 was relatively poor and is based on unsubstantiated complaints and not fully captured in current SWRCB datasets.

Risk Indicator	STEP 1	STEP 2			Potential Inclusion in Version 2.0?
	Applicability	Data Coverage	Data Availability	Data Accuracy/ Quality	
Disadvantaged community status	Fair	Good	Good	Good	Maybe
Location in a high priority groundwater basin	Fair	Good	Good	Good	Maybe
Treatment technique violations	Good	Good	Good	Good	Yes

Next Steps for the Development of Risk Assessment 2.0

July 22, 2020 Public Webinar Workshop

The State Water Board will be hosting a public webinar workshop on July 22, 2020 to solicit stakeholder feedback and recommendations on:

1. The list of potential risk indicators (Tables 3 through 6) being considered for inclusion in Version 2.0 of the Risk Assessment for public water systems.
2. The draft Risk Indicator Evaluation Tool.

Registration for webinar workshop can be done here:
SAFER Webinar: Identifying "At-Risk" Public Water Systems
https://www.eventbrite.com/e/safer-webinar-identifying-at-risk-public-water-ststems-tickets-111200906906

Materials on past Risk Assessment workshops can be found here:
SAFER website
https://www.waterboards.ca.gov/safer/

Planned Phases of Risk Assessment 2.0 Development for Public Water Systems

The State Water Board and UCLA have divided the development of Risk Assessment 2.0 for public water systems into five distinct phases:

Phase 1: Identify Potential Risk Indicators

- Expand upon the risk indicators utilized in Risk Assessment 1.0

- Develop a risk indicator evaluation tool to guide the selection of risk indicators for inclusion in the risk assessment.
- Host public webinar workshop July 22, 2020 to solicit recommendations on potential risk indicators and draft Evaluation Tool.

Phase 2: Select Risk Indicators

- Evaluate potential risk indicators using Evaluation Tool
- Host public webinar workshop in September or October 2020 to share results of evaluation and recommendations for the final list of risk indicators to be used in Risk Assessment 2.0.
- Incorporating public feedback, select final list of risk indicator for inclusion in Risk Assessment 2.0

Phase 3: Set Thresholds

- Identify appropriate, potentially-tiered thresholds for version 2.0 Risk Assessment risk indicators.
- Distinguish between legislative/regulatory-defined thresholds, thresholds determined by evidence-based studies, thresholds commonly utilized by regulatory agencies, thresholds recognized by sector experience.

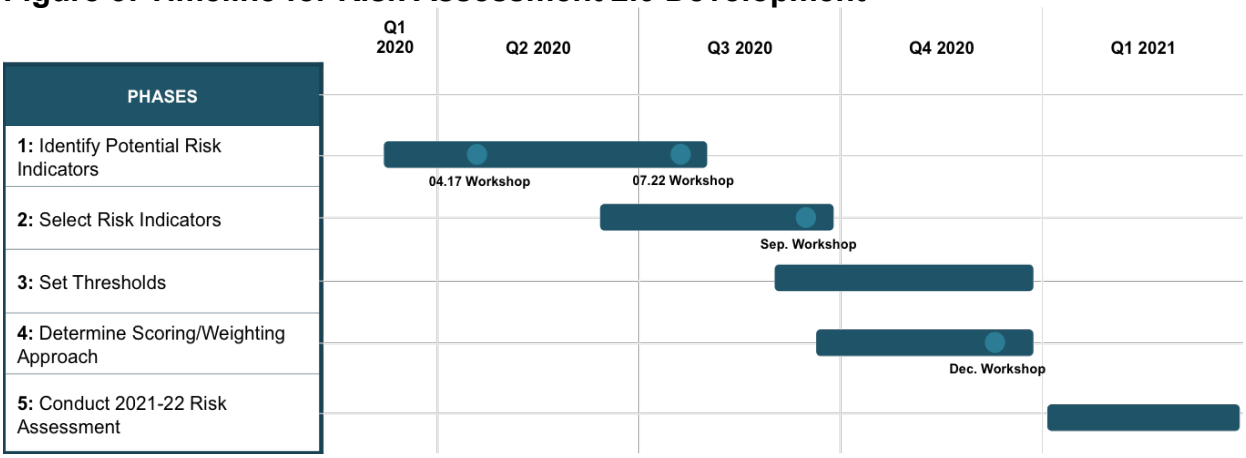
Phase 4: Determine Weighting/Scoring Approach

- Develop weighting/scoring Risk Assessment methodology – challenges to think through:
    - How does methodology change when data is missing?
    - How should weights be distributed across individual risk indicators and/or risk indicator categories?
- Develop at least three weighting/scoring options for Risk Assessment 2.0 methodology and pilot with a sample set of public water systems. Share results internally and with the public to vet accuracy of results.
- Host public webinar in December to solicit feedback and recommendations on Risk Assessment 2.0 options.

Phase 5: Finalize Methodology & Conduct 2021-22 Risk Assessment for Public Water Systems

- Incorporate feedback into final Risk Assessment 2.0.
- Develop a list of “at-risk” and “potentially at-risk” public water systems using Risk Assessment 2.0 for 2021-22 Fund Expenditure Plan.
- Make methodology available to the public.

Figure 3: Timeline for Risk Assessment 2.0 Development



Appendix A: Risk Assessment 1.0 Methodology and Results

Introduction

This Appendix summarizes the motivation behind and results from the initial phase of the small public water system Risk Assessment portion of the California State Water Resources Control Board's (State Water Board) ongoing Needs Assessment effort. As described above, while the State Water Board has contracted with UCLA and its research partners through March 2021 to carry out much of the initial Needs Assessment, the State Water Board is tasked by SB 200 to carry out an ongoing Needs Assessment.

Risk Assessment 1.0 focused on evaluating risk indicators for water quality compliance for community water systems with up to 3,300 service connections as well as non-transient non-community water systems which serve schools, due to the large number of historical violations associated with these systems. Risk Assessment 1.0 was applied to 2,841 water systems.[48]

One of the primary rationales for this size-specific assessment focus was that approximately 90% of California's public water system primary health-related (Maximum Contaminant Level, or MCL) violations occur in water systems serving 500 service connections or less, highlighting the generally-higher risks of small system size and corresponding lack of economies of scale. The state has also historically required more data reporting on multiple dimensions of performance for systems with more than 3,300 connections, and thus a focus on data and risks for smaller systems appeared uniquely valuable to inform the state's understanding and actions.

As described more fully later in this Appendix and in the April and July 2020 webinar workshop presentations, updating the Risk Assessment will be a long-term process managed by the State Water Board, and Risk Assessment 1.0 represents only the first step in this process. The State Water Board is currently and will continue to seek input from the public and will collaborate with other State Agencies doing similar work on an ongoing basis. Additional Board and stakeholder input will be put into practice before the assessment directly informs any state policy or funding decisions through the Advisory Committee process. UCLA will be supporting the Board in developing a 2.0 version of the Risk Assessment by March 2021.

Risk Assessment Version 1.0: Indicators & Methodology

Borrowing from the Intergovernmental Panel on Climate Change's framework for Climate Change Adaptation,[49] UCLA conceptually characterizes risk for a system as an outcome of:

[48] A handful of community water systems included in the analysis may subsequently be excluded pending further discussion between the Board and UCLA given that they represent special types of institutions, commonly: jails, hospitals, parks, military installations and power-generating facilities.

[49] See Cardona, O.D., M.K. van Aalst, J. Birkmann, M. Fordham, G. McGregor, R. Perez, R.S. Pulwarty, E.L.F. Schipper, and B.T. Sinh, 2012: Determinants of risk: exposure and vulnerability. In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)].

- exposure to a hazard (examples: drought, water contamination); and
- its vulnerability to the hazard.

Vulnerability is in turn determined for a system by the:

- sensitivity of its population (example: DAC status); and
- the system's internal adaptive capacity (example: Technical, Managerial, and Financial capability)

The Risk Assessment 1.0 methodology for small water systems was devised based on two primary considerations. First, risk indicators were included based on input on top risk indicators which the State Water Board received in a series of three workshops held with experts and the public from January- May 2019, as well as input from State Water Board district engineers who work directly with small water systems.[50] Further justification for the inclusion of each of these risk indicators is outlined in Appendix B. Second, final metric determination from identified risk indicators was based on the feasibility of data availability and operationalization for the time frame of Risk Assessment 1.0 completion by December 2019. With the passage of SB-200 and longer-term State Water Board staff availability and goals it was subsequently determined to simultaneously support the development of a longer-term Risk Assessment 2.0 public input process.

The determination of exact risk indicators, their comparative weightings and overall system scoring for Risk Assessment 1.0 were specified in the original scope of work in the contract between the State Water Board and UCLA, and carried out by UCLA exactly as specified in the contract, in close consultation with State Water Board staff.

Most data used for Risk Assessment 1.0 were provided by the State Water Board to UCLA in September-November 2019, except for data on active governance standing and priority groundwater basins, as described below.

As described below, data for many of the risk indicators required extensive cleaning and discretion in threshold setting by UCLA before being operationalized as risk indicators in the Risk Assessment 1.0. Procedures used to determine thresholds of concern for each indicator are described in Appendix B, and are also summarized in Table 1.

A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 65-108
https://www.ipcc.ch/site/assets/uploads/2018/03/SREX-Chap2_FINAL-1.pdf

[50] See the following link for details of workshop content:
Drinking Water Needs Assessment webpage
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/needs.html

Table 1: Method to convert risk indicators into binary metrics

Risk Indicators	Method
HR2W	Systems were classified in a binary fashion as either on the list and thus "in violation" or not
Waterborne Illness	Systems were categorized as "at risk" if they had more than one reported case of waterborne illness in 2016-2017 and no test result refuted the responsibility of the water system
Action Level: Pb or Cu	Systems were classified as "in violation" if they exceeded an Action Level (AL) between September 2018 and September 2019
E. coli	Systems were categorized as having this risk indicator if they incurred one or more E. coli violations between September 2018 and September 2019
Bacti Violation	Systems were categorized as having this risk indicator if they incurred one or more bacteriological violations between September 2016 and September 2019. Additionally, they were categorized as having this risk indicator if they had an E. coli violation between September 2016 and September 2018
Monitoring and Reporting Violation	Systems were categorized as having this risk indicator if they incurred one or more of these violations between September 2016 and September 2019
Treatment Technique Violation	Systems were categorized as having this risk indicator if they incurred one or more of these violations between September 2018 and September 2019
Operator Certification Violation	Systems were categorized as having this risk indicator if they did not employ a sufficient number of T&D operators at the levels required by the Board based on enforcement actions
Water Outages	Water systems with the highest proportion of outages per capita (the top decile of the distribution) were categorized as having this risk indicator
Active Standing with CA SoS Requirements	Systems were categorized as having this risk indicator only if they were clearly found to be in inactive standing
Extensive Treatment required	Systems were classified as having this risk indicator if they had one or more of these conditions: - Having a groundwater source concentration above a primary maximum contaminant level (MCL) - Having a groundwater source concentration that is 3 times above secondary MCL - Its surface water quality necessitates a surface water treatment plan
Disadvantaged Communities	Systems were identified as serving DAC if they benefited from a DAC fee reduction as of September 5th 2019
Single Groundwater Source	Systems were categorized as having this risk indicator if they relied on a single groundwater source
High Priority Basin	Systems were categorized as having this risk indicator if at least 50% of their service area was located within the boundaries of one or more high priority basins
Individual Meters	All systems with less than 50% of customers metered were counted for this risk indicator

Factors for Water Systems in Violation

- Listed as out-of-compliance on the HR2W list as of November 2019;
- With known cases of current waterborne illnesses based on State Water Board Division of Drinking Water records; and
- Above an Action Level for Lead or Copper

At-Risk Indicators for Water Systems

Water Quality

- With known cases of historic waterborne illnesses in the past three years based on State Water Board Division of Drinking Water records.;
- With water sources requiring extensive treatment (e.g. surface water treatment, groundwater treatment for a primary maximum contaminant level (MCL) or secondary MCL that has a source concentration that is 3 times the maximum contaminant level);
- With a bacteriological violation in the past three years or historical evidence of E. coli in an active source.

Water Accessibility

- With water outages in the past five years (except for planned maintenance);
- Located in a high priority groundwater basin;
- Reliant on a single groundwater well source.

Affordability & Technical, Managerial and Financial Capacity

- Private organizations or mutual water companies not in active standing with the California Secretary of State, or that have failed to organize or maintain an active board as an allowable business entity authorized to provide drinking water under the California Corporations Code;
- Lacking individual customer water meters;
- Failed to have an appropriately certified water treatment or distribution operator;
- Characterized as a disadvantaged community (defined as less than 80% of the Median Household Income (MHI), listed as a disadvantaged water system based on water supply fees, or based on collaboration with other partners;
- With a monitoring and reporting violation in the past three years;
- Treatment technique violation.[51]

The above risk indicators were transformed into metrics as illustrated in Table 1, and as described fully in the Appendix B. The risk metrics were then used to sort all systems into Risk Assessment result categories as specified in the following Tables 2 and 3. Again, due to their increased likelihood of being on the HR2W list, systems with 500 connections or less were effectively assessed as inherently being more at risk than systems with between 501-3,300 connections.

[51] Although not included in the original contract, the Water Board also provided data on treatment technique violations to UCLA, and this indicator was mutually agreed upon as a metric for inclusion. This additional risk indicator was incorporated with the same weight as the “other risk indicators” in the initial assessment, as described here.

Table 2: 500 or less connections or Schools

Risk Assessment Result Category	Definition
In Violation	Non-compliant on the HR2W List, current waterborne disease, or above an Action Level
At-Risk	Water outage, historical waterborne disease, extensive treatment, no active governance entity, or any two other risk indicators
Potentially At-Risk	Any one other risk indicator
Healthy	No risk indicators

Table 3: 501 or greater connections but no more than 3,300 connections

Risk Assessment Result Category	Definition
In Violation	Non-compliant on the HR2W list, current waterborne disease, or above an Action Level
At-Risk	Water outage, no active governance entity, or any three other risk indicators
Potentially At-Risk	Any two risk indicators, extensive treatment required, or in a high priority basin
Healthy	Remaining water systems with no more than one risk indicator

System-Wide Results of Risk Assessment 1.0

Risk Assessment 1.0 was applied to 2,841 water systems: 2,429 water systems with 500 or less connections and 412 water systems with more than 500 service connections but less than 3,301 service connections. Using this methodology, UCLA found a very large number of systems in violation, at-risk, and potentially at-risk, with only about a sixth being scored as healthy.[52] The results of this analysis are shown in both Table 4 and Figure 1 below.

Table 4: Results of Risk Assessment Version 1.0

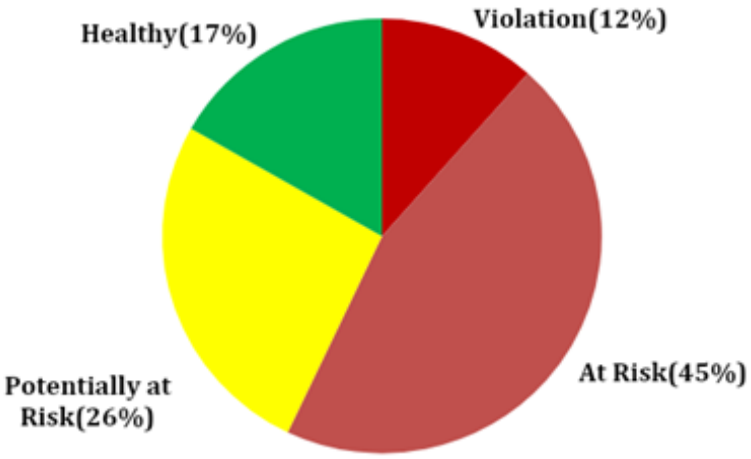
Water System	In Violation	At-Risk	Potentially At-Risk	Healthy
Water systems less than 501 service connections	299 WS (13%)	1,241 (51%)	566 (23%)	323 (13%)
Water systems between 501 and 3300 service connections	29 (7%)	52 (13%)	178 (43%)	153 (37%)
All water systems less than 3301	328 (12%)	1,293 (45%)	744 (26%)	476 (17%)

[52] It is important to note that this methodology includes systems which may not ultimately be desirable to keep within our analysis such as SFPUC wells or jails which are classified as community water systems, and also may exclude schools that do not have the word “school” in their name. Refer to the appendix for examples.

Water System	In Violation	At-Risk	Potentially At-Risk	Healthy
service connections				

In short, about 12% of all systems were classified as in violation, with smaller systems more likely to be so. The differences in risk by system sizes, however, are even more profound when looking at the other assessment categories. Over half of all systems with 500 service connections or less were deemed at-risk, and only 14% were scored as healthy. On the other hand, only 13% of all systems >500 service connections were classified as at-risk, with proportionally many more being scored as potentially at risk or healthy. Figure 1 depicts the combined assessment results for all systems, which is driven by the scoring of very small systems (86% of all systems analyzed).

Figure 1. Combined Classification of Risk Assessment 1.0 Results



UCLA also analyzed which risk indicators contributed to systems more commonly being classified as at-risk or potentially at-risk. UCLA found that a subset of the 14 risk indicators determined many systems' classifications. Table 5 shows the factors that contributed to these systems being labeled in higher risk categories most commonly, with the absence of individual meters, reliance on a single groundwater source, location in a high priority groundwater basin and the presence of monitoring and reporting violations standing out above other factors. Further detail on the prevalence of each risk indicator exceeding the threshold specified in the Risk Assessment 1.0 methodology is provided in Appendix B.

Table 5. Most Frequently-Incurred Risk Factors in Risk Assessment 1.0

Top 10 Risk Indicators	% of Water Systems "At- Risk"	% of Water Systems "Potentially At-Risk"
Absence of individual meters	63%	37%
Single groundwater well source	54%	37%
Located in high priority basin	40%	23%
Monitoring and reporting violation(s)	35%	14%
Bacteriological violation(s)	29%	5%

Top 10 Risk Indicators	% of Water Systems "At- Risk"	% of Water Systems "Potentially At-Risk"
Water source requiring extensive treatment	22%	18%
Not in active governance standing with state entity	12%	0%
Located in Disadvantaged Community	11%	13%
Substantial unplanned water outages	4%	0%
Presence of E. coli in the past 3 years	4%	0%
Total number of water systems:	**1,241**	**566**

UCLA further analyzed system assessment results by the number of risk indicators incurred and by ownership type. Systems currently in violation incurred an average of 2.6 risk indicators in addition to their HR2W violation or Action Level exceedance (or 3.6 total risk indicators), whereas systems assessed as at-risk incurred 2.5 risk indicators and potentially at-risk systems incurred 1 risk indicator. The presence of more risk indicators among systems in violation supports the basic utility of the Risk Assessment 1.0 methodology. On the other hand, initial modeling of the predictive value of existing risk indicators and system failure to comply with primary MCLs (on the HR2W list) was limited, suggesting that the assessment can be improved.

Moreover, analyzing system risk by ownership type suggests that the total population of small systems, and those in violation and at-risk, are concentrated in certain types of systems. Table 6 shows the ten most common ownership types among these systems. Systems which are mutual water companies, mobile home parks and non-investor owned utility (IOU) private systems stand out as having proportionally more at-risk systems than other system types, and County Service Areas (CSAs) have the highest proportion of in violation systems. Further analysis by ownership type or inclusion of this data in the form of a risk indicator may be merited.[53]

Table 6: Breakdown of Risk Assessment 1.0 Results by 10 Most Common System Ownership Types[54]

Ownership Type	In Violation	At-Risk	Potentially At-Risk	Healthy	Total (n)
Mutual water company	10%	41%	23%	25%	576
Private, non-IOU	14%	59%	19%	8%	466
Not available (many are schools)	15%	33%	42%	9%	379
Mobile home park	10%	70%	16%	3%	366
Community services district	14%	39%	27%	21%	168

[53] California WaterBlog
https://californiawaterblog.com/2019/09/01/who-governs-californias-drinking-water-systems/
[54] Coding for ownership type made possible by data provided by authors of Dobbin, K., Fencl, A., & Pannu, C. (2019) When Decentralization Fails: Governance and Inequity in California's Drinking Water System.

Ownership Type	In Violation	At-Risk	Potentially At-Risk	Healthy	Total (n)
Investor-owned utility	10%	28%	28%	33%	159
County Water District	6%	26%	38%	30%	113
City- municipal	7%	21%	42%	30%	112
County service area	21%	43%	23%	13%	75
Joint powers authority	7%	51%	19%	23%	70

Beyond Risk Assessment 1.0

The initial results of Risk Assessment 1.0 were presented to State Water Board staff in December 2019, refined and then were presented to the public at an April 17, 2020 State Water Board workshop. Feedback from State Water Board staff, UCLA research, subcontractors, and public input supported the development of Risk Assessment 2.0 that will:

1. Incorporate risk indicators that aligned with the four HR2W outcomes: water quality, water accessibility, water affordability, and Technical, Managerial, Financial (TMF) Capacity.
2. Explore tiered thresholds where possible.
3. Incorporate weighting and scoring methods that reflect the criticality of the risk indicators.

Example Potential Alternative Methodology Adapting Risk Assessment Version 1.0

How might making alterations beyond Risk Assessment 1.0 look in practice? Below is a brief example of how the risk methodology might be refined, and how this might lead to different Risk Assessment results. This alternative to Risk Assessment 1.0 illustrates how creating an additional category of overall risk, redefining weighting for existing risk indicators and for overall risk designations influences the risk assessment results. **It is important to note that this is an example using only 1.0 risk indicators, not a proposal.**

In this example, the following changes were made to Risk Assessment 1.0:

Threshold setting

- Changed the threshold for unplanned water outages to only consider it a risk indicator if it impacted more than 10% of the population

Weighting for individual metrics

- The weighting of E. coli was upgraded to add it to the list of risk indicators leading to water systems being classified as “in violation”

- Upgraded the weighting of the following risk indicators to make systems incurring them automatically “at risk”:
    - multiple violations (M&R and Bacti)
    - treatment technique violation
    - lack of certified operator
- Downgraded the weighting of the following risk indicators as shown in Table 7 below:
    - Extensive treatment requirement
    - Single groundwater source
    - Absence of metering
    - DAC status
    - High Priority Basin

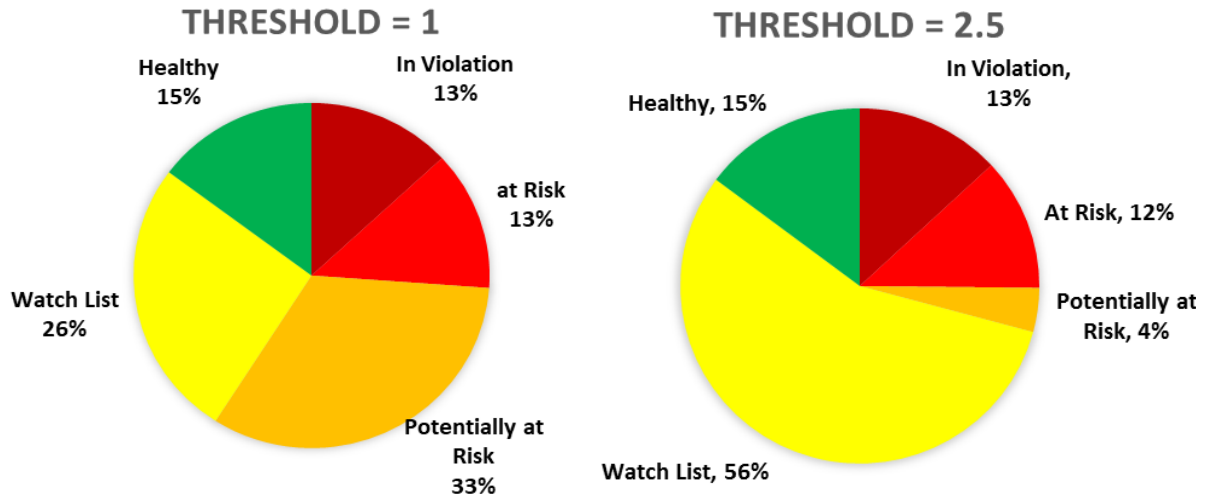
Table 7: Re-weighting Individual Risk Indicators

Risk Indicator	Weight/Score
Extensive Treatment	1
Single Bacti and/or M&R Violation	1
Single GW Source	0.5
Absence of Meter	0.5
DAC	0.25
High Priority Basin	0.25

Weighting for risk categories

An additional “Watch List” Risk Assessment results category was created and experimental adjustments were made to the weighting of the “Watch List” and “Potentially At-Risk” categories based on varying degrees of risk tolerance. As shown below, a threshold of 2.5 risk indicator points for categorizing systems as “potentially at-risk” leads to a dramatically more conservative approach in categorizing systems than a threshold of 1 risk point for this categorization.

Figure 2: Comparative results of systems assessed for risk with two different level of weighting schemes for “Potentially at risk” category



Again, this example illustrates the importance of methodological decisions in influencing final Risk Assessment results, not a formal recommendation for adjusting Risk Assessment 1.0. This illustration indicates why additional stakeholder input is desired prior to the full release of the Risk Assessment results, given that the State Water Board now has additional resources through SB-200. The second formal version of the Risk Assessment 2.0 will be developed by March 2021 informed by ongoing statistical analysis, stakeholder engagement, literature review, interviews of water experts and engineers, and collaboration with other State agencies. Furthermore, an iterative process to enhance the risk assessment over the long-term will be conducted by the State Water Board's Needs Analysis Unit in the Division of Drinking Water.

Appendix B. Risk Assessment 1.0 Risk Indicators

Straightforward Version 1.0 Risk Indicator Calculations

Ten of the fifteen factors operationalized as risk indicators in Risk Assessment 1.0 had both readily available data from existing State Water Board sources and had fairly straightforward binary thresholds for metric setting. While graduated threshold setting and weighting alterations may be considered for some of these metrics in future iterations of the risk assessment, many of these metrics are also tied to existing State Water Board regulatory standards.

HR2W List

In 2017, the State Water Board created the HR2W website portal and list to enable the public to look up their water system and see whether it complies with federal or State Safe Drinking Water Act standards. The list is updated and enhanced with additional information routinely by the State Water Board.

For the purposes of Risk Assessment 1.0, the list of systems classified as in violation on the Board's HR2W list was downloaded from the Water Boards' website[55] and merged with our list of water systems in November 2019. Systems were classified in a binary fashion as either on the list and thus "in violation" or not. A total of 259 water systems <501 service connections and 26 water systems > 500 service connections but less than 3,301 connections were classified as being in violation with Risk Assessment 1.0.

Waterborne Illness: Current or Historical

Regulated water systems are required by the State Water Board to self-report customer concerns regarding potential waterborne illness occurring as a result of contamination in the system's drinking water provision. These complaints are in turn often investigated by the systems, which conduct additional laboratory tests to either verify or dismiss the presence of contaminants associated with the complaint.

Reporting to the State Water Board is dependent upon water systems themselves reporting such information. Considering the self-reported nature of the data, and that many customer complaints are not verified by subsequent testing, it was decided for Risk Assessment 1.0 to only categorize water systems as in violation if:

- A system has a reported case of waterborne illness in 2018 and subsequent investigation showed a positive sampling result or that a corrective action was taken by the water system.

Systems were categorized as "at-risk" if:

- It had one or more reported case of waterborne illness in 2016-2017 and no test result refuted the responsibility of the water system.[56]

[55] Human Right to Water Portal: database named "Community, Schools, Daycares Public Water Systems Who Have Current Exceedance/Compliance Issues"
https://www.waterboards.ca.gov/water_issues/programs/hr2w/

[56] There have been some attempts made to obtain undisclosed laboratory test results by contacting regulating agencies or the concerned water systems.

As illustrated by the table below, no water system was considered "in violation" in the context of the Risk Assessment 1.0 as no "current" (2018), verified waterborne illness was reported. All four systems flagged in this process as water systems "at risk" due to "historical waterborne illness" reported in 2016 or 2017.

Lead and Copper

Due to their toxic health effects at elevated levels, especially for vulnerable populations, the 1991 Lead & Copper (LCR) Rule[57] requires water systems to monitor lead and copper levels at a sample of consumers' taps. However, due to cost and technical obstacles, testing only occurs at the taps of a small fraction of the overall customer population. However, those sampling locations are designed to represent the highest risk sampling locations. The LCR rule is important because it set an "Action Level" for water systems that exceed 0.015 mg/L for lead and 1.3 mg/L for copper which remains in place today. If Action Levels for lead or copper are exceeded, installation or modifications to corrosion control treatment are required. If the Action Level exceeded, public notification is also required.

For the purposes of Risk Assessment 1.0, a system was classified as in violation if it exceeded an Action Level between September 2018 and September 2019. A total of 49 WS were identified as having exceeded Action Levels for copper or lead. The table below breaks down those WS by size and exceedance type.

Table 8: Number of WS with Pb or Cu reported exceedance

Water System Type	Number of Systems with Lead Exceedance	Number of Systems with Copper Exceedance
Schools (Under 501 Connections)	9	7
All other WS under 501 SC	16	14
WS between 500 and 3,300 SC	0	3

Extensive Treatment Required

A 2013 State Water Board report[58] estimated that 680 community water systems rely on contaminated groundwater sources. The report found that of these 680 systems that rely on contaminated groundwater, 265 have provided water "that exceeded a public drinking water standard" during the compliance cycle from 2002 – 2010, suggesting a link between the existence of contaminated source water and the likelihood of a system serving water which violates a primary MCL.

Given these risks, the State Water Board compiles data on source water quality risks for regulated systems which necessitates these systems needing to perform "extensive treatment". There are three scenarios under which systems must undertake extensive treatment:

[57] A proposal for a federal revision of the LCR was released in 2019, but not finalized.
[58] Water Board (2013). Communities that Rely on a Contaminated Groundwater Source for Drinking Water

- Has a groundwater source concentration above a primary maximum contaminant level (MCL)
- Has a groundwater source concentration that is 3 times above secondary MCL
- Its surface water quality necessitates a surface water treatment plan

A system received a risk factor in Risk Assessment 1.0 if it had one or more of these conditions. Using these thresholds, 426 water systems were identified.

Monitoring and Reporting Violation

All water systems are required to monitor water quality and report water quality information both to regulators and to the public on regular intervals.[59] These monitoring and reporting requirements are mandatory under the Safe Drinking Water Act. [60] If a water system is found to not comply, it will receive a Monitoring and Reporting (M&R) violation.

M&R violations do not always reflect contamination of delivered water quality itself. Rather, monitoring and reporting violations show that proper reporting procedures or monitoring schedules regarding the containment were not followed.[61] A lack of compliance regarding procedural requirements can be considered as a proxy for lower technical or managerial capacity for a water system.

In Risk Assessment 1.0, systems were categorized as having this risk indicator if they incurred one or more of these violations between September 2016 and September 2019 (the last three years). 644 WS were identified as incurring an M&R violation using this metric. Out of those 644 water systems, 490 water systems < 501 service connections (or 23%), and 78 water systems > 500 service connections but less than 3,301 connections (or 19%). 246 of those systems had multiple violations.

Bacteriological Violation or E. coli

Bacteriological contaminants in drinking water can cause gastrointestinal diseases, infections, or more severe health impacts.[62] Bacteriological testing in drinking water typically is based on two types of testing in California, the presence of total coliform or the presence of E. coli. Coliforms are bacteria that are naturally present in the environment and are used as an indicator that other, potentially harmful, bacteria may be present. E. coli is a subset of the coliform bacteria that is typically considered to be of higher concern in drinking water systems. The presence of E. coli in drinking water suggests that the supply has fecal contamination, and in turn, that other pathogens

[59] EPA. (2019). Safe Drinking Water Act (SDWA) Resources and FAQs. Retrieved October 14, 2019 https://echo.epa.gov/help/sdwa-faqs
[60] Ibid
[61] Annual Compliance Report (2016). State of California & State Water Resources Control Board. https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/dwdocuments/2016/2016_acr_fnl070717.pdf
[62] International Human Rights Clinic. (2013). The Human Right to Water Bill in California: An Implementation Framework for State Agencies.

could be present.[63] The presence of these contaminants could also suggest that water treatment is inadequate, interrupted, or intermittent.[64]

In Risk Assessment 1.0, systems were categorized as having this risk indicator if they incurred one or more of these violations between September 2016 and September 2019 (the last three years). 408 water systems < 501 service connections and 57 water systems > 500 service but less than 3,301 connections were flagged as having at least one bacteriological violation using this metric. Among those water systems, 160 were reported to have multiple bacteriological violations.

Operator Certification Violations

Laws and regulations for public water system water treatment operators, initially dating back to 1971, set standards for the minimum levels at which water treatment facilities should be maintained, and the certification criteria for treatment and distribution system (T&D) operators. The level of certification required for T&D operators depends on the system size and source vulnerabilities.[65]

Guidelines for the certification and recertification for T&D operators of water supply systems were established in 1998, and California soon after established the Drinking Water Operator Certification Program, where 35,000 water treatment and distribution operators are tested. Certification is a two-step process that requires applicants to meet an educational requirement and also sit for an examination.[66]

A lack of adequately-trained water treatment or distribution operators may be indicative of larger technical and managerial risks borne by the system. Research shows that poorly trained staff and managers working on water systems can result in avoidable waterborne disease outbreaks.[67]

In Risk Assessment 1.0, systems were categorized as having this risk indicator if they did not employ a sufficient number of T&D operators at the levels required by the Board. Using enforcement data provided by the Board, only five WS have a reported operator certification violation and were flagged in the risk assessment. These systems, however, exhibited other important violations and risk indicators that can harm the population served. The Water Board is currently working on refining this data which may lead to the identification of additional operator certification violations through the use of better electronic annual report data tracking.

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[63] Coliform Bacteria and Drinking Water. (2011). Washington State Department of Health. https://www.doh.wa.gov/CommunityandEnvironment/DrinkingWater/Contaminants/Coliform

[64] Reynolds, K. A., Mena, K. D., & Gerba, C. P. (2008) Risk of waterborne illness via drinking water in the United States. Reviews of Environmental Contamination and Toxicology, 192, 117–158. https://doi.org/10.1007/978-0-387-71724-1_4

[65] Drinking Water Treatment & Distribution System Operators. (2019). Retrieved October 14, 2019 https://www.waterboards.ca.gov/drinking_water/certlic/occupations/DWopcert.html

[66] Drinking Water Treatment and Distribution Operator Certification Program Frequently Asked Questions. (2019). https://www.waterboards.ca.gov/drinking_water/certlic/occupations/documents/opcert/2013/dwocp_faq.pdf

[67] Hrudey SE, Hrudey EJ. Ensuring safe drinking water: learning from frontline experience with contamination. Denver (CO): American Water Works Association; 2014. Reviews key waterborne outbreaks and describes errors responsible

Treatment Technique Violations

According to US EPA and State Water Board regulations, systems must carry out specified treatment when there is no reliable or feasible method to measure the concentration of a contaminant to determine if there is a public health concern. A treatment technique is an enforceable procedure or level of technological performance which public water systems must follow to ensure control of a contaminant. The treatment technique rules also list the best available technology for meeting the standard, and the compliance technologies available and affordable for small systems. Some examples of treatment technique rules are the:

- Surface Water Treatment Rule (disinfection and filtration)
- Lead and Copper Rule (optimized corrosion control)
- Acrylamide and Epichlorohydrin Rules (purity of treatment chemicals)

This type of violation (which is distinct from more commonly-known MCL or M&R violations) is incurred when a water system does not follow required treatment techniques to reduce the risk from contaminants. In Risk Assessment 1.0, systems were categorized as having this risk indicator if they incurred one or more of these violations between September 2018 and September 2019 (the last year). Nineteen violations were identified across 8 systems.

Disadvantaged Community Status

Past research has found higher levels of contamination in regulated drinking water service provision to socio-economically disadvantaged areas in California; these areas also face issues with unequal maximum contaminant level compliance.[68] Disadvantaged community (DAC) status data for water systems provided by the State Water Board only included water systems that benefited from a DAC fee reduction as of September 5th 2019. A total of 160 water systems < 501 service connections and 114 water systems > 500 service connections but less than 3,301 connections were identified as being disadvantaged communities (DACs), with a median household income less than 80% of the state's, and thus received this risk indicator. If DAC status is included as a risk indicator in future Risk Assessments, a more inclusive approach to defining DAC status for systems will be incorporated.

Single Groundwater Source

The reliance of a water system on a single source of supply makes it inherently more at risk of failure in the case of severe drought or contamination of that source. In Risk Assessment 1.0, systems were categorized as having this risk indicator if they relied on a single groundwater source. According to data provided by the State Water Board, a

[68] Balazs, C. L., Morello-Frosch, R., Hubbard, A. E., & Ray, I. (2012). Environmental justice implications of arsenic contamination in California's San Joaquin Valley: A cross-sectional, cluster-design examining exposure and compliance in community drinking water systems. Environmental Health: A Global Access Science Source, 11(1), 1–12.
https://doi.org/10.1186/1476-069X-11-84
Balazs, C., Morello-Frosch, R., Hubbard, A., & Ray, I. (2011). Social disparities in nitrate-contaminated drinking water in California's San Joaquin Valley. Environmental Health Perspectives, 119(9), 1272–1278.
https://ehp.niehs.nih.gov/doi/10.1289/ehp.1002878

total of 1,014 water systems < 501 service connections and 5 water systems > 500 service connections but less than 3,301 connections rely on a single groundwater well.

More Complicated Version 1.0 Risk Indicator Calculations

By contrast with the ten indicators operationalized as risk indicators above, the five indicators described below either required extensive data collection before they could be interpreted or entailed considerable discretion in setting a binary threshold for a risk metric. Both binary and graduated threshold setting, and weighting alterations may be considered for some of these metrics in future iterations of the Risk Assessment.

Active Standing with CA Secretary of State Requirements

Some water systems are also entities such as corporations, limited liability companies and common interest development associations, which California law requires to update their registration with the California Secretary of State either every year or every two years to be considered active operating entities. Private entities that fail to file the required statements or to pay their fees can lose their good standing status and be considered "cancelled", "dissolved", or be attributed another inactive governance status as defined by the secretary of state.[69] The meaning and severity of these terms vary depending on the entity, the compliance requirements, and the duration of the registration failure. UCLA used this indicator hypothesizing that failure to register as an official entity signifies a lack of managerial capacity of the water system. Additionally, this was also considered a risk factor because the State Water Board's Division of Financial Assistance typically cannot provide funding to water systems, including grant funding to DAC systems, that do not maintain active status.

Based on the search engine provided by the Secretary of State's website, UCLA manually identified water systems that were not in compliance with active status requirements using their entity names. This was a very time-intensive process. As illustrated in the table below, out of a total of 1,585 private water systems, only 55% of the water systems were found to be active. 34% of the water systems were not found (Not/Available [N/A]), leaving a total of 11% of the private water systems clearly not being in active standing with the status requirements. In Risk Assessment 1.0, systems were categorized as having this risk indicator only if they were clearly found to be in inactive standing.

Table 9: Distribution of water systems based on their registration status

Status	Number of Water Systems
Merged Out	1
SOS/FTB Forfeited	1
Term Expired	1
SOS/FTB Suspended	6
SOS Suspended	17
Cancelled	30

[69] See California Secretary of State https://www.sos.ca.gov/business-programs/business-entities/cbs-field-status-definitions/

Status	Number of Water Systems
Dissolved	52
FTB Suspended	62
Not/Available	536
Active	879
Total	**1585**

Water systems categorized as N/A (536) may be attributable to variation between their state registration name and their water system name, or due to non-registration with the state; this lack of information yields an inconclusive understanding of the status of these systems. If this risk indicator is to be used going forward, an easier and more systematic method of identification may prove beneficial in identifying and tracking private water systems of interest.

Water Outages

There are numerous reasons why unplanned water outages can occur for a water system. Some are due to exogenous factors outside the system's control such as flooding, earthquakes, fire, or drought. Others are due to aging infrastructure, lack of necessary maintenance and investments which might have been avoided by better system technical management. The literature does not provide much guidance as to whether an expectation of zero outages across a service territory is reasonable, especially for large systems.

Water systems self-report to the State Water Board the number of their water outages per year and the main reason for the outage; no duration data was provided. A sizable number of water outages were either scheduled, or the result of power outages, or surrounding fires. UCLA excluded these types of outages manually from our calculations, which was a time-intensive process. A preliminary screening of water outage causes resulted in the table, which shows the most frequent reported causes of water outages. Fires and power outages (which in some cases are related), represent 20% of all outages.

After excluding every outage that should not be considered the responsibility of the water systems, it was found that 6% of all water systems <501 service connections and 16% of all water systems >500 but less than 3,301 connections had water outages in 2018. These proportions seem to hold true in prior years as well (between 2014 and 2018). Finally, when looking at the number of water outages per capita, 99% of the reported water outages affected less than 10% of the total population served. 96% of all reported water outages affected less than 5% of the total population.

In Risk Assessment 1.0, only the top decile of water systems with the highest proportion of outages per capita (106% to 2.4%) were categorized as having this risk indicator, resulting in 81 water systems identified with water outage problems. Only 62 of those systems were water systems included in our Risk Assessment: 59 water systems <501 service connections and 2 water systems >500 but less than 3,301 connections.

Absence of Customer-Level Meters

Without consumption meters in place for individual customers, water systems do not know how much water different households or buildings are using. Moreover, metering also allows for identification of leaks and pipe bursts via comparison to source water meters and therefore may decrease the response time to open pipes that could lead to bacteriological contamination. The absence of meters also suggests a lack of technical sophistication and may lead to managerial and financial difficulties. Despite state laws requiring all new developments and urban water systems to have meters installed, hundreds of water systems do not have the majority of their customers metered.

Water systems report to the State Water Board the number of service connections equipped with individual meters. Most systems either have 0% metered or 100% metered.

For the purpose of Risk Assessment 1.0, all systems with less than 50% of customers metered were counted for this risk indicator, as were the 258 water systems that reported "NULL" instead of a number. A total of 1,098 water systems < 501 service connections and 59 water systems >500 service connections but less than 3,301 connections were identified as having less than 50% of the service connections equipped with individual meters. Schools were excluded from calculation of this risk indicator due to lack of data and relevance.

Location in a High Priority Groundwater Basin

Finally, in 2015, the state of California passed the Sustainable Groundwater Management Act (SGMA).[70] Part of SGMA requires that the state prioritize each groundwater basin in the state, and those that are ranked as high and medium priority, and are required to meet certain sustainability standards on a specific timeline.[71] Basins are prioritized based on many factors such as population served, number of water wells that draw on each basin, degree to which people over the basin rely on groundwater, or potential impacts to the groundwater in the basin, including water quality impacts.[72]

UCLA overlaid SGMA high priority groundwater basin locations with water system boundaries using GIS tools,[73] hypothesizing that systems in high priority groundwater

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[70] State of California. (2014). Sustainable Groundwater Management Act. *Division of Agriculture and Natural Resources. University of California, Davis*.
http://groundwater.ucdavis.edu/SGMA/%0Awww.downeybrand.com

[71] DWR Releases Draft Prioritization of Groundwater Basins under SGMA. (2018). Retrieved October 14, 2019
https://water.ca.gov/News/News-Releases/2018/May-18/DWR-Releases-Draft-Prioritization-of-Groundwater-Basins-Under-SGMA

[72] California State Legislature (2015). Division 6, Part 2.11, Chapter 3: Groundwater Monitoring Program [10927 - 10936]. *California Legislative Information*.
https://leginfo.legislature.ca.gov/faces/codes_displayText.xhtml?lawCode=WAT&division=6.&title=&part=2.11.&chapter=3.&article=

[73] Data sources used for this spatial intersection were:
• California Open Data Portal-California county boundaries
https://data.ca.gov/dataset/ca-geographic-boundaries
• Tracking California-Water system boundaries: All "Current" water system boundaries
https://trackingcalifornia.org/
• DWR water atlas-Groundwater basin boundaries: Bulletin 118 basin shapefiles
http://atlas-dwr.opendata.arcgis.com/datasets/ca-bulletin-118-groundwater-basins

basins may be at greater risk than others. In Risk Assessment 1.0, systems were categorized as having this risk indicator if at least 50% of their service area was located within the boundaries of one or more high priority basins. A total of 657 water systems < 501 service connections and 102 water systems > 500 service connections but less than 3,301 connections were identified as being located within high priority groundwater basins.

• Basin Prioritization: Phase 1 (Final) Phase 2 (Draft) Basin Summary Table for SGMA
https://data.cnra.ca.gov/dataset/sgma-basin-prioritization