2021

DRINKING WATER COST ASSESSMENT & GAP ANALYSIS

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

The Cost Assessment & Gap Analysis is a component of the Needs Assessment. Access full Needs Assessment Report:

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

CALIFORNIA Water Boards

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CONTENTS

DEFINITION OF TERMS

This report includes the following defined terms.

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

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

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

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

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

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

"**California Native American Tribe**" means Federally recognized California Native American Tribes, and non-Federally recognized Native American Tribes on the contact list maintained by the Native American Heritage Commission for the purposes of Chapter 905 of the Statutes of 2004. (Health & Saf. Code, § 116766, subd. (c)(1).) Typically, drinking water systems for Federally recognized tribes fall under the regulatory jurisdiction of the United States Environmental Protection Agency (U.S. EPA), while public water systems operated by non-Federally recognized tribes currently fall under the jurisdiction of the State Water Board.

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

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

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

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

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

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

“**Disadvantaged community**” or “**DAC**” means the entire service area of a community water system, or a community therein, in which the median household income is less than 80% of the statewide annual median household income level. (Health & Saf. Code, § 116275, subd. (aa).)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

“**Public water system**” or “**PWS**” means a system for the provision to the public of water for human consumption through pipes or other constructed conveyances that has 15 or more service connections or regularly serves at least 25 individuals daily at least 60 days out of the year. A PWS includes any collection, pretreatment, treatment, storage, and distribution facilities under control of the operator of the system that are used primarily in connection with the system; any collection or pretreatment storage facilities not under the control of the operator that are used primarily in connection with the system; and any water system that treats water on behalf of one or more public water systems for the purpose of rendering it safe for human consumption. (Health & Saf. Code, § 116275, subd. (h).)

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

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

“**Risk Assessment**” means the identification of public water systems, with a focus on community water systems and K-12 schools, that may be at risk of failing to provide an adequate supply of safe drinking water. It also includes an estimate of the number of households that are served by domestic wells or state small water systems in areas that are at high-risk for groundwater contamination. Different Risk Assessment methodologies have been developed for different system types: (1) public water systems; (2) state small water systems and domestic wells; and (3) tribal water systems. (Health & Saf. Code, § 116769)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

COST ASSESSMENT RESULTS

OVERVIEW

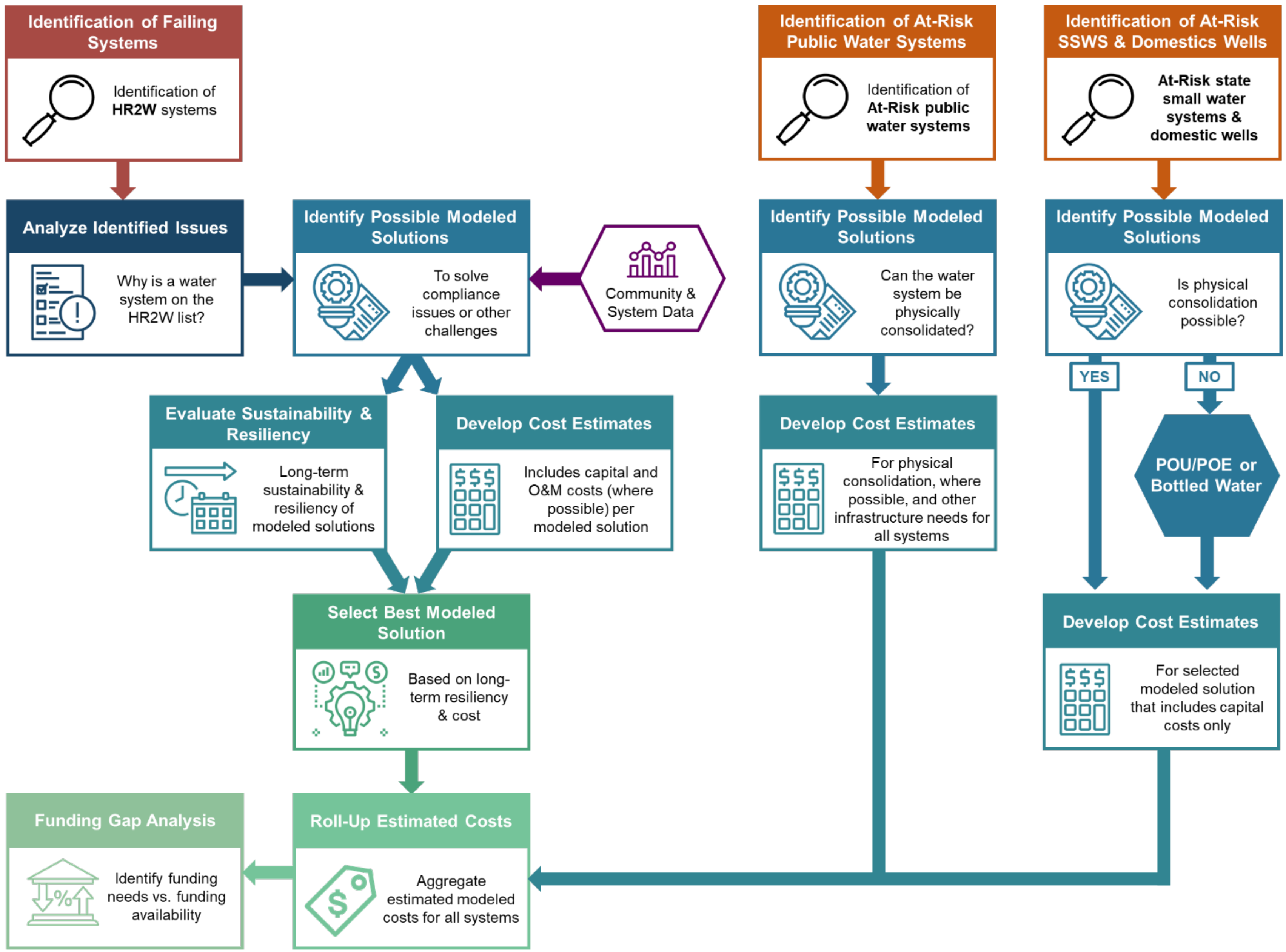
The State Water Board, in partnership with UCLA, Corona, and Sacramento State University OWP, developed a Cost Assessment methodology for estimating the cost of interim and long-term solutions for HR2W list and At-Risk public water systems, tribal water systems (Appendix F), At-Risk state small water systems, and domestic wells (Figure 34). The scope of the Cost Assessment is to assess the overall need of the systems analyzed by the SAFER Program. The estimated costs and resulting Gap Analysis will be utilized to inform the broader demands of the SAFER Program as well as the annual funding needs for the Safe and Affordable Drinking Water Fund. The embedded assumptions and cost estimates detailed in this report are purely for the purposes of the Needs Assessment. Local solutions and actual costs will vary from system to system and will depend on site-specific details. Therefore, the Cost Assessment will not be used to inform site-specific decisions but rather give an informative analysis on a statewide basis.

COST ASSESSMENT MODEL

Development of the Cost Assessment Model comprised of multiple stages between September 2019 and March 2021, each of which were detailed in publicly-available white papers, presented at public webinars, the public feedback from which was incorporated into the final Cost Assessment Model methodology and results. A brief summary of the Cost Assessment Model is provided below, while a detailed description is provided in Appendix C. Attachment C5 has more detailed information on the outcomes of the Cost Assessment.[1]

[1] Attachment C5: Additional Cost Assessment Results & Regionalization Analysis https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c5.pdf

Figure 34: Cost Assessment Model Process



Water Systems & Domestic Wells Assessed

The Cost Assessment models potential solution costs for HR2W list systems, At-Risk public water systems (PWSs), as well as At-Risk state small water systems (SSWSs) and At-Risk domestic wells. Table 15 documents the counts of different system types and domestic wells on the dates that they were included in the 2021 Cost Assessment. Water system compliance fluctuates and therefore this report represents a snapshot in time used to provide a comprehensive statewide estimate. The total number of systems, by system type, differ from the list of systems included in the Risk Assessment and Affordability Assessment results sections due to the timing requirements necessary to complete the Cost Assessment. Therefore, earlier lists of systems were utilized for this assessment.

Table 15: Summary of HR2W List & At-Risk Systems Included in the Cost Assessment

System Type	Total Systems	Notes
HR2W	305	Includes HR2W list systems as of 12/1/2020
At-Risk Public Water System (PWS)	630	Includes At-Risk and Expanded HR2W list systems as of 1/21/2021
At-Risk State Small Water System (SSWS)	455[2]	Monterey County SSWSs are based on actual water quality data, other counties' SSWSs are based on GAMA Model as of 9/21/2020
At-Risk Domestic Wells	62,607	Based on GAMA Model as of 9/21/2020

Possible Solutions Considered

The Cost Assessment considered various potential modeled solutions for HR2W list and At-Risk systems and domestic wells. Below are brief descriptions of the potential modeled solutions and Table 16 summarizes the number of potential solutions considered by water system type.

Physical Consolidation: The physical connection of two or more water systems that are geographically close. This solution was modeled for:

- HR2W list systems, At-Risk PWS, At-Risk SSWS, & At-Risk domestic wells.

Treatment: An infrastructure solution used to lower the concentration of contaminants that exceed water quality standards to ensure compliance. For the full list of treatment solutions considered, please refer to Appendix C. Treatment solutions were modeled for:

[2] The number of At-Risk state small water systems and domestic wells in the long-term solutions cost analysis is different than the number in the Risk Assessment results and the interim solutions cost analysis because the data for the long term cost was based on the GAMA model for the six contaminants that were available at the time the data was used. The interim solutions cost model was based on a later GAMA model that has all contaminants with an MCL.

- HR2W list systems only.

POU/POE: Point-of-use (POU) or point-of-entry (POE) treatment technologies are used to address contaminants that exceed water quality standards to ensure compliance, when other solutions are not cost effective or may be infeasible to maintain for a very small community. This solution was modeled for:

- HR2W list systems (200 connections or less), At-Risk SSWS, & At-Risk domestic wells.

Other Essential Infrastructure (OEI): A broad category of additional needed infrastructure for the successful implementation of the long-term modeled solution and to enhance system sustainability that includes storage tanks, new wells, well replacement, upgraded electrical, added backup power, replacement of distribution system, additional meters, and land acquisition. A percentage of these additional solutions were modeled for the system types below and applied to the total modeled cost:

- HR2W list systems & At-Risk PWSs.

Operations & Maintenance (O&M): Ongoing, day-to-day O&M of a treatment system, including operator labor. This solution was modeled for:

- HR2W list systems only.

Interim or Emergency Solutions: Due to data limitations for other potential interim solutions, only bottled water and POU and POE interim treatment, including the O&M costs for maintaining a temporary installment of POU/POE systems, were assessed. These solutions were modeled for:

- HR2W list systems, At-Risk SSWSs, & At-Risk domestic wells.

Technical Assistance (TA): A broad category of support to assist water system operators and managers with planning, construction projects, financial management and O&M tasks. This solution was modeled for:

- HR2W list systems & At-Risk PWSs.

Table 16: Frequency of Modeled Long-Term Solution Type Considered

System Type	# of Systems	Treatment	Physical Consolidation	POU/POE	OEI & TA
HR2W	305	305 (100%)	107 (35%)	194 (64%)	305 (100%)
At-Risk PWS	630	N/A	234 (37%)	N/A	630 (100%)
At-Risk SSWS	455	N/A	262 (58%)	455 (100%)	N/A
At-Risk Domestic Wells	62,607	N/A	25,696 (41%)	62,607 (100%)	N/A

Interim and/or emergency modeled solutions were only assessed for HR2W list systems and At-Risk SSWSs and domestic wells, as shown in Table 17 below. Interim modeled solutions were not calculated for At-Risk PWSs. Due to the timing constraints of the Cost Assessment Model development process, the interim modeled solutions were assessed for the inventory of HR2W list[3] and At-Risk SSWSs and domestic wells that were derived from the Risk Assessment results.[4]

Table 17: Frequency of Modeled Interim Solution Types Considered

System Type	# of Systems	POU	POE	POU & POE	Bottled Water
HR2W list	343	273 (80%)	273 (80%)	273 (80%)	343 (100%)
At-Risk SWSS	611	611 (100%)	611 (100%)	611 (100%)	611 (100%)
At-Risk Domestic Wells	77,569	77,569 (100%)	77,569 (100%)	77,569 (100%)	77,569 (100%)

Evaluating Possible Modeled Solutions

For some systems, the Cost Assessment Model identified multiple potential solutions based on the system's identified challenges and additional site-specific information. For these systems, the Cost Assessment Model needed to select one of the potential model solutions for the aggregated cost estimate. For the HR2W list systems, the State Water Board recognized that the lowest-cost model solution may not always be the best long-term solution for a system and the community it serves. Therefore, a sustainability and resiliency assessment (SRA) was used to narrow down the potential modeled solutions per system by evaluating a set of sustainability metrics: O&M Cost per Connection, Relative Operational Difficulty, Operator Training Requirements, and Waste Stream Generation (refer to Appendix C and Attachment C4 for additional details).[5]

Selecting Modeled Solutions for Aggregated Cost Estimate

Long-Term Modeled Solutions

The resulting SRA scores were then compared against solution costs to select one modeled solutioned (the "selected modeled solution") for each system. For example, of the 107 HR2W list water systems where physical consolidation was a potential modeled solution, the SRA and cost analysis indicated that this was the best modeled solution for 61 (57%) systems. The costs for HR2W and At-Risk consolidations utilize a one-water system to one-water system

[3] HR2W list of water systems from 12.21.2020. The long-term Cost Assessment Model utilizes the HR2W list of systems from 12.02.2020.

[4] The long-term Cost Assessment Model utilizes an older set of At-Risk PWSs, SSWSs, and domestic wells. The most notable difference is the number of At-Risk domestic wells 77,569 for interim modeled solutions vs. 62,607 for long-term modeled solutions.

[5] Attachment C4: Sustainability and Resiliency Assessment
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c4.pdf

approach, which may make some consolidations unaffordable. More information on cost reductions that can occur as a result of regional cost estimates for consolidation models is discussed below and Appendix C but not utilized in this iteration of the Cost Assessment. As a result, few consolidations and more POU/POE devices may have been selected during the assessment.

The costs for the selected modeled solutions were then used for the aggregated cost estimates presented in this report. Appendix C and Attachment C4 provide additional details of the SRA methodology and the model solution selection criteria which is based on the SRA score and costs estimates.[6] The selected solution counts are summarized in Table 18.

Table 18: Count of Selected Modeled Solution

System Type	# of Systems	Treatment	Physical Consol.	POU/ POE	OEI & TA	No Solution
HR2W list	305	138 (45%)	61 (20%)	106 (35%)	305 (100%)	0
At-Risk PWS	630	N/A	145 (23%)	N/A	630 (100%)	0
At-Risk SSWS	455	N/A	142 (31%)	303 (67%)	N/A	10[7] (2%)
At-Risk Domestic Well	62,607	N/A	25,696 (41%)	36,911[8] (59%)	N/A	0

Interim Modeled Solutions

Due to sustainability concerns, bottled water was only assigned in the cost estimation modeling as an interim solution if POU or POE was deemed infeasible from a treatment or monitoring standpoint. The full list of contaminants for which these treatment technologies were deemed sufficient for water quality compliance was manually determined in conjunction with State Water Board staff, and the list is provided in Appendix C. For example, high concentrations of nitrate (above 25 mg/L) cannot be effectively removed to regulatory standards by POU devices. Bacteriological growth, hard water, or the presence of iron or manganese may also cause issues with POU membrane fouling.

For HR2W list systems, POU, POE or a combination of the two technologies was thus assigned in every case where these technologies were appropriate and the system had 200

[6] Attachment C4: Sustainability and Resiliency Assessment https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c4.pdf

[7] Nitrate in 10 Monterey County systems has been measured above 25 mg/L as N, so POU is not considered a viable treatment alternative.

[8] Nitrate modeled above 25 mg/L as N in 1,216 domestic wells and 15 SSWS. POU treatment is not a viable option if the nitrate concentration is this high. Water quality samples should be collected to determine which sources are above this threshold. POU treatment has been budgeted as the modeled solution.

connections or less, as this system size was deemed in the model to be the maximum practical for device monitoring purposes. Because there was no connection size concern with At-Risk SSWSs and domestic wells, bottled water was only assigned in the estimation as an interim solution for these system types if POU or POE was infeasible from a treatment standpoint.

Based on the model decision criteria outlined above, Table 19 shows that nearly 43% of HR2W list systems were assigned bottled water as an interim modeled solution in the Cost Assessment. However, only 4% - 5% of At-Risk SSWSs and domestic wells were assigned bottled water as an interim solution.

Table 19: Interim Solutions Estimated by System Type[9]

System Type	# of Systems	POU	POE	POU & POE	Bottled Water
HR2W list	343	139 (41%)	37 (12%)	20 (6%)	147 (43%)
At-Risk SWSS	496	382 (77%)	30 (6%)	61 (12%)	23 (5%)
At-Risk Domestic Wells	59,366	39,656 (67%)	8,731 (15%)	7,501(13%)	3,478 (6%)

COST ESTIMATION LEVEL OF ACCURACY

It is important to note that the long-term Cost Assessment results summarized in the subsequent section correspond with a Class 5 cost estimate as defined by Association for the Advancement of Cost Engineering (AACE) International.[10] Class 5 cost estimates are considered appropriate for screening level efforts, such as the Cost Assessment, and have a level of accuracy ranging from -20% to -50% on the low end and +30% to +100% on the high end. The full range of estimate is thus -50% to +100%. A Class 5 cost estimate is standard for screening construction project concepts. These costs are for budgetary purposes only. A more site specific and detailed assessment will be needed to refine the costs and select a local solution that is most appropriate.

For the recommended long-term modeled solution costs, a point estimate of the cost estimates is sometimes shown; however, it is important the reader view each value with the accuracy in mind. For example, if a cost of $100 is presented, the corresponding range of anticipated costs is $50 to $200. Costs have been rounded to three significant figures in many cases so that the cost accuracy is not overrepresented.

[9] A total of 77,569 domestic wells and 611 SWSSs were analyzed to determine interim solution cost. Any domestic well or SWSSs with a recommended POU or POE filter combination interim solution that matches the recommended filter long term solution were excluded. The domestic wells and SWSSs in this analysis are in high risk aquifer risk map sections placing them at priority for long term solution spending.

[10] AACE International Recommended Practice No. 17R-97 Cost Estimate Classification System, TCM Framework: 7.3 - Cost Estimating and Budgeting, Rev. August 7, 2020.

STATEWIDE CAPITAL COST ESTIMATE

The capital cost range for the selected long-term modeled solutions, including OEI needs is shown in Table 20. Treatment options were not considered for At-Risk PWSs. OEI needs costs were applied to *all* HR2W list and At-Risk PWSs (why costs are high). Table 21 shows the average cost per connection for the selected modeled solutions.

Table 20: Selected Modeled Solution Costs, Excluding O&M, by System Type (in $ Millions)

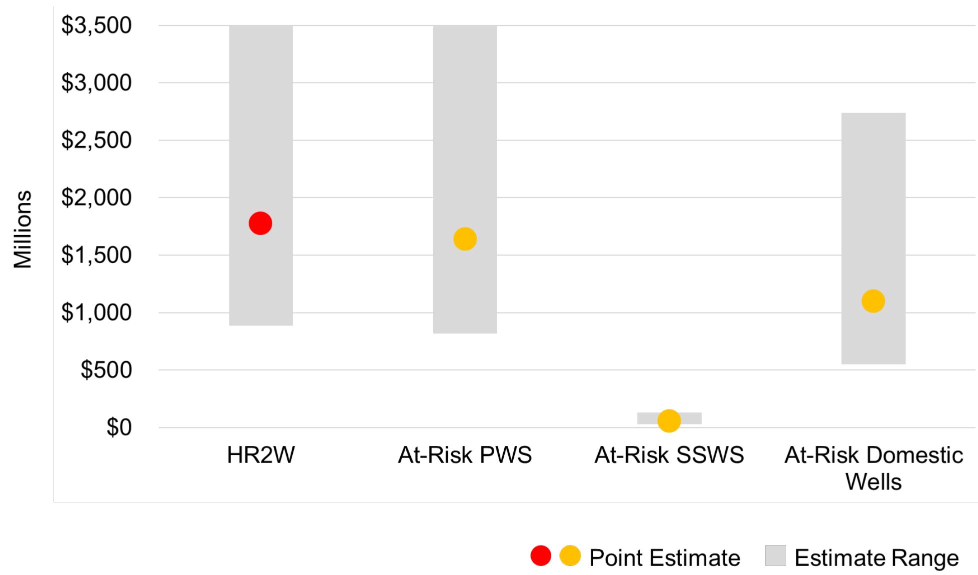
System Type	Treatment	Physical Consol.[11]	POU/ POE	OEI & TA	Point Est. Total	Range Total
HR2W	$201 - $802	$65 - $261	$9 - $37	$612 - $2,450	**$1,770**	**$887 - $3,550**
At-Risk PWS	N/A	$146 - $585	N/A	$673 - $2,690	**$1,640**	**$819 - $3,280**
At-Risk SSWS	N/A	$17 - $69	$9 - $37	N/A	**$53**	**$27 - $106**
At-Risk Domestic Wells	N/A	$400 - $1,600	$148 - $592	N/A	**$1,100**	**$548 - $2,190**
TOTAL:	**$201 - $802**	**$628 - $2,520**	**$166 - $666**	**$1,290 - $5,140**	**$4,560**	**$2,280 - $9,130**

Table 21: Selected Modeled Solution Average Costs per Connection, by System Type

System Type	Treatment	Physical Consol.	POU/ POE	OEI & TA
HR2W	$9,430 - $37,700	$14,700 - $58,800	$8,730 - $34,900	$34,300 - $137,300
HR2W Annual O&M	$388 - $1,600	$6 - $24	$727 - $2,900	N/A
At-Risk PWS	N/A	$17,400 - $69,700	N/A	$8,400 - $33,500
At-Risk SSWS	N/A	$15,000 - $59,900	$3,790 - $15,200	N/A
At-Risk Domestic Wells	N/A	$15,600 - $62,300	$1,000 - $4,000	N/A

[11] This analysis only considered system-to-system consolidation rather than regional consolidation due to data limitations. However, based on preliminary analysis of cost comparisons for regional consolidation as opposed to system-to-system consolidations, the State Water Board believes significant cost savings for consolidations can be achieved through a regional approach. See Attachment C5 for additional information. https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c5.pdf

Figure 35: Statewide Modeled Long-Term Capital Cost Estimates, By System Type



Average Capital Cost per Connection

The cost per connection of a solution is an important consideration for state funding eligibility, as further detailed in the funding Gap Analysis section of this report. Generally, the State Water Board can more easily grant fund projects for small, economically disadvantaged systems. The project funding range cap is often between $30,000 to $60,000 per connection, depending on the type of project. Table 22 summarizes the cost per connection of modeled capital costs, including OEI needs. The systems have been categorized by the number of connections they serve, from larger to smaller systems. This display of results illustrates the relatively higher per connection cost of bringing small systems into compliance, and thus the advantages of economies of scale.

Table 22: Average Long-Term Capital Cost per Connection by System Size for HR2W List Systems

System Type	3,300+[12]	3,300 – 1,001[13]	1,000 – 501	500 – 101	100 or less
HR2W	$4,900	$6,800	$11,700	$18,200	$86,900
HR2W Annual O&M	$230	$320	$560	$300	$910
HR2W Schools	N/A	N/A	N/A	$11,423	$87,863[14]
HR2W Schools Annual O&M	N/A	N/A	N/A	$47	$208

Table 23: Average Long-Term Capital Cost per Connection by System Size for At-Risk Systems

System Type	3,300+	3,300 – 1,001	1,000 – 501	500 – 101	100 or less
At-Risk PWS	$3,620	$17,300	$15,500	$26,200	$90,700
At-Risk Schools	N/A	N/A	N/A	$14,765	$1.82 M
At-Risk SSWS	N/A	N/A	N/A	N/A	$9,350[15]
At-Risk Domestic Wells	N/A	N/A	N/A	N/A	$17,500[16]

[12] Larger water systems typically have multiple sources. Modeled treatment is based on addressing only those sources that have known contamination. Under the additional infrastructure costs, no additional wells were assumed to be needed for redundancy if there is more than one source. For these reasons and economies of scale, the costs for larger systems are significantly lower for smaller systems.

[13] Larger water systems typically have multiple sources. Modeled treatment is based on addressing only those sources that have known contamination. Under the additional infrastructure costs, no additional wells were assumed to be needed for redundancy if there is more than one source. For these reasons and economies of scale, the costs for larger systems are significantly lower for smaller systems.

[14] The number of connections was adjusted to account for population size.

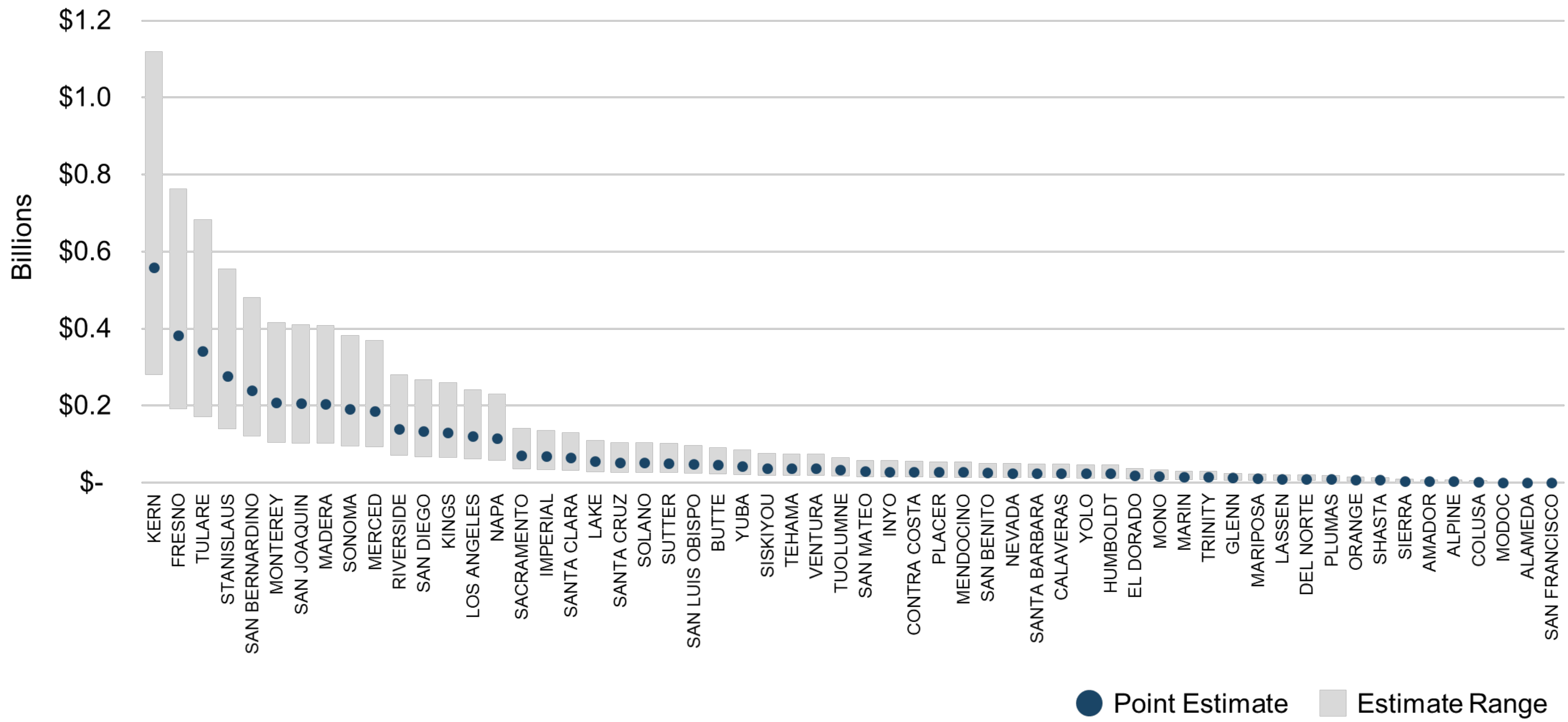
[15] Costs associated with domestic wells and SSWSs do not include additional infrastructure costs that are similar to public water systems. For example, well replacement costs and second wells for redundancy are not included since they are expected to be paid for by the homeowner.

[16] Costs associated with domestic wells and SSWSs do not include additional infrastructure costs that are similar to public water systems. For example, well replacement costs and second wells for redundancy are not included since they are expected to be paid for by the homeowner.

Estimated Capital Costs by County

Figure 36 shows the total capital cost by county for HR2W list systems, At-Risk PWSs, SSWSs, and domestic wells. Some areas of the state have noticeably more need when compared with other areas. For example, the Central Valley counties of Kern, Fresno, Tulare, and Stanislaus are four of the top five highest need counties, with San Bernardino being the lone county outside the Central Valley in the top five.

Figure 36: Total Long-Term Capital Costs, Including OEI Costs, by County



STATEWIDE O&M COSTS ESTIMATE

Table 24 shows the annual estimated O&M costs for HR2W list systems. There is a large difference in the total annual costs for POU/POE solutions versus treatment, $1.6 million and $52.4 million, respectively. However, the estimated O&M costs per connection are more comparable, at $1,500 per connection (POU/POE) and $780 per connection (treatment). Costs modeled for physical consolidation were focused on electrical pumping costs and found to be negligible. Estimated annual O&M costs for At-Risk systems were not included because the model proposed infrastructure upgrades and additional technical assistance in lieu of O&M support for systems where the model determined consolidation was not an option.

Table 24: Selected HR2W List Modeled Solution Total and Per Connection Annual O&M Costs[17]

Cost Type[18]	Treatment	POU/ POE	O&M Point Estimate Total	O&M Range Total
Total Cost	$52.4 M	$1.60 M	**$54.1 M**	**$24.0 M - $108 M**
Average Cost Per Connection	$780	$1,500	**$2,280**	**$1,140 - $4,560**

The 20-year net present worth (NPW) was estimated only for HR2W list systems, as shown in Table 25. Here, the NPW estimates the total sum of funds that need to be set aside today to cover all the expenses (capital, including OEI costs, and annual O&M) during the potential useful life of the infrastructure investment, which is conservatively estimated at 20-years. This calculation is only meaningful in the context of systems that have a calculated estimated annual O&M expense, thus NPW was not estimated for At-Risk systems and domestic wells, except in the case of interim solutions. The NPW for the HR2W list systems has a point estimate of $2.51 billion and range (-50%, +100%) of $1.25 billion to $5.3 billion.

Table 25: Selected Modeled Solution Total 20-Year Net Present Worth (NPW) for HR2W Systems, Including OEI Costs and O&M[19]

Total Cost	20-Yr. NPW Point Estimate Total	20-Yr. NPW Range Total
Total Cost for HR2W List Systems	**$2.51 B**	**$1.25 B - $5.02 B**
Average Cost per Connection	**$252,900**	**$126,500 - $505,900**

[17] Annual O&M costs were not estimate for any At-Risk systems

[18] Physical consolidation was evaluated for O&M costs based on electric costs for pumping, however, these costs were in most cases were negligible and therefore excluded from this table.

[19] NPW is only meaningful in the context of systems that have a calculated annual operations and maintenance expense, thus NPW was not estimated for At-Risk systems.

ADDITIONAL LONG-TERM COST ASSESSMENT ANALYSIS

Additional analysis of long-term solution costs was conducted as part of the Cost Assessment effort. Further analysis is also detailed in Attachment C5.[20]

Estimated Long-Term Costs by Contaminant

Table 26 shows the average costs for the selected modeled solution categorized by contaminant. Nitrate is estimated to be the most expensive to address on average using all three cost measures (capital costs, annual O&M costs, and 20-year NPW costs). Factors such as water system size have significant impact to the average capital costs. Additional information can be found on the assumptions impacting this data in Attachment C5.[21]

Table 26: Estimated Average HR2W List Costs per Contaminant per Connection, Excluding OEI Costs

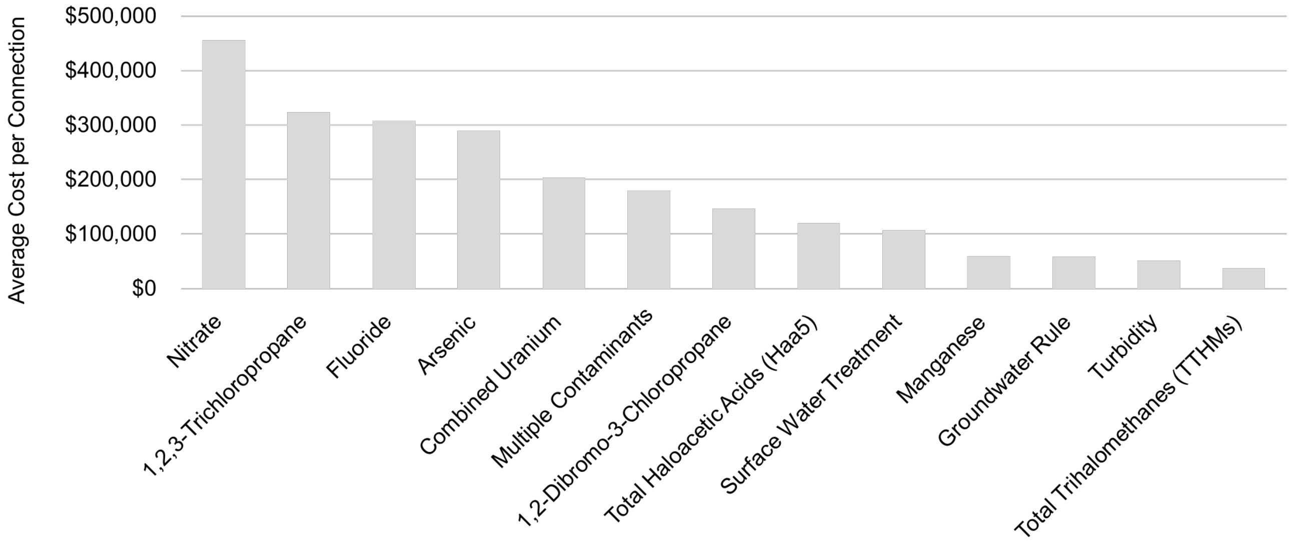
Contaminant	# of Systems	Average Capital Cost per Conn.	Average O&M Cost per Conn.	Average 20-Yr. NPW per Conn.
1,2,3-Trichloropropane	49	$319,000	$462	$324,000
1,2-Dibromo-3-Chloropropane	1	$146,000	N/A	$146,000
Arsenic	63	$279,000	$918	$290,000
Combined Uranium	17	$190,500	$1,320	$203,000
Fluoride	8	$304,000	$295	$308,000
Groundwater Rule	2	$57,000	$164	$58,000
Manganese	3	$55,800	$261	$59,400
Nitrate	37	$437,000	$1,760	$456,000
Surface Water Treatment	8	$94,000	$1,090	$106,800
Total Haloacetic Acids (Haa5)	7	$107,800	$1,002	$119,000
Total Trihalomethanes (TTHMs)	11	$32,060	$430	$36,900

[20] Attachment C5: Additional Cost Assessment Results & Regionalization Analysis
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c5.pdf

[21] Attachment C5: Additional Cost Assessment Results & Regionalization Analysis
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c5.pdf

Contaminant	# of Systems	Average Capital Cost per Conn.	Average O&M Cost per Conn.	Average 20-Yr. NPW per Conn.
Turbidity	1	$43,200	$612	$51,500
Multiple Contaminants[22]	98	$165,000	$1,340	$180,000

Figure 37: Average 20-Yr. NPW Cost per Contaminant per Connection



Consolidation vs. Regionalization Considerations

Cost Assessment Consolidation

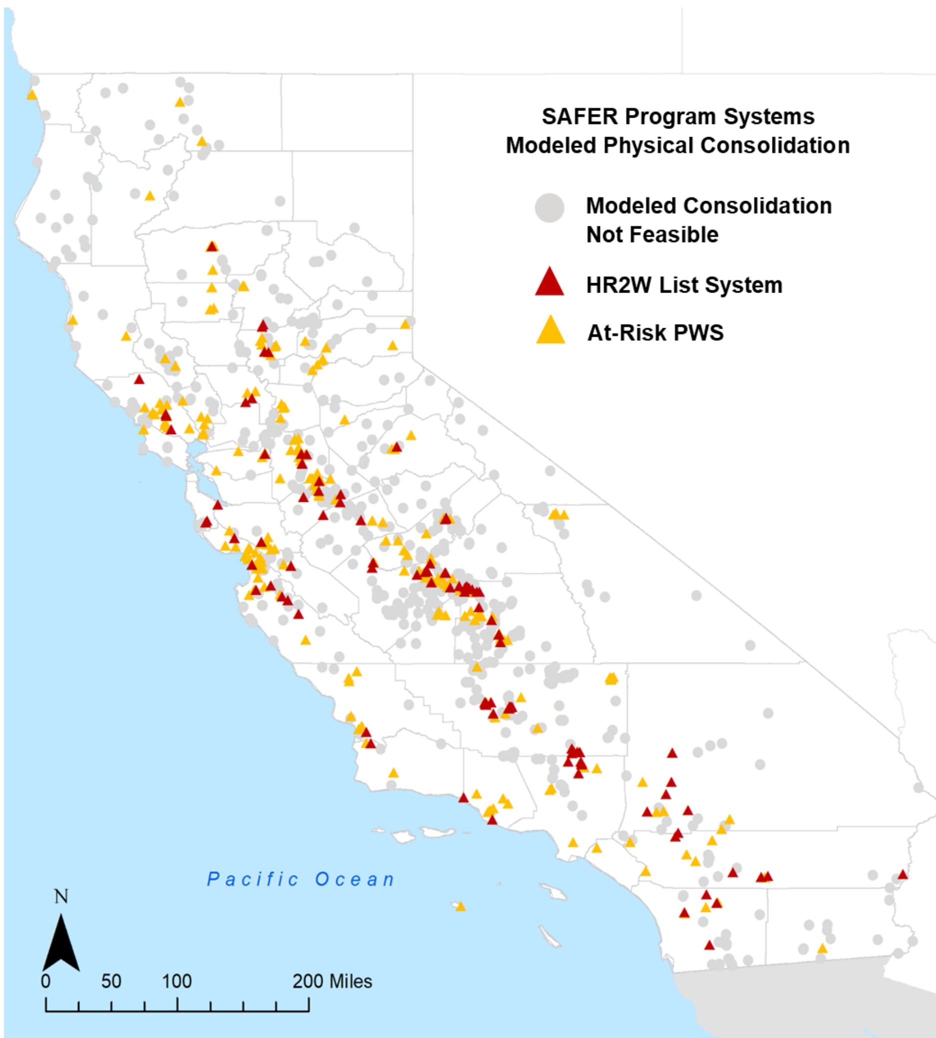
Physical consolidation options have been considered as potential solutions for HR2W list and At-Risk PWSs, SSWSs, and domestic wells. The costs for HR2W and At-Risk consolidations utilize a one-water system to one-water system approach, which may make some consolidations unaffordable. HR2W list system and At-Risk PWS consolidation costs reflect

[22] The Multiple Contaminant category includes all possible contaminant combinations in systems with two or more contaminants of concern. Consequently, this category may show lower average costs than other single-contaminant categories due to the following: (1) The high sample size (n) of multi-contaminant systems (98 of 305 HR2W systems), relative to single-contaminant systems, lowers the calculated average costs of multi-contaminant systems vis-à-vis single-contaminant systems. (2) The nature of contaminant combinations included in this category. While the treatment costs of some contaminant combinations (e.g. inorganic and VOC contaminants) are costly because they require multiple technology trains to treat, other contaminant combinations, which require a single technology train to address, have lower costs. For instance, 48 of 98 multi-contaminant systems have inorganic contaminant combinations that may be treated with a lower cost single treatment train.

the cost to connect to a nearby larger non-HR2W public water system within a maximum of a 3-mile area along public access roads. SSWSs and domestic wells were analyzed for consolidation costs only if they were along the pipeline path of another HR2W list system consolidation or an At-Risk consolidation. Details of the methodology are included in Attachment C1.[23]

Figure 38 illustrates the location of HR2W list systems and At-Risk PWSs where physical consolidation was considered as a potential solution (107 HR2W list and 234 At-Risk systems). Physical consolidation of systems was the selected modeled solution for 20% of HR2W list systems (61 of 305) and 23% At-Risk PWSs (145 of 630).

Figure 38: Map of Modeled Physical Consolidations



[23] Attachment C1: Geographic Information System and Database Methodologies
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c1.pdf

Regional Consolidation Potential
All non HR2W list, not At-Risk PWSs, SSWSs and domestic wells were also assessed for potential regional consolidations, **but they were not included in the aggregated cost estimate**. These systems were excluded from the aggregated Cost Assessment results because the scope of the Needs Assessment is to *only* estimate the needs for the HR2W list systems and At-Risk systems and domestic wells.

The State Water Board recognizes that additional cost efficiencies and better long-term solutions occur where there are regional consolidation projects resulting in larger water systems with economies of scale. For example, for the top 10 water systems that could potentially consolidate the most water systems within their regions, the average cost per connection drops 68% from $99,900 per connection to $25,200 per connection. The majority of these systems are located in Monterey, Sonoma, Fresno and Stanislaus counties, as shown the in Table 27 below. More information is provided in Attachment C5.[24]

Table 27: Regional Modeled Physical Consolidation Costs for the Top 10 Highest Number of Potential Joining Systems

Nearby City (County)	# Potential Joining Systems	Total Distance of Individual Routes (Mi)	Total Distance of Consol. Routes (Mi)	Individual Routes, Pipeline $/Connection	Regional Route, Pipeline $/Connection
Prunedale (Monterey)	177	321.4	32.3	$153,000	$15,000
West Salinas (Monterey)	100	173.3	36.8	$98,000	$21,000
Marina (Monterey)	85	138.3	25.4	$39,000	$7,000
Los Lomas (Monterey)	55	93.8	13.6	$169,000	$24,000
Pajaro (Monterey)	55	93.5	22.0	$90,000	$21,000
Fresno[25] (Fresno)	51	78.9	44.6	$38,000	$22,000
East Salinas (Monterey)	38	70.2	19.9	$217,000	$61,000
Sebastopol (Sonoma)	44	64.7	20.7	$118,000	$38,000

[24] Attachment C5: Additional Cost Assessment Results & Regionalization Analysis
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c5.pdf

[25] The State Water Board is currently collaborating on initial consolidation outreach in this area.

Nearby City (County)	# Potential Joining Systems	Total Distance of Individual Routes (Mi)	Total Distance of Consol. Routes (Mi)	Individual Routes, Pipeline $/Connection	Regional Route, Pipeline $/Connection
Modesto (Stanislaus)	55	60.8	34.6	$43,000	$25,000
Santa Rosa[26] (Sonoma)	44	55.7	30.4	$34,000	$18,000

Table 28 provides a summary of the number of systems and wells statewide with physical consolidation or regionalization potential. This modeling represents a snapshot of where there is consolidation potential based on individual pipelines between joining and receiving systems, as well as for integrating domestic wells along a pipeline connecting water systems to a nearby larger compliant system. However, the State Water Board recognizes that in addition to funding it is essential that community and local leader input be incorporated in order to bring these projects to fruition. Additionally, consolidation can be impacted by water rights or water allocation challenges as well. Therefore, Table 28 represents an estimate, but not a complete picture, of consolidation and regionalization potential in California.

Table 28: System Assessed for Modeled Regional Consolidation

System Type	# of Systems	Evaluated for Physical Consol.[27]	Potential Physical Consol. Identified
All Small Water Systems[28] (SWS)	7,190	7,070	**3,201**
All SSWS	1,848	1,848	**1,006**
All Domestic Wells	347,293	347,293	**133,265**

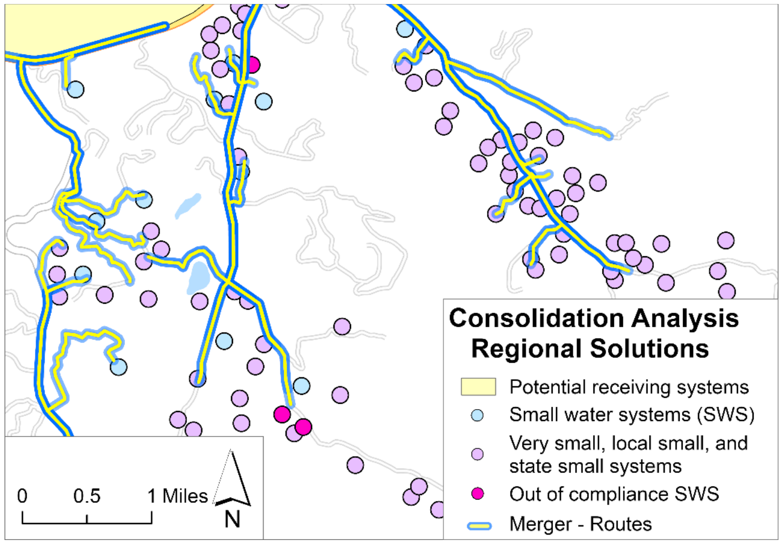
Figure 39 shows an example from Monterey County of a modeled regional consolidation which would integrate public water systems, state small water systems and domestic wells.

[26] The State Water Board is currently working with the City of Santa Rosa on a regional consolidation of eight water systems. The City had previously completed a regional consolidation of four water systems.

[27] Systems without location information were excluded from the analysis.

[28] All systems with 3,300 service connections or less.

Figure 39: Example of Regional Consolidation Analysis



INTERIM SOLUTION COST ASSESSMENT RESULTS

Interim solution costs were calculated for a six-year term for populations served by HR2W list systems, and a nine-year term for At-Risk SSWSs and domestic wells. Table 29 shows the estimated costs of providing interim solutions to all populations served by HR2W list systems and At-Risk SSWSs and domestic wells in need of such a solution,[29] both for the initial year in nominal cost terms and by the net present worth over the duration of the period envisioned for each population. The total NPW cost for the entire population in need is estimated at nearly billion, with over $1 billion in cost for HR2W list systems alone.

Table 29: Total First Year and NPW Cost of Interim Solutions (in $ Millions)

System Type	Total Systems Assigned an Interim Solution	Total First Year Cost Estimate	NPW Cost of Duration of Interim Solution[30]
HR2W list	343	$216	$1,000
At-Risk SSWS	496	$18	$35
At-Risk Domestic Wells	59,366	$280	$547
TOTAL:		**$514**	**$1,580**

[29] A total of 77,569 At-Risk domestic wells and 611 SWSS were originally identified as potentially in need of an interim solution. However, any At-Risk domestic well or SWSS which was already assigned POU or POE as the modeled selected long-term solution was excluded from the estimate of cost to receive the same technology as an interim solution. The rationale for this was that these long-term interventions and their costs are prioritized for SAFER spending, and thus these populations would not need an interim solution.

[30] Interim costs were calculated for a six-year term for populations served by HR2W list systems, and a nine-year term for At-Risk SSWSs and domestic wells.

Table 30 shows the estimated costs of providing interim solutions only to DAC populations served by HR2W list systems and At-Risk SSWSs and domestic wells in need of such a solution. Narrowing the focus of providing interim solutions to DAC populations lowers the total NPW cost by about a third. However, given that many HR2W list systems serve DAC populations, the total NPW of solutions remains above $1 billion.

Table 30: Total First Year and NPW Cost of Interim Solutions to DAC Populations ($ in Millions)[31]

System Type	Total Systems Assigned an Interim Solution	Total First Year Cost Estimate	Total Cost for Duration of Interim Solution[32]
DAC HR2W	222	$172	$845
DAC SSWSs	130	$5	$9
DAC Domestic Wells	20,443	$96	$192
TOTAL:		**$273**	**$1,050**

Table 31 further shows that over two-thirds of the cost of providing interim solutions to HR2W list is represented by large HR2W list systems (those with more than 3,300 connections).

Table 31: Total 6-Year NPW Interim Solution Cost by Number of Connections for HR2W List Systems (in $ Millions)

System Type	3,300+	3,300 – 1,001	1,000 – 501	500 – 101	100 or less
HR2W	$671	$176	$39	$80	$47

COST ASSESSMENT LIMITATIONS

The cost estimates developed for the 2021 Needs Assessment have several limitations and opportunities for improvement in future iterations. Overall, modeled solutions that have been developed lack some of the system-specific information that would be necessary to generate the level of precision for cost estimates such as those found in State Water Board planning studies for system-level funding agreements. Actual costs will vary from system to system and

[31] A total of 27,861 domestic wells and 181 SWSS serving DAC populations were analyzed to determine interim solution cost. Any domestic well or SWSS with a recommended POU or POE filter combination interim solution that matches the recommended filter long term solution were excluded. The domestic wells and SWSSs in this analysis are in high risk aquifer risk map sections placing them at priority for long term solution spending.

[32] Interim costs were calculated for a six-year term for populations served by HR2W list systems, and a nine-year term for At-Risk SSWSs and domestic wells.

will depend on site-specific details. The Cost Assessment will thus not be used to inform site-specific decisions but rather give an informative analysis on a statewide basis.

Timing Synchronization with the Risk Assessment

The long-term Cost Assessment for At-Risk state small water systems and domestic wells used a version of the GAMA model from September 2020. At that time six contaminants of concern were modeled. The version of the GAMA Aquifer Risk Map, released in January of 2021, has a model for all contaminants with a primary MCL. The number of SSWSs and domestic wells estimated as At-Risk is now higher than the number used in the Cost Assessment, and thus the cost to mitigate the issues in these additional wells may likely increase the estimates in the next Cost Assessment.

Similarly, the timing of the Risk Assessment for PWSs did not allow for full utilization of the At-Risk PWS drivers at the system level to be utilized by the Cost Assessment Model to refine potential solutions. Broad assumptions were made about the types of solutions these systems might require. The lack of system-specific information about At-Risk PWSs limits the accuracy of the Cost Assessment.

Water System Data Availability and Accuracy

A lack of inventoried data on water system assets and their condition for HR2W list and At-Risk PWS, led to the application of general assumptions around replacement and/or upgrade needs. Some of the information about existing infrastructure and asset condition, water production, and use rates is recorded in system-level sanitary surveys but is not in a database where it can be used. A lack of information around source capacity issues has also resulted in the Cost Assessment not addressing this challenge.

Water system boundary layers often show where a water system is currently serving or is allowed to serve, rather than where pipeline infrastructure ends. The potential inconsistency or accuracy of this data makes the physical consolidation analysis component of the Cost Assessment less precise. In such cases, physical consolidation costs may be higher than modeled costs for systems that currently show an allowed service area boundary. Additionally, the consolidation costs do not take into account where water rights or supply limitations may prevent consolidations.

Lack of data availability also prevented the inclusion of blending, new wells to avoid treatment, and managerial consolidation as potential modeled solutions that could be costed out in this iteration of the Cost Assessment. The only technical assistance that is currently included in the cost model is for managerial support.

Cost Data Quality

Cost estimates are based on consultant estimates, rather than historical cost data, especially work funded by the State Water Board, which would incorporate prevailing wage and have other administrative costs. Currently, the State Water Board captures funding agreement costs in the aggregate, but costs are not captured at the granular detail needed to directly inform the modeling for the long-term component of the Cost Assessment. For example, land acquisition costs for new wells is difficult to identify in current State Water Board data.

Interim Solution Costs

Interim costs are based on 6-9-year timeframes of need. In some cases, it may take longer to implement a long-term solution. For domestic wells, bottled water or POE/POU treatment may also be the only viable permanent solution and is not included in this model. Cost data for the full range of potential interim solutions is limited, this year's assessment was only able to assign POE/POU and bottled water interventions because there is so little data on other potential solutions such as vended and hauled water.

Methodology for Domestic Wells and State Small Water Systems
State small water systems had several data limitations including a lack of complete information on location, the number of connections, and water quality data. Similar data limitations exist for domestic wells. Availability of actual well location and whether the well is still in production for drinking water is limited. Additionally, domestic wells are not required to be sampled for water quality, unless mandated by local ordinance. Therefore, domestic well water quality data varies between counties and data gaps provides a challenge.

Modeled Solutions
The Cost Assessment Model may not be identifying the appropriate local solution for each water system due to limitations in data and the potential modeled solutions analyzed. For example, this effort did analyze regional consolidation project opportunities for State Water Board outreach purposes. However, the Cost Assessment did not include these efforts in the potential modeled solutions for HR2W systems and At-Risk systems. This choice was due to data limitations associated with water system boundaries, including jurisdictional uncertainties, as well as unknown community interest in each area. As a result, costs associated with consolidations are potentially higher and more water systems are chosen for POU/POE. POU/POE has several implementation limitations, such as bacteriological growth and long-term maintenance challenges, which may not make it the best long-term solution for some communities. There is also an equity concern with POU/POE solutions, because they do not provide the same level of service as typical public water systems. Therefore, because the Cost Assessment Model may be selecting potential solutions that ultimately may not be selected as the "real world" long-term solution for some communities, the aggregated cost estimates may not align with what actual costs may be.

Sustainability and Resilience Assessment
The Sustainability and Resiliency Assessment was limited by the number of metrics that could be included to evaluate the modeled solutions' long-term longevity and efficacy. Given its high-level analysis, only metrics that were applicable on a statewide scale could be incorporated into the assessment. Viable metrics that required site-specific data to accurately evaluate modeled solutions were not considered. Also, some recommended metrics could not be considered because they did not apply to all potential modeled solutions. Attachment C4 describes these limitations in detail.[33]

In terms of evaluating modeled solutions, the Cost Assessment Model can potentially overestimate the sustainability and resiliency of physical consolidation relative to other treatment solutions. This is primarily influenced by the selection of metrics, which focus on assessing sustainability and resiliency within the context of locally implementable treatment solutions. Consequently, physical consolidation is assigned a very high score because many of

[33] Attachment C4: Sustainability and Resiliency Assessment
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c4.pdf

the considerations and challenges affecting these treatment solutions, as evaluated by the Cost Assessment's metrics, are circumvented by physically consolidating into an established receiving system.

Regional Cost Differences
Regional differences in California may have significant impacts on costs, e.g. the cost to replace a pipeline in a downtown portion of the Bay Area is significantly different than the cost to replace the same length of pipe in a rural Central Valley area. The baseline cost estimates obtained from the subcontractors for this analysis were more focused on rural areas. A standard factor was utilized to attempt to correlate between urban and rural areas to the extent possible. However, those correlations were based on broad assumptions of land use in various counties. Review of future projects funded by the State Water Board's Division of Financial Assistance may allow for more detailed information in future iterations.

COST ASSESSMENT REFINEMENT OPPORTUNITIES

The Cost Assessment methodology will evolve over time to incorporate additional and better-quality data; better approaches modeling potential solutions for At-Risk water systems and domestic wells; and further input from the State Water Board and public. The following highlights are near-term opportunities for Cost Assessment refinement and Attachment C5 detailed additional opportunities for consideration.[34]

Correlation Between Risk Assessment and Cost Assessment
The State Water Board will continue to refine the Risk Assessment for public water systems, tribal water systems, state small water systems, and domestic wells. Further refinement will help improve the inventory of systems included in the Cost Assessment, resulting in an aggregated statewide cost estimate that better reflects potential need.

Future iterations of the Cost Assessment Model will better utilize the detailed results of the Risk Assessment to better match potential, and estimate costs for, modeled solutions. For example, At-Risk water systems face TMF capacity issues. The Cost Assessment model will be able to better estimate costs for non-capital potential solutions, including Administrator costs as that data becomes available.

Regionalization Cost Savings Over System to System Consolidations
The State Water Board recognizes that significant cost savings may be obtained using strategic regionalization strategies when compared to single system-to-system consolidations. As discussed, the average modeled cost per connection drops 68% from $99,900 per connection to $25,200 per connection for the top 10 potential areas of regionalization in the state. This illustrates the potential benefits of economies of scale. Areas where significant costs savings could be realized will be the target of increased outreach and engagement by the SAFER Program.

[34] Attachment C5: Additional Cost Assessment Results & Regionalization Analysis
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c5.pdf

The Coachella Valley Water District's approach to consolidation is an example model for regionalization efforts. The District identified nearby systems for potential consolidation and prioritized their regionalization efforts based on location and community interest. Large regionalization efforts are time-intensive endeavors and require community buy-in, comprehensive planning, and clear communication. Therefore, this may drive the need for increased funding for large-scale regionalization feasibility studies.

Cost Data Collection

The State Water Board's Division of Financial Assistance has begun developing a strategy to capture more detailed cost data. Adjustments to State Water Board managed databases will be made to better capture project and technical assistance cost data, especially for State Water Board funded projects through the SAFER Program.

Water System Boundaries

Improvement of water system boundary data statewide will enhance the accuracy of the Cost Assessment's modeling of potential physical consolidation solutions for HR2W list systems and At-Risk water systems and domestic wells. The State Water Board is currently working on developing the System Area Boundary Layer Admin App (SABL Admin), an administrative tool that allows District Offices, Local Primacy Agencies and public water system staff to upload and verify water system area boundaries to the SABL. Concurrently, State Water Board has developed a new SABL-Look up Application that will combine the SABL, other reference geographical information systems (GIS) layers and analysis tools, and water system data.

FUNDING GAP ANALYSIS RESULTS

OVERVIEW

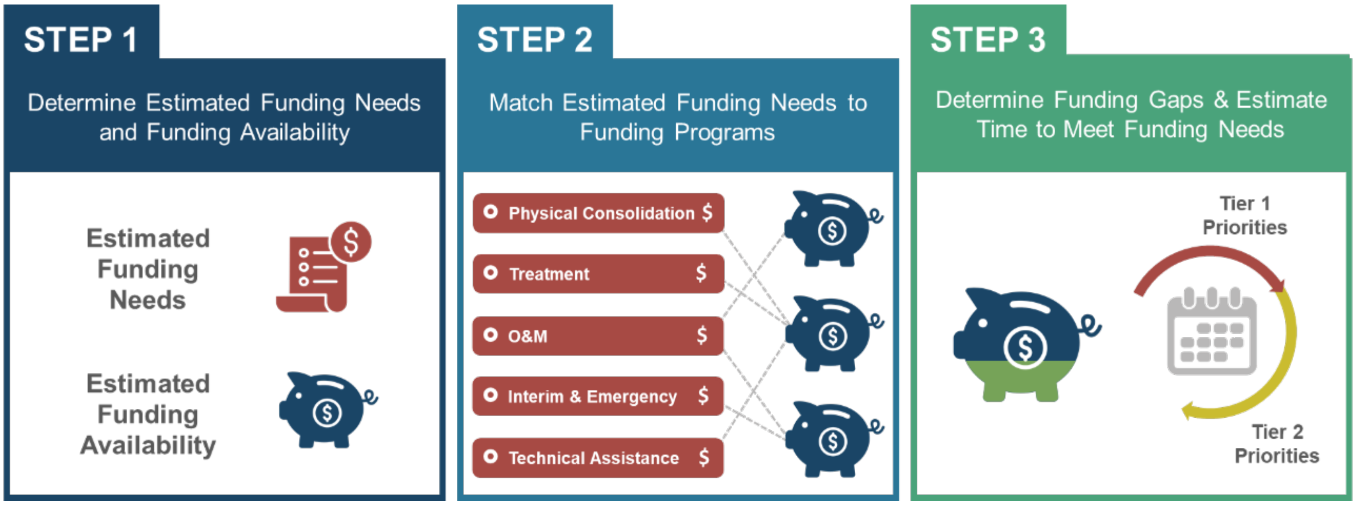
The Cost Assessment modeling process helps to determine the costs related to the implementation of interim and longer-term solutions for HR2W list and At-Risk public water systems (PWSs), state small water systems (SSWSs), and domestic wells. The Gap Analysis is the final step within the Cost Assessment.

Pacific Institute, a subcontractor to the Needs Analysis contract with UCLA, along with key State Water Board stakeholders, developed a Gap Analysis approach to (1) estimate the funding needed for solutions for HR2W list and At-Risk systems and (2) estimate the gap between the funding potentially available and the amount needed over one-year and five-year time increments looking forward. These estimates will help the State Water Board inform future Safe and Affordable Drinking Water Fund Expenditure Plans (SADWF FEP). This statewide analysis is not intended to inform specific funding decisions, nor local decisions, for drinking water system solutions.

GAP ANALYSIS METHODOLOGY

The Gap Analysis methodology is composed of three main steps (Figure 40). The first step focused on refining the funding needs, modeled by the Cost Assessment, associated with the implementation of interim and long-term solutions for current HR2W list and At-Risk systems. The second step identified State Water Board funding sources and external funding sources that can be leveraged to support the identified funding needs based on potential project and borrower/grantee eligibilities. DAC status and other system-level characteristics were utilized to refine this analysis. The third and final step uses the State Water Board's SAFER Program funding priorities to determine the funding gap for a refined estimated funding need. This third step of the analysis also estimates how many years it may take to meet all identified and projected funding needs. Together, these steps provide an estimate of how much it may cost and how long it may take to achieve the HR2W with existing funding sources. For a detailed description of the Gap Analysis methodology, please refer to Appendix D.

Figure 40: Gap Analysis Methodology



STEP 1: ESTIMATED NEEDS & FUNDING AVAILABILITY

ESTIMATED FUNDING & FINANCING NEEDS

The Gap Analysis methodology refined the modeled interim and long-term solution cost estimates produced by the Cost Assessment. The refinement process included the:

(1) Removal of Solution Costs for Systems with Funding Agreements: The first step taken to refine the Cost Assessment's estimated funding need was to remove the estimated interim and long-term solution costs associated with systems that already have funding agreements in place with the State Water Board. Refer to Appendix D for more details.

(2) Addition of Estimated New Costs Associated with New HR2W List and At-Risk Systems: The State Water Board estimates that approximately 47 unique water systems will be added to the HR2W list each year, starting with Year 1 (2021).[35] For purposes of the Gap Analysis, it is assumed that 95[36] new At-Risk PWSs added to the At-Risk list each year.[37] The Gap Analysis assumes no new additional At-Risk SSWSs and domestic wells will be added to the At-Risk list given the nature of the Risk Assessment employed for these systems.

[35] This estimate was derived from State Water Board analysis of historical HR2W lists from 2017-2019.

[36] No historical data exists for the number of systems added to the At-Risk list annually since this is the first year of the Risk Assessment. The Gap Analysis assumes the same proportion (approximately 15%) of PWSs will be added to the At-Risk list as to the HR2W list.

[37] The Gap Analysis takes the average cost per system (HR2W list or At-Risk PWS) derived from the Cost Assessment model and applies that cost to each of the new systems per year out to Year 5. The Gap Analysis also assumes these new groups of HR2W list systems and At-Risk PWSs have the same proportion of DAC status as the systems on the current HR2W list and At-Risk list.

(3) Removing Local Cost Share Estimates: The Cost Assessment's estimated funding needs were further refined based on the assumption that a proportion of the total cost burden would be borne by water systems, their ratepayers, and/or domestic well owners, and thus, not fully borne by the State Water Board's grant funding sources. Interim and long-term solution estimated funding needs were separated into three categories: costs that are grant eligible, costs that are loan eligible, and costs that are not loan or grant eligible. Costs that are not grant eligible are referred to as "Local Cost Share" since these costs will need to be financed by the water system or domestic wells owner through a loan or available cash on hand. Water systems may need to adjust their customer charges to meet these needs. Refer to Appendix D for more details on how local cost share estimates were calculated.

(4) Identifying Loan Eligible Local Cost Share Estimates: The local cost share estimate was further refined by identifying the portion of local cost share that would be eligible for financing (i.e. loans). These estimates were used to calculate the financing gap for the loan and the long-term 20-year local cost share burden that includes 20-year interest payment costs, 20-year O&M costs for long-term solutions, and 6 or 9 year O&M costs for interim solutions.

Together, these four steps produce the refined estimated funding and financing need utilized in the Gap Analysis. The funding and financing need for the implementation of modeled solutions for HR2W and At-Risk systems was estimated both for this current year ("Year 1") and for five years looking forward into the future ("Year 5"). This provides a short-term and longer-term understanding of the estimated funding and financing need over time. The Gap Analysis did not extend 9 years into the future, which is the full duration of the SADWF, due to the uncertainty surrounding future needs.

Tables 32 summarizes the results of the Cost Assessment estimated refined need for Year 1.

Table 32: Year 1 Refined Estimated Grant Eligible Funding Needs (in $ Millions)

System Type	# of Systems	Cost Assessment Model Results	Removed Existing Funding Agreement Costs[38]	Removed Local Cost Share[39]	Total Refined Yr. 1 Grant Funding Needs
HR2W list	352[40]	$2,350	$381	$981	**$992**
At-Risk PWS	725[41]	$2,360	$79	$1,200	**$1,080**

[38] Removed Existing Funding Agreement Costs are equal to the sum of modeled cost results for water systems with existing funding agreements with DFA.

[39] Local Cost Share includes modeled costs that for the Gap Analysis are projected to be borne by water systems, communities, and individual domestic well owners, based on grant eligibility requirements described in Appendix D, Table D3. Some of this financing need may be met with a State Water Board DWSRF loan.

[40] Year 1 assumes the addition of 47 new HR2W list systems.

[41] Year 1 assumes the addition of 95 At-Risk PWSs.

System Type	# of Systems	Cost Assessment Model Results	Removed Existing Funding Agreement Costs[38]	Removed Local Cost Share[39]	Total Refined Yr. 1 Grant Funding Needs
At-Risk SSWS	496[42]	$72	N/A	$9	**$64**
At-Risk Domestic Wells	59,366[43]	$1,400	N/A	$1,090	**$310**
TOTAL:		**$6,180[44]**	**$460**	**$3,280**	**$2,450**

Table 33 summarizes the estimated aggregated total funding needs in Year 5. This includes the additional funding needs associated with the estimated new 235 HR2W list systems (47/yr.) and 475 At-Risk PWSs (95/yr.) that are assumed to need assistance during this time and 5-year O&M costs for all grant-eligible interim and long-term solutions.

Table 33: Refined Total 5-Year Cumulative Estimated Grant Funding Needs (in $ Millions)

System Type	# of Systems	5-Yr. Est. Funding Need	5-Yr. Removed Local Cost Share	Total Refined 5-Yr. Grant Funding Needs
HR2W list	540[45]	$3,200	$1,800	**$1,400**
At-Risk PWS	1,200[46]	$3,450	$1,920	**$1,530**
At-Risk SSWS	496	$82	$22	**$60**
At-Risk Domestic Wells	59,366	$1,560	$1,300	**$260**
TOTAL:		**$8,290**	**$5,040**	**$3,250**

[42] Count of At-Risk SSWS represents interim solution count, but costs are representative of the combination of the interim and long-term costs for 830 SSWS. This is due to differences in the data sets used for calculating interim and long-term solutions.

[43] This figure represents the number of At-Risk domestic wells with interim solutions, but the costs needs represent the combination of interim and long-term costs for 98,315 domestic wells. This is due to differences in the data sets used for calculating interim and long-term solutions.

[44] Due to rounding, this figure appears $1 million above the actual sum of the column total.

[45] Assumes additional new 235 HR2W list systems (47/yr.).

[46] Assumes additional new 475 At-Risk PWSs (95/yr.).

Table 34 summarizes the estimated total Year 1 and cumulative 5-year local cost share needs. Total local cost share needs include non-grant eligible capital costs and 5-year O&M cost for long-term and interim solutions. Only a portion of local cost share are eligible for a State Water Board loan. Appendix D provides more details on State Water Board loan eligibilities utilized for this analysis.

Table 34: Estimated Year 1 and 5-Year Local Cost Share Needs ($ in Millions)

Water System Types	Total Yr. 1 Local Cost Share Needs	Total Yr. 1 Local Cost Share SWB Loan Eligible	Total 5-Yr. Local Cost Share Needs	Total 5-Yr. Local Cost Share SWB Loan Eligible
HR2W List Systems	$981	$854	$1,800	$1,470
At-Risk PWSs	$1,200	$1,200	$1,920	$1,920
At-Risk SSWSs	$9	$3	$22	$3
At-Risk Domestic Wells	$1,090	$658	$1,300	$658
TOTAL:	**$3,280**	**$2,720**	**$5,040**	**$4,050**

Table 35 summarizes the estimated long-term 20-year local cost share burden for all interim and long-term modeled 5-year solution costs[47] which are not eligible for grant funding. Total estimated 20-year local cost share burden includes non-grant eligible capital costs, 20-year interest costs (for loan eligible capital costs), 20-year O&M for long-term solutions, and 6 or 9 year O&M costs for interim solutions (not met by a grant).[48] The total cumulative estimated 20-year local cost share burden statewide is approximately $7 billion. This estimate was not included in the funding or financing gap analysis. The purpose of the total 20-year long-term local cost share that includes 20-year interest costs and O&M needs is to provide a more accurate estimate of how much Californian communities will need to pay to implement the Cost Assessment's modeled solutions.

[48] Details on how local cost share was calculated is detailed in Appendix D.

Table 35: Estimated Total 20-Yr. Local Cost Share ($ in Millions)

Water System Types	Total 20-Yr. Local Cost Share Capital Costs[49]	Total 20-Yr. Local Cost Share Interest Costs	Total 20-Yr. Local Cost Share O&M Costs[50]	Total 20-Yr. Local Cost Share Burden[51]
HR2W List Systems	$1,590	$242	$936	**$2,770**
At-Risk PWSs	$1,920	$7	$1	**$1,930**
At-Risk SSWSs	$7	$2	$56	**$65**
At-Risk Domestic Wells	$1,040	$414	$756	**$2,210**
TOTAL:	**$4,560**	**$665**	**$1,750**	**$6,980**

Table 36: Estimated Total 20-Yr. Local Cost Share per System and per Connection

Water System Types	Average 20-Yr. Local Cost Share Burden per System	Average 20-Yr. Local Cost Share Burden per Connection
HR2W List Systems	$6.4 M	$11,300
At-Risk PWSs	$1.6 M	$14,700
At-Risk SSWSs	$78,300	$9,500
At-Risk Domestic Wells	$22,500	$22,500

Ultimately, the refinement of the Cost Assessment's interim and long-term solution cost estimates is:

> **Year 1 Need**: Grant need is $2.45 billion, and the financing need is $2.72 billion.
>
> **Cumulative 5-Year Need**: Grant need is $3.43 billion, and the financing need is $4.05 billion.

The total refined cost estimate for the 5-year projected number of HR2W list and At-Risk systems and domestic wells is approximately $10.25 billion. This includes the estimated 5-year grant-eligible costs of $3.25 billion plus the long-term 20-year local cost share costs of $7 billion (non-grant eligible capital costs, 20-year interest payments, 20-year annual O&M for modeled long-term solutions, and 6 or 9 year O&M costs for interim solutions). $10.25 billion represents the total estimated cost of implementing interim and long-term solutions for HR2W

[49] Local Cost Share capital costs are the portion of capital costs that are not eligible for a State Water Board grant.

[50] 20-Year O&M costs include 20-year O&M costs for long-term solutions and 6 or 9 years of O&M costs for interim solutions.

[51] Refer to Appendix D for more information on how local cost share is calculated.

list systems, At-Risk water systems and well owners.

ESTIMATED FUNDING AND FINANCING AVAILABILITY

Potentially available funding and financing sources that can support the goals of the State Water Board's SAFER Program were divided into two categories. The first, State Water Board-managed funds, included the Safe and Affordable Drinking Water Fund (SADWF) and other sources administered by the State Water Board's Division of Financial Assistance (e.g. proposition funds). A summary list of these funds and their eligibility requirements are presented in Appendix D.

For the Gap Analysis, all funding programs managed by the State Water Board were considered and included based on each funds' relevance to the SAFER Program. Relevance was assessed using established fund eligibility criteria and their match to interim and long-term solutions modeled for HR2W list and At-Risk PWSs, SSWSs, and domestic wells. However, it is important to highlight that other State, Federal, and private funding may be available to meet some of these needs.

Table 37 provides a summary of current State Water Board funds' capacity and estimated cumulative future fund sizes. It is important to highlight that in order to conduct the Gap Analysis, the methodology assumes the total project's costs are allocated the full amount of funding needs within a year. This does not align with actual State Water Board capital and technical assistance financing practices, which often stretch the allocation of committed funding over a span of many years.

Table 37: State Water Board Funding (Grant) and Financing (Loan) Availability ($ in Millions) [104]

State Water Board Fund	Yr. 1 Est. Fund Size	Cumulative Est. 5-Yr. Fund Size
Safe and Affordable Drinking Water Fund (SADWF) (Grant)	$137[52]	$593
Drinking Water State Revolving Fund (DWSRF)[53] (Grant)	$120	$320
DWSRF Loan Capacity	*$ 300*	*$ 1,500*

[52] The Gap Analysis assumes approximately $137 million in grant funding availability in Year 1, which includes $130 million from new SADWF appropriations, reduced by $16 million for Administrator and State Water Board staff costs, and an added $23 million from fiscal year 2020-21 carryover U.S. EPA Pacific Southwest (Region 9) Drinking Water Tribal Set-Aside Program https://www.epa.gov/tribal-pacific-sw/epa-pacific-southwest-region-9-drinking-water-tribal-set-aside-program

The Drinking Water Tribal Set Aside Program is limited to community and not-for-profit, non-community public water systems that serve tribal populations. Water systems that serve commercial entities and/or non-tribal populations are not eligible for U.S. EPA funding.

[53] For principal forgiveness.

State Water Board Fund	Yr. 1 Est. Fund Size	Cumulative Est. 5-Yr. Fund Size
Small Community Drinking Water Funding Program (Grant)	$275	$275
Emergency Drinking Water/Cleanup & Abatement Account Programs – Urgent Drinking Water Needs Projects (Grant)	$9	$9
Water Board Household & Small Water System Drought Assistance Program; CAA – DW Well Replacement Program (Grant)	$0.861	$0.861
Water System Administrator Program (Grant)	$8	$8
TOTAL:	**$850**	**$2,710**

STEP 2: MATCHING FUNDING NEEDS TO FUNDING PROGRAMS

State Water Board funding sources each have specific eligibility requirements regarding applicant type and project type. When estimating funding availability, the Gap Analysis used these eligibility requirements to ensure the most appropriate funds are applied to specific categories of systems and solution types. Table 38 shows which funds were considered for which types of systems and solutions types. In the estimation for the funding gap, each fund's total available amount was spread proportionately between all eligible solution and system types. This process was applied to Approach 1 of the Gap Analysis described below in order to help match State Water Board fund sources to the solutions and systems identified by the Cost Assessment Model.

Table 38: State Water Board Funds Matched to Funding Needs

State Water Board Funds	System Types	Modeled Solution Types
Safe and Affordable Drinking Water Fund (SADWF)	HR2W, At-Risk	Capital/Construction (i.e., Physical Consolidation, Treatment, OEI), O&M, Interim solutions, Technical Assistance
Drinking Water State Revolving Fund (DWSRF)	HR2W, At-Risk	Capital/Construction (i.e., Physical Consolidation, Treatment, OEI), Technical Assistance
Small Community Drinking Water Funding Program	DAC/SDAC HR2W, DAC/SDAC At-Risk	Capital/Construction (i.e., Physical Consolidation,

State Water Board Funds	System Types	Modeled Solution Types
		Treatment, OEI), Technical Assistance
Emergency Drinking Water/Cleanup & Abatement Account Programs – Urgent Drinking Water Needs Projects	DAC/SDAC HR2W, DAC/SDAC At-Risk	Interim solutions, emergency supplies and repairs
Water Board Household & Small Water System Drought Assistance Program; CAA – DW Well Replacement Program	HR2W and At-Risk SSWS, Domestic Wells	Capital/Construction (i.e., Physical Consolidation, Treatment, OEI), Technical Assistance
Water System Administrator Program	HR2W, At-Risk	N/A[54]

This effort also evaluated non-State Water Board funds, both loan and grant programs, that could potentially be pursued to help fund solutions for HR2W list and At-Risk drinking water systems in California (e.g. U.S. Department of Agriculture's Rural Development Loan Program, DWR's Integrated Regional Water Management Implementation Grants, etc.). While these funding sources were not used in calculating the estimated funding gap, they are summarized in Appendix D.

STEP 3: GAP ANALYSIS RESULTS

The estimated funding gap has been assessed using the tiered prioritization of solution project types, based on the priorities established in the SADWF fiscal year 2020-21 FEP. The tiered prioritization was applied to all State Water Board funding programs relevant to drinking water needs. This approach considers the refined funding needs for all water systems and domestic wells included in the Cost Assessment. The results of the Gap Analysis will be utilized to inform the annual funding needs for the SADWF as well as the broader demands on State Water Board's drinking water funding programs.

GAP ANALYSIS OF ALL STATE WATER BOARD FUNDS

For the first approach to estimating the funding gap, available funding across all State Water Board's funding programs relevant to drinking water were analyzed and compared to the estimated total funding need. The total funding need was organized into **two tiers of**

[54] Currently, there is limited cost data to support the inclusion of the Administrator funding program into the Gap Analysis for the 2021 Needs Assessment. Future iterations will be able to assess the gap for Administrators when data becomes available.

spending prioritization based on the SADWF fiscal year 2020-21 FEP's "General Funding Approach and Prioritization."[55] (Figure 41).

Figure 41: Gap Analysis

Tier 1 Priority Systems: includes emergency/interim assistance, systems with a primary MCL violation, and consolidation projects for both HR2W list and At-Risk SSWSs and domestic wells. The number of systems that are State Water Board grant eligible and fall within Tier 1 are detailed in Table 39.[56]

Tier 2 Priority Systems: includes HR2W list systems with secondary MCL violations or monitoring and reporting violations and long-term O&M costs for these systems. Tier 2 also includes capital costs for At-Risk PWSs not captured in Tier 1 and long-term O&M costs for all At-Risk systems, for all solution types except consolidation.[57] The number of systems that are State Water Board grant eligible and are in Tier 2 are detailed in Table 39.

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[55] FY 2020-21 Fund Expenditure Plan, Pg. 12

https://www.waterboards.ca.gov/water_issues/programs/grants_loans/sustainable_water_solutions/docs/sadwfep_2020_07_07.pdf

[56] It is important to highlight that some systems in Tier 1 have both interim assistance and long-term capital needs. Therefore, the total number of systems in Table 39 do not represent unique water systems or domestic wells, but rather reflect the number of unique projects related to each system type. There was also overlap between the Tier 1 Priority categories in cases where systems with a primary MCL violation also have a modeled consolidation project solution. In the Gap Analysis, care was taken to ensure that no systems were dually allocated estimated funding in both categories, to avoid double counting of costs.

[57] Long-term O&M costs for At-Risk SSWS and domestic wells are included in the total (unrefined) need and local cost share estimates only.

Table 39: Total Number of Systems in Year 1 that Qualify for Grant Funding Assistance[58]

Priority Level	HR2W	At-Risk PWS	At-Risk SSWS	At-Risk Domestic Wells
Tier 1 Priorities				
Emergency/Interim Assistance	230	50	492	19,022
Systems w/ Primary MCL Violation	273	N/A	303	10,372
Consolidation Projects[59]	57	88	143	4,966
Tier 2 Priorities				
HR2W List Systems & At-Risk Systems not Captured in Tier 1	4	405	0	0
Long-Term O&M for Tier 1 and Tier 2 Systems	199	3	303	10,372

The Gap Analysis estimates that over the next 5 years approximately 34% (131) HR2W list systems will not be economically disadvantaged. The 2020-21 DWSRF IUP allows small DAC and Non-DAC systems with an MCL violation to obtain up to 75% grant for capital projects, recognizing that many of these small systems do not have adequate economies of scale to fund large capital projects. This relatively new provision is included in these eligibility assumptions.

Grant Funding Gap Estimate

Table 40 summarizes the estimated Year 1 grant funding need and gap for Tier 1 and Tier 2 priority systems. Based on the Gap Analysis' assumptions, the Year 1 grant funding need is $1.72 billion for Tier 1 priority systems and $727 million for Tier 2 priority systems. In Year 1, it is assumed that all available grant funding (estimated to be $541 million) is allocated towards Tier 1 priority systems, and no grant funding is available for any Tier 2 priority systems. This leaves a $1.18 billion grant funding gap for Tier 1 priority systems and a $727 million grant funding gap for Tier 2 priority systems.

[58] Tier 1 Priority, Emergency/Interim Assistance and Systems w/Primary MCL Violation are non-exclusive because the former is for modeled costs for interim solutions while the latter is for modeled costs of long-term solutions; therefore, total counts in these rows include duplicates of some systems. However, systems with Primary MCL Violation and Consolidation Projects are mutually exclusive because many systems have a primary MCL violation and their modeled long-term solution is consolidation.

[59] Consolidation projects for small DAC systems out of compliance with an MCL violation, At-Risk PWSs, SSWSs, and domestic wells.

Table 40: Total Estimated Year 1 Grant Funding Gap for Tier 1 and Tier 2 Priority Systems (in $ Millions)

Priority Level	Yr. 1 Est. Refined Grant Need	Yr. 1 Est. Grant Funding Availability	Yr. 1 Est. Grant Funding Gap
Tier 1 Priorities			
Emergency/Interim Assistance	$208	$25	$183
Systems w/ Primary MCL Violation	$898	$306	$592
Consolidation Projects	$617	$210	$407
TIER 1 SUBTOTAL:	**$1,720**	**$541**	**$1,180**
Tier 2 Priorities			
HR2W systems not captured in Tier 1	$12	$0	$12
At-Risk PWSs not captured in Tier 1	$666	$0	$666
Long-Term O&M for Tier 1 and Tier 2 Systems	$49	$0	$49
TIER 2 SUBTOTAL:	**$727**	**$0**	**$727**
YEAR 1 TOTAL:	**$2,450**	**$541**	**$1,910**

Based on the estimated grant funding needs for Tier 1 priority systems alone, most available State Water Board grant programs would be fully expended in Year 1 if they could theoretically be spent immediately. For example, the Small Community Drinking Water Funding Program, Emergency Drinking Water/Cleanup & Abatement Account Programs, and Water Board Household & Small Water System Drought Assistance Program would be completely depleted in Year 1. In this analysis only the SADWF and DWSRF, which are estimated to receive annual funding allocations, would have available funds (approximately $164 million a year combined) to meet a portion of estimated grant funding needs for Year 2 and beyond.

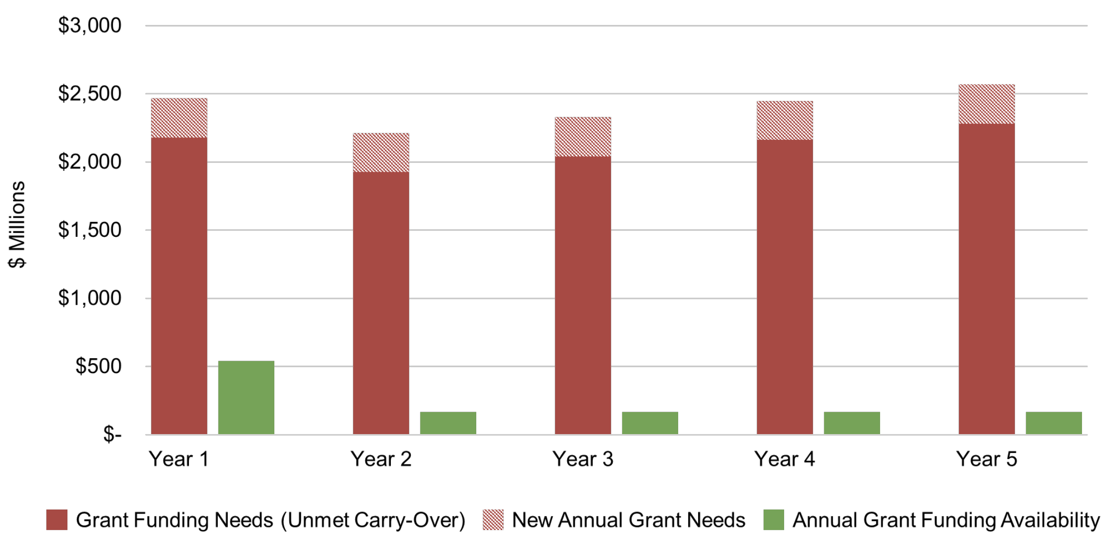
The grant Gap Analysis was analyzed over the next 5 years to better understand how the grant funding gap would change over time. Table 41 summarizes the estimated 5-year cumulative number of systems that are State Water Board grant eligible.

Table 41: Cumulative 5-Year Number of Systems that Qualify for Grant Funding Assistance[60]

Priority Level	HR2W	At-Risk PWS	At-Risk SSWS	At-Risk Domestic Wells
Tier 1 Priorities				
Emergency/Interim Assistance	350	102	492	19,022
Systems w/ Primary MCL Violation	461	N/A	303	10,372
Consolidation Projects	97	136	143	4,966
Tier 2 Priorities				
HR2W List Systems & At-Risk Systems not Captured in Tier 1	8	545	0	0
Long-Term O&M for Tier 1 and Tier 2 Systems	367	47	303	10,372

Figure 42 illustrates the combined 5-year estimated grant funding needs for Tier 1 and Tier 2 priority systems. The Gap Analysis indicated that the estimated new annual needs are greater than annual grant availability; therefore, the total estimated annual funding needs continue to increase each year. This is reflected in the estimated 5-year funding gap detailed in Table 42.

Figure 42: 5-Year Grant Funding Needs & Funding Availability



60 Tier 1 Priority, Emergency/Interim Assistance and Systems w/Primary MCL Violation are non-exclusive because the former is for modeled costs for interim solutions while the latter is for modeled costs of long-term solutions; therefore total counts in these rows include duplicates of some systems. However, systems with Primary MCL Violation and Consolidation Projects are mutually exclusive because many systems have a primary MCL violation and their modeled long-term solution is consolidation.

Table 42 summarizes the 5-year cumulative grant funding gap for Tier 1 and Tier 2 priority systems. Based on the Gap Analysis assumptions, the cumulative 5-year grant funding needs are $2.35 billion for Tier 1 priority systems and $892 million for Tier 2 priority systems. The cumulative 5-year State Water Board grant funding available is estimated to be $1.2 billion. The 5-year estimated grant funding gap is thus $1.16 billion for Tier 1 priority systems and $892 million for Tier 2 priority systems, with the total cumulative 5-year State Water Board grant funding gap being $2.05 billion.

Ultimately, the analysis estimates that no State Water Board grant funding would be available to meet any Tier 2 priority system needs over the 5-Year period. Furthermore, the annual grant funding gap for Tier 1 priority systems increases each year, which indicates that currently available State Water Board grant funds will never be able to meet all estimated grant funding needs. It is important to highlight that other State, Federal, and private funding may be available to meet some of these needs. See Appendix D for a summary of non-State Water Board funding and financing sources.

Table 42: 5-Year Cumulative Grant Funding Gap for Tier 1 and Tier 2 Priority Systems (in $ Millions)

Priority Level	Total Est. 5-Yr. Refined Grant Need	Total 5-Yr. Grant Funding Availability (Needs Met)	5-Yr. Grant Funding Gap
Tier 1 Priorities			
Emergency/Interim Assistance	$122	$61	$61
Systems w/ Primary MCL Violations	$1,360	$692	$672
Consolidation Projects	$869	$444	$425
TIER 1 SUBTOTAL:	**$2,350**	**$1,200**	**$1,160**
Tier 2 Priorities			
HR2W systems not captured in Tier 1	$21	$0	$21
At-Risk PWSs not captured in Tier 1	$863	$0	$863
Long-Term O&M for Tier 1 and Tier 2 Systems	$8	$0	$8
TIER 2 SUBTOTAL:	**$892**	**$0**	**$892**
5-YEAR TOTAL:	**$3,240**	**$1,200**	**$2,050**[61]

[61] Due to rounding, this figure appears $1 million below the actual sum of the column total.

Financing Gap Estimate

Table 43 shows the estimated local cost share needs in Year 1 for all Tier 1 and Tier 2 priority systems' capital and O&M needs not met by a State Water Board grant. The only State Water Board financing (e.g. loan) program included in the Gap Analysis is the DWSRF loan program. In Year 1 the estimated loan capacity of the DWSRF is $300 million. Refinement of local cost share needs estimates approximately $1.91 billion of Tier 1 and $810 million of Tier 2 local cost share needs are eligible for a State Water Board loan. The Year 1 gap in available financing is $2.42 billion.

Table 43: Total Estimated Year 1 Local Cost Share for Tier 1 and Tier 2 Priority Systems (in $ Millions)

Priority Level	Yr. 1 Est. Local Cost Share Needs	Yr. 1 Est. Local Cost Share SWB Loan Eligible	Yr. 1 Est. SWB Loan Capacity	Yr. 1 Est. Financing Gap
Tier 1 Priorities				
Emergency/Interim Assistance	$301	$0	N/A[62]	N/A
Systems w/ Primary MCL Violation	$1,031	$810	$127	$683
Consolidation Projects	$1,096	$1,096	$173	$923
TIER 1 SUBTOTAL:	**$2,430**	**$1,910**	**$300**	**$1,610**
Tier 2 Priorities				
HR2W systems not captured in Tier 1	$20	$20	$0	$20
At-Risk PWSs not captured in Tier 1	$790	$790	$0	$790
Long-Term O&M for Tier 1 and Tier 2 Systems	$42	$0	N/A	N/A
TIER 2 SUBTOTAL:	**$852**	**$810**	**$0**	**$810**
YEAR 1 TOTAL:	**$3,280**	**$2,720**	**$300**	**$2,420**

Table 44 provides an overview of the estimated cumulative 5-year financing needs and gap for Tier 1 and Tier 2 systems. The 5-year estimated loan capacity of the DWSRF is $1.5 billion. The 5-year estimated local cost share needs are $3.38 billion for Tier 1 priority systems and $1.66 billion for Tier 2 priority systems. Refinement of local cost share needs over the 5-year period yields an estimate of approximately $2.74 billion of Tier 1 and $1.31 billion of Tier 2 local cost share needs being eligible for a State Water Board loan. The 5-year gap in available

[62] The State Water Board does not have a financing/loan program that funds interim or emergency assistance.

financing is $2.57 billion. It is important to highlight that other State, Federal, and private financing may be available to meet some of these needs. See Appendix D for a summary of non-State Water Board funding and financing sources.

Table 44: 5-Year Cumulative Local Cost Share Analysis for Tier 1 and Tier 2 Priority Systems (in $ Millions)

Priority Level	Total 5-Yr. Est. Local Cost Share Needs (cap. and O&M)	Total 5-Yr. Est. Local Cost Share SWB Loan Eligible	Total 5-Yr. Est. SWB Loan Capacity	Total 5-Yr. Est. Financing Gap
Tier 1 Priorities				
Emergency/Interim Assistance	$418	$0	N/A	N/A
Systems w/ Primary MCL Violation	$1,620	$1,400	$766	$636
Consolidation Projects	$1,340	$1,340	$734	$609
TIER 1 SUBTOTAL:	**$3,380**	**$2,740**	**$1,500**	**$1,250**
Tier 2 Priorities				
HR2W systems not captured in Tier 1	$27	$27	$0	$27
At-Risk PWSs not captured in Tier 1	$1,280	$1,280	$0	$1,290
Long-Term O&M for Tier 1 and Tier 2 Systems	$352	$0	N/A[63]	N/A
TIER 2 SUBTOTAL:	**$1,660**	**$1,310**	**$0**	**$1,320**
TOTAL:	**$5,040**	**$4,050**	**$1,500**	**$2,570**

Gap Analysis Results Summary

Ultimately the results of the Gap Analysis yield a cumulative 5-Year estimated grant funding gap of $2.05 billion and a financing gap of $2.55 billion for Tier 1 and Tier 2 priority systems. It is important to highlight that other State, Federal, and private funding and financing may be available to meet some of these needs. See Appendix D for a summary of non-State Water Board funding and financing sources.

[63] The State Water Board does not have a loan program that funds O&M.

SUPPLEMENTAL GAP ANALYSIS FOR THE SADWF

A second funding Gap Analysis approach estimated the potential funding gap specifically for the Safe and Affordable Drinking Water Fund (SADWF). This analysis of the SADWF was conducted two different ways. First, in Approach 2A, a Gap Analysis was conducted for only the funding needs of small DAC/SDAC systems and domestic wells and compared that to available SADWF funding.[64] Second, in Approach 2B, an even smaller subset of funding needs was analyzed to examine only those DAC/SDAC costs that are only eligible for SADWF funding and not eligible for any other State Water Board long-term funding source. That small subset of costs was then compared to the funding available from the SADWF.

The results of the Gap Analysis Approach 2A indicate that the estimated 5-year cumulative SADWF funding gap for only DAC/SDAC water systems and domestic wells is $2.18 billion. When the analysis narrowed the sub-set of funding needs to those uniquely eligible to the SADWF, the estimated 5-year cumulative grant funding gap is $77 million for small DAC/SDAC systems and domestic wells only. The details of this analysis are available in Attachment D1.[65]

GAP ANALYSIS CONCLUSIONS

The purpose of the Gap Analysis is to provide an opportunity for the State Water Board and the public to view the refined estimated funding and financing needs from different perspectives. The results of the refinement of the Cost Assessment interim and long-term solution funding needs and the results of the Gap Analysis will be utilized to inform the annual funding plan for the SADWF as well as the broader demands on State Water Board's drinking water funding programs. The following is a summary of the results:

- **Refined Statewide Cost Estimate**: The total estimated grant and local cost share needs for the 5-year projected number of HR2W list and At-Risk systems and domestic wells is $10.2 billion. The combination of these refined needs represents the total estimated cost of implementing interim and long-term solutions for these systems and well owners.
- **Grant Funding Gap**: The Gap Analysis estimates a cumulative 5-year grant funding gap of $2.05 billion.[66]
- **Financing Gap**: The Gap Analysis estimated a cumulative 5-year financing gap of $2.55 billion.[67]
- **The Growing Funding & Financing Gap**: The estimated additional new grant-eligible and loan-eligible needs are expected to exceed the grant and loan funds available, into perpetuity. Therefore, without additional funds, the future grant funding and financing gaps are expected to grow. It is important to highlight that other State, Federal, and private funding and financing may be available to meet some of these needs. See

[64] Small DAC/SDAC systems are prioritized in the 2020-21 SADWF FEP.

[65] Attachment D1: Supplemental Gap Analysis for the Safe and Affordable Drinking Water Fund https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/d1.pdf

[66] Grant Funding Gap is based on an analysis of State Water Board grant programs only.

[67] Financing Gap is based on an analysis of the State Water Board's DWSRF only.

Appendix D for a summary of non-State Water Board funding and financing sources.

GAP ANALYSIS LIMITATIONS

The Gap Analysis contains an inherent amount of uncertainty that must be recognized when interpreting and applying the results. Earlier steps in the Risk Assessment and Cost Assessment Model each contain different amounts of uncertainty, and because the Gap Analysis is applying results from earlier steps, it includes the cumulative uncertainty from all previous steps.

Uncertainty embedded in the Gap Analysis also stems from additional assumptions made that were necessary to complete the estimation. The assumptions that contribute the most uncertainty in the Gap Analysis, not including estimates from the Cost Assessment, are:

Change in Funding Needs Over Time
The Gap Analysis assumes 47 unique new HR2W list systems and 95 new At-Risk PWSs are added to the cumulative funding need each year. While historical data was used to estimate the average number of new systems added to the HR2W list annually, no data exists to closely approximate the number of new unique systems added to the At-Risk list each year. The gap analyses therefore assumed the same proportion of systems may be added to the At-Risk list annually as on the HR2W list. The approximation of new additional funding needs over time can impact the accuracy of the results of the Gap Analysis. For example, in Approach 1 of the Gap Analysis, the estimated new need based on the annual addition of 47 HR2W list systems and 95 At-Risk PWSs is greater than the available funding added annually, which ultimately leads to a growing grant funding gap.

It is important to highlight that the approximation of new funding needs over time also does not take into consideration new regulatory requirements which may result in considerably more water systems being added to both the HR2W list and the At-Risk list than are accounted for using historical averages. Other challenges are also likely to impact funding needs such as drought and ongoing impacts of the COVID-19 pandemic that have left many communities and water systems with financial challenges.

Funding Availability
Projecting funding gaps are based on assumptions around funding availability. New funding sources may reduce the funding gaps. For example, if the DWSRF does not receive an annual allotment of $50 million per year for grant funds and $300 million per year for loans, the grant and local cost share funding gaps could be larger.

Project Funding & Financing
It typically takes several years to transact a funding agreement to facilitate actual project funding and financing for long-term solutions. Furthermore, funds for a long-term project are not typically disbursed in one year, and full commitment of funds annually is not typical. There is often carryover from the previous year. Thus, the yearly allocation and commitment estimates in the Gap Analysis will not exactly match project funding and financing patterns on the ground.

Estimated Local Cost Share

The Gap Analysis employs a number of assumptions around the calculation of local cost share. It assumes that all capital projects which are not funded via a grant are instead financed through either a public or private loan to the party executing the project. This assumption was made to be conservative in the estimate of local cost share burden. Some water systems and domestic well owners may have enough cash on hand to fund long-term solutions without the need for financing or may receive grant funds from sources outside the State Water Board's funding options, thus removing the portion of cost share estimated which is pure loan interest payment. This would result in a lower statewide local cost share estimate. The proportion of systems and domestic well owners that can pay some or the full portion of their project cost upfront in cash is unknown, which is why the Gap Analysis assumes no capital needs are funded in a pay-as-you-go fashion.

Determining Community Economic Status

The Gap Analysis used available data to approximate community economic status to designate systems as DAC, SDAC, or Non-DAC. A community's economic status influences the amount of grant funding that a water system is eligible for. Administrative data sources, however, lacked necessary detail to make this determination for some systems. This was particularly true for domestic wells. For public water systems and SSWSs with missing data, regional proportions based on a spatial analysis used in the Cost Model were used to assign systems as DAC, SDAC, or Non-DAC. Where data was missing for domestic wells, the Gap Analysis conservatively assumes these systems are Non-DAC.

GAP ANALYSIS REFINEMENT OPPORTUNITIES

Future gap analyses will compare the outcomes from this first annual snapshot to observed trends in the estimated need, funding availability, and application of the funds to solutions over time. Actual trend data will be used to modify assumptions to improve accuracy in future estimates.

Better Tracking of New SAFER Systems

The State Water Board is developing a new database to assist with the implementation of the SAFER Program. The SAFER Clearinghouse will be able to track the number of unique new HR2W list systems and At-Risk systems that are identified each year. This will help improve the accuracy of the projected needs estimated by the Gap Analysis.

Improved Tracking of Funding Assistance

The SAFER Clearinghouse will also create a 'pipeline' to track and measure the rate at which HR2W list and At-Risk systems move through the state's funding processes to finalize a long-term solution. Better information regarding the amount of time it takes to implement a long-term solution will enhance the accuracy of the Gap Analysis.

Incorporate Non-State Water Board Funding Programs

The Gap Analysis performed an initial identification of non-State Water Board funds that may be leveraged to meet the funding and financing capital needs identified through the Needs Assessment. These additional funding sources, however, were not included in the calculation of the Gap Analysis. Additional information about these funding programs, such as funding availability and local cost share requirements, would be needed to integrate into Gap Analysis estimates. Additionally, more information on the capability of bundling between funding programs, by different project and recipient types, would need to be explored before these programs can be incorporated into the Gap Analysis.

APPENDIX C:
COST ASSESSMENT METHODOLOGY

INTRODUCTION

The Cost Assessment methodology utilizes a model to estimate the financial costs of both necessary interim measures and longer-term solutions to bring HR2W list systems into compliance, address the challenges faced by At-Risk systems and domestic well as identified via the Risk Assessment. The goal of the Cost Assessment is to inform the prioritization of the spending of existing funding sources, particularly via the SB 200-mandated annual Safe and Affordable Drinking Water Fund Expenditure Plan, as well as to identify potential additional funding sources to leverage, and to estimate the size of the current funding gap to continue to advance the HR2W for all Californians.

COST ASSESSMENT METHODOLOGY DEVELOPMENT PROCESS

The development process of the Cost Assessment was designed to encourage public and stakeholder participation, providing opportunities for feedback and recommendations throughout the methodology development process. Figure C1 provides an overview of the Cost 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 Cost Assessment methodology and results.

The initial draft Cost Assessment methodology was developed by Corona Environmental, and the State Water Board, with support from UCLA and OWP at Sacramento State, from September 2019 to August 2020. Details on the initial draft Cost Assessment methodology were provided in the August 28, 2020 white paper *Long Term Solutions Cost Methodology for Public Water Systems and Domestic Wells*[68] and public webinar *Cost Estimate: Overview of Approach and Update.*[69]

Corona Environmental, the State Water Board, OWP at Sacramento State and UCLA refined the initial draft Cost Assessment methodology through multiple stages of development between August 2020 and March 2021. An updated Cost Assessment white paper titled *Long Term Solutions Cost Methodology for Public Water Systems and Domestic Wells*[70] was

[68] Draft White Paper: Long Term Solutions Cost Methodology for Public Water Systems and Domestic Wells https://www.waterboards.ca.gov/safer/docs/draft_whitepaper_lt_solutions_cost_meth_pws_dom_wells_updated.pdf

[69] August 28, 2020 Webinar Recording https://www.youtube.com/embed/ndsVqRS_-s8?modestbranding=1&rel=0&autoplay=1

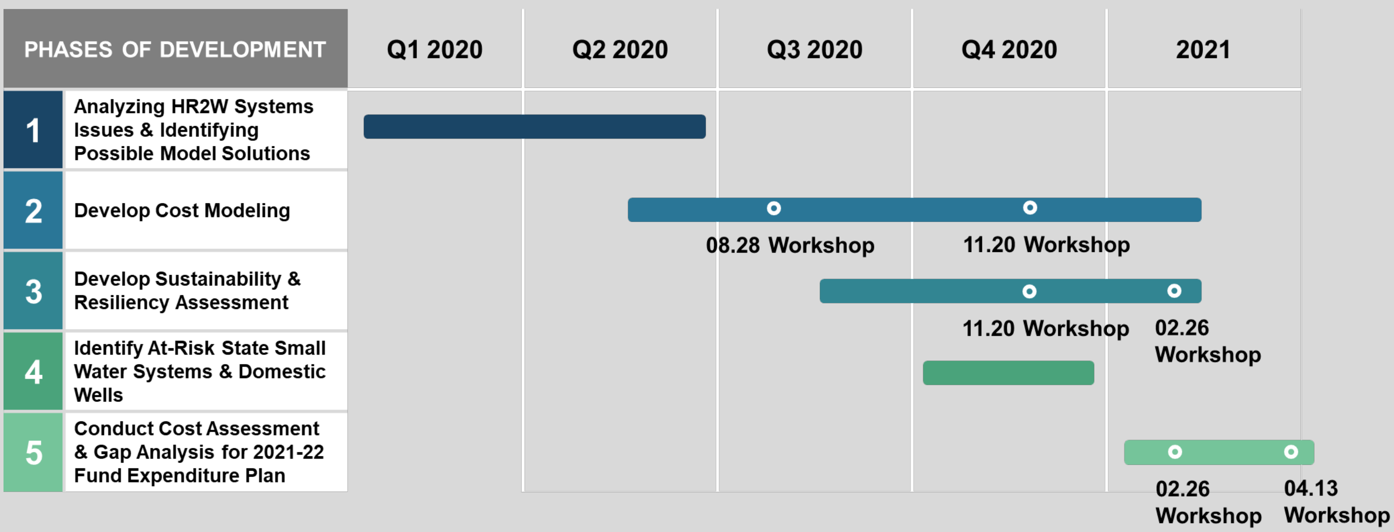
[70] White Paper: Long Term Solutions Cost Methodology for Public Water Systems and Domestic Wells https://www.waterboards.ca.gov/safer/docs/draft_whitepaper_lt_solutions_cost_methd_pws_dom_wells.pdf

published on November 20, 2020 and a public webinar was hosted on November 20, 2020 to solicit feedback on the Model for estimating costs associated with implementing interim and long-term solutions for failing HR2W list and At-Risk systems.

The third, and final, webinar workshop *Cost Assessment Model Preliminary Results and Gap Analysis*[71] was hosted on February 26, 2021 to seek public feedback on the revisions to the Cost Assessment of long-term solutions for HR2W list and At-Risk systems, and proposed methodology for the funding Gap Analysis. Details on the preliminary results from the Cost Assessment model and Gap Analysis were provided in the February 25, 2021 white paper *Gap Analysis for Funding Solutions for Human Right to Water and At-Risk Drinking Water Systems.*[72]

A handful of comment letters were received throughout this effort and some adjustments to the Cost Methodology have been made as a result. Additional details that were requested in the comment letters have been added to this Cost Assessment Methodology Appendix.

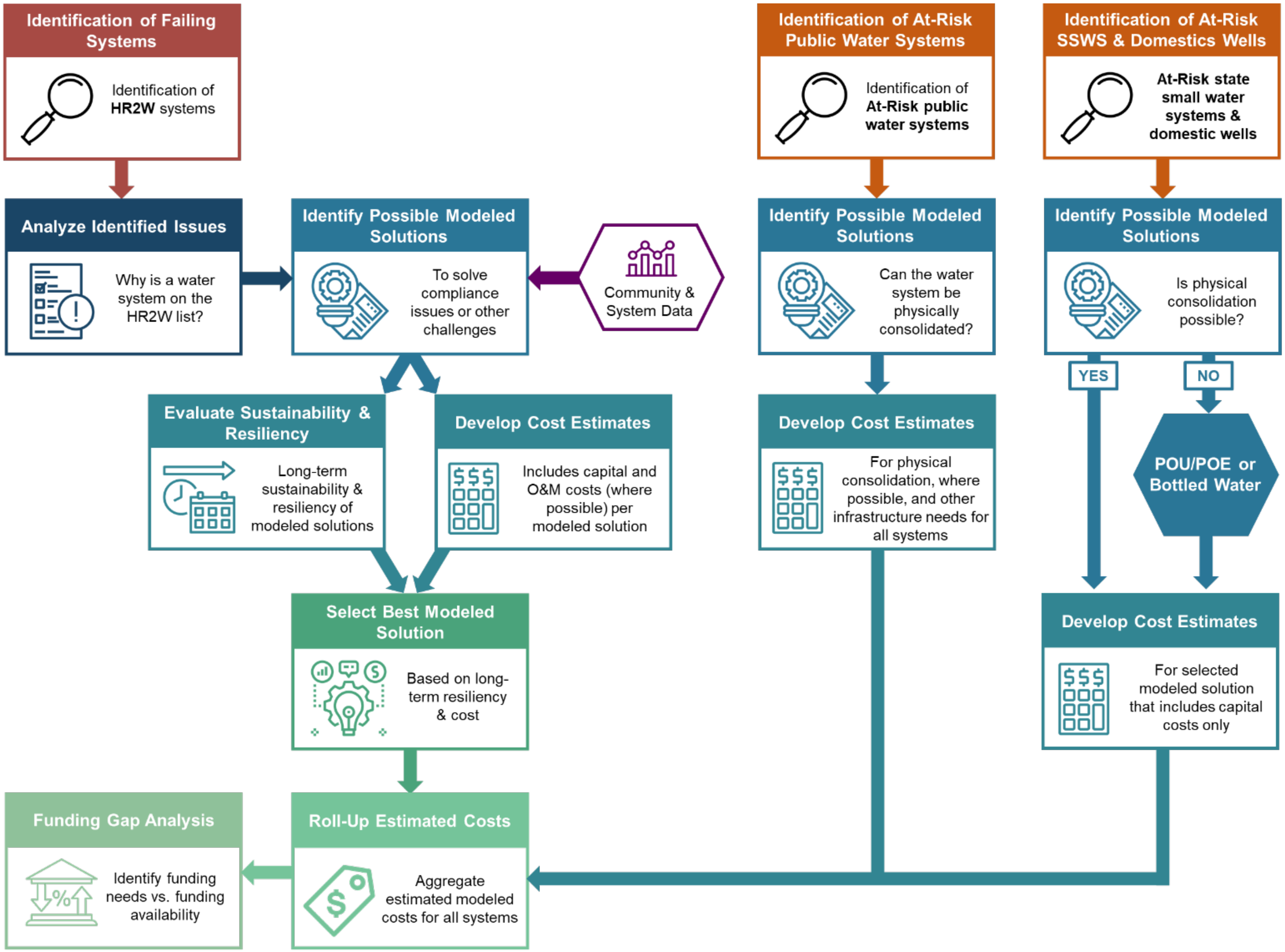
Figure C1: 2020-21 Public Engagement for the Development of the Cost Assessment



[71] Webinar recording can be found at the Needs Assessment website: Needs Assessment | California State Water Resources Control Board https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/needs.html

[72] White Paper: Gap Analysis for Funding Solutions for Human Right to Water and At-Risk Drinking Water Systems https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/docs/Draft_White_Paper_Needs_Assessment_Gap_Analysis_FINAL.pdf

Figure C2: Cost Assessment Model Methodology



COST ASSESSMENT METHODOLOGY

The goal of the Cost Assessment was to estimate the potential costs of addressing issues in water systems currently in violation (HR2W list systems) and those at risk of future violations (At-Risk PWS). Additionally, the Cost Assessment identified costs for state small water systems and domestic wells that may be at-risk of having water quality issues. The process is summarized in Figure C2. **The Cost Assessment was not intended to identify actual solutions that should be implemented for a given system. An evaluation of each system will be needed to identify and cost a range of solutions.** As the State Water Board's data improves, the Cost Assessment will improve over time.

IDENTIFICATION OF WATER SYSTEMS AND DOMESTIC WELLS

The purpose of the Cost Assessment Model is to estimate the potential cost of implementing solutions for failing HR2W list systems, At-Risk water systems, At-Risk state small water systems and At-Risk domestic wells. Therefore, the first critical dataset the model requires is the list of HR2W list systems and At-Risk water systems and domestic wells.

HR2W List Systems: The identification of HR2W list systems is conducted on a regular basis by the State Water Board utilizing enforcement and compliance data. The list of current HR2W list systems is maintained on the State Water Board website.[73] The list of HR2W list systems utilized for the 2021 Cost Assessment was based on the list of systems as of December 1, 2020, which contained 305 public water systems.

At-Risk Public Water Systems: The State Water Board and UCLA developed a methodology for determining At-Risk public water systems (Appendix A). The initial results of the Risk Assessment methodology identified 630 At-Risk public water systems. This initial list was incorporated into the 2021 Cost Assessment. Modifications were made to the initial Risk Assessment results, therefore the list of the At-Risk systems summarized inn the Risk Assessment Results for public water systems section above and in Appendix A differ slightly from the list used in the Cost Assessment.

At-Risk State Small Water Systems and Domestic Wells: The State Water Board's DWQ's Groundwater Ambient Monitoring and Assessment Program (GAMA) Unit developed the Risk Assessment methodology for state small water systems and domestic wells, which is focused on groundwater quality. This effort was accomplished through the mapping of aquifers that are used as a source of drinking water that are at high risk of containing contaminants that exceed primary drinking water standards. The Cost Assessment Model used the GAMA modeled data to determine which state small water systems and domestic wells may be at risk of water quality issues. The number of At-Risk state small water systems and domestic wells in the long-term solutions cost analysis is different than the number in the Risk Assessment results and the interim solutions cost analysis because the data for long term cost estimated was based on the

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

GAMA model for the six contaminants that were available at the time the data was used. The interim solutions cost model was based on a later Aquifer Risk Map that contains all contaminants with an MCL. Please refer to Appendix B to learn more about this Risk Assessment methodology and Attachment C1 for more information on how the Cost Assessment incorporated this information into the analysis.[74]

HR2W List and At-Risk Equivalent Tribal Water Systems: The State Water Board's Needs Analysis Unit and Office of Public Participation are working to collect data and develop a Risk Assessment methodology for Federally recognized tribal water systems located in California. The State Water Board has developed high level cost estimates based on the known number of Federally recognized tribal water systems, violation trends across USEPA Region 9, and typical costs for California water systems (Appendix F). State tribal water systems are under the regulatory jurisdiction of the State Water Board and are therefore incorporated within this Cost Assessment.

The Cost Assessment Model also utilizes location data of public water systems, state small water systems, and domestic wells that are not on the HR2W list or deemed At-Risk in order to identify possible physical consolidation and regional solutions. Detailed information on the datasets used to gather locational information on water systems and domestic wells, including water quality, is provided in Attachment C1.[75]

This model does not capture all needs for water systems and domestic wells throughout the state. It is important to note that the possible modeled solutions utilized in the Cost Assessment Model were only intended to provide a statewide cost estimate for implementing solutions for HR2W list systems, At-Risk systems, and domestic wells. Solutions modeled for individual systems in the Cost Assessment Model will not be utilized by the State Water Board to directly make technical, funding or technical assistance decisions. The State Water Board recognizes that HR2W list systems and At-Risk systems will require a site-specific, detailed evaluation conducted by a qualified engineer, or technical assistance provider, or other specialized firm, to identify implementable solutions for communities.

ANALYZE IDENTIFIED ISSUES

To estimate the cost of providing solutions to HR2W list systems and At-Risk PWS, the Model needed to incorporate and analyze the challenges and issues these systems are struggling with to provide sustained safe and accessible drinking water.

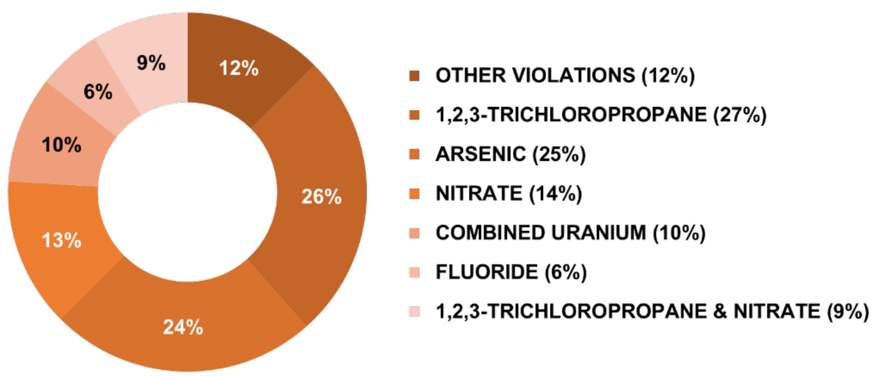
Corona Environmental conducted a case study of the HR2W list systems in Kern County to identify and refine the possible challenges the Cost Assessment Model needed to address. Kern County was selected for initial analysis because it had 61 of the state's 311 HR2W list

[74] Attachment C1: Geographic Information System and Database Methodologies https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c1.pdf

[75] Attachment C1: Geographic Information System and Database Methodologies https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c1.pdf

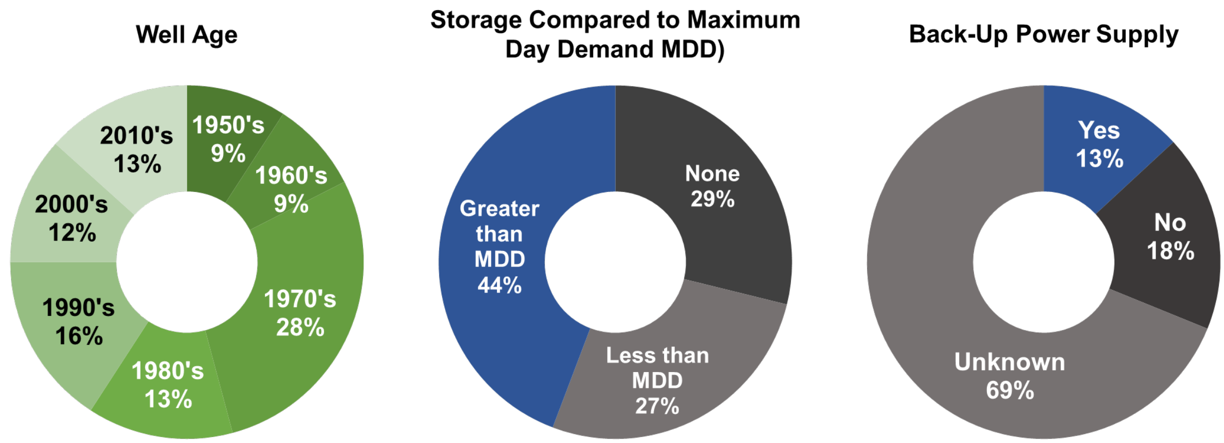
systems as of the spring of 2020. Figure C3 summarizes the different water quality violations in Kern County.

Figure C3: Kern County HR2W List Systems' Water Quality Violations



To examine contributing factors drivers of these challenges with more data, sanitary surveys[76] for 60 of the HR2W list systems in Kern County were analyzed to look at source age, source capacity, and storage capacity of the systems. Figure C4 summarizes the proportion of systems that may have additional infrastructure needs based on this review.

Figure C4: Additional Issues Identified for Kern County HR2W List Systems



The Kern County case study identified several challenges that are anticipated to be applicable

[76] The most recent Sanitary Surveys for Kern County Human Right to Water systems were provided by the State Water Board in PDF format.

across the state and utilized this information to develop more nuanced assumptions in the Model. These findings are summarized below and further discussed in Attachment C2.[77]

- In Kern County, 75% of the water systems served fewer than 200 connections. Small water systems having fewer technical, managerial and financial resources to leverage may need additional technical assistance or managerial support to achieve interim and long-term compliance.

- Approximately 48% of the water systems reviewed in the Kern County case study had only one well and thus lacked the water supply redundancy to meet current standards. These water systems frequently also had inadequate storage and no backup power. Therefore, water systems that are not consolidated may need additional water infrastructure redundancy to remain out of the At-Risk or Potentially At-Risk category.

- Only 25% of the wells were constructed within the past twenty years, indicating that at least some of the water system infrastructure is likely beyond its useful life. Aging infrastructure effects many of the water systems in Kern County. This is expected to impact the cost of consolidation/regionalization projects if receiving entities are hesitant to combine with water systems having poor existing infrastructure and/or increase the need for funding for infrastructure replacement.

The study also identified a high prevalence of 1,2,3-Trichloropropane (1,2,3-TCP) violations, which are likely in part a result of the relatively recent implementation of the maximum contaminant level, effective in December 2017. It was also observed that there was significant co-occurring contamination across Kern County with nitrate and that the presence of multiple contaminants will significantly increase treatment costs and complexity.

At the time, water quality information was not available for all state small water systems and domestic wells. Future iterations of the Cost Assessment Model would benefit from more specific information about these water sources and associated infrastructure. Regional water quality maps for selected constituents have been developed statewide by the State Water Board's Groundwater Ambient Monitoring and Assessment (GAMA) program.[78] Any domestic wells in areas of the state that were labeled as at risk of having source water quality issues mapped in the GAMA project were assumed to have those water quality issues. At the time of use in the long-term Cost Assessment, the GAMA model included the following constituents: arsenic, hexavalent chromium, nitrate, perchlorate, uranium, and 1,2,3-Trichloropropane. For the purpose of the Cost Assessment hexavalent chromium was not included, since there is no current regulation. State small water systems and domestic wells were considered "At-Risk" if they mapped into a grade 4, 5, or 6 area. Those grades indicated that the constituent had been found at or over the regulatory limit in the area. For state small water systems and local small

[77] Attachment C2: Kern County Case Study
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c2.pdf

[78] State Water Resources Control Board. 2020. Needs Analysis Groundwater Ambient Monitoring and Assessment (GAMA) Tool | GAMA Program.
https://gispublic.waterboards.ca.gov/portal/apps/webappviewer/index.html?id=292dd4434c9c4c1ab8291b94a91cee85

water systems in Monterey County, actual water quality results were used for the Cost Assessment. Details about this part of the methodology are in Attachment C1.[79]

IDENTIFYING POSSIBLE MODELED SOLUTIONS: ISSUES MAPPING TO POSSIBLE SOLUTIONS

For each category of issues identified, a range of potential solutions were considered in the Model. Tables C1 and C2 summarizes the issues and potential modeled solutions for the HR2W list and At-Risk PWS, and Table C3 identifies the issues and potential solutions for state small water systems and domestic wells. As more information becomes available for state small water systems, other potential modeled solutions can be added.

Table C1: Identified Issues and Potential Solutions for HR2W List Systems

Identified Issues	Potential Modeled Solutions
Water Quality	• Physical Consolidation • Centralized Treatment techniques • Point-of-Use or Point-of-Entry Treatment (less than 200 service connections).

• **Single Source**
• **Source Over 40-Years Old**
• **Insufficient Storage**
• **No Back-Up Generator**
• **Mains Over 40-Years Old**
• **No Meters**
	• "Other essential infrastructure" needed:
	  ○ New wells
	  ○ Storage tanks
	  ○ Booster pumps,
	  ○ Back-up generators
	  ○ Main replacement
	  ○ SCADA systems
	  ○ Meters

Insufficient TMF (Technical, Managerial, Financial) Capacity	• Technical Assistance (managerial support)

Table C2: Identified Issues and Potential Solutions for At-Risk PWS

Identified Issues	Potential Modeled Solutions
At-Risk due to Water Quality Accessibility, Affordability, and TMF Capacity	• Physical Consolidation

[79] Attachment C1: Geographic Information System and Database Methodologies
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c1.pdf

Identified Issues	Potential Modeled Solutions
• **Single Source** • **Source Over 40-Years Old** • **Insufficient Storage** • **No Back-Up Generator** • **Mains Over 40-Years Old** • **No Meters**	• "Other essential infrastructure" needed: ○ New wells ○ Storage tanks ○ Booster pumps, ○ Back-up generators ○ Main replacement ○ SCADA systems ○ Meters
Insufficient TMF (Technical, Managerial, Financial) Capacity	• Technical Assistance (managerial support)

Table C3: Identified Issues and Potential Solutions for At-Risk State Small Water Systems and Domestic Wells

Identified Issues	Potential Modeled Solutions
Water Quality	• Physical Consolidation • Point-of-Use or Point-of-Entry Treatment • Bottled Water where point-of-use or point-of-entry treatment is not a technically viable solution (e.g. high nitrate concentrations)

The following sections of this paper explain in greater detail the potential modeled solutions incorporated into the Model. Several additional potential modeled solutions were considered, but ultimately not included, because of a lack of information or due to uncertainty around the solutions ability to permanently address a water quality issue. Excluded modeled solutions include blending, managerial consolidation, and new wells in lieu of treatment. Additional information on these explored modeled solutions that were excluded can be found in white paper *Long Term Solutions Cost Methodology for Public Water Systems and Domestic Wells*.[80] In future iterations of the Cost Assessment, it may be beneficial to include these options if sufficient information becomes available.

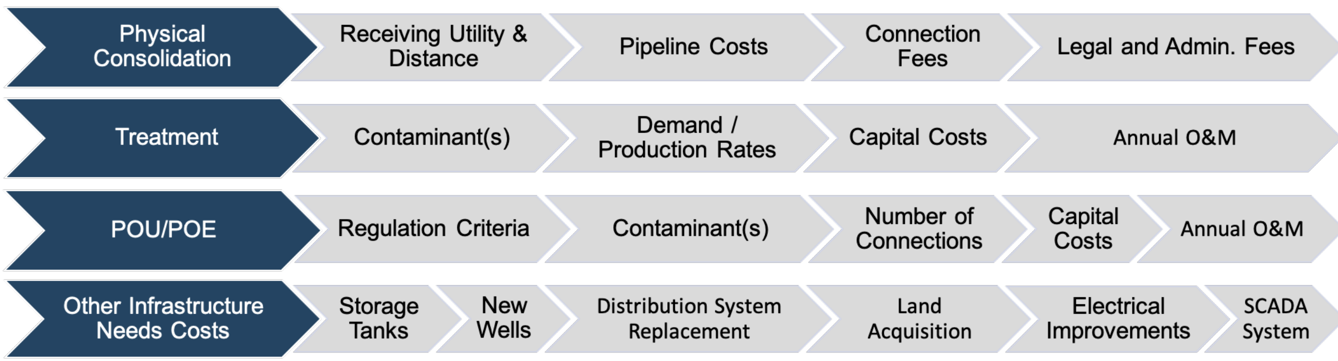
MODELED SOLUTIONS

The Cost Assessment methodology considers a range of regional and individual system-based model solutions for water systems and domestic wells as illustrated in Figure C5, along with additional considerations that are important to each potential modeled solution. The following

[80] White Paper: Long Term Solutions Cost Methodology for Public Water Systems and Domestic Wells
https://www.waterboards.ca.gov/safer/docs/draft_whitepaper_lt_solutions_cost_methd_pws_dom_wells.pdf

section describes the range of modeled solutions in more detail. In some cases, multiple modeled solutions were considered to address a water system's challenges.

Figure C5: Modeled Long-Term Solutions and Considerations Appraised



Interim Solutions

The State Water Board is committed to providing interim drinking water solutions in order to ensure a reliable and potable water source while longer-term solutions are being determined and implemented. Using historical cost data provided by the State Water Board, UCLA initially assessed the cost and feasibility of four interim measures: bottled water, POU or POE treatment, hauled water, and filling stations. Each of these considered interim measures had been deployed in previous or ongoing regional and statewide programs to provide emergency or interim drinking water access to communities in need.

For instance, during the 2012 – 2016 drought, dozens of water systems across the state struggled to provide drinking water to customers due to decreased water supply and increased concentrations of contaminants in diminishing water tables. The State Water Board deployed all four interim solutions evaluated in this analysis when it operated the Cleanup and Abatement Account (CAA) that funded interim emergency drinking water projects to address urgent needs in communities and schools. Projects eligible for the emergency interim drinking water funding included bottled water, vending machines, hauled water, and POU and POE treatment filtration devices. Data from these funded projects provided most of the real cost data used in this analysis.

However, relatively robust historical data to project interim solutions cost was only available for bottled water and POU and POE treatment, as opposed to hauled water (n=11 projects),[81] and communal filling stations (n=2 projects).[82] While communal access models for interim water

[81] Hauled water is typically used to supply locations with storage tanks (domestic well owners, schools, state smalls). Current allocations allow 50 gallons per person, per day for hauled water programs. A community-access model with common tanks had an average cost the cost per gallon to approximately $0.11 and allows communities without household storage tanks to benefit.

[82] At the time of data collection for this project, only two examples of state funded filling stations or vending machine programs exist, one of which charges customers $0.30 per gallon for water; the other provides 10-

showed promise in terms of per unit cost and feasibility of administration, their cost across the state could not be estimated until more data is collected. Accordingly, only bottled water and POU and POE treatment interim measures were applied to estimate the cost of interim supply to populations served by HR2W list systems and At-Risk state small water systems and domestic wells.

DAC status was assigned to HR2W list systems as detailed in the description of the %MHI indicator found in Appendix A. DAC status was assigned to At-Risk state small water systems and domestic wells based on the ACS block group data, also described in Appendix A, in which these water sources were found.

Bottled Water
For the purpose of this analysis, bottled water is defined as an "any water that is placed in a sealed container at a water-bottling plant to be used for drinking, culinary, or other purposes involving a likelihood of the water being ingested by humans."[83] The majority of literature on the cost of bottled water focuses on costs of locally purchased bottled water by residential consumers. State and Federal emergency preparedness plans include bottled water as an emergency water source when traditional water sources are unusable or inaccessible.[84] Types of bottled water provided by the State Water Board are typically either 1-gallon or 5-gallon bottles.

Point-of-Use (POU) or Point-of-Entry (POE) Treatment
Providing POU/POE treatment to customers served by affected water systems with less than 200 connections or domestic wells may be a viable interim and/or a necessary long-term solution option to address contaminants that exceed water quality standards. POU treatment was considered for most commonly occurring inorganic contaminants (for example nitrate or arsenic) and was not recommended when bacteriological contaminants exist.

POE treatment must be considered in the case of 1,2,3-TCP, or other volatile organic compounds, to address health impacts of inhaling the compounds during exposure in the shower for example. POU treatment is not acceptable for any contaminant that has a risk pathway beyond ingestion. Table C4 lists the contaminants that require treatment of this type, as determined in consultation with State Water Board staff. In communities where Nitrate levels exceed 25 mg/L filtration is no longer an effective option and bottled water must be provided as the interim solution.

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gallons at no charge to each household. Limited data on this option hinder the ability to conduct further analysis for the 2021 Needs Assessment.

[83] California Health and Safety Code Section 111070

[84] United States Environmental Protection Agency, "Planning for an Emergency Drinking Water Supply." (2011); California Governor's Office of Emergency Services, "Emergency Drinking Water Procurement & Distribution Guidance." (2014)

Table C4: Contaminants Treated by POU and POE

Point of Use (POU) Filtration	Point of Entry (POE) Filtration
Aluminum	1, 2 Dibromoethane (EDB)
Arsenic	1, 2-Dibromo-3-chloropropane (DBCP)
Antimony	1,2,3-Trichloropropane
Barium	Benzene
Cadmium	Benzo(a)pyrene
Chromium	Carbon Tetrachloride
Chromium Hexavalent	Chloroform
Copper	Di(2-ethylhexyl)phthalate (DEHP)
Fluoride	Dichloromethane (Methylene Chloride)
Gross Alpha radioactivity	MTBR (Methyl-tert-butyl ether)
Gross Beta radioactivity	N-Nitrosodimethylamine
Lead	Pentachlorophenol
Mercury	Tetrachloroethene
Nickel	Total Trihalomethanes
Nitrate	Trichloroethene
Nitrite	Vinyl Chloride
Perchlorate	
Radium 228	
Thallium	
Uranium	

Physical Consolidation

The challenges that water systems experience are often regional issues that stem from degraded source water quality, inconsistent source water availability, or the economic capacity of certain communities. Once challenges are identified at a regional and individual water system level, potential long-term solutions can be considered to eliminate current water quality violations and ensure long-term water quantity and water quality sustainability.

This methodology includes a regional component to identify opportunities where water systems and communities can work together to solve common issues. Some of the solutions evaluated that are aimed at resolving regional issues include:

Physical consolidation of two or more water suppliers that are geographically close together. Please refer to Attachment C1 for more information on the GIS methodology developed for this evaluation.[85]

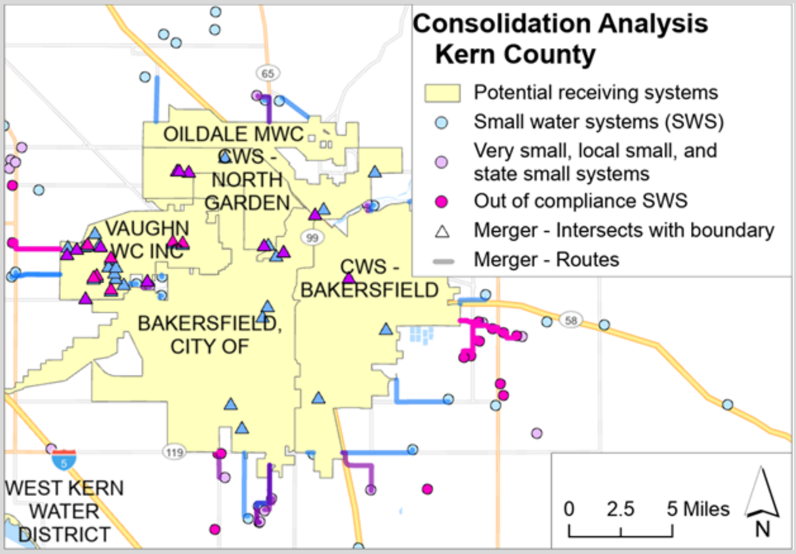
Physical consolidation is the joining of two or more water systems. For example, a small mobile home park that operates its own water system may be near or within a city (i.e. receiving system) and decides it no longer wishes to be responsible for providing drinking water. The city can begin providing water to the mobile home park through a master meter or other type of connection. Some of the benefits of physical consolidation include:

- The receiving water system may already have adequate treatment or the ability to construct water treatment that is designed to address the water quality challenges that impact area water supplies.
- The receiving water system may offer a diversified water supply portfolio affording optimization of available area water supplies to ensure that its population will not be faced with shortages. This alleviates small systems' issues with a lack of storage, inadequate pumping capacity, or inadequate individual well productivity.
- Consolidation of treatment and operations can improve water rate affordability by spreading costs over a larger customer base, decreasing redundant efforts and decreasing treatment costs through larger bulk purchases.
- Some physical consolidation projects may be in proximity to and thus allow for integration of small water systems, households served by domestic wells, and other At-Risk water systems, in addition to the targeted joining system. The physical consolidation analyses conducted as part of this methodology have determined the expected cost range of a given project.

Figure C6 shows an example physical consolidation analysis map. This methodology identified potential physical consolidation projects and even larger scale regional projects. While engineering and cost-modeling play a large role in consolidation and regionalization, the actual solution that will be implemented may be highly variable depending on other factors such as political boundaries, water rights boundaries, community interests, and other factors.

[85] Attachment C1: Geographic Information System and Database Methodologies
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c1.pdf

Figure C6: Example Physical Consolidation Analysis Map



Centralized Treatment

Treatment of groundwater or surface water to address contaminants that exceed water quality standards. Many of the water systems that were under evaluation, in particular those that were added to the HR2W list for recurring water quality violations, may require new or additional treatment. Some of the contaminants that have resulted in water quality violations in the systems under evaluation include:

- Arsenic
- Nitrate
- 1,2,3-TCP
- Disinfection byproducts - trihalomethanes (THM) and haloacetic acids (HAA)
- Perchlorate
- Uranium
- Surface Water Treatment and/or extensive bacteriological failures

In some cases, there were multiple treatment options that may effectively remove a contaminant. In other cases, there may only be a single treatment option that is currently available to treat a contaminant. And in yet other cases, there may be multiple contaminants that a water system needs treatment for. These realities ultimately impact the type of treatment required.

Other Needed Infrastructure

In addition to water quality challenges, many identified systems had additional infrastructure needs to address reliability and basic system operation. Examples of these items include storage tanks and booster pumps, second wells, replacement well(s), back-up generators, main replacement, etc.

Solution Options for State Small WATER SYSTEMS AND DOMESTIC WELLS

Physical consolidation and POU or POE treatment were considered in the model as the primary potential solution for State Small Water Systems and Domestic Wells. However, bottled water was also considered for those domestic wells that are believed to have nitrate levels exceeding 25 mg/L[86] as nitrogen because POU devices do not work at these levels.

No detailed information about the water quality of individual domestic wells was available and therefore several assumptions were required to be made. Locations of domestic wells were available as a count of wells in a square mile area. The status of the wells was unknown. Given the limitations of the existing data, this methodology assumed that all locations with domestic wells along a possible physical consolidation route could be connected to a public water system. Regional water quality maps for selected constituents were developed statewide by the State Water Board's Groundwater Ambient Monitoring and Assessment (GAMA) program.[87] As appropriate, POU or POE treatment was budgeted (or bottled water for some high nitrate levels) for any domestic wells in areas of the state that are expected to have the water quality issues mapped in the GAMA project and were not along a potential physical consolidation route. It is important to note that bacteriological water quality in domestic wells may also significantly alter the ability to use POU or POE but could not be modeled due to its site specific and changing nature.

DEVELOP COST ESTIMATES FOR MODELED SOLUTIONS

The Model methodology developed high-level cost estimates for the solutions that were identified as viable options to address water system challenges. The generalized costs developed did not include some site-specific details that will significantly impact total project costs. The estimates should thus be considered as planning numbers on a statewide level rather than a decision-making tool for a specific system. The following sections provide a summary of the potential modeled solutions considered and how the solution costs were developed.

COST ESTIMATION LEVEL OF ACCURACY

The methodology described above corresponds with a Class 5 cost estimate as defined by AACE International. Class 5 cost estimates are considered appropriate for screening level efforts and have a level of accuracy ranging from -20% to -50% on the low end and +30% to

[86] NSF/ANSI 58 – 2018, *Reverse Osmosis Drinking Water Treatment Systems*. Lists an influent nitrate concentration of 30 mg/L-N to achieve a treated water of 10 mg/L-N in the treated water. A safety factor has been applied to keep the treated water below 10 mg/L-N.

[87] State Water Resources Control Board. 2020. Needs Analysis Groundwater Ambient Monitoring and Assessment (GAMA) Tool GAMA Program. https://gispublic.waterboards.ca.gov/portal/apps/webappviewer/index.html?id=292dd4434c9c4c1ab8291b94a91cee85

+100% for an encompassing range of -50% to +100%. For the developed costs, the central tendency of the cost estimates is shown; however, it is important that the reader view each value with the accuracy in mind. For example, if a cost of $100 is presented, the corresponding range of anticipated costs is $50 to $200.

COST ESCALATION

Cost escalation has been accounted for using construction cost indices published by Engineering News-Record.[88] Capital and O&M costs have been adjusted as appropriate to January 2021 values. This approach will be replicated as future iterations of the model are executed to provide a reflection of current day costs.

NET PRESENT WORTH DEVELOPMENT

Lifecycle costs of selected alternative are presented in net present worth terms. All net present worth costs are developed using a 20-year period and 4% annual discount rate.

REGIONAL COST ADJUSTMENT

To adjust the cost estimates presented in the subsequent sections for regional cost variance, the Model applied an RSMeans[89] City Cost Index (CCI). RSMeans catalogs a database of material, labor and equipment costs across the United States and creates an RSMeans CCI number for selected cities. This CCI was used to compare or adjust costs between locations and the national average. For 2019, the most recent data publicly available, the national average CCI is 3.0. Not all cities have a CCI assigned, in which cases relatively similar CCI were selected by county based upon urban and rural considerations.

Cost estimates for treatment equipment and general civil site work were assigned the national average CCI of 3.0. The California CCI shown in Table C5 was then applied to adjust modeled capital costs based on each water system's location.

Table C5: RSMeans CCI Selected for Locational Cost Estimating

RSMeans City	Generalized Model Location	RSMeans CCI	Percent Adjustment
National Average	**Rural**	+3.0	0%
Oakland	**Urban**	+3.97	+32%
San Jose	**Suburban**	+3.89	+30%

[88] https://www.enr.com/economics

[89] RSMeans City Cost Index
https://www.rsmeans.com/rsmeans-city-cost-index

The categorization of counties by the generalized location for applying a CCI is shown in Table C6.

Table C6: California Counties Categorized by Generalized Model Location

Generalized Model Location	Counties
Rural	Alpine, Amador, Butte, Calaveras, Colusa, Del Norte, Fresno, Glenn, Humboldt, Imperial, Inyo, Kern, Kings, Lake, Lassen, Madera, Mariposa, Mendocino, Merced, Modoc, Mono, Nevada, Placer, Plumas, San Joaquin, Shasta, Sierra, Siskiyou, Stanislaus, Sutter, Tehama, Trinity, Tulare, Tuolumne, Yolo, Yuba
Suburban	Alameda, Contra Costa, El Dorado, Marin, Monterey, Napa, Orange, San Benito, San Bernardino, San Luis Obispo, Santa Barbara, Santa Cruz, Solano, Sonoma
Urban	Los Angeles, Riverside, Sacramento, San Diego, San Francisco, San Mateo, Santa Clara, Ventura

INTERIM SOLUTION COSTS

The evaluation of interim solutions primarily used data provided by the Division of Financial Assistance (DFA) regarding previous and currently funded interim drinking water projects, as well as knowledge on solution operation derived from conversations with multiple DFA staff. In addition to the data provided by the DFA, Interim Emergency Drinking Water and Drought Related funding applications publicly available on the Water Board's Financial Assistance Application Submittal Tool (FAAST) were reviewed. In some instances, the FAAST applications provided supplementary documents such as Scopes of Work, Project Timelines, and Itemized Budgets.

For a better understanding of how interim solutions are deployed in the field, interviews were also conducted with professional staff at organizations administering interim solutions and with staff of private companies providing the interim solutions. Secondary sources such as media stories with interim solution providers and emergency water recipients also provided corroborative insight into the costs of providing and maintaining interim drinking water solutions. When necessary, cost estimates derived from literature or other publicly available documents were used to supplement the cost data from the Water Board.

Interim solutions costs were only estimated for populations served by public water systems on the HR2W list and for At-Risk state small water systems and domestic wells, with a sub-analysis focusing only on the populations that also live in DACs. Based on board staff input, the term of interim water provision estimated was 6 years for HR2W list systems and 9 years for At-Risk state small water systems and domestic wells. Each domestic well was considered an individual connection. As in the long-term solution cost model, state small water systems are assumed to have 8 connections when connection data is not available for them.

In terms of deciding between bottled water versus POU or POE as an interim solution, POU or POE was assigned in every case where it was feasible given that it also has potential as a longer-term solution. That is, POU or POE was assigned in every case where either of these treatment technologies would address the underlying water quality issue(s) causing the water system, state small water systems, or domestic well to be on the HR2W list or At-Risk. Also, POU and POE were only assigned for systems serving 200 connections or less, as noted above.

Bottled Water Costs

To determine a cost per gallon figure, this analysis reviewed data on projects previously funded by the Water Board for 67 public water systems and 18 school systems. These findings were compared with estimated costs per gallon found in 48 applications for emergency bottled water projects in the FAAST database. The analysis considers the costs derived from FAAST applications but uses only costs from the funded projects and DFA analysis where there is confidence in actual spending amounts. DFA guidelines allocate a quantity 60 gallons of bottled water per month per connection for public water systems and 0.25 gallons per school day per person for school populations.

For the bottled water projects funded by the Water Board for 67 public water systems, the median cost of bottled water was $0.98 per gallon and the mean was $1.18 per gallon. In the funded school-system projects (at 18 school systems), the median cost of providing bottled water to school systems was $1.24 per gallon and the mean cost was $1.56 per gallon. Analysis provided by DFA of the cost per gallon for bottled water in school systems finds the cost per gallon to be $1.20 applied over a 180 day “school year”. The DFA figure is used in the analysis due to the small size of the school system data set.

This analysis attempted to explore potential factors driving variation in the average across systems: system size, duration of interim supply, system governance type, and location in the state. Due to the small sample size of past projects, however, the analysis could not confidently use these factors to model variation in cost per gallon of bottled water delivery for HR2W list systems.

The California Office of Emergency Services Emergency Drinking Water Procurement & Distribution Planning Guidance also contains a standing contract that the California Office of General Services Procurement Division entered into in 2014 and reports similar costs per gallon. This allows state and local governments to purchase emergency bottled water directly through the state contract. A half truckload of bottled water ranges from $0.98 - $1.58 per gallon per pallet while a full truckload costs $0.97 - $1.56 per gallon per pallet.[90]

Overall, these costs were in line with common bulk retail costs for bottled water, so there do not appear to be any apparent economies of scale advantage at play in the Board’s procurement and distribution process. This analysis tried to identify evidence of cost savings through economies of scale. As of yet, there is no evidence that the state benefits from bulk

[90] California Governor’s Office of Emergency Services, “Emergency Drinking Water Procurement & Distribution Guidance.” (2014)

bottled water agreements. There is anecdotal evidence that suggests in some school districts achieved cost savings in competitive bids or bulk purchasing but these costs savings cannot be confirmed or applied across the state.

There is also anecdotal evidence of project specific cost savings with local bottled water vendors or distributors offering reduced rates for bulk purchases or bidding a lower per-gallon rate in order to secure a purchase. However, there was no evidence to support that this would scale to a statewide level, due to the local conditions that play a part in these cost savings. Without cost savings the costs of providing bottled water can quickly add up when meeting daily consumption needs.

POU/POE

The Cost Assessment Model utilizes the same POU/POE costs for both long-term solutions and interim POU/POE solutions because many of the requirements related to POU/POE apply in both cases, e.g. pilot studies, water quality monitoring, etc. In some cases, fewer POU/POE units may be allowed for interim solutions as opposed to longer-term solutions. As the number of POU/POE units are determined on a case by case basis and current regulations require long-term POU/POE installations to be re-assessed every three years, the same cost assumptions are applied. Therefore, additional detailed cost information can be found below on POU/POE in the long-term solutions section.

PHYSICAL CONSOLIDATION COSTS

Capital Costs

The cost methodology for physical consolidation was based on previous work, entitled Cost Analysis of California Drinking Water System Mergers[91], which was completed by Corona for the Water Foundation. For the Needs Assessment, the cost details were updated. The approach was initially based on the method developed through a project at the UC Davis Center for Regional Change.[92] The costs accounted for in the physical consolidation of systems include:

- The capital costs of pipeline[93] needed to connect systems.
- Connection fees[94] charged by the receiving water system.
- Legal and administrative costs[95] to develop necessary agreements between connecting systems.

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[91] https://waterfdn.org/wp-content/uploads/2019/08/COSTAN1.pdf

[92] London, J.; Fencl, A.; Watterson, S.; Jarin, J.; Aranda, A.; King, A.; Pannu, C.; Seaton, P.; Firestone, L.; Dawson, M.; & Nguyen, P., 2018. The Struggle for Water Justice in California’s San Joaquin Valley: A Focus on Disadvantaged Unincorporated Communities. UC Davis Center for Regional Change.

[93] Provided by QK, Incorporated, which is an engineering design firm in the Central Valley.

[94] Based on the connection fees of 42 water systems reviewed.

[95] The legal and administrative cost assumption is based on information from an Investor Owned Utility for recent acquisitions in California. No other data or case studies are available.

- Service lines for systems already within the service area of another system (intersecting systems)
- A 20% contingency addition on the total.

Upgrades, such as back flow prevention, tanks, and metering required by receiving water system were addressed in the OEI needs section. The State Water Board recognizes that further analysis of corrosion control issues, disinfection byproduct formation, and residual degradation will need to be considered on a case-by-case basis but that it is highly location dependent and thus is out of the scope for this cost model.

The cost of physically consolidating systems can vary widely depending on several factors. High-level cost estimates were developed for this methodology which leverage existing California case studies from systems that have accomplished physical consolidation.

The distance along roadways from a joining system to a receiving system was determined using the methodology described in Attachment C1.[96] Physical consolidation costs were calculated as the sum of pipeline costs, service line costs, connection fees, and legal and administrative costs for system acquisition, with a 20% contingency. Cost assumptions are shown in Table C7. For domestic well pickups, $15,000 was also added for well destruction.

Table C7: Physical Consolidation Costs

Item	Cost Assumption
Pipeline Cost[97]	$155 per linear foot
Service Line Cost	$5,000
Connection Fees[98]	$6,600 per connection[99]
Legal and Administrative Costs for System Acquisition[100]	$200,000
CEQA	$85,000
Contingency	20% applied to total

[96] Attachment C1: Geographic Information System and Database Methodologies
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c1.pdf

[97] Provided by QK, Incorporated, which is an engineering design firm in the Central Valley. 12" C-900 PVC main was selected in order to achieve 1,500 gpm flow to accommodate fire flow.

[98] Based on the connection fees of 42 water systems reviewed.

[99] For some systems (many state small water systems (SSWS)) population and connection information was not available; for these systems the number of connections was set to eight. The connection fee is based on the average connection fee reported in the 2018 Electronic Annual Report for large systems (3,000 connections or more), excluding connection fees of $500 or less. This resulted in data from 180 systems being included in the average.

[100] The legal and administrative cost assumption is based on information from an Investor Owned Utility for recent acquisitions in California. No other data or case studies are available. CEQA costs are included in this cost assumption.

In the case of elevation changes, due to physical consolidation, that would result in a pressure loss over 10 psi, two booster stations were budgeted: one for fire flow, and another capable of meeting Maximum Day Demand (MDD). Property cost was assumed to be $150,000 for a 100-foot by 100-foot lot. The booster station cost is discussed in the OEI Needs section.

Operational Costs

Physical consolidation can result in additional electrical costs due to the need to pump water to overcome head loss due to pipeline friction and elevation changes. The elevation changes along pipeline routes were determined, along with the pipeline length. These were used to estimate the additional electrical costs.

WELL HEAD TREATMENT COSTS

Treatment costs relied on three components: (1) estimating water demand, design and average flow rates, (2) determining the appropriate treatment solution, and (3) developing capital and operational cost details. The following sub-sections describe the methodology for each. Additional details about the cost methodology for treatment are available in Attachment C3.[101]

Estimating Water Demand, Design, and Average Flow Rates

The development of suitable water demand approximations for each drinking water system was required for the selection of a successful treatment or non-treatment option. Water demand approximations were especially important when developing capital costs and ongoing operations and maintenance costs. As there was no site-specific information for the systems included on the HR2W list and At-Risk lists, system water demands were calculated based on the methodology outlined in the *1,2,3-Trichloropropane Maximum Contaminant Level Regulations Initial Statement of Reasons.*[102]

An average daily demand (ADD) of 150 gallons/person/day was applied to the system population obtained from the SDWIS database. This ADD was based on the water usage provided to the State Water Board by 386 California urban water suppliers in June 2014 with an additional 10% demand. This value can be adjusted in the future to better reflect the water usage at that time. A peaking factor of 1.5 was applied to the ADD to calculate the MDD as stated in the *1,2,3-Trichloropropane Maximum Contaminant Level Regulations Initial Statement of Reasons* and in the California Code of Regulations title 22, division 4, chapter 16, section 64454.

[101] Attachment C3: Treatment Cost Methodology Details
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c3.pdf

[102] California Water Boards. (2017). Initial Statement of Reasons 1,2,3-Trichloropropane Maximum Contaminant Level Regulations. Title 22, California Code of Regulations:
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/123-tcp/sbddw17_001/isor.pdf

To ensure that the proposed treatment capacity was conservative and to recognize that it was unrealistic to assume a source continuously operates 24 hours per day, treatment capacity was instead calculated by assuming the MDD must be produced during 16 hours a day, resulting in a 33% increase in capacity for treatment units and back-up wells.

Identifying Appropriate Treatment Solutions

HR2W list system violation types were identified, and only approaches listed as Best Available Technologies (BAT) in Title 22[103] were considered for treatment. A summary of the BATs for many of the violation types found in the HR2W list data are summarized in Table C8 below. Although adsorption was not listed as a BAT for arsenic removal, it was considered for small systems because of demonstrated performance and ease of operation.

Table C8: Summary of Drinking Water Best Available Technologies (BATs) for Common Groundwater Violations

Violation Type	Regulatory Limit (MCL)	Chemical Class	Best Available Technology (BAT)
Arsenic[104]	10 µg/L	Inorganic	Activated Alumina, **Coagulation/Filtration**,[105] Lime Softening,[106] Reverse Osmosis, Electrodialysis, Oxidation Filtration
1,2,3-TCP	5 ng/L	Organic	Granular Activated Carbon (GAC)
Nitrate	10 mg/L as NO_3	Inorganic	**Ion Exchange**, Reverse Osmosis, Electrodialysis
Uranium (Combined)	20 pCi/L	Radionuclides	**Ion Exchange**, Reverse Osmosis, Lime Softening,[107] Coagulation/Filtration
Fluoride	2 mg/L	Inorganic	Activated Alumina

With the exception of 1,2,3-TCP and fluoride, each of the violation types shown in the table had multiple BATs. For this methodology, treatment approaches were limited based on the assumption that liquid stream residuals disposal is not available on-site at impacted systems. This assumption eliminated processes like reverse osmosis and electrodialysis because the residuals volume requiring disposal would be physically and cost- prohibitive. Further, while processes like lime softening may be effective for some contaminants, they are rarely implemented for impacted systems. Capital and operational costs were developed for the

[103] State of California Drinking Water-Related Regulations https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Lawbook.html

[104] Adsorption technology, although not listed as a BAT, was considered for arsenic treatment in small systems because of demonstrated experience and ease of operation

[105] Not considered BAT for systems <500 service connections

[106] Not considered BAT for systems <500 service connections

[107] Not considered BAT for systems <500 service connections

technologies in bold in Table C8, with the exception of arsenic where adsorption was assumed for systems of with less than 500 service connections due the relatively simple operations when compared to coagulation/filtration.

Estimating Water Treatment System Capital Costs

Potential water treatment solutions can vary considerably based upon site-specific considerations. In some cases, water systems that have multiple wells install water treatment systems on only the wells that were impacted by contaminants that pose a threat to human health. In other cases, if multiple wells in a water system were impacted by the same contaminant(s), pumping the impacted groundwater to a centralized treatment facility may be more cost effective. Due to the lack of individual well location data, this methodology did not develop such ancillary costs associated with centralized treatment.

The methodology of the cost model did consider the fact that treatment costs were generally non-linear as a function of source capacity where the unit cost of water produced tends to increase as production capacity decreases.

Some of the other factors that may influence the capital cost associated with installing new treatment systems include:

- Land that may need to be purchased to accommodate treatment system facilities
- The availability of pre-constructed treatment systems vs. the need to construct customized treatment
- Treatment system capacity requirements
- Complexity of system, if treating multiple contaminants
- Electrical improvements for system operation
- Wellhead improvements to overcome additional head loss

For the methodology, treatment system capital costs were derived from a variety of sources including costs models, peer reviewed articles and manufacturer supplied information. An example of sources used is provided in Table C9 with example contaminant types.

Table C9: Data Sources Used for the Development Capital Cost Estimates

Technology	Example Contaminants	Data Source	Notes
Granular Activated Carbon (GAC)	Volatile organics and Total Organic Carbon (TTHM, HAA)	Vendor Supplied Quotes	Outputs developed over a range of system sizes, based on commercially available equipment

Technology	Example Contaminants	Data Source	Notes
Anion/Cation Exchange	Nitrate, uranium gross alpha due to uranium, radium, and perchlorate	EPA Work Breakdown Structure[108]; calibrated to recent bid costs	Calibrated to recent bid costs for small-scale treatment systems
Coagulation Filtration	Arsenic, and iron and manganese	Vendor Supplied Quotes	Regressions used to inform costs of coagulation filtration
Surface Water Package Plant	Surface Water Rule Treatment violations	Vendor Supplied Quotes	None
4-Log Virus Inactivation	Surface water and groundwater under the influence of surface water	Vendor Supplied Quotes	None
Adsorption	Arsenic and fluoride	Vendor Supplied Quotes	Regressions used to inform costs of adsorption systems

Engineering multipliers were applied to the treatment equipment capital cost estimates to develop an estimate of the installed capital costs. Due to the varied data sources providing capital cost estimates for a range of equipment with unique installation requirements, the engineering multipliers were modified for each treatment technology. Included in the multipliers were cost estimates for installation of the treatment equipment, general site work, electrical, contingency, and other planning and administrative fees. Installation costs can vary widely depending on the individual site constraints, and these multipliers were only used to provide a Class 5 estimate. Table C10 displays the engineering multipliers used for each treatment technology.

Table C10: Engineering Multipliers Applied to Treatment Technology Capital Costs

Technology	Multiplier
GAC	2.36
Anion/Cation Filtration	2.36 to 3.06[109]
Coagulation Filtration	2.36
Fluoride	3.06
Surface Water Package Plant	3.06

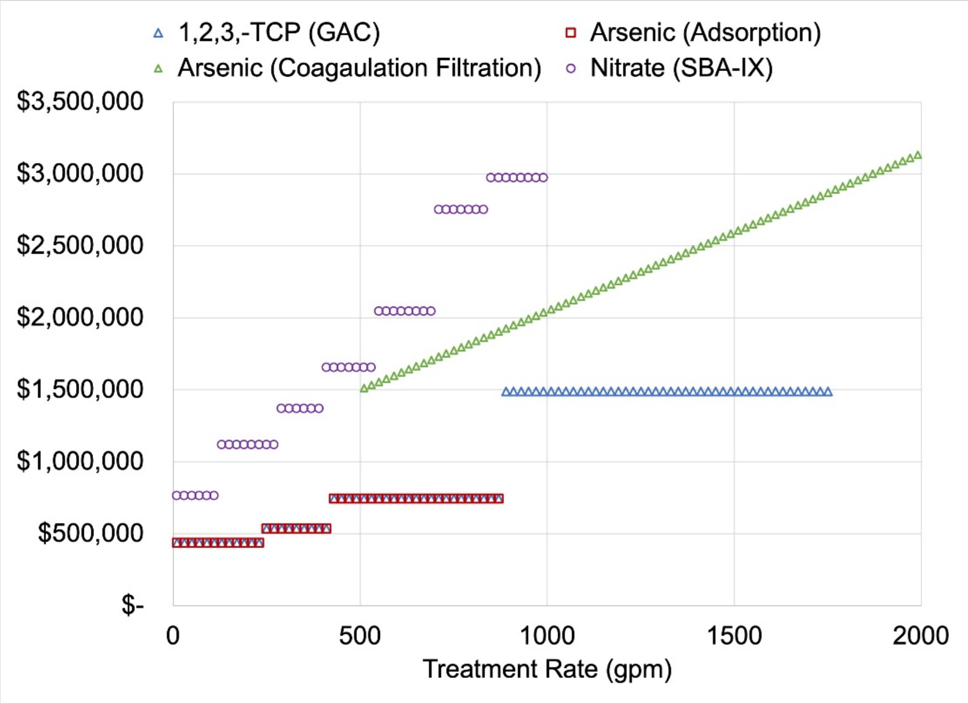
[108] Drinking Water Treatment Technology Unit Cost Models
https://www.epa.gov/sdwa/drinking-water-treatment-technology-unit-cost-models

[109] Indirect/installation costs included in the EPA Work Breakdown Structure plus 20% contingency

Technology	Multiplier
4-Log Virus Inactivation	3.06
Absorption	2.36

Attachment C3 contains the detailed methodology for each capital cost by technology.[110] An example of the resulting treatment costs for the most commonly applied treatment solutions is shown in Figure C7 as a function of flow rate. The treatment approach is shown in parenthesis following the contaminant's name. As described below, the same capital costs were applied for arsenic adsorption and GAC treatment which is illustrated by the overlap of these data series.

Figure C7: Installed Treatment Capital Cost Comparison Between Common Contaminants



Estimating Water Treatment System O&M Costs

While capital costs were an important factor to consider in the evaluation of water treatment solutions, it was just as important to have an understanding of the expected annual costs to operate and maintain a water treatment system. Operational costs for consumables were

[110] Attachment C3: Treatment Cost Methodology Details
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c3.pdf

typically driven by the volume of water that required treatment annually and the expense of having a certified operator oversee the treatment process. Examples of operational costs considered included the following:

- Consumables
    - Chemicals
    - Media replacement: Granular activated carbon (GAC), ion exchange resin, green sand, activated alumina, other adsorbents, etc.
- Disposal of water treatment residuals: Ion exchange brine, coagulation filtration dewatered solids, spent media
- Electricity
- Additional monitoring and reporting
- Labor

Attachment C3 contains the detailed methodology of the Operational and Maintenance (O&M) cost by technology.[111] Operational costs were estimated by soliciting costs for consumables including chemicals and media. The cost of water treatment residuals disposal can be more variable. Options available for disposal may vary depending on the volume of residuals that are estimated annually. For this analysis it was conservatively assumed that sewer access was not available, and all residuals required off-site management. A 20-year operations and maintenance cost were used to develop a lifecycle cost comparison. Electrical costs were estimated based on the median cost of electricity in California ($0.1646/kWh[112]) and assuming a 10 PSI pressure loss across the system.

An example of the relative O&M costs for different treatment approaches is summarized in Figure C8. Note that the costs displayed only account for consumables and residual disposal as these components were modeled linearly as a function of water produced.

[111] Attachment C3: Treatment Cost Methodology Details
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c3.pdf

[112] U.S. Energy Information Administration
https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_6_a

Figure C8: Comparison of Annual O&M Consumable & Disposal Costs by Treatment

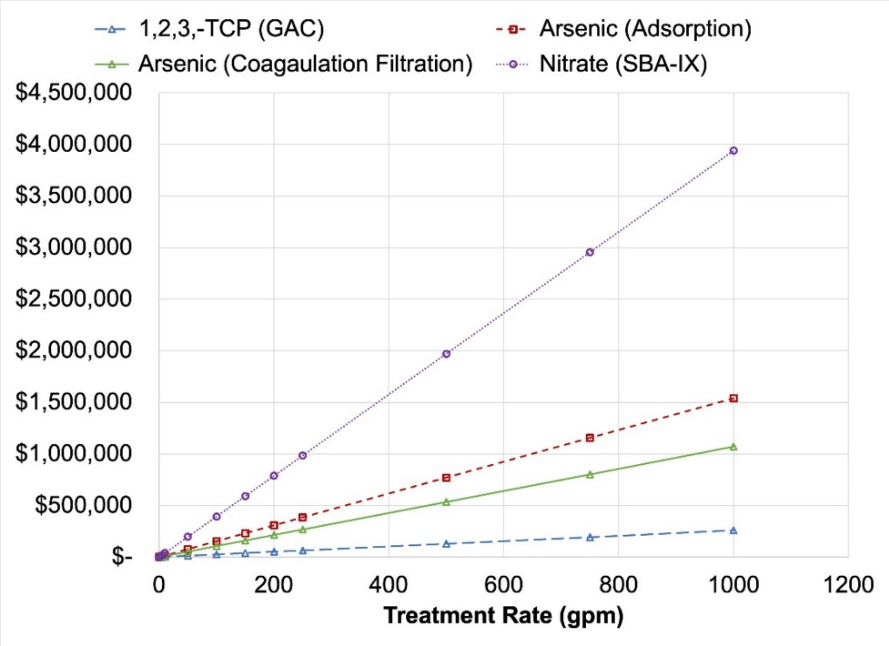


Table C11: Operator Salary and Benefits by Certification Levels[113]

Certification Level	Average of Total Pay, Including Benefits
T1	$ 97,000
T2	$ 105,000
T3	$ 132,000
T4	$ 164,000
T5	$ 181,000

Operator certification requirements were determined by the State Water Board, and for this model operator certification requirements were assumed as shown in Table C12. For budgeting purposes, operator labor cost was estimated by bins. Costs were binned by probable operator certification requirement and how much labor was required for each type of treatment. For example, both surface water treatment and nitrate treatment were considered to take 25% of a full-time operator. Surface water treatment was assumed to need a T4 operator, while nitrate treatment was assumed to need a T2 operator. Originally a T3 operator was

[113] Transparent California
https://transparentcalifornia.com/salaries/search/?page=20&y=2018&q=treatment+operator&s=-base
Base salaries and benefits from Transparent California were analyzed by Gregory Peirce at UCLA using 2018 data. Outliers were removed. Labor cost was adjusted to 2020 dollars.

specified for a water system with multiple contaminants, but the operator labor is associated with each treatment type specified, so systems with multiple contaminants have operator labor accounted for with each treatment unit, rather than one T3 operator labor rate.

Table C12: Annual Operator Labor Cost Estimate

Certification and Treatment Type	Percent of Full Time	Annual Cost
T4 Surface Water with high levels of source contamination	25%	$41,000
T2 High time intensity treatment (nitrate)	25%	$27,000
T2 Medium time intensity (U, As using CF)	20%	$22,000
T2 Low time intensity (GAC, Fe/Mn removal)	10%	$11,000

For many small systems, operator labor costs were a substantial part of annual operations and maintenance costs. Therefore, operator labor was kept as a separate line item in the operations and maintenance category for clarity.

POINT OF USE/POINT OF ENTRY TREATMENT COSTS

Point of Use or Point of Entry treatment was considered an option for public water systems with less than 200 connections and for state small water systems and domestic wells due to the complexity of monitoring and addressing units with individual residences. As previously discussed, Point of Entry Granular Activated Carbon (GAC) treatment was considered in the case of 1,2,3-TCP, or other volatile organic compounds to address health impacts of breathing the compounds during exposure in the shower. Point of Use treatment was considered for most commonly occurring inorganic contaminants (for example nitrate or arsenic). Point of Use was not recommended for nitrate over 25 mg/L[114] as nitrogen or for wells with bacteriological problems.

Limited installations of this type of treatment had been completed in California, and the costs have not always been clearly documented. The costs of POU and POE treatment were developed based on projected costs detailed in Table C13 and Table C14. The methodology assumed full replacement of the POU or POE treatment unit at 10 years. The cost for communication for POU or POE treatment is summarized in the next section.

[114] NSF/ANSI 58 – 2018, *Reverse Osmosis Drinking Water Treatment Systems*. Lists an influent nitrate concentration of 30 mg/L-N to achieve a treated water of 10 mg/L-N in the treated water. A safety factor has been applied to keep the treated water below 10 mg/L-N.

Table C13: Estimated Capital Cost for POE and POU Treatment

Treatment	Capital Cost per Connection	Installation Labor cost per Unit ($100/hr)	Admin/Project Management	Communication Cost
POE GAC Treatment	$3,700[115]	$1,000	$1,000	$300
POU Reverse Osmosis Treatment	$1,500[116]	$200	$1,000	$300

Note: For state small water systems and domestic wells an additional initial analytical budget of $500 was included because these wells rarely have water quality data.

Table C14: Estimated Annual Operations and Maintenance (O&M) for POE and POU Treatment

Treatment	Annual O&M per Connection	Operator and Communication Labor ($100/hr)	Analytical	Total
POE GAC Treatment	$410 (Prefilter and GAC Replacement 2x/year[117])	$300	$250 ($125 2x/year[118])	$960
POU Reverse Osmosis Treatment	$100 (Prefilter and Membrane Replacement 2x/year [119])	$300	$40 - $110 (2x/year)	$440 - 510

OTHER ESSENTIAL INFRASTRUCTURE (OEI) NEEDS

Many of the HR2W list and At-Risk public water systems may have additional infrastructure needs that need to be addressed in order to make the system more sustainable. The following list of additional other essential infrastructure (OEI) needs was developed based on the Kern

[115] Based on costs of available POE treatment units in California.

[116] Vender provided costs.

[117] Based on vendor recommendations and pricing.

[118] Pricing quotes provided by BSK Analytical, in Fresno, California.

[119] Based on vendor recommendations and pricing, with freight.

County case study analysis[120] and refined based on public feedback. The Cost Assessment Model applies the percentages detailed in Table C15 to all HR2W list systems and At-Risk PWSs. The following sections detail the cost estimates derived for these OEI needs.

Table C15: Changes in OEI Needs for HR2W List and At-Risk PWSs

Infrastructure	Kern County Case Study Analysis	Cost Assessment Model Assumptions
Add a second well	All systems with one well	80% with one well
Replace well due to age	46%	26%
Replace well pump and motor	29%	9%
Upgrade electrical	29%	9%
Additional storage	56%	36%
Add back-up power	58%	38%
Replace distribution system	66%	31%
Add meters	82%	31%
Managerial assistance	All systems	80%
Land acquisition for additional storage	56%	10%
Land acquisition for adding a second well	All systems with second well	5%

New Groundwater Well(s)

Many systems needed a new well to replace aging infrastructure or provide reliable production capacity. Based on the Kern County HR2W list systems analysis, detailed in Attachment C2, the following assumptions were developed for HR2W list and At-Risk Public Water Systems:[121]

- 47% need a second well
- 26% need a replacement well due to well age

Costs, shown in Table C16, for a range of new well sizes and flow rates were developed by QK, Incorporated, a design-engineering firm located in the Central Valley. Cost for land purchase of a 100-foot by 100-foot lot was assumed to be $150,000. These costs were likely more representative of costs in the Central Valley than more expensive parts of the state.

[120] Attachment C2 contains the details of the Kern County analysis and how these assumptions were derived. Attachment C2: Kern County Case Study
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c2.pdf

[121] Attachment C2: Kern County Case Study
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c2.pdf

However, a CCI index adjustment was applied based on location to make the costs more locally grounded.

Additionally, 1,000-foot well depth costs were used in the cost model. In other regions across the state, well costs may be higher, but wells tend to be shallower. Also, in hard rock regions two wells may be required instead of one to achieve adequate capacity.

Test holes were assumed to be needed to understand the water quality at different depths since contamination is likely present.

In some cases, a new well could successfully be installed to avoid the local contaminant of concern and the corresponding cost of treatment. However, newly drilled wells often face the same water quality issue or a different water quality issue requiring treatment. A new well, for the purpose of this methodology, was not assumed to alleviate the need for treatment.

Table C16: New Well Drilling Costs

Depts (feet)	Test Hole Drilling & Zone Sampling (5 Zones) Cost	Production Well Drilling Cost
500	$120,000	$500,000
1,000	$140,000	$650,000
1,500	$170,000	$770,000

Assumptions:

- Test holes drilled by casing hammer method
- Production well drilling is separate from test hole drilling
- 500 foot depth for new wells at $500,000
- $150,000 added for land acquisition,[122] in addition to the tank costs
- $85,000 for CEQA, in addition to the tank costs

Table C17: New Well Development Costs

Estimated Production (gpm)	Cost
500	$120,000
1,000	$140,000
1,500	$170,000

[122] Land acquisition was assumed to be needed for each new well and tank. This is an assumption that should be further refined in the future with actual data from DFA.

Table C18: New Well Pump and Motor Costs

Motor Size (HP)	Rates Flow (gpm)	Cost
25	85	$125,000
50	170	$135,000
75	255	$155,000
100	340	$165,000
150	500	$190,000
300	1,000	$250,000

List of Well Assumptions:

- 500-foot depth
- Vertical turbine pumps
- Variable Frequency Drive (VFD) equipped
- Discharge pressure of 55 psi
- 20 feet draw down
- 800-foot static water level
- Surface mounted motor
- New power and control connection

Table C19: New Well Electrical Upgrade Costs

SCADA (cost per site)	Electrical Upgrades Cost per Site
$100,000[123]	$440,000

Assumptions:

- Main switchboard and motor control center
- Electrical conduit and wire - all equipment on a single 200' x 200' site
- Site lighting
- Transformer slab

An additional construction multiplier of 0.25 was added to account for engineering, permitting, and other construction costs, such as mobilization and demobilization. The construction multiplier was developed by QK Inc. in conjunction with their cost development. The multiplier is broken down in Table C10. An estimated cost for CEQA permitting was added along with the multiplier.

[123] Based on public feedback, SCADA costs were excluded from OEI costs.

Distribution System Replacement, Tanks, Electrical Improvements and Meters

In addition to new well construction, HR2W list systems and At-Risk PWS often have other assets that had not been properly maintained or were never installed at the time of system construction. For instance, a system may not have had enough storage to meet MDD, thereby requiring a storage tank to alleviate the problem. With this in mind, examples of needs for which high-level cost[124] estimates that have been developed and included in the cost estimate are shown in Tables C20 through C27.

Table C20: OEI Costs: Pipelines C-900 PVC

Pipeline Diameter	Cost per Foot	Rates Flow (gpm)
4"	$75	195
6"	$90	440
8"	$100	780
12"	$140	1,750

Assumptions:

- 3 feet burial, C900 pipe
- Open trenching (add $15/LF for asphalt replacement)
- Maximum velocity of 5 fps

Table C21: OEI Costs: Hydro-Pneumatic Tanks

Volume (gallons)	Cost
2,000	$35,000
4,000	$41,750
10,000	$62,100

Assumptions:

- Gross Volume (water storage volume roughly 50% of gross)
- Includes top mounted air compressor
- $150,000 added for land acquisition[125]

[124] Costs for the major capital improvements provided by QK, Incorporated, which is an engineering design firm in the Central Valley.

[125] Land acquisition was assumed to be needed for each new well and tank. This is an assumption that should be further refined in the future with actual data from DFA.

Table C22: OEI Costs: Ground Level Tanks

Volume (gallons)	Cost
50,000	$150,000
100,000	$250,000
250,000	$500,000
500,000	$875,000
1,000,000	$1,200,000

Assumptions:

- Bolted steel
- Ring wall base
- No corrosion protection
- $150,000 added for land acquisition, in addition to the tank costs
- $85,000 for CEQA, in addition to the tank costs

Table C23: OEI Costs: Booster Pump Systems (One Operational and One Standby)

Capacity (gmp)	Motor Size (HP)	Cost
100	5	$40,000
200	10	$70,000
300	15	$82,000
400	20	$100,000
500	25	$115,000
750	35	$130,000
1,000	60	$150,000

Assumptions:

- VFD Package system - skid mounted with PLC and controls
- Piping and valving between pumps included
- Electrical costs not included
- Discharge pressure of 55 psi assumed

Table C24: OEI Costs: Well Pump and Motor Replacement

Motor Size (HP)	Rate Flow (gpm)	Cost
25	85	$125,000
50	170	$135,000

Motor Size (HP)	Rate Flow (gpm)	Cost
75	255	$155,000
100	340	$165,000

Assumptions:

- 500-foot depth
- Vertical turbine pumps
- VFD equipped
- Discharge pressure of 55 psi
- 20 feet draw down
- 800-foot static water level
- Surface mounted motor
- New power and control connection

Table C25: OEI Costs: Electrical Upgrades

SCADA (cost per site)	Electrical Upgrades Cost per Site
$100,000[126]	$440,000

Assumptions:

- Main switchboard and motor control center
- Electrical conduit and wire - all equipment on a single 200' x 200' site
- Site lighting
- Transformer slab

Table C26: OEI Costs: Generators

Size (KW)	Rate Flow (gpm)	Cost
5	18	$50,000
30	110	$64,000
50	180	$80,000
75	270	$110,000
100	365	$160,000

Assumptions:

- Sized with 25% reserve

[126] Based on public feedback, SCADA costs were excluded from OEI costs.

- Based on powering well pump based on the assumptions above
- Power to booster pumps and ancillary equipment
- Diesel generators
- Automatic transfer switch

Table C27: OEI Costs: Residential Water Meters

Equipment and Software (drive by[127])	1" Meters (drive by)
$29,000[128]	$825

Assumption: Installation on an existing service

All Costs Include:

- Shoring
- Storm Water Pollution Prevention Plan
- Prevailing Wage
- Associated taxes and delivery

Costs Do Not Include:

- Permitting with PG&E or SCE
- Engineering, design, permitting
- Mobilization/demobilization

The costs that were not included above (for example CEQA, permitting, and engineering) were handled with an additional construction multiplier of 0.25. The construction multiplier was developed by QK Inc. in conjunction with their cost estimates. The multiplier is broken down in Table C28. An estimated cost for CEQA permitting was added along with the multiplier.

Table C28: Construction Multiplier Breakdown[129]

Category	Multiplier
Engineering and Design	0.15
Permitting	0.05
Mobilization / Demobilization	0.05
TOTAL MULTIPLIER:	**0.25**

[127] This type of meter allows the meter reader to drive by and take an automated reading, as opposed to a manual reading.

[128] Based on public feedback, software costs were excluded from meter costs within the OEI costs.

[129] This is a construction multiplier for OEI needs and is based on cost estimates from the Central Valley. The construction multipliers are larger for modeled treatment solutions and are detailed in the sections above.

OEI General Assumptions

The following are general assumptions around OEI needs:

- 100% of wells at schools that may use physical consolidation as a solution will be assumed to be destroyed. Some schools may decide to use the contaminated well for irrigation. There is significant cost associated with separating a potable water system from an irrigation system.
- 100% of systems identified for nitrate treatment will have SCADA.
- Many of the systems with some storage are counting small pressure tanks. The Cost Assessment Model assumed that any system needing storage will need a tank sized to meet MDD.
- For main replacement costs we are assuming a 4-inch PVC main, and that each customer connection is associated with 80 feet of main, along the property fronts.
- For residential connections, 1" meters will be assumed.

Backflow prevention assemblies were proposed in the November 2020 version of proposed Cost Assessment methodology.[130] Based on public feedback, backflow prevention assemblies were removed from the OEI needs costs.

TECHNICAL ASSISTANCE (MANAGERIAL SUPPORT)

In many cases technical assistance (TA) does not eliminate the need for other capital improvements, but it should increase the technical, managerial, and financial capacity of systems to address issues in each system. Managerial support is designed to assist water systems in developing the financial and managerial structures to ensure a sustainable water system, including asset management plans, water rate studies, fiscal policies, drought plans, etc.

Available data on the costs associated with TA (managerial support) costs are sparse. Limited case studies,[131] summarized in Table C29, were gathered to inform managerial consolidation costs. In the case of a system needing an Administrator, service was assumed to be needed for 5 years, to have adequate time to obtain funding to assist in solving the challenges and developing a long-term strategy. As more systems implement managerial consolidation, more case studies will become available and the cost model will be refined. The average one time legal and administrative costs were applied to physical consolidation. In the future, this cost could be applied for a separate Managerial Consolidation modeled solution option.

[130] White Paper: Long Term Solutions Cost Methodology for Public Water Systems and Domestic Wells https://www.waterboards.ca.gov/safer/docs/draft_whitepaper_lt_solutions_cost_methd_pws_dom_wells.pdf

[131] Two case studies of receivership costs have been provided by the State Water Board. An Investor Owned Utility has provided an average cost for the legal and administrative fees associated with system acquisition in California.

Table C29: Managerial Costs

Annual Cost for TA for a Lower Need System	Annual Cost for TA for a Higher Need System
$12,000 ($60,000 for 5 years)	$60,000 ($300,000 for 5 years)

Assumptions for HR2W List and At-Risk Public Water Systems
HR2W list and At-Risk PWSs were expected to have a variety of technical, managerial, and financial capacity issues in addition to significant infrastructure needs. Technical assistance in the form of managerial support was assumed for all the HR2W list and At-Risk PWS. As shown in Table C29, the "Annual Cost for TA (Managerial Support)" t was set at $12,000 per year for 5 years ($60,000 total), likely representing a TA cost for a lower-need water system.

A combination of updated infrastructure and proactive long-term managerial and fiscal policies can help address affordability issues and preventatively meet the needs of these water systems before expensive emergency responses are necessary. Implementation of rate structures and fiscal policies to ensure repair and replacement of any installed infrastructure upgrades, funded by State grants, is anticipated to be a funding eligibility requirement for TA assistance.

SUSTAINABILITY AND RESILIENCY ASSESSMENT

For many systems, several solutions were identified via modeling as possible for HR2W list systems. The State Water Board recognizes that the lowest-cost modeled solution may not be the best long-term solution of a system or community. The Cost Assessment Model therefore incorporates the SRA to compare each HR2W list system's potential modeled solutions and select a single selected solution for the Cost Assessment. The SRA was developed and executed by OWP at Sacramento State and the State Water Board, in collaboration with UCLA, Corona, and the Pacific Institute.

The SRA uses four sustainability metrics to rank the potential modeled solutions for each system.[132] The metrics were selected based on a literature review of four primary categories of sustainability and resiliency: technical performance, economic viability, environmental sustainability and social acceptability. The identified metrics were then screened through internal consultation with project collaborators. The metrics remaining after the screening process were then evaluated based on their applicability and their data properties (i.e., data availability, quality, and site-specific requirements) to select a list of final metrics for inclusion for the SRA. Table C30 lists the final selected metrics and their definitions.

[132] Previous white papers published by the State Water Board associated with the development of the Cost Assessment included additional SRA metrics that were ultimately excluded from the Cost Assessment model.

Table C30: SRA Metrics and Definitions

SRA Metric	Definition
O&M Cost/Connection	O&M cost estimates of a potential solution divided by the # connections in a water system
Relative Operational Difficulty	Technical complexity of treating water to comply with water quality standards. Dependent on number and complexity of treatment processes
Operator Training Requirements	Grade-level certification required to operate a treatment and distribution system. Dependent on contaminant type and associated treatment processes
Waste Stream Generation	Difficulty of managing residuals created by a treatment solution. Dependent on whether a waste stream is generated, type of waste stream (solid vs. liquid), and residual properties (e.g. hazardous, special disposal required)

A scoring system was then developed to assign points to each metric based on the general characteristics of the various modeled solution types. The four metrics were each allotted a maximum of five points (where 5 is the most sustainable), so the maximum total SRA score after summing those from all metrics was 20 points. No weighting was used. To determine the actual score for each metric, matrices were developed that assign scores based on specific characteristics of the various possible modeled solutions.

For example, a modeled solution with a low O&M Cost per Connection, no waste stream generation and relatively high ease of operation would score higher (i.e., more indicative of being sustainable) than an alternative with a higher O&M Cost per Connection, a generated waste stream and a highly complex treatment process.

Figure C9 provides partial examples for the Relative Operational Difficulty and Waste Stream Generation metrics.

Figure C9: Example Matrices for SRA Scoring

Relative Operational Difficulty SRA Scoring

Model Solutions	*Requires Media Regeneration?*	*Requires Filter Backwash?*	*Requires Access to Home?*	*Requires Travel to Operate?*	Ordinal Score (1-5)
Physical Consolidation	No	No	No	No	**5**
Uranium Wellhead Treatment	No	No	No	No	**4**
POE	No	No	No	Yes	**3**
… See Attachment C4 for full list of solutions					

Waste Stream Generation SRA Scoring

<table>
<tr><th>Model Solutions</th><th>Ordinal Score (1-5)</th><th>Score Justification</th></tr>
<tr><td>Physical Consolidation</td><td>5</td><td rowspan="8">5 = No waste stream generated
4 = Treatment produces a waste stream that is hazardous AND has special disposal considerations
3 = Treatment produces a waste stream that is hazardous OR has special disposal considerations
2 = Treatment technology produces non-hazardous waste stream with no special disposal considerations
1= Multiple treatment technologies producing waste streams</td></tr>
<tr><td>Arsenic Wellhead Treatment</td><td>4</td></tr>
<tr><td>Nitrate Wellhead Treatment</td><td>2</td></tr>
<tr><td>Uranium Wellhead Treatment</td><td>3</td></tr>
<tr><td>Perchlorate Wellhead Treatment</td><td>3</td></tr>
<tr><td>Fluoride Wellhead Treatment</td><td>4</td></tr>
<tr><td>POU</td><td>2</td></tr>
<tr><td>… See Attachment C4 for full list of solutions</td><td></td></tr>
</table>

For the Relative Operational Difficulty metric, scores were based on the answers to following questions for each potential modeled solution:

- Does the solution require media regeneration?
- Does the solution require filter backwash?
- Does the solution require access to homes?
- Does the solution require an operator to travel to operate?

For physical consolidation solutions, the answer to all these questions is no, indicating a low level of relative operational difficulty. Physical consolidation was therefore assigned a maximum score of five. This is because it is assumed that with consolidation, operations will be taken over by another entity. which has the capacity to address the HR2W list systems' water quality needs.

For uranium wellhead treatment, all answers were also no, but the score assigned was four, just lower than physical consolidation. Systems using uranium wellhead treatment will require a system operator. For POE, the answers to the first three questions are no, but the last answer is yes. POE was assigned a score of three, assuming a moderate operational difficulty since maintenance requires scheduling with households to replace GAC to prevent

VOC/DBP/TCP breakthrough. Scores for other modeled solutions were assigned based on a similar question-by-question exercises.

Scoring assignments for the Waste Stream Generation metric were simpler. Ordinal scores of one through five were defined as shown in Table C31. Scores for each type of modeled solution were then assigned based on these definitions.

Table C31: Waste Stream Generation Score Definitions for SRA Scoring

Ordinal Score	Definition
5	No waste stream generated
4	Treatment produces non-hazardous waste stream with no special disposal considerations
3	Treatment produces a waste stream that is hazardous OR has special disposal considerations
2	Treatment produces a waste stream that is hazardous AND has special disposal considerations
1	Multiple treatment technologies producing waste streams

Scores were assigned to each modeled solution type for the Operator Training Requirements and O&M Cost per Connection metrics following similar processes that take solution characteristics into consideration. The Operator Training Requirements metric scoring was based on the requirements stated in California Code of Regulations Section 64413.1, Classification of Water Treatment Facilities. The O&M Cost per Connection metric scoring involved establishing tiers of numeric ranges, with a score between one and five assigned to each tier.

Attachment C4 provides the detailed scoring methodology for all metrics.[133] The SRA scores were then used with each potential modeled solution's costs to select a final modeled solution for each system. The aggregated costs of selected modeled solutions are what is summarized in the Needs Assessment report.

SELECT MODELED SOLUTION FOR EACH SYSTEM

HR2W LIST SYSTEMS

After estimating the costs and determining SRA scores for each system's potential modeled solutions, the SRA scores and cost estimates were compared to select a final modeled solution for each system. Then the costs of the selected modeled solution for each system were used to report the summaries presented in the Needs Assessment report. This selected modeled solution is only for the purpose of estimating an overall projected budget need for the

[133] Attachment C4: Sustainability and Resiliency Assessment
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/c4.pdf

State and does not dictate the solution that a system must select to achieve compliance and long-term resiliency. The ultimate solution that will be implemented will involve more detailed investigation of each water system and should include the input of the community and other stakeholders.

Selection of the final modeled solution followed a step wise process, as demonstrated in the decision tree in Figure C10. The selection process starts by examining whether a HR2W list system has more than one modeled solution. If only one solution is available, this solution is selected. However, if there are more than one modeled solution, the top two modeled solutions with the highest long-term sustainability and resiliency scores are selected.

After selecting the two modeled solutions with the highest sustainability and resiliency scores (the "top two selected modeled solutions"), the decision-making process becomes contingent on whether physical consolidation is one of the top two selected modeled solutions. If physical consolidation is not one of the two selected solutions, then the non-physical consolidation solution with the lowest 20-Year NPW is selected. However, if physical consolidation is one of the top two selected solutions, the process proceeds to examine whether it meets either of the following criteria: (1) Total capital costs less than $500k; or (2) Capital costs/connection less than $60k.

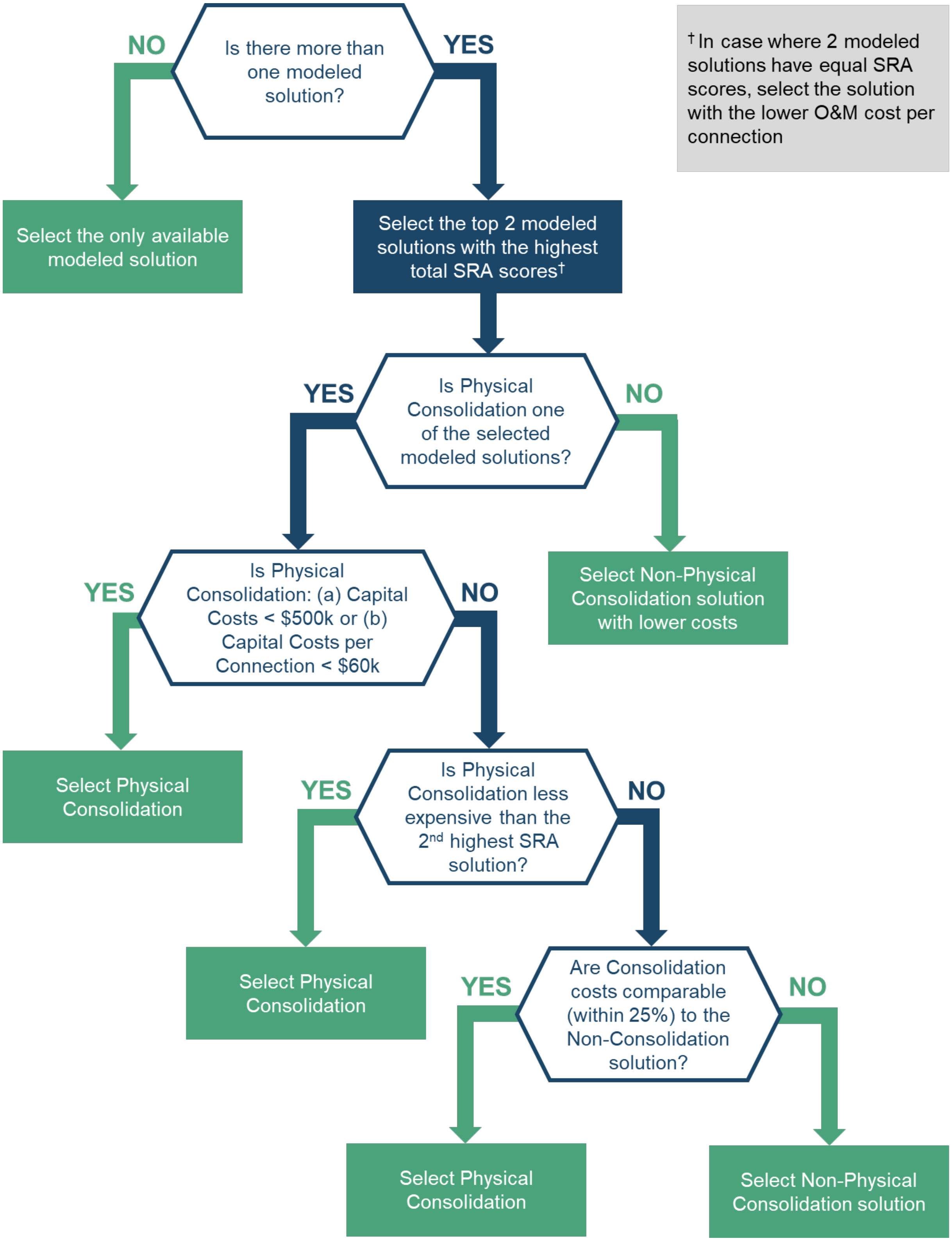
If physical consolidation meets either of these criteria, then it is chosen as the final selected modeled solution. However, if physical consolidation does not meet either criteria, then the process advances to check if physical consolidation has lower capital costs than the second selected solution.

If physical consolidation has a lower capital cost than the second selected modeled solution, then it is selected as the final modeled solution. Otherwise, if physical consolidation's capital costs exceed those of the second modeled solution, the model examines whether the capital cost of physical consolidation is comparable to those of the second modeled solution.

If the capital cost of physical consolidation is comparable to the alternative solution's capital costs, then physical consolidation is selected as a final modeled solution. Otherwise, the alternative non-physical consolidation solution is selected.

Note that for these latter decision steps, "comparable" is considered to be within 25% of each other. The 25% threshold was selected by the State Water Board as a reasonable cost differential margin within which to select physical consolidation despite its costs being higher and is used only for purposes of the Cost Assessment effort. This assumption does not guide State Water Board funding decisions.

Figure C10: Decision Tree for Selecting Final Modeled Solution Used for Cost Estimate Results for HR2W List Systems



AT-RISK PUBLIC WATER SYSTEMS

At-Risk PWSs were evaluated for physical consolidation as a possible modeled solution. Where physical consolidation was $60,000 per connection or less, this solution was assigned as the selected modeled solution. Where costs were greater than $60,000 per connection, physical consolidation was removed as a possible modeled solution. Further evaluation is needed to determine which of these physical consolidations could be part of a larger regional project. All At-Risk PWSs had OEI needs costs applied, as well as Technical Assistance for managerial support costs. No treatment or POU/POE treatment was considered for At-Risk PWSs.

AT-RISK STATE SMALL WATER SYSTEMS AND DOMESTIC WELLS

At-Risk state small water systems and domestic wells were evaluated for physical consolidation potential, POU and POE, as well as for interim solution costs. Physical consolidation was only considered a viable option if it was part of larger regional consolidation project and was cost effective. Cost effectiveness was defined as a per connection cost less than or equal to $60,000. For At-Risk SSWS and domestic wells where physical consolidation was not viable, POU and POE treatment was budgeted as a long-term solution. For some, as noted above, there was no viable solution besides bottled water because POU treatment cannot be effectively used for nitrate concentrations over 25 mg/L-N.

ROLL-UP OF ESTIMATED COSTS

The estimated costs of the selected solutions for HR2W list systems, At-Risk public water systems, state small water systems, and domestic wells were aggregated into a statewide cost estimate. This cumulative statewide cost estimate was meant to provide a broad overview of the potential projected demand for the Safe and Affordable Drinking Water Fund. The aggregated cost estimate will be conducted annually and will be included in the Fund Expenditure Plan.

IDENTIFY FUNDING NEEDS AND FUNDING GAP

The Pacific Institute, a subcontractor to the Needs Assessment team led by UCLA, developed an approach to (1) evaluate the funding alternatives available for both interim and long-term solutions identified by the Cost Assessment Model and (2) estimate the gap between the funding potentially available and the amount needed over time. Appendix D below provides full details of the Gap Analysis methodology.

APPENDIX D:
GAP ANALYSIS METHODOLOGY

INTRODUCTION

The Cost Assessment Model was developed to estimate the costs related to the implementation of interim and/or emergency measures and longer-term solutions for HR2W list and At-Risk systems. The Gap Analysis is the final step within the Cost Assessment Model.

The Pacific Institute, a subcontractor to the UCLA Needs Assessment contract, developed an approach to (1) estimate the funding needed for solutions for HR2W list and At-Risk systems and (2) estimate the gap between the funding and financing potentially available and the amount needed over one year and five year time periods into the future. These estimates will help the State Water Board inform future SADWF Fund Expenditure Plans (FEPs) and be used to communicate the SAFER Program's funding needs to decision makers and stakeholders. This statewide analysis was the final step of the Cost Assessment and was not intended to inform funding decisions nor local decisions for drinking water systems.

GAP ANALYSIS METHODOLOGY DEVELOPMENT PROCESS

The State Water Board and the Pacific Institute worked together to develop the funding and financing Gap Analysis methodology. The Gap Analysis development process was embedded in the development of the Cost Assessment. Both efforts were designed to encourage public and stakeholder participation, providing opportunities for feedback and recommendations throughout. The Gap Analysis methodology was also dependent on significant guidance from the State Water Board's Division of Financial Assistance (DFA). DFA provided insight on State Water Board funding availability, funding program eligibilities, and recommendations on how to assess potential funding and financing gaps.

The State Water Board and the Pacific Institute hosted a webinar workshop *Cost Assessment Model Preliminary Results and Gap Analysis*[134] on February 26, 2021 to seek public feedback on the proposed methodology for the funding and financing Gap Analysis. Details on the proposed methodology were provided in the February 25, 2021 white paper *Gap Analysis for Funding Solutions for Human Right to Water and At-Risk Drinking Water Systems*.[135]

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[134] Webinar recording can be found at the Needs Assessment website:
Needs Assessment | California State Water Resources Control Board
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/needs.html

[135] White Paper: Gap Analysis for Funding Solutions for Human Right to Water and At-Risk Drinking Water Systems
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/docs/Draft_White_Paper_Needs_Assessment_Gap_Analysis_FINAL.pdf

Adjustments to the Gap Analysis methodology were made based on feedback during the webinar and comment letters that were received following the webinar. Additional details that were requested in the comment letters have been added to this Gap Analysis Methodology Appendix.

GAP ANALYSIS METHODOLOGY

The Gap Analysis is the final step of the Cost Assessment (Figure D2) and its methodology is composed of three main steps. The first step focuses on refining the funding needs, modeled by the Cost Assessment, for implementation of interim and long-term solutions for current HR2W list and At-Risk systems. The second step concentrates on identifying State Water Board funding sources and external funding sources that can be leveraged to support the identified funding needs based on project and borrower eligibilities. DAC status and other system-level characteristics were utilized to refine this analysis. The third and final step uses the State Water Board's SAFER Program funding priorities to determine the funding and financing gap for the refined estimated funding need. This third step also estimates how many years it may take to meet all identified and projected funding needs. Together, these steps provide an estimate of how much it may cost and how long it may take to achieve the HR2W with existing funding sources. However, it is important to highlight that other State, Federal, and private funding and financing may be available to meet some of these needs, and that large regionalization projects may reduce cost needs.

Figure D1: Gap Analysis Methodology

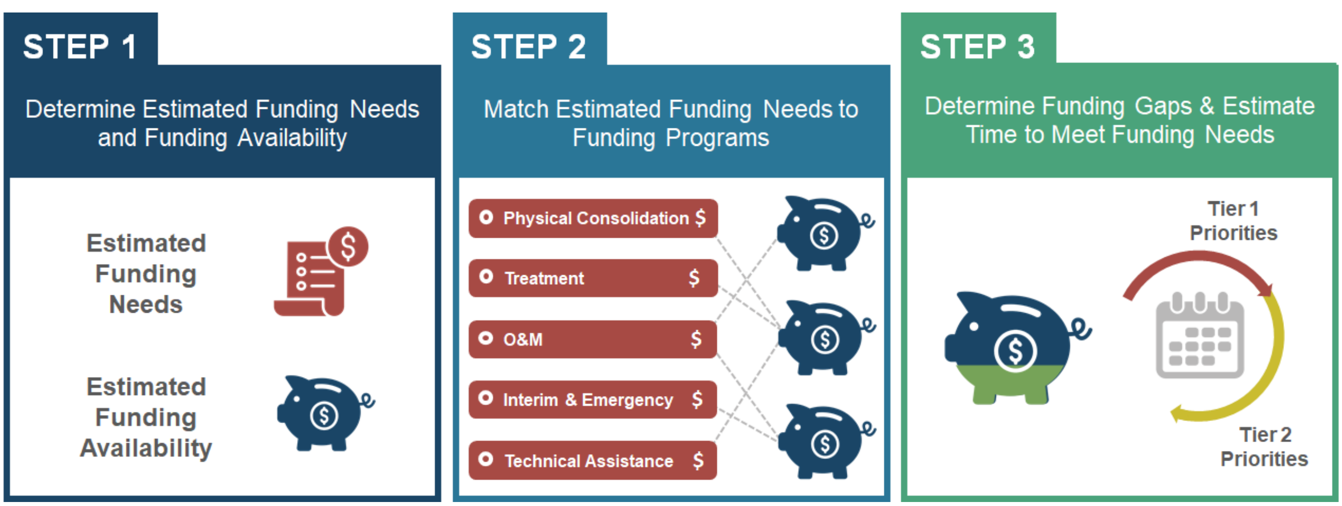
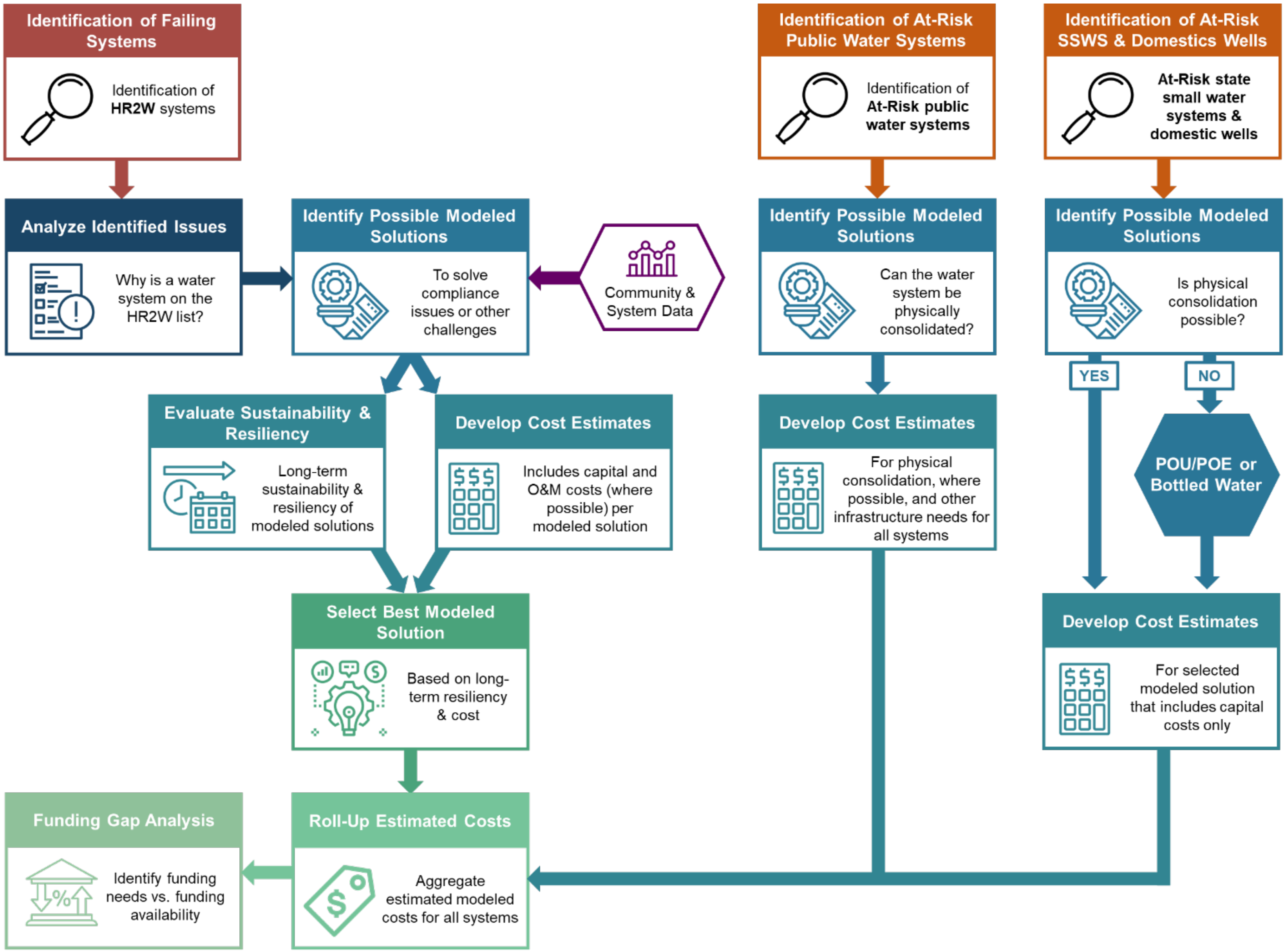


Figure D2: Cost Assessment Model Process

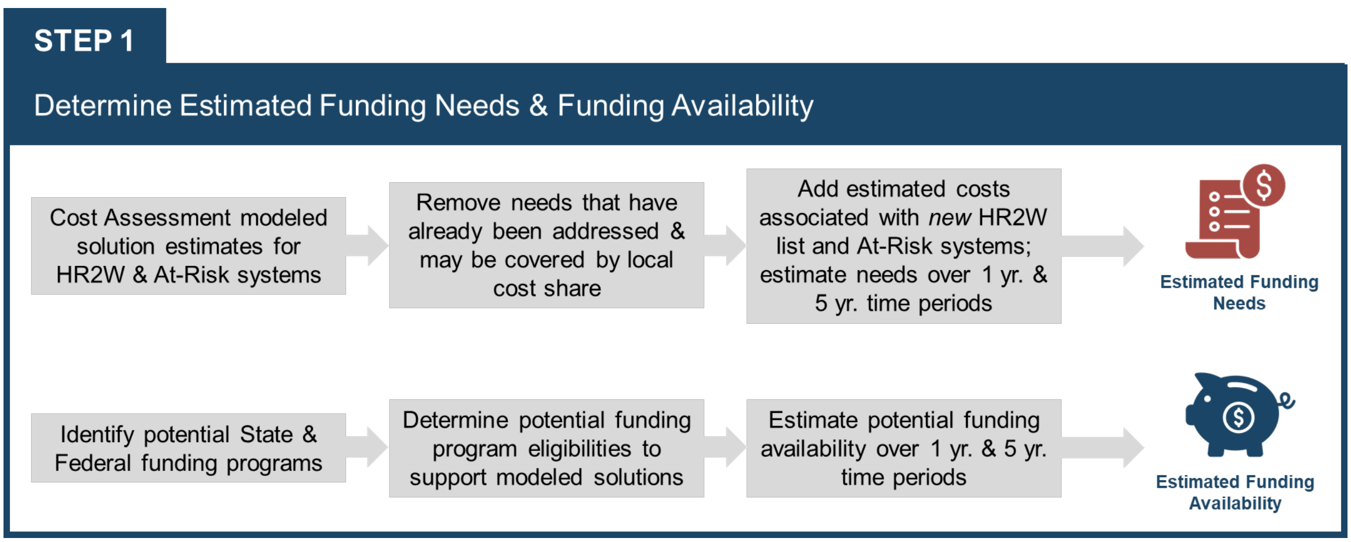


STEP 1: ESTIMATING FUNDING NEEDS AND FUNDING AVAILABILITY

The Gap Analysis methodology refined the modeled interim and long-term solution cost estimates produced by the Cost Assessment by: (1) removing the estimated costs for systems that have already received funding assistance; (2) removing a proportion of estimated costs that would be met by communities through local cost share; and (3) adding estimated new costs associated with new HR2W list water systems and At-Risk water systems each year for up to 5 years. Together, these three refinement steps produce the estimated funding need utilized in the Gap Analysis. Furthermore, the funding need for the modeled solutions for HR2W and At-Risk systems was estimated both for this current year ("Year 1") and for five years into the future ("Year 5"). This multi-pronged approach provides a short-term and longer-term understanding of the estimated funding need over time.

Available funding was determined by analyzing existing State Water Board funding programs. The Gap Analysis focused on the gap that may exist after State Water Board funding sources are exhausted; however, the Gap Analysis also highlighted opportunities where additional non-State Water Board state funding and Federal funding programs may be leveraged to expand the potential impact of the agency's available funding programs in the future.

Figure D3: Step 1 of the Gap Analysis Methodology



ESTIMATING FUNDING NEEDS

Cost Assessment Model Estimates

Earlier steps in the Cost Assessment Model identified and estimated the capital, operations and maintenance (O&M), and 20-year Net Present Value (NPV) costs for long-term modeled solutions for 305 HR2W list systems and approximately 620 At-Risk public water systems (PWS).[136] The Cost Assessment Model also generated cost estimates for At-Risk state small

[136] The information generated by this model will not be used to inform system or community-level decisions around solution selection, implementation, or funding allocations.

water systems (SSWS) and domestic wells. In addition, interim solution costs were modeled for HR2W list water systems, At-Risk PWS, SSWS, and domestic wells.

The number of systems modeled differs between the interim and long-term solution cost efforts. Table D1 shows the number of systems from the long-term and interim solutions data sets, with the total number of unique systems included in the first year of the Gap Analysis. Note that for Year 1 of the Gap Analysis, 47 new HR2W list systems and 95 new At-Risk PWS were added to the Gap Analysis, described further below. For SSWS, 455 systems were included in the cost model for long-term solutions, while 611 systems were included in the cost model for interim solutions. This difference is due to the risk status of the systems, with SSWS deemed at-risk receiving estimated interim solutions. For domestic wells, about 63,000 systems were included in the cost model for long-term solutions while about 78,000 systems were included in the cost model for interim solutions because different datasets were used in different elements of the cost model.

Table D1: Total Count of HR2W list systems, At-Risk PWS, At-Risk SSWS, and domestic wells in Year 1 of the Gap Analysis

System Type	# of Systems with Long-Term Solutions	# of Systems with Interim Solutions	# of Unique Systems in Yr. 1 of the Gap Analysis
HR2W list	305	305	352
At-Risk PWS	630	40	725
At-Risk SSWS	455	611	830
At-Risk Domestic Wells	62,607	77,567	98,315

Potential modeled solutions are listed and described in Table D2.

Table D2: Modeled Potential Solutions for HR2W List Systems, At-Risk PWS, At-Risk State Small Water Systems (SSWS), and At-Risk Domestic Wells[137]

Modeled Solution	Description	Modeled For
Physical Consolidation	The joining of infrastructure of two or more water systems that are geographically close.	HR2W, At-Risk PWS, At-Risk SSWS, At-Risk Domestic Wells
Treatment	Treatment solutions are used to address contaminants that exceed water quality	HR2W

137 Details on how the Gap Analysis will differentiate between local cost share and State Water Board support is provided in Tables 2 and 3.

Modeled Solution	Description	Modeled For
	standards. For a full list of treatment solutions considered, see "Long Term Solutions Cost Methodology for Public Water Systems and Domestic Wells, Version 2".[138]	
POU/POE	Point-of-use (POU) or point-of-entry (POE) treatment are used to address contaminants that exceed water quality standards, when other solutions are infeasible.	HR2W systems with less than 200 connections, At-Risk SSWS, At-Risk Domestic Wells where other options are infeasible
Other Essential Infrastructure (OEI)	A broad category that includes storage tanks, new wells, well replacement, upgrade electrical, add backup power, replace distribution system, add meters, and land acquisition.	HR2W, At-Risk PWS
Operations & Maintenance (O&M)	Ongoing, day-to-day operations and maintenance of a water system.	HR2W
Interim Solutions	POU/POE and bottled water, including the O&M costs for maintaining a temporary installment of POU/POE systems.	HR2W
Technical Assistance	A broad category of support to assist water system operators and managers with planning, construction projects, financial management, and O&M tasks.	HR2W, At-Risk PWS

After all feasible modeled solutions were identified, the Sustainability and Resilience Assessment (step 4a in the Cost Assessment Model for HR2W list systems) helped further refine the results of the Model by identifying the top two most sustainable and resilient modeled solutions for each HR2W list system. The Cost Assessment Model then applied a set of criteria to identify which of the two modeled potential solutions should be selected for the aggregated cost estimate. For details on the methods used for these steps in the Cost Assessment Model, refer to Appendix C.

[138] Long Term Solutions Cost Methodology for Public Water Systems and Domestic Wells https://www.waterboards.ca.gov/safer/docs/draft_whitepaper_lt_solutions_cost_methd_pws_dom_wells.pdf

Removing Costs for Systems with Funding Agreements

The first step of refining the Cost Assessment's estimated funding need is to remove the estimated interim and long-term solution costs associated with systems that already have funding agreements with the State Water Board. The funding agreements included were based on information from DFA from February 18, 2021 for HR2W list systems and from March 4, 2021 for At-Risk PWS.[139] This resulted in the removal of 21 HR2W list and 10 At-Risk systems with existing funding agreements for an interim solution, 52 HR2W list and 20 At-Risk systems with funding agreements for a long-term solution, and 19 HR2W list and 3 At-Risk systems with funding agreements for both an interim and a long-term solution.

Estimating and Removing Local Cost Share

To refine the estimated funding need, the Gap Analysis methodology assumed that a portion of the Cost Assessment for modeled solutions would be shared by water systems, communities, or well owners, as applicable, and not fully borne by the State Water Board. The local cost share for the Gap Analysis was based on four types of qualifications: disadvantaged (DAC) and severely disadvantaged (SDAC) status, water rates as percent of MHI, water system size, and water system type. Where water rate, MHI, and/or DAC status data was not available for a water system, the entity was assigned either DAC, SDAC, or non-DAC status based on spatial averages of the county where the system operated, calculated in association with the Cost Assessment Model. A status of non-DAC was assigned to all domestic wells without MHI or DAC status data. Once calculated, the percent local cost share was separated from the estimated need for the purposes of the Gap Analysis.[140]

The specific requirements used to calculate local cost share obligations for HR2W list, At-Risk PWSs, and At-Risk SSWSs were generally adapted from the Drinking Water State Revolving Loan Fund (DWSRF) Intended Use Plan (IUP) from FY 2020-2021 in Appendix E.[141] The specific percent of local cost share assumed for the Gap Analysis is presented in Table D3 (for grant/principal forgiveness) and Table D4 (for loans/repayable financing).[142]

[139] Data on funding for HR2W systems and some At-Risk systems can be found on the SAFER website: https://www.waterboards.ca.gov/safer/dw_systems_violations_tool.html

[140] Assignment of local cost share does not consider individual systems' ability to accept grant funds, which may vary according to the type of PWS entity or other factors. However, future gap analyses may address these differences.

[141] Drinking Water State Revolving Fund Intended Use Plan https://www.waterboards.ca.gov/drinking_water/services/funding/documents/dwsrf_iup_sfy2020_21_final.pdf

[142] The Gap Analysis assumed that all domestic well owners that are DAC and SDAC would receive grant funding from the State Water Board covering 100% of modeled interim and long-term solution costs, and all domestic well owners that are Non-DAC would bare 100% of modeled costs as local cost share.

Table D3: Criteria for Local Cost Share for Grant/Principal Forgiveness

Type of Community	Water Rate as % of MHI[143]	Local Cost Share (%)	Max. Amount Per Conn.
A-C Category Projects[144]			
Small DAC/SDAC,[145] Public K-12 Schools	N/A	0%	$60,000
Small Non-DAC, Expanded Small DAC/SDAC[146]	N/A	25%	$60,000
Large DAC,[147] Non-DAC systems	N/A	Not eligible for grant/principal forgiveness	N/A
D-F Category Projects[148]			
Small SDAC, Public K-12 Schools that serve a small DAC	N/A	10%	$45,000
Small DAC	>=1.5%	25%	$45,000
Expanded Small SDAC	>=1.5%	50%	$45,000
Expanded Small DAC	>=1.5%	75%	$45,000
Small DAC, Expanded Small DAC/SDAC	<1.5%	Not eligible for grant/principal forgiveness	NA
Large DAC, Non-DAC	NA	Not eligible for grant/principal forgiveness	NA

[143] The water rate as percent of MHI was obtained from the affordability assessment results on a system-by-system basis. For 333 of the 558 PWS that qualify as D-F projects, the water rate as percent of MHI was not available. For these systems, the cost share was estimated based on the average local proportion for systems with a similar number of connections according to the following system size bins: 1-100 connections, 101-500, 501-1000, 1001-3300, 1001-3300, and 3301 and above.

[144] A-C Category Projects are generally defined as follows: A = Immediate Health Risk; B = Untreated or At-Risk Sources; C = Compliance or Shortage Problems. For complete definitions see the "Policy for Implementing the Drinking Water State Revolving Fund.

Drinking Water State Revolving Fund Program
https://www.waterboards.ca.gov/drinking_water/services/funding/DWSRF_Policy.html

[145] "Small" refers to a community water system that serves no more than 3,300 service connections or a year-round population of no more than 10,000.

[146] "Expanded Small" refers to a community water system that serves no more than 6,600 service connections or a year-round population of no more than 20,000.

[147] 3,300 connections and/or more than 20,000 people

[148] D-F Category Projects are generally defined as follows: D = Inadequate Reliability; E = Secondary Risks; F = Other Projects. For complete definitions see the "Policy for Implementing the Drinking Water State Revolving Fund."

For all HR2W list and At-Risk systems the maximum eligible percentage of total modeled project cost was used, up to the maximum amount per connection.[149] For all costs that exceeded the maximum amount per connection for a given system, they were allocated 100% to local cost share. Where there are exceptions in practice to percentages listed in the IUP, the standard amount detailed in the IUP was used for the Gap Analysis.[150]

Table D4: Criteria for Local Cost Share for Loans/Repayable Financing

Type of Community	Interest Rate	Maximum Financing Term	Local Cost Share (%)
Small DAC, Small non-DAC, Expanded Small DAC/SDAC	0%	20 Years	100% of remaining portion, may be State Water Board loans
Large DAC, Non-DAC	2% for SWB (4% for private)	20 Years	100%, may be State Water Board loans[151] or other private funding

Estimating Need for Grants vs. Loans

The percentage of each HR2W list, At-Risk PWS, or At-Risk SSWS water system's modeled interim and long-term solution costs was assumed to be eligible for State Water Board grants as detailed in Table D3 based on eligibility requirements. For HR2W list and At-Risk PWS water systems not eligible for 100% grant coverage of their modeled solution capital cost, it was assumed that the remaining costs would be covered by local cost share through a State Water Board loan with either a 0% or 2% interest rate, detailed in Table D4. For At-Risk SSWS modeled costs that were not eligible for 100% grant coverage, it was assumed that the remaining costs would be covered by local cost share through a private loan at a 4% interest rate. For domestic wells, the Gap Analysis assumed that 100% of interim and long-term modeled solution costs for DAC/SDAC wells were grant eligible. Domestic well owners are not currently eligible for State Water Board loans and therefore, all local cost share for capital costs for domestic wells is assumed to need a private loan at a 4% interest rate.

Estimated O&M costs for long-term solutions for DAC/SDAC HR2W list and At-Risk PWS were considered grant-eligible and included in the estimated refined grant needs. Modeled O&M costs for long-term solutions for At-Risk SSWS and domestic wells were used to calculate the

[149] Maximum amount per connection was calculated for each system as the proportion of the total grant-eligible project cost divided by the number of connections. If the water system was a public school, the number of connections was calculated as 3.43*population to account for the very low connection count at schools.

[150] For example, it states in the DWSRF FY 2020-21 IUP: "The Deputy Director of DFA may approve up to 100% grant for capital costs required to complete a mandatory or voluntary consolidation."

[151] The Drinking Water SRF Policy states the financing term is the shorter of 30 years or useful life for public water systems not serving a DAC/SDAC and 40 years or useful life for public water systems serving a DAC/SDAC. For purposes of the Cost Assessment and Gap Analysis it is assumed that solutions have a 20-year useful life. https://www.waterboards.ca.gov/drinking_water/services/funding/documents/srf/dwsrf_policy/dwsrf_policy_final.pdf

total, unrefined need, but then were not incorporated into the total estimated grant funding need for the Gap Analysis. Any O&M cost for systems not met by a State Water Board grant was included in the calculation of local cost share. The Gap Analysis assumed no public or private financing is available to cover ongoing O&M cost needs.

Estimating Need Over Time

The funding need for modeled solutions for HR2W list and At-Risk systems was estimated both for this current year ("Year 1") and for five years into the future ("Year 5"). This provided a short-term and longer-term understanding of the funding need.

The State Water Board estimates that approximately 47 unique HR2W list systems will be added to the list each year based on the historical number of new systems added annually from 2017-2019 based on the expanded HR2W list criteria. This estimated number of new HR2W list systems was based on historical HR2W list data from 2017-2019. No historical data exists for the number of systems and domestic wells added to the At-Risk list annually since this is the first year of the Risk Assessment. Therefore, the Gap Analysis assumed the same proportion (approximately 15%) of systems will be added to the At-Risk list as the HR2W list. The total number of new At-Risk PWS added per year was 95.

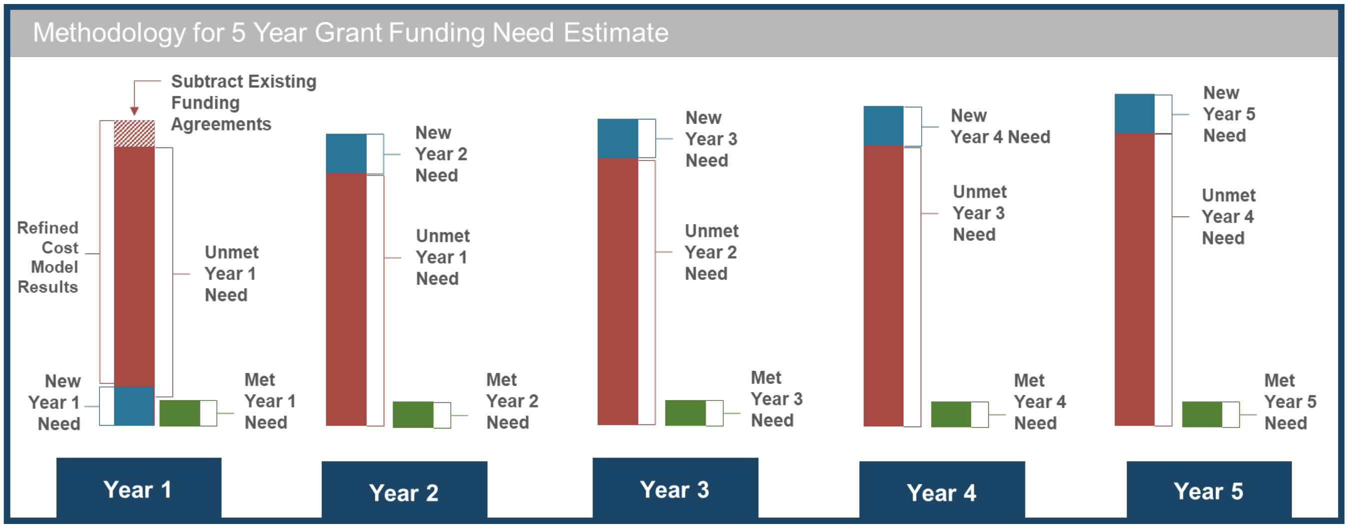
The Gap Analysis took the average costs per solution type (i.e., interim, long-term, and O&M) for HR2W list and At-Risk PWS systems, binned by connection size categories and by DAC status, as estimated by the Cost Assessment Model, and attributed those average costs proportionally to each of the 47 new HR2W list and 95 new At-Risk systems per year, out to Year 5.[152]

In addition to the anticipated increase in need annually over the next five years, any grant-eligible need from the previous year not funded was added to the next year's need (Figure D4). For long-term O&M need, the unfunded portion was not added to the next year's need, but instead was appropriated to local cost share. This was done to more closely match real-world scenarios where un-funded O&M would not be possible to carry forward, but would, by necessity, be borne by the community. This process is explained in more detail in Step 3: Estimating the Annual Funding Gap.

Most drinking water projects are funded on a multi-year basis, but for the Gap Analysis it is assumed that all projects receive their full funding in the first year, as funding is available. For the modeled interim solutions, the analysis assumed that the cost of the interim solution must still be applied during the first year that a long-term solution is funded.

[152] Bin sizes by connection were: 1-100, 101-500, 501-1,000, 1,001-3,300, 3,301+.

Figure D4: Estimating Need Over Time



ESTIMATING FUNDING AVAILABILITY

State Water Board Funds

While the SADWF is a unique fund that is wholly available to the SAFER Program, the State Water Board has additional funding programs that can be utilized to advance the SAFER Program's objectives. This analysis considered the SADWF along with other sources administered by DFA as one scenario and the SADWF as a standalone funding source as a separate scenario. Table D5 provides a complete list of all State Water Board funds that are available to help meet SAFER Program funding objectives.

Table D5: State Water Board Funding Programs[153]

Fund	Fund Size (as of 2/9/2021)	Projected Future Annual Allocation or Final Disbursement Date by Fund Source	Eligible Applicants	Eligible Projects
Safe and Affordable Drinking Water Fund (SADWF)	$152,505,586[154]	Up to $130 million per year through FY 2029-2030[155]	Public agencies, nonprofits, public utilities, mutual water companies, CA Native American tribes, Administrators, GW sustainability agencies, and public utilities regulated by PUC (so long as the project will benefit customers and not investors), state small water systems and domestic well owners	Provision of interim replacement water, planning or design, Construction, Consolidation (physical or managerial), Administrator funding, O&M, Technical Assistance
Drinking Water State Revolving Fund (DWSRF)	$119,840,349 for principal forgiveness	$50,000,000 expected annual funding capacity for grant/principal forgiveness, $300,000,000 expected annual funding capacity for loan/repayable financing	Privately-owned and publicly-owned CWSs or nonprofit non-CWSs, CWSs created by the project, Systems referred to in Section 1401(4)(B) of the SDWA for the purposes of point of entry or central treatment under Section 1401(4)(B)(i)(III)	Planning and design or construction of drinking water infrastructure, including treatment systems, distribution systems, interconnections, consolidations, pipeline extensions, water sources, water meters, water storages

[153] Summary information only. For full descriptions, please review fund expenditure plans.

[154] The Fund Size reported here is the total for Year 1 of the Gap Analysis, before removal of staff and Administrator costs. In Year 1 of the Gap Analysis that total funding available is reduced by $16 million to account for staff and Administrator costs, and therefore equals $136,505,586.

[155] For Year 2-5 of the Gap Analysis, $16 million is removed annually from the SADWF to account for staff and Administrator costs, leaving an annual fund availability of $114 million.

Fund	Fund Size (as of 2/9/2021)	Projected Future Annual Allocation or Final Disbursement Date by Fund Source	Eligible Applicants	Eligible Projects
Small Community Drinking Water Funding Program	$275,253,116	Final disbursement: June 2023 for Prop 1 and Prop 68 Groundwater funds, June 2024 for Prop 68 Drinking Water funds	Publicly-owned community water systems, Privately-owned community water systems, Community water systems created by the projects, non-profit or publicly owned non-community water systems, <10,000 pop served; MHI less than 80% statewide avg	Planning/design & construction of DW infrastructure: treatment systems; distribution systems; interconnections; consolidations; pipeline extensions; water sources; water meters; water storages
Emergency Drinking Water/Cleanup & Abatement Account Programs – Urgent Drinking Water Need Projects	$9,007,065	Final disbursement: June 2024 for AB 72 and AB 74 Funds	Public agencies, nonprofits, community water systems, tribal governments (on the CA Tribal Consultation List)	Provision of interim alternative water supplies, emergency improvements or repairs as necessary to provide an adequate supply of domestic water
Water Board Household & Small Water System Drought Assistance Program; CAA – DW Well Replacement Program	$860,646	Final disbursement: June 2024 for SB 108 and AB 72 funds	Individual households (homeowners) that qualify as "disadvantaged", Small Water Systems (serving less than 15 connections)	New well construction, design costs of necessary infrastructure, permit and connection fees, well rehabilitation/repair (including extending wells to deeper aquifers), distribution/conveyance pipelines (up to point of entry of household), limited consolidation efforts (i.e. laterals, above-ground interties), all necessary appurtenances, etc.

Fund	Fund Size (as of 2/9/2021)	Projected Future Annual Allocation or Final Disbursement Date by Fund Source	Eligible Applicants	Eligible Projects
Water System Administrator Program[156]	$8,159,143	Final disbursement: June 2024 for AB 72 funds	An Administrator can be an individual or an entity with the necessary qualifications to carry out the responsibilities required for a specific designated water system.	Administrative, technical, operational, legal, or managerial services, or any combination of those services (limited-scope administrator), as well as full management and control of all aspects to a designated water system (full-scope Administrator).

[156] Currently, there is limited cost data to support the inclusion of the Administrator funding program into the Gap Analysis for the 2021 Needs Assessment. Future iterations will be able to assess the gap for Administrators when data becomes available.

Funding Availability Over Time

For the Gap Analysis, it is assumed that the SADWF will receive the maximum potential allocation of $130 million per year through FY 2029-30 from the Greenhouse Gas Reduction Fund and that the DWSRF will have a $350 million funding capacity each year ($50,000,000 for grant/principal forgiveness and $300,000,000 for loan/repayable financing). No other funding sources were assumed to have additional allocations beyond the current available amounts.

Funding availability for the SADWF, for purposes of the Gap Analysis, is reduced by $16 million per year to account for staff costs and Administrator funding, based on the estimated costs in the SADWF FY 2020-21 FEP. Additionally, due to carry over from the previous year, for Year 1 of the Gap Analysis, the SADWF is assumed to have $152 million available, before staff costs and other program needs are removed. Funding availability for all other State Water Board funds already account for staff costs in the figure presented above.

NON-STATE WATER BOARD FUNDS

In addition to State Water Board funds, there are other loan and grant programs that may eventually be leveraged to support the implementation of solutions for HR2W list and At-Risk drinking water systems in California (Table D6). These funds were not incorporated into the Gap Analysis at this time and are only presented here for informational purposes. Future iterations of the Gap Analysis will consider the availability of these funding sources as more information is developed on the typical breakdown allocated to drinking water projects in California.

In order to identify a list of potential non-State Water Board funds, the Pacific Institute project team conducted desktop research and outreach to state, Federal, and private loan and grant programs designed to address drinking water system issues. Research and outreach sought to assess the likelihood that the funding source would remain active at least through 2022, the earliest year in which the SAFER Needs Assessment process will be positioned to consider leveraging outside funds. The research process also gathered key information regarding each fund, such as special application criteria, any matching requirements, and any information affecting the eligibility of small and DAC systems. Where available, historical award amounts to California entities were collected from the most recent fiscal year for which funding allocation data was available. These data were used to provide a rough estimate of the aggregate, non-State Water Board funds leverage potential in the future. Additional drinking water infrastructure funding and financing programs can be found in U.S. EPA's Water Finance Clearinghouse.[157]

[157] U.S. EPA Water Finance Clearinghouse
https://www.epa.gov/waterdata/water-finance-clearinghouse

Table D6: Additional Funding Resources[158]

Fund	Source Agency	Fund size (Number of awards to CA entities)	Eligible Applicants	Eligible Projects
DWR Integrated Regional Water Management Implementation Grants, Round 2	California DWR	To be announced ($181,000,000 expected)	Public agencies, non-profit organizations, public utilities, Federally recognized Indian tribes, state Indian tribes listed on the Native American Heritage Commission's Tribal Consultation list, mutual water companies. (Note: list from Round 1 Grant Program Guidelines.)	Water reuse and recycling, water-use efficiency and water conservation, water storage, regional water conveyance facilities, watershed protection, stormwater management, conjunctive use, water desalination, water supply decision support tools, and water quality improvement for drinking water treatment and distribution and other purposes. (Note: list from Round 1 Grant Program Guidelines.)
Household Water Well System Loan Program	USDA Rural Development Program[159]	FY20: $0 FY19: $225,000 (1 award) FY18: $308,000 (1)	Homeowners with a household income under $62,883 living in a rural area, town, or community with a population of fewer than 50,000 people.	Refurbishment, replacement, or construction of a household water well system.
Water & Waste Disposal Loan & Grant Program in California	USDA Rural Development Program	FY20: $13.8 million (7) FY19: $10.3m (10) FY18: $24.6m (26)	State and local government entities, private nonprofits, Federal tribes in rural areas with a population of less than 50,000	Acquisition, construction, or improvement of drinking water sourcing, treatment, storage, and distribution, in

[158] Summary information only. For full descriptions, please review fund expenditure plans.

[159] Rural Community Assistance Corporation (RCAC), Self-Help Enterprises (SHE)

Fund	Source Agency	Fund size (Number of awards to CA entities)	Eligible Applicants	Eligible Projects
			people, rural tribal lands, and colonias.	addition to other project eligibility such as waste disposal. Some funds for TA, training, and predevelopment planning.
Water & Waste Predevelopment Planning Grants	USDA Rural Development Program	FY20: $0 FY19: $139,820 (1) FY18: $0	State and local government entities, private nonprofits, Federal tribes in rural areas with a population of less than 10,000 people, rural tribal lands, and colonias. Median household income (MHI) must be below poverty line or less than 80% of statewide non-metropolitan MHI.	Pre-planning and development of applications for USDA Rural Development Water loans and grants.
SEARCH - Special Evaluation Assistance for Rural Communities & Households (grant)	USDA Rural Development Program	FY20: $90,000 (3) FY19: $288,620 (5) FY18: $56,000 (2)	State and local government entities, nonprofit organizations, Federally recognized tribes in rural areas with population of 2500 or less with MHI below poverty line or less than 80% of statewide non-metropolitan MHI.	Constructing, enlarging, extending or improving rural water, sanitary sewage, solid waste disposal and stormwater facilities.
Emergency Community Water Assistance Grants	USDA Rural Development Program	FY20: $390,154 (2) FY19: $1.5m (2) FY18: $1.1m (2)	State and local government entities, nonprofit organizations, Federally recognized tribes in rural areas and towns with populations of 10,000 or less and with an MHI less than state's MHI for non-metro areas facing a qualified emergency.	Projects to address drought, flood, earthquake, tornado, hurricane, disease outbreak, chemical spill, or other qualified emergency. Federal disaster designation is not required.

Fund	Source Agency	Fund size (Number of awards to CA entities)	Eligible Applicants	Eligible Projects
Environmental infrastructure loans (USDA bridge loans)	Rural Community Assistance Corp (RCAC)	Typically 8-10 CA loans annually. FY20: approximately $3.3m (10)	Rural areas with population of 50,000 or less or 10,000 or less for USDA long-term loans.	Water and waste facility projects for small, rural communities.
Circuit Rider Program - Technical Assistance for Rural Water Systems	USDA, U.S. EPA	FY21: $19m nationally. CA: $0 over last 3 years.	Rural water, wastewater, and solid waste systems; nonprofit water systems, municipal water systems.	Day-to-day operational issues, financial issues, management issues, energy audits.
Community Facilities Direct Loan and Grant Program	USDA Rural Development Program	FY20: Grants $4.4m (52) FY19: Grants $887,800 (26) FY18: $1.8m (29)	Systems serving fewer than 20,000 people, with a focus on systems serving fewer than 5,000 people.	Purchase, construct, and/or improve essential community facilities, purchase equipment and pay related project expenses.
306C Water and Waste Grants	USDA Rural Development Program	FY19: $2m (2)	Federally recognized tribes, colonias designated before October 1, 1989, and rural areas and towns with populations of fewer than 10,000 people.	Basic drinking water and waste disposal systems, including storm drainage.
Assistance for Small and Disadvantaged Communities Drinking Water Grant	U.S. EPA	FY19-20: $3.8m to SRF	Public water systems, existing privately-owned and publicly owned community water systems, and non-profit non-community water systems, including system utilizing POE or residential central treatment.	Investments necessary for public water systems to comply with the Safe Drinking Water Act (see Section 1459A of the SDWA).

Fund	Source Agency	Fund size (Number of awards to CA entities)	Eligible Applicants	Eligible Projects
Water Infrastructure Finance and Innovation (loan)	U.S. EPA	FY20: $1.7B (11)	Local, state, tribal, and Federal government entities; partnerships and joint ventures; corporations and trusts; CWSRF and DWSRF programs. Total Federal assistance may not exceed 80% of projects eligible costs. Minimum project costs of $20m for communities of more than 25,000 people, $5m for communities of 25,000 people or less.	CWSRF and DWSRF projects, enhanced energy efficiency at drinking water and wastewater facilities, desalination, aquifer recharge, alternative water supply, water recycling, drought prevention and reduction or mitigation, property acquisition if necessary. Planning and construction projects both eligible.
WaterSMART Water and Energy Efficiency Grants	U.S. Bureau of Reclamation (USBR)	FY19: $9.5m (12)	State, tribe, irrigation district, water district, or other organization with water or power delivery authority.	50-50 cost share projects addressing water conservation and efficiency, hydropower, conflict risk, and water supply reliability.
Small-Scale Water Efficiency Projects (grant)	USBR	FY20: $862,000 (14)	State, tribe, irrigation district, water district, or other organization with water or power delivery authority.	50-50 cost share projects addressing canal lining/piping, municipal metering, irrigation flow measurement, Supervisory Control and Data Acquisition and Automation (SCADA), irrigation measures, and other projects.

Fund	Source Agency	Fund size (Number of awards to CA entities)	Eligible Applicants	Eligible Projects
Native American Affairs (NAA) Technical Assistance Program (TAP)	USBR	FY20: $200,000 (1)	Federally recognized Indian Tribes.	Projects concerning management, protection, or development of water and related resources.
Rural Water and Wastewater Lending	CoBank	Historically $2.2B to 300 borrowers nationwide	Water cooperatives, water companies, and non-profit water systems.	Not specified.
Rural Water Loan Fund	National Rural Water Association	FY20: 15 loans nationally (average loan size $67,000). No loans to CA in 2020, but 10 loans have been made to CA since the program's inception.	Public entities including municipalities, counties, special purpose districts, Native American tribes, nonprofit corporations, and cooperatives serving rural areas or communities of 10,000 people or less.	Pre-development (planning) costs for infrastructure projects; replacement equipment, system upgrades, maintenance and small capital projects; energy efficiency projects to lower costs and improve system sustainability; and disaster recovery or other emergency loans.
Public Works (grant)	Economic Development Administration (EDA), US Department of Commerce	FY18: $17.8m (6)	District organizations; Indian tribes; states; county, or city, or other political subdivision of a state; institutions of higher education; public or private non-profits.	Competitive national fund to address EDA's investment priorities meeting economic distress criteria. Amount of EDA award may not exceed 50% of project costs.

Fund	Source Agency	Fund size (Number of awards to CA entities)	Eligible Applicants	Eligible Projects
Economic Adjustment Assistance (grant)	EDA	FY18: $5.6m (6)	District organizations; Indian tribes; states; county, or city, or other political subdivision of a state; institutions of higher education; public or private non-profits.	Competitive national fund to finance construction, non-construction, technical assistance, and revolving loan fund projects.
Community Development Block Grant (CDBG) program	Housing and Urban Development (HUD), California Department of Housing and Community Development	FY20: $413m to water & sewer projects nationally FY19: $413m to water & sewer projects nationally FY18: $395m to water & sewer projects nationally	Non-entitlement jurisdictions (cities with a population under 50,000 and counties with a population under 200,000 in unincorporated areas that do not participate in HUD CDBG entitlement program); non-Federally recognized Native American communities; colonias.	Community development projects, including water and wastewater systems.

Litigation Funds and other Contaminant Mitigation Programs

It is also recognized that treatment costs associated with certain contaminants— e.g.1,2,3-trichloropropane (1,2,3 –TCP) — may be covered through monetary damages awarded from legal settlements. Funding may also be made available from other mitigation programs for contaminants such as nitrate as part of the Central Valley Salinity Alternatives for Long-term Sustainability (CV-Salts) program. However, the extent of the availability of this type of funding tends to be site specific and is unknown currently, particularly on an aggregated Statewide basis. Therefore, this version of the Gap Analysis assumed that no necessary solution costs would be covered by litigation awards or other programs. However, it is recognized that any funding awarded through litigation should either reimburse costs that have already been met by the state and/or be utilized, to the extent possible, to expedite funding of solutions for other HR2W list or At-Risk water systems where there may otherwise be insufficient funding.

STEP 2: MATCHING FUNDING NEEDS TO FUNDING PROGRAMS

State Water Board funding sources each have specific eligibility requirements regarding applicant type and project type (Table D3, above). When estimating funding availability, the Gap Analysis used these eligibility requirements to ensure the most appropriate funds are applied to specific categories of systems and solution types (Figure D5). Table D7 shows which funds were considered for which types of systems and solutions types. In the estimation for the funding gap, each fund's total available amount was spread proportionately between all eligible solution and system types. This process was applied to the first approach to Gap Analysis described below in order to help match State Water Board fund sources to the solutions and systems identified in the Cost Assessment. For the second approach to the Gap Analysis, matching was not necessary as the approach focuses solely on the SADWF.

Figure D5: Step 2 of the Gap Analysis Methodology

Table D7: State Water Board Funds Matched to HR2W List and At-Risk Systems Modeled Solutions

State Water Board Funds	System Types	Modeled Solution Types
Safe and Affordable Drinking Water Fund (SADWF)	HR2W, At-Risk	Capital/Construction (i.e., Physical Consolidation, Treatment, OEI), O&M, Interim solutions, Technical Assistance
Drinking Water State Revolving Fund (DWSRF)	HR2W, At-Risk	Capital/Construction (i.e., Physical Consolidation, Treatment, OEI), Technical Assistance
Small Community Drinking Water Funding Program	DAC/SDAC HR2W, DAC/SDAC At-Risk	Capital/Construction (i.e., Physical Consolidation, Treatment, OEI), Technical Assistance
Emergency Drinking Water/Cleanup & Abatement Account Programs – Urgent Drinking Water Needs Projects	DAC/SDAC HR2W, DAC/SDAC At-Risk	Interim solutions, emergency supplies and repairs
Water Board Household & Small Water System Drought Assistance Program; CAA – DW Well Replacement Program	HR2W and At-Risk SSWS, Domestic Wells	Capital/Construction (i.e., Physical Consolidation, Treatment, OEI), Technical Assistance
Water System Administrator Program	HR2W, At-Risk	N/A[160]

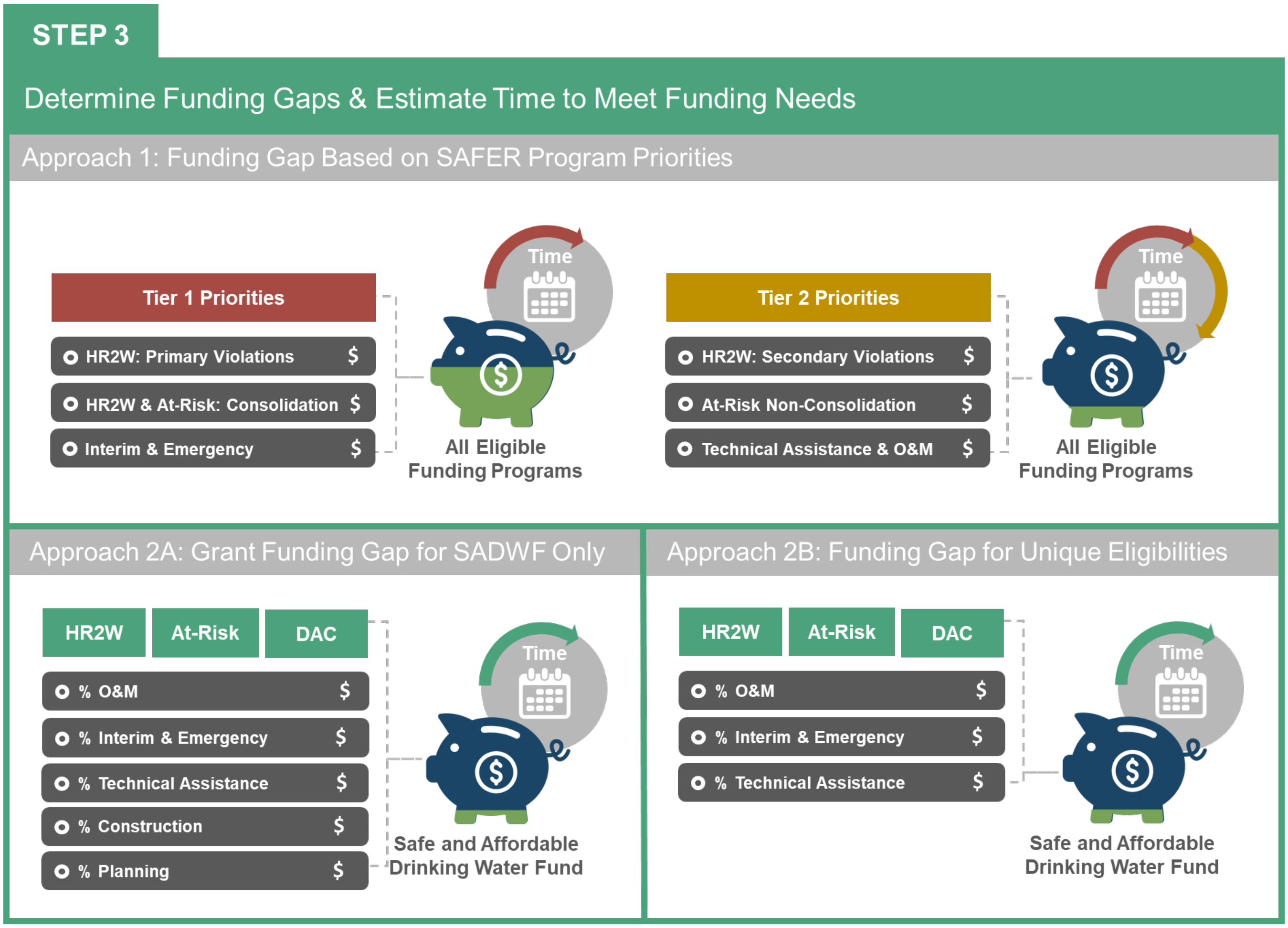
STEP 3: ESTIMATING THE FUNDING GAP

The funding gap informed an estimate of the time it will take to meet the estimated need and how much need cannot be met based on existing funding sources. Two approaches were taken to make these estimates (Figure D6). The first approach took into account a tiered prioritization of project types based on the priorities established in the SADWF FY 2020-21 FEP and applied this prioritization to all State Water Board funding programs relevant to the SAFER program. The second approach specifically analyzed the funding gap for the SADWF

[160] Currently, there is limited cost data to support the inclusion of the Administrator funding program into the Gap Analysis for the 2021 Needs Assessment. Future iterations will be able to assess the gap for Administrators when data becomes available.

by applying the fund target expenditures by solution type as presented in the SADWF FY 2020-21 FEP.

Figure D6: Step 3 of the Gap Analysis Methodology



APPROACH 1: TIERED PRIORITIZATION BASED ON SYSTEM AND MODELED SOLUTION TYPES

For the first approach to estimating the gap, the estimated grant funding need that has been matched to funding sources based on the modeled solutions was applied to the funding available in all State Water Board funding programs relevant to the SAFER Program, over time, using a two-tier prioritization. Under this approach, all available grant funding was first applied to all estimated need for Tier 1. If any funding remained after this application, then remaining funds were to be applied to Tier 2.

These priorities were used in the Gap Analysis to prioritize all State Water Board funding resources, not solely the SADWF. Even so, it was not expected that there would be sufficient funding for all estimated need to be met by State Water Board funds. The difference between the estimated grant funding available and the estimated need for both systems meeting Tier 1 and Tier 2 criteria accounts for the "gap" for calculated grant funding for each year of the estimate.

First Tier Prioritization

Tier 1 prioritization was based on the SADWF FY 2020-21 Fund Expenditure Plan's "General Funding Approach and Prioritization" (p. 12).[161] The Fund Expenditure Plan specifies that the top priorities for expenditures from the SADWF for FY 2020-21 include:

> 1) addressing any emergency or urgent funding needs, where other emergency funds are not available, and a critical water shortage or outage could occur without support from the Fund;[162]
>
> 2) addressing CWSs and school water systems out of compliance with primary drinking water standards, focusing on small DACs;[163]
>
> 3) accelerating consolidations for systems out of compliance, At-Risk systems, as well as state smalls and domestic wells, focusing on small DACs; and
>
> 4) providing interim solutions, initiating planning efforts for long-term solutions, and funding capital projects for state smalls and domestic wells with source water above a primary MCL.

Second Tier Prioritization

Tier 1 prioritization does not cover certain systems, such as those on the HR2W list solely on the basis of secondary drinking water violations or monitoring and reporting violations. Therefore, a second set of prioritization criteria was needed for the Gap Analysis. Tier 2 included:

> 1) HR2W list systems not captured in Tier 1; and
>
> 2) all other At-Risk systems not captured in Tier 1.

Any unfunded portion of long-term O&M need was not added to the next year's need, but instead was appropriated to local cost share. This was done to more closely match real-world

[161] FY 2020-21 Fund Expenditure Plan https://www.waterboards.ca.gov/water_issues/programs/grants_loans/sustainable_water_solutions/docs/sadwfep_2020_07_07.pdf

[162] This category included interim capital and O&M costs. To account for the ongoing need for interim O&M costs in the Gap Analysis, first, the proportion of the combined interim capital and O&M costs to the total amount of those costs that were funded in the previous year, by system type (HR2W list, At-Risk PWS, At-Risk SSWS, At-Risk domestic well), was calculated. Then, this proportion was multiplied by the remaining costs in this category for that year. Finally, this amount was added to all of the following years' estimated need to ensure the ongoing interim O&M need was included.

[163] 298 out of 305 systems on the HR2W list used in this analysis were out of compliance with a primary drinking water standard. The other seven systems, which were out of compliance for secondary drinking water standards, were prioritized as Tier 2 in this analysis.

scenarios where un-funded O&M would not be possible to carry forward, but would, by necessity, be borne by the water system or domestic well owner.

Local Cost Share Gap Calculations

All project costs that were not grant eligible, as described above in Table D3, were refined into costs that were either (A) eligible for a State Water Board loan (B) eligible for a non-State State Water Board loan or (C) not eligible for a loan (i.e. O&M costs). To calculate the estimated State Water Board financing gap, the total estimated State Water Board loan eligible needs were compared to estimated annual DWSRF loan financing availability ($300 million per year). The Gap Analysis applied total annual financing availability towards Tier 1 prioritized systems first with any remaining annual financing capacity then applied to Tier 2 prioritized systems.

The Gap Analysis utilized the interest rates detailed in Table D4 to calculate the 20-yr. financing costs associated with all loan-eligible estimated capital costs. The Gap Analysis then summed the non-grant eligible capital costs, 20-year interest costs, and 20-year O&M costs, to estimate the total 20-year local cost share burden.

APPROACH 2: SADWF TARGET EXPENDITURES

The second funding Gap Analysis approach estimated a potential funding gap specifically for the SADWF with an exclusive focus on small DAC and SDAC systems. This analysis was in turn conducted two different ways (Figure D6). The first method (Approach 2A) included the majority of SADWF target expenditures. The second method (Approach 2B) removed Construction and Planning target expenditures to estimate the funding gap for the project type and recipient eligibilities uniquely covered by the SADWF. For these approaches, the estimated number of systems and associated costs of those expected to be added to the HR2W and At-Risk PWS lists was likewise limited to small DACs and SDACs. Small DAC/SDAC systems are prioritized in the 2020-21 SADWF FEP.

In both approaches, a small share of interim need was added in each year to account for the ongoing operations and maintenance need for these systems. As operations and maintenance need was calculated to be 4% of the overall refined interim need for the existing systems, an additional 4% of the interim need covered in the previous year was added to the calculated refined interim need each year, when interim need was not fully met.

Approach 2A

This approach analyzes the potential funding gap for the SADWF based on the target expenditures outlined in the 2020-21 FEP. Table D9 details the proportion of grant funding allocations employed in Approach 2A for year 1, while Table D11 details the proportions for years 2 through 5. While the percentages presented are rounded, the analysis was conducted with unrounded figures to provide the highest level of accuracy. For the purposes of the Gap Analysis, some of the percentages were re-allocated based on available modeled Cost Assessment estimates for long-term solutions. For Approach 2A and 2B, staff costs and other program needs were not allocated according to a percentage but were assumed to be $16 million in each year. This assumption was based on the FY 2020-2021 FEP Table ES-1. Accordingly, the percentages in Table D8 do not sum to 100%; the omitted portion of SADWF funds comprise the $16 million allocated towards Administrator and Staff Costs in the 2020-21 FEP and is thus not included in this analysis.

Table D8: 2020-21 SADWF Year 1 Target Expenditures as Percentages for the Gap Analysis

Water System Category	Interim Water Supplies and Emergencies	Technical Assistance	O&M Support	Construction & Planning
HR2W Systems	8.15%	5.15%	4.15%	17.15%
At-Risk PWS Systems	3.15%	14.15%	4.15%	17.15%
At-Risk SSWSs & Domestic Wells	6.15%	0%[164]	0%	10.15%

Table D9 summarizes available funding by category for the SADWF in Year 1 (fiscal year 2021-22) based on the percentages in Table D8. The Gap Analysis assumes approximately $137 million in grant funding availability in Year 1, which includes $130 million from new SADWF appropriations, reduced by $16 million for Administrator and State Water Board staff costs, and an added $23 million from fiscal year 2020-21 carryover.

Table D9: Approach 2A Estimated Year 1 SADWF Grant Funding Availability When Applying 2020-21 FEP Target Fund Expenditures as Percentages ($ Millions)

Water System Category	Emergency/Interim Assistance	Technical Assistance	O&M Support	Construction & Planning	Total 1st Yr. Funding Availability
HR2W list	$12	$8	$6	$26	**$53**
At-Risk PWS	$5	$22	$6	$26	**$59**
At-Risk SSWSs & Domestic Wells	$9	N/A	N/A	$15	**$25**
TOTAL:	**$2**	**$29**	**$13**	**$68**	**$137**

164 The 2020-21 FEP has 4% allocated towards Technical Assistance for At-Risk SSWSs and domestic wells. However, the Cost Assessment Model results did not estimate technical assistance needs for these systems. Therefore, the 4% allocation has been equally divided and applied to the Emergency/Interim and Construction/Planning categories for At-Risk SSWSs and domestic wells.

Table D10 reports a separate, slightly modified set of percentages that guide Approach 2A for years 2-5. As with Table D8, these percentages reflect the $16 million removed for staff costs and other program needs. The Year 2-5 percentages differ from the Year 1 percentages reported in Table D8 because the $16 million figure is assumed to remain constant while the overall funding is lower as there are assumed to be no carryover costs for years 2 through 5.

While this analysis assumed that the percentages do not change from Year 2 onward, however, for future Fund Expenditure Plans, all target expenditures will be reviewed and adjusted annually based on actual need, public input, and the SAFER Advisory Group recommendations.

Table D10: 2020-21 SADWF Year 2-5 Target Expenditures as Percentages for the Gap Analysis

Water System Category	Interim Water Supplies and Emergencies	Technical Assistance	O&M Support	Construction & Planning
HR2W Systems	7.97%	4.97%	3.97%	16.97%
At-Risk PWS Systems	2.97%	13.97%	3.97%	16.97%
At-Risk SSWSs & Domestic Wells	5.97%	0% [165]	0%	9.97%

While total available funding of the SADWF in Year 1 of the analysis includes uncommitted funds from the previous fiscal year, the Gap Analysis assumes full commitment each year. Therefore, from Year 2 through Year 5 the total annual SADWF funding availability drops to $114 million (the full $130 million appropriation less $16 million for staff and Administrator costs). Table D11 summarizes the total available SADWF funding in Years 2 through 5 utilized in the Gap Analysis.

[165] The 2020-21 FEP has 4% allocated towards Technical Assistance for At-Risk SSWSs and domestic wells. However, the Cost Assessment Model results did not estimate technical assistance needs for these systems. Therefore, the 4% allocation has been equally divided and applied to the Emergency/Interim and Construction/Planning categories for At-Risk SSWSs and domestic wells.

Table D11: Approach 2A Estimated Annual SADWF Grant Funding Availability (Years 2 through 5) When Applying 2020-21 FEP Target Fund Expenditures as Percentages ($ Millions)

Water System Category	Emergency/Interim Assistance	Technical Assistance	O&M Support	Construction & Planning	Total Annual Funding Availability
HR2W list	$10	$6	$5	$22	**$44**
At-Risk PWS	$4	$18	$5	$22	**$49**
At-Risk SSWSs & Domestic Wells	$8	N/A	N/A	$13	**$21**
TOTAL:	**$22**	**$24**	**$10**	**$57**	**$114**

For Approach 2A, if the funding available based on the allocations described above was more than the estimated refined need for a specific solution within a water system category (e.g., if there was less than $18 million of Technical Assistance need for At-Risk PWS in year 2-5), then the surplus funds were re-allocated equally across the other solutions within that same water system category. The one exception was if the funding available for At-Risk PWS O&M support was more than the need, then the surplus funds from this category were re-allocated to the HR2W list O&M support need category.

Approach 2B

The purpose of Approach 2B is to assess the potential funding gap for the SADWF that specifically focuses on the fund's unique funding eligibilities. For this approach, all refined estimated construction and planning needs that are associated with HR2W list and At-Risk PWS systems were removed, as these costs may be covered by other State Water Board funding programs. The SADWF fiscal year 2020-21 FEP construction and planning target expenditure percentages were equally redistributed into the other solutions within each water system category, either HR2W list or At-Risk PWS, detailed in Table D12.

As under Approach 2A, staff costs and other program needs were not allocated according to a percentage but were assumed to be $16 million each year. This assumption was based on the FY 2020-2021 FEP Table ES-1. Accordingly, the percentages in these tables do not sum to 100%; the omitted portion of SADWF funds comprise the $16 million allocated towards Administrator and Staff Costs in the 2020-21 FEP. As under Approach 2A, these percentages are presented as rounded figures, however the analysis was conducted with the unrounded percentages for greater accuracy.

Table D12: 2020-21 SADWF Year 1 Target Expenditures as Percentages for the Gap Analysis with Construction and Planning Removed for PWSs

Water System Category	Interim Water Supplies and Emergencies	Technical Assistance	Direct O&M Support	Construction & Planning
HR2W Systems	13.67%	10.67%	9.67%	0%
At-Risk PWS Systems	8.67%	19.67%	9.67%	0%
State Small Systems & Domestic Wells	6%	0%	0%	10%

The redistribution of target fund expenditures shifts the annual estimated need that can be met by the SADWF. Mirroring Approach 2A, these estimates assume approximately $137 million grant funding availability in Year 1, which includes $130 million from new SADWF appropriations, reduced by $16 million for Administrator and State Water Board staff costs, and $27 million from fiscal year 2020-21 carryover. Table D13 details how the $137 million available in Year 1 of the analysis was distributed based on the target expenditure percentages in Table D12.

Table D13: Approach 2B Estimated Year 1 SADWF Grant Funding Availability When Applying 2020-21 FEP Target Fund Expenditures as Percentages from Table D12

Water System Category	Emergency/Interim Assistance	Technical Assistance	O&M Support	Construction & Planning	Total 1st Yr. Funding Availability
HR2W list	$21	$17	$15	N/A	**$53**
At-Risk PWS	$14	$30	$15	N/A	**$59**
At-Risk SSWSs & Domestic Wells	$9	N/A	N/A	$16	**$25**
TOTAL:	**$44**	**$47**	**$30**	**$16**	**$137**

Table D14 shows the Year 2-5 percentages.

Table D14: 2020-21 SADWF Year 2-5 Target Expenditures as Percentages for the Gap Analysis with Construction and Planning Removed for PWSs[166]

Water System Category	Interim Water Supplies and Emergencies	Technical Assistance	Direct O&M Support	Construction & Planning
HR2W Systems	13.86%	10.86%	9.86%	0%
At-Risk PWS Systems	8.86%	19.86%	9.86%	0%
State Small Systems & Domestic Wells	6.19%	0%	0%	10.19%

As with Approach 2A, in Year 2 through Year 5 the total annual SADWF funding availability drops to $116 million (the full $130 million appropriation less $16 million for staff costs). Table D15 summarizes the total available SADWF funding in Years 2 through 5 applied following 2020-21 FEB target fund expenditures.

Table D15: Approach 2B Estimated Years 2-5 Annual SADWF Grant Funding Availability When Applying 2020-21 FEP Target Fund Expenditures as Percentages from Table D14

Water System Category	Emergency/Interim Assistance	Technical Assistance	O&M Support	Construction & Planning	Total Annual Funding Availability
HR2W list	$18	$14	$13	N/A	**$45**
At-Risk PWS	$11	$26	$13	N/A	**$50**
At-Risk SSWSs & Domestic Wells	$8	N/A	N/A	$13	**$21**
TOTAL:	**$37**	**$40**	**$26**	**$13**	**$116**

[166]Note that percentages in Table D14 do not add up to 100% as this table only includes solutions types modeled by the Cost Assessment, and therefore, Administrator solutions and other program needs are not included in the Gap Analysis at this time. Furthermore, Table D14 does not include staff costs associated with implementing the SAFER Program, which are anticipated to increase over time.

Reallocation of funds for the Approach 2B gap estimate followed the same methods as described for Approach 2A. However, for Approach 2B, it was necessary to reallocate funds across water system categories, with surplus funds first being reallocated from the At-Risk PWS category to the HR2W list category, and then, if surplus were still available, it was applied to the At-Risk SSWS and domestic well category.

The results of Gap Analysis Approaches 2A and 2B are summarized in Attachment D1.[167]

[167] Attachment D1: Supplemental Gap Analysis for the Safe and Affordable Drinking Water Fund https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/d1.pdf