2022

DRINKING WATER

NEEDS ASSESSMENT

RISK ASSESSMENT FOR PUBLIC WATER SYSTEMS

CALIFORNIA
Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

Full report:
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2022needsassessment.pdf

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Contributors

This report was prepared by the California State Water Resources Control Board within the California Environmental Protection Agency (CalEPA). Contributing authors include:

Kristyn Abhold, William Allen, Andrew Altevogt, Matthew Basinger, Michelle Frederick, Emily Houlihan, Mawj Khammas, David Leslie, Hee Kyung Lim, and Bansari Tailor.

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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 2022 Affordability Assessment, the State Water Board employed affordability thresholds for the following indicators: Percent Median Household Income; Extreme Water Bill; Percent Residential Arrearages; and Residential Arrearage Burden. 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).

"**Arrearage**" means debt accrued by a water system's customers for failure to pay their water service bill(s) that are at least 60 days or more past due.

"**At-Risk public water systems**" or "**At-Risk PWS**" means community water systems with up to 30,000 service connections or 100,000 population served 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).)

"**Constituents of emerging concern**" means synthetic or naturally occurring chemicals or material that have been detected in water bodies, that cause public health impacts, and are not regulated under current primary or secondary maximum contaminant level (MCL). For purposes of the 2022 Risk Assessment, three chemicals: hexavalent chromium, 1,4-dioxane, and per- and polyfluoroalkyl substances (PFAS), were incorporated.

"**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.)

“**Electronic Annual Report**” or “**EAR**” means is a survey of public water systems, currently required annually, to collect critical water system information intended to assess the status of compliance with specific regulatory requirements, provides updated contact and inventory information (such as population and number of service connections), and provides information that is used to assess the financial capacity of water systems, among other information reported.

“**Fire flow**” it is the amount of water designated to be used for firefighting purposes.

“**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 section 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 “**Failing: 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. (Health & Saf. Code, § 116275(c).)

“Intertie” means an interconnection allowing the passage of water between two or more water systems.

“**Local Primacy Agency**” or “**LPA**” means a local health officer within a county to whom the State Water Board has delegated primary responsibility for the administration and enforcement of California Safe Drinking Water Act. LPA is authorized by means of a local primacy delegation agreement if the local health officer demonstrates that it has the capability to meet the local primacy program requirements established by the State Water Board pursuant to subdivision (h) of Health and Safety Code section 116375. (Health & Saf. Code, § 116330, subd. (a).)

“**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.

“**Medium Community Water Systems”** means water systems that served up to 30,000 service connections or 100,000 population served.

“**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.

“**Point-of-use**” or **“POU**” means a water treatment device that treats water at the location of the back-end customer.

“**Point-of-entry**” **or “POE**” means a water treatment device that is located at the inlet to an entire building or facility.

“**Potentially At-Risk**” means community water systems with 30,000 service connections or less, or population served up to 100,000 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, section 116365, subd. (j). and (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, pre-treatment, 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).)

"**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.

"**Sanitary survey**" means a comprehensive inspection to evaluate water system potency to provide safe drinking water to their customers and to ensure compliance with the federal Safe Drinking Water Act (SDWA).

"Sounder" means a tool used to measure groundwater depth in a well.

"**Significant Deficiencies"** means identified deficiencies by State Water Board staff or LPA staff 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.

"**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.

"**SAFER Clearinghouse**" means a database system, developed and maintained by the State Water Board to assist with the implementation, management, and tracking of the SAFER Program.

"**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).)

"**Senate Bill No. 200**" means a legislative law that enabled the State Water Board to establish the Safe and Affordable Funding for Equity and Resilience (SAFER) Program to advance the goals of the Human Right to Water. (Senate Bill No. 200, CHAPTER 120)

"Senate Bill No. 552" means a legislative law that requires small water suppliers and non-transient non-community water systems, to apply draught resiliency measures subject to funding availability. (Senate Bill No. 552, CHAPTER 245)

"**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))

"**Source capacity**" means the total amount of water supply available, expressed as a flow, from all active sources permitted for use by the water system, including approved surface water, groundwater, and purchased water. (Title 22 of the California Code of Regulations, § 64551.40.)

"**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**” or “**SDAC**” 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.

“Static well level” means the resting state of the water level in a well under normal, no pumping conditions.

“**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 § 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.

KEY 2022 RISK ASSESSMENT METHODOLOGY UPDATES

The following summarizes the enhancements the State Water Board has made to the Risk Assessment methodology for public water systems. See Appendix A for more information:

Expanded the inventory of water systems assessed to include some medium-size community water systems. Only community water systems and K-12 schools with 3,300 connections or less were included in 2021 Risk Assessment. In 2022, the State Water Board expanded the inventory to include medium-size community water systems with 30,000 service connections or less; and serving a population of 100,000 or less. Community water systems that serve more than 30,000 service connections or serve a population greater than 100,000 continue to be excluded from the Risk Assessment.

Removed five risk indicators from the Risk Assessment. These risk indicators include: Maximum Duration of High Potential Exposure; Water Source Types; Percent Shut-Offs for Non-Payment; Number of Service Connections, and Extensive Treatment Installed. Learn more in Appendix A.

Incorporated eight new risk indicators into the Risk Assessment. These new risk indicators include: Constituents of Emerging Concern; Source Capacity Violations; Bottled or Hauled Water Reliance; Percentage of Residential Arrearages; Residential

Arrearage Burden; Days Cash on Hand; Operating Ratio; and Total Annual Income. Learn more in Appendix A.

Updated the risk indicator calculation methodology for Critically Overdrafted Groundwater Basin, Absence of an Intertie, % Median Household Income (MHI), Extreme Water Bill, Past Presence on the Failing: HR2W List, Increasing Presence of Water Quality Trends Towards MCL, and Percentage of Sources Exceeding an MCL. Learn more in Appendix A.

Adjusted the At-Risk and Potentially At-Risk thresholds to adjust for changes in the total aggregated risk scores statewide. Learn more in Appendix A.

PUBLIC WATER SYSTEMS ASSESSED

In 2021, 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. The 2022 Risk Assessment was expanded to include medium-size community water systems. The expansion of the Risk Assessment to include medium-size community water systems allows the State Water Board to more thoroughly track the performance and capacity of community water systems, especially the medium-size water systems that are or have been on the Failing: HR2W list. Furthermore, the State Water Board has expanding funding eligibilities within its 2021-22 Intended Use Plan to medium disadvantaged community water systems.[1]

The 2022 Risk Assessment excludes 70 wholesalers because they do not provide direct service to residential customers. Some water system types have also been excluded from certain risk categories or specific risk indicators. Please refer to Table 1 for details.

Table 1: Public Water Systems Analyzed in the 2022 Risk Assessment

Water System Type[2]	Number	Water Quality	Accessibility	Affordability	TMF Capacity
Community Water Systems[3]	2,692	Yes	Yes	Yes	Yes[4]
K-12 Schools[5]	374	Yes	Yes	No[6]	Yes

[1] Drinking Water State Revolving Fund (DWSRF) Intended Use Plan https://www.waterboards.ca.gov/water_issues/programs/grants_loans/docs/dwsrf_iup_sfy2021_22_final2.pdf

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

[3] Wholesalers were excluded.

[4] Military bases were excluded from the financial risk indicators: Days Cash on Hand, Operating Ratio, and Income.

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

[6] Schools do not typically charge for water; therefore, schools received a risk score of zero in the Affordability category for the Risk Assessment.

Water System Type[2]	Number	Water Quality	Accessibility	Affordability	TMF Capacity
TOTAL ANALYZED:	**3,066**				

RISK ASSESSMENT METHODOLOGY

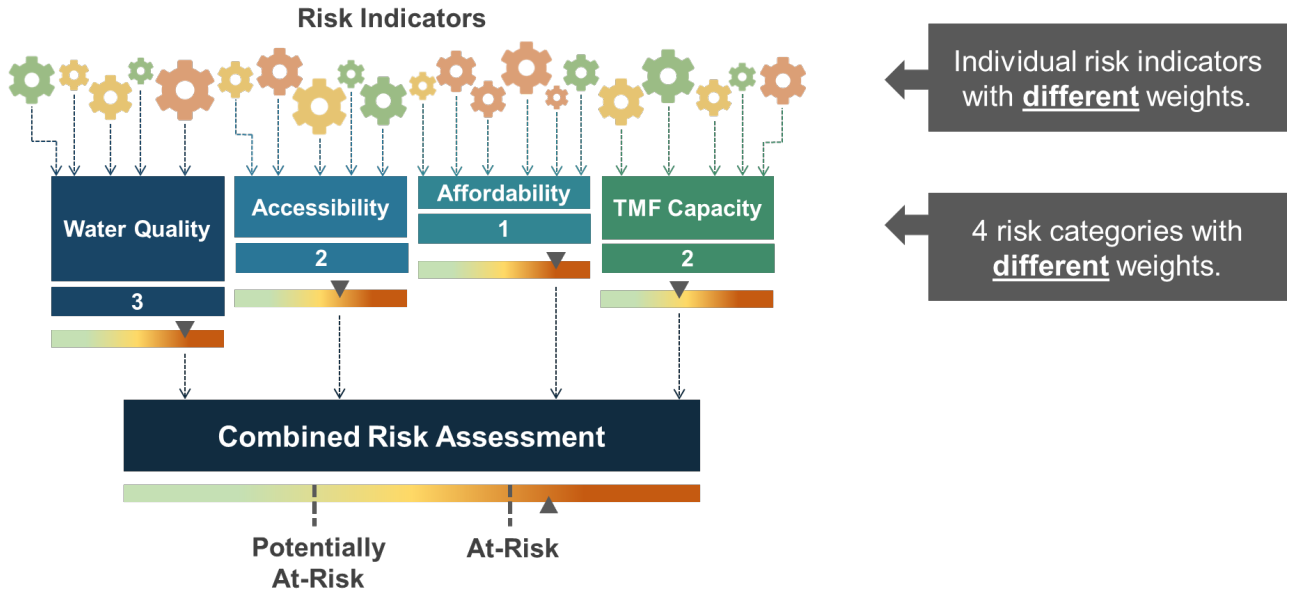
The State Water Board and UCLA developed the 2021 Risk Assessment methodology though a phased public process from January 2019 through January 2021. One in-person and four public webinar workshops were hosted to solicit public feedback. The State Water Board hosted a public webinar workshop in February 2022 to solicit feedback on adjustments to the 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 (Figure 1):

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 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.

Figure 1: Illustration of the Risk Assessment Methodology



RISK INDICATORS

The 2021 Risk Assessment utilized 19 risk indicators. These risk indicators were identified and developed from 2019-2021 in partnership between the State Water Board and UCLA and with public feedback.[7] 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 water system's ability to remain in compliance with safe drinking water standards. In response to public feedback after the 2021 release of the Risk Assessment results, the State Water Board has removed five of the original risk indicators and added eight new risk indicators (Table 2) in the 2022 analysis. Information on each risk indicator calculation methodology, thresholds, scores, and weights can be found in Appendix A.

Table 2: Risk Indicators

Category	2021 Risk Indicators	2022 Risk Indicators
Water Quality	History of *E. coli* Presence	History of *E. coli* Presence
	Increasing Presence of Water Quality Trends Toward MCL	Increasing Presence of Water Quality Trends Toward MCL
	Treatment Technique Violations	Treatment Technique Violations
	Past Presence on the HR2W List	Past Presence on the HR2W List
	Maximum Duration of High Potential Exposure (HPE) (**Removed 2022**)	Percentage of Sources Exceeding an MCL
	Percentage of Sources Exceeding an MCL	**NEW**: Constituents of Emerging Concern
Accessibility	Number of Sources	Number of Sources
	Absence of Interties	Absence of Interties
	Water Source Types (**Removed 2022**)	DWR – Drought & Water Shortage Risk Assessment Results
	DWR – Drought & Water Shortage Risk Assessment Results	Critically Overdrafted Groundwater Basin
	Critically Overdrafted Groundwater Basin	**NEW**: Bottled or Hauled Water Reliance
		NEW: Source Capacity Violations

[7] The effort to identify and select the initial 2021 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. 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:
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

Category	2021 Risk Indicators	2022 Risk Indicators
Affordability	Percent of Median Household Income (%MHI)	Percent of Median Household Income (%MHI)
	Extreme Water Bill	Extreme Water Bill
	% Shut-Offs (**Removed 2022**)	**NEW**: Residential Arrearage Burden
		NEW: Percentage of Residential Arrearages
TMF Capacity	Number of Service Connections (**Removed 2022**)	Operator Certification Violations
	Operator Certification Violations	Monitoring and Reporting Violations
	Monitoring and Reporting Violations	Significant Deficiencies
	Significant Deficiencies	**NEW**: Days Cash on Hand
	Extensive Treatment Installed (**Removed 2022**)	**NEW**: Operating Ratio
		NEW: Net Annual Income

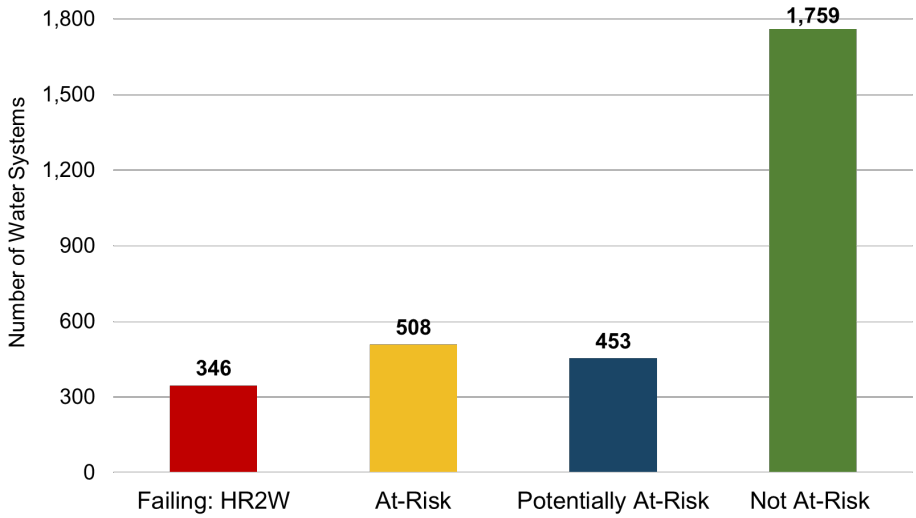
RISK ASSESSMENT RESULTS

AT-RISK WATER SYSTEMS

The 2022 Risk Assessment was conducted for 3,066 public water systems. Due to the enhancements made to the selection of risk indicators included, better data coverage, and corrections made to data calculations, there was a statewide drop in total average risk scores from 0.82 in 2021 to 0.59 in 2022. The drop in total scores reflects the methodology and calculation changes, rather than water system performance improvements. The State Water Board needed to adjust the At-Risk and Potentially At-Risk thresholds to align with the drop in total risk scores. To do this, the State Water Board analyzed the results of the 2022 Risk Assessment and selected a new threshold that achieved the same predicative power of the 2021 Risk Assessment in identifying Failing: HR2W list water systems (77%).

Utilizing the new thresholds and after removing the 346 Failing: HR2W list systems, the 2022 Risk Assessment results identified 508 (19%) At-Risk water systems, 453 (17%) Potentially At-Risk water systems, and 1,759 (65%) Not At-Risk water systems (Figure 2). Compared to the 2021 Risk Assessment results, the 2022 Assessment identifies fewer At-Risk water systems, but maintains the same predictive power of identifying Failing: HR2W list systems as the 2021 Assessment.

Figure 2: Number of Community Water Systems and K-12 Schools At-Risk and Potentially At-Risk (n=3,066)



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.[8] 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.

The Risk Assessment results for public water systems indicated that systems on the Failing: HR2W list had more than double the average risk score (1.1 vs.0.5) when compared to non-Failing: HR2W list systems. Furthermore, 277 (80%) Failing: HR2W list systems exceeded the At-Risk threshold compared to 508 (19%) non-Failing: HR2W list systems (2,720) (Figure 3).

[8] 2022 Risk Assessment Results: Attachment A1
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2022risk.xlsx

Figure 3: Distribution of Total Risk Score for Water Systems (n=3,066)

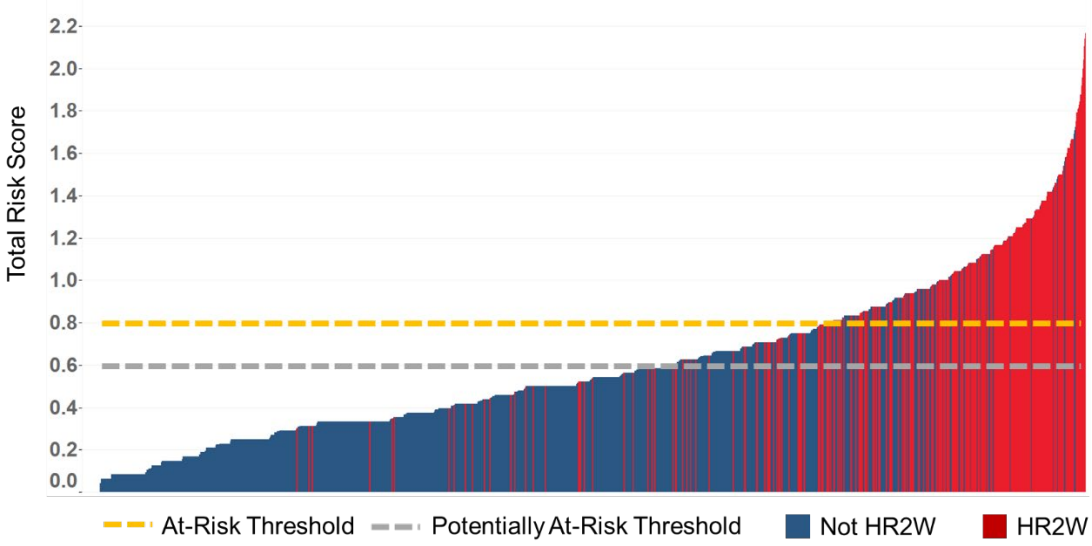
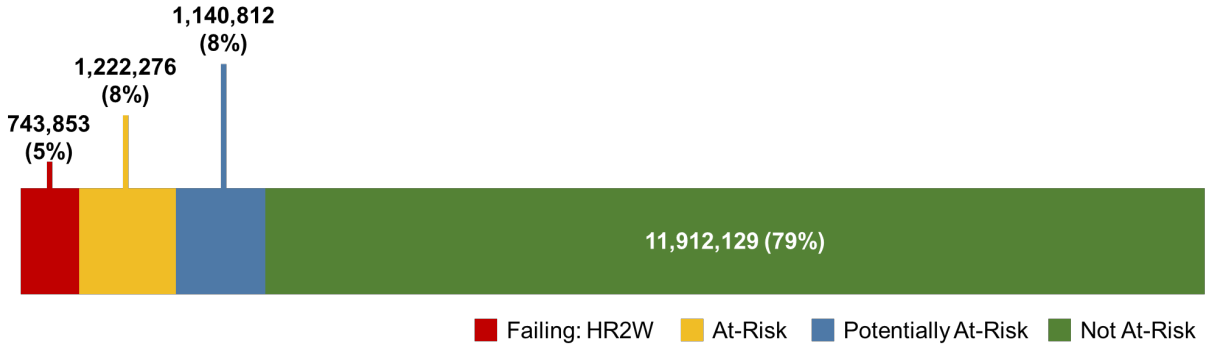


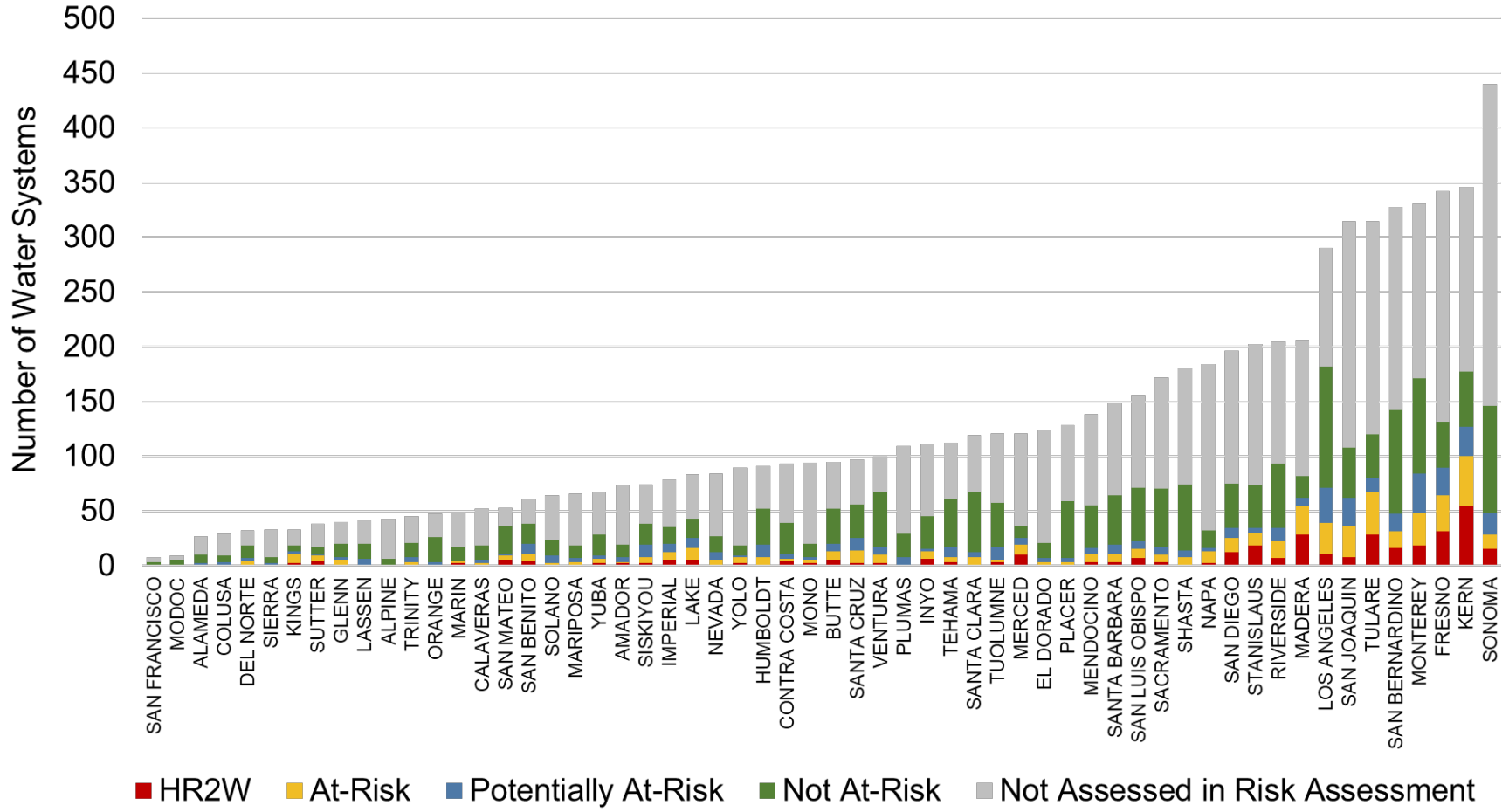
Figure 4 shows the proportion of population served by SAFER status of water systems included in the Risk Assessment. The majority of the population, approximately 79%, is served by Not At-Risk water systems. Both A-Risk and Potentially At-Risk water systems serve approximately 8% of the population served compared to systems included in the Risk Assessment and Failing: HR2W list systems serve 5%.

Figure 4: Population of At-Risk and Potentially At-Risk Communities



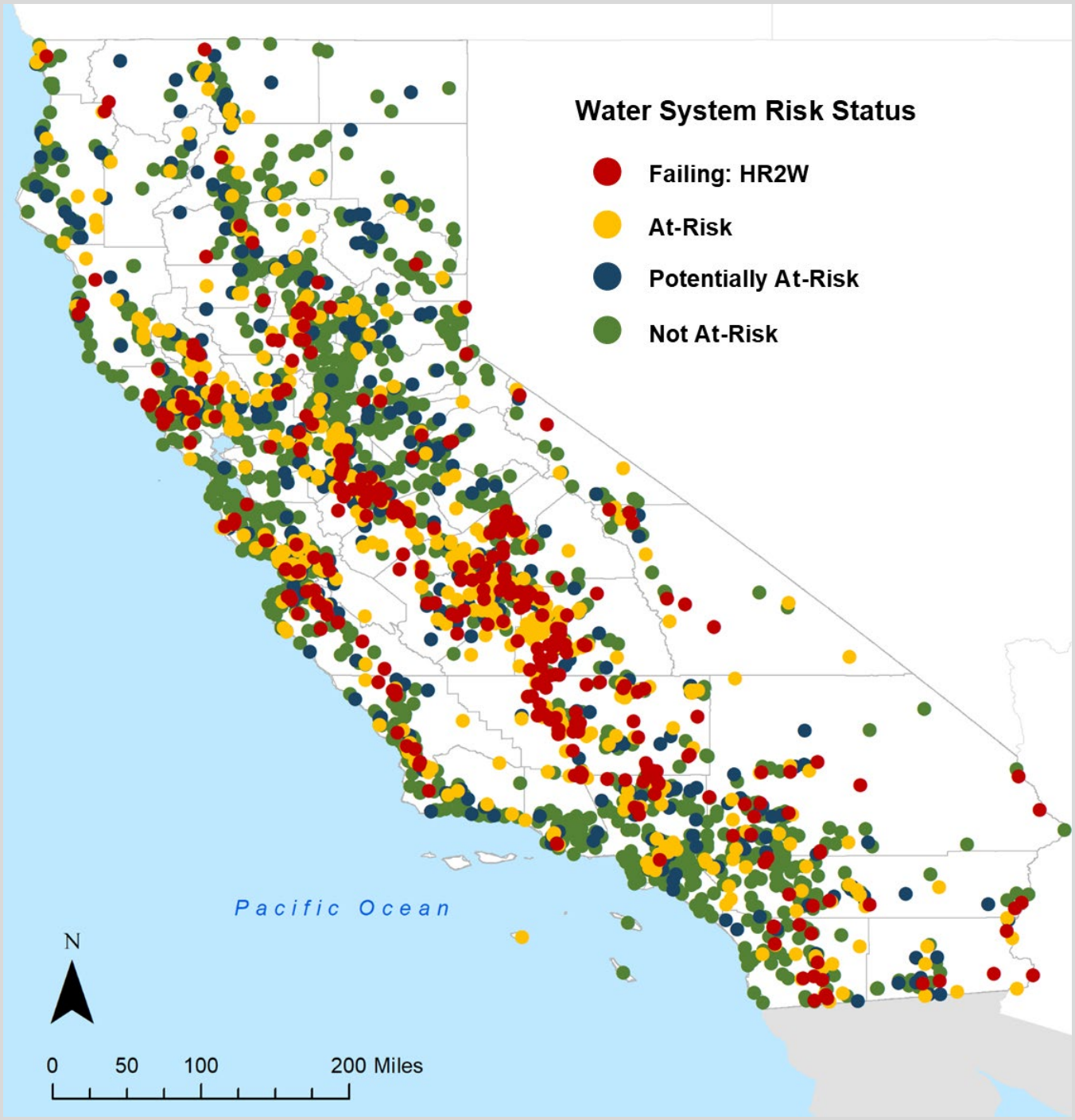
The distribution of At-Risk and Potentially At-Risk systems also varies substantially across the state, as shown in Figure 5 and Figure 6. For instance, Madera County has the highest proportion of At-Risk systems (59%), whereas Modoc County, Orange County, and San Francisco County have the lowest proportion of At-Risk systems (0%).

Figure 5: Proportion of HR2W List and At-Risk Water Systems in Each County[9]



[9] 2022 Risk Assessment Results: Attachment A1
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2022risk.xlsx

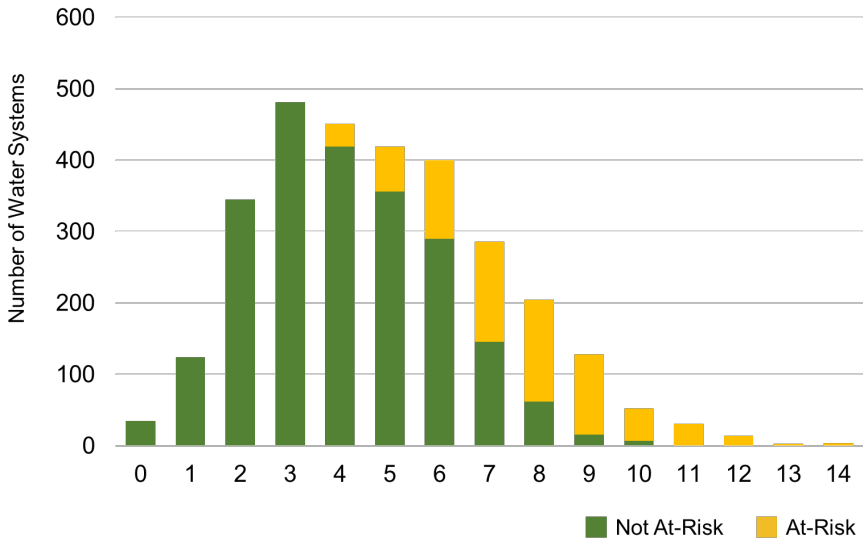
Figure 6: Map of Public Water Systems Evaluated for the Risk Assessment (n=3,088)



RISK DRIVERS

As Figure 7 below shows, all At-Risk systems exceed a threshold of concern for at least four risk indicators, with the average At-Risk system exceeding more than seven 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.

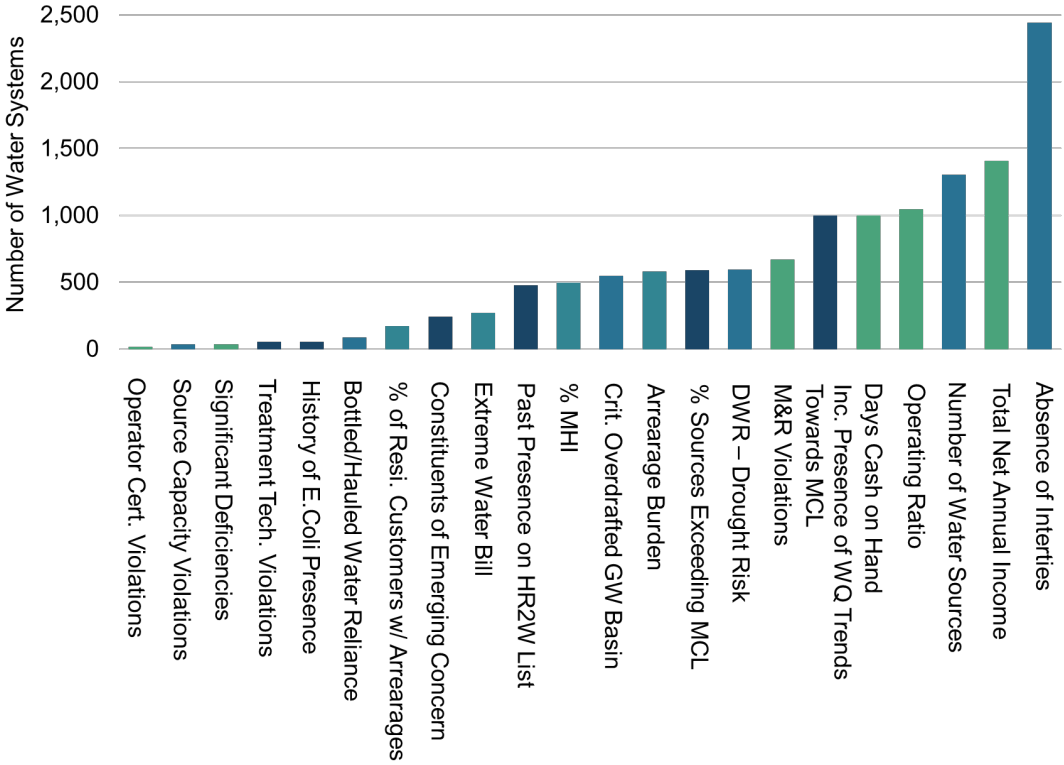
Figure 7: Distribution of the Number of Risk Indicator Thresholds Exceeded by At-Risk and Not At-Risk Water Systems (n=2,978)[10]



An analysis was also conducted to identify which risk indicator minimum thresholds were exceeded the most. As shown in Figure 8, the 'Absence of Interties', 'Total Net Annual Income', 'Number of Water Sources', 'Operating Ratio', and 'Days Cash on Hand' are the five risk indicators that the majority of water systems were exceeding the minimum risk threshold for. Two of these risk indicators fall into the Accessibility category, and three are in the TMF Capacity category.

[10] Systems that were automatically At-Risk for meeting the risk thresholds for "Number of Water Sources" and/or "Bottled or Hauled Water Reliance" were excluded from this analysis.

Figure 8: Risk Indicators Ranked by Number of Systems Exceeding Min. Risk Threshold



Based on the Risk Assessment methodology, individual risk indicators are assigned weights between one and three depending on how critical they are for a water system to meet the goals of the HR2W. To better understand which risk indicators are contributing the most towards a water system's total risk score, the average weighted scores for each risk indicator were calculated for At-Risk water systems. Table 3 shows in descending order the most influential risk indicators which contributed the most weighted points to the final risk scoring for all At-Risk systems.

Table 3: Risk Indicators Ranked by their Contribution to Total Risk Scores for At-Risk Water Systems

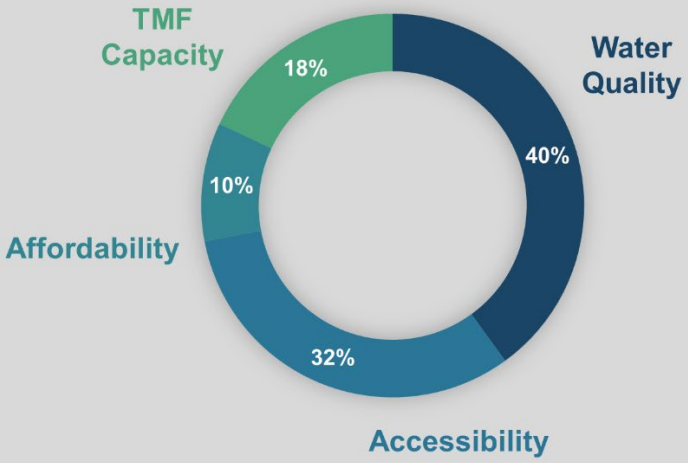
Category	Risk Indicator	Max Possible Weighted Risk Score	Avg. Weighted Score	Percent Contributing to Total Risk Score
Accessibility	Number of Water Sources	3	1.78	15.6%
Water Quality	Percentage of Sources Exceeding an MCL	3	1.77	15.5%
Accessibility	Absence of Interties	1	0.94	8.2%
TMF Capacity	Monitoring & Reporting Violations	2	0.79	7.0%

Category	Risk Indicator	Max Possible Weighted Risk Score	Avg. Weighted Score	Percent Contributing to Total Risk Score
Water Quality	Increasing Presence of Water Quality Trends Toward MCL	2	0.71	6.2%
Accessibility	Critically Overdrafted Groundwater Basin	2	0.71	6.2%
Affordability	Percent of Median Household Income	3	0.84	6.1%
TMF Capacity	Total Net Annual Income	1	0.49	4.2%
TMF Capacity	Operating Ratio	1	0.47	4.0%
Water Quality	Past Presence on the HR2W List	2	0.46	4.0%
Accessibility	DWR – Drought & Water Shortage Risk Assessment Results	2	0.42	3.7%
Affordability	Arrearage Burden	2	0.49	3.6%
TMF Capacity	Days Cash on Hand	1	0.42	3.5%
Water Quality	Constituents of Emerging Concern	3	0.39	3.4%
Accessibility	Bottled Water or Hauled Water Reliance	3	0.34	2.9%
Water Quality	History of *E. coli* Presence	3	0.17	1.5%
Affordability	Percent of Residential Customers with Arrearages	2	0.20	1.5%
Affordability	Extreme Water Bill	1	0.12	0.9%
Accessibility	Source Capacity Violations	3	0.08	0.7%
TMF Capacity	Significant Deficiencies	3	0.08	0.7%
TMF Capacity	Operator Certification Violations	3	0.05	0.5%
Water Quality	Treatment Technique Violations	1	0.04	0.4%

RISK INDICATOR CATEGORY RESULTS

The performance of At-Risk water systems across all individual risk indicators shows that the Water Quality category contributes the most weighted risk points to At-Risk scoring (40%), with Accessibility coming second (32%) and the TMF Capacity (18%) and Affordability (10%) categories contributing distant third and fourth highest shares of risk points.

Figure 9: Share of Each Risk Indicator Category in Calculating the Total Risk Score for Systems Meeting At-Risk Threshold (n=785)



SOCIOECONOMIC ANALYSIS OF FAILING & AT-RISK PUBLIC WATER SYSTEMS

Results for the 2022 Risk Assessment for public water systems can be combined with demographic data to better understand the populations most at-risk. However, there are several limitations to this demographic analysis. Demographic data is collected at the census block group or census tract level, and current census surveys do not indicate household drinking water source type. Therefore, the demographic information presented in the tables below may not represent the actual population served by public water systems. Any interpretation of these results should keep in mind the limitations of the analysis.

Demographic data (household size, linguistic isolation, poverty, median household income, and race/ethnicity) was taken from the 2019 American Community Survey. CalEnviroScreen 4.0 data is from OEHHA.[11] The CalEnviroScreen 4.0 data is displayed as percentiles, with higher percentiles indicating areas that are most affected by pollution and where people are especially vulnerable to the effects of pollution. The socioeconomic analysis was calculated using water service area boundaries, area-weighted census tract data where appropriate, and calculating weighted averages. This methodology means that there may be a bias towards

[11] OEHHA CalEnviroScreen
https://oehha.ca.gov/calenviroscreen

demographic data from larger, rural tracts/block groups as these areas are often larger than smaller, urban tracts/block groups.

When compared with not at-risk water systems, Failing: HR2W list and At-Risk public water systems areas tend to have higher CalEnviroScreen scores, a higher percentage of households in poverty, a higher percentage of limited English speaking households, a larger household size, non-white communities, and are equally likely to be in a DAC or SDAC area.

Table 4: Socioeconomic Analysis for At-Risk and Failing: HR2W List Systems

	Statewide (all areas)	Not At-Risk	Potentially At-Risk	At-Risk	Failing: HR2W
Total Count of Systems	**3,066**	**1,759**	**453**	**503**	**346**
Average CalEnviroScreen 4.0 Percentile	43.1	37.6	45.6	51.5	54.6
Average CalEnviroScreen 4.0 Population Characteristics Percentile	44.5	40.4	47.0	50.5	53.0
Average CalEnviroScreen 4.0 Pollution Burden Percentile	42.7	37.9	43.9	50.8	53.7
Average percentage of households 2x below federal poverty	31.9%	29.2%	33.1%	35.5%	38.4%
Average percentage of households with limited English speaking	6.31%	4.81%	6.65%	8.21%	10.6%
Average household size	2.82	2.74	2.83	2.95	3.02
Percent of systems in DAC/SDAC areas	44.6% (1,367)	38.3% (673)	51.7% (234)	54.3% (276)	53.2% (184)
Percent of non-white customers served	42.5%	38.7%	44.2%	48.3%	51.1%

Figure 10: Distribution of Failing: HR2W List Water Systems by Majority Race/Ethnicity of Census Tract

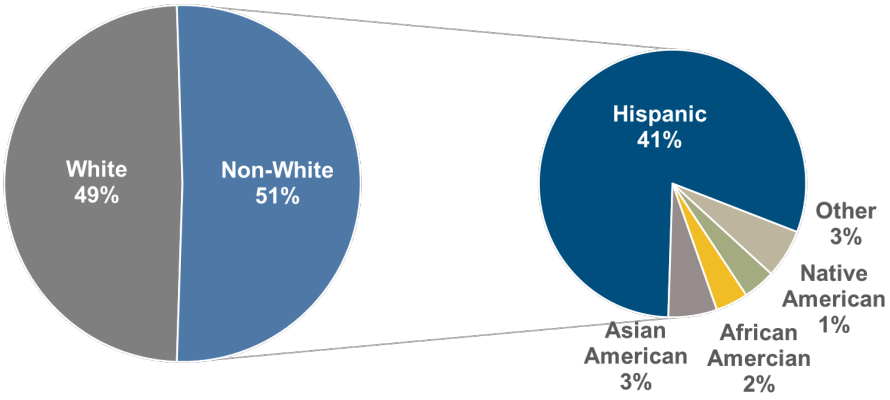
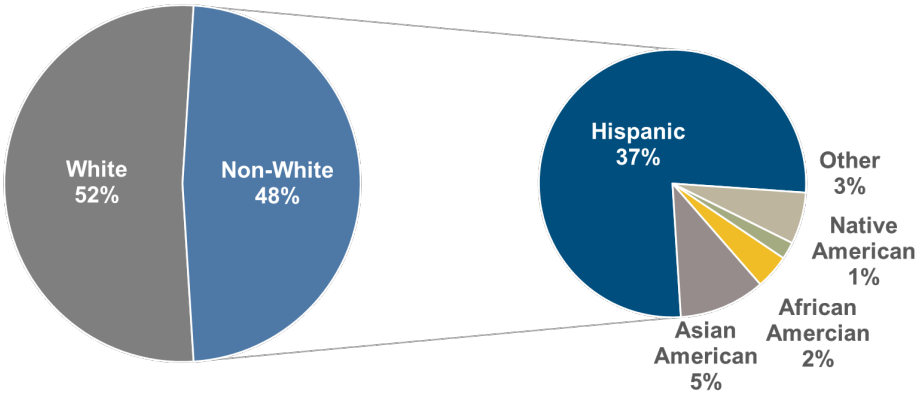


Figure 11: Distribution of At-Risk Public Water Systems by Majority Race/Ethnicity of Census Tract



LIMITATIONS OF THE RISK ASSESSMENT FOR PUBLIC WATER SYSTEMS

The Risk Assessment for public water systems is an important endeavor in assessing water system performance and risk. While the State Water Board has worked to advance the methodology since the first iteration of the Risk Assessment in 2021, 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 and 2022 Risk Assessment. First, federally recognized tribal systems were originally envisioned to be included in the same risk assessment as public water systems 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. Instead, State Water Board is working with U.S. EPA and Indian Health Service to merge and compare existing risk/need assessments for tribal water systems. Second, public water systems with greater than 30,000 service connections or more than 100,000 population served were not included, but these larger systems may be included in future iterations of the Risk Assessment. Finally, wholesalers were also excluded from the 2021 and 2022 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 as there are not always direct correlations on risk indicators.

Data Quality

In 2021 the State Water Board expanded the Electronical Annual Report (EAR) to require the submission of income data for the first time. Many water systems struggled to provide this information. Many water systems may have provided inaccurate data which may explain why three of the top five risk indicators with thresholds exceeded are the new financial risk indicators utilizing this data in the TMF Capacity category. The State Water Board has provided additional guidance for water systems completing the EAR to assist systems in providing accurate information. Updates to the EAR, including improved data validation checks and warning messages, will also improve data quality for future years.

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. 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 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 the Modified Drinking Water Watch,[12] the EAR[13] 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

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

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

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 was conducted in 2021 by the State Water Board and the Department of Water Resources (DWR). These outreach efforts were centered on informing tribal government and their representatives 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. In the interim, SAFER Program staff will implement the SAFER Tribal Drinking Water Outreach Plan[14] and work with individual tribes, as requested by tribal governments or in response to drinking water needs identified through coordination with the U.S. EPA and DWR.

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. Regulations for compliance for secondary standards typically require sampling at the source, rather than the distribution system. 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.[15]

Expanded Data Collection Efforts
The State Water Board has already begun taking steps necessary to improve data coverage and accuracy for the Risk Assessment. Improvements to the EAR include new requirements for completing survey questions related to the Needs Assessment.[16] EAR functionality has been developed that will help auto-calculate certain datapoints like average customer charges for six HCF. This helps reduce data errors. The 2021 EAR also has a new and improved section that collects annual revenues and incurred expenses data from community water systems. This data will continue to be integrated into future iterations of the Risk Assessment to better assess water system financial risk.

The State Water Board will also begin developing new strategies to collect data related to drought resiliency, asset management and TMF Capacity for future iterations of the Needs Assessment. Recommendations on potential asset management and TMF Capacity risk

[14] SAFER 2022 Tribal Outreach Plan
https://www.waterboards.ca.gov/safer/docs/2022/SAFER-Tribal-Outreach-Plan-ENG-03242022.pdf

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

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

indicators identified through the Risk Assessment methodology development process[17] will serve as a starting point for this effort.

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:[18] 'Household Burden Indicator,' 'Poverty Prevalence Indicator,' and 'Housing Burden.'[19] The State Water Board has partnered with the Office of Environmental Health Hazard Assessment (OEHHA) to develop potential affordability indicators and will begin stakeholder engagement needed to develop the appropriate affordability thresholds necessary for inclusion in the Risk Assessment and Affordability Assessment.

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.

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[17] 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

[18] 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

[19] *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.

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 2021 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. The 2022 Risk Assessment was expanded to include medium-sized community water systems. The expansion of the Risk Assessment to include larger community water systems allows the State Water Board to more thoroughly track the performance and capacity of community water systems, especially the larger water systems that are or have been on the Failing: HR2W list.

The 2022 Risk Assessment excludes 70 wholesalers because they do not provide direct service to residential customers. Some water system types have also been excluded from certain risk categories or specific risk indicators See Table A1 for details.

Table A1: Public Water Systems Analyzed in the 2022 Risk Assessment

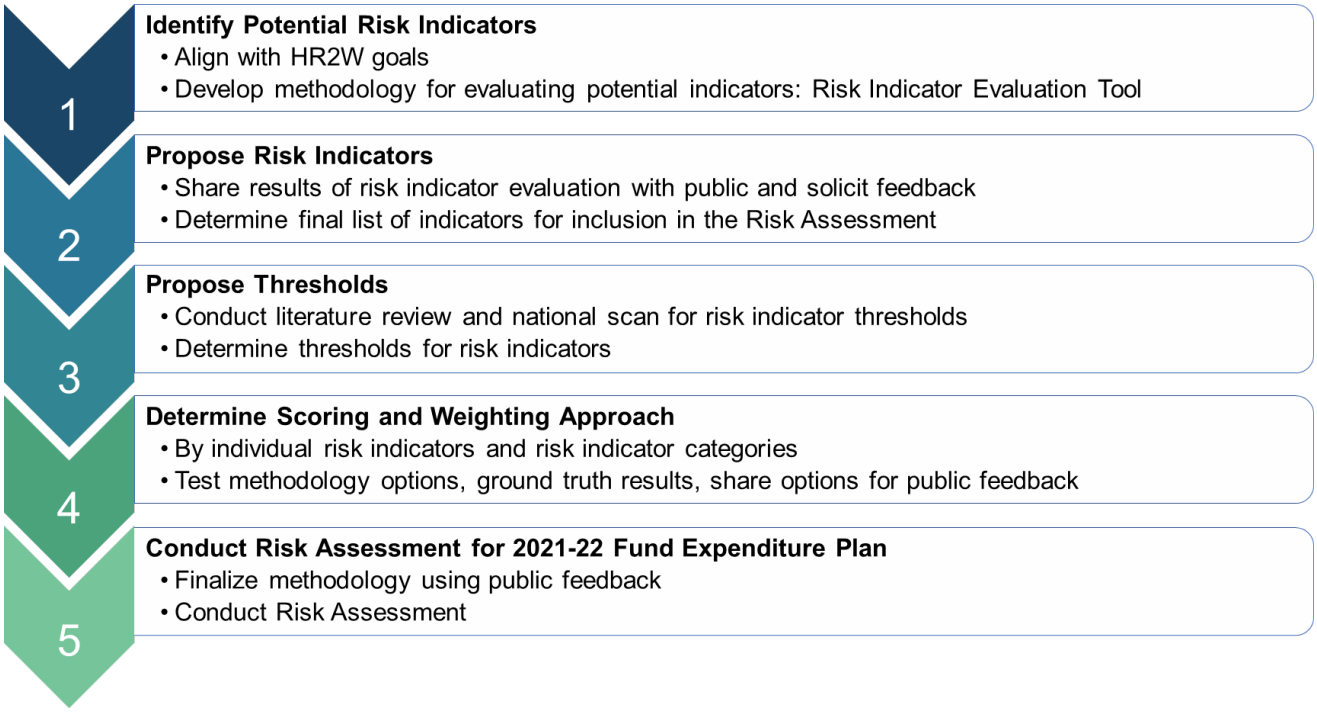
Water System Type	Number	Water Quality	Accessibility	Affordability	TMF Capacity
Community Water Systems	2,692	Yes	Yes	Yes	Yes
K-12 Schools	374	Yes	Yes	No	Yes
TOTAL ANALYZED:	**3,066**				

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.*[20]

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.

Figure A1: Phases of 2021 Risk Assessment Development



[20] 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

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. Approximately 683 individuals[21] participated in these workshops through either Zoom or CalEPA's live webcast.

In 2021, the State Water Board responded to feedback received with the release of the 2021 Risk Assessment to refine the methodology to include a larger inventory of water systems, incorporate better risk indicators that identify source capacity challenges, and add new risk indicators to assess water systems financial capacity. The State Water Board hosted a public webinar workshop in February 2022 to solicit feedback on the recommended changes to the Risk Assessment.[22] The State Water Board incorporated many suggested changes submitted during the feedback period and are reflected in the current methodology.

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:

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.

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

[22] July 28, 2022 White Paper: Proposed Changes for the 2022 Drinking Water Needs Assessment
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/needs-assessment-white-paper-draft.pdf

February 2, 2022 Webinar Presentation
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/proposed-changes-drinking-water-needs-assessment.pdf

February 2, 2022 Webinar Recording (English)
https://www.youtube.com/watch?v=a-KJxB0YII8

February 2, 2022 Webinar Recording (Spanish)
https://www.youtube.com/watch?v=nPwx23GOHCY

RISK INDICATORS

INITIAL 2020 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.[23] 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),[24] the Department of Water Resources (DWR),[25] and the California Public Utilities Commission.[26]

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 A2) 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.*[27]

[23] 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

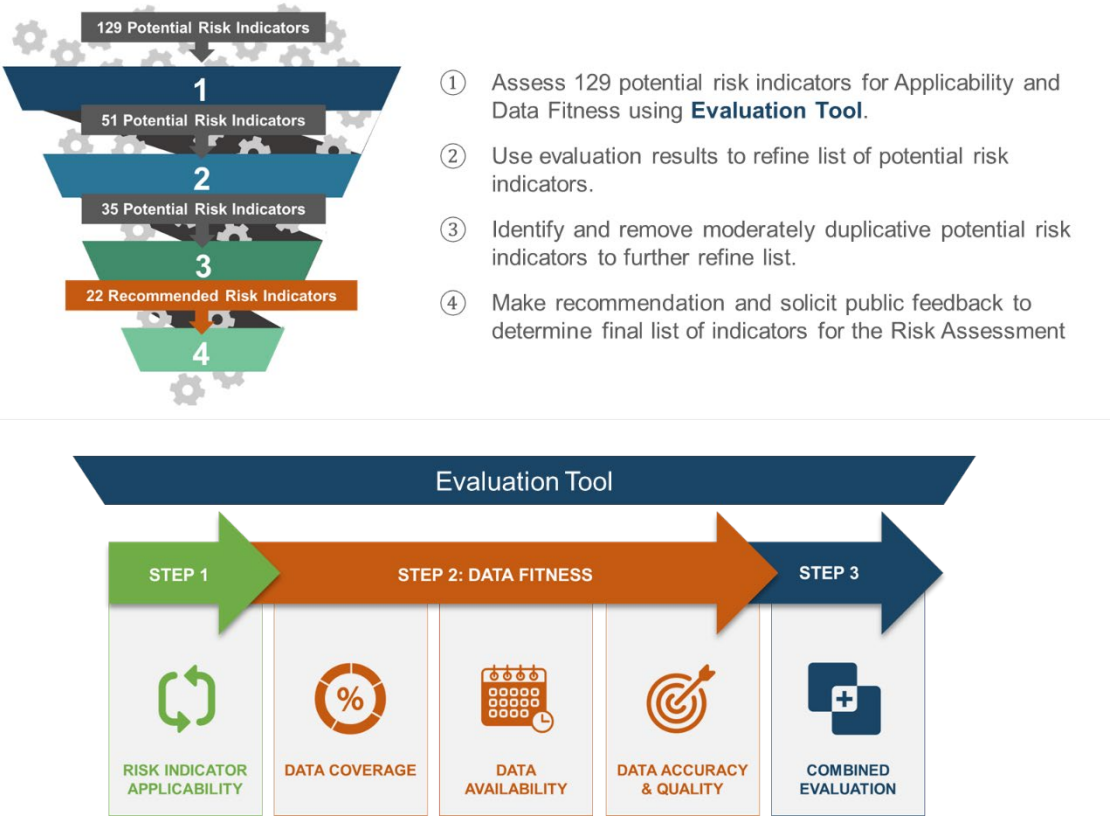
[24] The Human Right to Water in California | OEHHA
https://oehha.ca.gov/water/report/human-right-water-california

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

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

[27] 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

Figure A2: Potential Risk Indicator Evaluation Process



The 2019-2020 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 and the new list for the 2022 Risk Assessment. Sections below provide details on each individual risk indicator including definitions, required datapoints, and calculation methodologies.

2022 NEW AND REMOVED RISK INDICATORS

To respond to stakeholder feedback, the State Water Board has removed five risk indicators and added eight new risk indicators to the 2022 Risk Assessment.

Removed Risk Indicators

Maximum Duration of High Potential Exposure (HPE)
The purpose of this risk indicator is to identify systems that experience an ongoing contamination problem. The calculation for this indicator is twofold. It first identifies the contaminants with high potential exposure level by estimating the average annual

concentration of delivered water for each of 19 selected contaminants and assessing whether the average annual concentration is greater than the MCL. The duration of high potential exposure is calculated by summing the number of years for which each contaminant had high potential exposure. The indicator score is based on the maximum duration of high potential exposure across all contaminants during the nine-year period to capture recurring exposure. Capturing this recurring exposure may be important, especially when such exposure involves contaminants whose health effects are associated with chronic exposure. However, the complicated nature of how this risk indicator is calculated and determined was difficult for stakeholders, water systems, and State Water Board staff to understand. Therefore, the State Water Board has removed this indicator from the Risk Assessment. The State Water Board may develop new indicators in the future to better assess how long a water system is out of compliance.

Water Source Types

This risk indicator analyzes the diversity of water source types utilized by a water system, e.g. groundwater, surface water, etc. However, it is strongly correlated with another risk indicator in the Accessibility category of the Risk Assessment: Number of Water Sources. Therefore, the State Water Board has removed this indicator from the Risk Assessment.

Percent Shut-Offs for Non-Payment

The purpose if this risk indicator is to identify water systems that have residential customers struggling to pay their water bills due to affordability challenges. The 2021 Risk Assessment and Affordability Assessment utilized 2019 data from the Electronic Annual Report (EAR). However, Governor Newsom issued an Executive Order that prohibited water shut-offs beginning March 4, 2020 through December 31, 2021.[28] This information was therefore unavailable for the majority of 2020 and will not be collected in the 2021 EAR. Thus, the State Water Board has removed this indicator from the Risk Assessment.

Number of Service Connections

This risk indicator measures the total number of customer service connections a water system serves and was utilized in the 2021 Risk Assessment as a proxy measure of a water system's financial capacity to support staff and budget. The State Water Board required new financial reporting in the 2020 EAR to collect data to better analyze the financial capacity of water systems. The addition of new financial capacity risk indicators in the Risk Assessment eliminates the need for this risk indicator. Therefore, the State Water Board has removed this indicator from the Risk Assessment.

Extensive Treatment Installed

The purpose of this risk indicator was to identify water systems requiring extensive treatment due to poor source water quality and treatment complexity. The State Water Board removed this risk indicator because of the expansion of the water systems included in the Risk Assessment. The inclusion of medium-sized water systems would result in many of these systems receiving risk points due to the calculation methodology of this risk indicator. For example, 157 (40%) of large and medium-sized water systems with more than 3,300 service

[28] Governor Newsom Executive Order
https://www.gov.ca.gov/2020/04/02/governor-newsom-issues-executive-order-protecting-homes-small-businesses-from-water-shutoffs/

connections would receive risk points. The inherent bias of this risk indicator, without any additional analysis of the system's technical capacity, led the State Water Board to remove it from the Risk Assessment.

New Risk Indicators

The State Water has added 8 new risk indicators to the Risk Assessment. Table A2 provides a summary of the 22 risk indicators utilized in the 2022 Risk Assessment. Sections below provide details on each individual risk indicator including definitions, required datapoints, calculation methodologies, thresholds, scores, and weights.

Water Quality
The State Water Board added one new risk indicator to the Water Quality category of the Risk Assessment:

- **Constituents of Emerging Concern**: The purpose of this risk indicator is to identify water systems that could potentially come out of compliance if certain constituents of emerging concern (CECs) were to be regulated by a primary and/or secondary maximum contaminant level (MCL). While there are many CECs, the State Water Board is proposing a limited list of CECs for inclusion in the calculation of this risk indicator based on the likelihood that an MCL will be developed. This risk indicator would only assess water systems that have water quality sample results associated with hexavalent chromium (CrVI), 1,4-dioxane, and/or the 18 chemicals associated with per- and polyfluoroalkyl substances (PFAS). More chemicals may be included in future iterations of the Risk Assessment.

Accessibility
The State Water Board has added two new risk indicators to the Accessibility category of the Risk Assessment. These new risk indicators are meant to identify water systems that may be experiencing source capacity challenges. Stakeholder feedback on the 2021 Risk Assessment called for the inclusion of additional risk indicators that better assess water system source capacity and their ability to meet customer demand.

Section 64602 of the California Code of Regulations requires water systems to maintain a minimum level of service during normal (non-emergency) operating conditions. Consumers have a reasonable expectation to an adequate supply of water not just during average conditions but also during high demand periods. Source capacity and reliability have a significant effect on the ability of the water system to meet sanitation needs, future regulatory obligations and consumer expectations.

- **Source Capacity Violations**: The purpose of this risk indicator is to identify water systems that have violated source capacity standards as required in California Waterworks Standards[29] within the last three years. This violation criteria includes:
    - Failure to maintain adequate source capacity (may include curtailment order and/or service connection moratorium).

[29] California Code of Regulations Title 22 Division 4 Chapter 16: https://govt.westlaw.com/calregs/Browse/Home/California/CaliforniaCodeofRegulations?guid=I437FD430D4BA11DE8879F88E8B0DAAAE&originationContext=documenttoc&transitionType=Default&contextData=(sc.Default)

    - Failure to maintain adequate pressure leading to a water outage.
    - Failure to complete a required source capacity planning study.
- **Bottled or Hauled Water Reliance**: The purpose of this risk indicator is to identify water systems that have had to supplement or replace their source supply to meet customer demand with bottled water, and/or hauled water at any point within the past three years. A water system that is unable to meet the demand with their available sources due to water quality issues or source capacity challenges is at-risk of failing to provide water to the customers. Water systems that meet this threshold criteria are automatically added to the At-Risk list.

Affordability
The State Water Board has added two new risk indicators to the Affordability Capacity category of the Risk Assessment. These new risk indicators are meant to identify water systems that have a community that is experiencing household affordability challenges. The two risk indicators are direct measures of household drinking water affordability.

- **Percentage of Residential Arrearages:** The purpose of this risk indicator is to identify water systems that have a high percentage of their residential customers that have not paid their water bill and are at least 60 days or more past due.
- **Residential Arrearage Burden**: The purpose of this risk indicator is to identify water systems that would have a high residential arrearage burden if they were to distribute their residential arrearages across their total residential rate base. This indicator measures how large of a burden non-payment is across the water system's residential customers.

2021 Drinking Water Arrearage Payment Program[30]

The initial data used for the two new arrearage affordability indicators comes from the State Water Board's 2021 Drinking Water Arrearage Payment Program. The State Water Board received $985 million to address community water system residential and commercial customer water debt that accrued during the COVID-19 pandemic (March 4, 2020 through June 15, 2021). The State Water Board collected residential arrearage information from an initial survey on outstanding debt and during the Program's application period. This data was utilized to calculate the new arrearage affordability indicators. It is important to note that some community water systems choose not to participate in the initial survey or Program. Therefore, this dataset may not represent the total amount of outstanding arrearages statewide. Moving forward, additional State assistance programs and datasets may be used to supplement this dataset as they become available.

TMF Capacity
The State Water Board has added three new risk indicators to the TMF Capacity category of the Risk Assessment. These new risk indicators are meant to assess risk related to the

[30] California Water and Wastewater Arrearage Payment Program
https://www.waterboards.ca.gov/arrearage_payment_program/

financial capacity of water systems. Financial capacity refers to a water system's ability to balance its budget on an annual basis, maintain cash reserves for emergencies, and maintain sufficient cash to pay its bills on a timely basis.

- **Operating Ratio**: The purpose of this risk indicator is to identify water systems that do not have sufficient revenues to cover their costs of operating and maintaining their system. Specifically, "Operating Ratio" is a ratio of annual revenues compared to annual operating expenses. To be a self-supporting, a water system should strive to have at least as much annual revenue as it has operating expenses. In general, a water system should collect revenues greater than expenses in order to accommodate for future investments.
- **Total Annual Income**: The purpose of this risk indicator is to identify water systems whose total annual revenue is unable to cover their total annual expenses. A water system should generate enough revenue to cover all incurred expenses (including operational expenses) throughout the year. Total Net Annual Income of a water system should be a positive (+) value. If more money is spent than is brought in, then the water system will have to make adjustments in order to maintain operations. If the expenditures are outpacing revenue too quickly, then the water system may have to cut costs or decrease its level of service.
- **Days Cash on Hand**: The purpose of this risk indicator is to approximate the number of days a water system can cover its daily operations and maintenance costs, relying only on their current cash or liquid reserves, before running out of cash. It is a helpful measure of how long a system can operate if it has a sudden and dramatic reduction in operating income, perhaps from a large customer leaving or an environmental emergency (fire, drought restrictions, etc.).

Table A2: Risk Indicators

Category	2021 Risk Indicators	2022 Risk Indicators
Water Quality	History of *E. coli* Presence	History of *E. coli* Presence
	Increasing Presence of Water Quality Trends Toward MCL	Increasing Presence of Water Quality Trends Toward MCL
	Treatment Technique Violations	Treatment Technique Violations
	Past Presence on the HR2W List	Past Presence on the HR2W List
	Maximum Duration of High Potential Exposure (HPE) (**Removed 2022**)	Percentage of Sources Exceeding an MCL
	Percentage of Sources Exceeding an MCL	**NEW**: Constituents of Emerging Concern
Accessibility	Number of Sources	Number of Sources
	Absence of Interties	Absence of Interties

Category	2021 Risk Indicators	2022 Risk Indicators
	Water Source Types (**Removed 2022**)	DWR – Drought & Water Shortage Risk Assessment Results
	DWR – Drought & Water Shortage Risk Assessment Results	Critically Overdrafted Groundwater Basin
	Critically Overdrafted Groundwater Basin	**NEW**: Bottled or Hauled Water Reliance
		NEW: Source Capacity Violations
Affordability	Percent of Median Household Income (%MHI)	Percent of Median Household Income (%MHI)
	Extreme Water Bill	Extreme Water Bill
	% Shut-Offs (**Removed 2022**)	**NEW**: Residential Arrearage Burden
		NEW: Percentage of Residential Arrearages
TMF Capacity	Number of Service Connections (**Removed 2022**)	Operator Certification Violations
	Operator Certification Violations	Monitoring and Reporting Violations
	Monitoring and Reporting Violations	Significant Deficiencies
	Significant Deficiencies	**NEW**: Days Cash on Hand
	Extensive Treatment Installed (**Removed 2022**)	**NEW**: Operating Ratio
		NEW: Net Annual Income

RISK INDICATOR THRESHOLDS, SCORES, & WEIGHTS

THRESHOLDS

To develop thresholds for the risk indicators in the Risk Assessment, 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.

Based on the research conducted, most 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 Failing: HR2W list systems started to cluster, as well as the professional opinion of external stakeholders, State Water Board 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 external stakeholders, State Water Board staff, as well as an internal advisory group of District Engineers (Table A3).

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 A3). 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 external stakeholders, State Water Board staff, as well as an internal advisory group of District Engineers. In 2020, an analysis of how the application of risk indicator weights impacts the performance of Failing: 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[31] and a December 14, 2020 webinar,[32] which ultimately supported the final inclusion decision regarding individual risk indicator weights in the Risk Assessment.

[31] 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

[32] 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/6XDak8R5lDk?cc_load_policy=1&modestbranding=1&rel=0&autoplay=1

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

Risk Indicator	Thresholds	Score		Weight	Max Score
History of *E. coli* Presence	**Threshold 0** = **No** history of *E. coli* presence within the last three years.	0		N/A	0
	Threshold 1 = **Yes** history of *E. coli* presence (*E. coli* violation and/or Level 2 Assessment) within the last three years.	1		3	3
Increasing Presence of Water Quality Trends Toward MCL	**Threshold 0** = **Less than 25%** of sources have increasing presence of water quality trends toward MCL.	0	Average across all contaminated sources (0 ≤ score ≤ 1)	2	2
	Threshold 1 = **Secondary Contaminants**: 25% or greater of sources have 9-year average of running annual averages at or greater than 80% of MCL and the running annual average has increased by 20% or more.	0.25 per source			
	Threshold 2 = **Primary Non-Acute Contaminants**: 25% or greater of sources have 9-year average of running annual averages at or greater than 80% of MCL and the running annual average has increased by 5% or more.	0.5 per source			
	Threshold 3 = **Acute Contaminants**: 25% or greater of sources have: • 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 per source			

Risk Indicator	Thresholds	Score	Weight	Max Score
Treatment Technique Violations	**Threshold 0** = **0** Treatment technique violations over the last three years.	0	N/A	0
	Threshold 1 = **1 or more** Treatment technique violations over the last three years.	1	1	1
Past Presence on the Failing: HR2W List	**Threshold 0** = **0** Failing: HR2W list occurrence over the last three years.	0	N/A	0
	Threshold 1 = **1** Failing: HR2W list occurrence over the last three years.	0.5	2	1
	Threshold 2 = **2 or more** Failing: HR2W list occurrences over the last three years.	1	2	2
Percentage of Sources Exceeding an MCL	**Threshold 0** = **less than 50%** of sources exceed an MCL.	0	N/A	0
	Threshold 1 = **50% or greater** of sources exceed an MCL.	1	3	3
Constituents of Emerging Concern	**Threshold 0** = **Less than 25%** of sources are meeting the criteria for Thresholds 1 and 2.	0	Average across all contaminated sources (0 ≤ score ≤ 1)	3	3
	Threshold 1 = **25% or greater** of sources are meeting the following criteria: • **CrVI: 1 or more** calculated RAA(s) over 5-year period are at or above 80% of the former MCL and below the former MCL (8 µg/L ≤ RAA < 10 µg/L); or • **PFAS: 2 or more** samples over 5-year period are positive; this criterion applies to all 18 chemicals.	0.5 per source			

Risk Indicator	Thresholds	Score		Weight	Max Score
	Threshold 2 = **25% or greater** of sources are meeting the following criteria: • **CrVI: 1 or more** calculated RAA(s), over 5-year period, are at or above the former MCL (10 µg/L ≤ RAA); or • **PFAS: 2 or more** samples, over 5-year period, are at or above the notification level; this criterion only applies to 3 chemicals that have notification level; or • **1,4-Dioxane: 1 or more** calculated RAA(s), over 5-year period, are at or above the notification level (1 µg/L ≤ RAA).	1 per source			

Number of Sources	**Threshold X** = **0** sources.	Automatically At-Risk		N/A	Automatically At-Risk
	Threshold 0 = **multiple** sources.	0		N/A	0
	Threshold 1 = **1** source only.	1		3	3

Absence of Interties	**Threshold 0** = **1 or more** interties.	0		N/A	0
	Threshold 1 = **0** interties.[33]	1		1	1

[33] All water systems with 10,000 service connections or greater, that have more than one source are excluded and risk scores of 0 are assigned. If a water system with 10,000 service connections or more has only one source and it is not an intertie, they receive a risk score of 1.

Risk Indicator	Thresholds	Score	Weight	Max Score
DWR – Drought & Water Shortage Risk Assessment Results	**Threshold 0** = **Below top 25%** of systems most at risk of drought and water shortage.	0	N/A	0
	Threshold 1 = **Between top 25% - 10.01%** of systems most at risk of drought and water shortage.	0.25	2	0.5
	Threshold 2 = **Top 10%** of systems most at risk of drought and water shortage.	1	2	2
Critically Overdrafted Groundwater Basin	**Threshold 0** = **Less than 25%** of system's wells are located within a critically overdrafted basin.	0	N/A	0
	Threshold 1 = **25% or greater** of system's wells are located within a critically overdrafted basin.	1	2	2
Source Capacity Violations	**Threshold 0 = 0** source capacity violations or service connection moratoriums within the past 3 years.	0	N/A	0
	Threshold 1 = 1 or more source capacity violation or service connection moratorium within the past 3 years.	1	3	3
Bottled or Hauled Water Reliance	**Threshold 0 = 0** occurrences of bottled or hauled water reliance within the past 3 years.	0	N/A	0
	Threshold 1 = 1 or more occurrences of bottled or hauled water reliance within the past 3 years.	Automatically At-Risk	N/A	Automatically At-Risk

Risk Indicator	Thresholds	Score	Weight	Max Score
Percent of Median Household Income (%MHI)	**Threshold 0** = **Less than 1.49%**	0	N/A	0
	Threshold 1 = **1.5% - 2.49%**	0.75	3	2.25
	Threshold 2 = **2.5% or greater**	1	3	3
Extreme Water Bill	**Threshold 0** = **Below 149.99%** of the statewide average.	0	N/A	0
	Threshold 1 = **150% - 199.99%** of the statewide average.	0.5	1	0.5
	Threshold 2 = **200% or greater** of the statewide average.	1	1	1
Percentage of Residential Arrearages	**Threshold 0** = **0% to 9%** residential arrearages.	0	N/A	0
	Threshold 1 = **10% to 29%** residential arrearages.	0.5	2	1
	Threshold 2 = **30% to 100%** residential arrearages**.**	1	2	2
Residential Arrearage Burden	**Threshold 0** = **Below top 40%** of systems with residential arrearage burden.	0	N/A	0
	Threshold 1 = **Top 40%** of systems with residential arrearage burden.	0.5	2	1
	Threshold 2 = **Top 20%** of systems with residential arrearage burden.	1	2	2

Risk Indicator	Thresholds	Score	Weight	Max Score
Operator Certification Violations	**Threshold 0** = **0** Operator Certification violations over the last three years.	0	N/A	0
	Threshold 1 = **1 or more** Operator Certification violations over the last three years.	1	3	3
Monitoring & Reporting Violations	**Threshold 0** = **1 or less** Monitoring & Reporting violations over the last three years.	0	N/A	0
	Threshold 1 = **2 or more** Monitoring & Reporting violations over the last three years.	1	2	2
Significant Deficiencies	**Threshold 0** = **0** Significant Deficiencies over the last three years.	0	N/A	0
	Threshold 1 = **1 or more** Significant Deficiencies over the last three years.	1	3	3
Operating Ratio	**Threshold 0** = **1 or greater**	0	N/A	0
	Threshold 1 = **Less than 1**	1	1	1
Total Annual Income	**Threshold 0** = **Greater than $0** total annual income.	0	N/A	0
	Threshold 1 = $0 total annual income.	0.5	1	0.5
	Threshold 2 = **Less than $0** total annual income.	1	1	1

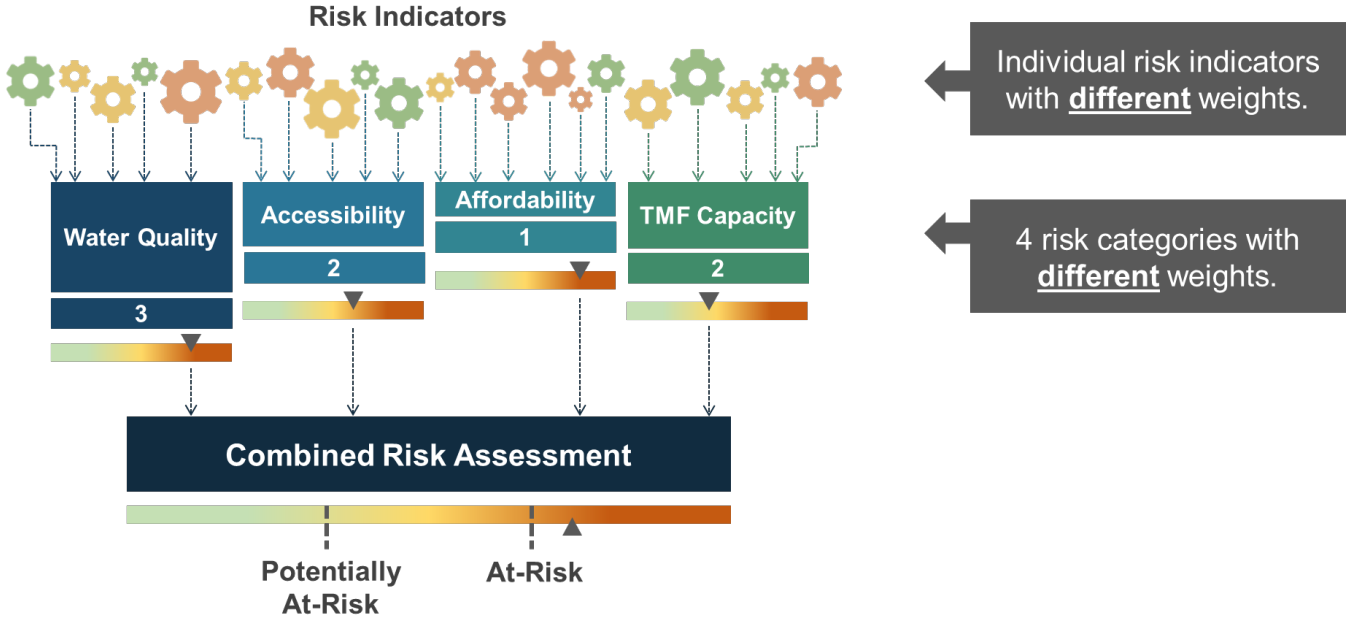
Risk Indicator	Thresholds	Score	Weight	Max Score
Days Cash on Hand	**Threshold 0** = **90 days or more** cash on hand.	0	N/A	0
	Threshold 1 = **30 days or greater** and **Less than 90 days** cash on hand.	0.5	1	0.5
	Threshold 2 = **Less than 30 days** cash on hand.	1	1	1

RISK INDICATOR CATEGORY WEIGHTS

Public feedback during the initial Risk Assessment methodology development workshops indicated that the Risk Assessment should include risk indicator category weights. An analysis of how the application of risk indicator category weights impacts the performance of Failing: 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*[34] and a December 14, 2021 webinar,[35] which ultimately supported the final inclusion category weights in the Risk Assessment.

Weights between 1 and 3 were applied to each risk indicator category, with a weight of 3 indicating the highest level of criticality (Figure A3). Risk indicator category weights were developed with the professional opinion of the broader research team contracted through UCLA during the development of the 2021 Risk Assessment, State Water Board staff, as well as an internal advisory group of District Engineers.

Figure A3: Aggregated Risk Assessment Methodology with Category Weights



[34] 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

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

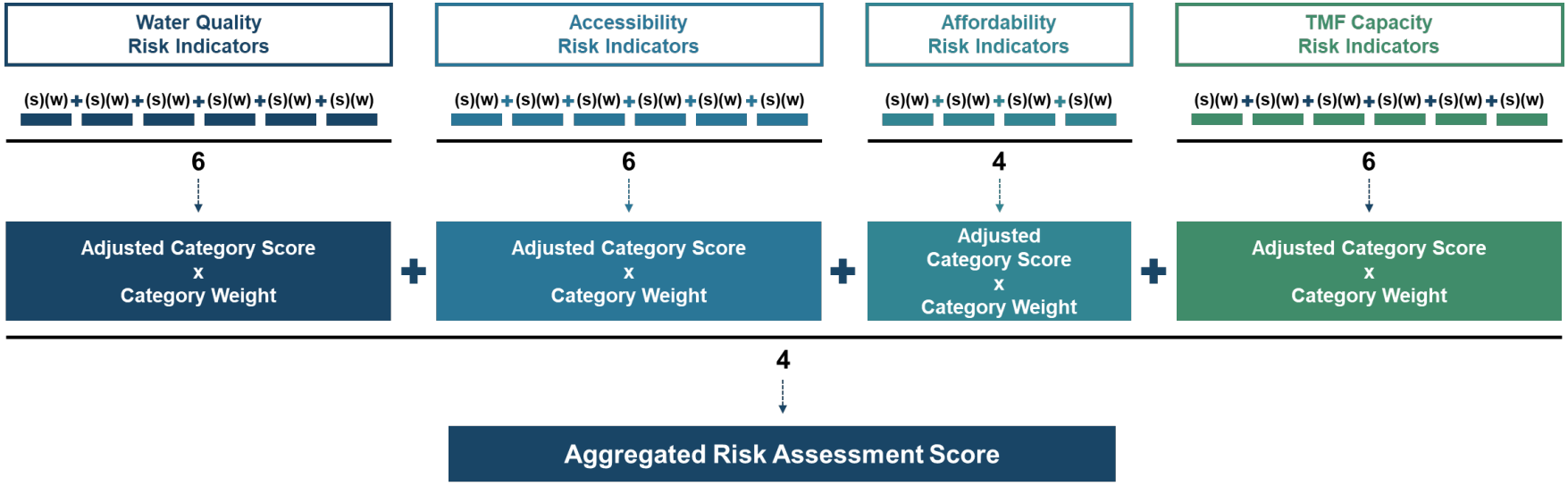
December 14, 2020 Webinar Recording
https://www.youtube.com/embed/6XDak8R5IDk?cc_load_policy=1&modestbranding=1&rel=0&autoplay=1

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 system 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 A4 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 A4: 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.[36] [37] 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 A5). 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.

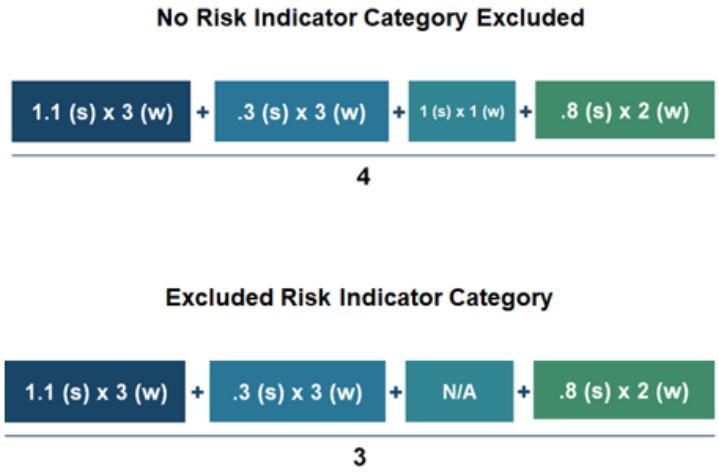
Figure A5: Example of How the Aggregated Risk Assessment Adjusts for Missing Risk Indicator Data

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 had 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 and given a risk score of 0 for this category. 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 A6.

[36] 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

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

Figure A6: How the Aggregated Risk Assessment Adjusts for a Missing Risk Indicator Category



AGGREGATED RISK ASSESSMENT THRESHOLDS

Due to the enhancements made to the selection of risk indicators included, better data coverage, and corrections made to data calculations, there was a statewide drop in total average risk scores from 0.82 in 2021 to 0.59 in 2022. The drop in total scores reflects the methodology and calculation changes, rather than water system performance improvements. The State Water Board adjusted the At-Risk and Potentially At-Risk thresholds to align with the drop in total risk scores. To do this, the State Water Board analyzed the results of the 2022 Risk Assessment and selected a new threshold that achieved the same predicative power of the 2021 Risk Assessment in identifying Failing: HR2W list water systems (77%).[38]

The 2022 Risk Assessment thresholds are 0.8 for At-Risk water systems and 0.6 for Potentially At-Risk water systems. Compared to the 2021 Risk Assessment results, the 2022 Assessment identifies fewer At-Risk water systems, but maintains the same predictive power of identifying Failing: HR2W list systems as the 2021 Assessment.

[38] The State Water Board used the unique water systems that were on the Failing: HR2W list in 2021 to conduct the predictive power analysis using the 2021 and 2022 Risk Assessment results.

Figure A7: Distribution of 2021 Total Risk Scores for Water Systems (n=2,779)

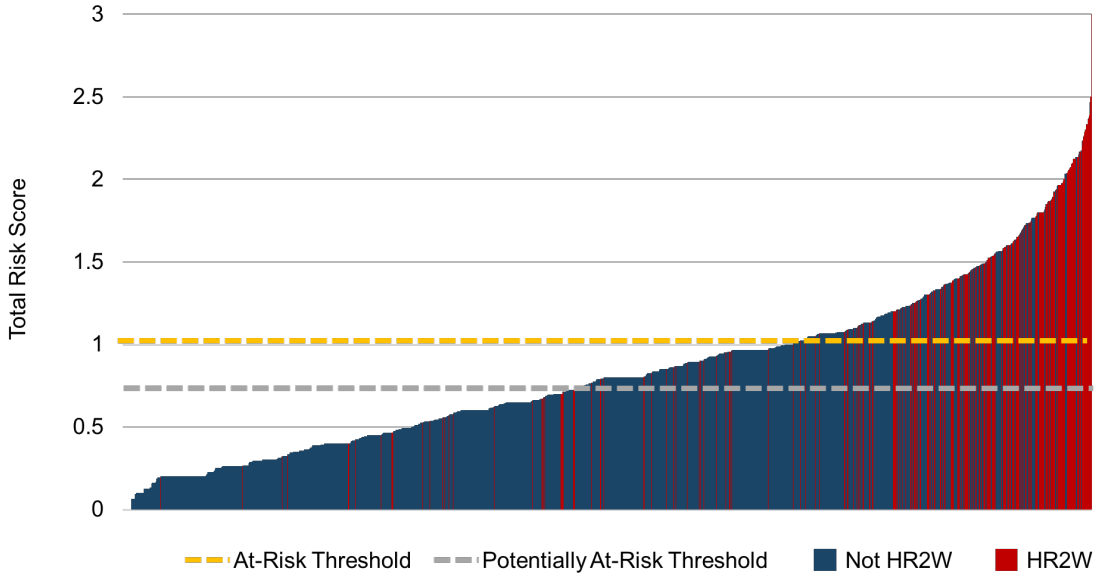
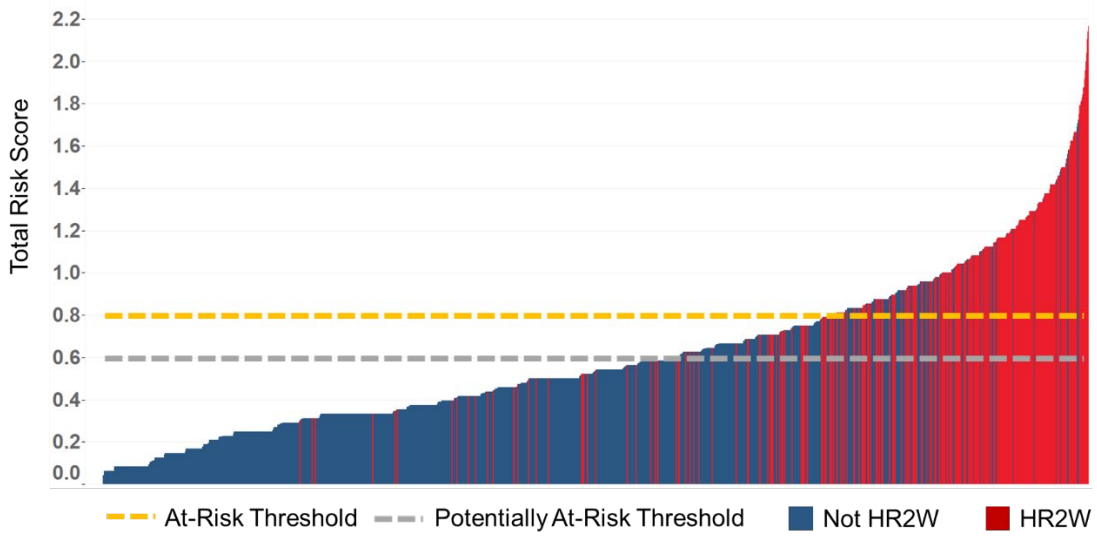


Figure A8: Distribution of 2022 Total Risk Scores for Water Systems (n=3,066)



RISK INDICATOR DETAILS

IDENTIFICATION OF WATER SYSTEMS ASSESSED

The State Water Board conducts the Risk Assessment for a specific inventory of drinking water systems determined annually. In 2021, the State Water Board conduced a Risk Assessment for K-12 schools and community water systems with 3,300 service connections or less. In 2022, the inventory of system included in the Assessment expanded to include systems with 30,000 service connections or less and less than 100,000 population served.

The following section summarizes the methodology employed to identify which water systems are included in the Risk Assessment using SDWIS data:

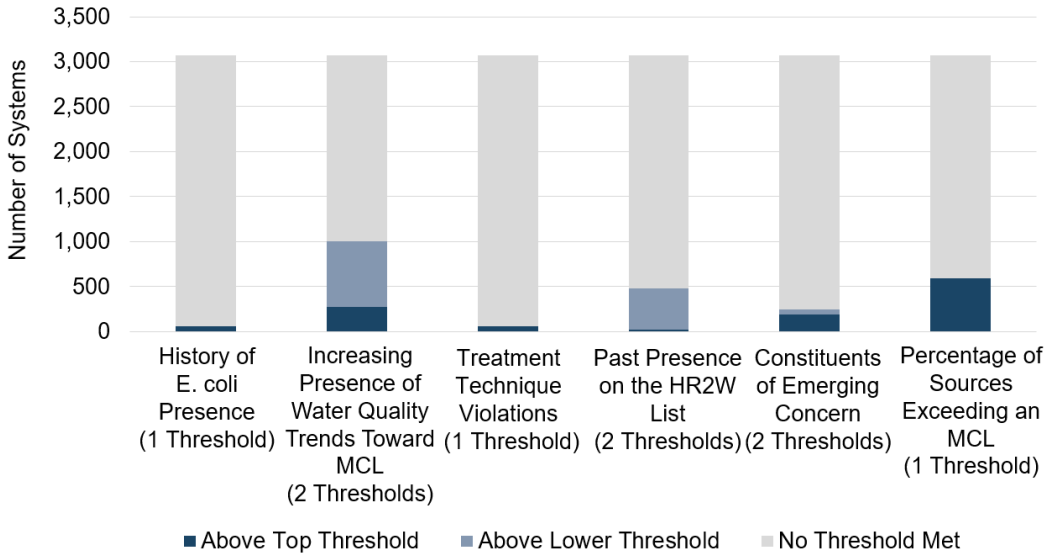
- Identify all active[39] water systems with a Federal Water System Type of "Community" and exclude systems with a primary service area of "Wholesaler." Does not exclude systems with multiple service areas and one of the non-primary service areas are designated as "Wholesaler." Some schools will be included in this category if they are designated as "Community" type.
- Identify all active water systems with a Federal Water System Type of "Non-Transient Non-Community" and with a primary service area of either "Daycare" or "School." Exclude schools that are not K-12 (i.e., colleges and pre-schools).
- Remove water systems that are larger than the determined service connection and population cutoffs for the Risk Assessment.

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 regulatory requirements, as well as frequency of exposure to drinking water contaminants. Figure A9 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.

[39] "Active" means the water system was active at the time the data was pulled.

Figure A9: 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 water supply may be contaminated with human or animal waste, and in turn, that other pathogens could be present. The presence of this contaminant 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 bacteriological 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. A Level 1 Assessment is triggered by any of the following conditions.[40]

- A public water system collecting fewer than 40 samples per month has two 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

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

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:[41]

- A water system incurs an *E. coli* MCL violation.
- A water system has a second Level 1 Assessment within a rolling 12-month period.

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.
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).

[41] Level 2 Assessment: A Quick Reference Guide
https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100K9MP.txt

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 Failing: HR2W list criteria which relies on whether the water system has an open enforcement action for the violation.[42] For the Risk Assessment, a modified version of the expanded Failing: 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 Failing: 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 the 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 "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	Max Risk Score	Risk Level
0	**No** history of *E. coli* presence over the last three years.	0	N/A	0	None
1	**Yes**, history of *E. coli* presence (*E. coli* violation and/or Level 2 Assessment) over the last three years.	1	3	3	High

INCREASING PRESENCE OF WATER QUALITY TRENDS TOWARD MCL

This risk indicator identifies sources with an 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. Water systems with 25% of their sources or more experiencing upwards trends in contaminant concentrations are at-risk of

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

exceeding regulatory water quality requirements and are therefore assigned risk points in the Risk Assessment.

Calculation Methodology

Important Note: *The State Water Board has adjusted the calculation of this risk indicator from the approach used in the 2021 Needs Assessment to account for the inclusion of medium-size water systems that have many sources.*

Required Risk Indicator Data Points & Sources:

- Dataset - SDWIS:
    - Data Point(s) - Water System Inventory
        - Active Source Water Facilities including[43]
            - Consecutive Connection (CC)
            - Infiltration Gallery (IG)
            - IN – Intake (IN)
            - Roof Catchment (RC)
            - Spring (SP)
            - WL Well (WL)
        - Active Water System Sampling Points for above Source Water Facilities[44]
    - Data point(s) - Water System Water Quality[45]
        - Water Quality Monitoring Sample Results and Dates for above sample points.
        - Water Quality Contaminants for Sample Results for above sample point.
        - List of eligible contaminants described below in Table A6, Table A7, and Table A8.

- Dataset – Water Quality Inquiry Replacement (WQIR):
    - Data point(s) for Contaminant Information:
        - Regulatory threshold information including:
            - Maximum Contaminant Levels (MCL)
            - Detection Limits for purposes of Reporting (DLR)
            - Notification Levels (NL)

Analyte names and codes for the contaminants of interest per contaminant category in SDWIS are listed in Table A6, Table A7, and Table A8.

[43] Source Water Facility Types not included in the list are excluded from analysis (ex. hauled water).

[44] Source Water Facility Types with no active sample points are excluded from analyses.

[45] Water Quality Data that is flagged as False Positive (FP), Invalid (IV), or Questionable (QQ) is excluded from the analysis. Water Quality Data that was also outside of the desired time frame is excluded.

Acute Contaminants[46] – Per the Tier 1 public notification rule[47]

Table A6: Acute Contaminants with a Primary MCL

Contaminant	SDWIS Analyte Code
Nitrate	1040
Nitrate-Nitrite	1038
Nitrite	1041
Perchlorate	1039
Chlorite	1009
Chlorine Dioxide	1008

Non-Acute Primary Contaminants

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

Contaminant	SDWIS Analyte Code
Aluminum	1002
Antimony, Total	1074
Arsenic	1005
Asbestos	1094
Barium	1010
Beryllium	1075
Cadmium	1015
Chromium	1020
Cyanide	1024
Fluoride	1025
Mercury	1035
Nickel	1036
Selenium	1045
Thallium, Total	1085
Benzene	2990
Carbon Tetrachloride	2982
O-Dichlorobenzene	2968
P-Dichlorobenzene	2969
1,1-Dichloroethane	2978

[46] CCR section 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.

[47] CCR section 64463.1. Tier 1 Public Notice.

Contaminant	SDWIS Analyte Code
1,2-Dichloroethane	2980
1,1-Dichloroethylene	2977
cis-1,2-Dichloroethylene	2380
trans-1,2-Dichloroethylene	2979
Dichloromethane	2964
1,2-Dichloropropane	2983
1,3-Dichloropropene	2413
Ethylbenzene	2992
Methyl-tert-butyl ether	2251
Chlorobenzene	2989
Styrene	2996
1,1,2,2-Tetrachloroethane	2988
Tetrachloroethylene	2987
Toluene	2991
1,2,4-Trichlorobenzene	2378
1,1,1-Trichloroethane	2981
1,1,2-Trichloroethane	2985
Trichloroethylene	2984
Trichlorofluoromethane	2218
Vinyl Chloride	2976
Xylenes, Total	2955
Lasso (Alachlor)	2051
Atrazine	2050
Bentazon	2625
Benzo(a)pyrene	2306
Carbofuran	2046
Chlordane	2959
2,4-D	2105
Dalapon	2031
1,2-dibromo-3-chloropropane	2931
Di(2-ethylhexyl)adipate	2035
Di(2-ethylhexyl)phthalate	2039
Dinoseb	2041
Diquat	2032
Endothall	2033
Endrin	2005
Ethylene Dibromide	2946

Contaminant	SDWIS Analyte Code
Glyphosate	2034
Heptachlor	2065
Heptachlor Epoxide	2067
Hexachlorobenzene	2274
Hexachlorocyclopentadiene	2042
BHC-GAMMA	2010
Methoxychlor	2015
Molinate	2626
Oxamyl	2036
Pentachlorophenol	2326
Picloram	2040
Total Polychlorinated Biphenyls (PCB)	2383
Simazine	2037
Thiobencarb (Bolero)	2727
Toxaphene	2020
1,2,3-Trichloropropane	2414
2,3,7,8-TCDD	2063
2,4,5-TP	2110
Combined Radium (–228 & –226)	4010
Gross Alpha particle Activity	4109
Combined Uranium	4006
Gross Beta particle activity	4100
38-Strontium-90	4174
Tritium	4102

Secondary Contaminants

Table A8: Constituents that have a Secondary MCL*

Contaminant	SDWIS Analyte Code
Aluminum	1002
Color	1905
Copper, Free	1022
Foaming Agent (Surfactants)	2905
Iron	1028
Manganese	1032
Methyl tert-butyl ether (MTBE)	2251
Odor	1920

Contaminant	SDWIS Analyte Code
Silver	1050
Thiobencarb (Bolero)	2727
Turbidity	0100
Turbidity, Field	C254
Zinc	1095

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

Prepare Primary and Secondary Data:

Compliance for non-acute contaminants are typically based on calculations of the Running Annual Average (RAA) because they are focused on long-term health risks over time. Therefore, to assess the risk for potential failure of a maximum contaminant for non-acute primary and secondary contaminants calculations of the RAAs are needed.

Below is how the Running Annual Average is calculated for the purposes for the Needs Assessment:

- Step 1 - Calculate RAA for each sample point:
  - Define a search period that eligible sample results dates must occur in.
  - Calculate all quarters between the start and end date of the search period.
    - Example:
      - Start Date: 1/1/2012 - End Date: 1/1/2021
      - Number of Years = 9 Years = 36 Quarters
        - 2012-Quarter 1, 2012-Quarter 2, 2012-Quarter 3, 2012-Quarter 4, 2013-Quarter 1, etc.
  - For every sample result date, determine what quarter it falls in and assign that a sample result value. If there are multiple sample result dates per quarter, then those sample results will be averaged so that only one sample result value per quarter exists.

- Step 2 - RAA Periods are calculated by averaging four consecutive quarters of data.
  - Example: (2012-Quarter 2 + 2012-Quarter 3 + 2012-Quarter4 + 2013-Quarter 1)/4
  - Some water systems do not always have four quarters of data in every RAA period. Therefore, the number of quarters used in each RAA calculation is based on the data available during that RAA period. For example, if only three quarters of data are available during a particular RAA period, then only those three quarters will be used to calculate the RAA.
    - Example: (2012-1 + MISSING + 2012-3 + 2012-4)/3

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 through workshops and white papers in 2020 and ultimately incorporated into the Risk Assessment.

Risk Indicator Scoring & Weighting

As stated above, either RAAs or counts are calculated per each contaminant group and at each water system's sample point. Table A9 describes how each contaminant group is initially scored.

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

Threshold Number	Threshold	Score per Active Source
0	**Less than 25%** of sources have increasing presence of water quality trends toward MCL.	0
1	**Secondary Contaminants**: 25% or greater of sources have 9-year average of running annual averages at or greater than 80% of MCL and the running annual average has increased by 20% or more.	0.25
2	**Primary Non-Acute Contaminants**: 25% or greater of sources have 9-year average of running annual averages at or greater than 80% of MCL and the running annual average has increased by 5% or more.	0.5
3	**Acute Contaminants**: 25% or greater of sources have: • 9-year average (no running annual average) is at or greater than 80% of MCL; or • most recent 24-month average is at or greater than 80% of MCL; or • Any one sample over the MCL.	1

After initial scoring, each contaminant group is checked to see if 25% or more of the water system's sources are impaired. If it is, then the score remains. If it is not, then the score for that RAA period or count is reset to zero. See acute contaminant example in Table A10:

Table A10: Example of Source Scoring

Contaminant Group	Source	Exceedance	Score	Impaired (Y/N)	Impaired Count
Acute	Well 01	9-year Average ≥ 80% MCL	1	Yes	1
Acute	Well 02	N/A	0	No	0
Acute	Well 03	N/A	0	No	0
Acute	Well 04	One sample over MCL	1	Yes	1

Contaminant Group	Source	Exceedance	Score	Impaired (Y/N)	Impaired Count
Acute	Well 05	24-month Average ≥ 80% MCL	1	Yes	1

In this example, the score for the Acute containment group would NOT be reset to zero. This occurs because of the following calculation:

- # of impaired Source Water Facilities = 3
- Total Number of Source Water Facilities = 5
- (3/5) * 100 = 60%
- 60% > 25% = Score remains

Water systems with less than 25% of their sources impaired per contaminant will have their assigned scores reset to 0. Sources will be assigned the maximum score per source if the source has multiple contaminates meeting the determined thresholds. See example in Table A11.

Table A11: Selection of Max Score Per Source

	Well 01	Well 02	Well 03	Well 04	Well 05	Well 06
Acute Risk Score	1.0	1.0	1.0	0	0	0
Non-Acute Risk Score	0.5	0.5	0.5	0.5	0	0
Secondary Risk Score	0	0	0.25	0.25	0.25	0
Max Score Per Source	1	1	1	0.5	0.25	0

After selecting the maximum score for each source, an average of al the non-zero risk scores will be calculated. See example below:

$$\frac{1 + 1 + 1 + 0.5 + 0.25}{5} = \mathbf{0.75}$$

Risk indicator weights between 1 and 3 are also applied to individual risk indicators. Based on feedback from the State Water Board's internal stakeholder group, the weight of 2 is applied to the "Increasing Presence of Water Quality Trends Toward MCL" risk indicator. Therefore, the minimum risk score for this indicator is 0 and the maximum risk score is 2. Table A12 summarizes the total risk score ranges and weights applied to this risk indicator.

Table A12: "Increasing Presence of Water Quality Trends Toward MCL" Total Risk Scores & Weights

Total Score Range	Weight	Max Risk Score	Risk Level
0	0	0	None
0 < n ≤ 0.5	2	1	Medium
0.5 < n ≤ 1	2	2	High

Explore Water System Risk Indicator Performance

The distribution of how water systems have performed for this risk indicator is accessible using the hyperlink below. The results can be filtered by water system size (i.e., number of service connections).

Increasing Presence of Water Quality Trends Toward MCL: https://tabsoft.co/3DhDhrC

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[48] (disinfection and filtration)
- Ground Water Rule[49]
- 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.

[48] 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)

[49] 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)

Calculation Methodology

Required Risk Indicator Data Points & Sources:

- Treatment Technique violations: SDWIS

Table A13: Treatment Technique Violation Codes

Violation Type Code	SDWIS Violation Name
07	Treatment Techniques (Other)
12	Qualified Operator Failure
33	Failure to 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
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 A13 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 Failing: 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 Failing: HR2W list.

Threshold Determination
The State Water Board has developed a threshold for Treatment Technique violations (in lieu of an MCL) for the expanded Failing: 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.[50] For the Risk Assessment, a modified version of the expanded Failing: HR2W list 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 Failing: 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 the 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 A14 summarizes the thresholds, scores, and weight for this risk indicator.

Table A14: "Treatment Technique Violations" Thresholds & Scores

Threshold Number	Threshold	Score	Weight	Max Risk Score	Risk Level
0	**0** Treatment Technique violation over the last three years.	0	N/A	0	None
1	**1 or more** Treatment Technique violations over the last three years.	1	1	1	High

Explore Water System Risk Indicator Performance
The distribution of how water systems have performed for this risk indicator is accessible using the hyperlink below. The results can be filtered by water system size (i.e., number of service connections).

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

Treatment Technique Violations: https://tabsoft.co/3NwYgLx

PAST PRESENCE ON THE FAILING: HR2W LIST

This indicator reflects past presence on the Failing: HR2W list within the last three years. The expanded Failing: 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), a current treatment technique violation, and/or systems that have had three of more treatment technique violations in the past 3 years. A system is removed from the Failing: 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 or monitoring and reporting 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 Failing: HR2W website[51] for detailed criteria and methodology for the HR2W list.

> ***Important Note***: In 2021, the State Water Board corrected to the historical Failing: HR2W list using a new and improved query methodology to analyze historical violation and enforcement data to better identify Failing: HR2W list occurrence start and end dates.

Threshold Determination

In 2020, data on Past Presence of the Failing: HR2W list was available for all 2,850 water systems. 2,393 water systems (82%) had zero Failing: 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.[52] Therefore, tiered thresholds were developed, where more occurrences on the Failing: 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 the 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

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

[52] 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.

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 Failing: HR2W List" risk indicator. Therefore, the minimum risk score is 0 and the maximum risk score is 2. Table A15 summarizes the thresholds, scores, and weight for this risk indicator.

Table A15: "Past Presence on the Failing: HR2W List" Thresholds & Scores

Threshold Number	Threshold	Score	Weight	Max Score	Risk Level
0	**0** Failing: HR2W list occurrence over the last three years.	0	N/A	0	None
1	**1** Failing: HR2W list occurrence over the last three years.	0.5	2	1	Medium
2	**2** or more Failing: HR2W list occurrences over the last three years.	1	2	2	High

Explore Water System Risk Indicator Performance

The distribution of how water systems have performed for this risk indicator is accessible using the hyperlink below. The results can be filtered by water system size (i.e., number of service connections).

Past Presence on the Failing: HR2W List: https://tabsoft.co/3IGSLGJ

PERCENTAGE OF SOURCES EXCEEDING AN MCL

Percentage of sources that exceed any primary drinking water MCL within the past three years. Water systems with impaired water sources make it more difficult to provide safe drinking water, particularly in the event of a drought or treatment failure.

Calculation Methodology

Required Risk Indicator Data Points & Sources:

- Dataset - SDWIS:
  - Data Point(s) - Water System Inventory
    - Active Source Water Facilities including[53]
      - Consecutive Connection (CC)
      - Infiltration Gallery (IG)
      - IN – Intake (IN)
      - Roof Catchment (RC)
      - Spring (SP)

[53] Source Water Facility Types not included in the list is excluded from analysis (ex. hauled water).

        - WL Well (WL)
    - Active Water System Sampling Points for above Source Water Facilities[54]

- Data point(s) - Water System Water Quality[55]
    - Water Quality Monitoring Sample Results and Dates for above sample points.
    - Water Quality Contaminants for Sample Results for above sample point.
        - List of eligible contaminants described below in Table A16.

- Dataset – Water Quality Inquiry Replacement (WQIR):
    - Data point(s) for Contaminant Information:
        - Regulatory threshold information including:
            - Maximum Contaminant Levels (MCL)
            - Detection Limits for purposes of Reporting (DLR)
            - Notification Levels (NL)

Table A16: Analytes in WQIr Chemical Table

Analyte Name	SDWIS Analyte Code
1,1,1-Trichloroethane	2981
1,1,2,2-Tetrachloroethane	2988
Trichlorofluoromethane	2218
1,1,2-Trichloroethane	2985
1,1-Dichloroethane	2978
1,1-Dichloroethylene	2977
1,2,3-Trichloropropane	2414
1,2,4-Trichlorobenzene	2378
O-Dichlorobenzene	2968
1,2-Dichloroethane	2980
1,2-Dichloropropane	2983
1,3-Dichloropropene	2413
P-Dichlorobenzene	2969
2,3,7,8-TCDD	2063
2,4,5-TP	2110
2,4-D	2105
Lasso (Alachlor)	2051
Aluminum	1002
Antimony, Total	1074
Arsenic	1005

[54] Source Water Facility types with no active sample points is excluded from analyses.

[55] Water Quality Data that is flagged as False Positive (FP), Invalid (IV), or Questionable (QQ) is excluded from the analysis. Water Quality Data that was also outside of the desired time frame is excluded.

Analyte Name	SDWIS Analyte Code
Asbestos	1094
Atrazine	2050
Barium	1010
Bentazon	2625
Benzene	2990
Benzo(a)pyrene	2306
Beryllium, Total	1075
Bromate	1011
Cadmium	1015
Carbofuran	2046
Carbon Tetrachloride	2982
Chlordane	2959
Chlorite	1009
Chromium (Total)	1020
CIS-1,2-Dichloroethylene	2380
CIS-1,3-Dichloropropene	2228
Combined Radium (-226 & -228)	4010
Cyanide	1024
Dalapon	2031
Di(2-Ethylhexyl)Phthalate	2039
1,2-Dibromo-3-Chloropropane	2931
Dichloromethane	2964
Dinoseb	2041
Diquat	2032
Endothall	2033
Endrin	2005
Ethylbenzene	2992
Ethylene Dibromide	2946
Fluoride	1025
Glyphosate	2034
Gross Alpha Particle Activity	4109
Gross Beta Particle Activity	4100
Total Haloacetic Acids (HAA5)	2456
Heptachlor	2065
Heptachlor Epoxide	2067
Hexachlororobenzene	2274
Hexachlorocyclopentadiene	2042
BHC-Gamma	2010
Manganese, Dissolved	1034
Mercury	1035
Methoxychlor	2015
Methyl-tert-butyl ether	2251
Molinate	2626

Analyte Name	SDWIS Analyte Code
Chlorobenzene	2989
Nickel	1036
Nitrate	1040
Nitrate-Nitrite	1038
Nitrite	1041
Oxamyl	2036
Pentachlorophenol	2326
Perchlorate	1039
Picloram	2040
Total Polychlorinated Biphenyls (PCB)	2383
Selenium	1045
Simazine	2037
38-Strontium-90	4174
Styrene	2996
Tetrachloroethylene	2987
Thallium, Total	1085
Thiobencarb (Bolero)	2727
Toluene	2991
Trihalomethanes (TTHM)	2950
Toxaphene	2020
Trans-1,2-Dichloroethylene	2979
Trans-1,3-Dicholropropene	2224
Tricholoroethylene	2984
Trichlorofluoromethane	2218
Tritium	4102
Combined Uranium	4006
Vinyl Chloride	2976
Xylenes, Total	2955

Risk Indicator Calculation Methodology:

- Determine the number of impaired sources. Impaired sources with any sample results above their perspective MCL for the chemicals listed above.
- Determine the total number of sources. Based on the source types listed above.
- Calculate the percentage of impaired sources by dividing the total number of sources with MCL exceedances by the total number of sources and then multiply that number by 100.

Threshold Determination
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 in 2020 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 the 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 A17 summarizes the thresholds, scores, and weight for this risk indicator.

Table A17: "Percentage of Sources Exceeding MCL" Thresholds & Scores

Threshold Number	Threshold	Score	Weight	Max Risk Score	Risk Level
0	**less than 50%** of sources exceed an MCL.	0	N/A	0	None
1	**50% or greater** of sources exceed an MCL.	1	3	3	High

Explore Water System Risk Indicator Performance

The distribution of how water systems have performed for this risk indicator is accessible using the hyperlink below. The results can be filtered by water system size (i.e., number of service connections).

Percentage of Sources Exceeding MCL: https://tabsoft.co/3DgkcWJ

CONSTITUENTS OF EMERGING CONCERN

Constituents of emerging concern (CEC) are unregulated chemicals[56] that are potentially imposing adverse health effects and are likely present (i.e., known or anticipated to occur) at public water systems or in groundwater sources. The purpose of this risk indicator is to identify water systems that could potentially come out of compliance if certain constituents of emerging

[56] Chemicals that are not regulated by the National/State Primary & Secondary Drinking Water Regulations.

concern (CECs) were to be regulated by a primary and/or secondary maximum contaminant level (MCL).

While there are many CECs, the State Water Board is proposing a limited list of CECs for inclusion in the calculation of this risk indicator based on the likelihood that an MCL will be developed. This risk indicator would only assess water systems that have water quality sample results associated with hexavalent chromium (CrVI), 1,4-dioxane, and/or the 18 chemicals pertaining to per- and polyfluoroalkyl substances (PFAS) chemical group. The selection of these chemicals was influenced by monitoring data coverage and current regulatory priorities. More chemicals may be included in future iterations of the Risk Assessment.

> **Hexavalent chromium (CrVI)**: Chromium is a heavy metal that occurs throughout the environment. The Trivalent form is a required nutrient and has very low toxicity. The hexavalent form, also commonly known as Chromium-6, is more toxic and has been known to cause cancer when inhaled. In recent scientific studies in laboratory animals, CrVI has also been linked to cancer when ingested. Much of the low level CrVI found in drinking water is naturally occurring, reflecting its presence in geological formations throughout the state. However, there are areas of contamination in California from historic industrial use, such as the manufacturing of textile dyes, wood preservation, leather tanning, and anti-corrosion coatings, where CrVI contaminated waste has migrated into the underlying groundwater.
>
> **1,4-Dioxane**: 1,4-dioxane has been used as a solvent and stabilizer for other solvents in a number of industrial and commercial applications. In 1988, 1,4-dioxane was added to the list of chemicals known to the state to cause cancer[57] and is also considered to pose a cancer risk by U.S. EPA. Over the past decade, 1,4-dioxane has been found in a number of wells, mostly in southern California. The drinking water notification level for 1,4-dioxane is 1 microgram per liter (µg/L). More information can be found at the State Water Board webpage.[58]
>
> **Per- and polyfluoroalkyl substances (PFAS)**: PFAS are a large group of synthetic fluorinated chemicals widely used in industrial processes and consumer products. These synthetic compounds are very persistent in the environment. People are exposed to these compounds through food, food packaging, textiles, electronics, personal hygiene products, consumer products, air, soils, and drinking water. PFAS contamination is typically localized and associated with an industrial facility that manufactured these chemicals or an airfield at which they were used. Studies indicate that continued exposure to low levels of PFAS may result in adverse health effects.

Calculation Methodology
Required Risk Indicator Data Points & Sources:

- Dataset - SDWIS:
    - Data Point(s) - Water System Inventory

[57] Office of Environmental Health Hazard Assessment - Proposition 65 (California Code of Regulations, Title 27, § 27001): https://oehha.ca.gov/proposition-65

[58] California State Water Resources Control Board - 1,4-Dioxane: https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/14-Dioxane.html

        - Active Source Water Facilities Including[59]
            - Consecutive Connection (CC)
            - Infiltration Gallery (IG)
            - IN – Intake (IN)
            - Roof Catchment (RC)
            - Spring (SP)
            - WL Well (WL)
        - Active Water System Sampling Points for above Source Water Facilities[60]
    - Data Point(s) - Water System Water Quality[61]
        - Water Quality Monitoring Sample Results and Dates for above sample points.
        - Water Quality Contaminants for Sample Results for above sample point.
        - List of eligible contaminants described below in Table A18.

- Dataset – Water Quality Inquiry Replacement (WQIR):
    - Data point(s) for Contaminant Information:
        - Regulatory thresholds information including:
            - Maximum Contaminant Levels (MCL)
            - Detection Limits for purposes of Reporting (DLR)
            - Notification Levels (NL)

Analyte names and codes for the contaminants of interest in SDWIS are listed in Table A18.

Table A18: Analyte Names and Codes for CrVI, 1,4-Dioxane & PFAS

Analyte Name	SDWIS Analyte Code
Hexavalent Chromium (CrVI)	1080
1,4-Dioxane	2049
Per- and polyfluoroalkyl substances (PFAS)	
Perfluorobutanesulfonic Acid (PFBS)	2801
Perfluoroheptanoic Acid (PFHpA)	2802
Perfluorohexane Sulfonic Acid (PFHxS)	2803
Perfluorononanoic Acid (PFNA)	2804
Perfluoroctane Sulfonic Acid (PFOS)	2805
Perfluoroctanoic Acid (PFOA)	2806
Perfluorodecanoic Acid (PFDA)	2807
Perfluorododecanoic Acid (PFDoA)	2808

[59] Source Water Facility Types not included in the list are excluded from analysis (e.g., hauled water).

[60] Source Water Facility Types with no active sample points are excluded from analyses.

[61] Water Quality Data that is flagged as False Positive (FP), Invalid (IV), or Questionable (QQ) is excluded from the analysis. Water Quality Data that was also outside of the desired time frame is excluded.

Analyte Name	SDWIS Analyte Code
Perfluorohexanoic Acid (PFHxA)	2809
Perfluorotetradecanoic Acid (PFTA)	2810
Perfluorotridecanoic Acid (PFTrDA)	2811
Perfluoroundecanoic Acid (PFUnA)	2812
11-Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid (11Cl-PF3OUdS)	2813
9-Chlorohexadecafluoro-3-Oxanone-1-Sulfonic Acid (9Cl-PF3ONS)	2814
4,8-Dioxa-3h-Perfluorononanoic Acid (ADONA)	2815
Hexafluoropropylene Oxide Dimer Acid (HFPO-DA)	2816
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	2817
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	2818

Risk Indicator Calculation Methodology:

Compliance for non-acute contaminants are typically based on calculations of the Running Annual Average (RAA) because they are focused on long-term health risks over time. Therefore, to assess risk for potential failure of a maximum contaminant for non-acute primary and secondary contaminants RAAs are needed.

Below is how the Running Annual Average is calculated for the purposes for the Needs Assessment:

Prepare CrVI Data:

- Step 1 - Calculate RAA for each sample point:
  - Define a search period that eligible sample results dates must occur in.
  - Calculate all quarters between the start and end date of the search period.
    - Example:
      - Start Date: 1/1/2012 - End Date: 1/1/2021
      - Number of Years = 9 Years = 36 Quarters
        - 2012-Quarter 1, 2012-Quarter 2, 2012-Quarter 3, 2012-Quarter 4, 2013-Quarter 1, etc.
  - For every sample result date, determine what quarter it falls in and assign that sample result value. If there are multiple sample result dates per quarter, then those sample results will be averaged so that only one sample result value per quarter exists.

- Step 2 - RAA Periods are calculated by averaging four consecutive quarters of data.
  - Example:(2012-Quarter 2 + 2012-Quarter 3 + 2012-Quarter4 + 2013-Quarter 1)/4

- Some water systems do not always have four quarters of data in every RAA period. Therefore, the number of quarters used in each RAA calculation is based on the data available during that RAA period. For example, if only three quarters of data are available during a particular RAA period, then only those three quarters will be used to calculate the RAA.
    - Example: (2012-1 + MISSING + 2012-3 + 2012-4)/3

Prepare PFAS Data:

- Define a search period that eligible sample results dates must occur in.
- Count the number of positive sample results (greater than detection limit) per PFAS chemical results during the search period for each water system.
- Count sample results above the Notification Level (NL) for chemicals that have an NL during the search period for each water system.
- Count the total number of positive sample results (greater than detection limit) over the search period for each water.

Table A19: PFAS Notification Levels

Analyte Name	Notification Level (NL)
PFOS	0.0065 µg/L
PFOA	0.0051 µg/L
PFBS	0.5 µg/L

Prepare 1,4-Dioxane Data:

- Step 1 - Calculate RAA for each sample point:
    - Define a search period that eligible sample results dates must occur in.
    - Calculate all quarters between the start and end date of the search period.
        - Example:
            - Start Date: 1/1/2012 - End Date: 1/1/2021
            - Number of Years = 9 Years = 36 Quarters
                - 2012-Quarter 1, 2012-Quarter 2, 2012-Quarter 3, 2012-Quarter 4, 2013-Quarter 1, etc.
    - For every sample result date, determine what quarter it falls in and assign that sample result value. If there are multiple sample result dates per quarter, then those sample results will be averaged so that only one sample result value per quarter exists.

- Step 2 - RAA Periods are calculated by averaging four consecutive quarters of data.
    - Example:(2012-Quarter 2 + 2012-Quarter 3 + 2012-Quarter4 + 2013-Quarter 1)/4
    - Some water systems do not always have four quarters of data in every RAA period. Therefore, the number of quarters used in each RAA calculation is based on the data available during that RAA period. For example, if only three quarters

of data are available during a particular RAA period, then only those three quarters will be used to calculate the RAA.

- Example: (2012-1 + MISSING + 2012-3 + 2012-4)/3

Threshold Determination

CrVI: On July 1, 2014, an MCL of 10 µg/L CrVI was approved by the Office of Administrative Law. On May 31, 2017, the Superior Court of Sacramento County issued a judgment invalidating the MCL on the basis that the state had not properly considered the economic feasibility of complying with the MCL. The State Water Board is currently working on the development of a new MCL for CrVI.[62] Until a new MCL is developed, the State Water Board is recommending using the previous MCL as part of a tiered threshold for this risk indicator. Water systems with one or more RAA over a 5-year period are at or above 80% of the former MCL are considered medium risk and any RAA over a 5-year at or above the former MCL is considered high risk.

PFAS: Due to the ubiquitous nature of these contaminants, two positive samples are suggested as part of the tiered threshold to ensure that the water quality sample was not compromised. Since the risk related to each of the PFAS chemicals is not fully known, water quality is noted as a medium risk for any two positive samples of any PFAS contaminant. Three of the 18 PFAS chemicals have a notification level.[63] When two or more samples for these three PFAS chemicals are at or above their notification levels, they are considered to be at high risk for this indicator threshold.

1,4-Dioxane: The State Water Board is recommending a binary threshold for 1,4-Dioxane. The drinking water notification level for 1,4-dioxane is 1 microgram per liter (µg/L).[64] In January 2019, the State Water Board requested for the Office of Environmental Health Hazard Assessment (OEHHA) to establish a public health goal for 1,4-dioxane.[65] When one or more samples are detected at or above their notification level, they are considered to be at high risk for this indicator threshold.

Risk Indicator Scoring & Weighting

As stated above, either RAAs or counts are calculated per each contaminant group and at

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[62] Hexavalent Chromium Drinking Water MCL
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Chromium6.html

[63] The State Water Board recognizes that more work is being done in this area and that the presence of any PFAS in drinking water may pose a public health risk. Notification levels are nonregulatory, health-based advisory levels established for contaminants in drinking water for which MCL have not been established. A notification level may be considered a candidate for the establishment of an MCL in the future, but it has not completed going through the regulatory standard setting process.

[64] 1,4-Dioxane
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/14-Dioxane.html

[65] Public Health Goals (PHGs) - OEHHA
https://oehha.ca.gov/water/public-health-goals-phgs

each water system's sample point. The below table describes how each contaminant group is initially scored.

Table A20: "Constituents of Emerging Concern" Thresholds & Scores per Source

Threshold Number	Threshold	Score per Active Source
0	**CrVI: All** calculated RAA(s), over 5-year period, are below 80% of the former MCL (RAA < 8 µg/L); and **PFAS: Less than 2** samples, over 5-year period, are positive; and **1,4-Dioxane: 0** calculated RAA(s), over 5-year period, are at or above the notification level.	0
1	**CrVI: 1 or more** calculated RAA(s) over 5-year period are at or above 80% of the former MCL and below the former MCL (8 µg/L ≤ RAA < 10 µg/L); or **PFAS: 2 or more** samples over 5-year period are positive; this criterion applies to all 18 chemicals.	0.5
2	**CrVI: 1 or more** calculated RAA(s), over 5-year period, are at or above the former MCL (10 µg/L ≤ RAA); or **PFAS: 2 or more** samples, over 5-year period, are at or above the notification level; this criterion only applies to 3 chemicals that have notification level; or **1,4-Dioxane: 1 or more** calculated RAA(s), over 5-year period, are at or above the notification level (1 µg/L ≤ RAA).	1

After initial scoring, each contaminant group is checked to see if 25% or more of the water system's sources are impaired. If it is, then the score remains. If it is not, then the score for that RAA period or count is reset to zero. See CrVI example in Table A21:

Table A21: Example of Source Scoring

RAA Period	Source	Contaminant	Score	Impaired (Y/N)	Impaired Count
2012-1 -- 2012-4	Well 01	CrVI	0.0	No	0
2012-1 -- 2012-4	Well 02	CrVI	1.0	Yes	1
2012-1 -- 2012-4	Well 03	CrVI	0.0	No	0
2012-1 -- 2012-4	Well 04	CrVI	0.0	No	0
2012-1 -- 2012-4	Well 05	CrVI	0.0	No	0

In this example, the score for the CrVI contaminant group would be reset to zero. This occurs because of the following calculation:

- # of impaired Source Water Facilities = 1
- Total Number of Source Water Facilities = 5
- (1/5) * 100 = 20%
- 20% < 25% = Score is reset to 0

Water systems with 25% or more of their sources impaired per contaminant will be assigned their initial scores. Sources will be assigned the maximum score per source if the source has multiple contaminants meeting the determined thresholds. See example below.

Table A22: Selection of Max Score Per Source

	Well 01	Well 02	Well 03	Well 04	Well 05	Well 06
CrVI Risk Score	0.5	1	0.5	0	0	0
PFAS Risk Score	0.5	0.5	1	0.5	0	0
1,4-Dioxane Risk Score	1	1	1	0	0	0
Max Score Per source	1	1	1	0.5	0	0

After selecting the maximum score for each source, an average of al the non-zero risk scores will be calculated. See example below:

$$\frac{1+1+1+0.5}{4} = \mathbf{0.875}$$

Risk indicator weights between 1 and 3 are also applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 3 is applied to the "Constituents of Emerging Concern" risk indicator. Therefore, the minimum risk score for this indicator is 0 and the maximum risk score is 3. Table A23 summarizes the total risk score ranges and weights applied to this risk indicator.

Table A23: "Constituents of Emerging Concern" Total Risk Scores & Weights

Total Score Range	Weight	Max Risk Score	Risk Level
0	0	0	None
0 < n ≤ 0.5	3	1.5	Medium
0.5 < n ≤ 1	3	3	High

Explore Water System Risk Indicator Performance

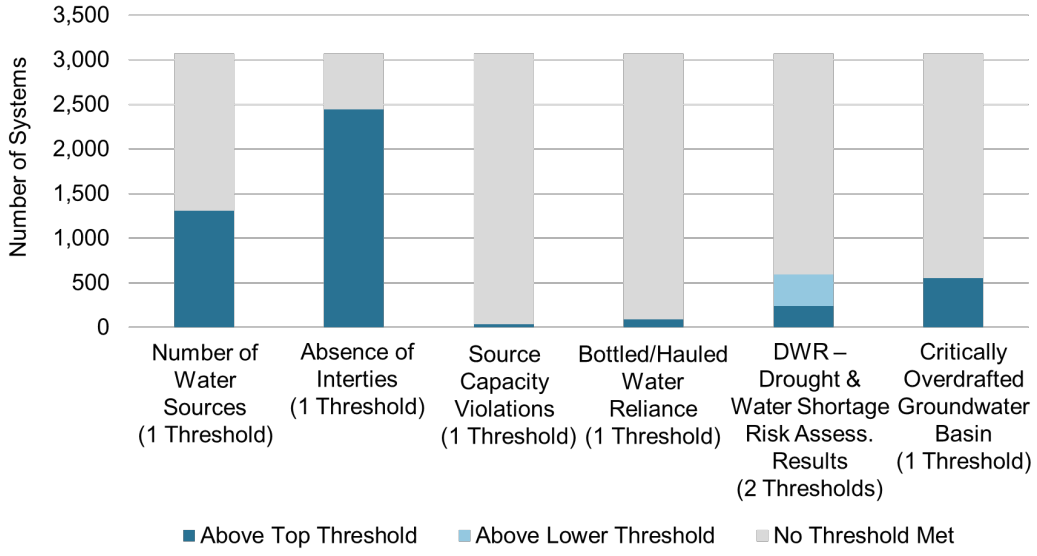
The distribution of how water systems have performed for this risk indicator is accessible using the hyperlink below. The results can be filtered by water system size (i.e., number of service connections).

Constituents of Emerging Concern: https://tabsoft.co/3ItssDK

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 A10 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 A10: 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
    a. CC – Consecutive Connection
    b. IG – Infiltration Gallery
    c. IN – Intake
    d. RC – Roof Catchment
    e. SP – Spring
    f. WL – Well

g. ST – Storage Tank

Risk Indicator Calculation Methodology:

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

Threshold Determination
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.[66] 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 approved sources 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 the 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 A24 summarizes the thresholds, scores, and weight for this risk indicator.

Table A24: "Number of Sources" Thresholds, Weights, & Scores

Threshold Number	Threshold	Score	Weight	Max Risk Score	Risk Level
X	**0** source (automatically At-Risk).	N/A	N/A	N/A	Very High
0	**2 or more** sources.	0	N/A	0	None
1	**1** source.	1	3	3	High

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

Explore Water System Risk Indicator Performance
The distribution of how water systems have performed for this risk indicator is accessible using the hyperlink below. The results can be filtered by water system size (i.e., number of service connections).

Number of Sources: https://tabsoft.co/3iFgoF3

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

Important Note: *The State Water Board has adjusted the calculation of this risk indicator from the approach used in the 2021 Needs Assessment to account for the inclusion of medium-size water systems that have many sources.*

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 consecutive connection (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
    a. CC – Consecutive Connection
        i. 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

Interties can be a critical lifeline for water systems, especially when faced with an emergency. A water system is at a higher risk of failure if their sources were to become contaminated, dry, collapse, or be taken out of service (i.e., for maintenance etc.), without an intertie to a nearby system for back-up supply. The State Water Board has adopted a binary threshold for "Absence of Intertie." Water systems without an intertie are assigned risk scores and those with an intertie receive 0 risk score. The developed threshold aligns with DWR's Drought & Water Shortage Risk Assessment.[67] All water systems with 10,000 service connections or greater, that have more than one source are excluded and risk scores of 0 are assigned. If a water system with 10,000 service connections or more has only one source and it is not an intertie, they receive a risk score of 1. Water systems with 10 or more water sources are also excluded and risk scores of 0 are assigned.

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 the 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 "Absence of Interties" 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: "Absence of Interties" Thresholds, Weights, & Scores

Threshold Number	Threshold	Score	Weight	Max Risk Score	Risk Level
0	**1 or more** interties.	0	N/A	0	None
1	**0** interties.	1	1	1	High

Explore Water System Risk Indicator Performance

The distribution of how water systems have performed for this risk indicator is accessible using the hyperlink below. The results can be filtered by water system size (i.e., number of service connections).

[67] 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

Absence of Interties: https://tabsoft.co/3ILZhfo

DWR – DROUGHT & WATER SHORTAGE RISK ASSESSMENT RESULTS

This indicator utilizes DWR's Drought and Water Shortage Risk Scoring Tool[68] results which identify 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)
  - 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)

[68] 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

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.[69] Additional information is available on the DWR Countywide Drought and Water Shortage Contingency Plans website.[70]

Threshold Determination
The 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.

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 the 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 A26 summarizes the thresholds, scores, and weight for this risk indicator.

Table A26: "DWR Assessment Results" Thresholds, Weights, & Scores

Threshold Number	Threshold	Score	Weight	Max Risk Score	Risk Level
0	**Below top 25%** of systems most at risk of drought and water shortage.	0	N/A	0	None

[69] 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

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

1	**Top 25%** of systems most at risk of drought and water shortage.	0.25	2	0.5	Low
2	**Top 10%** of systems most at risk of drought and water shortage.	1	2	2	High

Explore Water System Risk Indicator Performance
The distribution of how water systems have performed for this risk indicator is accessible using the hyperlink below. The results can be filtered by water system size (i.e., number of service connections).

DWR Assessment Results: https://tabsoft.co/3tIFusS

CRITICALLY OVERDRAFTED GROUNDWATER BASIN

Water systems reliant on groundwater wells in basins considered to be in Critical Overdraft per DWR's Bulletin 118 may be at greater risk of meeting demand, especially during drought conditions. 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

Important Note: *The State Water Board has adjusted the calculation of this risk indicator from the approach used in the 2021 Needs Assessment to account for the inclusion of medium-size water systems that have many sources.*

Required Risk Indicator Data Points & Sources:

- SGMA Basin Prioritization Statewide Summary Table:[71] 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.

[71] 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

- Water System Source Water Identification – SDWIS – Water systems screened for source water (groundwater/surface water) to determine reliance on groundwater.

Threshold Determination
In the 2021 Risk Assessment, the State Water Board used 75% threshold of water system service area intersecting with a critically overdrafted groundwater basin. However, due to the data availability of system well locations and source types, the thresholds for this risk indicator have been updated for the 2022 Needs Assessment to reflect the percentage of a water system's groundwater source wells within a critically overdrafted groundwater basin. A binary threshold is still utilized where a system that has at least 25% or more of its ground water source wells within a critically overdrafted basin are assigned a risk score of 1 and those with less than 25% of their total sources within a critically overdrafted basin receiving a risk score of 0.

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 the 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 A27 summarizes the thresholds, scores, and weight for this risk indicator.

Table A27: "Critically Overdrafted Groundwater Basin" Thresholds, Weights, & Scores

Threshold Number	Threshold	Score	Weight	Max Risk Score	Risk Level
0	**Less than 25%** of system's wells are located within a critically overdrafted basin.	0	N/A	0	None
1	**More than 25%** of system's wells are located within a critically overdrafted basin.	1	2	2	High

Explore Water System Risk Indicator Performance
The distribution of how water systems have performed for this risk indicator is accessible using the hyperlink below. The results can be filtered by water system size (i.e., number of service connections).

Critically Overdrafted Groundwater Basin: https://tabsoft.co/3wKIiYn

SOURCE CAPACITY VIOLATIONS

The purpose of this risk indicator is to identify water systems that have violated source capacity standards as required in California Waterworks Standards[72] within the last three years. This violation criteria includes:

- Failure to maintain adequate source capacity (may include curtailment order and/or service connection moratorium).
- Failure to maintain adequate pressure leading to a water outage.
- Failure to complete a required source capacity planning study.

The State Water Board developed new source capacity violation codes in 2021 to better track and identify water systems failing to meet source capacity standards. Historically, the State Water Board has responded to source capacity violations with targeted citations, curtailment orders, and service connection moratoriums. Since the new source capacity violations only reflect recent actions, this risk indicator will also include water systems that have had active connection moratoriums within the last three years.

Calculation Methodology

Required Risk Indicator Data Points & Sources:

- Service Connection Moratoriums: SDWIS
- Source Capacity Violations: Violation Type Code in SDWIS (Table A28): WW – Waterworks Standards

Table A28: Source Capacity Violation Analyte Codes

Violation Criteria	Analyte Code	Description
Failure to Maintain Adequate Source Capacity	C277 – CCR section 64554 – SRC CAPACITY	If a water system fails to have adequate source capacity pursuant to CCR section 64554[73]
Failure to Maintain Adequate Source Capacity	C278 – CCR section 64554 – SRC CAPACITY (CURTAILMENT)	If a water system fails to have adequate source capacity pursuant to CCR section 64554 AND a curtailment order has been issued (i.e., the failure is directly related to curtailments)

[72] California Code of Regulations Title 22 Division 4 Chapter 16 https://govt.westlaw.com/calregs/Browse/Home/California/CaliforniaCodeofRegulations?guid=I437FD430D4BA11DE8879F88E8B0DAAAE&originationContext=documenttoc&transitionType=Default&contextData=(sc.Default)

[73] At all times, public water system's water source(s) shall have the capacity to meet the system's maximum day demand (MDD).

1. ≥ 1,000 service connections – source capacity, storage capacity, and/or emergency source connections must meet 4 hours of peak hourly demand (PHD)
2. < 1,000 service connections – storage capacity ≥ MDD

Violation Criteria	Analyte Code	Description
Failure to Maintain Adequate Pressure Leading to a Water Outage[74]	C279 – CCR section 64602 – WATER OUTAGE	If a water system fails to maintain the minimum required pressure of 20 pounds per square inch in its distribution system due to inadequate capacity
Failure to Complete A Source Capacity Planning Study	C280 – CCR section 64558 – SRC CAPACITY STUDY FAILURE	If a water system fails to complete a source capacity planning study required as part of an enforcement action

Risk Indicator Calculation Methodology:

- Source capacity violations - Identify systems that have had one or more source capacity violations within the past three years using the violation type code and analyte codes listed in Table A28.
- Service connection moratoriums (SCM) - Identify water systems that have had one or more SCM, based on referrals from State Water Board District staff, within the past three years.
    - Start Date & End Date
        - Historical SCM – have both the Start Date & End Date
        - Current (Active) SCM – have only Start Date

Threshold Determination

The State Water Board has developed a binary threshold for the Source Capacity Violations risk indicator. Any water systems that have not been able to meet source capacity water works standards within the last three years should receive risk points.

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. Risk indicator weights between 1 and 3 are also applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the maximum weight of 3 is suggested for the "Source Capacity Violations" risk indicator. Therefore, the minimum risk score for this indicator is 0 and the maximum risk score is 3. Table A29 summarizes the thresholds, score, and weights for Source Capacity Violations.

[74] This violation criterion is used for repeated, long-term water outages, consistent, repeated low-pressure event. This is not for routine main breaks or short-term outages.

Table A29: "Source Capacity Violations" Thresholds, Weights, & Scores

Threshold Number	Threshold	Score	Weight	Max Risk Score	Risk Level
0	**0** source capacity violations within the past 3 years; and **0** service connection moratoriums within the past 3 years.	0	N/A	0	None
1	**1 or more** source capacity violations within the past 3 years; or **1 or more** service connection moratoriums within the past 3 years.	1	3	3	High

Explore Water System Risk Indicator Performance
The distribution of how water systems have performed for this risk indicator is accessible using the hyperlink below. The results can be filtered by water system size (i.e., number of service connections).

Source Capacity Violations: https://tabsoft.co/3NgCawF

BOTTLED OR HAULED WATER RELIANCE

The purpose of this risk indicator is to identify water systems that have had to supplement or replace their source supply to meet customer demand with bottled water, and/or hauled water at any point within the past three years. A water system that is unable to meet the demand with their available sources due to water quality issues or source capacity challenges is at-risk of failing to provide water to the customers.

Calculation Methodology
Required Risk Indicator Data Points & Sources:

To identify water systems that have had reliance on bottled water and/or hauled water at any point within the past 3 years, the following data points from multiple sources were used.

- Internal State Water Board Interim Solution Data Spreadsheet: Division of Financial Assistance (DFA)
  - Type of Assistance in "Regional Project" tab
    - Bottled Water
    - Hauled Water
  - Category in "All other funding" tab
    - Bottled Water
    - Hauled Water

- Water Source Facility: SDWIS
  - Water Source Facility Name – any facility names containing "Hauled"; or

    - Water Source Facility Type Code
        - NN – Non-Piped, Non-Purchased
        - NP – Non-Piped, Purchased

- Drought Report Data Spreadsheet: Division of Drinking Water (DDW)
    - Actions taken in response to water outage or shortage
        - Bottled Water
        - Hauling Water

- Drought Projects Funding Commitments Data Spreadsheet[75]: Department of Water Resources (DWR)
    - Project Type - any project types containing "Bottled" and/or "Hauled"

Risk Indicator Calculation Methodology:

- Prepare DFA data – Identify water systems that have had one or more enrollments for receiving assistance of bottled water and/or hauled water. Some water systems may have multiple enrollments across different assistance types, funding sources and communities served.

- Prepare SDWIS data
    - Availability Codes reflect the availability for NN and NP facilities.
        - P – Permanent (the source is used all year round)
        - I – Interim (the source is used partly during the year)
        - E - Emergency (the source is used only during emergencies)

Table A30: Preparation of SDWIS Hauled Water Data

Availability Code	Rely on hauled water only?	Include in the dataset?
P – Permanent	Yes	Include
P – Permanent	No	Include if system has been under hauled water reliance within the past 3 years.
I – Interim	Yes	Include
I – Interim	No	Include if system has been under hauled water reliance within the past 3 years.
E – Emergency	Yes or No	Include if system is listed in DFA Interim Solution Data and DDW Drought Report

[75] DWR's funding commitments up to December 2021 were provided to the State Water Board. Any projects with a county applicant were excluded from the analysis because these projects are typically designed to support private domestic wells, not public water systems. It is important to note that after applying this filter only one applicant appeared to be a public water system; however, confirmation of its identity was not available because the applicant name did not closely align with any public water system in the State Water Board's databases. DWR does not track public water system applicants by PWSID, which is a unique identifier used by the State Water Board.

- Prepare DDW Drought Report Data – Identify water systems that have had bottled/hauled water in response to water outage or shortage due to drought.
- Combine two DFA spreadsheet tabs, SDWIS data and DDW Drought Report data.
- Remove any duplicate of the water systems to identify unique systems.

Threshold Determination

The State Water Board analyzed how water systems performed for this risk indicator by 2021 SAFER status: Failing: HR2W, At-Risk, Potentially At-Risk, and Not At-Risk. This analysis concluded that the majority of water systems that have relied on bottled water or hauled water over the last three years are either currently failing or at risk of failing (Table A31). Since there is a strong correlation between this risk indicator and failing, the State Water Board has developed a binary threshold of at least one or more occurrences.

Table A31: 2021 SAFER Status of Systems that Have Bottled Water or Hauled Water Reliance

TOTAL	Failing: HR2W List[76]	At-Risk	Potentially At-Risk	Not At-Risk
88	57 (65%)	18 (20%)	9 (10%)	4 (5%)

Risk Indicator Scoring & Weighting

Due the strong correlation between this risk indicator and failing, the State Water Board has determined that any water systems that has relied on bottled or hauled water over the last three years to supplement their sources should **automatically be classified as At-Risk** if they are not currently on the Failing: HR2W list.

Table A32: "Bottled or Hauled Water Reliance" Thresholds & Scores

Threshold Number	Threshold	Score	Weight	Max Risk Score	Risk Level
0	**0** occurrences of bottled water or hauled water reliance within the last three years.	0	N/A	0	None
1	**1 or more** occurrences of bottled water or hauled water reliance within the last three years.	Automatically At-Risk	N/A	N/A	Very High

Explore Water System Risk Indicator Performance

The distribution of how water systems have performed for this risk indicator is accessible using

[76] Failing: HR2W List retrieved from the State Water Board SAFER Clearinghouse database on January 3, 2022.

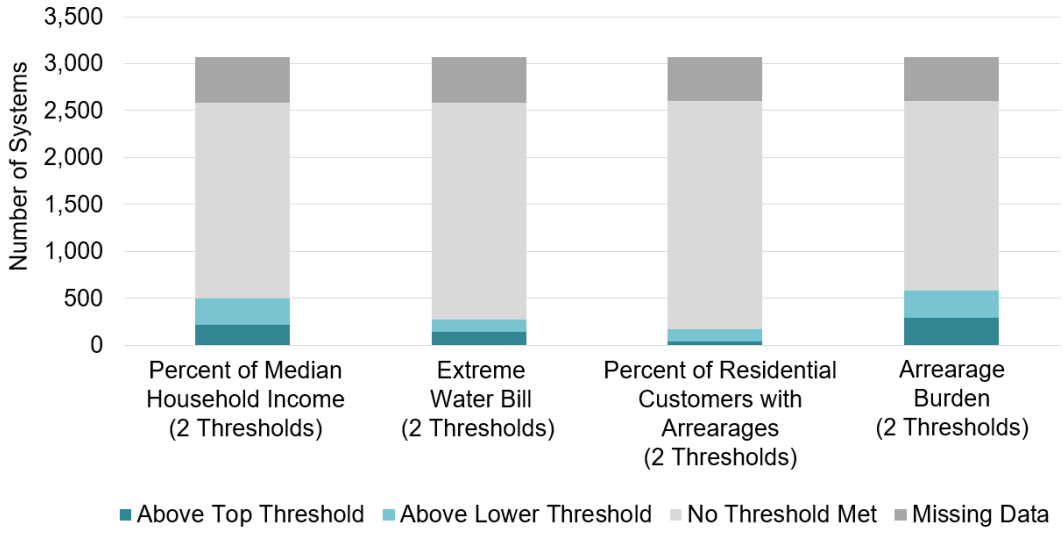
the hyperlink below. The results can be filtered by water system size (i.e., number of service connections).

Bottled or Hauled Water Reliance: https://tabsoft.co/3qvb8It

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 A11 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 A11: 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 six 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: 2019 U.S. Census Bureau's American Community Survey
- Drinking Water Customer Charges: 2020 Electronic Annual Report (EAR)
- Other Customer Charges: 2020 EAR

Average monthly drinking water customer charges are collected through the EAR. Historically this data has not been required for reporting leading to poor data coverage and accuracy issues. Extensive changes have been made to the 2020 Electronic Annual Report making reporting customer charges mandatory with checks in place to improve the data quality. In addition to the changes made to the EAR, over 600 water systems' customer charges were reviewed and edited manually by State Water Board staff.

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. 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 DFA's 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:

Equation A1: MHI Calculation

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

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 DFA 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 six HCF 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
%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[77] the thresholds determined by the State Water Board for this indicator.[78] Other states, including North Carolina,[79] 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 the Risk

[77] 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.

[78] 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

[79] 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%2020160317.pdf

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 A33 summarizes the thresholds, scores, and weight for this risk indicator.

Table A33: "Percent Median Household Income" Thresholds & Scores

Threshold Number	Threshold	Score	Weight	Max Risk Score	Risk Level
0	**Less than 1.5%**	0	N/A	0	None
1	**1.5% or greater**	0.75	3	2.25	Medium
2	**2.5% or greater**	1	3	3	High

Explore Water System Risk Indicator Performance
The distribution of how water systems have performed for this risk indicator is accessible using the hyperlink below. The results can be filtered by water system size (i.e., number of service connections).

Percent Median Household Income: https://tabsoft.co/3tO05Mc

EXTREME WATER BILL

This indicator measures drinking water customer charges that meet or exceed 150% of statewide average drinking water customer charges at the six hundred cubic feet (HCF) level of consumption.

Calculation Methodology
Required Risk Indicator Data Points & Sources:

- Drinking Water Customer Charges: 2020 EAR
- Other Customer Charges: 2020 EAR

Risk Indicator Calculation Methodology:

Extreme Water Bill for a water system is determined using Average Monthly six 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 service connections. Due to data quality concerns, water systems that reported less than $5 or greater than $500 in monthly customer charges for six HCF were excluded from the analysis and the calculated statewide average.

Threshold Determination
The State Water Board's AB 401 report[80] 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 six HCF.

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 the 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 A34 summarizes the thresholds, scores, and weight for this risk indicator.

Table A34: "Extreme Water Bill" Thresholds, Weights & Scores

Threshold Number	Threshold	Score	Weight	Max Risk Score	Risk Level
0	**Below 150%** of the statewide average.	0	N/A	0	None
1	**Greater than 150%** of the statewide average.	0.5	1	0.5	Medium
2	**Greater than 200%** of the statewide average.	1	1	1	High

Explore Water System Risk Indicator Performance
The distribution of how water systems have performed for this risk indicator is accessible using the hyperlink below. The results can be filtered by water system size (i.e., number of service connections).

Extreme Water Bill: https://tabsoft.co/3iGW1XM

PERCENTAGE OF RESIDENTIAL ARREARAGES

The purpose of this risk indicator is to identify water systems that have a high percentage of their residential customers that have not paid their water bill and are at least 60 days or more past due. The higher the percentage of residential customers, the more vulnerable the community is to affordability challenges.

[80] AB 401 Final Report
https://www.waterboards.ca.gov/water_issues/programs/conservation_portal/assistance/docs/ab401_report.pdf

Calculation Methodology
Required Risk Indicator Data Points & Sources:

- Total number of residential accounts in arrears: Drinking Water Arrearage Payment Program applicants (October through December 2021).
- Total number of residential accounts: SDWIS

Risk Indicator Calculation Methodology:

Equation A2: Percentage of Residential Arrearages

$$\frac{\textit{Total Number of Residential Accounts in Arrears}}{\textit{Total Number of Residential Accounts}}$$

Water systems that were included in an aggregated application for the Drinking Water Arrearage Payment Program, for example investor-owned utilities with multiple water systems, were excluded from the calculation of this risk indicator because the State Water Board is unable to disaggregate the number of residential accounts in arrears by individual public water system ID (PWSID).

Threshold Determination
An indicator threshold for the percent of residential arrearages, 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, the State Water Board utilized a 10% threshold for the risk indicator "% Shut-Offs for Non-Payment" in the 2021 Risk Assessment.[81] This risk indicator is similar in that it measured residential customers that were unable to pay their water bills and had their water shut-off. Therefore, the State Water Board has developed a tiered threshold for this indicator, drawing upon the threshold developed for "% Shut-Offs for Non-Payment."

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. Risk indicator weights between 1 and 3 are also applied to individual risk indicators. Based on feedback from an internal State Water Board, Division of Drinking Water workgroup, the weight of 2 is applied to the "Percentage of Residential Arrearages" risk indicator. Therefore, the minimum risk score for this indicator is 0 and the maximum risk score is 2. Table A35 summarizes the thresholds, score, and weights for Percentage of Residential Arrearages.

[81] The State Water Board is recommending the removal of the risk indicator "% Shut-Offs for Non-Payment" because there was an Executive Order that prohibited water shut-offs beginning March 4, 2020 through December 31, 2021. This information was therefore unavailable for the majority of 2020 and will not be collected by the State Water Board for 2021 annual reporting.

Table A35: "Percentage of Residential Arrearages" Thresholds, Weights, & Scores

Threshold Number	Threshold	Score	Weight	Max Risk Score	Risk Level
0	**0% to 9%** residential arrearages.	0	N/A	0	None
1	**10% to 29%** residential arrearages.	0.5	2	1	Medium
2	**30% to 100%** residential arrearages.	1	2	2	High

Explore Water System Risk Indicator Performance
The distribution of how water systems have performed for this risk indicator is accessible using the hyperlink below. The results can be filtered by water system size (i.e., number of service connections).

Percentage of Residential Arrearages: https://tabsoft.co/3uiHcQM

RESIDENTIAL ARREARAGE BURDEN

The purpose of this risk indicator is to identify water systems that would have a high residential arrearage burden if they were to distribute their residential arrearages accrued during the COVID-19 pandemic period (March 4, 2020 through June 15, 2021) across their total residential rate base. This indicator measures how large of a burden non-payment is across the water system's residential customers.

Calculation Methodology
Required Risk Indicator Data Points & Sources:

- Total outstanding residential arrears: Drinking Water Arrearage Payment Program applicants (October through December 2021).
- Total number of residential accounts: SDWIS

Risk Indicator Calculation Methodology:

Equation A3: Residential Arrearage Burden

$$\frac{\textit{Total Residential Arrearages } (\$)}{\textit{Total Number of Residential Accounts}}$$

Water systems that were included in an aggregated application for the Drinking Water Arrearage Payment Program were excluded from the calculation of this risk indicator because the State Water Board is unable to disaggregates total residential arrearages by individual PWSID.

Threshold Determination
An indicator threshold for residential arrearage burden, 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, the State Water Board adopted a similar tiered threshold utilized for the "Extreme Water Bill" affordability risk indicator, which utilizes an approach that compares how individual water systems are scoring to their peers, where data is available.

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. Risk indicator weights between 1 and 3 are also applied to individual risk indicators. Based on feedback from an internal State Water Board, Division of Drinking Water workgroup, the weight of 2 is applied to the "Residential Arrearage Burden" risk indicator. Therefore, the minimum risk score for this indicator is 0 and the maximum risk score is 2. Table A36 summarizes the thresholds, score, and weights for Residential Arrearage Burden.

Table A36: "Residential Arrearage Burden" Thresholds, Weights, & Scores

Threshold Number	Threshold	Score	Weight	Max Risk Score	Risk Level
0	**Below top 40%** of systems with residential arrearage burden.	0	N/A	0	None
1	**Top 40%** of systems with residential arrearage burden.	0.5	2	1	Medium
2	**Top 20%** of systems with residential arrearage burden.	1	2	2	High

Explore Water System Risk Indicator Performance
The distribution of how water systems have performed for this risk indicator is accessible using the hyperlink below. The results can be filtered by water system size (i.e., number of service connections).

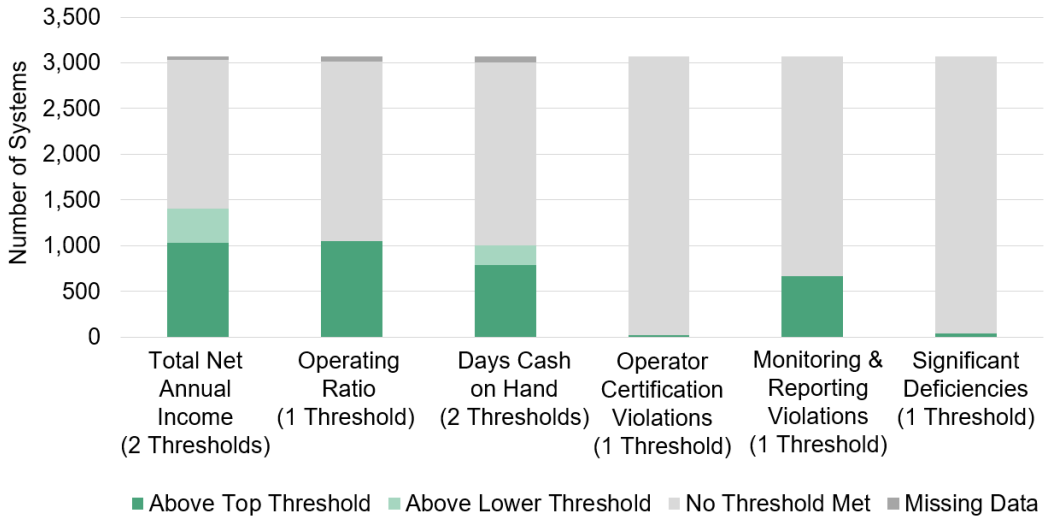
Residential Arrearage Burden: https://tabsoft.co/3wAoU07

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 A12 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 A12: Number of Systems Exceeding Thresholds for Each TMF Capacity Risk Indicator



OPERATOR CERTIFICATION VIOLATIONS

Water systems that do not have an appropriately certified water treatment or distribution operator will receive an operator certification violation. 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
Peer-reviewed studies suggest that the absence of a certified operator is associated with water

system failure.[82] Moreover, operator certification violations are an established threshold for additional regulatory oversight by states, such as Illinois.[83] 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 the 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 A37 summarizes the thresholds, scores, and weight for this risk indicator.

Table A37: "Operator Certification Violations" Thresholds, Weights, & Scores

Threshold Number	Threshold	Score	Weight	Max Risk Score	Risk Level
0	**0** Operator Certification violations over the last three years.	0	N/A	0	None
1	**1 or more** Operator Certification violations over the last three years.	1	3	3	High

Explore Water System Risk Indicator Performance

The distribution of how water systems have performed for this risk indicator is accessible using the hyperlink below. The results can be filtered by water system size (i.e., number of service connections).

Operator Certification Violations: https://tabsoft.co/36U2iNt

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 legally prescribed time frame. A water system that fails to perform required monitoring for a group of chemicals (such as

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

[83] 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

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 A38: 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)
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

Violation Type Code	SDWIS Violation Name
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 A38. This excludes MCL and TT related Monitoring & Reporting violations described below that are included in the expanded HR2W list criteria:
  - Systems 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
The State Water Board has developed a threshold for Monitoring & Reporting violations (related to an MCL or Treatment Technique) as criteria for the Failing: HR2W list. The Failing: 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 developed a slightly modified version of the Failing: HR2W list criteria threshold. Systems that have had two or more Monitoring & Reporting violations over the last three years are more at-risk.[84]

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 the 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

[84] Systems that meet the Failing: HR2W list criteria are not included in the Risk Assessment results.

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 A39 summarizes the thresholds, scores, and weight for this risk indicator.

Table A39: "Monitoring and Reporting Violations" Thresholds, Weights, & Scores

Threshold Number	Threshold	Score	Weight	Max Risk Score	Risk Level
0	**1 or less** Monitoring & Reporting violations over the last three years.	0	N/A	0	None
1	**2 or more** Monitoring & Reporting violations over the last three years.	1	2	2	High

Explore Water System Risk Indicator Performance

The distribution of how water systems have performed for this risk indicator is accessible using the hyperlink below. The results can be filtered by water system size (i.e., number of service connections).

Monitoring and Reporting Violations: https://tabsoft.co/3NwnaLe

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 corrective 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
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.[85] Finally, similar measures of significant deficiencies are used as an established threshold of concern by states such as Alaska and Nevada,[86] Connecticut,[87] and New Mexico,[88] 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 the 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

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

[86] 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

[87] 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

[88] 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 A40 summarizes the thresholds, scores, and weight for this risk indicator.

Table A40: "Significant Deficiencies" Thresholds, Weights, & Scores

Threshold Number	Threshold	Score	Weight	Max Risk Score	Risk Level
0	**0** Significant Deficiencies over the last three years.	0	N/A	0	None
1	**1 or more** Significant Deficiencies over the last three years.	1	3	3	High

Explore Water System Risk Indicator Performance
The distribution of how water systems have performed for this risk indicator is accessible using the hyperlink below. The results can be filtered by water system size (i.e., number of service connections).

Significant Deficiencies: https://tabsoft.co/3NqSqeJ

OPERATING RATIO

Operating Ratio is a measure of whether a water system's revenues are sufficient to cover the costs of operating the water system. Specifically, "Operating Ratio" is a ratio of the water system's annual revenues compared to annual operating expenses. To be self-supporting, a water system should have at least as much annual revenue as it has operating expenses, e.g., an operating ratio equal to or greater than 1.0. The operating ratio does not include planned investments in future years. Therefore, a water system should collect revenues greater than expenses to accommodate for future investments by building up their financial reserves.

Annual Revenue: includes total annual revenues generated from customer charges and fees (meter fees, base service charges, fixed charges, late fees, penalties, shutoff fees, reconnection fees, etc.); intergovernmental fund transfers (i.e., city or county tax revenues etc.); revenues generated through rent, land lease, or other revenue-generating activities.

Operations and Maintenance Expenses: expenses incurred during the system's normal operation during the reporting year. It may include salaries, benefits for employees, utility bills, system repair and maintenance, supplies (e.g., treatment chemicals), insurance, water purchased for resale, etc.

Calculation Methodology

Required Risk Indicator Data Points & Sources:

- 2020 Electronic Annual Report, Total Annual Revenue – Section 8B1.8
- Total Annual Revenue for the Reporting Year = Residential Water Rate Revenue (B1.1) + Non-Residential Water Rate Revenue (B1.2) + Residential Fees and Charges Revenue (B1.3) + Non-Residential Fees and Charges Revenue (B1.4) + Interfund or Governmental Revenue (B1.5.2) – Interfund or Government Revenue Lost (B1.6) + Other Revenue (B1.7)
- 2020 Electronic Annual Report, Total Annual Operating Costs – Section 8B2.1

Risk Indicator Calculation Methodology:

Equation A4: Operating Ratio

$$\frac{Annual\ Revenue\ (\$)}{Annual\ Operating\ Expenses\ (\$)}$$

Threshold Determination

The threshold for this risk indicator was developed through an analysis of industry, academic, and state publications (Table A41). Feedback was also solicited from the Division of Drinking Water's internal stakeholder group. Many have suggested that a viable water system should have a current ratio of at least 1 or greater. An operating ratio of 1 is the lowest level for a self-supporting water system. A ratio below one means expenses are higher than revenues. If a water system has outstanding debt, an operating ratio above one is required. Usually, the higher the debt/equity ratio, the higher the operating ratio required.

Table A41: Industry Recommended Operating Ratio

Organization	Recommended Operating Ratio	Resources
Community Resource Group, Inc.	1	Small System Guide: Understanding Utility Financial Statements[89]
University of North Carolina Environmental Finance Center	≥ 1.2	California Small Water Systems Rates Dashboard[90]
Rural Community Assistance Partnership (RCAP)	≥ 1	Financial Management Guide[91]

[89] See Small System Guide: Understanding Utility Financial Statements (2011). Community Resource Group, Inc.: https://www.in.gov/iurc/files/small_system_guide_to_understanding_financial_statments.pdf

[90] See California Small Water Systems Rates Dashboard (2021). Environmental Finance Center at the University of North Carolina, Chapel Hill: https://dashboards.efc.sog.unc.edu/ca

[91] The Basics of Financial Management for Small-community Utilities http://www.rcapsolutions.org/wp-content/uploads/2013/06/RCAP-Financial-Management-Guide.pdf

Organization	Recommended Operating Ratio	Resources
University of Georgia	≥ 1.2	Evaluating Water System Financial Performance and Financing Options[92]
Brookings	> 1	Appendix B: Investing in water: Comparing utility finances and economic concerns across U.S. cities[93]
Arizona Department of Environmental Quality	≥ 1	Capacity Development Application for a New Public Water System[94]
State of Florida Public Service Commission	≥ 1.25	Docket No. 20 180141-WS - Proposed adoption of Rule 25-30.4575, F.A.C., Operating Ratio Methodology[95]

Based on the industry standards summarized above, the State Water Board adopted a binary threshold for "Operating Ratio" as summarized in Table A42.

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. Risk indicator weights between 1 and 3 are also applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the minimum weight of 1 is suggested for the "Operating Ratio" risk indicator due to data quality concerns. Therefore, the minimum risk score for this indicator is 0 and the maximum risk score is 1. Table A42 summarizes the thresholds, score, and weights for Operating Ratio.

[92] See Jeffrey L. Jordan. Issue 3: Evaluating Water System Financial Performance and Financing Options. University of Georgia Department of Agricultural & Applied Economics. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.195.4657&rep=rep1&type=pdf

[93] See Joseph W. Kane (2016). Investing in water: Comparing utility finances and economic concerns across U.S. cities. Brookings. https://www.brookings.edu/research/investing-in-water-comparing-utility-finances-and-economic-concerns-across-u-s-cities/

[94] See Capacity Development Application for a New Public Water System. Arizona Department of Environmental Quality. https://legacy.azdeq.gov/environ/water/dw/download/appe.pdf

[95] See Office of the General Counsel (Harper), Division of Accounting and Finance (Galloway), Division of Economics (Guffey) (2018). Docket No. 20 180141-WS - Proposed adoption of Rule 25-30.4575, F.A.C., Operating Ratio Methodology. State of Florida Public Service Commission http://www.psc.state.fl.us/library/filings/2018/06300-2018/06300-2018.pdf

Table A42: "Operating Ratio" Thresholds, Weights, & Scores

Threshold Number	Threshold	Score	Weight	Max Risk Score	Risk Level
0	**1 or greater**	0	N/A	0	None
1	**Less than 1**	1	1	1	High

Explore Water System Risk Indicator Performance
The distribution of how water systems have performed for this risk indicator is accessible using the hyperlink below. The results can be filtered by water system size (i.e., number of service connections).

Operating Ratio: https://tabsoft.co/3IBV2CW

TOTAL ANNUAL INCOME

The purpose of this risk indicator is to identify water systems whose total annual revenue is unable to cover their total annual expenses. A water system should generate enough revenue to cover all incurred expenses (including operational expenses) throughout the year. Total Net Annual Income of a water system should be a positive (+) value. If more money is spent than is brought in, then the water system will have to make adjustments in order to maintain operations. If the expenditures are outpacing revenue too quickly, then the water system may have to cut costs or decrease its level of service. Reserves or available cash savings allows for a financial cushion in times when expenses are greater than revenues.

A water system may generate enough revenue to cover their annual operating and maintenance costs (operating ratio = 1 or greater), but in some cases revenues may fall short in covering a water system's total annual expenses. These additional expenses that fall outside of general operating and maintenance costs typically include debt/loan repayments, new/upgraded infrastructure investments, unforeseen emergency costs, etc.

Calculation Methodology
Required Risk Indicator Data Points & Sources:

- 2020 Electronic Annual Report, Total Annual Revenue - 8B1.8
- 2020 Electronic Annual Report, Total Annual Expenses - 8B2.5

Risk Indicator Calculation Methodology:

Equation A5: Total Annual Income

$$\boldsymbol{Total\ Annual\ Income = Total\ Annual\ Revenue - Total\ Annual\ Expenses}$$

Threshold Determination
Water systems may have emergencies they must respond to or a large capital investment that occurs within a year which may lead to negative total annual income. Based on industry standards and recommendations for State Water Board engineers, the tiered thresholds in Table A43 were developed for Total Annual Income.

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. Risk indicator weights between 1 and 3 are also applied to individual risk indicators. Based on feedback from the State Water Board's engineers, the minimum weight of 1 is suggested for the "Total Annual Income" risk indicator due to data quality concerns. Therefore, the minimum risk score for this indicator is 0 and the maximum risk score is 1. Table A43 summarizes the thresholds, score, and weights for Total Annual Income.

Table A43: "Total Annual Income" Thresholds, Weights, & Scores

Threshold Number	Threshold	Score	Weight	Max Risk Score	Risk Level
0	**Greater than $0** total annual income	0	N/A	0	None
1	**$0** total annual income	0.5	1	0.5	Medium
2	**Less than $0** total annual income	1	1	1	High

Explore Water System Risk Indicator Performance
The distribution of how water systems have performed for this risk indicator is accessible using the hyperlink below. The results can be filtered by water system size (i.e., number of service connections).

Total Annual Income: https://tabsoft.co/3801FCv

DAYS CASH ON HAND

Days cash on hand is the estimated number of days a water system can cover its daily operations and maintenance costs, relying only on their current cash or liquid reserves, before running out of cash. This metric measures a system's financial capacity and is an estimate of how long a system can operate *without* new revenues or additional funding. It is a helpful measure of how long a system can operate if it has a sudden and dramatic reduction in

operating income, perhaps from a large customer leaving or an environmental emergency (fire, drought restrictions, etc.).[96]

According to Moody's definition, "Cash is the most important resource utilities have to meet expenses, deal with emergencies, and survive temporary disruptions to cash flow without missing required payments."[97] Days cash on hand is a ratio that is calculated by dividing a water system's unrestricted cash by the system's estimated daily expenses. This calculation approach allows for the comparison of water systems of different sizes by accounting for differences in operational expenses (Table A44). The higher the number, the more days an organization can sustain its operations without any additional cash inflows.

Table A44: Comparison Example Between Large and Small Water System

Large Water System	Small Water System
$\frac{Unrestricted\ Cash: \$\mathbf{5,000,000}}{Average\ Daily\ Operation\ Expenses: \$\mathbf{100,000}}$	$\frac{Unrestricted\ Cash: \$\mathbf{20,000}}{Average\ Daily\ Operation\ Expenses: \$\mathbf{400}}$
Days Cash on Hand = **50 Days**	Days Cash on Hand = **50 Days**

Calculation Methodology

Required Risk Indicator Data Points & Sources:

- 2020 Electronic Annual Report, Section 8B.10

Risk Indicator Calculation Methodology:

- Risk indicator calculation formula (water system calculated and reported in 2020 Electronic Annual Report):
  - Calculate water system's **daily operating expenses**: [Annual Operating Expenses] / [365]
  - Calculate **days cash on hand**: [Total Unrestricted Cash] / [Daily Operating Expenses]

Equation A6: Days Cash on Hand

$$\frac{Unrestricted\ Cash\ (\$)}{Daily\ Operating\ Expenses\ (\$)}$$

[96] See Glenn Barnes (2015). Key Financial Indicators for Water and Wastewater Systems: Days of Cash on Hand. Environmental Finance Center at the University of North Carolina. https://efc.web.unc.edu/2015/06/24/days-cash-on-hand/

[97] See Edward Damutz, Leonard Jones, (2017). Moody's Utility Revenue Bond Rating Methodology. Moody's Investors Services. https://www.moodys.com/research/Moodys-updates-its-methodology-for-rating-US-municipal-utility-revenue--PR_373942

Threshold Determination

The thresholds for the "Days Cash on Hand" risk indicator were developed by assessing peer-reviewed publications and soliciting feedback from the State Water Board's Division of Drinking Water internal stakeholder group. Table A45 and Table A46 summarize recommendations made by industry groups and rating agencies for minimum days cash on hand.

Table A45: Industry Recommended Days Cash on Hand

Organization	Recommended Days Cash on Hand	Resources
University of North Carolina Environmental Finance Center	90+ days	California Small Water Systems Rates Dashboard[98]
Utility Financial Solutions, LLC	90+ days; Higher bond rating 200+ days	Managing Your Community's Stimulus Money[99]
International City/County Management Association (ICMA)	30 - 60 days	Capital Budgeting and Finance: A Guide for Local Governments[100]
Government Finance Officers Association	45+ days	Overview of GFOA's Best Practices in Budgeting[101]
American Water Works Association	270 - 365 days	Developing a New Framework for Household Affordability and Financial Capability Assessment in the Water Sector[102]

[98] See California Small Water Systems Rates Dashboard (2021). Environmental Finance Center at the University of North Carolina, Chapel Hill. https://dashboards.efc.sog.unc.edu/ca

[99] See Sally Duffy, P.E., Ian Robinson, Dawn Lund (2021). Managing Your Community's Stimulus Money. MI - AWWA, MWEA, and MRWA. https://cdn.ymaws.com/www.mi-water.org/resource/resmgr/docs/Managing_Stimulus_webinar_07.pdf

[100] See Robert L. (Bob) Bland, Michael R. Overton, (2019). A Budgeting Guide for Local Government, Fourth Edition. ICMA. https://icma.org/publications/budgeting-guide-local-government-fourth-edition

[101] See John Fishbein (2019). Overview of GFOA's Best Practices in Budgeting. Technical Services Center, Government Finance Officers Association (GFOA). https://nesgfoa.org/wp-content/uploads/2019/05/overview_of_gfoas_best_practices_in_budgeting_april_4_2019.pdf

[102] See R. Raucher, E. Rothstein, J. Mastracchio (2017): Developing a New Framework for Household Affordability and Financial Capability Assessment in the Water Sector. The American Water Works Association (AWWA). https://www.awwa.org/Portals/0/AWWA/Government/DevelopingNewFrameworkForAffordabilityReport.pdf

Table A46: Financial Scoring Criteria for Major Rating Agencies

Moody's[103]					
Aaa	Aa	A	Baa	Ba	B & Below
> 250 days	250 ≥ n > 150 days	250 ≥ n > 150 days	150 ≥ n > 35 days	35 ≥ n > 15 days	≤ 7 days

S&P Global[104]					
1: Extremely Strong	2: Very Strong	3: Strong	4: Adequate	5: Vulnerable	6: Highly Vulnerable
> 150 days	150 ≥ n > 90 days	90 ≥ n > 60 days	60 ≥ n > 30 days	15 ≥ n > 30 days	≤ 15 days

Fitch[105] Liquidity Cushion		
Stronger	Neutral	Weaker
> 120 days	120 ≥ n > 90 days	< 90 days

Based on the industry standards summarized above, the State Water Board developed a tiered threshold for "Days Cash on Hand" as summarized in Table A47.

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. Risk indicator weights between 1 and 3 are also applied to individual risk indicators. Based on feedback from the State Water Board's Division of Drinking Water internal stakeholder group, the minimum weight of 1 is suggested for the "Days Cash on Hand" risk indicator. Table A47 summarizes the thresholds, score, and weights for Days Cash on Hand.

Table A47: "Days Cash on Hand" Thresholds, Weights, & Scores

Threshold Number	Threshold	Score	Weight	Max Risk Score	Risk Level
0	**90 days or more** cash on hand.	0	N/A	0	None

[103] See Moody's Investors Service, US Municipal Utility Revenue Debt. October 19, 2017. https://www.moodys.com/researchdocumentcontentpage.aspx?docid=PBM_1095545

[104] S&P Global, Criteria | Governments | U.S. Public Finance: U.S. Public Finance Waterworks, Sanitary Sewer, And Drainage Utility Systems: Rating Methodology and Assumptions. January 19, 2016; last update October 11, 2021; Accessed December 30, 2021 at https://disclosure.spglobal.com/ratings/en/regulatory/article/-/view/type/HTML/id/2735324

[105] Fitch Ratings, U.S. Water and Sewer Rating Criteria, March 18, 2021. https://www.fitchratings.com/research/us-public-finance/us-water-sewer-rating-criteria-18-03-2021

Threshold Number	Threshold	Score	Weight	Max Risk Score	Risk Level
1	**Less than 90 days** cash on hand.	0.5	1	0.5	Medium
2	**Less than 30 days** cash on hand.	1	1	1	High

Explore Water System Risk Indicator Performance
The distribution of how water systems have performed for this risk indicator is accessible using the hyperlink below. The results can be filtered by water system size (i.e., number of service connections).

Day Cash on Hand: https://tabsoft.co/3JI5n1u