2021

DRINKING WATER RISK ASSESSMENT FOR PUBLIC WATER SYSTEMS

Informing the 2021-22 Safe & Affordable Drinking Water Fund Expenditure Plan

The Risk Assessment is a component of the Needs Assessment. Access full Needs Assessment Report:

https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2021_needs_assessment.pdf

CALIFORNIA Water Boards

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Acknowledgements

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DEFINITION OF TERMS

This report includes the following defined terms.

"**Affordability Threshold**" means the level, point, or value that delineates if a water system's residential customer charges, designed to ensure the water systems can provide drinking water that meets State and Federal standards, are unaffordable. For the purposes of the 2021 Affordability Assessment, the State Water Board employed affordability thresholds for the following indicators: Percent Median Household Income; Extreme Water Bill; and Percent Shut-Offs. Learn more about current and future indicators and affordability thresholds in Appendix E.

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

"**Administrator**" means an individual, corporation, company, association, partnership, limited liability company, municipality, public utility, or other public body or institution which the State Water Board has determined is competent to perform the administrative, technical, operational, legal, or managerial services required for purposes of Health and Safety Code section 116686, pursuant to the Administrator Policy Handbook adopted by the State Water Board. (Health & Saf. Code, §§ 116275, subd. (g), 116686, subd. (m)(1).)

"**Affordability Assessment"** means the identification of any community water system that serves a disadvantaged community that must charge fees that exceed the affordability threshold established by the State Water Board in order to supply, treat, and distribute potable water that complies with Federal and state drinking water standards. The Affordability Assessment evaluates several different affordability indicators to identify communities that may be experiencing affordability challenges. (Health & Saf. Code, § 116769, subd. (2)(B).

"**At-Risk public water systems**" or "**At-Risk PWS**" means community water systems with 3,300 service connections or less and K-12 schools that are at risk of failing to meet one or more key Human Right to Water goals: (1) providing safe drinking water; (2) accessible drinking water; (3) affordable drinking water; and/or (4) maintaining a sustainable water system.

"**At-Risk state small water systems and domestic wells**" or "**At-Risk SSWS and domestic wells**" means state small water systems and domestic wells that are located in areas where groundwater is at high risk of containing contaminants that exceed safe drinking water standards. This definition may be expanded in future iterations of the Needs Assessment as more data on domestic wells and state small water systems becomes available.

"**California Native American Tribe**" 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).) Typically, drinking water systems for Federally recognized tribes fall under the regulatory jurisdiction of the United States Environmental Protection Agency (U.S. EPA), while public water systems operated by non-Federally recognized tribes currently fall under the jurisdiction of the State Water Board.

"**Capital costs**" means the costs associated with the acquisition, construction, and development of water system infrastructure. These costs may include the cost of infrastructure (treatment solutions, consolidation, etc.), design and engineering costs, environmental compliance costs, construction management fees, general contractor fees, etc. Full details of the capital costs considered and utilized in the Needs Assessment are in Appendix C.

"**Community water system**" or "**CWS**" means a public water system that serves at least 15 service connections used by yearlong residents or regularly serves at least 25 yearlong residents of the area served by the system. (Health & Saf. Code, § 116275, subd. (i).)

"**Consistently fail**" means a failure to provide an adequate supply of safe drinking water. (Health & Saf. Code, § 116681, subd. (c).)

"**Consolidation**" means joining two or more public water systems, state small water systems, or affected residences into a single public water system, either physically or managerially. For the purposes of this document, consolidations may include voluntary or mandatory consolidations. (Health & Saf. Code, § 116681, subd. (e).)

"**Contaminant**" means any physical, chemical, biological, or radiological substance or matter in water. (Health & Saf. Code, § 116275, subd. (a).)

"**Cost Assessment**" means the estimation of funding needed for the Safe and Affordable Drinking Water Fund for the next fiscal year based on the amount available in the fund, anticipated funding needs, and other existing State Water Board funding sources. Thus, the Cost Assessment estimates the costs related to the implementation of interim and/or emergency measures and longer-term solutions for HR2W list systems and At-Risk public water systems, state small water systems, and domestic wells. The Cost Assessment also includes the identification of available funding sources and the funding and financing gaps that may exist to support interim and long-term solutions. (Health & Saf. Code, § 116769.)

"**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% of the statewide annual median household income level. (Health & Saf. Code, § 116275, subd. (aa).)

"**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).)

"**Drinking Water Needs Assessment"** or "**Needs Assessment**" means the comprehensive identification of California drinking water needs. The Needs Assessment consist of three core components: the Affordability Assessment, Risk Assessment, and Cost Assessment. The results of the Needs Assessment inform the State Water Board's annual Fund Expenditure Plan for the Safe and Affordable Drinking Water Fund and the broader activities of the SAFER Program. (Health & Saf. Code, § 116769.)

"**Fund Expenditure Plan**" or "**FEP**" means the plan that the State Water Board develops pursuant to Article 4 of Chapter 4.6 of the Health and Safety Code for the Safe and Affordable Drinking Water Fund, established pursuant to Health and Safety Code § 116766.

“**Human consumption**” means the use of water for drinking, bathing or showering, hand washing, oral hygiene, or cooking, including, but not limited to, preparing food and washing dishes. (Health & Saf. Code, § 116275, subd. (e).)

*“***Human Right to Water**” or “**HR2W***”* means the recognition that “every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking and sanitary purposes,” as defined in Assembly Bill 685 (AB 685). (California Water Code § 106.3, subd. (a).)

“**Human Right to Water list**” or “**HR2W list**” means the list of public water systems that are out of compliance or consistently fail to meet primary drinking water standards. Systems that are assessed for meeting the HR2W list criteria include Community Water Systems and Non-Community Water Systems that serve K-12 schools and daycares. The HR2W list criteria were expanded in April 2021 to better align with statutory definitions of what it means for a water system to “consistently fail” to meet primary drinking water standards. (California Health and Safety Code § 116275(c).)

“**Interim replacement water**” or **“Interim solution”** includes, but is not limited to; bottled water, vended water, and point-of-use or point-of-entry treatment units. (Health & Saf. Code, § 116767, subd. (q).)

“**Loan**” means any repayable financing instrument, including a loan, bond, installment sale agreement, note, or other evidence of indebtedness.

“**Local cost share**” means a proportion of the total interim and/or long-term project cost that is not eligible for a State grant and would therefore be borne by water systems, their ratepayers, and/or domestic well owners. Some local cost share needs may be eligible for public or private financing (i.e. a loan). Some local costs share needs may not be eligible for financing and is typically funded through available reserves or cash on hand.

“**Maximum contaminant level**” or “**MCL**” means the maximum permissible level of a contaminant in water. (Health & Saf. Code, § 116275, subd. (f).)

“**Median household income**” or “**MHI**” means the household income that represents the median or middle value for the community. The methods utilized for calculating median household income are included in Appendix A and Appendix E. Median household incomes in this document are estimated values for the purposes of this statewide assessment. Median household income for determination of funding eligibility is completed on a system by system basis by the State Water Board’s Division of Financial Assistance.

“**Net present worth**” or “**NPW**” means the estimate of the total sum of funds that need to be set aside today to cover all expenses (capital, including other essential infrastructure costs, and annual O&M) during the potential useful life of the infrastructure investment, which is conservatively estimated at 20-years. The estimate of the total sum of funds is adjusted by an annual discount rate which accounts for the higher real cost of financial outlays in the immediate future when compared to the financial outlays in subsequent years.

“**Non-Community Water System**” means a public water system that is not a community water system. (Health & Saf. Code, § 116275, subd. (j).)

"**Non-transient Non-Community Water System**" means a public water system that is not a community water system and that regularly serves at least 25 of the same persons for six months or more during a given year, such as a school. (Health & Saf. Code, § 116275, subd. (k).)

"**Operations and maintenance**" or "**O&M**" means the functions, duties and labor associated with the daily operations and normal repairs, replacement of parts and structural components, and other activities needed by a water system to preserve its capital assets so that they can continue to provide safe drinking water.

"**Other essential infrastructure**" or "**OEI**" encompasses a broad category of additional infrastructure needed for the successful implementation of the Cost Assessment's long-term modeled solutions and to enhance the system's sustainability. OEI includes storage tanks, new wells, well replacement, upgraded electrical, added backup power, replacement of distribution system, additional meters, and land acquisition.

"**Potentially At-Risk**" means community water systems with 3,300 service connections or less and K-12 schools that are potentially at risk of failing to meet one or more key Human Right to Water goals: (1) providing safe drinking water; (2) accessible drinking water; (3) affordable drinking water; and/or (4) maintaining a sustainable water system.

"**Primary drinking water standard**" means: (1) Maximum levels of contaminants that, in the judgment of the state board, may have an adverse effect on the health of persons. (2) Specific treatment techniques adopted by the state board in lieu of maximum contaminant levels pursuant to Health & Saf. Code, § 116365, subd. (j). (3) The monitoring and reporting requirements as specified in regulations adopted by the state board that pertain to maximum contaminant levels. (Health & Saf. Code, § 116275, subd. (c).)

"**Public water system**" or "**PWS**" 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).)

"**Refined grant needs**" means the estimated costs, generated from the Cost Assessment Model, that have been adjusted by removing costs for water systems that have existing funding agreements with the State Water Board and identifying the proportion of costs that are grant-eligible.

"**Resident**" means a person who physically occupies, whether by ownership, rental, lease, or other means, the same dwelling for at least 60 days of the year. (Health & Saf. Code, § 116275, subd. (t).)

"**Risk Assessment**" means the identification of public water systems, with a focus on community water systems and K-12 schools, that may be at risk of failing to provide an

adequate supply of safe drinking water. It also includes an estimate of the number of households that are served by domestic wells or state small water systems in areas that are at high-risk for groundwater contamination. Different Risk Assessment methodologies have been developed for different system types: (1) public water systems; (2) state small water systems and domestic wells; and (3) tribal water systems. (Health & Saf. Code, § 116769)

"**Risk indicator**" means the quantifiable measurements of key data points that allow the State Water Board to assess the potential for a community water system or a transient non-community water system that serves a K-12 school to fail to sustainably provide an adequate supply of safe drinking water due to water quality, water accessibility, affordability, institutional, and/or TMF capacity issues.

"**Risk threshold**" means the levels, points, or values associated with an individual risk indicator that delineates when a water system is more at-risk of failing, typically based on regulatory requirements or industry standards.

"**Safe and Affordable Drinking Water Fund**" or "**SADWF**" means the fund created through the passage of Senate Bill 200 (SB 200) to help provide an adequate and affordable supply of drinking water for both the near and long terms. SB 200 requires the annual transfer of 5 percent of the annual proceeds of the Greenhouse Gas Reduction Fund (GGRF) (up to $130 million) into the Fund until June 30, 2030. (Health & Saf. Code, § 116766)

"**Safe and Affordable Funding for Equity and Resilience Program**" or "**SAFER Program**" means a set of State Water Board tools, funding sources, and regulatory authorities designed to meet the goals of ensuring safe, accessible, and affordable drinking water for all Californians.

"**Safe drinking water**" means water that meets all primary and secondary drinking water standards, as defined in Health and Safety Code section 116275.

"**Score**" means a standardized numerical value that is scaled between 0 and 1 for risk points across risk indicators. Standardized scores enable the evaluation and comparison of risk indicators.

"**Secondary drinking water standards**" means standards that specify maximum contaminant levels that, in the judgment of the State Water Board, are necessary to protect the public welfare. Secondary drinking water standards may apply to any contaminant in drinking water that may adversely affect the public welfare. Regulations establishing secondary drinking water standards may vary according to geographic and other circumstances and may apply to any contaminant in drinking water that adversely affects the taste, odor, or appearance of the water when the standards are necessary to ensure a supply of pure, wholesome, and potable water. (Health & Saf. Code, § 116275, subd. (d).)

"**Service connection**" means the point of connection between the customer's piping or constructed conveyance, and the water system's meter, service pipe, or constructed conveyance, with certain exceptions set out in the definition in the Health and Safety Code. (See Health & Saf. Code, § 116275, subd. (s).)

“**Severely disadvantaged community**” or “**SDAC**” means the entire service area of a community water system in which the MHI is less than 60% of the statewide median household income. (See Water Code § 13476, subd. (j))

“**Small community water system**” means a CWS that serves no more than 3,300 service connections or a yearlong population of no more than 10,000 persons. (Health & Saf. Code, § 116275, subd. (z).)

“**Small disadvantaged community**” or “**small DAC**” means the entire service area, or a community therein, of a community water system that serves no more than 3,300 service connections or a year-round population of no more than 10,000 in which the median household income is less than 80% of the statewide annual median household income.

“**State small water system**” or “**SSWS**” 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).)

“**State Water Board**” means the State Water Resources Control Board.

“**Technical, Managerial and Financial capacity**” or “**TMF capacity**” means the ability of a water system to plan for, achieve, and maintain long term compliance with drinking water standards, thereby ensuring the quality and adequacy of the water supply. This includes adequate resources for fiscal planning and management of the water system.

“**Waterworks Standards**” means regulations adopted by the State Water Board entitled “California Waterworks Standards” (Chapter 16 (commencing with Section 64551) of Division 4 of Title 22 of the California Code of Regulations). (Health & Saf. Code, § 116275, subd. (q).)

“**Weight**” means the application of a multiplying value or weight to each risk indicator and risk category within the Risk Assessment, as certain risk indicators and categories may be deemed more critical than others.

RISK ASSESSMENT RESULTS FOR PUBLIC WATER SYSTEMS

OVERVIEW

The purpose of the Risk Assessment for public water systems is to identify systems at risk or potentially at risk of failing to meet one or more key Human Right to Water goals: (1) providing safe drinking water; (2) accessible drinking water; (3) affordable drinking water; and/or (4) maintaining a sustainable water system. Data on performance and risk is most readily available for public water systems and thus the risk assessment methodology for public water systems allows for a multi-faceted examination across four risk indicator categories: Water Quality, Accessibility, Affordability; and TMF (technical, managerial, and financial) Capacity.

PUBLIC WATER SYSTEMS ASSESSED

The Risk Assessment for public water systems was conducted for community water systems with 3,300 service connections or less and all non-transient non-community water systems which serve K-12 schools. 72 wholesalers were not included in the Risk Assessment because they do not provide direct service to residential customers and larger water systems were excluded in this assessment because the overwhelming majority of violations occur in small systems. See Table 11 for details.

Table 11: Public Water Systems Analyzed in the Risk Assessment

Water System Type[1]	Number	Water Quality	Accessibility	Affordability	TMF Capacity
Public Water Systems[2] (≤ 3,300 connections)	2,241	Yes	Yes	Yes	Yes

[1] Systems on the HR2W list were included in the Risk Assessment analysis, however, they were excluded from the final Risk Assessment results.

[2] Wholesalers were excluded.

Water System Type[1]	Number	Water Quality	Accessibility	Affordability	TMF Capacity
K-12 Schools[3]	383	Yes	Yes	No	Yes
Other Public Water Systems[4]	155	Yes	Yes	No	Yes
TOTAL ANALYZED:	**2,779**				

RISK ASSESSMENT METHODOLOGY

The State Water Board and UCLA developed the 2021 Risk Assessment methodology though a phased public process from January 2019 through January 2021. One in-person and four public webinar workshops were hosted to solicit public feedback. The Risk Assessment methodology and the development process are detailed in Appendix A. The Risk Assessment methodology relies on three core elements which are utilized to calculate an aggregated risk score for the public water system assessed (Figure 12):

Risk Indicators: quantifiable measurements of key data points that allow the State Water Board to assess the potential for a water system to fail to sustainably provide an adequate supply of safe drinking water due to water quality, water quantity, infrastructure, and/or institutional issues. Risk indicators that measure water quality, accessibility, affordability, and TMF capacity are incorporated based on their criticality as it relates to a system's ability to remain in compliance with safe drinking water standards and their data availability and quality across the State.

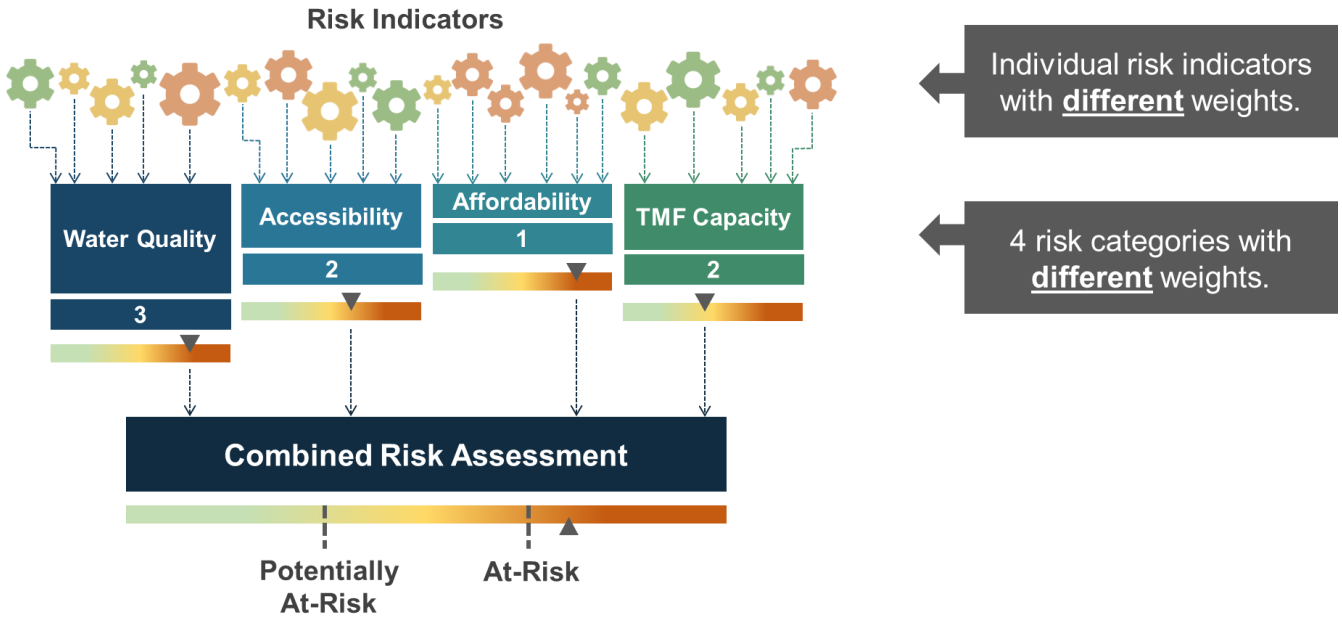
Risk Indicator Thresholds: the levels, points, or values associated with an individual risk indicator that delineates when a water system is more at-risk of failing, typically based on regulatory requirements or industry standards.

Scores & Weights: the application of a multiplying value or weight to each risk indicator and risk category, as certain risk indicators and categories may be deemed more critical than others and/or some may be out of the control of the water system. The application of weights to risk indicators and risk categories allows the State Water Board multiple ways to assess all risk indicators within each category together in a combined Risk Assessment score.

[3] These systems were manually identified by the State Water Board.

[4] Transient Areas, Recreational Facilities, Hotels, Summer Camps, Prisons, Medical Facilities, Military Complexes

Figure 12: Illustration of the Risk Assessment Methodology



RISK INDICATORS

The State Water Board, in partnership with UCLA and with public feedback, identified 19 risk indicators to utilize in the Risk Assessment. A concerted effort was made to select a range of risk indicators that measure water quality, accessibility, affordability, and TMF capacity based on their criticality as it relates to a system's ability to remain in compliance with safe drinking water standards.

The effort to identify and select these risk indicators included full consideration of indicators identified in efforts conducted by the Office of Environmental Health Hazard Assessment (OEHHA), the Department of Water Resources (DWR), and the California Public Utilities Commission. Risk indicators were also assessed based on the availability of quality statewide data. The definitions and calculation methodologies for each risk indicator are summarized in Appendix A. Information on how the 19 risk indicators were selected from a list of 129 potential risk indicators is detailed in the October 7, 2020 white paper.[5]

[5] October 7, 2020 White Paper:
Evaluation of Potential Indicators and Recommendations for Risk Assessment 2.0 for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/e_p_i_recommendations_risk_assessment_2_public_water_systems.pdf

Table 12: Risk Assessment Risk Indicators

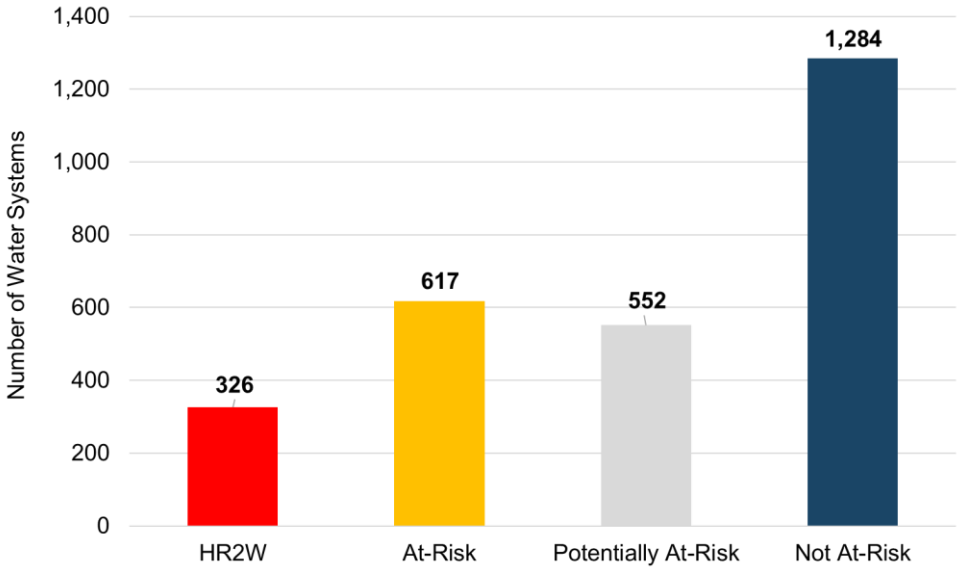
Risk Indicator Category	Risk Indicators
Water Quality	History of E. coli Presence
	Increasing Presence of Water Quality Trends Toward MCL
	Treatment Technique Violations
	Past Presence on the HR2W List
	Maximum Duration of High Potential Exposure (HPE)
	Percentage of Sources Exceeding an MCL
Accessibility	Number of Sources
	Absence of Interties
	Water Source Types
	DWR – Drought & Water Shortage Risk Assessment Results
	Critically Overdrafted Groundwater Basin
Affordability	Percent of Median Household Income (%MHI)
	Extreme Water Bill
	% Shut-Offs
TMF Capacity	Number of Service Connections
	Operator Certification Violations
	Monitoring and Reporting Violations
	Significant Deficiencies
	Extensive Treatment Installed

RISK ASSESSMENT RESULTS

AT-RISK WATER SYSTEMS

The 2021 Risk Assessment was conducted for 2,779 public water systems. After removing 326 (12%) HR2W systems with 3300 connections or less, the results identified 617 (25%) At-Risk water systems, 552 (23%) Potentially At-Risk water systems, and 1,284 (52%) Not At-Risk water systems (Figure 13).

Figure 13: Number of Public Water Systems (3,300 service connection or less) and K-12 Schools At-Risk and Potentially At-Risk (excluding HR2W list systems)



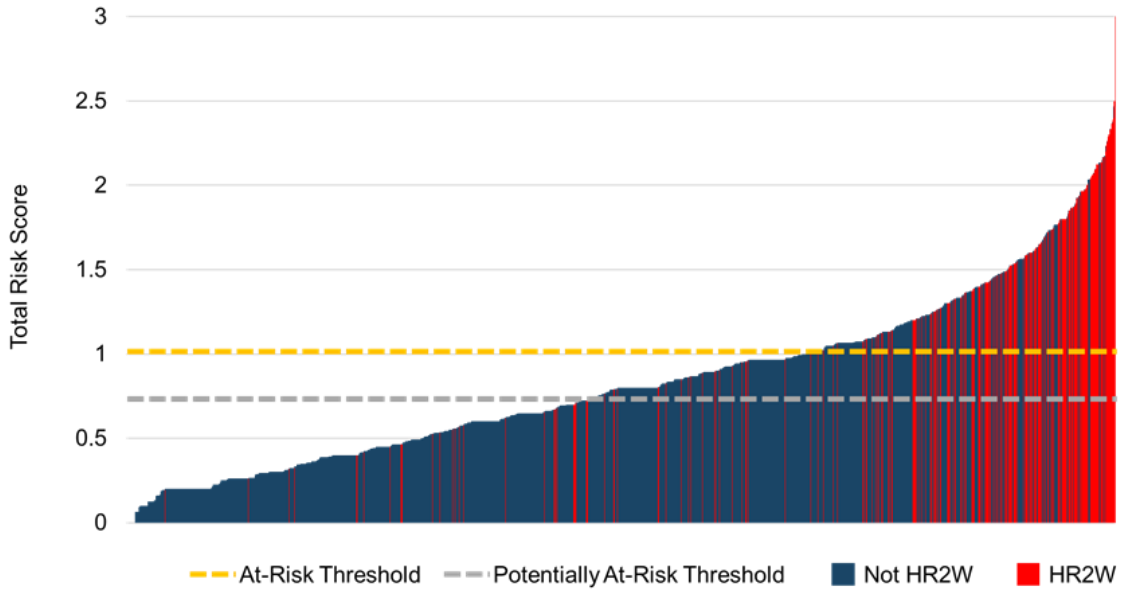
Access the Current List of At-Risk and Potentially At-Risk Water Systems:

The full list of At-Risk and Potentially At-Risk water systems is available in Attachment A1.[6] The State Water Board will be maintaining this list as data changes occur. Therefore, the list of water systems designated At-Risk and Potentially At-Risk in this Attachment may have evolved from the aggregated assessment results summarized in this report.

[6] Attachment A1: 2021 Risk Assessment Results
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/docs/a1.xlsx

The Risk Assessment results for public water systems is supported by the results which indicated that failing systems on the HR2W list had more than double the average risk score (1.5 vs. 0.7). Furthermore, 268 (82%) HR2W list systems exceeded the At-Risk threshold compared to all 2453 (25%) of the other systems analyzed (Figure 14).

Figure 14: Distribution of Total Risk Score for Water Systems (n=2,779)



The distribution of At-Risk and Potentially At-Risk systems also varies substantially across the state, as shown in Figures 16 and 17. For instance, Kings County has the highest proportion of At-Risk systems (75%), whereas Modoc County and San Francisco County have the lowest proportion of At-Risk systems (0%).

Figure 15: Population of At-Risk and Potentially At-Risk Communities

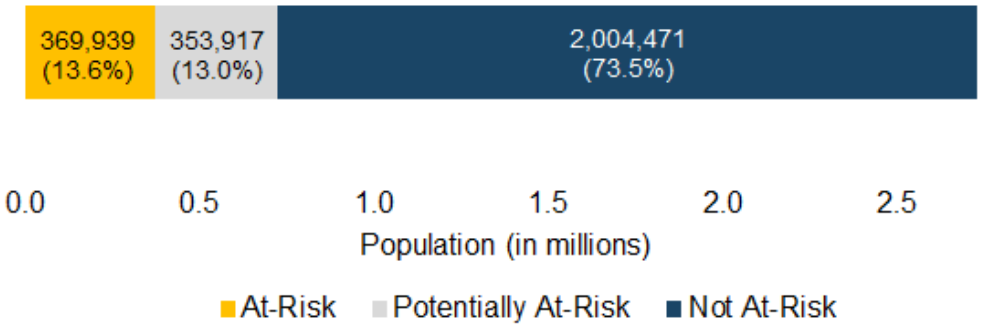
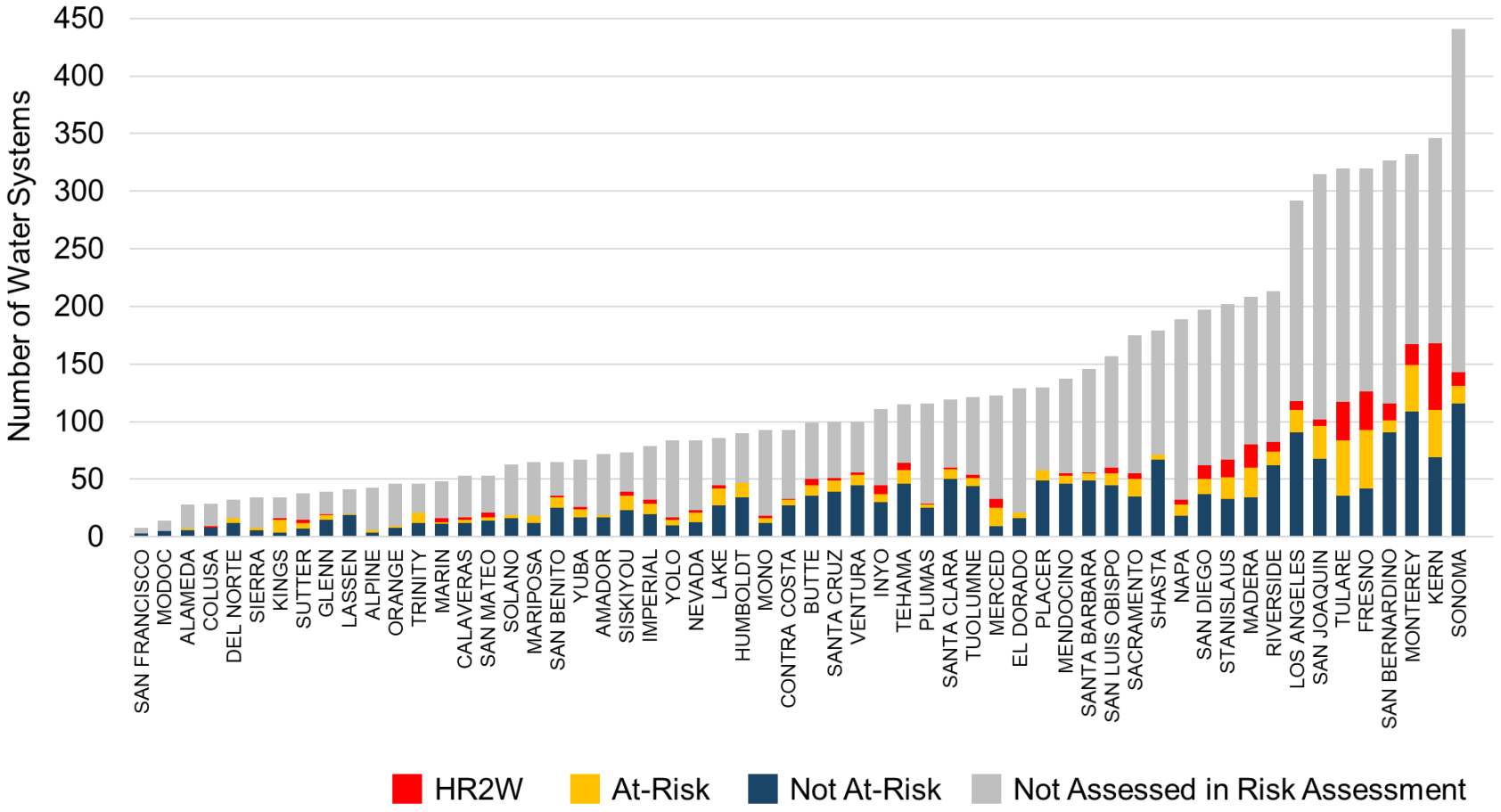
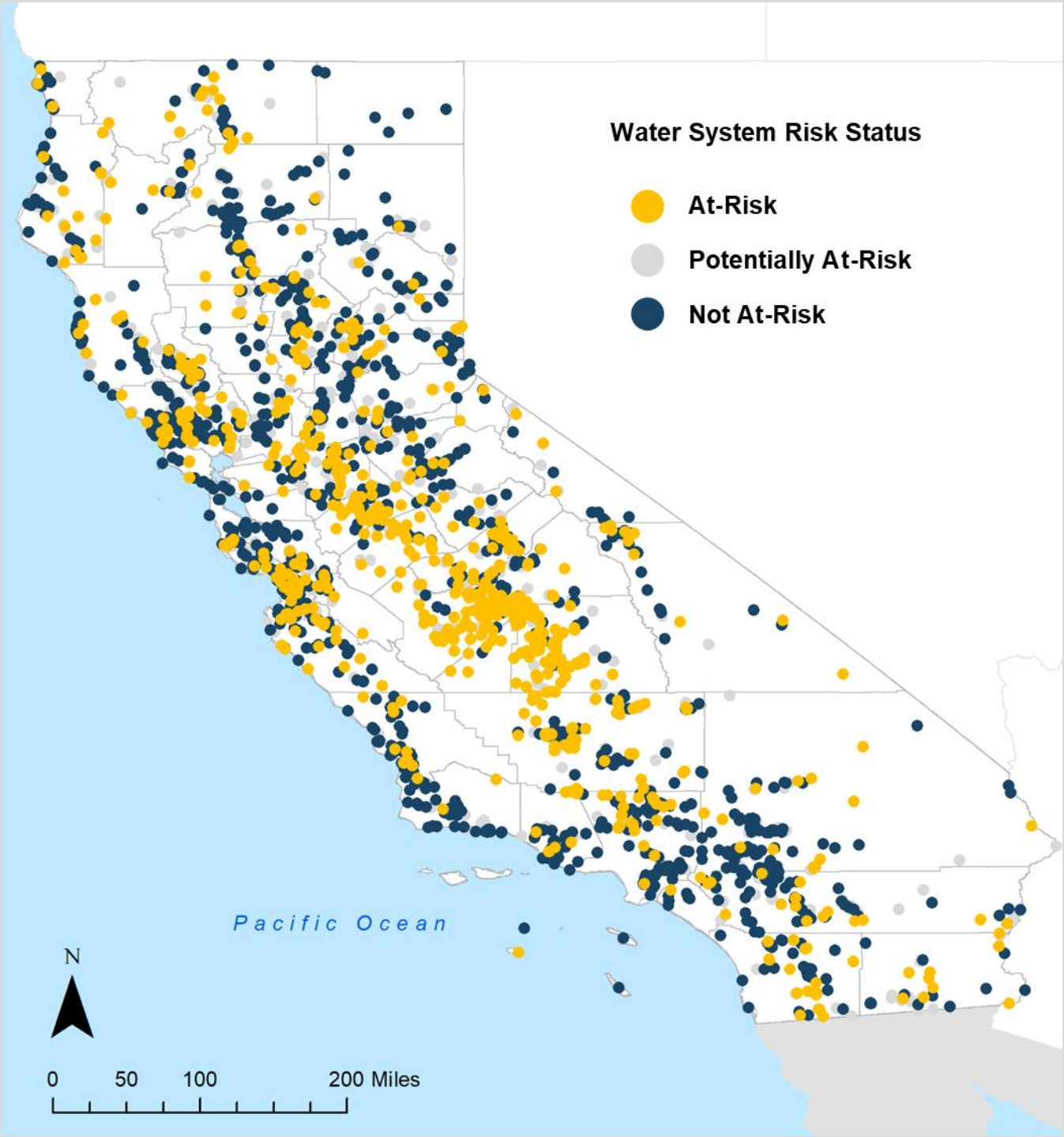


Figure 16: Proportion of HR2W List and At-Risk Water Systems in Each County[7]



[7] Attachment A1: 2021 Risk Assessment Results
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/docs/a1.xlsx

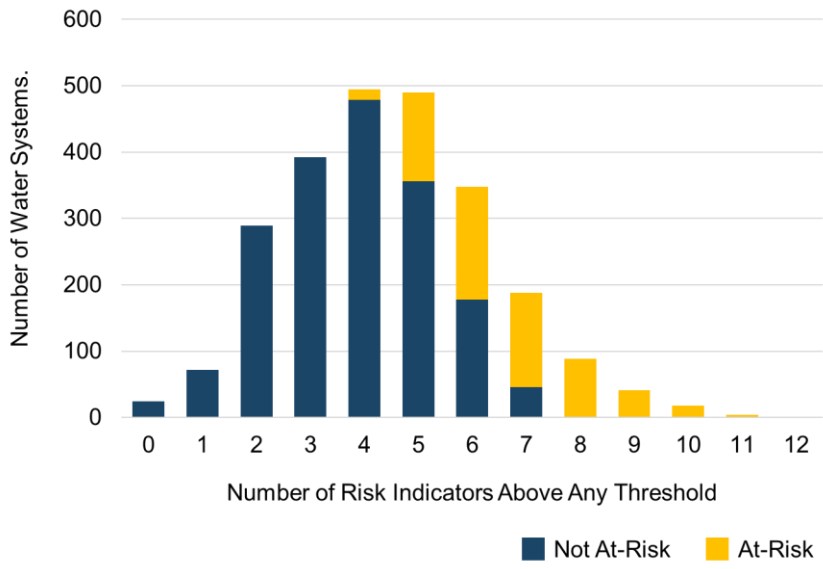
Figure 17: Map of Public Water Systems Evaluated for the Risk Assessment (n=2,779)



RISK INDICATOR DRIVERS

As Figure 18 below shows, all At-Risk systems exceed a threshold of concern for at least 4 risk indicators, with the average At-Risk system exceeding more than six risk indicator thresholds of concern. This means that systems were not designated as At-Risk based on a single or even a handful of risk indicators. Moreover, At-Risk systems tended to have many more indicator concerns than Not At-Risk systems.

Figure 18: Distribution of the Number of Risk Indicator Thresholds Exceeded by At-Risk and Not At-Risk Water Systems (n=2,426)



Certain individual risk indicators and risk indicator categories also had more influence than others on water systems' total risk scores. Table 13 shows in descending order the 10 risk indicators which contributed the most weighted points to the final risk scoring, for both all At-Risk systems and those with the top quintile of risk scores.

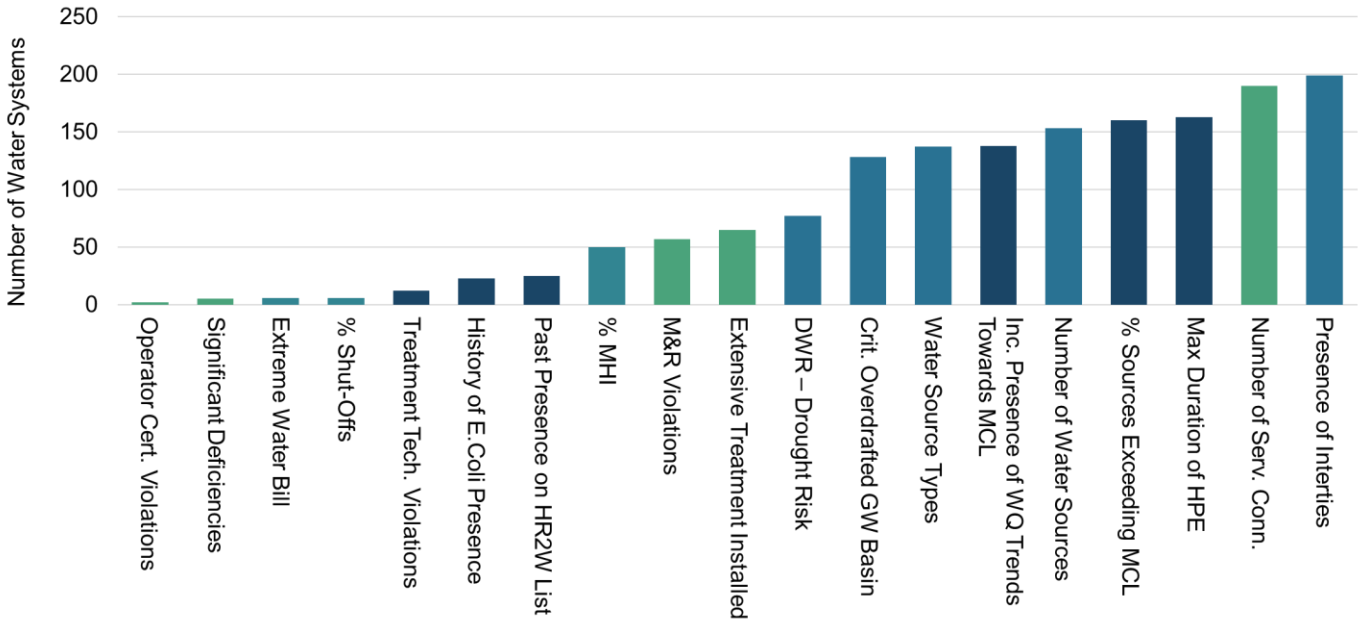
Table 13: Risk Indicators Ranked by Their Average Weighted Score Among At-Risk Water Systems

Category	Risk Indicator	All At-Risk	Top 20% At-Risk
Accessibility	Number of Water Sources	2.24	2.61
Water Quality	Maximum Duration of High Potential Exposure (HPE)	1.35	2.32
Water Quality	Percentage of Sources Exceeding an MCL	1.13	2.14
Accessibility	Presence of Interties	0.97	0.98
TMF Capacity	Number of Service Connections	0.94	0.98

Category	Risk Indicator	All At-Risk	Top 20% At-Risk
Affordability	Percent of Median Household Income (%MHI)	0.92	1.14
Accessibility	Critically Overdrafted Groundwater Basin	0.85	0.99
Accessibility	Water Source Types	0.73	0.85
Water Quality	Increasing Presence of Water Quality Trends Toward MCL	0.68	1.00
Accessibility	DWR – Drought & Water Shortage Risk Assessment Results	0.59	0.74

An analysis was also conducted to examine the effect of each individual risk indicator on the number of water systems it moved onto the At-Risk list, holding all other indicators constant. As shown in Figure 19, the 'Presence of Interties', 'Number of Service Connections', 'Maximum Duration of High Potential Exposure', 'Percentage of Sources Exceeding a MCL', and 'Number of Water Sources' are the five risk indicators that had the greatest effect on the number of At-Risk systems. Two of these risk indicators fall into the Accessibility category, one is in the TMF Capacity category, and two are in the Water Quality category.

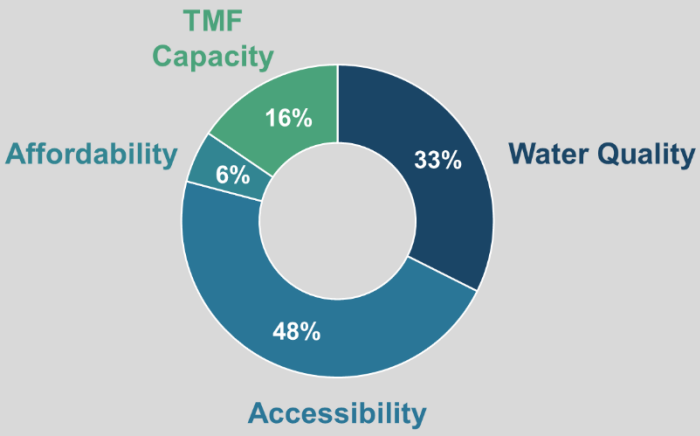
Figure 19: Risk Indicators Ranked by Their Effect on the Number of At-Risk Systems



RISK INDICATOR CATEGORY RESULTS

The performance of water systems across all individual risk indicators shows that the Accessibility category contributes the most weighted risk points to At-Risk scoring (48%), with Water Quality coming second (33%) and the TMF Capacity (16%) and Affordability (6%) categories contributing distant third and fourth highest shares of risk points. Data availability for the Affordability risk indicators was poor compared to the other categories. In future iterations of the Risk Assessment, the State Water Board will incorporate additional TMF Capacity and Affordability risk indicators to better reflect their contribution to water system performance risk.

Figure 20: Share of Each Risk Indicator Category in Calculating the Total Risk Score for At- Risk Water Systems (n=613)



WATER QUALITY

Figure 21 illustrates how HR2W list and non-HR2W list water systems perform in the Water Quality risk category, which is the second most influential category in the overall Risk Assessment. Risk category scores reflect the average of weighted water quality indicators included in the Risk Assessment. About 38% (n=1,050) of systems score 0 points, whereas the average score for this category across all other systems is 0.52. Systems on the HR2W list score significantly higher in this category than systems that are not on the HR2W list.

Figure 21: Water Quality Score for Each Water System (n=1,729)

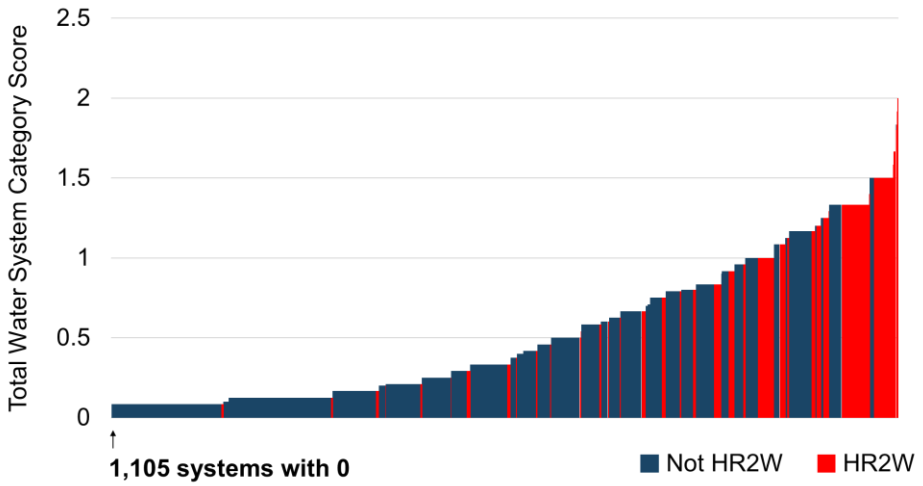
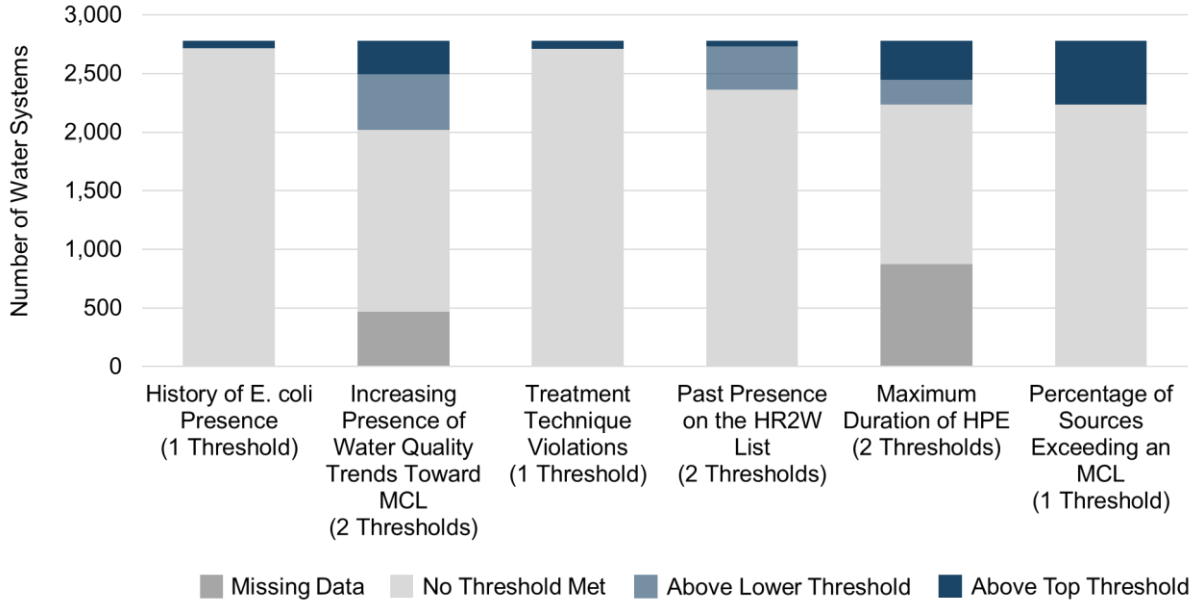


Figure 22 illustrates the number of water systems that exceeded the risk indicator thresholds within the Water Quality category. The range of potential thresholds for each risk indicator are summarized in the respective risk indicator labels.

Figure 22: Systems Exceeding Thresholds for Each Water Quality Risk Indicator



ACCESSIBILITY

Figure 23 illustrates how HR2W list and non HR2W list water systems perform in the Accessibility risk category, which is the most influential category in the overall Risk Assessment. Risk category scores reflect the average of weighted water accessibility

indicators included in the Risk Assessment. Only about 7% (n=185) of systems score 0 points, whereas the average score for this category across all other systems is 0.78. Systems on the HR2W list score slightly higher (average score= 0.88) in this category than systems that are not on the HR2W list (average score=0.76).

Figure 23: Accessibility Score for Each Water System (n=2,594)

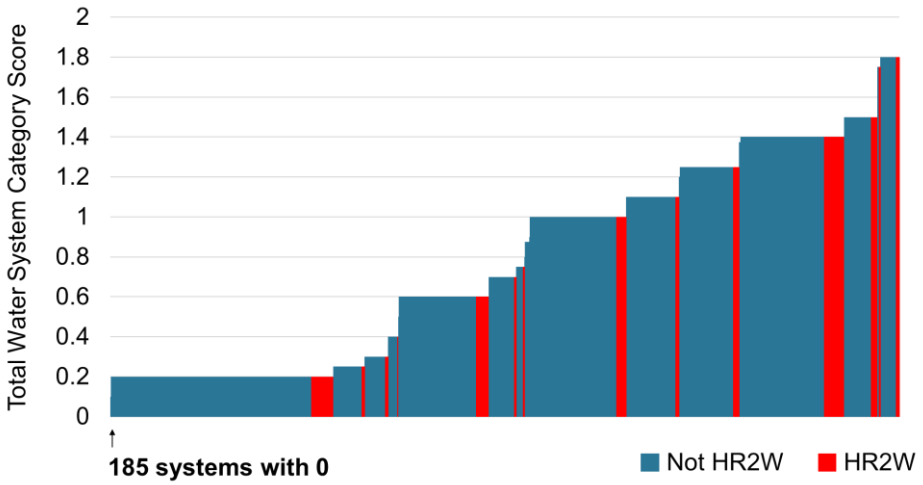
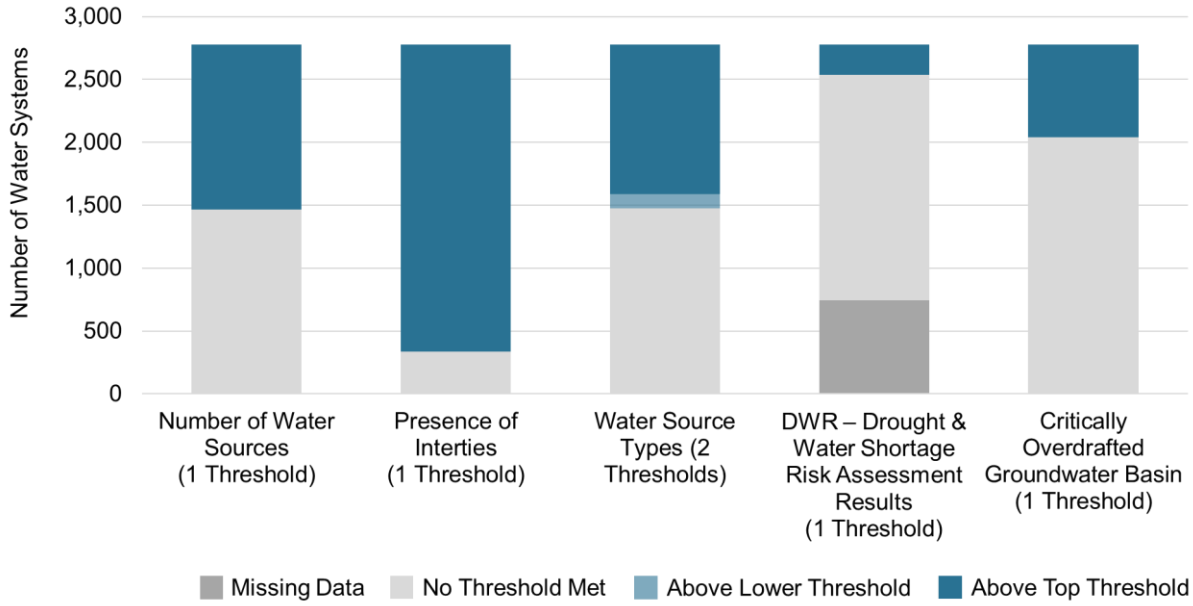


Figure 24 illustrates the number of water systems that exceeded the risk indicator thresholds within the Accessibility category. The range of potential thresholds for each risk indicator are summarized in the respective risk indicator labels.

Figure 24: Systems Exceeding Thresholds for Each Accessibility Risk Indicator



AFFORDABILITY

Figure 25 shows how HR2W list and non HR2W list water systems perform in the Water Accessibility risk category, which is the least influential category in the overall Risk Assessment. Risk category scores reflect the average of weighted water affordability indicators included in the Risk Assessment. Keeping in mind that 541 water systems were excluded from the affordability scoring due to lack of data, about 76% (n=1,772) scored 0 points, whereas the average score for this category across all other systems is 0.86. Systems with insufficient data did not receive a score for the Affordability category. For these systems, instead the other risk categories were more heavily weighted to account for the absence of an affordability score.

Systems on the HR2W list score the same as systems that are not on the HR2W list (both have an average of 0.76). It is important to note that water systems that do not have the necessary treatment may have lower operations and maintenance costs and therefore these are not necessarily expected to directly correspond.

Figure 25: Affordability Score for Each Water System (n=466)

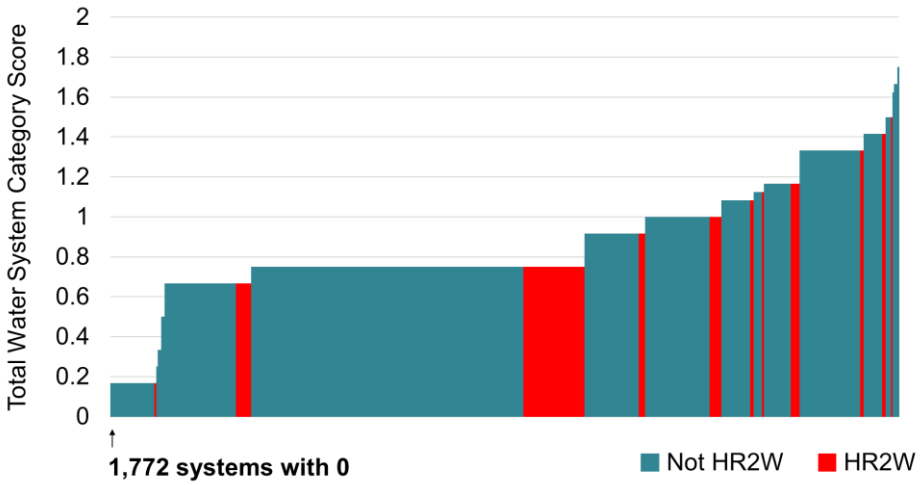
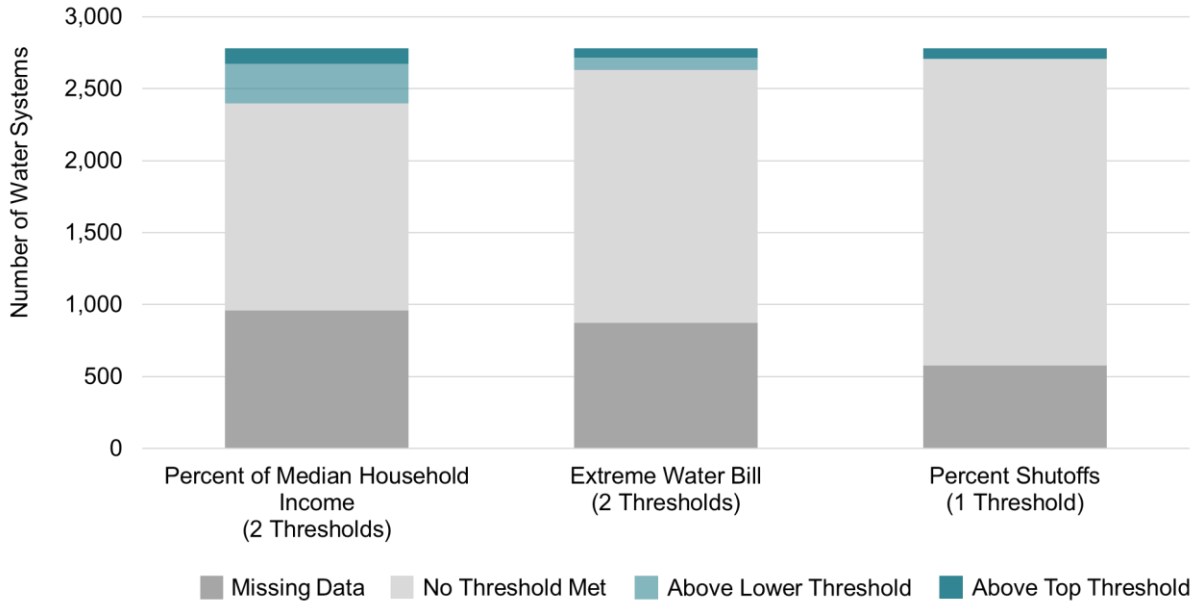


Figure 26 illustrates the number of water systems that exceeded the risk indicator thresholds within the Affordability category. The range of potential thresholds for each risk indicator are summarized in the respective risk indicator labels.

Figure 26: Systems Exceeding Thresholds for Each Affordability Risk Indicator



TMF CAPACITY

Figure 27 shows how HR2W list and non HR2W list water systems perform in the TMF Capacity risk category, which is the second least influential category in the overall Risk Assessment. Risk category scores reflect the average of weighted TMF Capacity indicators included in the Risk Assessment. Only 10% (n=279) of systems score 0 risk points. Systems on the HR2W list score higher in this category (average risk score=0.36) than systems that are not on the HR2W list (average risk score=0.30).

Figure 27: TMF Capacity Score for Each Water System (n=2,500)

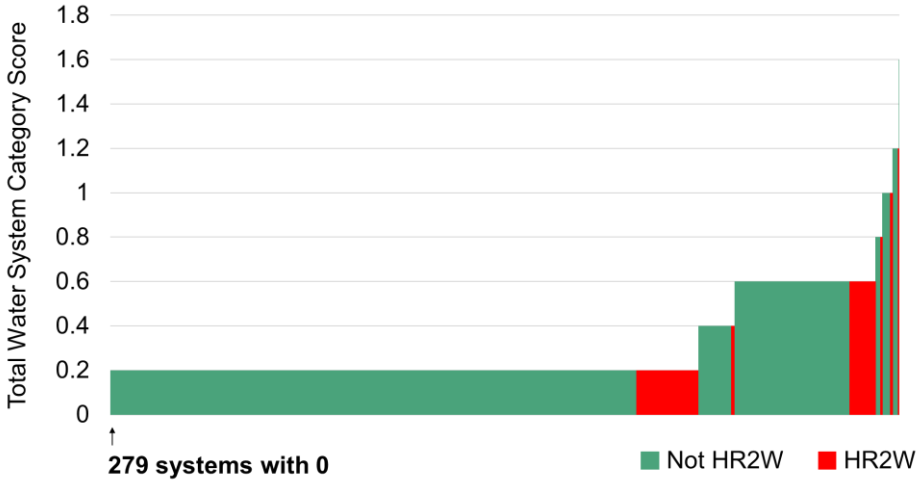
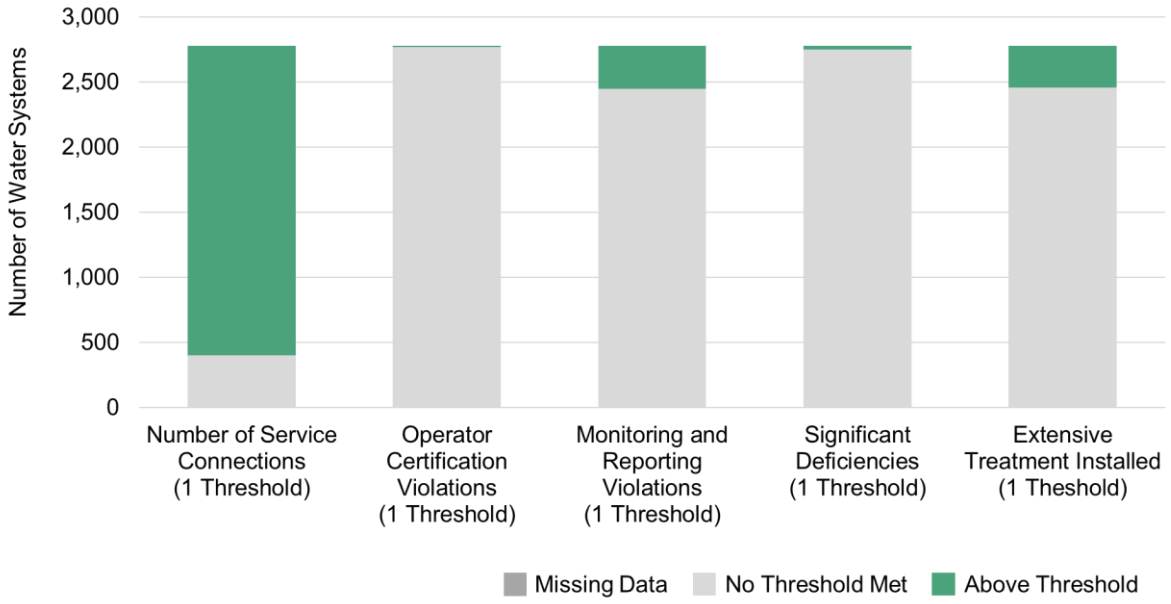


Figure 28 illustrates the number of water systems that exceeded the risk indicator thresholds within the TMF Capacity category. The range of potential thresholds for each risk indicator are summarized in the respective risk indicator labels.

Figure 28: Number of Systems Exceeding Thresholds for Each TMF Capacity Risk Indicator



LIMITATIONS OF THE RISK ASSESSMENT FOR PUBLIC WATER SYSTEMS

The 2021 Risk Assessment for public water systems represents a major first step in assessing risk for systems with 3,300 connections or less, and which can be applied to all public water systems in future years. While the State Water Board and UCLA have worked to advance the methodology as far as possible since 2019, the following limitations exist in the current methodology and approach:

Water Systems Not Assessed

Three types of systems were not able to be incorporated in the 2021 Risk Assessment. First, Federally recognized tribal systems were originally envisioned to be included, and attempts were made to gather data to this end, but ultimately tribal systems had to be excluded from the assessment due to missing data although general estimates of the potential number of equivalent systems were developed in an alternative Tribal Needs Assessment detailed in Appendix F. Second, public water systems with 3,300 connections or more were not included, due to State Water Board and contractor capacity to analyze them, but these larger systems may be included in future iterations of the Risk Assessment. Finally, wholesalers were also excluded from the 2021 Risk Assessment. To evaluate the performance risk of wholesalers, the State Water Board may need to develop an alternative approach to assessing these

systems than the methodology developed for other public water systems and there are not always direct correlations on risk indicators.

Missing Data for Selected Risk Indicators

The State Water Board and UCLA conducted an extensive evaluation of the risk indicators recommended for the Risk Assessment. Many potential risk indicators were excluded from the 2021 Risk Assessment due to limitations in the coverage, availability, and quality (collectively, "fitness") of the data necessary for calculating these indicators.[8] Ultimately, however, the inclusion of some risk indicators with data coverage issues was necessary to achieve diversity of indicators within each of the four risk indicator categories: Water Quality, Accessibility, Affordability, and TMF Capacity. In particular, many water systems lacked necessary data for the Affordability risk indicator category. For example, 872 water systems lacked water rates data necessary for two of the three Affordability risk indicators, '% MHI' and 'Extreme Water Bill.' The Assessment indicated 578 water systems lacked data for the third Affordability risk indicator '% Shut-Offs.' The Risk Assessment methodology has an approach for addressing missing data, but the lack of data resulted in a limited Affordability Assessment for these systems.

Limited Risk Indicator Selection

As previously mentioned, the State Water Board and UCLA conducted an extensive evaluation of potential risk indicators for the 2021 Risk Assessment. Unfortunately, many of the identified potential risk indicators did not meet the data fitness requirements necessary for inclusion. In particular, insufficient data is currently available to assess the financial capacity of water systems, capital asset conditions, source capacity, etc. The limited range of risk indicators currently available for the TMF Capacity category may help explain why this category is not contributing much to overall risk scoring for the vast majority or water systems assessed.

Furthermore, some risk indicators may be more applicable to some governance types of systems than others. For instance, some of the feedback received on the Affordability risk indicators was that using rates-based indicators does not capture the ways in which some systems finance the full cost of service provision. Another point raised was that some individual water systems are connected to larger utility structures that help mitigate TMF capacity and affordability risk in ways that are currently uncaptured in the Risk Assessment.

Database and Data Collection Limitations

The State Water Board's primary violation, enforcement and regulatory tracking database, Safe Drinking Water Information Systems (SDWIS), was designed for reporting compliance to the U.S. Environmental Protection Agency (U.S. EPA) for national tracking purposes. The database was not designed for the type of complex risk assessments being done in California or tailored to California's specific water quality regulations or drought-monitoring needs. SDWIS is limited in its ability to store technical, managerial and financial data and currently

[8] October 7, 2020 White Paper:
Evaluation of Potential Indicators and Recommendations for Risk Assessment 2.0 for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/e_p_i_recommendations_risk_assessment_2_public_water_systems.pdf

does not separate out other key system-level data components such as source capacity enforcement actions, boil water notices, how water system connections are utilized, water quality trends, etc. Several efforts to augment this data collection and management have been made by the State Water Board through project-specific efforts, such as Modified Drinking Water Watch,[9] the Electronic Annual Reports (EAR)[10] and the creation of the SAFER Clearinghouse. The ideal solution would likely entail the creation of a comprehensive data management system to fully support the transparent and data driven work required for this program.

RISK ASSESSMENT REFINEMENT OPPORTUNITIES

The Risk Assessment methodology will evolve over time to incorporate additional and better-quality data; evidence from targeted research to support existing and new risk indicators and thresholds; experience from implementing the SAFER Program; and further input from the State Water Board and public. The following highlights are near-term opportunities for Risk Assessment refinement:

Outreach to Tribal Water Systems
Concerted outreach to Tribal water systems is planned for 2021. These outreach efforts will be centered on informing tribal leaders about the purpose of the SAFER Program and informing them on the benefits of sharing information so that they may be included in future Risk Assessments. Outreach may also include combined efforts with the Department of Water Resources (DWR) to obtain drought related information to minimize State related information requests. In the interim, SAFER Program staff will continue to work with individual tribes, as requested by tribal leaders or in response to requests from the U.S. EPA.

Mid-Sized Urban Disadvantaged Water Systems
Mid-sized urban disadvantaged water systems, like those in Los Angeles County, in some cases appear to be ranking lower on the At-Risk list than expected. This may be attributed to the fact that many of the risk indicators in the Water Quality category do not score issues related to secondary standards as high compared to primary standards. Furthermore, many of these systems have interties and multiple sources, which means they do not score as many risk points in the Accessibility category. The limitations of the TMF Capacity Category discussed above also contribute to the lower risk scores for some of these systems. Thus, the State Water Board will be both working internally and partnering with the Water Replenishment District of Southern California (WRD) on their Needs Assessment efforts to help find ways to refine statewide data collection to ensure that more representative results are seen within these mid-sized systems.[11]

[9] Drinking Water Watch
https://sdwis.waterboards.ca.gov/PDWW/

[10] Electronic Annual Report (EAR) | California State Water Resources Control Board
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/ear.html

[11] Draft State Water Resources Control Board, Resolution No. 2020
https://www.waterboards.ca.gov/board_info/agendas/2020/jul/072120_4_drftreso.pdf

Expanded Data Collection Efforts
The State Water Board has already begun taking necessary steps to improve data coverage and accuracy for the Risk Assessment. Improvements to the 2020 reporting year EAR include new requirements for completing survey questions focused on customer charges.[12] EAR functionality has been developed that will help auto-calculate average customer charges for 6 HCF, which will help reduce data errors. Furthermore, the EAR will be able to better distinguish between water systems that do not charge for water compared to those that do.

The 2020 EAR also has a new section that will begin collecting annual revenues and incurred expenses data from community water systems. This data may be integrated into future iterations of the Risk Assessment to better assess water system financial risk. The State Water Board will also begin developing a new TMF Capacity section for future iterations of the EAR. Recommendations on potential TMF Capacity risk indicators identified through the Risk Assessment methodology development process[13] will serve as a starting point for this effort.

Source Capacity
Currently, source capacity violation and enforcement data in SDWIS is coded under the broad Waterworks Violation category because of its location in drinking water regulations.[14] As a result, source capacity violations and enforcement actions cannot be easily separated from other types of violations, e.g. failing to use certified chemicals or equipment, etc., without review of actual enforcement documents. The Waterworks Violation category as a whole will be revisited for its inclusion in future Risk Assessment iterations, as well as possible policy changes that would allow for clearer tracking of source capacity specific violations.

Refinement of Risk Indicators and Thresholds
During the Risk Assessment methodology development process, three additional Affordability risk indicators were recommended for inclusion in future iterations of the Risk Assessment:[15] 'Household Burden Indicator,' 'Poverty Prevalence Indicator,' and 'Housing Burden.'[16] The

[12] Electronic Annual Report (EAR) | California State Water Resources Control Board
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/ear.html

[13] October 7, 2020 White Paper:
Evaluation of Potential Indicators and Recommendations for Risk Assessment 2.0 for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/e_p_i_recommendations_risk_assessment_2_public_water_systems.pdf

[14] California Code of Regulation, Title 22, Chapter 16. California Waterworks Standards §64551.40 Source Capacity

[15] October 7, 2020 White Paper:
Evaluation of Potential Indicators and Recommendations for Risk Assessment 2.0 for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/e_p_i_recommendations_risk_assessment_2_public_water_systems.pdf

[16] *Household Burden Indicator*: This indicator measures the economic burden that relatively low income households face in paying their water service costs by focusing on the percent of these costs to the 20th percentile income (i.e. the Lowest Quintile of Income (LQI) for the service area). This indicator is calculated by adding the average drinking water customer charges, dividing them by the 20th Percentile income in a community water system, and multiplying this by one hundred.

State Water Board will begin conducting the proper research and stakeholder engagement needed to develop the appropriate affordability thresholds necessary for inclusion in the Risk Assessment and potentially the Affordability Assessment as well.

Furthermore, as data on water system risk indicators and failures is tracked consistently over time going forward, future versions of the Risk Assessment will be able to more fully evaluate data-driven weighting and scoring approaches to characterizing water system risk. This may lead to dropping risk indicators from the assessment which demonstrate less relationship to risk than expected, and adding others which reflect new, or previously underestimated dimensions of risk.

The intent of the State Water Board going forward is to update the Risk Assessment annually, and in so doing, enhance the accuracy and inclusiveness of the assessment via an iterative, engaged process. Accordingly, future versions of the Risk Assessment will continue to incorporate new data and enhance existing data quality.

Poverty Prevalence Indicator: This indicator measures the percentage of population served by a community water system that lives at or below 200% the Federal Poverty Level. This measurement indicates the degree to which relative poverty is prevalent in the community.

Housing Burden: This indicator measures the percent of households in a water system's service area that are both low income and severely burdened by housing costs (paying greater than 50% of their income for housing costs). This metric is intended to serve as an indicator of the affordability challenges low-income households face with respect to other non-discretionary expenses, which may impact their ability to pay for drinking water services.

APPENDIX A:
RISK ASSESSMENT METHODOLOGY FOR PUBLIC WATER SYSTEMS

INTRODUCTION

The purpose of the Risk Assessment for public water systems is to identify systems at-risk or potentially at-risk of failing to meet one or more key Human Right to Water goals: (1) providing safe drinking water; (2) accessible drinking water; (3) affordable drinking water; and/or (4) maintaining a sustainable and resilient water system. Data on performance and risk is most readily available for public water systems and thus the risk assessment methodology for public water systems allows for a multi-faceted examination across four risk indicator categories: Water Quality, Accessibility, Affordability; and TMF (technical, managerial, and financial) Capacity.

PUBLIC WATER SYSTEMS ASSESSED

The Risk Assessment for public water systems was conducted for community water systems with 3,300 service connections or less and all non-transient non-community water systems which serve K-12 schools. 72 wholesalers were not included in the Risk Assessment because they do not provide direct service to residential customers and larger water systems were excluded in this assessment because approximately 90% of the violations occur with systems less than 500 connections. See Table A1 for details.

Table A1: Public Water Systems Analyzed in the Risk Assessment

Water System Type*	Number	Water Quality	Accessibility	Affordability	TMF Capacity
Public Water Systems (3,300 connections or less; wholesalers *excluded*)	2,241	Yes	Yes	Yes	Yes
K-12 Schools**	383	Yes	Yes	No	Yes
Other Public Water Systems***	155	Yes	Yes	No	Yes
TOTAL ANALYZED:	**2,779**				

* Systems on the HR2W list were included in the Risk Assessment analysis, however, they were excluded from the final Risk Assessment results.
** These systems were manually identified by the State Water Board.

*** Transient Areas, Recreational Facilities, Hotels, Summer Camps, Prisons, Medical Facilities, Military Complexes.

RISK ASSESSMENT METHODOLOGY DEVELOPMENT PROCESS

The initial draft Risk Assessment methodology was developed by UCLA from September 2019 to March 2020 and incorporated 14 risk indicators. Details on the initial draft Risk Assessment methodology and results are provided in the July 22, 2020 white paper *Identification of Risk Assessment 2.0 Indicators for Public Water Systems.*[17].

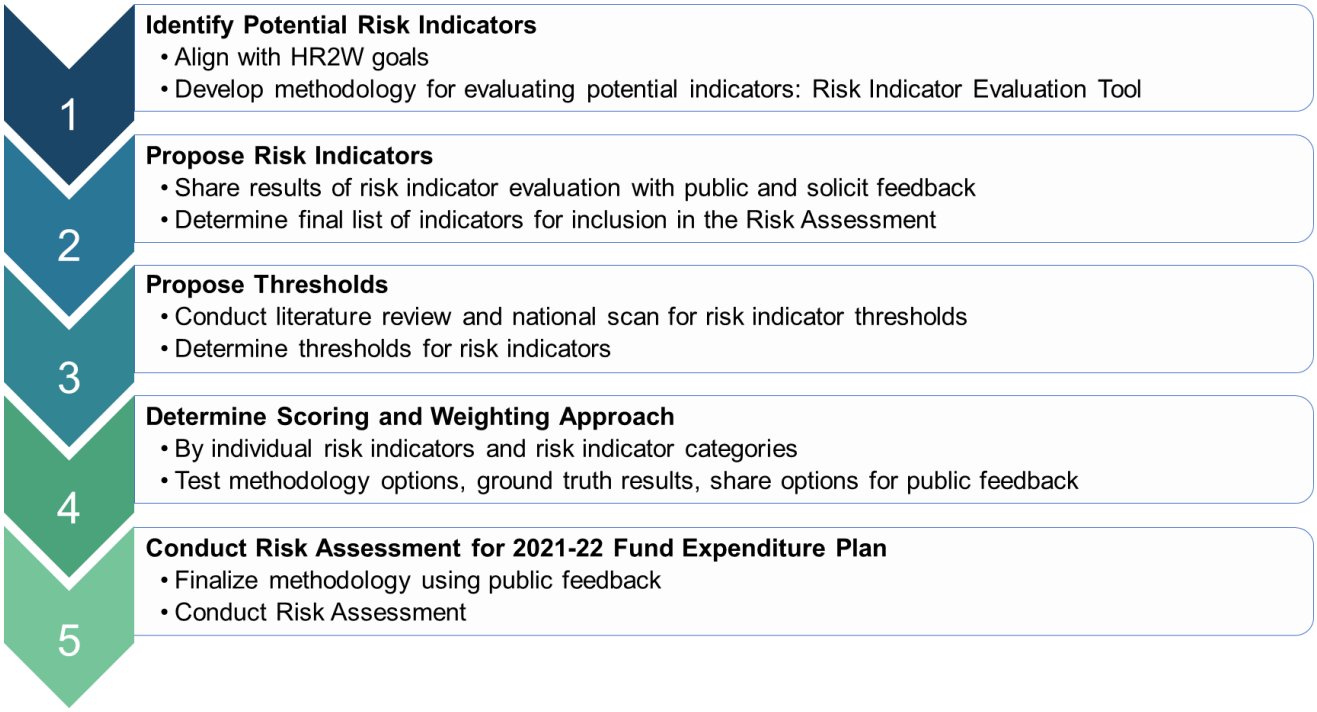
The State Water Board and UCLA refined the initial draft Risk Assessment methodology through multiple stages of development between April 2020 and March 2021. This effort was designed to encourage public and stakeholder participation, providing opportunities for feedback and recommendations throughout the methodology development process. Figure A1 provides an overview of the Risk Assessment development phases. Each of these development phases were detailed in publicly available white papers, presented at public webinars, and the public feedback received was incorporated into the final Risk Assessment methodology and results.

[17] July 16, 2020 White Paper:
Identification of Risk Assessment 2.0 Indicators for Public Water Systems
https://www.waterboards.ca.gov/drinking_water/programs/safer_drinking_water/docs/draft_white_paper_indicators_for_risk_assessment_07_15_2020_final.pdf

July 22, 2020 Webinar Presentation
https://www.waterboards.ca.gov/drinking_water/programs/safer_drinking_water/docs/july22_risk_assessment_slides.pdf

July 22, 2020 Webinar Recording
https://www.youtube.com/embed/H57wBnWij1Y?modestbranding=1&rel=0&autoplay=1

Figure A1: Phases of Risk Assessment Development

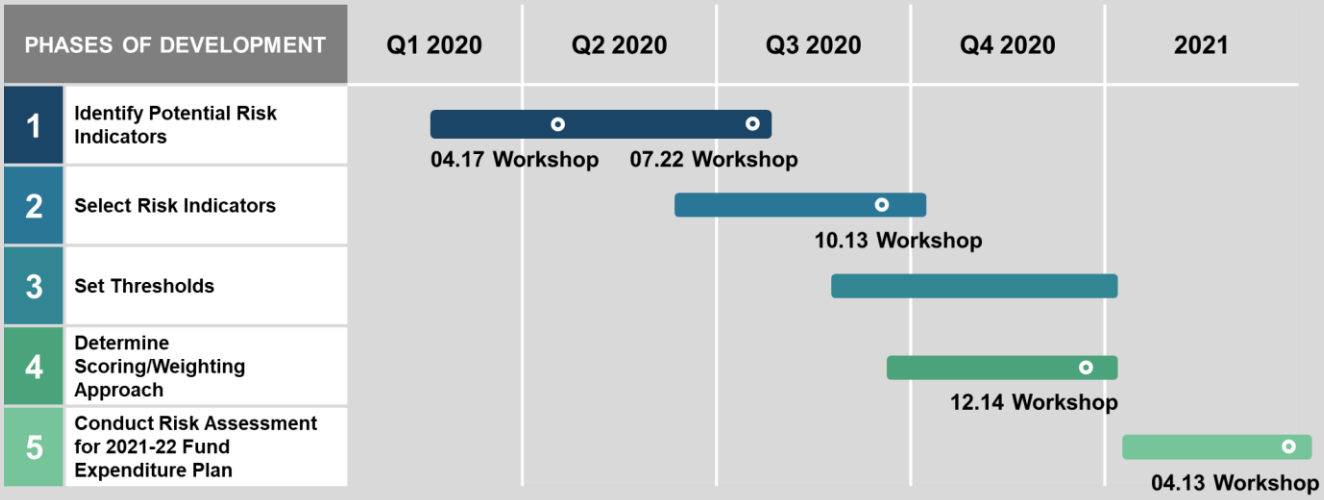


The State Water Board and UCLA hosted four public webinar workshops in 2020 to solicit feedback and recommendations on the development of the Risk Assessment (Figure A2). Approximately 683 individuals[18] participated in these workshops through either Zoom or CalEPA's live webcast. The following sections summarize the workshops and more information about each event, including white papers, presentations, and webinar recordings can be found on the State Water Board's Needs Assessment webpage.[19]

[18] Individuals that participated in more than webinar workshop are double counted in this figure.

[19] California Drinking Water Needs Assessment webpage
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/needs.html

Figure A2: 2020 Public Engagement for the Development of the Risk Assessment for Public Water Systems



PUBLIC WEBINAR WORKSHOP – APRIL 17, 2020

On April 17, 2020, the State Water Board and UCLA hosted a public webinar workshop to introduce the results of the initial Risk Assessment methodology developed by UCLA and solicit public feedback and recommendations on how to improve it. Feedback from this workshop led the State Water Board and UCLA to identify additional potential risk indicators that align with the three fundamental components of the HR2W (*i.e.* water quality, accessibility, and affordability), and extended its search to incorporate technical, managerial, and financial (TMF) capacity risk indicators as well. More information about this webinar workshop can be accessed on the State Water Board's Needs Assessment webpage.[20]

PUBLIC WEBINAR WORKSHOP – JULY 22, 2020

On July 16, 2020, the State Water Board and UCLA made publicly available a white paper on the *Identification of Risk Assessment 2.0 Indicators for Public Water Systems.*[21] On July 22, 2020, the State Water Board and UCLA hosted a webinar workshop to solicit stakeholder feedback and recommendations on:

[20] California Drinking Water Needs Assessment webpage
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/needs.html

[21] July 16, 2020 White Paper:
Identification of Risk Assessment 2.0 Indicators for Public Water Systems
https://www.waterboards.ca.gov/drinking_water/programs/safer_drinking_water/docs/draft_white_paper_indicators_for_risk_assessment_07_15_2020_final.pdf

- Draft definitions of the four risk indicator categories: Water Quality, Accessibility, Affordability, and TMF Capacity.
- Expanded list of 118 potential risk indicators to be considered for inclusion in the Risk Assessment Version. This effort included full consideration of risk indicators identified in complementary efforts conducted by the Office of Environmental Health Hazard Assessment (OEHHA),[22] the Department of Water Resources (DWR), and the California Public Utilities Commission (CPUC), as well as additional indicators that are recognized by the water sector and its advocates to be key measures of water system resiliency.
- Draft Risk Indicator Evaluation Tool used to assess the applicability and data fitness of the identified potential risk indicators.

Stakeholder feedback and recommendations provided through the public webinar, written comments, and continued dialogue during the feedback period (07.16.2020 – 08.21.2020) are detailed in the white paper.[23] The following is a brief summary of incorporated feedback:

- 11 new potential risk indicators were identified for consideration and added to the list of indicators to be evaluated. Three potential risk indicators were removed from the list due to redundancy.
- Step 3 of the Risk Indicator Evaluation Tool was modified to strengthen the criteria for "Maybe": changing from "Step 1 results may be Good or Fair" to "Step 1 results ***must*** be Good."
- Specific comments regarding the applicability of individual potential risk indicators were considered when determining Step 1 evaluation scores (Supplemental Appendices D.1 through D.4).[24]

PUBLIC WEBINAR WORKSHOP – OCTOBER 13, 2020

On October 7, 2020, the State Water Board made publicly available a white paper on the *Evaluation of Potential Indicators & Recommendations for Risk Assessment 2.0 for Public*

[22] The Human Right to Water in California | OEHHA
https://oehha.ca.gov/water/report/human-right-water-california

[23] October 7, 2020 White Paper (p.28):
Evaluation of Potential Indicators & Recommendations for Risk Assessment 2.0 for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/e_p_i_recommendations_risk_assessment_2_public_water_systems.pdf

[24] October 7, 2020 White Paper Supplemental Appendices:

D.1 Potential Water Quality Risk Indicator Evaluations
https://www.waterboards.ca.gov/safer/docs/safer_supp_appxd1_101320.pdf

D.2 Potential Accessibility Risk Indicator Evaluations
https://www.waterboards.ca.gov/safer/docs/safer_supp_appxd2_101320.pdf

D.3 Potential Affordability Risk Indicator Evaluations
https://www.waterboards.ca.gov/safer/docs/safer_supp_appxd3_101320.pdf

D.4 Potential TMF Capacity Risk Indicator Evaluations
https://www.waterboards.ca.gov/safer/docs/safer_supp_appxd4_101320.pdf

Water Systems.[25] On October 13, 2020, the State Water Board and UCLA hosted a webinar workshop to solicit stakeholder feedback and recommendations on:

- Evaluation results of 129 potential risk indicators using the Evaluation Tool.
- The State Water Board and UCLA's recommendation of 22 risk indicators for inclusion in the Risk Assessment for public water systems.
- How the State Water Board should utilize a number of the potential risk indicators that are non-MCL violations. Specifically, how these metrics should be assessed for systems that "consistently fail" or are "At-Risk."
- Initial considerations on scoring and weighting options for individual risk indicators and risk indicator categories.

Stakeholder feedback and recommendations provided through the public webinar, written comments, and continued dialogue during the feedback period (10.07.2020 – 10.30.2020) are detailed in white paper.[26] The following is a brief summary of incorporated feedback:

- Based on feedback and further assessment of the proposed risk indicator "Increasing Presence of Water Quality Trends Towards MCL," the State Water Board is proposing removing this risk indicator from the Risk Assessment for the 2021-22 Fund Expenditure Plan so that more time can be dedicated to setting more appropriate thresholds, scores, and weight.[27]
- In most cases, the State Water Board and UCLA proposed higher risk indicator and category weights for indicators that may be influenced by water system management and lower weights for those that are outside a water system's sphere of influence.
- The State Water Board explored and proposed expanded "failing" criteria for the HR2W list.[28]

PUBLIC WEBINAR WORKSHOP – DECEMBER 14, 2020

On December 10, 2020, the State Water Board made a white paper publicly available on the *Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water*

[25] October 7, 2020 White Paper:
Evaluation of Potential Indicators & Recommendations for Risk Assessment 2.0 for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/e_p_i_recommendations_risk_assessment_2_public_water_systems.pdf

[26] December 14, 2020 White Paper (pp.39-48):
Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/draft_white_paper.pdf

[27] December 14, 2020 White Paper (pp.54-60):
Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/draft_white_paper.pdf

[28] December 14, 2020 White Paper (pp.115-132):
Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/draft_white_paper.pdf

Systems.[29] On December 14, 2020, the State Water Board and UCLA hosted a webinar to solicit stakeholder feedback and recommendations on:

- Proposed expanded criteria for including systems on the HR2W list that are out of compliance or consistently failing.
- Impacts of setting thresholds of concern and criticality weighting each risk indicator.
- Proposed risk indicator thresholds and scores.
- Proposed risk indicator and category weights.
- "At-Risk" scoring methodology options and recommendations to inform the 2021-22 Fund Expenditure Plan.

Stakeholder feedback and recommendations were provided through the public webinar, written comments, and continued dialogue during the feedback period (12.10.2020 – 1.6.2021). The following is a brief summary of incorporated feedback and changes that were made to the Risk Assessment following the December 14, 2020 webinar:

- The underlying data for the following 12 indicators was updated to enhance data recency, accuracy, and coverage:
    - Extreme Water Bill
    - History of E. Coli Presence
    - Increasing Presence of Water Quality Trends Toward MCL
    - Maximum Duration of High Potential Exposure
    - Monitoring and Reporting Violations
    - Number of Service Connections
    - Operator Certification Violations
    - Percent Shutoffs
    - Percent of Median Household Income (% MHI)
    - Percentage of Sources Exceeding an MCL
    - Significant Deficiencies
    - Treatment Technique Violation
- 71 water systems were removed from the analysis because they were identified as either wholesalers or inactive systems, reducing the total number of water systems assessed from 2,850 to 2,779.
- The risk indicator "Increasing Presence of Water Quality Trends Toward MCL" was incorporated into the Risk Assessment, as explained further below.

RISK ASSESSMENT METHODOLOGY

The Risk Assessment methodology relies on three core elements which are utilized to calculate an aggregated risk score for the public water system assessed:

[29] December 14, 2020 White Paper:
Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/draft_white_paper.pdf

Risk Indicators: quantifiable measurements of key data points that allow the State Water Board to assess the probability of a water system's failure to deliver safe drinking water or other infrastructure and institutional failures. Risk indicators that measure water quality, accessibility, affordability, and TMF capacity are incorporated based on their criticality as it relates to a system's ability to remain in compliance with safe drinking water standards and their data availability and quality across the State.

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

Scores & Weights: the application of a multiplying value or weight to each risk indicator and risk category, as certain risk indicators and categories may be deemed more critical than others and/or some may be out of the control of the water system. The application of weights to risk indicators and risk categories allows the State Water Board multiple ways to assess all risk indicators within each category together in a combined Risk Assessment score.

RISK INDICATORS

The State Water Board, in partnership with UCLA, began an effort in April 2020 to identify potential risk indicators to be considered for inclusion in the Risk Assessment for public water systems. The initial version of the draft Risk Assessment utilized 14 risk indicators.[30] In response to public feedback from its April 17, 2020 webinar workshop, the State Water Board and UCLA expanded the Risk Assessment scope to evaluate a much broader number of risk indicators. The State Water Board, UCLA, and the public identified 129 potential risk indicators, several from other complementary State agency efforts, to help predict the probability of a water system's failure to deliver safe drinking water. A concerted effort was made to identify potential risk indicators that measure water quality, accessibility, affordability, and TMF capacity based on their criticality as it relates to a system's ability to remain in compliance with safe drinking water standards. This effort included full consideration of risk indicators identified in efforts conducted by the Office of Environmental Health Hazard Assessment (OEHHA),[31] the Department of Water Resources (DWR),[32] and the California Public Utilities Commission.[33]

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[30] July 16, 2020 White Paper:
Identification of Risk Assessment 2.0 Indicators for Public Water Systems
https://www.waterboards.ca.gov/drinking_water/programs/safer_drinking_water/docs/draft_white_paper_indicators_for_risk_assessment_07_15_2020_final.pdf

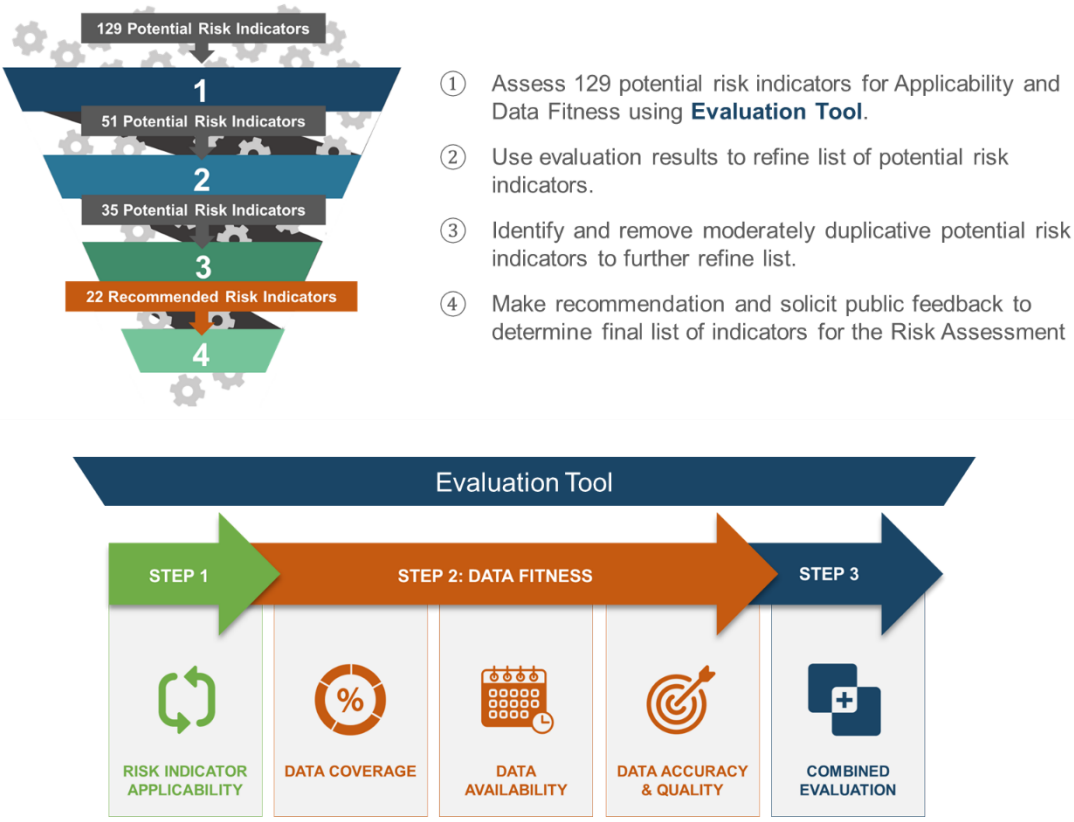
[31] The Human Right to Water in California | OEHHA
https://oehha.ca.gov/water/report/human-right-water-california

[32] Countywide Drought and Water Shortage Contingency Plans | DWR
https://water.ca.gov/Programs/Water-Use-And-Efficiency/Making-Conservation-a-California-Way-of-Life/CountyDrought-Planning

[33] California Public Utilities Commission
https://www.cpuc.ca.gov/

To facilitate the selection of the final indicators for the Risk Assessment, the State Water Board and UCLA conducted an extensive potential risk indicator evaluation process (Figure A3) with internal and external feedback to refine the list of 129 potential risk indicators to a recommend list of 22 risk indicators for the Risk Assessment. Learn more about the risk indicator identification, refinement, and selection process in the October 7, 2020 white paper *Evaluation of Potential Indicators & Recommendations for Risk Assessment 2.0 for Public Water Systems.*[34]

Figure A3: Potential Risk Indicator Evaluation Process



The potential risk indicator evaluation process yielded a recommended list of 22 risk indicators, but three of these are affordability risk indicators that need to be further refined and verified in terms of determining important thresholds of risk before they can be incorporated into the Risk Assessment. Table A2 provides a summary of the selected 19 risk indicators utilized in the 2021 Risk Assessment. Sections below provide details on each individual risk indicator including definitions, required datapoints, and calculation methodologies.

[34] October 7, 2020 White Paper:
Evaluation of Potential Indicators & Recommendations for Risk Assessment 2.0 for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/e_p_i_recommendations_risk_assessment_2_public_water_systems.pdf

Table A2: Risk Assessment Risk Indicators

Risk Indicator Category	Risk Indicator
Water Quality	History of E. coli Presence
	Increasing Presence of Water Quality Trends Toward MCL
	Treatment Technique Violations
	Past Presence on the HR2W List
	Maximum Duration of High Potential Exposure (HPE)
	Percentage of Sources Exceeding an MCL
Accessibility	Number of Sources
	Absence of Interties
	Water Source Types
	DWR – Drought & Water Shortage Risk Assessment Results
	Critically Overdrafted Groundwater Basin
Affordability	Percent of Median Household Income (%MHI)
	Extreme Water Bill
	% Shut-Offs
TMF Capacity	Number of Service Connections
	Operator Certification Violations
	Monitoring and Reporting Violations
	Significant Deficiencies
	Extensive Treatment Installed

RISK INDICATOR THRESHOLDS, SCORES, & WEIGHTS

THRESHOLDS

To develop thresholds for the 19 risk indicators in the Risk Assessment, UCLA and the State Water Board reviewed multiple available types of evidence, looking both within California, across other state agencies nation-wide, and at the U.S. EPA's standards. Few exact risk indicator thresholds relating to water system failure were derived from sources beyond California legislative and regulatory definitions, given both the unique definition of water system failure employed in this assessment and the unique access to indicator data which this assessment enabled. However, similar indicators and associated thresholds to inform this

process were also identified across other sources. The results of this effort are detailed in white paper *Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water Systems*.[35]

Based on the research conducted, most of the risk indicators did not have regulatorily-defined thresholds. For binary risk indicators (*e.g.* operator certification violations), the process of setting thresholds was straightforward because it is either present or absent. For other risk indicators with continuous or categorical data, thresholds were derived using cut points in the distribution of a given risk indicator, where HR2W list systems started to cluster, as well as the professional opinion of the broader research team contracted through UCLA, DDW staff, as well as an internal advisory group of District Engineers. Where possible tiered thresholds were determined to capture more nuanced degrees of risk within indicators. Sections below provide more details about the rationale for the thresholds developed for each indicator.

Moving forward, the State Water Board will continue to refine the risk indicator thresholds as data availability improves and the SAFER Program matures. The process may include refining thresholds by analyzing historical data trends such as looking at the relationship between historical thresholds and the likelihood that systems came out of compliance.

SCORES

To enable the evaluation and comparison of risk indicators, a standardized score between 0 and 1 has been applied to each developed risk indicator threshold. This is important since many of the risk indicators are measured in different units and scales. The score normalizes the thresholds and allows the Risk Assessment to assess water system performance across all risk indicators. The scores assigned to the risk indicator thresholds were developed with the professional opinion of the broader research team contracted through UCLA, DDW staff, as well as an internal advisory group of District Engineers (Table A3). The thresholds scores were shared with the public for feedback with white paper *Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water Systems*[36] and December 14, 2021 webinar.[37]

[35] December 14, 2020 White Paper:
Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/draft_white_paper.pdf

[36] December 14, 2020 White Paper:
Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/draft_white_paper.pdf

[37] December 14, 2020 Webinar Presentation
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/safer_risk_assessment_webinar_accessible.pdf

December 14, 2020 Webinar Recording
https://www.youtube.com/embed/6XDak8R5IDk?cc_load_policy=1&modestbranding=1&rel=0&autoplay=1

WEIGHTS

When evaluating the risk indicators, the Risk Assessment methodology can either apply the same "weight" to each risk indicator or apply different weights (see Figure A4). Public feedback during four public workshops indicated that the Risk Assessment should weight some risk indicators higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Weights between 1 and 3 were applied to individual risk indicators (see Table A3, with a weight of 3 indicating the highest level of criticality). The individual risk indicator weights were developed with the professional opinion of the broader research team contracted through UCLA, DDW staff, as well as an internal advisory group of District Engineers. An analysis of how the application of risk indicator weights impacts the performance of HR2W list systems was shared with the public for feedback with white paper *Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water Systems*[38] and December 14, 2021 webinar,[39] which ultimately supported the final inclusion decision regarding individual risk indicator weights in the Risk Assessment.

[38] December 14, 2020 White Paper:
Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/draft_white_paper.pdf

[39] December 14, 2020 Webinar Presentation
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/safer_risk_assessment_webinar_accessible.pdf

December 14, 2020 Webinar Recording
https://www.youtube.com/embed/6XDak8R5IDk?cc_load_policy=1&modestbranding=1&rel=0&autoplay=1

Figure A4: Water Quality Category Results with and Without Risk Indicator Weights

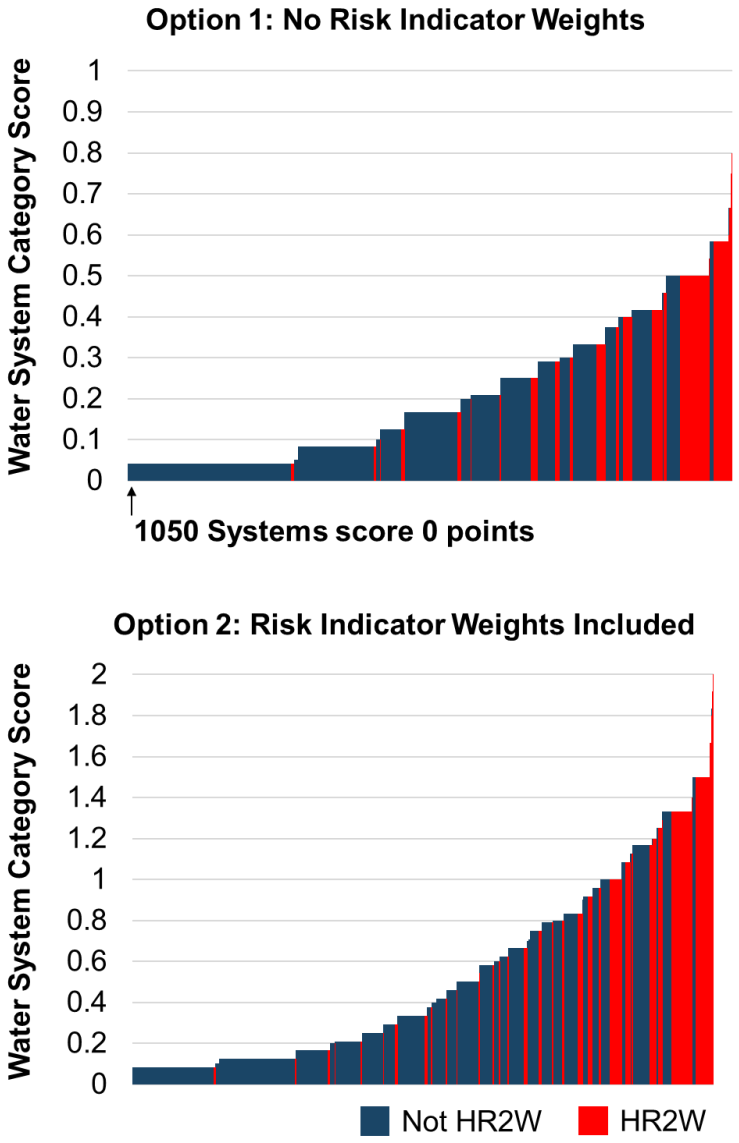


Table A3: Individual Risk Indicator Thresholds, Scores, and Weights

Risk Indicator	Thresholds	Score	Weight
History of E. coli Presence	**Threshold 0** = **No** history of E. coli presence within the last three years.	0	N/A
	Threshold 1 = **Yes**, history of E. coli presence (E. coli violation and/or Level 2 Assessment) within the last three years.	1	3
Increasing Presence of Water Quality Trends Toward MCL	**Threshold 0** = **No** Increasing Presence of Water Quality Trends Toward MCL.	0	N/A
	Threshold 1 = **Secondary Contaminants**: 9-year average of running annual average is at or greater than 80% of MCL and running annual average has increased by 20% or more.	0.25	2
	Threshold 2 = **Primary Non-Acute Contaminants**: 9-year average of running annual average is at or greater than 80% of MCL and running annual average has increased by 5% or more.	0.5	2
	Threshold 3 = **Acute Contaminants**: • 9-year average (no running annual average) is at or greater than 80% of MCL; or • 24-month average is at or greater than 80% of MCL; or • Any one sample over the MCL.	1	2
Treatment Technique Violations	**Threshold 0** = **0** Treatment Technique violations over the last three years.	0	N/A
	Threshold 1 = **1 or more** Treatment Technique violations over the last three years.	1	1
Past Presence on the HR2W List	**Threshold 0** = **0** HR2W list occurrence over the last three years.	0	N/A
	Threshold 1 = **1** HR2W list occurrence over the last three years.	0.5	2
	Threshold 2 = **2 or more** HR2W list occurrences over the last three years.	1	2

Risk Indicator	Thresholds	Score	Weight
Maximum Duration of High Potential Exposure (HPE)	**Threshold 0** = **0** years of HPE over the last nine years.	0	N/A
	Threshold 1 = **1** year of HPE over the last nine years.	0.25	3
	Threshold 2 = **2** years of HPE over the last nine years.	0.5	3
	Threshold 3 = **3 or more** years of HPE over the last nine years.	1	3
Percentage of Sources Exceeding an MCL	**Threshold 0** = **less than 49.9%** of sources exceed an MCL.	0	N/A
	Threshold 1 = **50% or greater** of sources exceed an MCL.	1	3
Number of Sources	**Threshold X** = **0** sources.	Automatically At-Risk	N/A
	Threshold 0 = **multiple** sources.	0	N/A
	Threshold 1 = **1** source only.	1	3
Absence of Interties	**Threshold 0** = **1 or more** interties.	0	N/A
	Threshold 1 = **0** interties.	1	1
Water Source Types	**Threshold 0** = **2 or more** water source types.	0	N/A
	Threshold 1 = **1** water source type and that source is **purchased** water.	0.5	1
	Threshold 2 = **1** water source type and that source is either **groundwater or surface water**.	1	1
DWR – Drought & Water Shortage Risk	**Threshold 0** = **Below top 25%** of systems most at risk of drought and water shortage.	0	N/A
	Threshold 1 = **Between top 25% - 10.01%** of systems most at risk of drought and water shortage.	0.25	2

Risk Indicator	Thresholds	Score	Weight
Assessment Results	**Threshold 2** = **Top 10%** of systems most at risk of drought and water shortage.	1	2
Critically Overdrafted Groundwater Basin	**Threshold 0** = **Less than 74.99%** of system's service area boundary is within a critically overdrafted basin.	0	N/A
	Threshold 1 = **75% or greater** of systems service area boundary is within a critically overdrafted basin.	1	2
Percent of Median Household Income (%MHI)	**Threshold 0** = **Less than 1.49%**	0	N/A
	Threshold 1 = **1.5% - 2.49%**	0.75	3
	Threshold 2 = **2.5% or greater**	1	3
Extreme Water Bill	**Threshold 0** = **Below 149.99%** of the statewide average.	0	N/A
	Threshold 1 = **150% - 199.99%** of the statewide average.	0.5	1
	Threshold 2 = **Greater than 200%** of the statewide average.	1	1
% Shut-Offs	**Threshold 0** = **less than 9.99%** customer shut-offs over the last calendar year.	0	N/A
	Threshold 1 = **10% or greater** customer shut-offs over the last calendar year.	1	2
Number of Service Connections	**Threshold 0** = **greater than 501** service connections.	0	N/A
	Threshold 1 = **500 or less** service connections.	1	1
Operator Certification Violations	**Threshold 0** = **0** Operator Certification violations over the last three years.	0	N/A
	Threshold 1 = **1 or more** Operator Certification violations over the last three years.	1	3

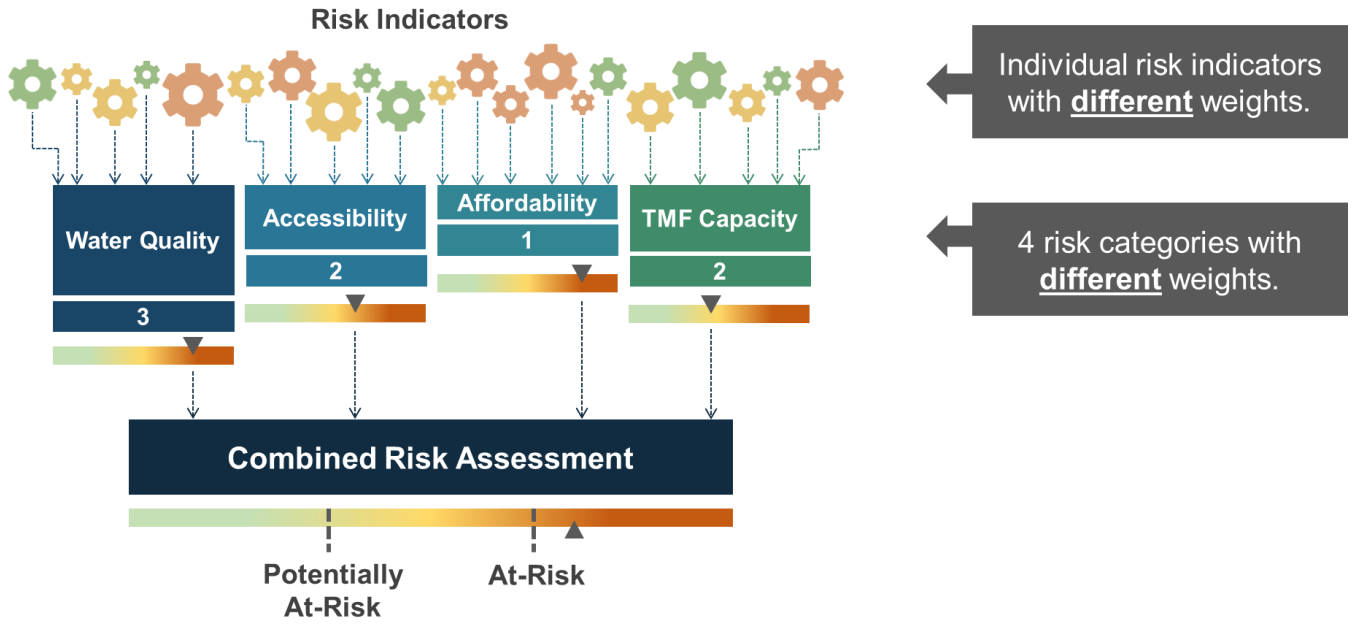
Risk Indicator	Thresholds	Score	Weight
Monitoring & Reporting Violations	**Threshold 0** = **1 or less** Monitoring & Reporting violations over the last three years.	0	2
	Threshold 1 = **2 or more** Monitoring & Reporting violations over the last three years.	1	2
Significant Deficiencies	**Threshold 0** = **0** Significant Deficiencies over the last three years.	0	N/A
	Threshold 1 = **1 or more** Significant Deficiencies over the last three years.	1	3
Extensive Treatment Installed	**Threshold 0** = **No** extensive treatment installed.	0	N/A
	Threshold 1 = **Yes**, extensive treatment is installed.	1	2

RISK INDICATOR CATEGORY WEIGHTS

Another methodology option is to weight the aggregated categories of the Risk Assessment (*i.e.* Water Quality, Accessibility, Affordability and TMF Capacity). The assessment methodology can either apply the same "weight" to each risk indicator category or apply different weights. Public feedback from four public workshops indicated that the Risk Assessment a risk indicator category weighted approach based on criticality is preferred to no weights. Weights between 1 and 3 were applied to each risk indicator category, with a weight of 3 indicating the highest level of criticality (Figure A5).

The risk indicator category weights were developed with the professional opinion of the broader research team contracted through UCLA, DDW staff, as well as an internal advisory group of District Engineers. An analysis of how the application of risk indicator category weights impacts the performance of HR2W list systems was shared with the public for feedback with white paper *Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water Systems* [40] and December 14, 2021 webinar,[41] which ultimately supported the final inclusion category weights in the Risk Assessment.

Figure A5: Aggregated Risk Assessment Methodology with Category Weights



[40] December 14, 2020 White Paper:
Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/draft_white_paper.pdf

[41] December 14, 2020 Webinar Presentation
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/safer_risk_assessment_webinar_accessible.pdf

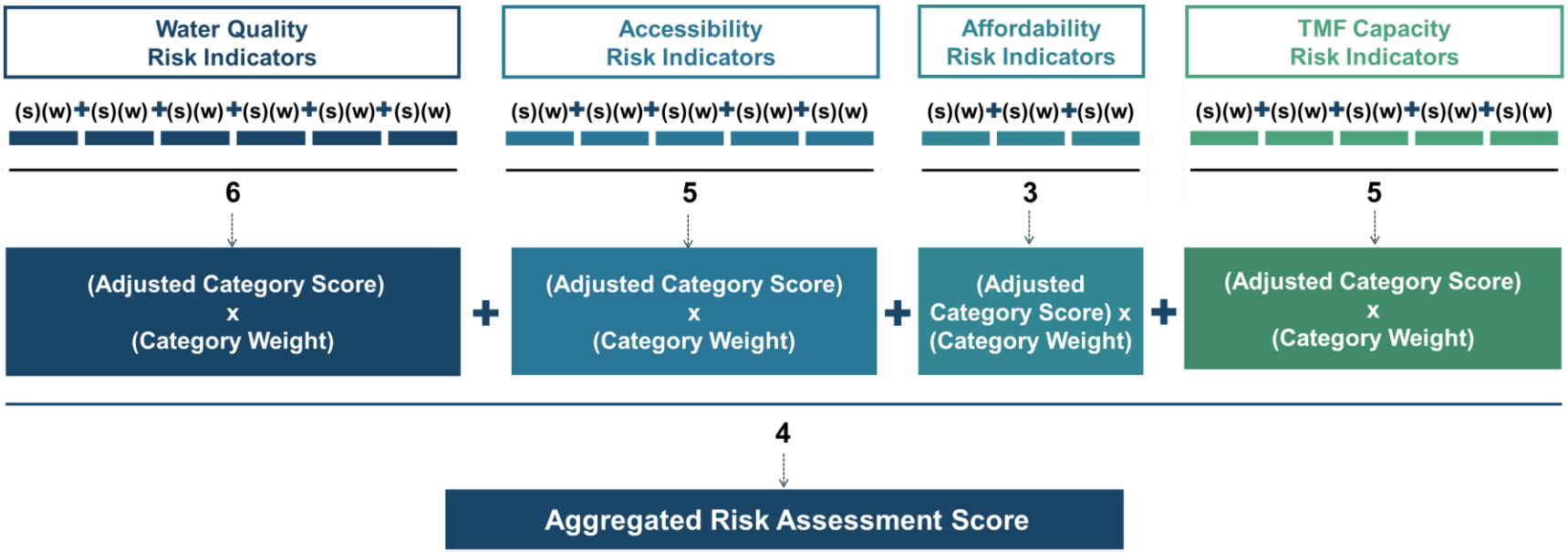
December 14, 2020 Webinar Recording
https://www.youtube.com/embed/6XDak8R5IDk?cc_load_policy=1&modestbranding=1&rel=0&autoplay=1

AGGREGATED RISK ASSESSMENT CALCULATION METHODOLOGY

The assessment of individual risk indicators within each category and for the aggregated risk assessment relies on: (1) the amount of risk scores or points each systems accrues per indicator, (2) the number of indicators that system is assessed for in each category, and (3) the weights applied to individual risk indicators and categories. Figure A6 provides an illustration of the aggregated Risk Assessment calculation method.

The aggregated Risk Assessment methodology takes the standardized score, between 0 and 1, for each risk indicator and applies a criticality weight to each indicator, between 1 and 3. Then a criticality weight is also applied to each risk indicator category (*e.g.* Water Quality, Accessibility, *etc.*), between 1 and 3. The final score is an average of the weighted category scores.

Figure A6: Illustration of the Risk Assessment Calculation Methodology with Risk Indicator Scores (s) and Risk Indicator and Categories Weights (w)



ADJUSTING FOR MISSING DATA

It is important that the Risk Assessment methodology adapt for where data may be missing for certain water systems, either because a system failed to report necessary data or because the system may not have data to report. For example, some water systems do not charge for water. Therefore, those systems do not have the necessary data (*i.e.* customer charges) for two of the three risk indicators in the Affordability category.

Multiple different methods for handling missing data, including DWR and OEHHA's methods, as well as statistical imputation methods, were considered for the Risk Assessment.[42] [43] Ultimately, the strategy that was chosen for the Risk Assessment was to omit any value for a missing risk indicator and to instead re-distribute the weights/scores to risk indicators within the same category which did have valid values (Figure A7). In future versions of the Risk Assessment, however, systems with considerable missing data due to non-reporting of required data may be assessed negative points in a new indicator developed in the TMF Capacity category.

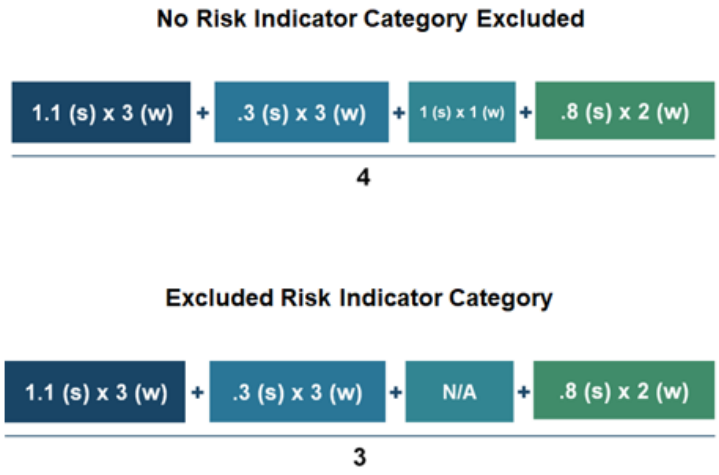
Figure A7: Example of How the Aggregated Risk Assessment Adjusts for Missing Risk Indicator Data

There were some cases where risk indicator data for a whole category, particularly the Affordability category, were missing. However, many of these systems were unconventional community water systems in the sense that they have a stable population base, but no ratepayer base (for example, schools, prisons, parks). These systems, where identifiable, were excluded from the Affordability category of the Risk Assessment altogether. The Risk Assessment redistributes the weights/score of a missing risk indicator category to the other categories when an entire category is excluded from the assessment, as illustrated in Figure A8.

[42] For instance, see Rubin, D. B. (1976). Inference and missing data. Biometrika, 63(3), 581-592. doi:10.1093/biomet/63.3.581; Little, R. J. (1998). A Test of Missing Completely at Random for Multivariate Data with Missing Values. Journal of the American Statistical Association, 83(404), dec, 1198-1292. doi:10.2307/2290157; Rhoads, C. H. (2012). Problems with Tests of the Missingness Mechanism in Quantitative Policy Studies. Statistics, Politics, and Policy, 3(1). doi:10.1515/2151-7509.1012

[43] OECD (2008). Handbook on Constructing Composite Indicators: Methodology and User Guide. https://www.oecd.org/sdd/42495745.pdf

Figure A8: How the Aggregated Risk Assessment Adjusts for a Missing Risk Indicator Category



AGGREGATED RISK ASSESSMENT THRESHOLDS

Based on the distribution of the HR2W list systems in the aggregated and weighted Risk Assessment results, the State Water Board recommended a “Potentially At-Risk" threshold of 0.75 and an “At-Risk” threshold of 1.0 for public consideration (Figure A9). These threshold recommendations were determined based on where the current and expanded HR2W list systems started to cluster. These recommendations were shared with the public for feedback with white paper *Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water Systems*[44] and December 14, 2021 webinar.[45] Ultimately, public feedback supported the recommended thresholds and no objections were received.[46]

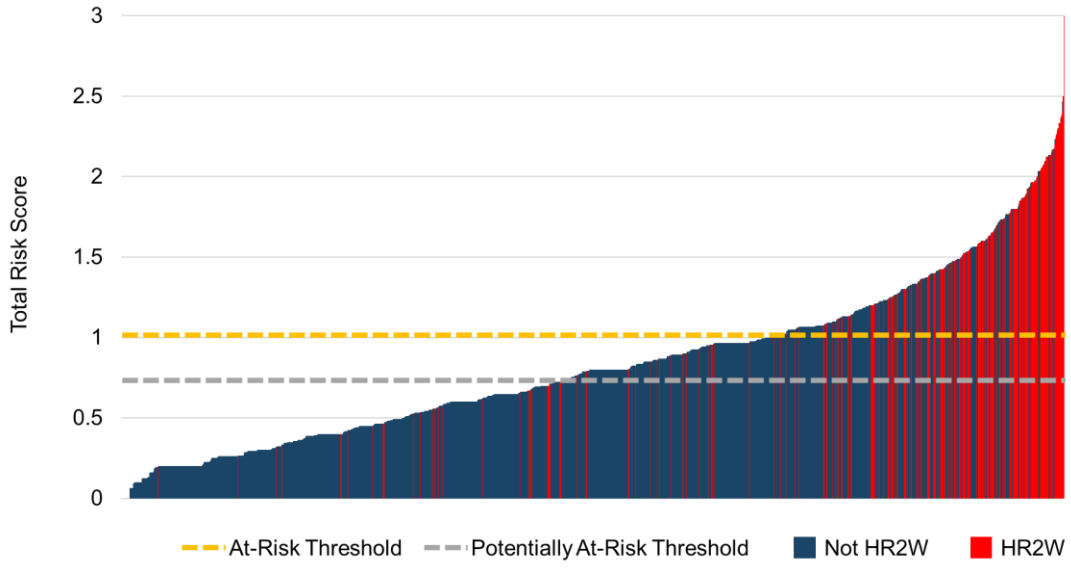
[44] December 14, 2020 White Paper:
Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/draft_white_paper.pdf

[45] December 14, 2020 Webinar Presentation
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/safer_risk_assessment_webinar_accessible.pdf

December 14, 2020 Webinar Recording
https://www.youtube.com/embed/6XDak8R5IDk?cc_load_policy=1&modestbranding=1&rel=0&autoplay=1

[46] At the time the recommended thresholds were shared, the list of water systems that would be designated At-Risk and Potentially At-Risk was not made publicly available in order to (1) prevent bias in recommendations and (2) to limit unintended consequences of being on a preliminary draft At-Risk list.

Figure A9: Distribution of Total Weighted Risk Score for Assessed Water Systems (n=2,779)

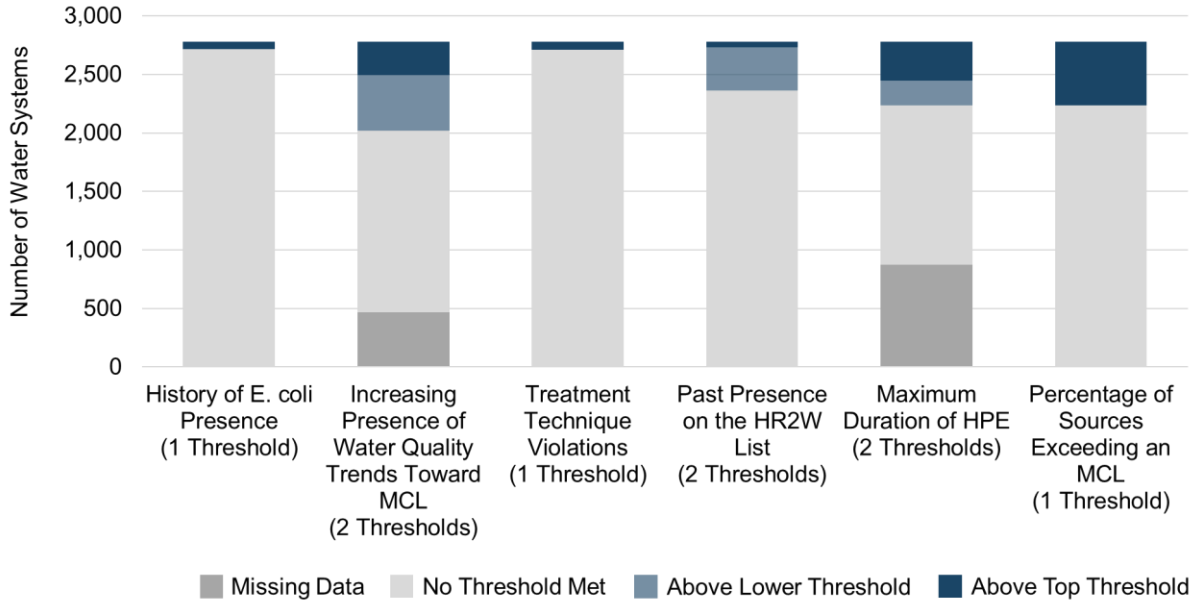


RISK INDICATOR DETAILS

WATER QUALITY RISK INDICATORS

This section provides full details on each Water Quality risk indicator used in the Risk Assessment. Water Quality risk 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. Figure A10 illustrates the number of water systems that exceeded the risk indicator thresholds within the Water Quality category. The range of potential thresholds for each risk indicator are summarized in the respective risk indicator label and detailed below.

Figure A10: Number of Systems Exceeding Thresholds for Each Water Quality Risk Indicator



HISTORY OF E. COLI PRESENCE

The presence of E. coli in drinking water suggests that the supply has fecal contamination, and in turn, that other pathogens could be present. The presence of these contaminants could also suggest that water treatment is inadequate, interrupted, or intermittent. Water systems are required to conduct a Level 1 and/or a Level 2 Assessment if conditions indicate they might be vulnerable to contamination.

A Level 1 Assessment is performed by a water system owner or operator when laboratory results indicate that bacteriological threats may exist, an assessment form must be filled and

submitted to the State within 30 days. Level 1 Assessment is triggered by any of the following conditions.[47]

- A public water system collecting fewer than 40 samples per month has 2 or more total coliform positive routine/repeat samples in the same month.
- A public water system collecting at least 40 samples per month has greater than 5.0 percent of the routine/repeat samples in the same month that are total coliform positive.
- A public water system fails to take every required repeat sample after any single total coliform positive sample.

A Level 2 Assessment is performed by the State or State-approved entity, but the water system is responsible for ensuring the completion of the assessment regardless of the entity conducting it. Once Level 2 is triggered an assessment form must be completed and submitted to the State within 30 days. A Level 2 Assessment is triggered by the following conditions[48]:

- A water system incurs an E. coli MCL violation.
- A water system has a second Level 1 Assessment within a rolling 12 months period.
- A water system on State-approved annual monitoring has a Level 1 Assessment trigger in two consecutive years.

Water systems must fix any sanitary defects within a required timeframe.

Calculation Methodology

Required Risk Indicator Data Points & Sources:

- E. coli violations – Analyte Code 3014: Safe Drinking Water Information System (SDWIS).
    - Query systems that only have E. coli related treatment technique and/or MCL violations. See list of violation codes below:

Table A4: Identified Violation Types Related to E. coli

Violation Number	Violation Type	Description
01*	**MCL, Single Sample**	MCL violation based on a single sample, or an organic analyte that is 10X the MCL.
1A	**MCL, E. coli, Positive E. coli (RTCR)**	E. coli MCL violation based on a single sample.

[47] Level 1 Assessment: A Quick Reference Guide
https://www.epa.gov/dwreginfo/revised-total-coliform-rule-and-total-coliform-rule

[48] Level 2 Assessment: A Quick Reference Guide
https://www.epa.gov/dwreginfo/revised-total-coliform-rule-and-total-coliform-rule

Violation Number	Violation Type	Description
02*	**MCL, Numeric Average of Samples Taken**	A violation for an inorganic, organic, or radiological constituent where compliance is based on a running annual average or more monitoring period average.
T1*	**State Violation – Treatment Technique**	A violation where the water system failed to treat water using the treatment process the State has primacy to regulate (*i.e.* treatment failed per the system's permit).

* These violations were inadvertently used to record an E. coli violation and therefore are being shown in this Table. Violation Number 1A is the code that should be used to record these violations.

- Level 2 Assessments
  - Violation Type Code (2B): SDWIS.
  - Level 2 Assessment Activities Spreadsheet: Maintained by State Water Board's Program Liaison Unit (PLU).

Risk Indicator Calculation Methodology:

- Determine which systems have had E. coli violations within the last three years with a SOX (State Compliance Achieved) Enforcement Action.
- Determine which systems have had a Level 2 Assessment over the last three years.

Threshold Determination

The State Water Board has adopted a threshold for E. coli violations for the expanded HR2W list criteria which relies on whether the water system has an open enforcement action for the violation. [49] For the Risk Assessment, a modified version of the expanded HR2W list criteria threshold was developed for the "History of E. Coli Presence" risk indicator. Systems that have had an E. coli violation or Level 2 Assessment within the last three years are considered more at risk than systems that have not.

Correlational and regression analysis between the risk indicator as defined with this threshold and water system failure to deliver safe drinking water as defined in the HR2W list shows a statistically significant relationship.

Risk Indicator Scoring & Weighting

To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be

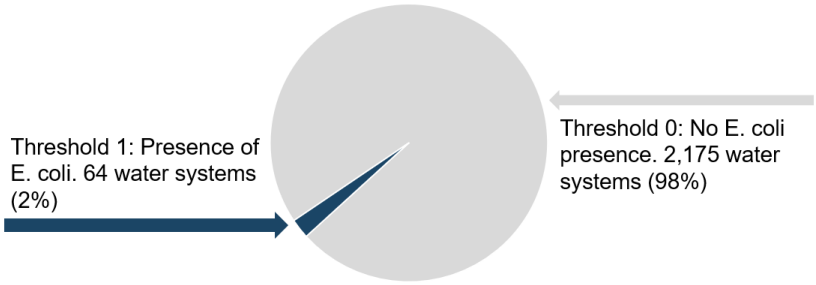
[49] Systems that meet the HR2W list criteria will not be included in the Risk Assessment.

weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 3 is applied to the "History of E. Coli Presence" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 3. Table A5 summarizes the thresholds, scores, and weight for this risk indicator.

Table A5: "History of E. coli Presence" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**No** history of E. coli presence over the last three years.	0	N/A
1	**Yes**, history of E. coli presence (E. coli violation and/or Level 2 Assessment) over the last three years.	1	3

Figure A11: Water Systems (3,300 service connections or less) with a History of E. coli Presence Within the Last 3 Years (n=2,779)



Presence of E. coli was found by analyzing E. coli violation and Level 2 Assessment (L2) data for all 2,779 water systems. Presence of E coli was determined for any system identified with either an E. coli violation or L2. 53 water systems had no E. coli violation but did have an L2. Four systems had an E. coli violation but no L2. Seven systems had both. The average number of violations per water system is 0.03, the minimum is 0, and the maximum is 4. 62 water systems (2%) meet Threshold 1 having a presence of E. coli. 2,788 water systems (98%) meet Threshold 0 having no E. coli presence.

INCREASING PRESENCE OF WATER QUALITY TRENDS TOWARD MCL

Increasing presence of one or more regulated contaminants, especially those attributable to anthropogenic causes, that are detected at or greater than 80% of the MCL within the past nine years. Additional discussion is provided below. The risk indicator may be utilized in future a Risk Assessment after additional analysis are included.

***Important Note**: As previous white papers have detailed, this risk indicator was initially excluded from the Risk Assessment methodology due to concerns regarding how its inclusion*

was affecting the overall risk scoring and distribution.[50] *However, errors in the original calculations were identified and corrected, and the use of the raw data to construct the risk indicator and its weighting was re-considered and executed in a new way. After making these changes, the effect of this risk indicator on overall scoring was in line with original expectations for its use. Thus, it has been included in the final Risk Assessment.*

Calculation Methodology
Required Risk Indicator Data Points & Source:

WQIr chemical table[51] for the following:

Acute Contaminants[52] – Per the Tier 1 public notification rule[53]

Table A6: Acute Contaminants with a Primary MCL

Contaminant	Analyte Number
Nitrate (as Nitrogen)	00618
Nitrate + Nitrite (as Nitrogen)	A-029
Nitrite (as Nitrogen)	00620
Perchlorate	A-031
Chlorite	50074
Chlorine Dioxide (MRDL instead of MCL)	50070

Non-Acute Primary Contaminants

Table A7: Non-Acute Constituents[54] that have a Primary MCL

Contaminant	Analyte Number
Aluminum	01105
Antimony	01097
Arsenic	01002
Asbestos	81855
Barium	01007

[50] December 14, 2020 White Paper:
Recommendations for Risk Assessment 2.0 Thresholds, Scores, & Weights for Public Water Systems
https://www.waterboards.ca.gov/safer/docs/draft_white_paper.pdf

[51] Bacteriological constituents are excluded from this risk indicator.

[52] CCR § 64400. Acute Risk. "Acute risk" means the potential for a contaminant or disinfectant residual to cause acute health effects, i.e., death, damage or illness, as a result of a single period of exposure of a duration measured in seconds, minutes, hours, or days.

[53] CCR § 64463.1. Tier 1 Public Notice.

[54] Beryllium was inadvertently omitted from the list of Non-Acute Primary Contaminants included in the Risk Assessment presented in this report. The State Water Board will be updating the Risk Assessment results to include this constituent in the near future.

Contaminant	Analyte Number
Cadmium	01027
Chromium	01034
Cyanide	01291
Fluoride	00951
Mercury	71900
Nickel	01067
Selenium	01147
Thallium	01059
Benzene	34030
Carbon Tetrachloride	32102
1,2-Dichlorobenzene	34536
1,4-Dichlorobenzene	34571
1,1-Dichloroethane	34496
1,2-Dichloroethane	34531
1,1-Dichloroethylene	34501
cis-1,2-Dichloroethylene	77093
trans-1,2-Dichloroethylene	34545
Dichloromethane	34423
1,2-Dichloropropane	34541
1,3-Dichloropropene	77173
Ethylbenzene	34371
Methyl-tert-butyl ether	46491
Monochlorobenzene	34301
Styrene	77128
1,1,2,2-Tetrachloroethane	34516
Tetrachloroethylene	34475
Toluene	34010
1,2,4-Trichlorobenzene	34551
1,1,1-Trichloroethane	34506
1,1,2-Trichloroethane	34511
Trichloroethylene	39180
Trichlorofluoromethane	34488
1,1,2-Trichloro-1,2,2-Trifluoroethane	34511
Vinyl Chloride	39175
Xylenes	81551
Alachlor	77825
Atrazine	39033
Bentazon	38710

Contaminant	Analyte Number
Benzo(a)pyrene	34247
Carbofuran	81405
Chlordane	39350
2,4-D	39730
Dalapon	38432
Dibromochloropropane	38761
Di(2-ethylhexyl)adipate	A-026
Di(2-ethylhexyl)phthalate	39100
Dinoseb	81287
Diquat	78885
Endothall	38926
Endrin	39390
Ethylene Dibromide	77651
Glyphosate	79743
Heptachlor	39410
Heptachlor Epoxide	39420
Hexachlorobenzene	39700
Hexachlorocyclopentadiene	34386
Lindane	39340
Methoxychlor	39480
Molinate	82199
Oxamyl	38865
Pentachlorophenol	390032
Picloram	39720
Polychlorinated Biphenyls	39516
Simazine	39055
Thiobencarb	A-001
Toxaphene	39400
1,2,3-Trichloropropane (1,2,3-tcp)	77443
2,3,7,8-TCDD (Dioxin)	34676
2,4,5-TP (Silvex)	39045
Radium-226	A-074
Radium–228	A-075
Gross Alpha particle (excluding radon/uranium)	01501
Uranium	28012
Beta/photon emitters	03501
Strontium-90	13501
Tritium	07000

Secondary Contaminants

Table A8: Constituents that have a Secondary MCL*

Contaminant	Analyte Number
Aluminum	01105
Color	00081
Copper	01042
Foaming Agent (MBAS)	38260
Iron	01045
Manganese	01056
Methyl-*tert*-butyl ether (MTBE)	46491
Odor	00086
Silver	01077
Thiobencarb	A-001
Turbidity	82078
Zinc	01092

* Total Dissolved Solids, Specific Conductance, Chloride, and Sulfate are excluded.

Threshold Determination

The increasing presence of water quality trends toward an MCL violation, as defined here or a similar measure, has not been assessed in other previous studies as related to water system failure or employed by other regulatory agencies or stakeholders as a threshold of concern. The State Water Board's workgroup of district engineers determined the draft tiered thresholds for this risk indicator based on their experience working with water systems throughout the state. These draft thresholds were shared with the public and ultimately incorporated into the Risk Assessment.

Risk Indicator Scoring & Weighting

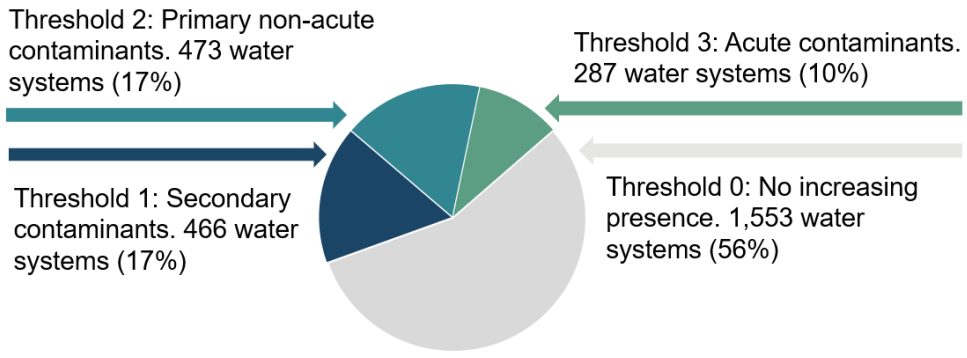
To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 2 is applied to the "Increasing Presence of Water Quality Trends Toward MCL" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 2. Table A9 summarizes the thresholds, scores, and weight for this risk indicator.

Table A9: "Increasing Presence of Water Quality Trends Toward MCL" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**No** Increasing Presence of Water Quality Trends Toward MCL	0	N/A
1	**Secondary Contaminants**: 9-year average of running annual average is at or greater than 80% of MCL and running annual average has increased by 20% or more.	0.25	2
2	**Primary Non-Acute Contaminants**: 9-year average of running annual average is at or greater than 80% of MCL and running annual average has increased by 5% or more.	0.5	2
3	**Acute Contaminants**: • 9-year average (no running annual average) is at or greater than 80% of MCL; or • 24-month average is at or greater than 80% of MCL; or • Any one sample over the MCL.	1	2

Figure A12 shows 1,553 water systems (56%) had no increasing presence of water quality trends toward MCL. 466 water systems (17%) exhibited increasing trends in secondary contaminants, whereas 473 water systems (17%) exhibited increasing trends in primary non-acute contaminants. Finally, 287 water systems (10%) exhibited increasing trends in acute contaminants.

Figure A12: Increasing Presence of Water Quality Trends Toward MCL (n=2,779)



TREATMENT TECHNIQUE VIOLATIONS

According to U.S. 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 for small systems. Some examples of treatment technique rules are the following:

- Surface Water Treatment Rule[55] (disinfection and filtration)
- Ground Water Rule[56]
- 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 monitoring and reporting violations) is incurred when a water system does not follow required treatment techniques to reduce the risk from contaminants, *e.g.*, exceeding the maximum allowable turbidity or flow rate of a surface water treatment plant.

Calculation Methodology
Required Risk Indicator Data Points & Sources:

- Treatment Technique violations: SDWIS

Table A10: Treatment Technique Violation Codes

Violation Type Code	SDWIS Violation Name
07	Treatment Techniques (Other)
12	Qualified Operator Failure
33	Failure Submit Treatment Requirement Report
37	Treatment Tech. No Prior State Approval
40	Treatment Technique (FBRR)
41	Failure to Maintain Microbial Treatment
42	Failure to Provide Treatment
43	Single Turbidity Exceed (Enhanced SWTR)
44	Monthly Turbidity Exceed (Enhanced SWTR)
45	Failure to Address A Deficiency

[55] Title 22 CCR, Division. 4, Chapter 17 Surface Water Treatment
https://govt.westlaw.com/calregs/Browse/Home/California/CaliforniaCodeofRegulations?guid=I501543B0D4BA11DE8879F88E8B0DAAAE&originationContext=documenttoc&transitionType=Default&contextData=(sc.Default)

[56] Title 22 CCR, Division 4, Chapter 15, Article 3.5 Groundwater Rule
https://govt.westlaw.com/calregs/Browse/Home/California/CaliforniaCodeofRegulations?guid=I729BEDE0B98711E0B493EB23F8012672&originationContext=documenttoc&transitionType=Default&contextData=(sc.Default)

Violation Type Code	SDWIS Violation Name
46	Treatment Technique Precursor Removal
47	Treatment Technique Uncovered Reservoir
48	Failure to Address Contamination
57	OCCT/SOWT Recommendation
58	OCCT/SOWT Install Demonstration
59	WQP Level Non-Compliance
63	MPL Level Non-Compliance
64	Lead Service Line Replacement (LSLR)
65	Public Education
2A	Level 1 Assessment Treatment Technique
2B	Level 2 Assessment Treatment Technique
2C	Corrective Actions/Expedited Actions TT
2D	Start-up Procedures Treatment Technique
T1	State Violation-Treatment Technique

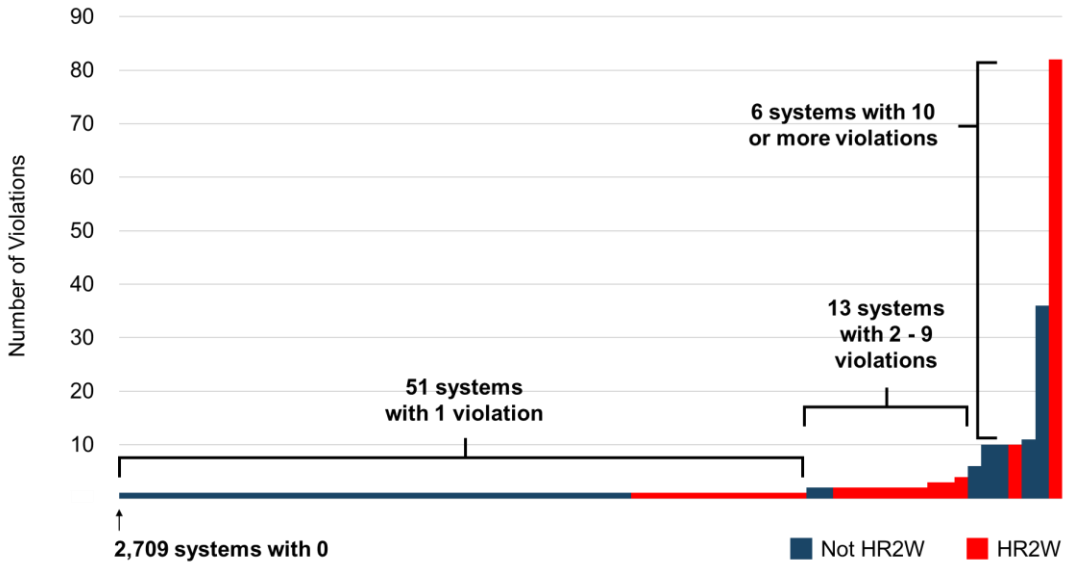
Risk Indicator Calculation Methodology:

- Determine which systems have had one or more Treatment Technique violations within the last three years using the Treatment Technique violation codes listed in Table A10 and excluding the following scenarios below:
    - Systems with an open Enforcement Action are excluded from the Risk Assessment because they meet the criteria for the expanded HR2W list.
    - Systems that have had three or more Treatment Technique violations within the last three years are also excluded from the Risk Assessment because they meet the criteria for the HR2W list.

Threshold Determination

Treatment Technique violation data was analyzed for 2,779 water systems (Figure A13). The minimum number of violations found was 0, the maximum for one water system was 82 violations in the last 3 years, and the average violation count was 0.09 per system. 2,709 water systems had 0 violations, 51 water systems had 1 violation, 9 water systems had 2 violations, 2 water systems had 3 violations, water systems had 4 violations, 1 water system had 6 violations, and 7 water systems had more than 10 violations.

Figure A13: Water Systems with Treatment Technique Violations Over the Last 3 Years (n=2,779)



The State Water Board has developed a threshold for Treatment Technique violations (in lieu of an MCL) for the expanded HR2W list criteria that relies on: (1) whether the water system has an open enforcement action for the violation or (2) the system has had three or more Treatment Technique violations in the past three years.[57] For the Risk Assessment, a modified version of the expanded HR2W criteria threshold was developed for the "Treatment Technique Violations" risk indicator. Systems that have one or more treatment technique violations within the last three years are considered more at risk than systems that have not.

Correlational and regression analysis between the risk indicator as defined with this threshold and water system failure to deliver safe drinking water as defined in the HR2W list shows a statistically significant relationship.

Risk Indicator Scoring & Weighting

To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 1 is applied to the "Treatment Technique Violations" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 1. Table A11 summarizes the thresholds, scores, and weight for this risk indicator.

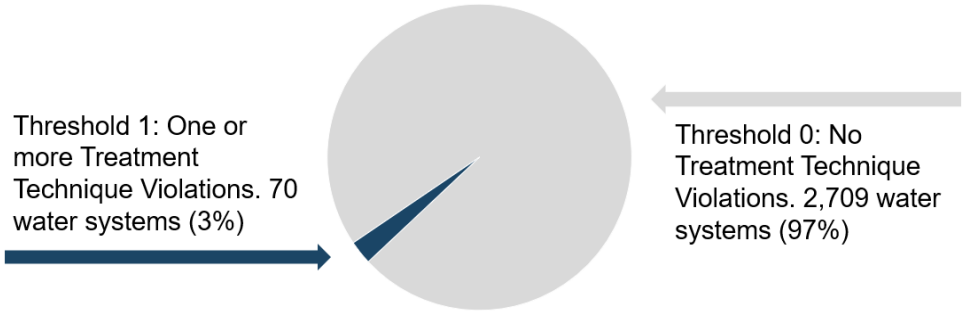
[57] Systems that meet the HR2W list criteria will not be included in the Risk Assessment.

Table A11: "Treatment Technique Violations" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**0** Treatment Technique violation over the last three years.	0	N/A
1	**1 or more** Treatment Technique violations over the last three years.	1	1

Figure A14 shows 70 water systems meet Threshold 1, having one or more treatment technique violations within the last three years. The remaining 2,709 water systems (97%) had no treatment technique violations within the last three years.

Figure A14: Water Systems with Treatment Technique Violations within the Last 3 Years (n=2,779)



PAST PRESENCE ON THE HR2W LIST

This indicator reflects past presence on the HR2W list within the last three years. The expanded HR2W list includes systems that have an open enforcement action for a primary MCL violation, secondary MCL violation, E. coli violation, monitoring and reporting violation (15 months or more), treatment technique violation, and/or systems that have had three of more treatment technique violations. A system is removed from the HR2W list after they have come back into compliance and a return to compliance enforcement action has been issued and/or the system has less than three treatment technique violations over the last three years.

Calculation Methodology
Required Risk Indicator Data Point & Source:

- Violation Data: SDWIS
- Enforcement Action Data: SDWIS

- Refer to State Water Board's HR2W website[58] for detailed criteria and methodology for the HR2W list.

Threshold Determination
Data on Past Presence of the HR2W list was available for all 2,850 water systems. 2,393 water systems (82%) have zero HR2W list occurrences over the past three years. There are 457 (16%) water systems with one or more occurrence in the past three years. Of these systems the minimum occurrence was once, the maximum was 3. Peer-reviewed studies suggest that past presence of drinking water quality violations is associated with subsequent present-day violations.[59] Therefore tiered thresholds were developed, where more occurrences on the HR2W list is associated with greater risk.

Risk Indicator Scoring & Weighting
To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 2 is applied to the "Past Presence on the HR2W List" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 2. Table A12 summarizes the thresholds, scores, and weight for this risk indicator.

Table A12: "Past Presence on the HR2W List" Thresholds & Scores

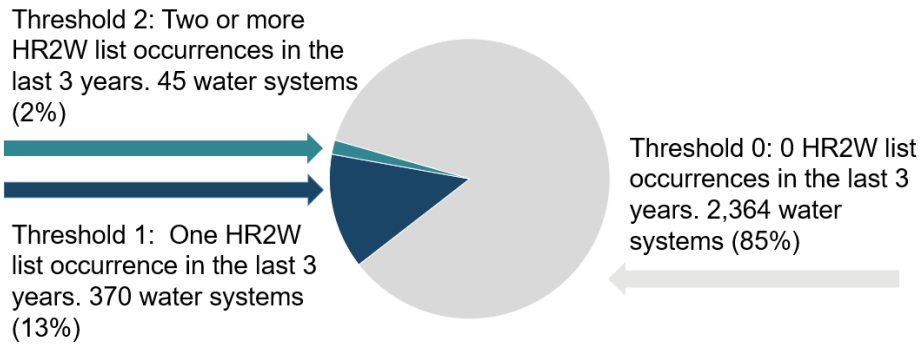
Threshold Number	Threshold	Score	Weight
0	**0** HR2W list occurrence over the last three years.	0	N/A
1	**1** HR2W list occurrence over the last three years.	0.5	2
2	**2** or more HR2W list occurrences over the last three years.	1	2

Figure A15 shows 2,364 water systems (85%) had no HR2W list occurrences in the last 3 years. 415 water systems (15%) had at least 1 HR2W list occurrence in the last 3 years. Among these systems, 370 (13% of the total) meet Threshold 1 with only one occurrence in the last three years, whereas 45 water systems (23%) meet Threshold 2 having two or more occurrences in the last three years.

[58] Human Right to Water | California State Water Resources Control Board
https://www.waterboards.ca.gov/water_issues/programs/hr2w/

[59] See McDonald, Yolanda J., and Nicole E. Jones. "Drinking water violations and environmental justice in the United States, 2011–2015." *American journal of public health* 108.10 (2018): 1401-1407.

Figure A15: Past Presence on the HR2W List over the Last 3 Years (n=2,779)



MAXIMUM DURATION OF HIGH POTENTIAL EXPOSURE (HPE)

Maximum Duration of HPE is developed and utilized by OEHHA in their HR2W Tool.[60] This indicator first measures the duration of HPE for each of 19 analyzed contaminants and selects the maximum duration across all contaminants. This indicator focuses on the recurring nature of contamination. Accordingly, it highlights systems that experience an ongoing contamination problem. Capturing this recurring exposure may be important, especially when such exposure involves contaminants whose health effects are associated with chronic exposure. A long duration of high potential exposure can also signal that a system may need additional resources or support to remedy contamination.

Calculation Methodology
Required Risk Indicator Data Points & Sources:

- Water Quality Monitoring database (WQM) between 2011 and 2019: Water quality sampling data for the list of chemicals housed in WQIr chemical table (see below).
- MCL violations Total Coliform Rule (TCR) and Revised Total Coliform Rule (RTCR) from SDWIS.
- Lead Sampling Analyte results from SDWIS.[61]

Table A13: Contaminants Utilized by OEHHA for HPE*

Analyte Name	Analyte Number (in WQIr)
Arsenic	01002
Barium	01007

[60] Human Right to Water Data Tool
https://oehha.maps.arcgis.com/apps/MapSeries/index.html?appid=a09e31351744457d9b13072af8b68fa5
Achieving the Human Right to Water in California: An Assessment of the State's Community Water Systems January 2021
https://oehha.ca.gov/media/downloads/water/report/hrtwachievinghrtw2021f.pdf

[61] Action Level (0.015 mg/L) exceedance at "90th percentile" lead level.

Analyte Name	Analyte Number (in WQIr)
Benzene	34030
Cadmium	01027
Carbon Tetrachloride	32102
Mercury	71900
Methyl Tertiary Butyl Ether (MTBE)	46491 (A-030)
1,2,3-trichloropropane (1,2,3-TCP)	77443/7744x
Nitrate as Nitrogen	00618
Perchloroethylene (PCE)	34475
Perchlorate	A-031
Trichloroethylene (TCE)	39180
Toluene	34010
Xylene	81551
1,2-dibromo-3-chloropropane (DBCP)	38761
Total trihalomethanes (TTHM)	82080
Gross Alpha	01501

* Lead and TCR/RTCR are excluded from this table

Risk Indicator Calculation Methodology

To create the indicator OEHHA:[62]

- Used the average annual concentration for each contaminant (except for Total Coliform/E.coli).
- Summed the number of years (within 9-year compliance cycle) for which any contaminant's annual average concentrations was greater than the MCL (or Action Level for lead) for each contaminant and summed the total years of TCR/RTCR MCL violations.
- Selected the maximum duration of high potential exposure across the 19 contaminants.

Threshold Determination

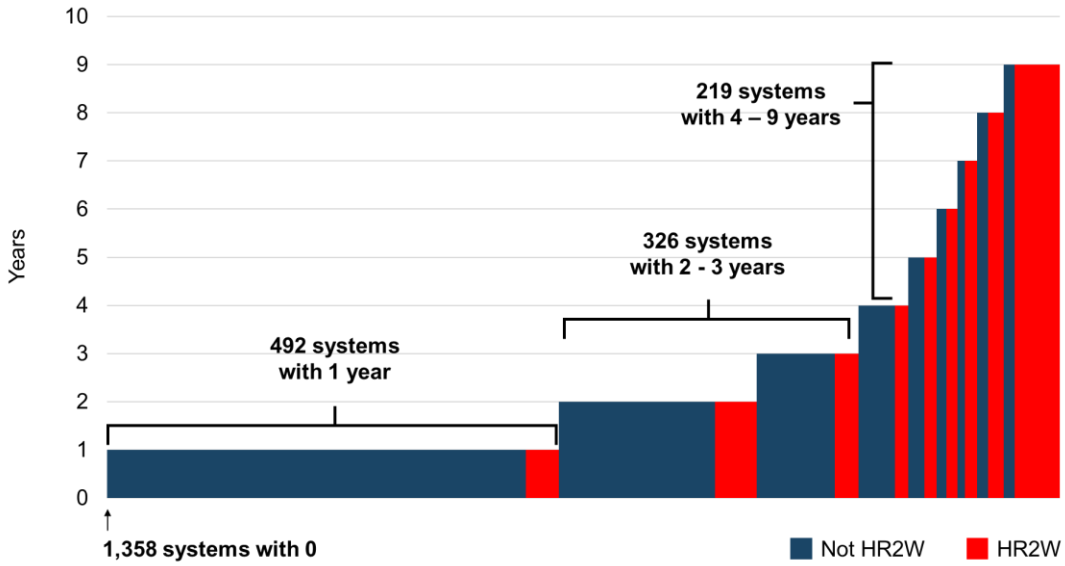
Data coverage for Maximum Duration of HPE is 86% with data available for 2,395 water systems. The minimum years of HPE in the data set is 0 years, the maximum is 9 years, and the average is 1.12 years. 1,358 water systems (49%) had zero years HPE.

100% data coverage was not available because the inventory of water systems assessed by OEHHA for HPE only includes community water systems. The inventory of systems assessed

[62] From Page 25 in OEHHA's *Achieving the Human Right to Water in California: An Assessment of the State's Community Water Systems January 2021*:
https://oehha.ca.gov/media/downloads/water/report/hrtwachievinghrtw2021f.pdf

by the State Water Board's Risk Assessment also includes non-transient, non-community systems, specifically schools K-12. HPE data is not available for these systems.

Figure A16: Water Systems' Max Duration of HPE over the Last 9 Years (n=2,395)



As described above, the Maximum Duration of HPE is developed and utilized by OEHHA in their HR2W Tool. OEHHA set different thresholds of concern for HPE at each of 0, 1, 2 to 3, 4 to 5, and 6+ years with score values ranging from 0 to 4. The State Water Board adapted this range of thresholds in coordination with OEHHA to align with the Risk Assessment's maximum range of three thresholds.

Risk Indicator Scoring & Weighting

To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 3 is applied to the "Maximum Duration of HPE" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 3. Table A14 summarizes the thresholds, scores, and weight for this risk indicator.

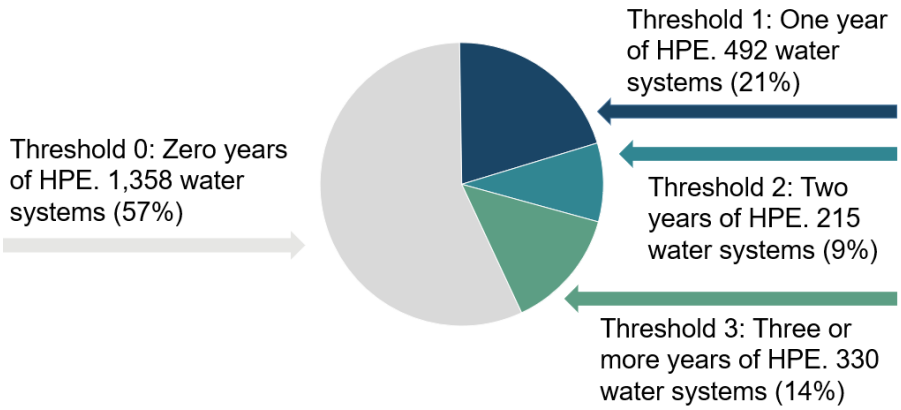
Table A14: "Maximum Duration of HPE" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**0** year of HPE over the last nine years.	0	N/A
1	**1** year of HPE over the last nine years.	0.25	3

Threshold Number	Threshold	Score	Weight
2	**2** years of HPE over the last nine years.	0.5	3
3	**3 or more** years of HPE over the last nine years.	1	3

Figure A17 shows 1,358 water systems (57%) have zero years of HPE. 492 water systems (21%) meet Threshold 1 having one-year HPE, compared to 215 water systems (9%) which meet Threshold 2 having two years of HPE. Finally, 330 water systems (14%) meet Threshold 3 having three or more years of HPE.

Figure A17: Maximum Duration of High Potential Exposure (HPE) (n=2,395)



PERCENTAGE OF SOURCES EXCEEDING AN MCL

Percent of the number of sources that exceed any MCL in the table below. The number includes water systems sources with an exceedance of any primary chemical contaminant within the past three years. This indicator assumes that the water system is not in violation overall.

Calculation Methodology
Required Risk Indicator Data Points & Sources:

- Water source facility type from SDWIS:
  - CC – Consecutive Connection
  - IG – Infiltration Gallery
  - IN – Intake
  - RC – Roof Catchment
  - SP – Spring
  - WL – Well
- WQIr chemical table:

Table A15: Analytes in WQIr Chemical Table

Analyte Name	Analyte Number (in WQIr)
1,1,1-Trichloroethane	34506
1,1,2,2-Tetrachloroethane	34516
Trichlorotrifluoroethane	81611
1,1,2-Trichloroethane	34511
1,1-Dichloroethane	34496
1,1-Dichloroethylene	34501
1,2,3-Trichloropropane (1,2,3-TCP)	77443
1,2,4-Trichlorobenzene	34551
1,2-Dichlorobenzene	34536
1,2-Dichloroethane	34531
1,2-Dichloropropane	34541
1,3-Dichloropropane (TOTAL)	34561
1,4-Dichlorobenzene	34571
2,3,7,8-TCDD (Dioxin)	34676
2,4,5-TP (Silvex)	39045
2,4-D	39730
Alachlor	77825
Aluminum	01105
Antimony	01097
Arsenic	01002
Asbestos	81855
Atrazine	39033
Barium	01007
Bentazon	38710
Benzene	34030
Benzo (A) Pyrene	34247
Beryllium	01012
Bromate	A-027
Cadmium	01027
Carbofuran	81405
Carbon Tetrachloride	32102
Chlordane	39350
Chlorite	50074
Chromium (Total)	01034
CIS-1,2-Dichloroethylene	77093
CIS-1,3-Dichloropropene	34704
Combined RA 226 + RA 228	11503
Cyanide	01291
Dalapon	38432
Di(2-Ethylhexyl)Phthalate	39100
Dibromochloropropane (DBCP)	38761

Analyte Name	Analyte Number (in WQIr)
Dichloromethane	34423
Dinoseb	81287
Diquat	78885
Endothall	38926
Endrin	39390
Ethylbenzene	34371
Ethylene Dibromide (EDB)	77651
Fluoride (F) (Natural-Source)	00951
Glyphosate	79743
Gross Alpha	01501
Gross Beta	03501
Haloacetic Acids (5) (HAA5)	A-049
Heptachlor	39410
Heptachlor Epoxide	39420
Hexachlororobenzene	39700
Hexachlorocyclopentadiene	34386
Lindane	39340
Manganese, Dissolved	01056
Mercury	71900
Methoxychlor	39480
Methyl Tertiary Butyl Ether (MTBE)	46491
Molinate	82199
Monochlorobenzene	34301
Nickel	01067
Nitrate as Nitrogen	00618
Nitrate + Nitrite (As N)	A-029
Nitrite (As N)	00620
Oxamyl	38865
Pentachlorophenol	390032
Perchlorate	A-031
Picloram	39720
Polychlorinated Biphenyls, Total, As DCB	39516
Selenium	01147
Simazine	39055
Strontium-90	13501
Styrene	77128
Tetrachloroethylene	34475
Thallium	01059
Thiobencarb	A-001
Toluene	34010
Total Trihalomethanes	82080

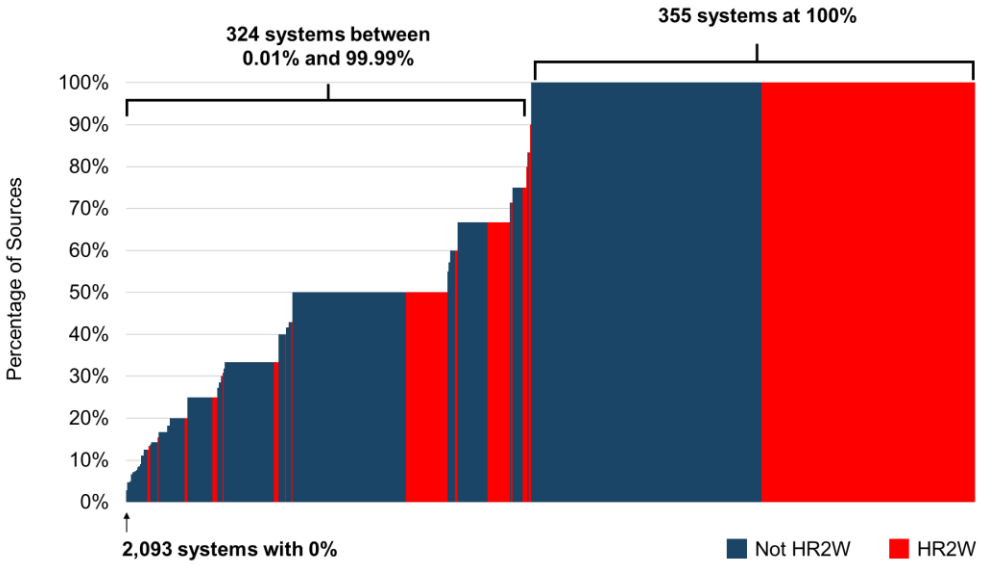
Analyte Name	Analyte Number (in WQIr)
Toxaphene	39400
Trans-1,2-Dichloroethylene	34545
Trans-1,2-Dicholropropene	34546
Tricholoroethylene	39180
Trichlorofluoromethane Freon 11	34488
Tritium	07000
Uranium (PCl/L)	28012
Vinyl Chloride	39175
Xylene (Total)	81551

Risk Indicator Calculation Methodology:

- Prepare SDWIS data
    - Combine two SDWIS tables (the Water System table and Water System Facility table).
    - Apply filters to prepared data and get counts of the total number of Water System Facilities for each Water System.
        - Filters applied
            - Active Water Systems Only
            - Active Water System Facilities Only
            - Water System Facilities with a facility type of CC, IG, IN, RC, SP, and WL
- Prepare WQI data
    - Combine three WQI tables (the Findings, Chemicals (Storets), and Chemical Levels).
    - Apply filters to prepared data and get counts of MCL exceedances for each source
        - Filters applied:
            - Primary contaminants only
            - Primary contaminants with an MCL exceedance
- Combine filtered SDWIS and WQI data
- Calculate the percentage of impaired sources by dividing the total number of sources with MCL exceedances (From WQI) by the total number of sources (From SDWIS) and then multiply that number by 100.

Threshold Determination
Data for 2,772 water systems was available to analyze the Percentage of Sources Exceeding MCL indicator. The minimum percentage found is zero, the maximum percentage found is 100%, and the average percentage found is 18%.

Figure A18: Water Systems' Percentage of Sources Exceeding an MCL (n=2,772)



The percentage of sources exceeding an MCL, as defined here or a similar measure, has not been assessed in other previous studies as related to water system failure or employed by other regulatory agencies or stakeholders as a threshold of concern. However, this lack of precedent likely reflects that this indicator threshold is hard to obtain and analyze without significant expertise and experience with source water quality data and data processing capability. The State Water Board's workgroup of district engineers determined the draft tiered thresholds for this risk indicator based on their experience working with water systems throughout the state. These draft thresholds were shared with the public and ultimately incorporated into the Risk Assessment.

Risk Indicator Scoring & Weighting

To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 3 is applied to the "Percentage of Sources Exceeding MCL" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 3. Table A16 summarizes the thresholds, scores, and weight for this risk indicator.

Table A16: "Percentage of Sources Exceeding MCL" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**less than 49.9%** of sources exceed an MCL.	0	N/A
1	**greater than 49.9%** or sources exceed an MCL.	1	3

Figure A19 shows 2,226 water systems (80%) have less than 49.9% of their water sources exceeding an MCL. 546 water systems (20%) meet Threshold 1 having greater than 49.9% of their water sources exceeding an MCL.

Figure A19: Percentage of Sources Exceeding an MCL (n=2,772)

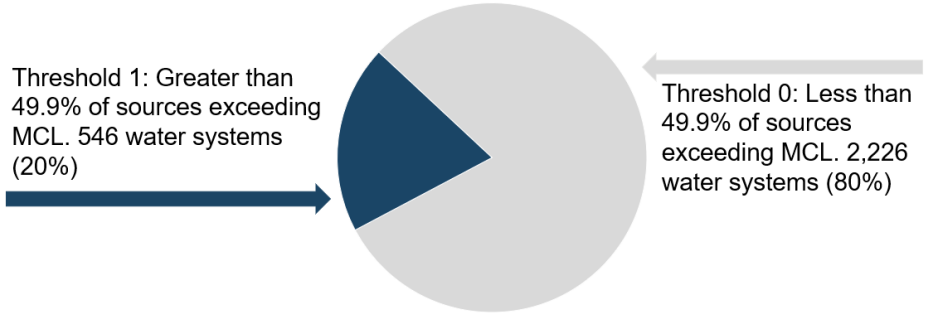
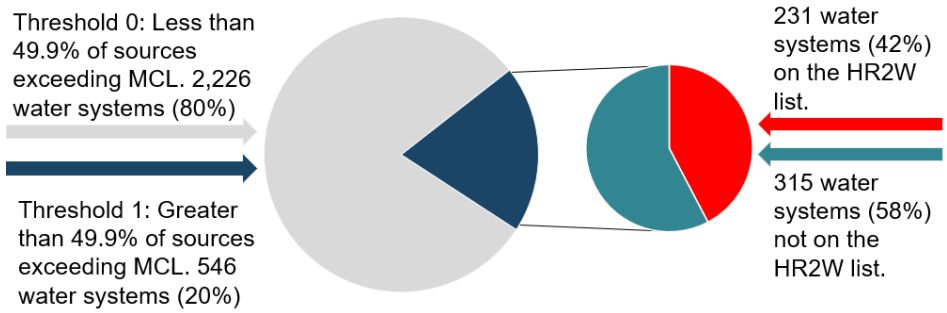


Figure A20 indicates 231 HR2W list water systems (80%) meet Threshold 1 having greater than 49.9% of their water sources exceeding an MCL. 57of HR2W list water systems (20%) have less than 49.9% of their water sources exceeding an MCL.

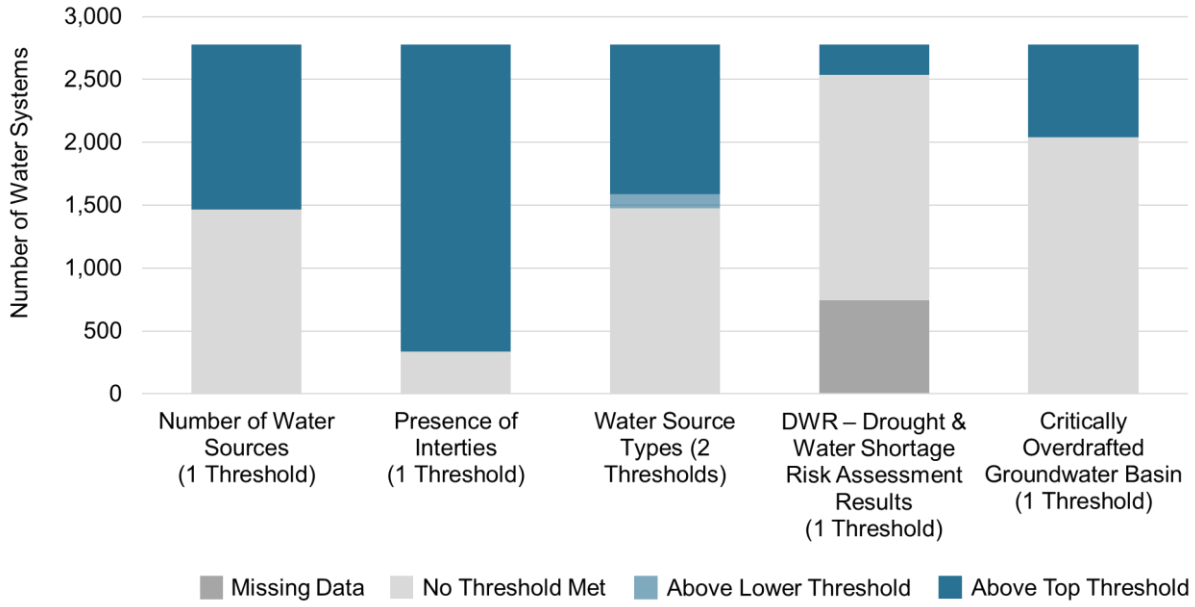
Figure A20: HR2W List System's Percentage of Sources Exceeding an MCL



ACCESSIBILITY RISK INDICATORS

This section provides full details on each Accessibility risk indicator used in the Risk Assessment. Accessibility risk indicators measure a system's ability to deliver safe, sufficient, and continuous drinking water to meet public health needs. Figure A21 illustrates the number of water systems that exceeded the risk indicator thresholds within the Accessibility category. The range of potential thresholds for each risk indicator are summarized in the respective risk indicator label and detailed below.

Figure A21: Number of Systems Exceeding Thresholds for Each Accessibility Risk Indicator



NUMBER OF SOURCES

Total number of available water sources including surface water, wells, and imported/purchased water.

Calculation Methodology
Required Risk Indicator Data Point & Source:

- Water Source Facility Type: SDWIS
  - CC – Consecutive Connection
  - IG – Infiltration Gallery
  - IN – Intake
  - RC – Roof Catchment
  - SP – Spring
  - WL – Well
  - ST – Storage Tank

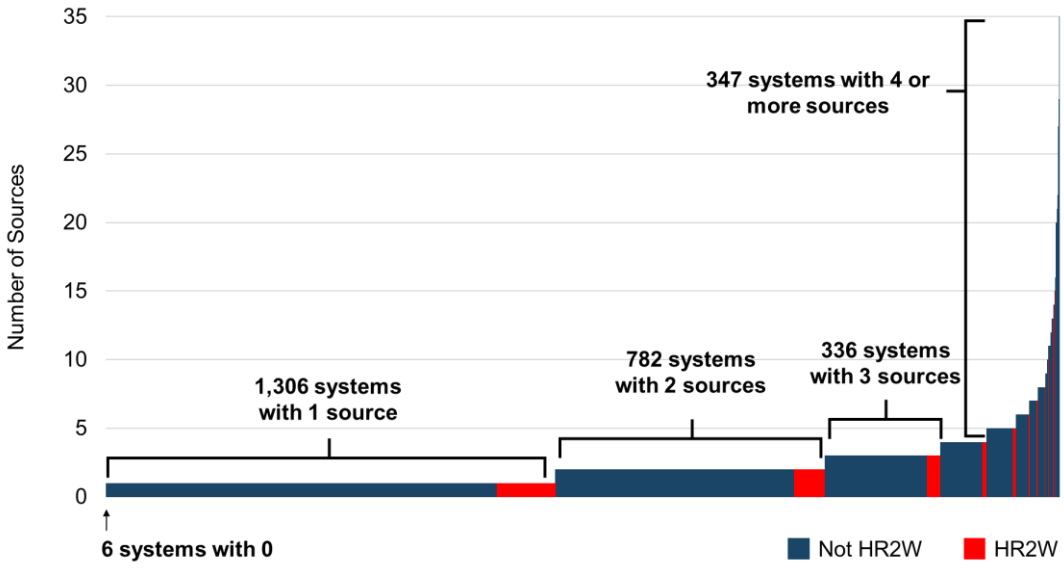
Risk Indicator Calculation Methodology:

- Prepare data
  - Combine two SDWIS tables (the Water System table and Water System Facility table).
  - Apply filters to prepared data and get counts of the total number of Water System Facilities for each Water System.
    - Filters applied
      - Active Water Systems Only
      - Active Water System Facilities Only
      - Water System Facilities with a facility type of CC, IG, IN, RC, SP, and WL

Threshold Determination

Data on the number of water sources is available for 2,779 water systems. The minimum number of sources found was 0, the maximum number of sources found was 35, and the average number of sources found was 2.2.

Figure A22: Number of Sources (n=2,779)



The threshold developed for the number of sources risk indicator mostly aligns with the thresholds used by DWR's Drought & Water Shortage Risk Assessment. Peer-reviewed studies also suggest that single source reliance is associated with water system failure.[63] Moreover, Section 64554(c) of the California Code of Regulations (CCR) requires new community water systems using only groundwater sources to have a minimum of two

[63] See Mullin, M. (2020). The effects of drinking water service fragmentation on drought-related water security. *Science, 368*(6488), 274-277.

approved sources capable each capable to meet the maximum day demand of the water system.

Risk Indicator Scoring & Weighting

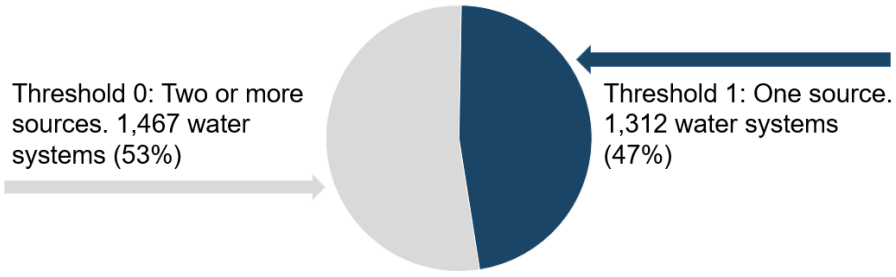
To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 3 is applied to the "Number of Sources" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 3. Table A17 summarizes the thresholds, scores, and weight for this risk indicator.

Table A17: "Number of Sources" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
X	**0** source (automatically At-Risk).	N/A	N/A
0	**2 or more** sources.	0	N/A
1	**1** source.	1	3

Figure A23 shows 6 water systems have 0 water sources and are considered automatically "At-Risk". 1,467 water systems (53%) meet Threshold 0 of having two or more water sources. 1,312 water systems (47%) meet Threshold 1 of having only one water source.

Figure A23: Number of Sources (n=2,779)



ABSENCE OF INTERTIES

An intertie or interconnection is a connection between one or more water systems where systems can either supply or receive water from each other. Presence of interties is assumed to reduce the risk of a water outage by allowing water systems to switch sources and even governance structure support, if needed.

Calculation Methodology

Required Risk Indicator Data Points & Source:

In SDWIS, this type of data is stored as a water system facility with a consecutive connection designation. Additionally, these types of water system facilities can be described in terms of their availability of use. According to internal SDWIS procedure documents, only the receiving facility should have a CC water system facility represented in SDWIS. The procedure document does not indicate whether emergency or seasonal CCs should be entered. The purpose of this metric is to capture the number of interties per water system entered in SDWIS, regardless of availability.

- Water source facility type and availability: SDWIS
  - CC – Consecutive Connection
  - Availability:
    - I – Interim
    - E – Emergency
    - O – Other
    - P – Permanent
    - S – Seasonal

Risk Indicator Calculation Methodology:

- Prepare data:
  - Combine two SDWIS tables (the Water System table and Water System Facility table).
- Apply filters to prepared data and get counts for each Water Source Type per Water System.
  - Filters applied:
    - Active Water Systems Only
    - Active Water System Facilities Only
    - Water System Facilities with a facility type of CC

Threshold Determination

Absence of Intertie data is available for all 2,850 water systems. The minimum number of interties found is zero and the maximum presence of interties is 1. The developed threshold aligns with DWR's Drought & Water Shortage Risk Assessment.[64]

Risk Indicator Scoring & Weighting

To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the

[64] Countywide Drought and Water Shortage Contingency Plans | DWR
https://water.ca.gov/Programs/Water-Use-And-Efficiency/Making-Conservation-a-California-Way-of-Life/CountyDrought-Planning

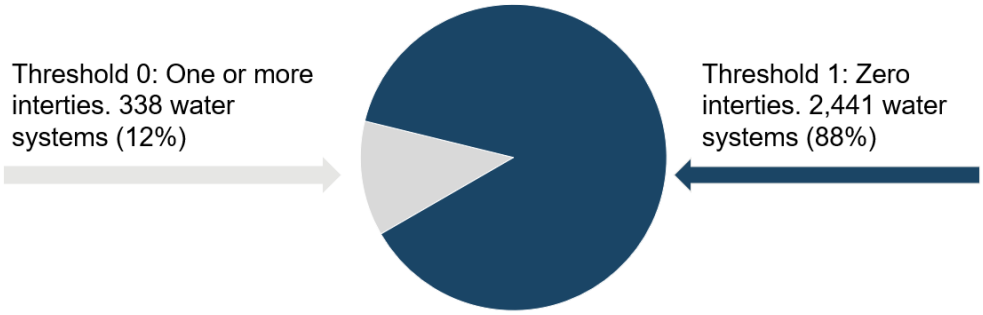
maximum weight of 1 is applied to the “Absence of Interties” risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 1. Table A18 summarizes the thresholds, scores, and weight for this risk indicator.

Table A18: “Absence of Interties” Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**1 or more** interties.	0	N/A
1	**0** interties.	1	1

Figure A24 shows 338 water systems (12%) have one or more interties. 2,441 water systems (88%) meet Threshold 1 of having zero interties.

Figure A24: Absence of Interties (n=2,779)



WATER SOURCE TYPES

Total number of water source types utilized by the water system. Water source types include groundwater, surface water, and purchased water.

Calculation Methodology
Required Risk Indicator Data Points & Sources:

Both of the following data points for this indicator are required and collected through the initial water system permitting process and entered into SDWIS by State Water Board staff. This data is verified through Sanitary Surveys and necessary updates are made in SDWIS.

- Water Source Facility Type: SDWIS
  - CC – Consecutive Connection
  - IG – Infiltration Gallery
  - IN – Intake
  - RC – Roof Catchment
  - SP – Spring
  - WL – Well

    - ST – Storage Tank

- Water Source Facility Water Type Code: SDWIS
    - GW – Groundwater
    - GU – Ground water under direct influence of surface water (Consider to be ground water)
    - SW – Surface Water
    - Both – GW and SW

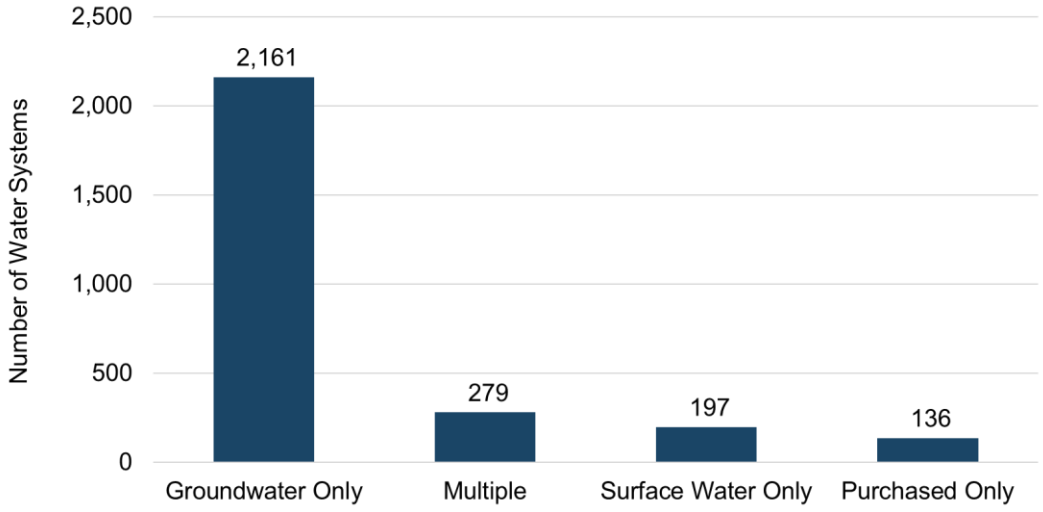
Risk Indicator Calculation Methodology:

- Prepare data
    - Combine two SDWIS tables (the Water System table and Water system Facility table)

- Apply filters to prepared data and get counts for each Water Source Type per Water System
    - Filters applied for Groundwater Counts:
        - Active Water Systems Only
        - Active Water System Facilities Only
        - Water System Facilities with a facility type of IG, RS, RC, SP, or WL
        - Water System Facilities with a Water Type Code of GW or GU
    - Filters applied for Purchased Water Counts:
        - Active Water Systems Only
        - Active Water System Facilities Only
        - Water System Facilities with a facility type of CC
    - Filters applied for Surface Water Counts:
        - Active Water Systems Only
        - Active Water System Facilities Only
        - Water System Facilities with a facility type of IG, IN, RC, or SP
        - Water System Facilities with a Water Type Code of SW

Threshold Determination
Water Source Type data is available for all 2,779 water systems. 279 water systems had multiple water sources. 2,161 had groundwater only, 197 had surface water only, and 136 had purchased only.

Figure A25: Water Source Types (n=2,779)



Peer-reviewed studies suggest that water source type, particularly single-source groundwater reliance, is associated with water system failure.[65] The developed threshold for the type of sources risk indicator is similar to that used in DWR's Drought & Water Shortage Risk Assessment.

Risk Indicator Scoring & Weighting

To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 1 is applied to the "Water Source Types" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 1. Table A19 summarizes the thresholds, scores, and weight for this risk indicator.

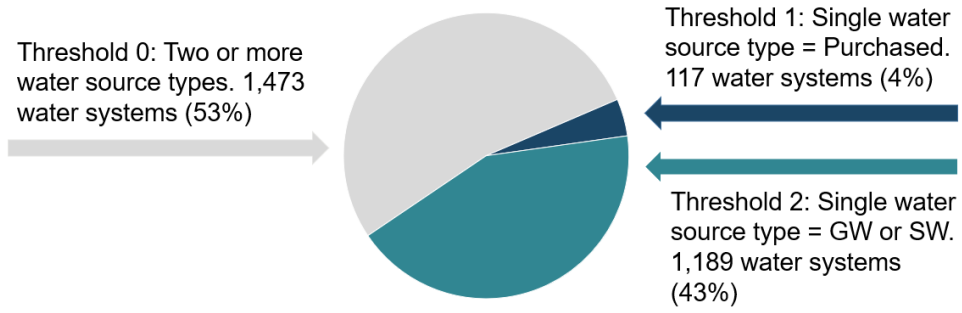
Table A19: "Water Source Types" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**2 or more** water source types.	0	N/A
1	**1** water source type and that source is **purchased** water.	0.5	1
2	**1** water source types and that source is either **groundwater** or **surface water**.	1	1

[65] See Pennino, M. J., Compton, J. E., & Leibowitz, S. G. (2017). Trends in drinking water nitrate violations across the United States. *Environmental science & technology, 51*(22), 13450-13460.

Figure A26 shows there are 1,473 water systems (53%) with two or more water source types, meeting Threshold 0. There are 1,306 water systems (47%) with a single water source type. Of these water systems, 117 (4%) meet Threshold 1 with "Purchased" as their source type. The remaining 1,189 water systems (43%) meet Threshold 2 with a groundwater or surface water source type.

Figure A26: Water Source Types (n=2,779)



DWR – DROUGHT & WATER SHORTAGE RISK ASSESSMENT RESULTS

This indicator utilizes DWR's Drought and Water Shortage Risk Scoring Tool[66] results which identifies small water suppliers and rural communities (defined as *Self-Supplied Communities* in the tool) that are potentially at-risk of drought and vulnerable to water shortages. For this tool, small water suppliers are considered publicly regulated systems with fewer than 3,000 service connections and using fewer than 3,000 acre-feet per year. Self-supplied communities are water systems with fewer than 15 service connections, which covers state small water systems (5 to 14 connections), local small water systems (2 to 4 connections), and domestic wells. This tool creates an aggregated, comparative risk score for each water system and community derived from a set of indicators that capture different dimensions of exposure to hazards, physical/social vulnerability, and observed supply shortages (29 indicators for small water suppliers and 29 indicators for self-supplied communities).

Calculation Methodology

For the *small water suppliers*, the 29 risk indicators utilized by DWR were categorized and scored according to three components:

- Exposure:
  - Climate change impacts (weighted: 0.25)
  - Recent or current hazardous conditions and events (weighted: 0.75)
- Vulnerability:
  - Infrastructure vulnerability (system connectivity and other factors) (weighted: 4 connectivity indicators at 0.67 plus 4 other factor indicators at 0.33)

[66] Drought and Water Shortage Risk Explorer Tool for Small Water Suppliers and Rural Communities https://dwr.maps.arcgis.com/apps/MapSeries/index.html?appid=3353b370f7844f468ca16b8316fa3c7b

    - Organizational vulnerability (demographic and socioeconomic characteristics) (weighted: 0.33)
- Observed Water Shortage:
    - Experienced drought impacts or shortage records (weighted: 0.33)

For *self-supplied communities*, the 29 similar risk indicators were categorized and scored according to the same three components:

- Exposure:
    - Climate change impacts (weighted: 0.25)
    - Recent or current hazardous conditions and events (weighted: 1.0)
- Vulnerability
    - Physical vulnerability (weighted: 0.25)
    - Socioeconomic vulnerability (weighted: 0.75)
- Observed Water Shortage
    - Water outage records (weighted: 0.5)

For both the *small water suppliers* and *self-supplied communities* scoring, the risk indicator variables were all rescaled 0-1 numbers (1 is high and 0 is low) and combined with the other variables in their respective component. A simple calculation that weights each variable (noted above) within its given component was applied, and then the weighted component scores were aggregated.

Each group of variables is then combined with the other group scores for each component (Exposure, Vulnerability, and Observed Water Shortage). Finally, the raw risk score from each component is summed and rescaled from 0 to 100 using a min-max scaling technique to calculate the final risk score.

The draft drought scoring for the small water suppliers and self-supplied communities can be found in the Drought and Water Shortage Risk Explorer Tool for Small Water Suppliers and Rural Communities.[67]

Additional information is available on the DWR Countywide Drought and Water Shortage Contingency Plans website.[68]

Threshold Determination
DWR Assessment Results were available for 2,420 water systems. The minimum score found was 0.2, the maximum score found was 100.3, and the average score was 54. The proposed thresholds for this indicator (the top 10% and 25% of systems analyzed) are based on the illustrative cutoff provided by DWR in its presentation of Drought & Water Shortage Risk Assessment Results.

[67] Drought and Water Shortage Risk Explorer Tool for Small Water Suppliers and Rural Communities
https://dwr.maps.arcgis.com/apps/MapSeries/index.html?appid=3353b370f7844f468ca16b8316fa3c7b

[68] Countywide Drought and Water Shortage Contingency Plans | DWR
https://water.ca.gov/Programs/Water-Use-And-Efficiency/2018-Water-Conservation-Legislation/County-Drought-Planning

Risk Indicator Scoring & Weighting

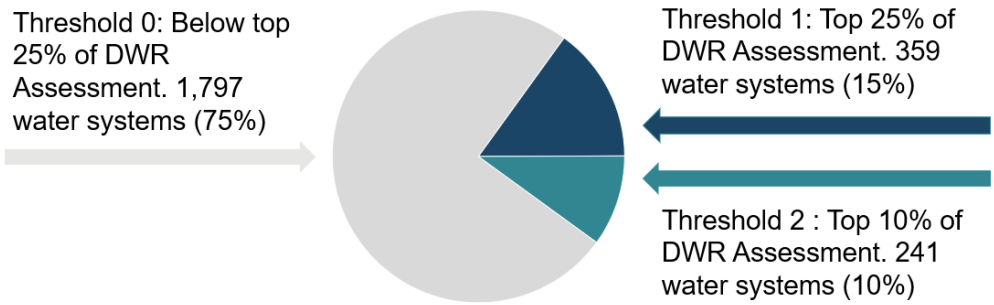
To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 2 is applied to the "DWR Assessment Results" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 2. Table A20 summarizes the thresholds, scores, and weight for this risk indicator.

Table A20: "DWR Assessment Results" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**Below top 25%** of systems most at risk of drought and water shortage.	0	N/A
1	**Top 25%** of systems most at risk of drought and water shortage.	0.25	2
2	**Top 10%** of systems most at risk of drought and water shortage.	1	2

Figure A27 shows 1,797 water systems (75%) scored below the top 25% in the DWR assessment. 359 water systems (15%) meet Threshold 1, as they fall within the top 10% - 25% of the DWR assessment. 241 water systems (10%) meet Threshold 2, as they fall within the top 10% of the DWR assessment.

Figure A27: Water System DWR Assessment Results (n=2,397)



CRITICALLY OVERDRAFTED GROUNDWATER BASIN

Water systems in basins considered to be in Critical Overdraft per DWR's Bulletin 118. A basin is subject to critical conditions of overdraft when continuation of current water management

practices would probably result in significant adverse overdraft-related environmental, social, or economic impacts.

Calculation Methodology
Required Risk Indicator Data Points & Sources:

- SGMA Basin Prioritization Statewide Summary Table[69]: DWR
- Water System Boundaries: State Water Board Service Area Boundary Layer (SABL)
- Water Type Code: SDWIS
    - GW – Groundwater
    - SW – Surface Water
    - Both – GW and SW

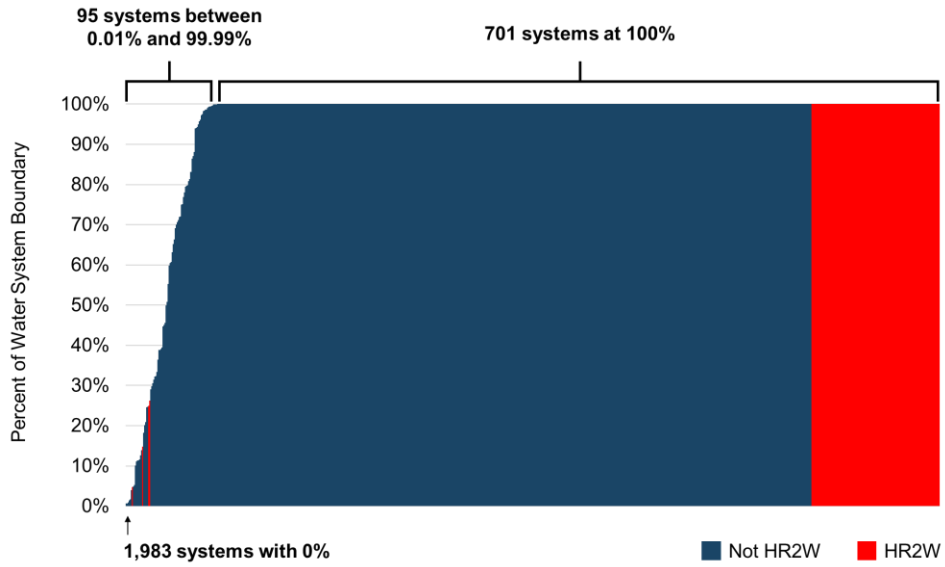
Risk Indicator Methodology:

- Water System Boundaries – SABL – Water systems boundaries are overlaid with the critically overdrafted groundwater basins.
- Water System Source Water Identification – SDWIS – Water systems screened for source water (groundwater/surface water) to determine reliance on groundwater.

Threshold Determination
Data on the location of water systems in critically overdrafted groundwater basins is available for all 2,779 water systems. The minimum percentage of service area within a critically overdrafted groundwater basin is 0%, the maximum percentage is 100%, and the average percentage is 27%.

[69] SGMA Basin Prioritization Statewide Summary Table
https://data.cnra.ca.gov/dataset/13ebd2d3-4e62-4fee-9342-d7c3ef3e0079/resource/6347629e-340d-4faf-ae7f-159efbfbcdc9/download/final-515-table.xlsx

Figure A28: Percent of Water System Boundary within an Overdrafted Groundwater Basin (n=2,779)



The percentage of a water system's boundary overlapping with a critically over-drafted groundwater basin, as defined here or a similar measure, has only been assessed in DWR Assessment Results as a binary factor, likely reflecting the relatively recent nature of SGMA. Moreover, the determination of a numerical threshold between 1-100% (as opposed to 0%) leads to little difference in the number of systems deemed as above the threshold for this indicator.

Risk Indicator Scoring & Weighting

To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 2 is applied to the "Critically Overdrafted Groundwater Basin" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 2. Table A21 summarizes the thresholds, scores, and weight for this risk indicator.

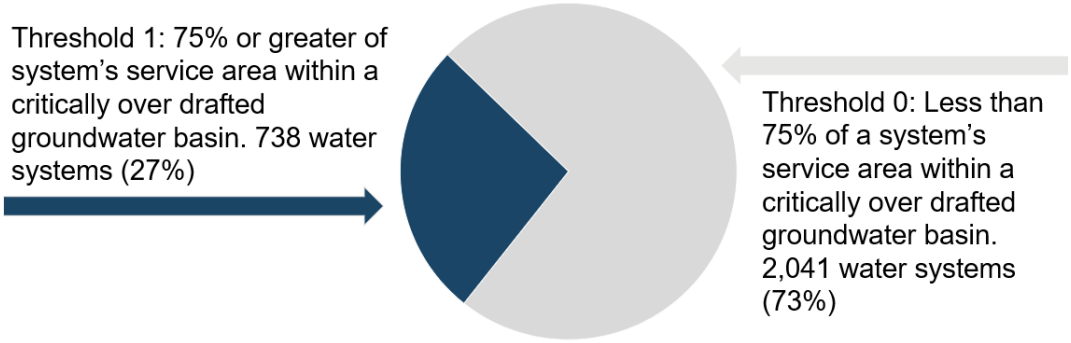
Table A21: "Critically Overdrafted Groundwater Basin" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**Less than 75%** of system's service area boundary is within a critically overdrafted basin.	0	N/A

Threshold Number	Threshold	Score	Weight
1	**75% or greater** of systems service area boundary is within a critically overdrafted basin.	1	2

Figure A29 shows 2,041 water systems (73%) have less than 75% of their service area within a critically endangered overdrafted groundwater basin. 738 water systems (27%) meet Threshold 1 with 75% or greater of their service area within a critically overdrafted groundwater basin.

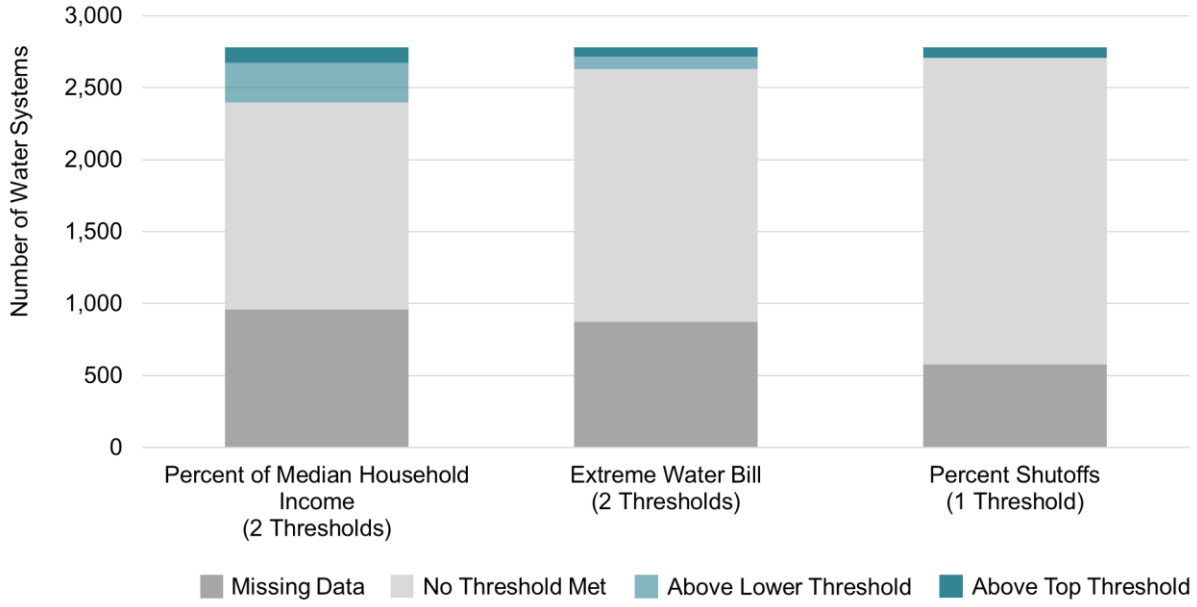
Figure A29: Water Systems in Critically Overdrafted Groundwater Basins (n=2,779)



AFFORDABILITY RISK INDICATORS

This section provides full details on each Affordability risk indicator used in the Risk Assessment. Affordability risk indicators measure the capacity of households and the customer base as a whole to supply the revenue necessary for a water system to pay for necessary capital, operations, and maintenance expenses. Figure A30 illustrates the number of water systems that exceeded the risk indicator thresholds within the Affordability category. The range of potential thresholds for each risk indicator are summarized in the respective risk indicator label and detailed below.

Figure A30: Number of Systems Exceeding Thresholds for Each Affordability Risk Indicator



PERCENT OF MEDIAN HOUSEHOLD INCOME (%MHI)

This indicator measures the annual system-wide average residential water bill for 6 Hundred Cubic Feet (HCF) per month relative to the annual Median Household Income (MHI) within a water system's service area.

Calculation Methodology
Required Risk Indicator Data Points & Sources:

- Water system service area boundaries: SABL
- Block group-Income in the Past 12 Months: U.S. Census Bureau's American Community Survey
- Drinking Water Customer Charges: Electronic Annual Report (EAR)
- Other Customer Charges: EAR

Average monthly drinking water customer charges is collected through the EAR. However, this data has historically not been required for reporting. Therefore, the 2019 EAR data had coverage and accuracy issues. The State Water Board attempted to validate and supplement this dataset through a water rate survey conducted in November 2020. Additionally, customer charges data was collected through the UNC EFC's development of the Small Water System's Rates Dashboard. This data was used when available and applicable. It is anticipated that the coverage and accuracy of drinking water customer charges data will improve with the revisions made to the 2020 reporting year EAR.

Risk Indicator Calculation Methodology:

Median household income (MHI) is determined for a water system using American Community Survey data for household income. Community Water System boundaries typically do not align with census boundaries where per capita income data is regularly collected. In order to assign an average median household income to a community water system spatially weighted income data is aggregated by census block group within the water system service area.

The methodology for this indicator was based on the Division of Financial Assistance (DFA) MHI methodology. While the MHI calculation methodology for the Affordability Assessment generally aligns with the Division of Financial Assistance's (DFA) MHI determination methodologies, there are slight differences. The differences found in the calculation of MHI's for cities and census designated places and in the application of the Margin of Error (MOE).

The DFA methodology dictates that when it is determined that a system boundary exactly matches city boundaries or closely matches a census designated place boundary, the MHI for the entire city or census designated place should be directly applied to the system rather than using areally-interpolated block group data. This likely leads to more accurate MHI estimation in these cases. However, this method was not used in the Needs Assessment given that a case by case determination of matching of cities and census designated places to system boundaries was not feasible for the entire state. The MHI for each water system is a population-weighted MHI, using census block group area and population data. A population factor is generated based on the area of each census block group that falls within the water system boundary. The water system MHI is then calculated using population-adjusted MHIs for each census block group that falls within the water system boundary using the formula below:

$$\sum \frac{(Block\ Group\ MHI) \times (Adjusted\ Block\ Group\ Population)}{(Total\ Adjusted\ Block\ Groups\ Population)}$$

MOE for MHI American Community Survey data is also included in the MHI calculation. A population adjusted MOE is found using the same methodology described for MHI. The lower range of the MOE will be applied to a community's estimated MHI up to a maximum MOE value of $7,500 for communities with more than 500 people and $15,000 for communities with 500 or fewer people. The MOE will be subtracted from the estimated MHI.

The DFA methodology uses a lower bound MHI by subtracting the block group MOE from the block group MHI, with limits based on community size prior to applying the population factor to

MHI and MOE. The methodology applied in the Needs Assessment set margin of error limits and then applied them to population adjusted MHI figures, resulting in slightly different community water system MHI calculations than the DAF methodology.

As a result of these slight variations and the changing nature of household income, all funding related financial assessments must be completed by the DFA as their assessments are water system specific as opposed to the aggregated analysis done for the purposes of the Needs Assessment.

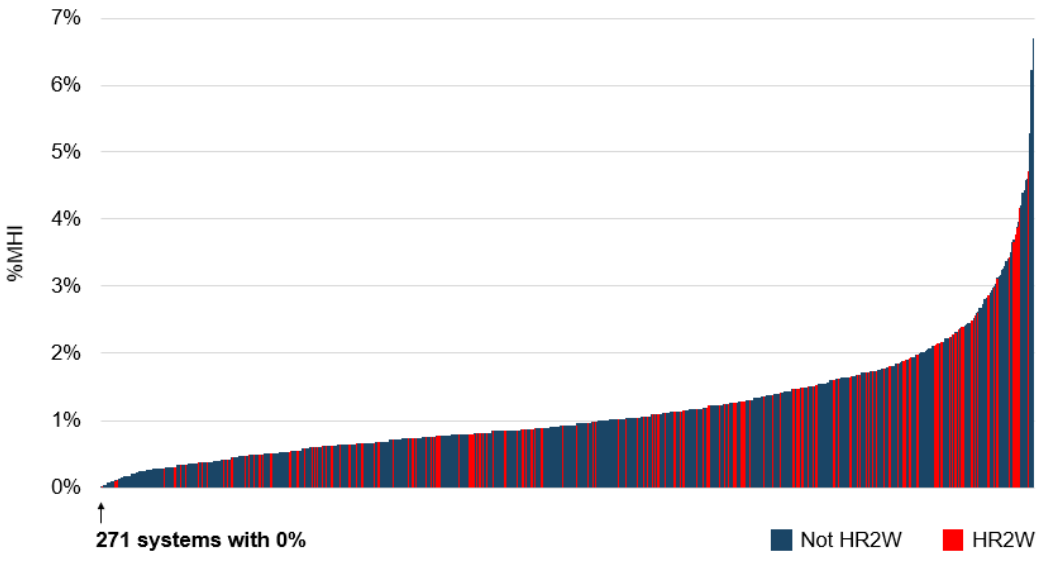
Average monthly drinking water customer charges are calculated using:

- Drinking water service costs estimated at 6 Hundred Cubic Feet per month. This level of consumption is in line with statewide conservation goals of 55 gallons per capita per day, in an average 3-person household.
- When data becomes available, additional approximated customer charges (not collected through a customer's bill) will be added to this figure to calculate Total Drinking Water Customer Charges.

%MHI = [Average Monthly Drinking Water Changes] / [MHI]

Threshold Determination
Data on %MHI is available for 1,822 of the water systems in the data set. The minimum %MHI found was 0%, the maximum %MHI found was 46.3%, and the average %MHI found was 1%. The State Water Board recognizes that customer charges data collected through the EAR may have data quality issues. The Needs Analysis Unit directly contacted some water systems to confirm their water rates and charges data submitted through the 2019 EAR.

Figure A31: %MHI Distribution, Excluding 6 Systems with %MHI > 10% (n=1,876)



%MHI is commonly used by state and Federal regulatory agencies and by water industry stakeholders for assessing community-wide water charges affordability for decades. %MHI is

utilized by the State Water Board (at 1.5% threshold) and the U.S. EPA (at 2.5% threshold) for assessing affordability. The State Water Board and DWR use %MHI to determine Disadvantaged Community (DAC) status, among other income-related metrics. DAC status is often used to inform funding eligibilities for different financial programs offered by the State and other agencies. OEHHA's Human Right to Water (HR2W) Tool also utilizes[70] the thresholds determined by the State Water Board for this indicator.[71] Other states, including and North Carolina,[72] presently or have recently used 1.5% of MHI spent on water and sewer costs as a threshold for water system funding decisions.

Risk Indicator Scoring & Weighting

To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 3 is applied to the "Percent Median Household Income" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 3. Table A22 summarizes the thresholds, scores, and weight for this risk indicator.

Table A22: "Percent Median Household Income" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**Less than 1.5%**	0	N/A
1	**1.5% or greater**	0.75	3
2	**2.5% or greater**	1	3

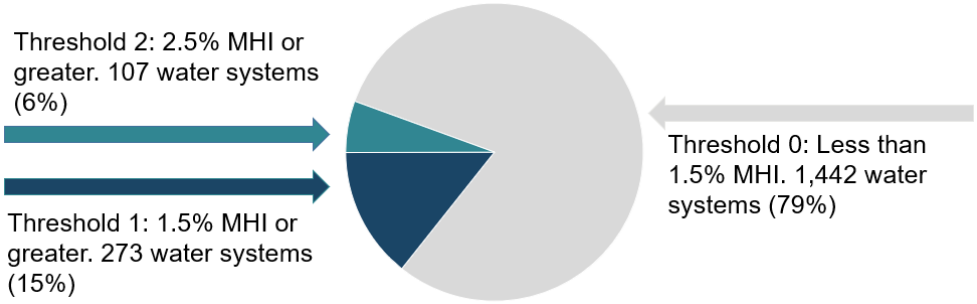
Figure A32 shows 1,442 water systems (79% of those with available data) have an average water charge less than 1.5% MHI. 273 water systems (15%) meet Threshold 1 having an average water charge at 1.5% MHI or greater, whereas 107 water systems (6%) meet Threshold 2 having an average water charge at 2.5% MHI or greater.

[70] There has been criticism of this metric by academics, water system associations, and the broader water sector mostly around its accuracy in measuring household affordability for those truly in need and the setting of arbitrary %MHI thresholds, limitations which the U.S. EPA has recently acknowledged.

[71] Arkansas Natural Resources Commission (2020). Safe Drinking Water Fund Intended Use Plan SFY 2019: https://www.agriculture.arkansas.gov/wp-content/uploads/2020/05/0_-_2019_DWSRF_IUP_-_AMENDED_January_2019_01082019_1156hrs.pdf

[72] North Carolina Department of Environmental Quality, Joint Legislative Economic Development and Global Engagement Oversight Committee (March 17, 2016) https://www.ncleg.gov/DocumentSites/Committees/JLEDGEOC/2015-2016/Meeting%20Documents/3%20-%20March%2017,%202016/2%20%20DEQ_Kim%20Colson%20Water%20Infrastructure%20JLOC%20EDGE%20160317.pdf

Figure A32: Percent of Median Household Income (%MHI) (N=1,822)



EXTREME WATER BILL

This indicator measures drinking water customer charges that meet or exceed 150% of statewide average drinking water customer charges at the 6 Hundred Cubic Feet (HCF) level of consumption.

Calculation Methodology
Required Risk Indicator Data Points & Sources:

- Drinking Water Customer Charges: EAR
- Other Customer Charges: EAR

Risk Indicator Calculation Methodology:

Extreme Water Bill for a water system is determined using Average Monthly 6 HCF Drinking Water Customer Charges and Other Customer Charges divided by the State's Monthly Average Drinking Water Charges. The Risk Assessment is applied to water systems with less than 3,300 service connections; however, this methodology utilizes the statewide average customer charges to calculate extreme water bill, which includes systems with greater than 3,300 connections.

Threshold Determination
Data on Extreme Water Bill is available for 1,907 water systems. 1,616 water systems (85%) had an average monthly water bill greater than $0. The minimum average monthly water bill found was $0.00, the maximum average monthly water bill found was $350.00, and the average water bill found was $51.03.

Figure A33: Average Monthly Water Bill (n=1,907)

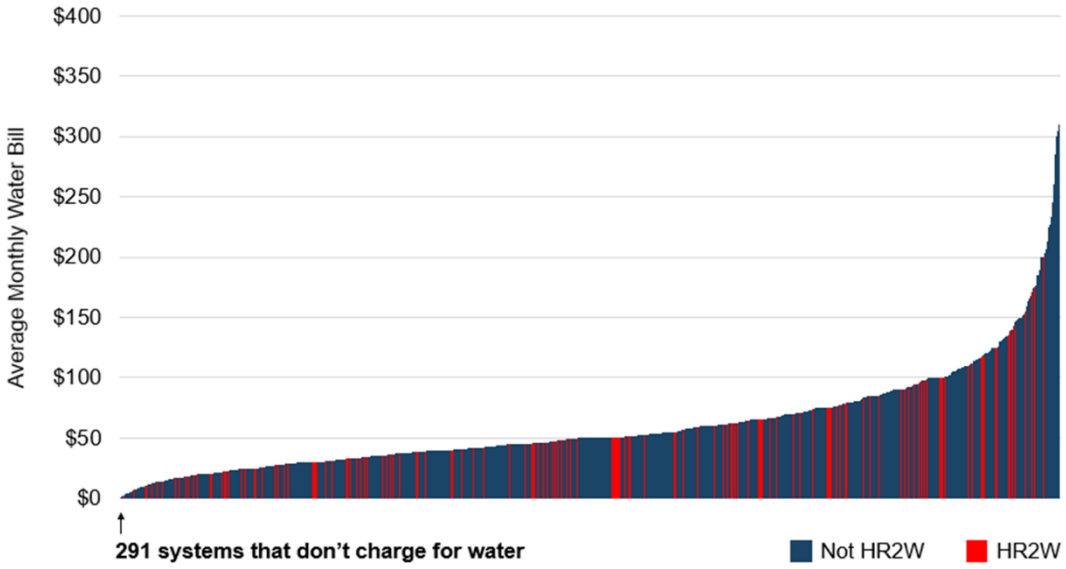
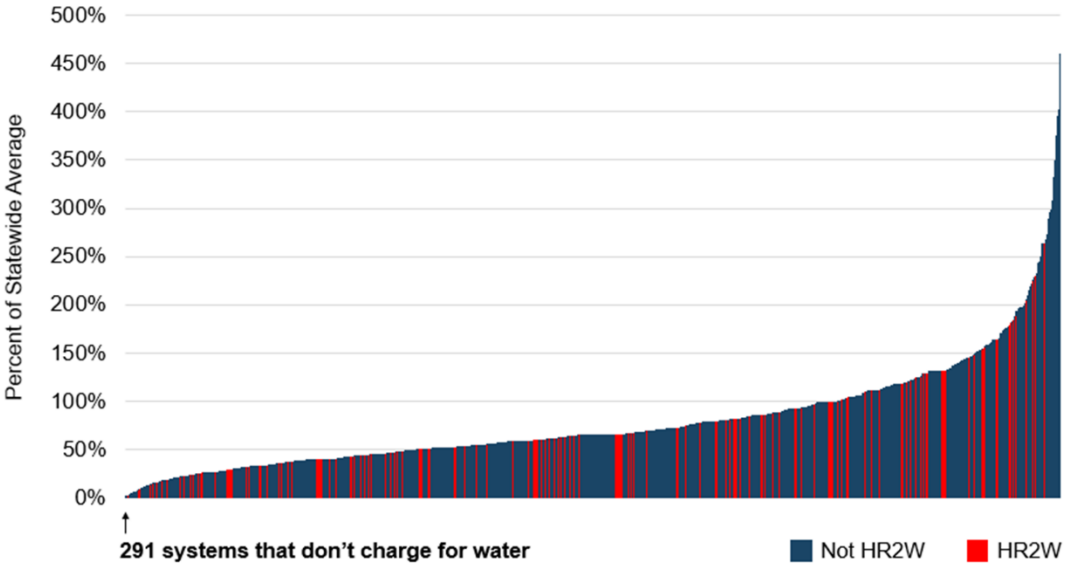


Figure A34: Average Monthly Water Bill as a Percent of the Statewide Average ($75.95) (n=1,907)



The State Water Board's AB 401 report[73] recommended statewide low-income rate assistance program elements utilize the two recommended tiered indicator thresholds of 150% and 200% of the state average drinking water bill for 6 HCF.

[73] AB 401 Final Report:

Risk Indicator Scoring & Weighting

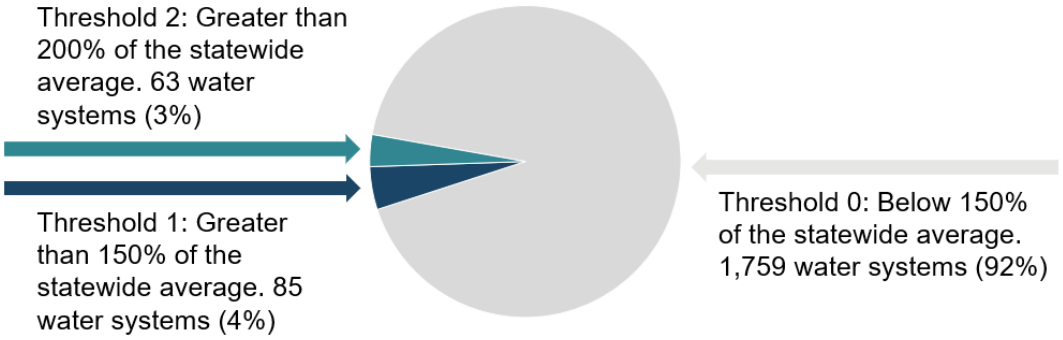
To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 1 is applied to the "Extreme Water Bill" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 1. Table A23 summarizes the thresholds, scores, and weight for this risk indicator.

Table A23: "Extreme Water Bill" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**Below 150%** of the statewide average.	0	N/A
1	**Greater than 150%** of the statewide average.	0.5	1
2	**Greater than 200%** of the statewide average.	1	1

Figure A35 shows 1,759 water systems (92%) have an average water bill below 150% of the statewide average. 85 water systems (4%) meet Threshold 1 with an average water bill greater than 150% of the statewide average, whereas 63 water systems meet Threshold 2 with an average water bill greater than 200% the statewide average.

Figure A35: Extreme Water Bill (n=1,907)



Recommendations for Implementation of a Statewide Low-Income Water Rate Assistance Program
https://www.waterboards.ca.gov/water_issues/programs/conservation_portal/assistance/docs/ab401_report.pdf

% SHUT-OFFS

Percentage of residential customer base with service shut-offs due to non-payment in a given year.

Calculation Methodology
Required Risk Indicator Data Points & Sources:

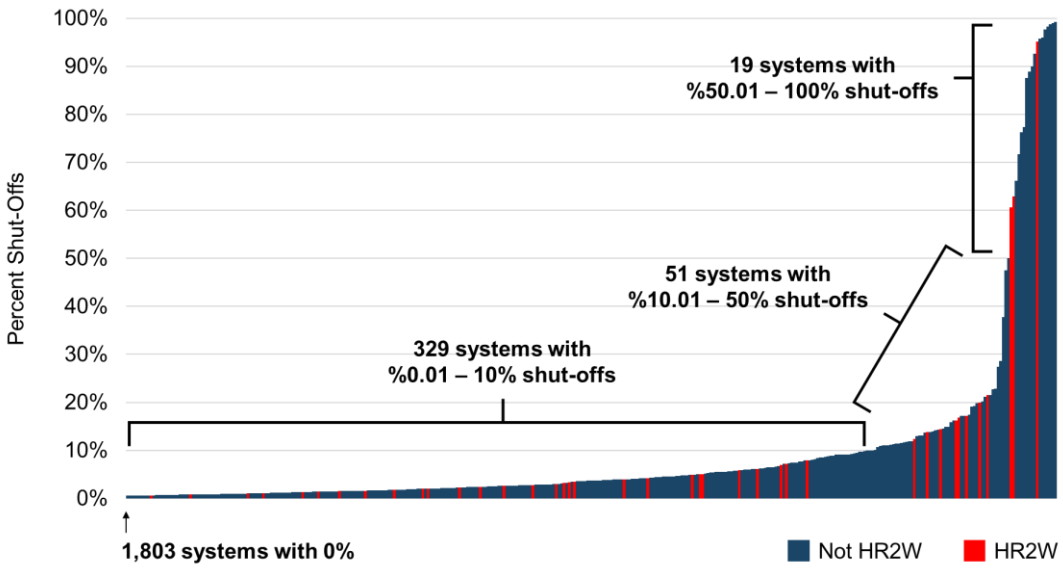
- Number of residential service connections with water shut-off more than once due to failure to pay: EAR
    - Total Single-Family Shut-offs
    - Total Multi-Family Shut-offs
- Total Number of Service Connections: EAR

Risk Indicator Calculation Methodology:

- % Shut-Offs = ([Total Single-Family Shut-offs + Total Multi-Family Shut-offs] / Total Number of Service Connections) x 100

Threshold Determination
Data on the percent of customer accounts shut-off is available for 2,201 water systems. The minimum percentage of customer accounts shut-off was 0%, the maximum was 99%, and the average was 1.6%.

Figure A36: Percent Shut-Offs (n=2,201)



An indicator threshold for the percent of residential service connections shut-off due to non-payment, as defined here or a similar measure, has not to the State Water Board's knowledge been assessed in other previous studies as related to water system failure. However, a

standard of zero has been employed by the State,[74] other regulatory agencies and stakeholders as a threshold of concern particularly during the COVID-19 pandemic. In addition to affordability concerns, high percentages of shut-offs may also negatively impact a water system's financial capacity.

Risk Indicator Scoring & Weighting

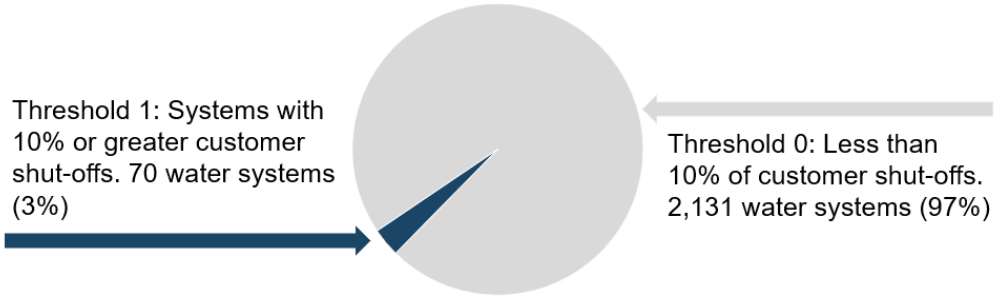
To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 2 is applied to the "Percent Shut-Offs" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 2. Table A24 summarizes the thresholds, scores, and weight for this risk indicator.

Table A24: "Percent Shut-Offs" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**less than 10%** customer shut-offs over the last calendar year.	0	N/A
1	**10% or greater** customer shut-offs over the last calendar year.	1	2

Figure A37 shows 2,131 water systems (97%) had less than 10% of their customer account shut-off due to non-payment. 70 water systems (3%) meet Threshold 1 with 10% or greater customer accounts experiencing a shut-off due to non-payment.

Figure A37: 2019 Percent Shut-Offs (n=2,201)

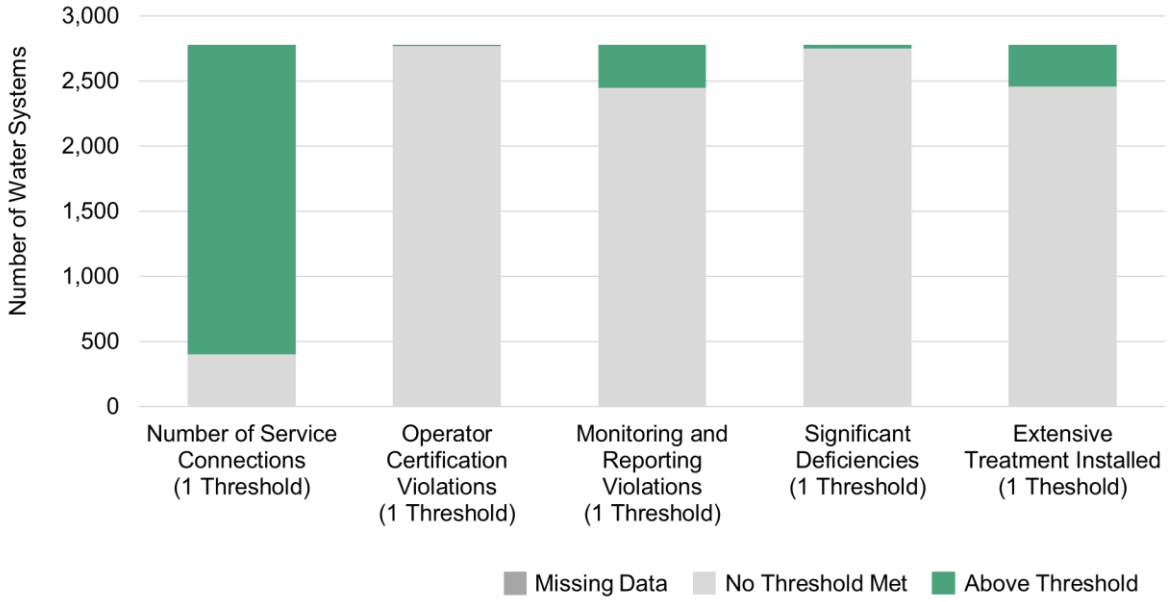


[74] Executive Order N-42-20 https://www.gov.ca.gov/wp-content/uploads/2020/04/4.2.20-EO-N-42-20-text.pdf

TMF CAPACITY RISK INDICATORS

This section provides full details on each TMF Capacity risk indicator used in the Risk Assessment. TMF Capacity risk indicators measure a system's technical, managerial and financial (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. Figure A38 illustrates the number of water systems that exceeded the risk indicator thresholds within the TMF Capacity category. The range of potential thresholds for each risk indicator are summarized in the respective risk indicator label and detailed below.

Figure A38: Number of Systems Exceeding Thresholds for Each TMF Capacity Risk Indicator



NUMBER OF SERVICE CONNECTIONS

This indicator measures the total number of customer service connections of the water system. Number of service connections may be used as a proxy to assess whether a water system has adequate financial capacity to support staff and budget.

Calculation Methodology
Required Risk Indicator Data Point & Source:

- Water System Details – Service Connection Count: SDWIS

Threshold Determination
Data for all 2,779 water systems was available to analyze Number of Service Connections. The minimum number of service connections found was one, the maximum number of service connections found was 3,300, and the average number of service connections found was

285.4. Several peer-reviewed studies suggest that a threshold of 500 connections for system connections is associated with water system failure.[75]

Figure A39: Number of Service Connections (n=2,779)

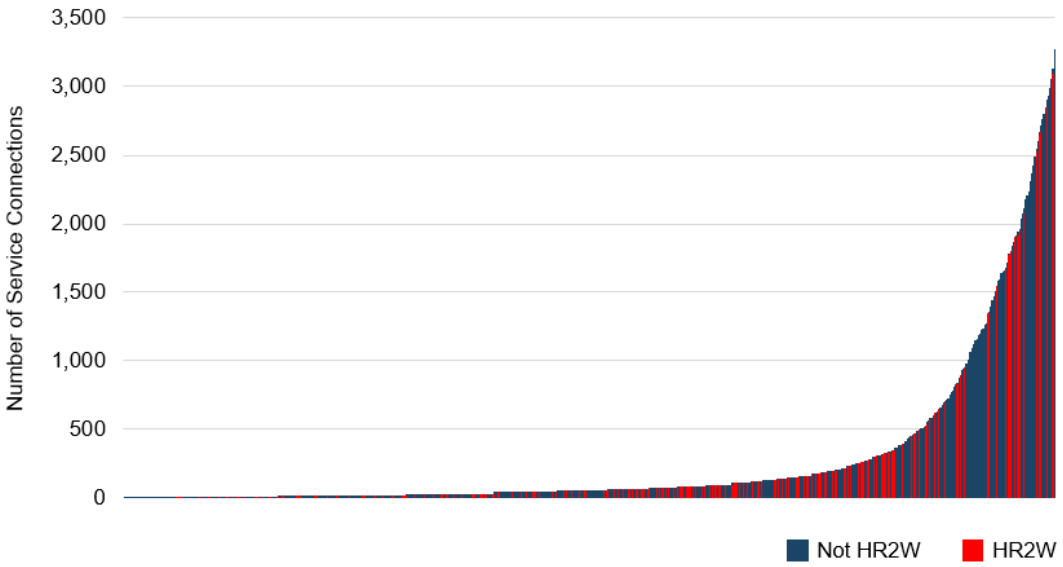
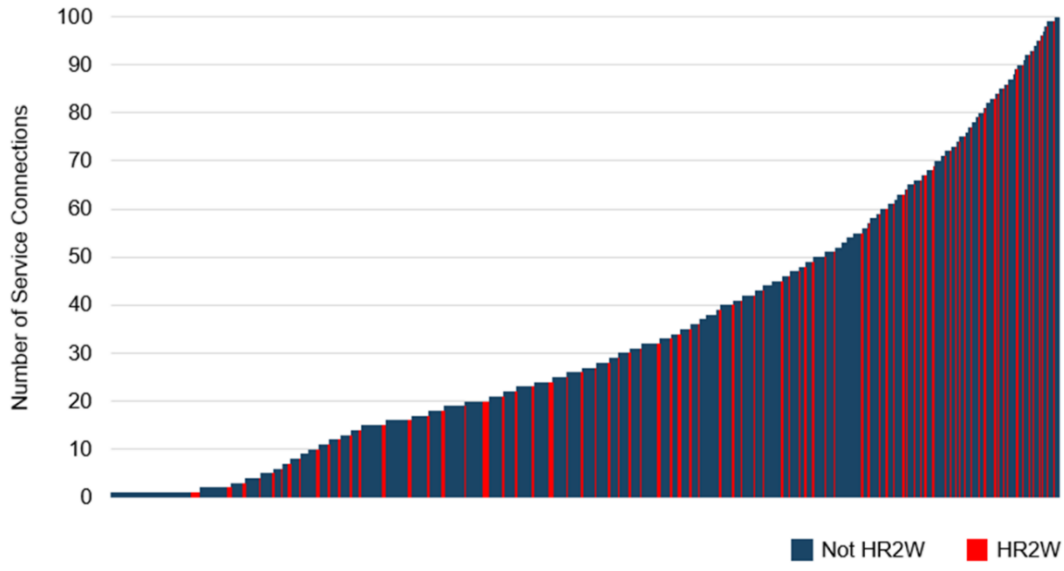


Figure A40: Number of Service Connections (0 – 100) (n=1,803)



[75] See Michielssen, S., Vedrin, M. C., & Guikema, S. D. (2020). Trends in microbiological drinking water quality violations across the United States. *Environmental Science: Water Research & Technology, 6*(11), 3091-3105; Oxenford, J. L., & Barrett, J. M. (2016). Understanding small water system violations and deficiencies. *Journal-American Water Works Association, 108*(3), 31-37.

Figure A41: Number of Service Connections (100 – 1,000) (n=713)

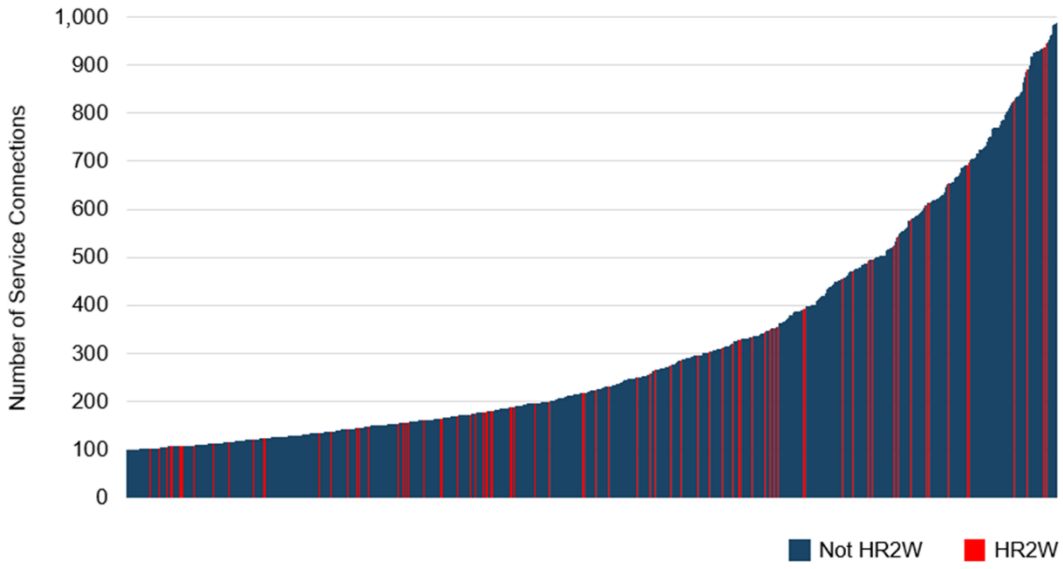
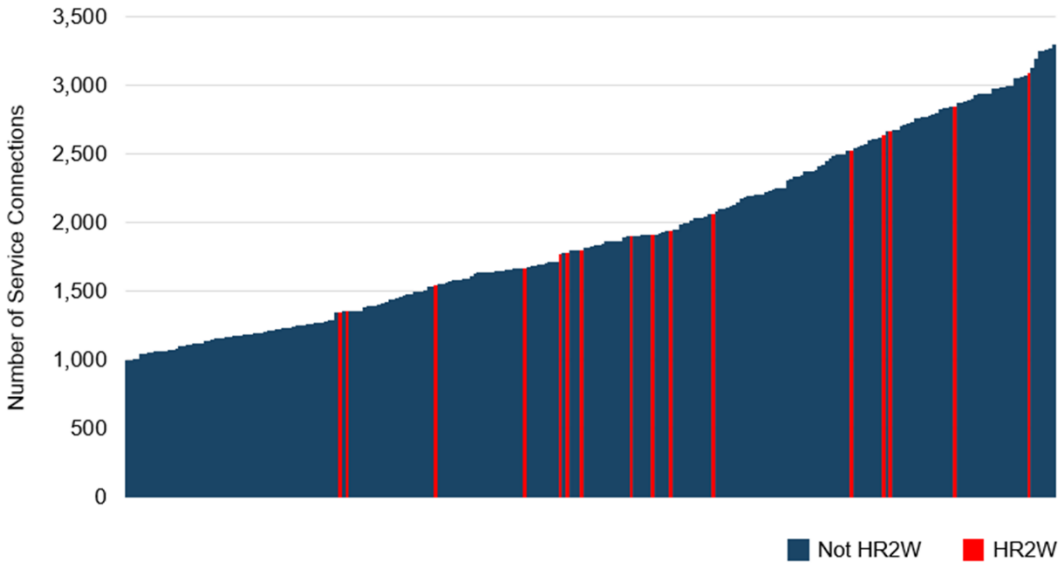


Figure A42: Number of Service Connections (1,000 – 3,300) (n=263)



Risk Indicator Scoring & Weighting

To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to

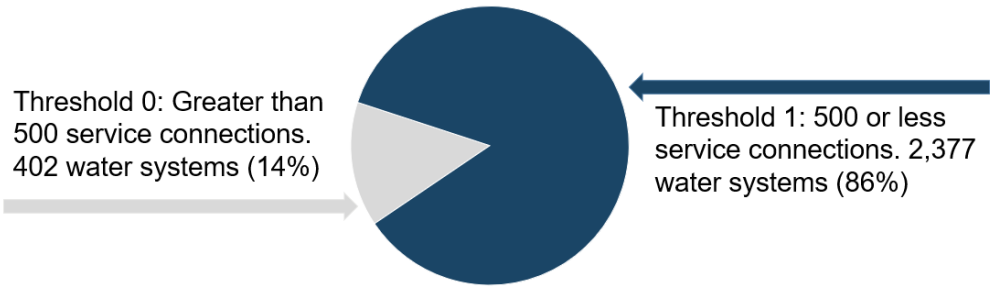
individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 1 is applied to the "Number of Service Connections" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 1. Table A25 summarizes the thresholds, scores, and weight for this risk indicator.

Table A25: "Number of Service Connections" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**greater than 500** service connections.	0	N/A
1	**500 or less** service connections.	1	1

Figure A43 shows 402 water systems (14%) meet Threshold 0 of having 500 or more service connections. 2,377 water systems (86%) meet Threshold 1 of having 500 or fewer service connections.

Figure A43: Number of Service Connections (n=2,779)



OPERATOR CERTIFICATION VIOLATIONS

Failure to have an appropriately certified water treatment or distribution operator. 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. Chief and shift operators must possess valid operator certificates pursuant to CCR Sections 63765 and 63770.

Calculation Methodology
Required Risk Indicator Data Point & Source:

- Operator Certification Violations: SDWIS Violation Codes:
  - 12
  - OP

Risk Indicator Methodology:

- Determine which systems have had an Operator Certification Violation within the last three years.
    - Systems that are currently out of compliance or have returned to compliance are included.

Threshold Determination
Data on operator certification violations is available for 2,850 water systems. An analysis of the counts of operator certification violations over the last three years finds no violations when an open enforcement action. The systems that have had an operator certification violation over the last three years have only had one violation each during this time period.

Peer-reviewed studies suggest that the absence of a certified operator is associated with water system failure.[76] Moreover, operator certification violations are an established threshold for additional regulatory oversight by states such as Illinois.[77] Therefore a threshold of 1 or more operator certification violations over the last three years was determined.

Risk Indicator Scoring & Weighting
To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 3 is applied to the "Operator Certification Violations" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 3. Table A26 summarizes the thresholds, scores, and weight for this risk indicator.

Table A26: "Operator Certification Violations" Thresholds & Scores

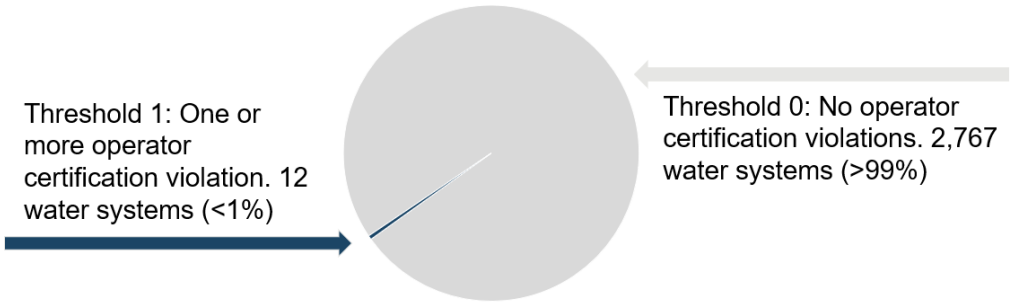
Threshold Number	Threshold	Score	Weight
0	**0** Operator Certification violations over the last three years.	0	N/A
1	**1 or more** Operator Certification violations over the last three years.	1	3

Figure A26 shows there are 2,767 water systems (>99%) which have had 0 operator certification violations over the last three years. There are 12 water systems (<1%) that meet Threshold 1 for having one or more violations in the last three years.

[76] See Oxenford, J. L., & Barrett, J. M. (2016). Understanding small water system violations and deficiencies. *Journal-American Water Works Association, 108*(3), 31-37.

[77] Office of the Illinois State Fire Marshal (2012.). "Notification of New NOV for Operator Certification Violations." Retrieved from: https://www2.illinois.gov/sites/sfm/SFMDocuments/Documents/NoticeRedTagOperators.pdf

Figure A44: Operator Certification Violations (n=2,779)



MONITORING & REPORTING VIOLATIONS

A water system is required to monitor and verify that the levels of contaminants present in the drinking water supplies do not exceed an MCL. A monitoring violation occurs when a water system fails to have its water tested as required within the required time frame. A water system that fails to perform required monitoring for a group of chemicals (such as synthetic organic chemicals or volatile organic chemicals) would incur a monitoring violation for each of the individual chemicals within the group.

A reporting violation occurs when a water system fails to report test results in a timely manner to the regulatory agency or fails to provide certification that mandated information was provided to the public, such as through the issuance of a public notice or the annual Consumer Confidence Report. A system may also receive a reporting violation for not submitting an Annual Report the State Water Board.

This indicator measures the total number of monitoring and reporting violations during a 3-year compliance cycle.

Calculation Methodology
Required Risk Indicator Data Point & Source:

- Monitoring and Reporting violations: SDWIS

Table A27: Monitoring & Reporting Violation Codes

Violation Type Code	SDWIS Violation Name
03	Monitoring, Regular
04	Monitoring, check, repeat, or confirmation
19	Failure to Conduct Assessment Monitoring
23	Monitoring, Routine Major (TCR)
24	Monitoring, Routine Minor (TCR)
25	Monitoring, Repeat Major (TCR)
26	Monitoring, Repeat Minor (TCR)

Violation Type Code	SDWIS Violation Name
27	Monitoring, Routine (DBP)
29	Failure Submit Filter Profile/CPE Report
30	Monitoring, Routine (IDSE)
31	Monitoring of Treatment (SWTR-Unfilt/GWR)
32	Monitoring, Source Water (LT2)
34	Monitoring, Source Water (GWR)
35	Failure Submit IDSE/Subpart V Plan Rpt
36	Monitoring of Treatment (SWTR-Filter)
38	Monitoring, Turbidity (Enhanced SWTR)
39	Monitoring and Reporting (FBRR)
51	Initial Tap Sampling for Pb and CU
52	Follow-Up or Routine LCR Tap M/R
53	Water Quality Parameter M/R
56	Initial, Follow-Up, or Routine SOWT M/R
66	Lead Consumer Notification
3A	Routine Monitoring
3B	Additional Routine Monitoring
3C	TC Samples (triggered by turbidity exceedance) Monitoring
3D	Monitoring, Lab Cert/Method Errors
4A	Assessment Forms Reporting
4B	Sample Result/Fail to Monitor Reporting
4C	Start-up Procedures Certification Form Reporting
4D	EC+ Notification Reporting
4E	E. coli MCL Reporting
4F	L1/L2 TT Vio or Correct Action Reporting
S1	State Violation-M&R (Major)
AR	Failure to Complete an Annual Report
RR	State Reporting Requirement Violation (review in one year for lead service line replacement)

Risk Indicator Methodology:

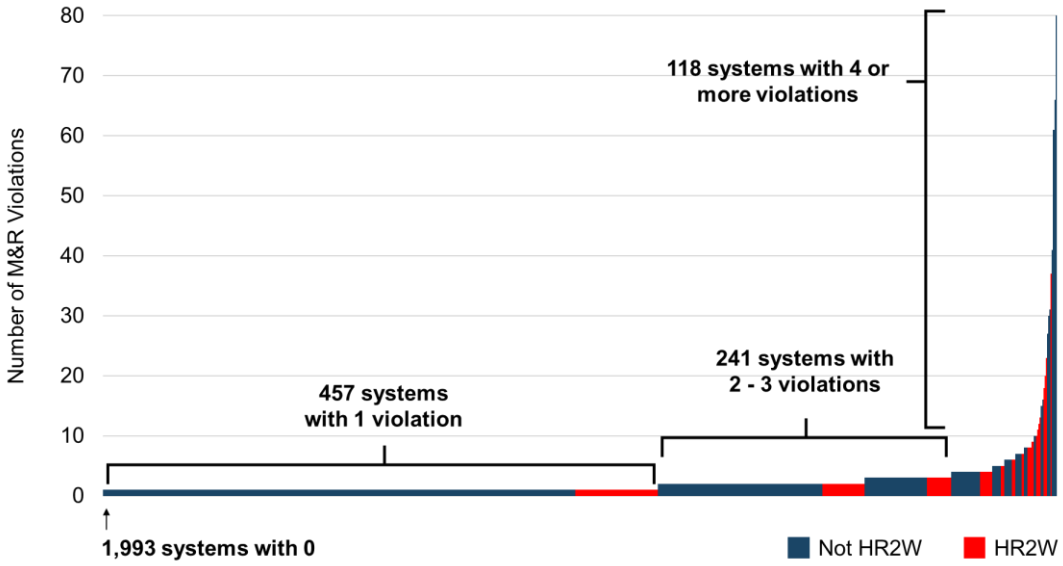
- Determine which systems have had Monitoring & Reporting violations over the last 3-year compliance period using the Monitoring & Reporting violation codes in Table B24. This excludes MCL and TT related Monitoring & Reporting violations described below that are included in the expanded HR2W list criteria:

- System that have three or more Monitoring and Reporting violations within the last three years where at least one violation has an Enforcement Action that has been open for 15 months or greater.

Threshold Determination

Data on Monitoring and Reporting violations is available for 2,779 water systems. An analysis of the counts of Monitoring & Reporting violations over the last three years finds the minimum number of Monitoring & Reporting violations as 0, the maximum as 85, and the average of 0.7 per system.

Figure A45: Monitoring & Reporting Violations Over the Last 3 Years (n=2,779)



The State Water Board has developed a threshold for Monitoring & Reporting violations (related to an MCL or Treatment Technique) as criteria for the HR2W list. The HR2W list criteria threshold is three or more MCL/TT-related Monitoring & Reporting violations within the last three years where at least one violation has an open enforcement action greater than 15 months. For the Risk Assessment, the State Water Board and UCLA developed a slightly modified version of the HR2W list criteria threshold. Systems that have had two or more Monitoring & Reporting violations over the last three years are more at-risk.[78]

Moreover, correlation and regression analysis between the indicator threshold and water system failure definition employed in Risk Assessment 1.0 shows a statistically significant relationship.

Risk Indicator Scoring & Weighting

To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be

[78] Systems that meet the HR2W criteria will not be included in the Risk Assessment.

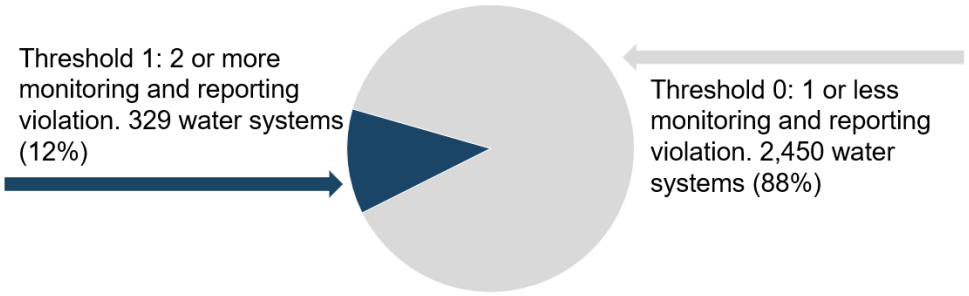
weighted higher than others because they may be more “critical” as they relate to a water system’s ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board’s engineers, the maximum weight of 2 is applied to the “Monitoring and Reporting Violations” risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 2. Table A28 summarizes the thresholds, scores, and weight for this risk indicator.

Table A28: “Monitoring and Reporting Violations” Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**1 or less** Monitoring & Reporting violations over the last three years.	0	N/A
1	**2 or more** Monitoring & Reporting violations over the last three years.	1	2

Figure A46 shows 2,450 water systems (88%) have had 1 or fewer Monitoring & Reporting violations. 329 water systems (12%) meet Threshold 1 of having 2 or more Monitoring & Reporting violations.

Figure A46: Monitoring and Reporting Violations (n=2,779)



SIGNIFICANT DEFICIENCIES

Significant Deficiencies are identified by State Water Board staff or a Local Primacy Agency (LPA) during a Sanitary Survey and other water system inspections. Significant Deficiencies include, but are not limited to, defects in the design, operation, or maintenance, or a failure or malfunction of the sources, treatment, storage, or distribution system that U.S. EPA determines to be causing or have the potential for causing the introduction of contamination into the water delivered to consumers. Significant Deficiencies can be identified for both groundwater and surface water systems, although the compliance deadlines and requirements differ depending on the applicable rule (Groundwater Rule vs. Long Term 2 Enhanced Surface Water Treatment [LT2] Rule).

State Water Board and LPA staff must enter these deficiencies into SDWIS and must follow-up on the addressing actions taken by the water system to correct the deficiencies. The State Water Board and LPA must provide written notification of a Significant Deficiency within 30 days and require the water system to respond within 30 days with a correction action plan. Scheduled return to compliance dates should be noted in the plan and approved by the State Water Board or LPA. The water system must implement the appropriate corrective action within 120 days of notification or be in compliance with a State-approved plan for correcting the deficiency at the end of the same 120-day period. The State Water Board and LPAs must then confirm that the deficiency has been addressed within 30 days after the scheduled date of correction.

A water system can incur a violation for failing to respond to or correct a Significant Deficiency (Title 22 CCR § 64430 and 40 CFR § 141.404 (s) for systems subject to the Groundwater Rule, or Title 22 CCR § 64650(f) and 40 CFR § 141.723 having for systems subject to LT2 Rule). The State Water Board and LPAs may take additional enforcement action as necessary to correct the deficiency.

Calculation Methodology
Required Risk Indicator Data Point & Source:

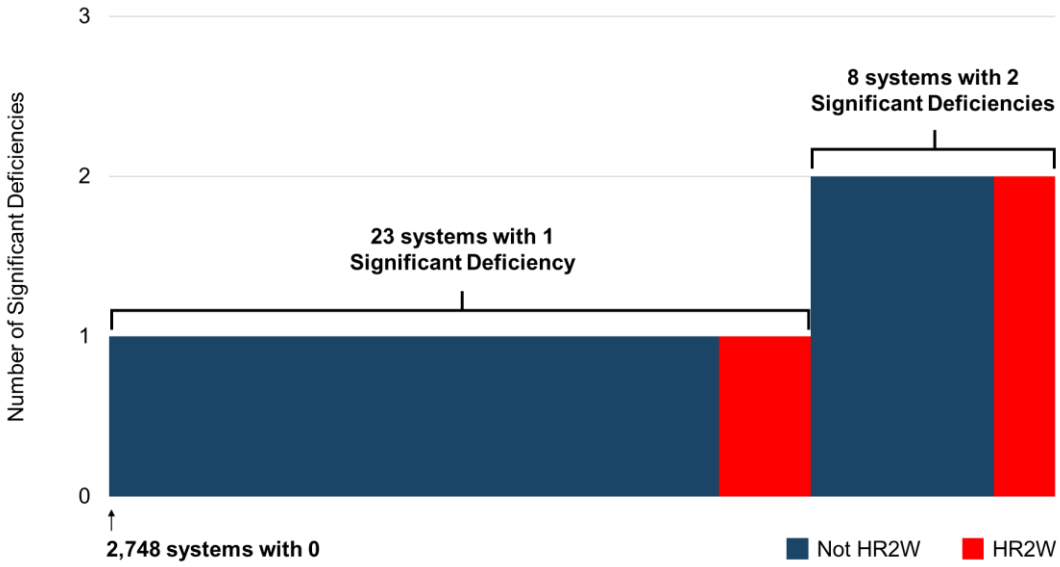
- Significant Deficiencies: Table in SDWIS with a SIG (Significant) severity designation

Risk Indicator Calculation Methodology:

- Determine which systems have had a Significant Deficiency **within the last three years** using the visit date in SDWIS (date the State Water Board became aware of the Significant Deficiency).
    - Systems that are currently out of compliance or have returned to compliance are included.

Threshold Determination
Data on Significant Deficiencies is available for 2,779 water systems. The minimum number of Significant Deficiencies found is 0, the maximum number found is 2, and the average number of Significant Deficiencies found is 0.01. 23 water systems had 1 significant deficiency and 8 water systems had 2 significant deficiencies.

Figure A47: Significant Deficiencies Within the Last 3 Years (n=2,779)



As described above, the presence of Significant Deficiencies has already been defined as a threshold for State Water Board action. Moreover, peer-reviewed studies suggest that the presence of Significant Deficiencies is associated with water system failure.[79] Finally, similar measures of significant deficiencies are used as an established threshold of concern by states such as Alaska and Nevada,[80] Connecticut,[81] and New Mexico,[82] among others. Therefore, the threshold of one or more Significant Deficiencies within the last three years has been determined to be an appropriate threshold for risk.

Risk Indicator Scoring & Weighting

To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the

[79] See Oxenford, J. L., & Barrett, J. M. (2016). Understanding small water system violations and deficiencies. Journal-American Water Works Association, 108(3), 31-37.

[80] State Strategies to Assist Public Water Systems in Acquiring and Maintaining Technical, Managerial, and Financial Capacity." Retrieved from: https://books.google.com/books?id=MK64VtYz-SsC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

[81] Systems that meet the HR2W criteria will not be included in the Risk Assessment. McPhee, Eric (n.d.). "Significant Deficiencies" Connecticut Department of Public Health: Drinking Water Division. Retrieved from: https://portal.ct.gov/-/media/Departments-and-Agencies/DPH/dph/drinking_water/pdf/CTAWWAGWRTraining2009SigDefpdf.pdf?la=en

[82] New Mexico Environment Department: Drinking Water Bureau (2016). "Surface Water Rule and Interim Enhanced Surface Water Treatment Rule: Significant Deficiency Policy" Retrieved from: https://www.env.nm.gov/wp-content/uploads/sites/5/2018/11/RE_Surface-Water-Rule-Significant-Deficiency_Policy_020816.pdf

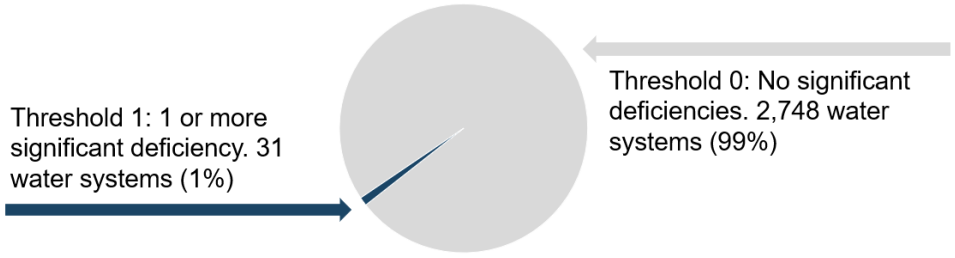
maximum weight of 3 is applied to the “Significant Deficiencies” risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 3. Table A29 summarizes the thresholds, scores, and weight for this risk indicator.

Table A29: “Significant Deficiencies” Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**0** Significant Deficiencies over the last three years.	0	N/A
1	**1** or more Significant Deficiencies over the last three years.	1	3

Figure A48 shows 2,748 water systems (99%) have had no Significant Deficiencies in the last three years. 31 water systems (1%) meet Threshold 1 of having 1 or more Significant Deficiency in the last three years.

Figure A48: Significant Deficiencies (n=2,779)



EXTENSIVE TREATMENT INSTALLED

Extensive Treatment Installed is when one or more of the following conditions are met:

- Groundwater source(s) necessitating the use of a treatment plant that has a treatment facility classification of T3 or higher.
- Surface water quality necessitating a surface water treatment plant.

In accordance with CCR Section 64413.1, water treatment facility operator certification grades are based on a classification of system that stresses influent water quality (e.g. influent turbidity, microbial quality and MCL compliance), treatment complexity, and the population supplied by the treatment plant based on facility flows greater than 2 million gallons per day. Water systems serving less than 3,300 connections are unlikely to have water treatment plants that exceed 2 million gallons per day. Therefore, facility certification level at this size range focuses on the risks associated with poor raw water quality and treatment complexity. Water treatment facilities with operator certification grades T3, T4, and T5 are also relatively expensive compared to lower certification facilities, particularly when there is a small rate base

to distribute the cost of treatment. Furthermore, the threat to customers if failure occurs is greater if the source water is significantly impaired and required extensive treatment.

Calculation Methodology
Required Risk Indicator Data Points & Sources:

- Federal Primary Source Type: SDWIS
  - GW – Groundwater
  - GU – Ground water under direct influence of surface water (Consider to be ground water)
  - GWP – Purchased Ground water under direct influence of surface water (Consider to be ground water)
  - SW – Surface Water
  - SWP – Purchased Surface Water

- Operating Category Code: SDWIS
  - T3: Treatment plants requiring a Treatment Operator Certification Grade 3
  - T4: Treatment plants requiring a Treatment Operator Certification Grade 4
  - T5: Treatment plants requiring a Treatment Operator Certification Grade 5

Risk Indicator Calculation Methodology:

- Water Systems where split into two groups based on their Federal Primary Source Type:
  - Group 1 – Groundwater systems – included the following SDWIS categories: GU, GW, and GWP.
  - Group 2 – Surface water systems – included the following SDWIS categories: SW and SWP.

- For groundwater systems, the maximum treatment classification was identified and any systems with T3, T4, or T5 treatment plants were considered as having extensive treatment.
  - There were also 14 systems that were found to have missing treatment classifications associated with their treatment plants and a system represented was contacted to get those missing classifications. In the end only one additional system was identified as having a level T3 treatment plant.

- For surface water systems, several methods were implored to determine if the systems had extensive treatment installed.
  - Surface water systems with intakes were considered to have extensive treatment installed.
  - Surface water systems that had no intakes but received raw surface water from an intertie were identified and considered to have extensive treatment installed. Some interties were incorrectly identified as not receiving treatment, but after further review were found to have extensive treatment installed.

Threshold Determination
Data on extensive treatment installed is available for 2,850 water systems. There is a minimum of 0 extensive treatment installed, a maximum of 1 extensive treatment installed, and an average of 0 across the data set.

Risk Indicator Scoring & Weighting
To enable the evaluation and comparison of risk indicators, a standardized scale between 0 and 1 for risk scores has been applied to each threshold. Public feedback during with Risk Assessment methodology development process indicated that some risk indicators should be weighted higher than others because they may be more "critical" as they relate to a water system's ability to stay in compliance. Risk indicator weights between 1 and 3 were applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 2 is applied to the "Extensive Treatment Installed" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 2. Table A30 summarizes the thresholds, scores, and weight for this risk indicator.

Table A30: "Extensive Treatment Installed" Thresholds & Scores

Threshold Number	Threshold	Score	Weight
0	**No** extensive treatment installed.	0	N/A
1	**Yes,** extensive treatment is installed.	1	2

Figure 49 shows 2,456 water systems (88%) have no extensive treatment installed, whereas 323 water systems (12%) meet Threshold 1 of having extensive treatment installed.

Figure A49: Extensive Treatment Installed (n=2,779)