CALIFORNIA
Water Boards

APPENDIX:
COST ASSESSMENT METHODOLOGY

LAST UPDATED: JUNE 2024

CONTENTS

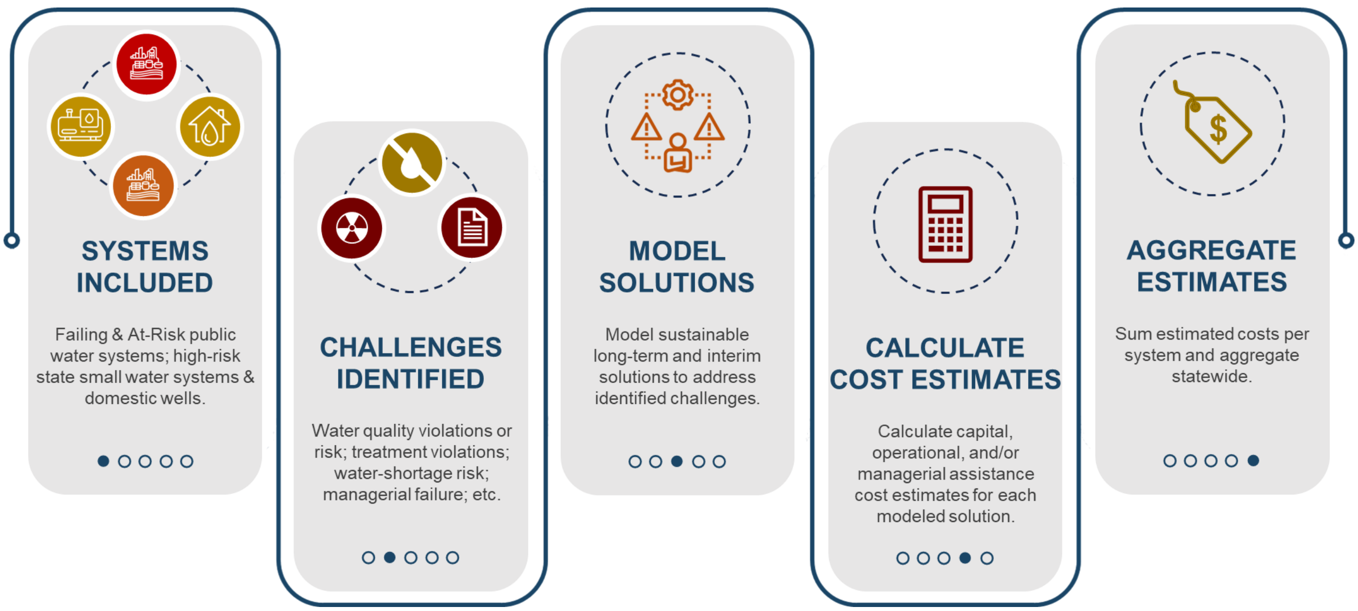
INTRODUCTION

WHAT IS THE COST ASSESSMENT?

The Cost Assessment is a model comprised of decision criteria, cost assumptions, and calculation methodologies used to estimate a statewide cost for implementing long-term and interim solutions for Failing public water systems,[1] At-Risk public water systems, high-risk state small water systems and domestic wells.[2] The Cost Assessment results estimate the statewide cost of achieving the Human Right to Water[3] for all Californians.

The goal of the Cost Assessment is to inform the spending prioritization of existing State Water Board funding sources, particularly via the Senate Bill 200-mandated annual Safe and Affordable Drinking Water Fund Expenditure Plan.

Figure 1: Cost Assessment Model



The Cost Assessment results include the following:

- **Capital Cost Estimate**: Includes all estimated costs associated with the construction and installation of modeled physical consolidation, treatment technologies, and/or other essential infrastructure. In addition to the estimated equipment cost, the capital cost estimate may also include costs associated with electrical expenses (wiring), engineering services design fees, project management and administrative activities,

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1 Failing Water Systems Criteria:
https://www.waterboards.ca.gov/water_issues/programs/hr2w/docs/hr2w_expanded_criteria.pdf
2 2023 Risk Assessment Results for public water systems, state small water systems and domestic wells:
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2023needsassessment.pdf
3 State Water Resources Control Board Resolution No. 2016-0010
https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2016/rs2016_0010.pdf

construction contingency, contractor's labor, business overhead, and California Environmental Quality Act (CEQA) related costs.

- **Operations and Maintenance (O&M) Cost Estimate**: Includes the estimated 20-year annual expenses associated with operating and maintaining the modeled treatment technologies. Annual O&M estimates may account for consumables, labor, power, and waste discharge fees.
- **Managerial Assistance Cost Estimates:** Include costs associated with providing modeled technical assistance, Administrator assistance, and community engagement.

WHAT THE COST ASSESSMENT IS NOT

The purpose of the Cost Assessment is to estimate the cost of achieving the Human Right to Water, which is the cost of ensuring safe and affordable drinking water for all Californians. It is not a comprehensive assessment of statewide drinking water infrastructure needs. All drinking water systems require routine maintenance, infrastructure replacement and enhancements, etc. The Cost Assessment only includes a small proportion of drinking water systems in the state and should not be used to illustrate the full extent of drinking water funding needs.

The embedded assumptions and cost estimates detailed in the Cost Assessment 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 is not intended to be used by the State Water Board or any community to inform community-level decisions,** as it includes many assumptions about local needs and capacity. The purpose of the Cost Assessment is to provide an informative analysis of estimated needs statewide.

The Cost Assessment evaluates only a narrow range of possible interim and long-term solutions. Communities included in the analysis should be conducting a detailed evaluation of their unique drinking water challenges and identify a range of possible solutions to select the best path forward.

The Cost Assessment is not used by the State Water Board or any of its partners to inform local decisions. In particular, the Cost Assessment's output and underlying assumptions are not used by the State Water Board to make funding and assistance decisions.

COST ASSESSMENT METHODOLOGY DEVELOPMENT PROCESS

The State Water Board is committed to engaging the public and key stakeholder groups to solicit feedback and recommendations to inform the enhancement of the Cost Assessment. Since 2019, 15 public workshops (some covering multiple Needs Assessment component topics) have been hosted to inform the development of the Cost Assessment Model. White papers, presentations, public feedback received, and webinar recordings can be found on the State Water Board's Needs Assessment webpage.[4] The State Water Board will continue to host public workshops to provide opportunities for stakeholders to learn about and contribute to the State Water Board's efforts to enhance and develop a more robust Cost Assessment.

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

Figure 2: Cost Assessment Workshops

NEEDS ASSESSMENT COMPONENTS	2019	2020	2021	2022	2023
Failing List		1	1	1	2
Risk Assessment: Public Water Systems	1	3	1	2	3
Risk Assessment: State Small Water Systems & Domestic Wells	1	4	2	2	3
Cost Assessment	3	2	2	3	5
Affordability Assessment		2	1	5	3

2021 COST ASSESSMENT

The first iteration of the Cost Assessment conducted for the 2021 Drinking Water Needs Assessment was developed by the State Water Board, in partnership with the University of California, Los Angeles Luskin Center for Innovation (UCLA), Corona Environmental Consulting (Corona), and Sacramento State University Office of Water Programs (OWP).

The initial draft Cost Assessment Model 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 Model methodology were provided in the August 28, 2020 white paper *Long Term Solutions Cost Methodology for Public Water Systems and Domestic Wells*[5] and public webinar *Cost Estimate: Overview of Approach and Update*.[6] Corona Environmental, the State Water Board, OWP at Sacramento State and UCLA refined the initial draft Cost Assessment Model 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*[7] was published on November 20, 2020 and a public webinar was hosted on November 20, 2020 to solicit feedback on the Cost Assessment Model for estimating costs associated with implementing interim and long-term solutions for Failing and At-Risk systems.

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[5] 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

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

[7] 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

The third, and final, webinar workshop *Cost Assessment Model Preliminary Results and Gap Analysis*[8] was hosted on February 26, 2021 to seek public feedback on the revisions to the Cost Assessment Modal for long-term solutions for Failing 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*.[9]

PUBLIC WORKSHOPS 2019-2021

January 11, 2019: *Drinking Water Needs Assessment Workshop: Public Water Systems*

- Public Notice

January 18, 2019: *Drinking Water Needs Assessment Workshop: Domestic Wells*

- Public Notice

May 10, 2019: *Cost Analysis Workshop*

- Public Notice
- Agenda
- Webcast Recording
- Consolidation-Related Presentation PDFs:
    - SWRCB DDW, D. Polhemus
    - Corona Environmental Consulting, T. Henrie
    - UCLA, Y. Cohen
    - Los Angeles County Sativa, D. Lafferty

August 28, 2020: *Cost Estimate: Overview of Approach and Update*

- Public Notice
- White Paper
- Webinar Recording

November 20, 2020: *Cost Estimate: In-Depth Cost Methodology Discussion Webinar*

- Public Notices: English | Spanish
- White Paper
- Presentation
- Webinar Recording

[8] February 26, 2021 SAFER Webinar Recording: https://www.youtube.com/embed/Ds-5tbJGpG4?modestbranding=1&rel=0&autoplay=1

[9] 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

February 26, 2021: SAFER: *Cost Assessment Model Preliminary Results and Gap Analysis Webinar*

- White Paper
- Webinar Recording

April 13, 2021: *2021 Needs Assessment Results*

- Report
- Press Release
- FAQs
- Presentation
- Webinar Recording

A handful of comment letters were received throughout this effort and some adjustments to the 2021 Cost Assessment Model's final methodology. Additional details that were requested in the comment letters were added to the 2021 Cost Assessment Methodology Appendix.[10]

Ultimately the results of the 2021 Cost Assessment and the detailed Cost Assessment methodology were detailed and published in the 2021 Drinking Water Needs Assessment.[11]

2022 DROUGHT INFRASTRUCTURE COST ASSESSMENT

Due to minor changes to the number of Failing and At-Risk systems in 2022, the State Water Board did not update the Cost Assessment estimates in the 2022 Needs Assessment. However, in September 2021 the Governor approved Senate Bill (SB) 552[12] which requires small water systems (15 – 2,999 connections) and schools to meet new drought infrastructure resiliency measures. In response to stakeholder feedback for better drought-related cost estimates and the need to support SB 552 planning, the State Water Board conducted a targeted Drought Infrastructure Cost Assessment for the 2022 Needs Assessment.[13] Many of the underlying cost assumptions utilized in the Drought Infrastructure Cost Assessment were adopted and/or updated from the 2021 Cost Assessment methodology. The State Water Board hosted one workshop in 2022 to solicit stakeholder input on the Drought Infrastructure Cost Assessment's methodology:

[10] 2021 Drinking Water Needs Assessment https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2021_needs_assessment.pdf

[11] 2021 Drinking Water Needs Assessment https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2021_needs_assessment.pdf

[12] Senate Bill No. 552, section 10609.62, Chapter 245 https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=202120220SB552

[13] 2022 Drinking Water Needs Assessment https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2022needsassessment.pdf

PUBLIC WORKSHOPS 2022

February 2, 2022: ***Proposed Changes for the 2022 Needs Assessment***

- Public Notices: English | Spanish
- White Paper
- Presentation
- Webinar Recording English I Spanish

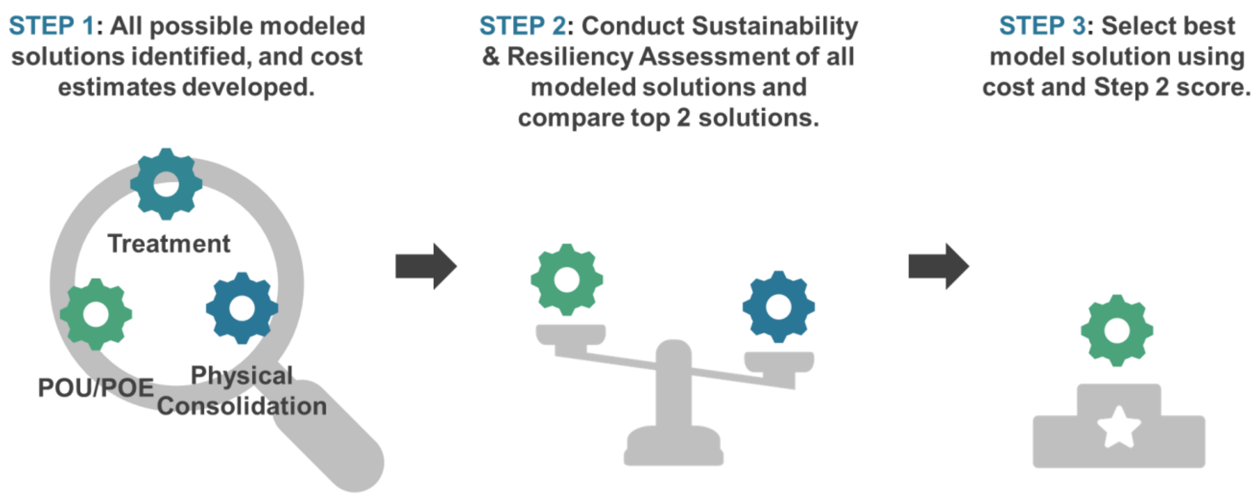
May 5, 2022: ***2022 Needs Assessment Results***

- Public Notices: English | Spanish
- Report
- Presentation: English | Spanish
- Webinar Recording: English | Spanish

2022-23 REBUILDING THE COST ASSESSMENT MODEL

The original 2021 Cost Assessment Model employed a three-step approach for identifying the best long-term modeled treatment solution for Failing water systems with water quality violations (Figure 3). In Step 1, the Cost Assessment Model would assess Failing water systems; select treatment technologies based on the system's failing analyte(s); estimate capital and operational costs for centralized treatment, decentralized treatment, and physical consolidation; and then compare the different potential solutions across several criteria in Step 2 (Sustainability & Resiliency Assessment) of the Cost Assessment Model before selecting the final modeled solution in Step 3.

Figure 3: 2021 Cost Assessment Model Long-Term Solution Selection Process for Failing Water Systems



For Failing water systems, the 2021 Cost Assessment selected decentralized treatment (Point of Use/Point of Entry) for 35%; centralized treatment for 45%; and physical consolidation for 20%. At the time of publication, the State Water Board recognized inherent limitations in the original Cost Assessment Model that led to the over-selection of decentralized treatment and under-selection of physical consolidation as the modeled long-term solution. These limitations were attributed to the lack of data availability; the exclusion of modeled regional consolidation projects that would have driven down the modeled cost estimate of physical consolidation; and the inability of the Cost Assessment Model's design to account for the inherent risk and long-term maintenance challenges posed by decentralized treatment. Therefore, the 2021 Cost Assessment's results did not fully reflect the State Water Board SAFER program's core mission and direction to promote physical consolidations where feasible and only advance decentralized treatment where no other long-term options may be viable.

Based on external feedback and internal deliberations, the State Water Board rebuilt the Cost Assessment Model in 2022-2023 with stakeholder engagement through five public workshops. The updated Cost Assessment Model takes a more streamlined approach to selecting modeled long-term solutions. The updated Cost Assessment Model first assesses the viability for physical consolidation for all systems. If physical consolidation is not viable, then alternative long-term solutions are explored in order of long-term sustainability. Learn more in the sections below.

PUBLIC WORKSHOPS 2022-2023

August 8, 2022: *Proposed Changes for the Cost Assessment*

- Public Notices: English | Spanish
- White Paper
- Presentation
- Webinar Recording

July 14, 2023: *Proposed Updates to the Drinking Water Cost Assessment Model – Workshop 1: Physical Consolidation Analysis*

- Public Notices: English | Spanish
- White Paper
- Presentation
- Webinar Recording

October 5, 2023: *Proposed Updates to the Drinking Water Cost Assessment Model – Workshop 2: Modeled Treatment Analysis*

- Public Notice: English | Spanish
- White Paper
- Presentation
- Webinar Recording

December 20, 2023: *Proposed Updates to the Drinking Water Cost Assessment Model – Workshop 3: Other Essential Infrastructure, Administrative Needs, and Interim Solutions*

- Public Notice: English | Spanish
- White Paper
- Presentation
- Webinar Recording

December 20, 2023: *Proposed Updates for the 2024 Drinking Water Needs Assessment*

- Public Notice: English | Spanish
- White Paper
- Presentation
- Webinar Recording

The Cost Assessment Model's underlying cost assumptions were updated in 2023 to reflect current market values. The cost assumptions were derived from extensive internal and external outreach:

- Review of 2021 Cost Assessment Model documentation from contractors.
- Consultations with many California-based and national vendors and consulting firms.
- Review of State Water Board funding project files.
- Review of U.S. EPA Work Breakdown Structure (WBS) Models.
- Data collection from water systems to collect and confirm cost information and assumptions.
- Consulting with an internal workgroup of Division of Drinking Water engineers and Division of Financial Assistance staff on a bi-weekly basis.
- Solicitation of public feedback and recommendations through multiple public webinar workshops and open comment periods.

The State Water Board received many quotes, receipts, and modeling advice from a wide range of stakeholders throughout this process, helping validate and adjust the Cost Assessment Model's inputs along the way. All cost assumptions are fully cited in the Appendixes of the published white papers and Supplemental Appendixes to promote transparency.

2024 COST ASSESSMENT

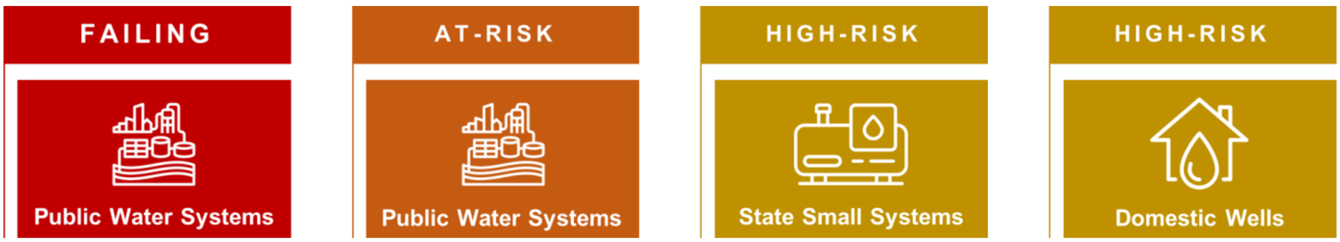
In 2024 the State Water Board conducted a Cost Assessment utilizing the newly updated Cost Assessment Model. This Appendix and its Supplemental Appendixes detail the methodology and cost assumptions utilized to produce the Cost Assessment results published in the 2024 Drinking Water Needs Assessment.[14] Any future enhancements to the Cost Assessment will be updated in a new version of this Appendix.

[14] 2024 Drinking Water Needs Assessment
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2024/2024-needs-assessment.pdf

SYSTEMS ASSESSED & CHALLENGES IN NEED OF MODEL SOLUTIONS

Senate Bill 200 directs the State Water Board to estimate the funding needed for the Safe and Affordable Drinking Water Fund to achieve the Human Right to Water. Therefore, the Cost Assessment estimates the cost for implementing interim and long-term solutions for Failing public water systems[15], At-Risk public water systems, high-risk state small water systems, and domestic wells. This inventory of systems represents a small proportion of California water systems. Therefore, the results of the Cost Assessment do not reflect statewide drinking water infrastructure needs.

Figure 4: Systems Included in the Cost Assessment



FAILING PUBLIC WATER SYSTEMS

Since 2017, the State Water Board has assessed community water systems[16] and public water systems that serve K-12 schools that fail[17] to meet the goals of the Human Right to Water. The State Water Board maintains a "Failing list" of water systems and map of their locations on its website.[18] Water systems that are on the Failing list are those that are out of compliance or consistently out of compliance with drinking water regulations. More information about the criteria and conditions that add and remove water systems from the Failing list are available online.[19] As shown in Figure 4, public water systems can fail for a variety of violation types. The Cost Assessment Model uses decision-making to model potential interim and long-term

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

[16] Community Water System is 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).)

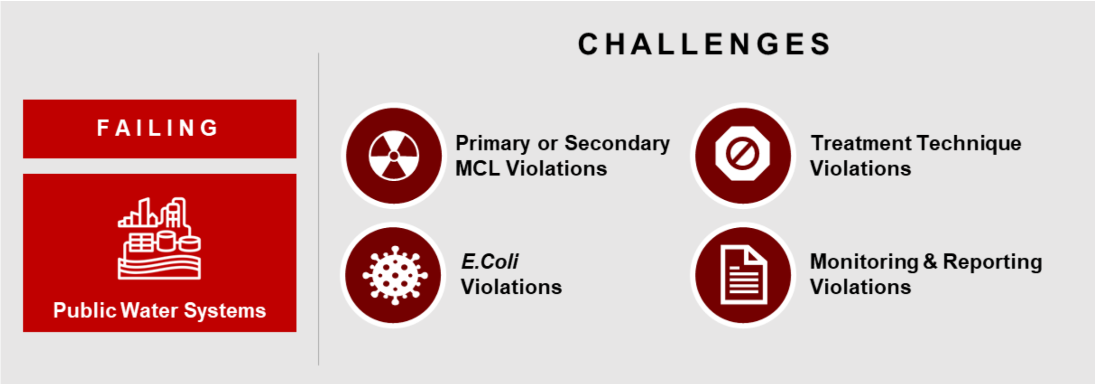
[17] Failing: the inability of a public water system to provide an adequate and reliable supply of drinking water which is at all times pure, wholesome, and potable (Health & Saf. Code, § 116555).

[18] SAFER Dashboard https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/saferdashboard.html

[19] Failing Criteria for Community Water Systems & Schools https://www.waterboards.ca.gov/water_issues/programs/hr2w/docs/hr2w_expanded_criteria.pdf

solutions to address the challenges leading the water system to be on the Failing list.

Figure 5: Failing Public Water System Challenges



AT-RISK PUBLIC WATER SYSTEMS

At-Risk public water systems are categorized by the State Water Board utilizing the results of the Risk Assessment for public water systems.[20] The purpose of the Risk Assessment for public water systems is to identify systems 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. The Risk Assessment methodology currently utilizes risk indicators to identify At-Risk K-12 schools and community water systems serving up to 30,000 service connections and no more than 100,000 population served. Risk indicators assess risk in the following categories: water quality, accessibility, affordability, and TMF (technical, managerial, and financial) capacity.

Figure 6: At-Risk Public Water System Challenges

[20] 2024 Drinking Water Needs Assessment https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2024/2024-needs-assessment.pdf

Table 1: 2024 Failing and At-Risk Public Water Systems

Water System Type	Large[21]	Medium[22]	Small[23]	K-12 Schools	TOTAL
Failing Public Water Systems	1 (0%)	16 (2%)	318 (32%)	50 (5%)	**385** (39%)
At-Risk Public Water Systems	*Excluded* (0%)	31 (3%)	511 (51%)	71 (7%)	**613** (61%)
TOTAL:	**1 (0%)**	**47 (5%)**	**829 (83%)**	**121 (12%)**	**998 (100%)**

HIGH-RISK STATE SMALL WATER SYSTEMS & DOMESTIC WELLS

The Cost Assessment includes communities served by high-risk state small water systems and domestic wells. **These systems are not regulated by the State Water Board, but rather County public health agencies.** Data and information regarding these systems is limited:

State Small Water Systems: A state small water system is 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.[24]

Domestic Wells: A domestic well is 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 has no more than four service connections.[25]

The "high-risk" categorization of communities served by state small water systems and domestic wells is determined by the State Water Board using the results of the Risk Assessment for state small water systems and domestic wells.[26] The Risk Assessment identifies areas where groundwater is at high-risk of containing contaminants that exceed safe drinking water standards, is at high-risk of water shortage, and where there is high socioeconomic risk. For the purposes of the Cost Assessment, only state small water systems and domestic wells that are designated high-risk in the *Water Quality* and/or the *Water Shortage* categories of the Risk Assessment are included in the analysis. State small water

[21] Large water system = Greater than 30,000 service connections.
[22] Medium water system = 3,001 to 30,000 service connections.
[23] Small water system = 3,000 service connections or less.
[24] Health & Saf. Code, § 116275, subd. (n).
[25] Health & Saf. Code, § 116681, subd. (g).
[26] 2024 Drinking Water Needs Assessment https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2024/2024-needs-assessment.pdf

systems and domestic wells that are designated high-risk *only* in the Socioeconomic Burden category of the Risk Assessment are excluded from the Cost Assessment.

High *Water Quality* Risk: The risk analysis in the *Water Quality* category uses proxy groundwater quality data to identify areas where shallow groundwater quality may exceed primary drinking water standards. *These proxy data do not assess the compliance with state or federal water quality standards.* As a result, the presence of a given state small water system or domestic well within a “high-risk” area does not signify that they are known to be accessing groundwater with contaminants above drinking water standards.

High *Water Shortage* Risk: The risk analysis in the *Water Shortage* category, conducted by California Department of Water Resources, includes a suite of risk indicators that indicate where state small water systems and domestic wells may experience water shortage issues. The risk indicators utilize modeled data and observed data to assess systems for water shortage risk. As a result, the presence of a given state small water system or domestic well within a “high-risk” area does not signify that the well has gone dry or is experiencing water shortage issues.

Table 2: 2024 High-Risk State Small Water Systems and Domestic Wells (Statewide)

System Type	High *Water Quality* Risk Only	High *Water Shortage* Risk Only	Both High *Water Quality & Shortage* Risk	TOTAL
State Small Water Systems Statewide: 1,282	464 (36%)	130 (10%)	133 (10%)	**727 (57%)**
Domestic Wells Statewide: 296,283	39,709 (13%)	63,146 (21%)	40,808 (14%)	**143,663 (48%)**

MODELED LONG-TERM SOLUTIONS

The Cost Assessment Model utilizes water system information to identify the most sustainable and potentially feasible modeled long-term solution. Modeled long-term solutions in the Cost Assessment include physical consolidation, centralized treatment, decentralized treatment, new public or private wells, bottled water, technical assistance, Administrator assistance, and other essential infrastructure. Some systems may have one or more modeled long-term solution depending on the system type, their identified challenges, and other system or community characteristics. Figure 7 and Figure 8 summarizes which long-term solutions may be modeled for different system types in the Cost Assessment based on their challenges.

Figure 7: Possible Modeled Long-Term Solutions for Failing & At-Risk Public Water Systems

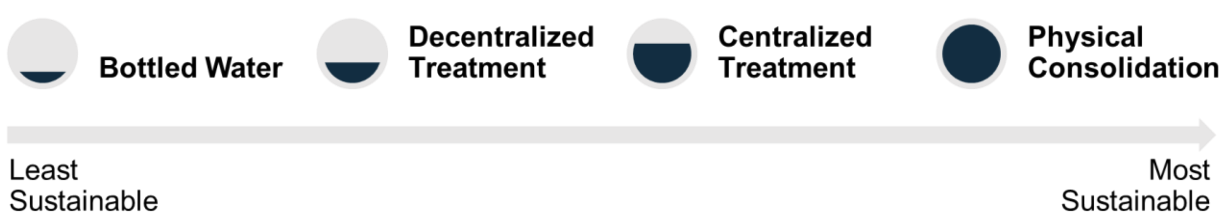
	FAILING Public Water Systems				AT-RISK Public Water Systems
	Primary or Secondary MCL Violations	*E.Coli* Violations	Treatment Technique Violations	Monitoring & Reporting Violations	
Physical Consolidation	✓	✓	✓	✓	✓
Centralized Treatment	✓	✓	✓		
Decentralized Treatment	✓		✓		
Other Essential Infrastructure	✓	✓	✓	✓	✓
New Public Supply Well	✓	✓	✓	✓	✓
Technical Assistance	✓	✓	✓	✓	✓
Administrator Assistance	✓	✓	✓	✓	✓

Figure 8: Possible Modeled Long-Term Solutions for High-Risk State Small Water Systems & Domestic Wells

HIGH-RISK State Small Water Systems & Domestic Wells	Water Quality Risk Only	Water Shortage Risk Only	Water Quality & Water Shortage Risk
Physical Consolidation	✓	✓	✓
Decentralized Treatment	✓		✓
Bottled Water	✓		✓
New Private Well		✓	✓
Technical Assistance	✓		✓

Where there are multiple potential long-term solutions that may address a particular challenge, the Cost Assessment Model is designed to select the most sustainable long-term solution for each system. For example, Failing public water systems that are failing for a water quality related violation may achieve compliance through physical consolidation, installation of centralized treatment, or use of decentralized treatment. Each of these modeled solutions have varying upfront capital costs and ongoing operational costs. Rather than selecting the modeled solution with the lowest cost, the Cost Assessment Model selects the most sustainable modeled long-term solution. Figure 9 ranks these modeled solutions from least sustainable to most sustainable.

Figure 9: Least to Most Sustainable Modeled Long-Term Solutions



WHY SELECT THE MOST SUSTAINABLE OVER THE LOWEST COST MODELED SOLUTION?

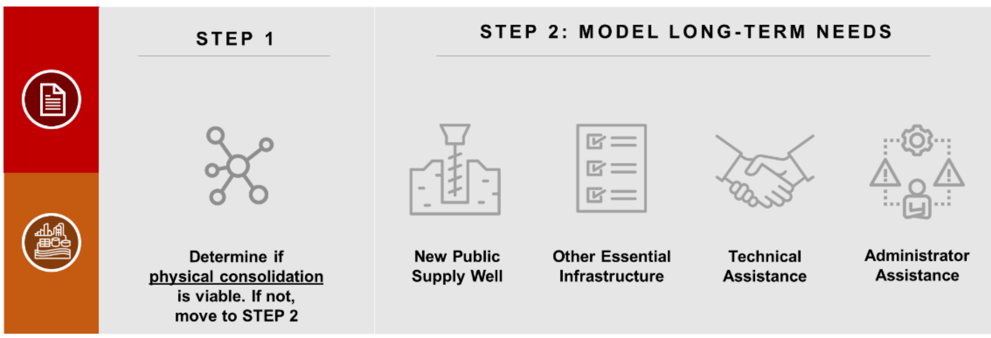
The State Water Board recognizes that the lowest-cost drinking water solution may not be the most sustainable long-term solution for a water system or the community. The Cost Assessment Model's limited long-term modeled solutions vary dramatically in cost, operational complexity, and desirability. For example, estimated physical consolidation capital costs on average range from $0.6 - $12.5 million compared to modeled decentralized treatment capital costs ranging from $0.05 - $0.07 million. However, the risk of treatment failure is much lower for physical consolidation when compared to decentralized treatment. Decentralized treatment 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 decentralized treatment because it does not provide the same level of service as typical public water systems. Therefore, the sustainability and desirability of physical consolidation may outweigh the cost savings compared to decentralized treatment. Thus, the Cost Assessment Model selects the most sustainable long-term modeled solution for water systems and communities.

Failing public water systems that are failing for a water quality-related violation (primary MCL, secondary MCL, *E. coli*, or treatment technique) will first be assessed for modeled physical consolidation viability in the Cost Assessment Model. If modeled physical consolidation is not viable, then modeled centralized treatment is assessed for viability. If centralized treatment is not viable then modeled decentralized treatment is selected by the Cost Assessment Model. Figure 10 illustrates how the modeled long-term solution selection process works for Failing public water systems with water quality-related violations. Figure 11 illustrates how the modeled long-term solution selection process works for Failing public water systems with non-water quality-related violations and At-Risk public water systems.

After the Cost Assessment Model identifies whether physical consolidation, centralized treatment, or decentralized treatment is the selected long-term modeled solution, it then assesses Failing water systems for additional needs. Additional long-term needs may include a new public supply well, other essential infrastructure, technical assistance, and/or Administrator assistance. These additional costs are added to the Failing system's modeled long-term solution cost estimate to produce a final modeled long-term cost estimate per system.

Figure 10: Modeled Long-Term Solution Selection Process for Failing Public Water Systems with Water Quality Violations

Figure 11: Modeled Long-Term Solution Selection Process for Failing Public Water Systems with Monitoring and Reporting Violations & At-Risk Systems

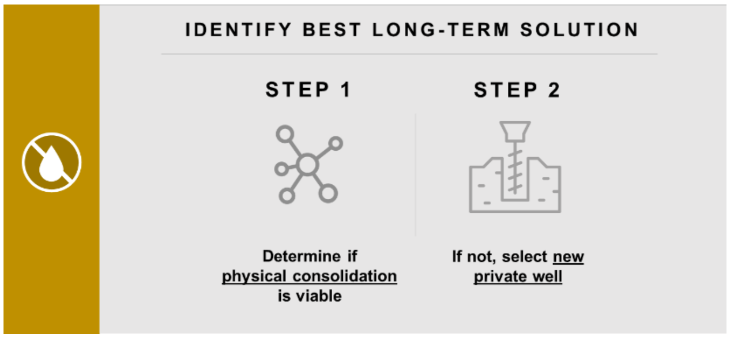


For communities served by state small water systems and domestic wells with high *Water Quality* risk, the Cost Assessment Model first assesses whether modeled physical consolidation is a viable long-term solution. If physical consolidation is not viable, the Cost Assessment Model will determine if modeled decentralized treatment is viable based on modeled water quality data. If decentralized treatment is not viable, the Cost Assessment Model selects bottled water as the modeled long-term solution (Figure 12).

Figure 12: Modeled Long-Term Solution Selection Process for High *Water Quality* Risk State Small Water Systems & Domestic Wells

For communities served by state small water systems and domestic wells with high *Water Shortage* risk, the Cost Assessment Model first assesses whether modeled physical consolidation is a viable long-term solution. If physical consolidation is not viable, the Cost Assessment Model will estimate the costs for constructing a new private well (Figure 13).

Figure 13: Modeled Long-Term Solution Selection Process for High *Water Shortage* Risk State Small Water Systems & Domestic Wells



The sections below summarize each modeled long-term solution in the Cost Assessment Model. Additional information about which systems are assessed for each modeled solution, the methodology used to conduct the analysis, and the underlying cost assumptions is included in the following supplemental appendices:

- Supplemental Appendix: Physical Consolidation Cost Estimate Methodology
- Supplemental Appendix: Centralized Treatment Cost Estimate Methodology
- Supplemental Appendix: Decentralized Treatment Cost Estimate Methodology
- Supplemental Appendix: Additional Long-Term Modeled Solutions Cost Estimate Methodology

PHYSICAL CONSOLIDATION

Physical consolidation is one of many possible long-term solutions modeled in the Cost Assessment. "Consolidation" means joining two or more public water systems, state small water systems, or affected residences (domestic well) into a single public water system, either physically or managerially.[27] Due to limited data and modeling constraints, the Cost Assessment Model only includes physical consolidation of two systems. Managerial consolidations and regionalization (joining of three or more systems) is not included in the analysis.

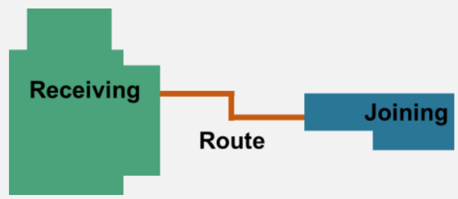
The physical consolidation analysis conducted within the Cost Assessment Model includes community water systems, non-transient non-community (NTNC) K-12 schools, state small water systems, and domestic wells. The analysis identifies potential one-to-one physical

[27] Health & Saf. Code, § 116681, subd. (e).

consolidations between two different systems. These systems are classified in the Cost Assessment Model as either “Receiving” or “Joining” systems:

- **Receiving Systems**: Commonly larger public water systems that expand to subsume Joining systems and provide water supply to both of their customers.
- **Joining Systems**: Commonly smaller public water systems, state small water systems, and domestic wells that are dissolved into existing receiving public water systems and are no longer responsible for providing water to their own customers.

Figure 14: Physical Consolidation of Two Public Water Systems

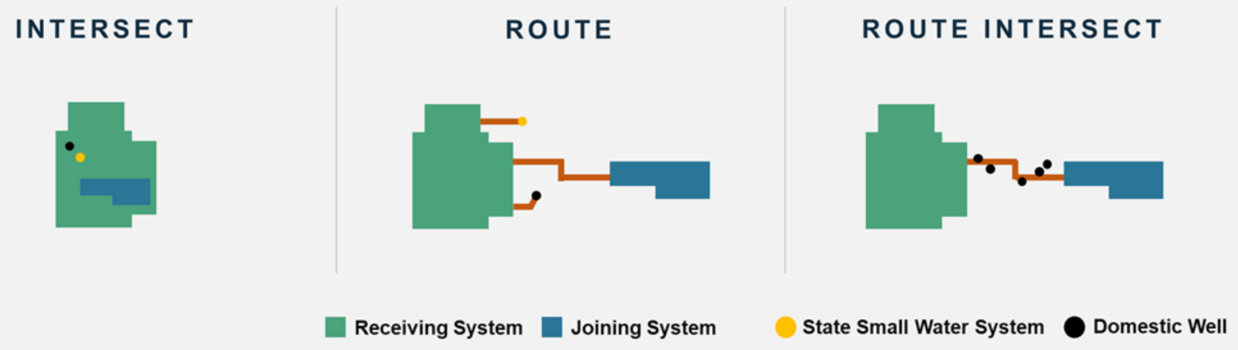


The Cost Assessment Model’s physical consolidation analysis includes a spatial geographic information system (GIS) analysis to identify if the inventory of potential Joining and Receiving systems meets physical consolidation distance criteria.[28] A GIS analysis identifies three different types of physical consolidations (Figure 15):

- **Intersect**: Where the Joining system, state small water system, or domestic well is physically located within the service area boundary of a potential Receiving system.
- **Route**: Where the Joining system is physically located within a maximum distance from the service area boundary of a potential Receiving system along a street.
- **Route Intersect**: Where the Joining state small water system or domestic well is along the modeled route of a potential public water system[29] physical consolidation.

[28] Modeled physical consolidation distance criteria includes all intersects; route = < 3 miles for public water systems and < 0.38 miles for state small water systems and domestic wells; route intersect for domestic wells only = within 1 mile section that intersects a viable public water system’s modeled physical consolidation route.
[29] State small water system physical consolidation routes are excluded from the domestic well route intersect analysis.

Figure 15: Possible Modeled Physical Consolidations



The Cost Assessment Model calculates[30] estimated modeled physical consolidation capital costs for the systems meeting the distance criteria. If a water system or domestic well meets the Cost Assessment Model's distance and funding viability thresholds,[31] then physical consolidation is the Model-selected long-term solution.[32] Learn more in **Supplemental Appendix: Physical Consolidation Cost Estimate Methodology**.

CLICK HERE to navigate to ***Supplemental Appendix: Physical Consolidation Cost Estimate Methodology***[33]

CENTRALIZED TREATMENT

Centralized treatment is one of many possible long-term solutions modeled in the Cost Assessment. "Centralized treatment" means treating water at a central place before conveying it through a dedicated distribution system to customers. The Cost Assessment Model only assesses centralized treatment for Failing public water systems where (1) modeled physical

[30] [Cost Assessment Supplemental Appendix: Physical Consolidation Cost Estimate Methodology](https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2024/2024costassessment-physical-consolidation.pdf) https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2024/2024costassessment-physical-consolidation.pdf

[31] Cost Assessment Model's funding viability thresholds: public water system > 75 service connection = estimated capital cost per connection < $96,000; public water system < 75 service connection = estimated total capital cost < $7.2 million; state small water system = estimated total capital cost < $2 million; domestic well = estimated total capital cost < $150,000.

[32] Failing water systems that are identified by the Cost Assessment Model has a *Receiving* water system, will also have centralized treatment modeled as an additional long-term solution.

[33] [Cost Assessment Supplemental Appendix: Physical Consolidation Cost Estimate Methodology](https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2024/2024costassessment-physical-consolidation.pdf) https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2024/2024costassessment-physical-consolidation.pdf

consolidation is not viable; (2) the system is failing for water-quality related violations (primary, secondary, *E. coli*, or treatment technique violations); (3) the system is a school or has 20 service connections or greater; and (4) the system's water quality results are within centralized treatment technical limits. Learn more in **Supplemental Appendix: Centralized Treatment Cost Estimate Methodology**.[34]

The Cost Assessment Model excludes state small water systems and domestic wells from modeled centralized treatment due to its higher capital and O&M costs compared to decentralized treatment. At-Risk public water systems are also excluded from the centralized treatment analysis because they are currently in compliance with drinking water standards.

Best Available Technologies (BAT) are identified by the Cost Assessment Model that can reduce contaminant concentrations that exceeded the Maximum Contaminant Level (MCL). The Cost Assessment Model includes multiple modeled centralized treatment solutions based on Title 22 California Code of Regulations.[35] Title 22 defines applicable BATs as the technologies identified by the State Water Board as the best available technology, treatment techniques, or other means available for achieving compliance with MCLs.

There are many centralized treatment technologies that are available to reduce contamination; however, the State Water Board designed the Cost Assessment Model to include modeled treatment technologies that have lower operational costs and are easier to maintain. This decision was, and continues to be, driven by the high percentage of Failing water systems that are small (less than 3,000 service connections). Small water systems often have less financial capacity to sustainably operate more sophisticated and resource-intensive treatment technologies.

The Cost Assessment Model includes the following centralized treatment technologies:

- Granular Activated Carbon (GAC)
- Adsorption
- Coagulation Filtration
- Filtration
- Regenerable Resin Anion Exchange
- Regenerable Resin Cation Exchange
- Single-Use Ion Exchange
- Activated Alumina
- 4-log Virus Treatment
- Surface Water Treatment Package Plant

In the Cost Assessment Model, water sources are assumed to be far enough apart from each other so that separate treatment is needed for each source. Given that assumption, the Cost

[34] Cost Assessment Supplemental Appendix: Centralized Treatment Cost Estimate Methodology
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2024/2024costassessment-centralized-treatment.pdf
[35] Title 22, Article 12, Table 64447.2-A, Table 64447.3-A, Table 64447.4-A
https://govt.westlaw.com/calregs/Browse/Home/California/CaliforniaCodeofRegulations?guid=I799B50E05B6111EC9451000D3A7C4BC3&originationContext=documenttoc&transitionType=Default&contextData=(sc.Default)

Assessment Model selects modeled treatment technologies per contaminated source, rather than per water system.

Some Failing water systems have one or more active sources that have multiple (co-occurring) contaminants exceeding an MCL. For these Failing water systems, the Cost Assessment Model will identify the modeled treatment technology needed to address each contaminant. Each technology will be costed out by the Cost Assessment Model separately per contaminant, per source. The Cost Assessment Model then determines the final treatment cost estimate for the Failing water systems using the following decision criteria:

- If the co-contaminants can be removed with the same treatment technology and have the same modeled treatment costs; then, the Cost Assessment Model will only include the cost of a single treatment technology per source.
- If the co-contaminants can be removed with the same treatment technology, but each contaminant has different modeled annual O&M costs; then the Cost Assessment Model will select the single treatment technology with the highest annual O&M cost.
- If the co-contaminants cannot be removed with the same treatment technology; then the Cost Assessment Model will combine the costs of multiple treatment technologies.

If the Failing water system has one or more sources with co-contaminants that would have different modeled treatment technologies; then, the Cost Assessment Model utilizes a set of more comprehensive decision criteria to select which treatment technology(ies) best suit the co-contaminants. Learn more in **Supplemental Appendix: Centralized Treatment Cost Estimate Methodology**.

The Cost Assessment Model will estimate both the upfront capital costs for installing centralized treatment as well as the annual O&M costs for the modeled treatment.

CLICK HERE to navigate to ***Supplemental Appendix: Centralized Treatment Cost Estimate Methodology***[36]

DECENTRALIZED TREATMENT

Decentralized treatment is one of many possible long-term solutions modeled in the Cost Assessment. "Decentralized treatment" is water treatment units that remove contaminants from the water served to only one home or building and are not used to treat irrigation water. Decentralized treatment in the Cost Assessment Model includes point of entry (POE) and point of use (POU) technologies. While POE devices treat the water supply for an entire building or

[36] Cost Assessment Supplemental Appendix: Centralized Treatment Cost Estimate Methodology https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2024/2024costassessment-centralized-treatment.pdf

residence, POU devices are applied to a single water tap, usually in a kitchen, for drinking water and cooking. POU devices leave the water from other household taps, such as showers, untreated.

A core component of the Cost Assessment Model is the selection and cost estimation of decentralized treatment technologies for Failing public water systems,[37] high-risk state small water systems and domestic wells where (1) water quality challenges exist; (2) modeled physical consolidation is not viable as a *Joining*[38] system; and (3) modeled centralized treatment is not viable. At-Risk public water systems are excluded from the decentralized treatment analysis because they are currently in compliance with drinking water standards.

The Cost Assessment Model includes two types of decentralized treatment technologies: point of use and point of entry treatment devices.

POINT OF USE

A point of use (POU) treatment device is a decentralized treatment technology that is applied to a single tap and can help reduce contaminant levels. There are various types of POU installations such as under the sink or installation on a countertop. These devices can treat specific contaminants, or a range of contaminants, depending on the need of the customer. Table 3 summarizes the contaminates treated by POU devices in the Cost Assessment Model and the system criteria.

Table 3: Contaminants Treated by POU in the Cost Assessment Model

Contaminate	System Criteria
Inorganics/Radionuclides,[39] ***some examples include*****:** • **Nitrate** • **Arsenic** • **Uranium** • **Fluoride**	• Failing water systems with < 20 service connections. • State small water systems that are high-risk due to water quality. • Domestic wells that are high-risk due to water quality.

POINT OF ENTRY

A point of entry (POE) device is located outside the building and applied to drinking water entering a house or building. Unlike a POU device that treats one tap inside a house or building, a POE device treats all water entering the house or building. Since more water is being treated, POE devices are generally more expensive than POU devices in both capital

[37] Failing for water quality related criteria only. Systems failing for monitoring and reporting violations are excluded from the centralized treatment analysis.
[38] Joining Systems: Commonly smaller public water systems, state small water systems, and domestic wells that are dissolved into an existing Receiving public water system and are no longer responsible for providing water to their own customers.
[39] Radon is excluded per CCR, Title 22, Section 64418: General Provisions of Point-of Use Treatment: https://govt.westlaw.com/calregs/Document/I77CCD27D5B6111EC9451000D3A7C4BC3?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default)

and O&M costs. POE treatment is selected by the Cost Assessment Model to treat for volatile organic chemicals (VOCs) or synthetic organic chemicals (SOCs), such as 1,2,3-trichloropropane (1,2,3-TCP), as exposure can happen through inhalation/ingestion. POU treatment is not considered for any contaminant that has a risk pathway beyond ingestion. POE treatment is also selected for treating disinfection byproducts (DBPs). Please see Table 4 below.

Table 4: Contaminants Treated by POE in the Cost Assessment Model

Contaminate	System Criteria
SOCs, *some examples include*: • **1,2,3-Trichloropropane (1,2,3-TCP)** • **Dibromochloropropane (DBCP)** • **Ethylene Dibromide (EDB)** **VOCs, *some examples include*:** • **1,1-Dichloroethylene (1,1-DCE)** • **Trichloroethylene (TCE)** **DBPs:** • **Total Trihalomethanes (TTHM)** • **Haloacetic Acids (five) (HAA5)**	• Failing water systems with < 20 service connections. • State small water systems that are high-risk due to water quality. • Domestic wells that are high-risk due to water quality.

The Cost Assessment Model will estimate both the upfront capital costs for installing decentralized treatment as well as the annual O&M costs for the modeled treatment. Learn more in **Supplemental Appendix: Decentralized Treatment Cost Estimate Methodology**.

CLICK HERE to navigate to ***Supplemental Appendix: Decentralized Treatment Cost Estimate Methodology***[40]

[40] Cost Assessment Supplemental Appendix: Decentralized Treatment Cost Estimate Methodology https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2024/2024costassessment-decentralized-treatment.pdf

LONG-TERM BOTTLED WATER

For the purposes of the Cost Assessment, 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."[41]

The Cost Assessment Model assumes bottled water is the long-term modeled solution for state small water systems and domestic wells **where all other modeled long-term solutions are not feasible**. This is considered by the State Water Board as a "worst-case" scenario and one that the Agency would hope to avoid at all costs. However, there are communities where bottled water reliance may be the only sustainable, long-term solution until a better solution becomes available. Long-term bottled water needs are not modeled for Failing or At-Risk public water systems in the Cost Assessment Model.

The Cost Assessment Model will estimate the upfront capital costs for providing bottled water as well as ongoing bottled water replacement for 10 years. Learn more in **Supplemental Appendix: Additional Long-Term Modeled Solutions Cost Estimate Methodology**.

CLICK HERE to navigate to ***Supplemental Appendix: Additional Long-Term Modeled Solutions Cost Estimate Methodology***[42]

NEW PUBLIC SUPPLY WELL

Water systems dependent on a single source to meet their maximum daily demand, need to have another source to provide emergency supply and ensure system redundancy during an emergency. Reliance on a single source to meet customer demand is an accessibility risk for a water system. The water system is at a higher risk of failure if their single source were to become contaminated, dry, collapses, or is taken out of service (i.e., for maintenance, etc.). Furthermore, wells that are near or past their useful life should be upgraded or replaced to ensure the water system is able to meet demand.

Failing and At-Risk public water systems are assessed in the Cost Assessment Model for a new and/or a replacement public supply well. The Cost Assessment Model utilizes available

[41] California Health and Safety Code Section 111070.
[42] Cost Assessment Supplemental Appendix: Additional Long-Term Modeled Solutions Cost Estimate Methodology
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2024/2024costassessment-add-longterm-solutions.pdf

water system facility data maintained by the State Water Board to determine which systems should be modeled for a new public supply well. Failing and At-Risk water systems, regardless of size, with a single well are included in the cost estimate. Failing and At-Risk water systems with an active well greater than 25 years old are also modeled for a replacement public supply well.

The Cost Assessment Model will estimate the upfront capital costs for installing a new public supply well. The Cost Assessment Model does not include an estimate of annual O&M costs associated with maintaining the modeled public supply well. Learn more in **Supplemental Appendix**.

CLICK HERE to navigate to ***Supplemental Appendix: Additional Long-Term Modeled Solutions Cost Estimate Methodology***[43]

OTHER ESSENTIAL INFRASTRUCTURE

Many Failing and At-Risk public water systems have aging infrastructure. Upgrading and replacing them is essential to maintaining compliance with drinking water standards and to ensure system reliability. These other essential infrastructure (OEI) needs are estimated to ensure the Cost Assessment Model's output is more holistic in estimating how much it may cost to ensure the water system is more sustainable and resilient. In the Cost Assessment Model, OEI needs are estimated based on system and location-specific information. Many of the Cost Assessment Model's OEI solutions align with the SB 552 drought resiliency infrastructure requirements.[44]

Cost Assessment Model assesses OEI needs based on system and location-specific information. Water system data pulled from the State Water Board's database of water system facility information[45] and data reported to the State from the electronic Annual Report (eAR) is utilized to determine which Failing and At-Risk public water system should be assessed for each OEI component.

[43] Cost Assessment Supplemental Appendix: Additional Long-Term Modeled Solutions Cost Estimate Methodology
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2024/2024costassessment-add-longterm-solutions.pdf
[44] Senate Bill No. 552
https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220SB552
[45] Safe Drinking Water Information System (SDWIS)

Table 5: Other Essential Infrastructure (OEI) Components

Components	Systems Included
Service Connection Meters	• Failing and At-Risk systems without 100% metered service connections.
Back-Up Electrical Supply	• Failing and At-Risk systems that do not currently have back-up power for their sources.
Sounder to Measure Static Well Levels	• Failing and At-Risk systems that do not currently have access to a device that will allow them to measure their well's groundwater level.
Additional Storage	• Failing and At-Risk systems that need additional storage.
SCADA & Electrical Upgrades	• Incorporated into cost estimates for new storage tanks.

High-risk state small water systems and domestic wells are also excluded from the OEI analysis in the Cost Assessment Model. Not enough information is available to assess additional infrastructure needs beyond treatment and/or replacement wells.

The Cost Assessment Model will estimate the upfront capital costs for installing OEI. The Cost Assessment Model does not include an estimate of annual O&M costs associated with modeled OEI. Learn more in **Supplemental Appendix**.

CLICK HERE to navigate to ***Supplemental Appendix: Additional Long-Term Modeled Solutions Cost Estimate Methodology***[46]

NEW PRIVATE WELL

For state small water systems and domestic wells that are high-risk in the *Water Shortage* category of the Risk Assessment, and where modeled physical consolidation is not viable, the Cost Assessment Model develops a cost estimate for constructing a new private well. The new private well is estimated to be 500 feet deep with a diameter ranging between 4-6 inches.

[46] Cost Assessment Supplemental Appendix: Additional Long-Term Modeled Solutions Cost Estimate Methodology
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2024/2024costassessment-add-longterm-solutions.pdf

The Cost Assessment Model will estimate the upfront capital costs for installing a new private well. The Cost Assessment Model does not include an estimate of annual O&M costs associated with maintaining the modeled private well. Learn more in **Supplemental Appendix: Additional Long-Term Modeled Solutions Cost Estimate Methodology**.

CLICK HERE to navigate to ***Supplemental Appendix: Additional Long-Term Modeled Solutions Cost Estimate Methodology***[47]

ADMINISTRATOR ASSISTANCE

The appointment of an Administrator is an authority that the State Water Board considers when necessary to provide an adequate supply of affordable, safe drinking water.[48] In September 2019 (revised in 2023), the State Water Board adopted an Administrator Policy Handbook[49] to provide direction regarding the appointment of administrators by the State Water Board of designated water systems.

Administrators may be individual persons, businesses, non-profit organizations, local agencies like counties or nearby larger utilities, and other entities. Administrators generally act as a water system general manager, or may be assigned limited specific duties, such as managing an infrastructure improvement project on behalf of a designated water system. Administrators are named for a limited term to help a water system through a consolidation process or to otherwise come into compliance.

The Cost Assessment Model includes estimated Administrator assistance needs for small[50] DAC Failing and At-Risk public water systems. Learn more in **Supplemental Appendix: Additional Long-Term Modeled Solutions Cost Estimate Methodology**.

[47] Cost Assessment Supplemental Appendix: Additional Long-Term Modeled Solutions Cost Estimate Methodology
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2024/2024costassessment-add-longterm-solutions.pdf
[48] Administrator webpage
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/administrator.htm
[49] Administrator Policy Handbook
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/docs/2023/administrator-policy-handbook-2023-revision.pdf
[50] Failing systems less than 500 service connections and At-Risk public water systems with less than 200 service connections.

CLICK HERE to navigate to ***Supplemental Appendix: Additional Long-Term Modeled Solutions Cost Estimate Methodology***[51]

TECHNICAL ASSISTANCE

The Cost Assessment Model includes estimated technical assistance (TA) needs for small (less than 3,300 service connections) DAC Failing and At-Risk public water systems. In many cases 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. 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. Learn more in **Supplemental Appendix: Additional Long-Term Modeled Solutions Cost Estimate Methodology**.

CLICK HERE to navigate to ***Supplemental Appendix: Additional Long-Term Modeled Solutions Cost Estimate Methodology***[52]

MODELED INTERIM SOLUTIONS

The goal of the SAFER Program is to help address Failing and At-Risk water systems – building local capacity to ensure water systems are able to operate sustainably and achieve the Human Right to Water. The State Water Board recognizes that it may take many months or years to implement long-term sustainable solutions. Planning and construction timelines can vary dramatically due to the complexity of a project, public participation needs, funding availability, permitting schedules, labor, material availability, etc. Therefore, interim solutions may be needed to ensure communities have access to safe drinking water during this timeframe.

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[51] Cost Assessment Supplemental Appendix: Additional Long-Term Modeled Solutions Cost Estimate Methodology
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2024/2024costassessment-add-longterm-solutions.pdf

[52] Cost Assessment Supplemental Appendix: Additional Long-Term Modeled Solutions Cost Estimate Methodology
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2024/2024costassessment-add-longterm-solutions.pdf

The Cost Assessment Model includes estimated interim needs for disadvantaged communities (DAC). **Supplemental Appendix: Interim Solutions Cost Estimate Methodology**[53] includes an in-depth overview of which systems are assessed for interim assistance needs, the underlying cost assumptions and estimated interim assistance durations for certain system types included in the Cost Assessment Model.

DECENTRALIZED TREATMENT

Decentralized treatment, such as POU and POE devices, are often installed at individual homes or businesses. Decentralized treatment is included in the Cost Assessment Model as both a modeled long-term solution and interim solution option. DAC systems that have either physical consolidation or centralized treatment as their modeled long-term solution will be assessed for interim decentralized treatment. Available and modeled water quality data for these systems is used by the Cost Assessment Model to determine if decentralized treatment is viable. If water quality data indicates decentralized treatment may not be viable, the system is assessed for interim bottled water assistance.

CLICK HERE to navigate to ***Supplemental Appendix: Interim Solutions Cost Estimate Methodology***[54]

INTERIM BOTTLED WATER

In the Cost Assessment Model, interim bottled water needs are only estimated for DAC populations served by Failing public water systems and high *Water Quality* risk state small water systems and domestic wells where modeled decentralized interim solutions are not viable. High *Water Shortage* risk DAC state small water systems and domestic wells are assessed for interim bottled water assistance as well.

CLICK HERE to navigate to ***Supplemental Appendix: Interim Solutions Cost Estimate Methodology***[55]

[53] Cost Assessment Supplemental Appendix: Interim Solutions Cost Estimate Methodology https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2024/2024costassessment-Interim-solutions.pdf

[54] Cost Assessment Supplemental Appendix: Interim Solutions Cost Estimate Methodology https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2024/2024costassessment-Interim-solutions.pdf

[55] Cost Assessment Supplemental Appendix: Interim Solutions Cost Estimate Methodology https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2024/2024costassessment-Interim-solutions.pdf

TOTAL COST MODIFIERS & MULTIPLIERS

Many of the Cost Assessment Model's component cost estimates are adjusted to account for the elements summarized in Table 6 and Table 7. The application of certain cost modifiers and multipliers is based on (1) the age of the component cost estimate data source(s); (2) the region where the capital investment will occur; (3) the nature of the capital investment; etc.

Table 6: Multiplier per Modeled Solution for Public Water Systems

Modeled Solution	Regional Multiplier[56]	Inflation	Electrical	Planning & Construction	Engineering Services	Legal & Admin.	Contingency	Overhead	Permitting & Environmental
Physical Consolidation	0% - 32%	3.1%	N/A	10%	15%	15%	20%	N/A	$25,000 - $100,000
Centralized Treatment	0% - 32%	3.1%	10%	20%	20%	10%	25%	15%	2%
Decentralized Treatment	0% - 32%	3.1%	N/A	3%	15%	$551	5%	N/A	3%
New Public Well	0% - 32%	3.1%	20%	10%	15%	10%	15%	10%	$85,000
Storage Tank	0% - 32%	3.1%	20%	10%	15%	10%	15%	10%	$85,000
Meters	0% - 32%	3.1%	N/A	N/A	8%	N/A	10%	N/A	$4,000
Back-up Electrical Supply	0% - 32%	3.1%	5%	N/A	N/A	N/A	25%	N/A	5%
Sounder	0% - 32%	3.1%	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Interim Bottled Water	0% - 32%	3.1%	N/A	N/A	N/A	N/A	N/A	N/A	N/A

[56] Rural = 0%; Suburban = 32%; and Urban = 30%.

Table 7: Multiplier per Modeled Solution for State Small Water Systems & Domestic Wells

Modeled Solution	Regional Multiplier	Inflation	Electrical	Planning & Construction	Engineering Services	Legal & Admin.	Contingency	Overhead	Permitting & Environmental
Physical Consolidation: State Small Water System	0% - 32%	3.1%	N/A	10%	15%	15%	20%	N/A	$25,000 - $100,000
Physical Consolidation: Domestic Well	0% - 32%	3.1%	N/A	10%	15%	N/A	N/A	N/A	N/A
Decentralized Treatment	0% - 32%	3.1%	N/A	3%	15%	$551	5%	N/A	3%
New Private Well	0% - 32%	3.1%	$600	N/A	N/A	N/A	N/A	N/A	N/A
Bottled Water	0% - 32%	3.1%	N/A	N/A	N/A	N/A	N/A	N/A	N/A

REGIONAL MULITIPLIER

To adjust the modeled cost estimates for regional cost variance, the Cost Assessment Model applies an RSMeans[57] City Cost Index (CCI) multiplier. 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 is used to compare or adjust costs between locations and the national average. In 2019, the data publicly available at that time indicated the national average CCI was 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.

In the Cost Assessment Model, cost estimates for treatment equipment and general civil site work are assigned the national average CCI of 3.0. The California CCI shown in Table 8 is applied to adjust modeled capital costs based on each water system's location (Table 9).

Table 8: RSMeans CCI Selected for Locational Cost Estimating

Location	RSMeans CCI	Percent Adjustment
Rural	+ 3.00	0%
Suburban	+ 3.97	+ 32%
Urban	+ 3.89	+ 30%

Table 9: California Counties Categorizes by Generalized Model Location

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

INFLATION

Due to increases in the price of construction materials, labor, and on-going supply chain issues stemming from the COVID-19 pandemic, the Cost Assessment Model adjusts the modeled solutions costs with a 3.1%[58] inflation rate multiplier. This multiplier is a California-specific

[57] RSMeans City Cost Index
https://www.rsmeans.com/rsmeans-city-cost-index
[58] Inflation is forecasted between April 2023 to April 2024.

inflation rate multiplier based on the California Department of Finance's[59] Urban Consumer Price Index (CPI-U).[60]

ELECTRICAL

Electrical costs vary depending on the type of project and can cover a variety of expenses including but not limited to electrical equipment, instrumentation, conduits, duct banks, wiring, grounding, programming configuration and testing, commissioning, and systems testing and startup. The Cost Assessment Model assumes different electrical needs per modeled solution. Table 10 and Table 11 summarize the electrical multipliers applied to each modeled solution.

Table 10: Electrical Multiplier for Public Water Systems by Solution Type

Public Water Systems	Multiplier
Centralized Treatment	10%[61]
New Well	20%[62]
Storage Tank	20%[63]
Backup Power	5%[64]

Table 11: Electrical Multiplier for State Small Water Systems & Domestic Wells by Solution Type

State Small Water Systems & Domestic Wells	Multiplier
New Well	$600[65]

[59] Economic Forecasts, U.S. and California | Department of Finance
https://dof.ca.gov/forecasting/economics/economic-forecasts-u-s-and-california/
[60] The inflation rate can be calculated month-to-month using a publicly available resource. Consumer Price Index Forecast — Annual & Monthly: https://dof.ca.gov/wp-content/uploads/sites/352/2024/01/US-CA-Inflation-Forecast-MR-2024_25.xlsx
[61] U.S. EPA Drinking Water Treatment Technology Unit Cost Model includes 10% indirect capital cost for electrical.
https://www.epa.gov/sdwa/drinking-water-treatment-technology-unit-cost-models
[62] This percentage is derived from a Golden State Water Company – water system project (2023). The electrical cost includes electrical equipment, instrumentation, conduits, duct banks, wiring, grounding, programming configuration and testing, commissioning, systems testing, and startup costs.
[63] This percentage is derived from a Golden State Water Company – water system project (2023). The electrical cost includes electrical equipment, instrumentation, conduits, duct banks, wiring, grounding, programming configuration and testing, commissioning, systems testing, and startup costs.
[64] This percentage is derived from a Lime Saddle Marina emergency generators project (2023). The percentage is based on an average of the electoral costs associated with the installation of three generators: lake intake (4.5%), water treatment plant (3.75%), mid-zone pump station (5.6%). The electrical cost includes generator accessories power, and conduit/conductor entrance.
[65] This cost estimate was provided by Self Help Enterprises and accounts for the control box and electrical components.

PLANNING & CONSTRUCTION

Planning and construction multipliers account for accrued costs associated with fundamental planning and management of any construction project. Planning involves defining the work task, technology, resources and duration of each task and potential interactions amongst work tasks. The Cost Assessment Model assumes different planning and construction needs per modeled solution. Table 12 and Table 13 summarize the planning and construction multipliers applied to each modeled solution.

Table 12: Planning and Construction Multiplier for Public Water Systems by Solution Type

Public Water Systems	Multiplier
Physical Consolidation	10%[66]
Centralized Treatment	20%[67]
Decentralized Treatment	3%[68]
New Well	10%[69]
Storage Tank	10%[70]

Table 13: Planning and Construction Multiplier for State Small Water Systems & Domestic Wells by Solution Type

State Small Water Systems & Domestic Wells	Multiplier
Physical Consolidation	10%
Decentralized Treatment	3%[71]

[66] This percentage was developed based on internal feedback from expert staff within the State Water Board.
[67] According to U.S. EPA Drinking Water Treatment Technology Unit Cost Models indirect capital cost for site civil work, equipment installation, delivery, and planning may include expenses for site preparation, finishing, installation materials, equipment rental, transportation of various components (such as pipes, vessels, towers, valves, pumps, blowers, and mixers), as well as inspection and testing services. The State Water Board recommend using 20% costs for planning and construction.
https://www.epa.gov/sdwa/drinking-water-treatment-technology-unit-cost-models
[68] U.S. EPA Drinking Water Treatment Technology Unit Cost Models include a 3% indirect capital cost for pilot testing.
https://www.epa.gov/sdwa/drinking-water-treatment-technology-unit-cost-models
[69] This percentage is derived from a Golden State Water Company - water system project (2023). Planning and construction cost covers construction inspection and management.
[70] This percentage is derived from a Golden State Water Company - water system project (2023). Planning and construction cost covers construction inspection and management.
[71] U.S. EPA Drinking Water Treatment Technology Unit Cost Models include a 3% indirect capital cost for pilot testing.
https://www.epa.gov/sdwa/drinking-water-treatment-technology-unit-cost-models

ENGINEERING SERVICES

Engineering services include indirect expenses associated with consultation, organizing, designing, implementation, construction, oversight, and compliance check of any construction project. Engineering services fees vary depending on the complexity of the project and the type of engineer's services required in the project. The Cost Assessment Model assumes different engineering service needs per modeled solution. Table 14 and
Table 15 below summarize the engineering service multipliers applied to each modeled solution.

Table 14: Engineering Service Multiplier for Public Water Systems by Solution Type

Public Water Systems	Multiplier
Physical Consolidation	15%[72]
Centralized Treatment	20%[73]
Decentralized Treatment	15%[74]
New Well	15%[75]
Storage Tank	15%[76]
Meters	8%[77]

Table 15: Engineering Service Multiplier for State Small Water Systems &Domestic Wells by Solution Type

State Small Water Systems & Domestic Wells	Multiplier
Physical Consolidation	15%[78]
Decentralized Treatment	15%[79]

[72] This percentage was developed based on internal feedback from expert staff within the State Water Board.
[73] U.S. EPA Drinking Water Treatment Technology Unit Cost Models include 5 -20% indirect capital cost for process engineering services.
https://www.epa.gov/sdwa/drinking-water-treatment-technology-unit-cost-models
[74] U.S. EPA Drinking Water Treatment Technology Unit Cost Models include 15% indirect capital cost for engineering services.
https://www.epa.gov/sdwa/drinking-water-treatment-technology-unit-cost-models
[75] This percentage is derived from a Golden State Water Company - water system project (2023). Engineering services cover well design costs.
[76] This percentage is derived from a Golden State Water Company - water system project (2023), engineering services cover project design fees.
[77] City of Williams- water meter replacement project (2016). Engineering services cost accounts for preliminary engineering report, construction and post constriction phase services, and preliminary and final design phase services.
[78] This percentage was developed based on internal feedback from expert staff within the State Water Board.
[79] U.S. EPA Drinking Water Treatment Technology Unit Cost Models include 15% indirect capital cost for Engineering.
https://www.epa.gov/sdwa/drinking-water-treatment-technology-unit-cost-models

LEGAL & ADMINISTRATION

This includes fees related to logistical administrative and legal tasks that support a construction project from start to end. The cost includes ensuring that all permits, licenses, and regulatory paperwork are in order. Also included is keeping track of contracts and managing insurance requirements to protect the project team and stakeholders from any unpredictable circumstances. The Cost Assessment Model assumes different legal and administrative multipliers needs per modeled solution.

Table 1, Table 16, and Table 17 below summarize the legal and administration multipliers applied to each modeled solution.

Table 16: Legal & Administration Multiplier for Public Water Systems by Solution Type

Public Water Systems	Multiplier
Physical Consolidation	15%[80]
Centralized Treatment	10%[81]
Decentralized Treatment	$551[82]

Table 17: Legal & Administration Multiplier for State Small Water Systems & Domestic Wells by Solution Type

State Small Water Systems & Domestic Wells	Multiplier
Physical Consolidation	15%[83]
Decentralized Treatment	$551[84]

[80] This percentage was developed based on external quote verified by internal staff. Total construction cost is factored in.

[81] U.S. EPA Drinking Water Treatment Technology Unit Cost Models include 2% indirect capital cost for legal fees and 6% indirect capital cost for construction administration. Construction Administration fee was 10% of subtotal construction cost for City of Livingstone, 2022. The State Water Board recommends averaging 6% construction administration indirect capital cost recommended by U.S. EPA's Model and 10% cited from City of Livingstone's project to arrive at 8%. Therefore, 10% of the Legal & Administration costs consist of 2% for legal fees and 8% for construction administration fees.
https://www.epa.gov/sdwa/drinking-water-treatment-technology-unit-cost-models

[82] Developed based on the State Water Board funded project and external quotes in the whitepaper: Proposed Changes for Modeled Long-Term Treatment October 2023.
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/docs/2023/modeled-treatment-draft-whitepaper.pdf

[83] Applied to state small water systems only, based on external quote verified by internal staff where total construction cost is factored in.

[84] Developed based on the State Water Board funded project and external quotes in the whitepaper: Proposed Changes for Modeled Long-Term Treatment October 2023.
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/docs/2023/modeled-treatment-draft-whitepaper.pdf

CONTINGENCY

Construction contingency is the money allotted for unexpected costs during construction. It is a form of risk management used to avoid cutting costs in other areas to keep the project's schedule and quality commitments. For the purposes of the Cost Assessment Model, a contingency multiplier may be applied to certain capital cost estimates where there may be more variability in market prices and construction risk. The Cost Assessment Model assumes different contingency multipliers needs per modeled solution.

Table 1, Table 18, and Table 19 below summarize the contingency multipliers applied to each modeled solution.

Table 18: Contingency Multiplier for Public Water Systems by Solution Type

Public Water Systems	Multiplier
Physical Consolidation	20%[85]
Centralized Treatment	25%[86]
Decentralized Treatment	5%[87]
New Well	15%[88]
Storage Tank	15%[89]
Meters	10%[90]
Backup Power	25%[91]

Table 19: Contingency Multiplier for State Small Water Systems & Domestic Wells by Solution Type

State Small Water Systems & Domestic Wells	Multiplier
Physical Consolidation	20%[92]

[85] This multiplier was developed by Corona Environmental and utilized in the 2021 Needs Assessment. After conducting internal and external verifications, it is proposed to maintain contingency at 20% to account for fluctuating costs and to ensure appropriately allocated estimated cost. https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2021_needs_assessment.pdf

[86] Contingency 25% of total construction cost City of Chino, 2019.

[87] 5% contingency is based on the experience of technical assistance providers that work on POU projects.

[88] This percentage is derived from a Golden State Water Company - water system project (2023). This percentage covers general construction contingency.

[89] This percentage is derived from a Golden State Water Company - water system project (2023). This percentage covers general construction contingency.

[90] City of Williams- water meter replacement project (2016). Contingency cost accounts for general construction contingency.

[91] Total project contingency, Lime Saddle Marina emergency generators 2023.

[92] This multiplier was developed by Corona Environmental and utilized in the 2021 Needs Assessment. After conducting internal and external verifications, it is proposed to maintain contingency at 20% to account for fluctuated costs and to ensure appropriately allocated estimated cost. This multiplier is applied to state small water systems only. https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2021_needs_assessment.pdf

State Small Water Systems & Domestic Wells	Multiplier
Decentralized Treatment	5%[93]

OVERHEAD

Overhead costs include a wide array of expenses incurred by an organization that directly or indirectly supports infrastructure construction. Overhead costs are generally expenses that cannot be charged directly to a particular branch of work but are required to construct the project. Overhead costs also include expenses related to the cost of doing business and often are considered as fixed expenses that must be paid by the contractor. Overhead costs represent general and administrative functions, such as human resources; finance and accounting; information technology; legal services; purchasing and procurement; facilities management; etc. Most infrastructure projects, including those funded by the State Water Board, include an overhead component. The Cost Assessment Model assumes different overhead multipliers needs per modeled solution. Table 20

Table 1 below summarizes the overhead multipliers applied to each modeled solution.

Table 20: Overhead Multiplier for Public Water Systems by Solution Type

Public Water Systems	Multiplier
Centralized Treatment	15%[94]
New Well	10%[95]
Storage Tank	10%[96]

ENVIRONMENTAL & PERMITTING

New capital projects must often pass the CEQA (California Environmental Quality Act) environmental review process used to determine compliance with appropriate state and federal environmental regulations. The applicant must provide the final, project-specific environmental document, associated reports, and other supporting materials demonstrating compliance with CEQA as part of the application’s Environmental Package. The costs for preparing CEQA-related documents are included in the Cost Assessment Model for certain modeled solutions as summarized in Table 21. The Cost Assessment Model assumes different environmental

[93] 5% contingency is based on the experience of technical assistance providers that work on POU projects.
[94] According to U.S. EPA Drinking Water Treatment Technology Unit Cost Models, indirect capital cost for overhead and profit may include expenses for the installing contractor's labor and business overhead costs. The State Water Board recommend using 15% costs for overhead and profit.
https://www.epa.gov/sdwa/drinking-water-treatment-technology-unit-cost-models
[95] This percentage is derived from a Golden State Water Company - water system project (2023), it covers contractor's overhead and profit.
[96] This percentage is derived from a Golden State Water Company - water system project (2023), it covers contractor's overhead and profit.

and permitting multipliers needs per modeled solution. Table 21 and Table 22 below summarize the environmental and permitting multipliers applied to each modeled solution.

In the Cost Assessment Model, a CEQA cost estimate is applied for public water systems and state small water systems with modeled physical consolidation as a long-term solution, based on the distance between *Receiving* and *Joining* systems. For intersect systems $25,000 is assumed to be needed for CEQA and for route systems $100,000 is assumed. A CEQA cost estimate is excluded from domestic well modeled physical consolidation capital cost estimates since these projects are relatively less complex and do not typically generate a significant adverse effect on the environment and surroundings. A $85,000 CEQA cost estimate is applied for a new modeled public supply well and storge tank. Modeled customer meter installation includes a flat cost estimate of $4,000 to account for categorial exemption filling fees associated with CEQA requirements. For decentralized treatment, permitting fees are assumed to be 3% of the total capital cost to ensure compliance with National Sanitation Foundation (NSF) certificate.

Table 21: Environmental and Permitting Multiplier for Public Water Systems by Solution Type

Public Water Systems	Multiplier
Physical Consolidation	$25,000 to $100,000[97]
Centralized Treatment	2%[98]
Decentralized Treatment	3%[99]
New Well	$85,000[100]
Storage Tank	$85,000[101]
Meters	$4,000[102]
Backup Power	5%[103]

97 Based on external quote, a cost range that varies with distance between the consolidating systems.
98 Environmental (i.e., CEQA) 2% of Capital Construction Cost City of Parlier 2020.
99 U.S. EPA Drinking Water Treatment Technology Unit Cost Models include 3% indirect capital cost for permitting.
https://www.epa.gov/sdwa/drinking-water-treatment-technology-unit-cost-models
100 This cost was developed by Corona Environmental to cover CEQA fees and was utilized in the 2021 Needs Assessment.
101 This cost was developed by Corona Environmental to cover CEQA fees and was utilized in the 2021 Needs Assessment.
102 Based on reviewing internally funded projects for meter installation, it was noted that these types of projects are likely to require filling for CEQA Categorical Exemption/Environmental impact report. Based on California Department of Fish and Wildlife the filing fees cost as of 2024 is $4,051.25.
https://wildlife.ca.gov/Conservation/Environmental-Review/CEQA/Fees.
103 This multiplier was developed for the Drought Infrastructure Cost Assessment Final results, based on public and external feedback. This cost covers air pollution permitting fees. 2022 Drinking Water Needs Assessment:
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2022needsassessment.pdf.

Table 22: Environmental and Permitting Multiplier for State Small Water Systems & Domestic Wells by Solution Type

State Small Water Systems & Domestic Wells	Multiplier
Physical Consolidation	$25,000 to $100,000[104]
Decentralized Treatment	3%[105]

SUMMARY OF COST ESTIMATES DEVELOPED

The Cost Assessment results are aggregated and analyzed in many ways in the Drinking Water Needs Assessment. The core outputs of the Cost Assessment are summarized in the following sections.

CAPITAL COSTS

Capital costs are 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.

The capital cost for different individual modeled solution types is calculated by gathering all needed unit costs and utilizing them in various methods to calculate the total costs. Total capital costs are then modified using different multipliers to adjust the cost estimates accordingly. For example, modeled physical consolidation is calculated by gathering the most up-to-date unit costs, such as: pipeline, service line, connection fees, and CEQA and then aggregating the cost per systems. Finally, adjusting the cost with all applicable cost modifiers.

For centralized treatment, each modeled treatment capital cost is calculated differently. Some centralized treatment technologies are modeled utilizing U.S. EPA Work Breakdown Structure (WBS) Models, while others utilize regression equations that were developed based on vendor quotes and recent State Water Board funded project cost data. The output costs for these modeled solutions are then adjusted using the cost modifiers listed in Table 6.

ANNUAL OPERATIONS & MAINTENANCE COSTS

While capital costs are an important factor to consider when estimating the cost of achieving the Human Right to Water, it is just as important to have an understanding of the expected annual costs to operate and maintain many of these modeled long-term solutions. The Cost Assessment Model estimates annual O&M expenses related to modeled long-term centralized

[104] Applied to state small water systems only, based on external quote, a cost range that varies with distance between the consolidating systems.
[105] U.S. EPA Drinking Water Treatment Technology Unit Cost Models include 3% indirect capital cost for permitting.
https://www.epa.gov/sdwa/drinking-water-treatment-technology-unit-cost-models

and decentralized treatment because SAFER program funding can support qualifying O&M expenses.[106]

Operational costs for consumables are typically driven by the volume of water requiring treatment annually and the expense of having an appropriately certified operator oversee the treatment process. Examples of operational costs considered in the Cost Assessment Model 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

Details on the centralized and decentralized treatment O&M component costs, underlying assumptions, and calculation methodologies are detailed in **Supplemental Appendix: Centralized Treatment Cost Estimate Methodology**[107] and **Supplemental Appendix: Decentralized Treatment Cost Estimate Methodology.**[108]

It is important to note that the Cost Assessment Model's O&M estimates are not representative of the total O&M costs needs to sustainability run a drinking water system. They only represent the estimated cost associated with the *new* modeled centralized or decentralized treatment.

20-YEAR NET PRESENT WORTH OF CAPITAL AND O&M COSTS

Lifecycle costs of modeled capital costs and O&M costs are presented in net present worth terms (NPW). All net present worth costs are developed using a 20-year period and 4% annual discount rate.

The Cost Assessment Model develops a lifecycle O&M Net Present Value (NPV) cost estimate for each modeled treatment technology. All NPVs are developed based on a 20-year period and an annual 4% interest rate.

Equation 1: O&M NPV Calculations

O&M NPV = Total Annual O&M x [(1+i) ^n-1] / [i x (1+i) ^n]

[106] FY 2022-23 Fund Expenditure Plan (pg. 3-4) https://www.waterboards.ca.gov/water_issues/programs/grants_loans/docs/2022/final-2022-23-sadw-fep.pdf
[107] Cost Assessment Supplemental Appendix: Centralized Treatment Cost Estimate Methodology https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2024/2024costassessment-centralized-treatment.pdf
[108] Cost Assessment Supplemental Appendix: Decentralized Treatment Cost Estimate Methodology https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2024/2024costassessment-decentralized-treatment.pdf

Where: Total Estimated Annual O&M = (Consumables + Waste Discharge + Labor + Electricity)

i = 4% interest rate

n = 20-year life cycle

Equation 2: NPW Calculations

20-year NPW = Capital Cost + O&M NPV

Where: Capital Cost includes all estimated costs associated with the construction and installation of modeled physical consolidation, treatment technologies, and/or other essential infrastructure. In addition to the estimated equipment cost, the capital cost estimate may also include costs associated with electrical expenses (wiring), engineering services design fees, project management and administrative activities, construction contingency, contractor's labor, business overhead, and California Environmental Quality Act (CEQA) related costs.

MANAGERIAL ASSISTANCE & COMMUNITY ENGAGEMENT COSTS

Some of the modeled solutions in the Cost Assessment Model include costs associated with managerial assistance or community outreach and engagement. These costs are often embedded in total project costs. For the purposes of the Cost Assessment, the following costs are estimated and analyzed separately from capital and O&M costs. Many State Water Board funding programs, including the Safe and Affordable Drinking Water Fund, support contracts with third-party organizations that provide the assistance summarized below. For SAFER program budgetary planning purposes, it is important to understand what the estimated demand for these services may be.

The Cost Assessment Model groups the following cost estimates into this category of cost estimates.

Technical Assistance: Technical assistance is designed to assist public 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.

Administrator Assistance: Administrators generally act as a public water system general manager, or may be assigned limited specific duties, such as managing an infrastructure improvement project on behalf of a designated water system. Administrators are named for a limited term to help a water system through a consolidation process or to otherwise come into compliance.

Community Outreach & Engagement (Technical Assistance): Outreach to DAC state small water systems and domestic wells regarding the instillation of decentralized treatment devices.

APPENDIX

This appendix summarizes the changes made to the 2024 Cost Assessment Model since the release of the preliminary 2023 Cost Assessment results in December 2023. Feedback from internal and external stakeholders resulted in the following modifications:

Administrative Cost

- Administrator cost is calculated based on an averaging of eight Administrator projects that had been funded by State Water Board since 2021. Based on external feedback from stakeholders, and after internal discussions, Administrator cost had been recalculated after adjusting one of the approved project amounts. This resulted in an increase in the estimated Administrator cost from $733,052 in the preliminary 2023 Cost Assessment to $914,763 in the 2024 Cost Assessment.

New Public Supply Well Costs

- Based on internal and external feedback, State Water Board staff conducted additional research on well drilling costs. Feedback indicated the preliminary 2023 Cost Assessment Model's cost assumptions were too high. Based on research results, estimated public supply well drilling costs decreased from $2.5 million in the preliminary 2023 Cost Assessment Model to $900,000 in the 2024 Cost Assessment Model. The updated cost estimate is for a modeled 12-inch diameter, 1,000 ft deep well.
- State Water Board staff utilized the additional new public supply well cost research to update additional modeled public supply well assumptions. The 2024 Cost Assessment Model's well pump, motor, and well development cost regression equations were updated to reflect newly acquired project quotes/invoices.
- Internal feedback from expert staff indicated the Cost Assessment Model's initial public supply well water quality sampling cost estimates were not capturing the full list of analytes that a public well supply needs to test to be permitted. Therefore, State Water Board staff contacted several labs to collect quotes for testing the full range of analytes. The 2024 Cost Assessment Model's assumptions for the initial water quality sampling cost was increased from $825 to $3,030.
- Modeled electrical costs associated with a new public supply well were assumed to be $440,000 per well in the preliminary 2023 Cost Assessment Model. State Water Board staff were unable to validate this cost estimate, which some stakeholders believed was too high. Ultimately, the new public supply well cost research resulted in the replacement of the $440,000 cost assumption with a 20% of the total construction cost formula for estimate new public supply well electrical costs.

Averaging Decentralized Treatment O&M Cost Estimates

- The preliminary 2023 Cost Assessment Model estimated decentralized treatment O&M cost by contaminant for each modeled device. However, the estimated annual O&M cost per contaminant for each device was relatively similar. Therefore, in an effort to simplify the Cost Assessment Model, the State Water Board updated the modeled decentralized treatment O&M methodology to utilize the average unit costs across all the contaminants treated by decentralized treatment. Learn more in Supplemental Appendix: Decentralized Treatment Cost Estimate Methodology.[109]

Technical Assistance for DAC State Small Water Systems and Domestic Wells

- The 2023 Preliminary Cost Assessment Model assumed $631 for community/household outreach and communication costs a component of the modeled decentralized treatment capital cost estimate. Stakeholder feedback suggested that community/household outreach and communication associated with the installation of decentralized treatment for high-risk state small water systems and domestic wells should be modeled separately as technical assistance for these communities. The State Water Board currently funds technical assistance providers to perform these types of services. Therefore, community/household outreach and communication estimated costs were removed from the capital cost estimate for modeled decentralized treatment when modeled for high-risk state small water systems and domestic wells.[110] These costs were then calculated as technical assistance for state small water systems and domestic wells that have decentralized treatment modeled as their long-term solution in the 2024 Cost Assessment Model. Learn more in Supplemental Appendix: Decentralized Treatment Cost Estimate Methodology.[111]

Increased Estimated Duration of Interim Assistance

- In the 2021 Cost Assessment Model, interim assistance was estimated for 6 years for Failing water systems; and 9 years for high-risk state small water systems and domestic wells. The preliminary 2023 Cost Assessment Model lowered the interim assistance duration, based on the observed trends in emergency/interim projects funded by the State Water Board: 3 years for Failing water systems and high-risk state small water systems; and 2 years for high-risk domestic wells. Public feedback indicated the scale of this decrease was too large and did not reflect actual interim assistance need. Therefore, the estimated duration for interim assistance was updated from 3 years to 5 years for Failing public water systems and high-risk state small water systems. The estimated duration for high-risk domestic wells remains 2 years.

Modeled Centralized Treatment Technologies Water Quality Viability

- In the preliminary 2023 Cost Assessment modeled regenerable resin anion exchange was only modeled for Failing systems with an average nitrate influent concentration less than 25 mg/L, and mean sulfate concentration less than 250 mg/L. When analyzing water quality data for Failing systems, several systems exceeded these nitrate and sulfate thresholds. These systems would have been excluded from modeled long-term centralized treatment. State Water Board staff conducted external research and

[109] Cost Assessment Supplemental Appendix: Decentralized Treatment Cost Estimate Methodology https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2024/2024costassessment-decentralized-treatment.pdf

[110] Community/household outreach and communication costs are still included when modeling decentralized treatment for public water systems.

[111] Cost Assessment Supplemental Appendix: Decentralized Treatment Cost Estimate Methodology https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2024/2024costassessment-decentralized-treatment.pdf

outreach and identified a selective resin that can handle large loads of contamination. The 2024 Cost Assessment models this selective resin, enabling modeled anion exchange treatment for Failing water systems with nitrate contamination regardless of their nitrate or sulfate levels.

Determining Decentralized Treatment Viability for Iron/Manganese

- The preliminary 2023 Cost Assessment modeled decentralized treatment (POU) for iron/manganese reduction for Failing water systems with 20 service connections or less. The State Water Board internal workgroup recommended removing this system size restriction for selecting POU treatment as a long-term solution. The recommendation was based on the consideration of reverse osmosis membrane's fouling.[112] The 2024 Cost Assessment Model was updated to select modeled centralized treatment (Filtration) regardless of the system size.
- The preliminary 2023 Cost Assessment modeled interim decentralized treatment (POU) for iron/manganese reduction for Failing water systems that had modeled centralized treatment or physical consolidation as a long-term solution. Utilizing the same reasoning related to membrane fouling, the 2024 Cost Assessment Model does not select POU treatment as an interim solution for Failing water systems with iron/manganese contamination. The 2024 Cost Assessment models interim bottled water for these systems.

Updating Cost Multipliers

- Based on public feedback, the State Water Board conducted additional research and streamlined the application of cost multipliers for individual modeled solutions. For more details, refer to Table 23 through Table 31 to compare the changes to the Cost Assessment Model's cost modifiers from the 2021 and preliminary 2023 Cost Assessment Model to the final multiplier assumptions utilized in the 2024 Cost Assessment.
- The preliminary 2023 Cost Assessment Model utilized an engineering multiplier to translate the equipment costs to an installed capital cost for some modeled centralized treatment technologies. In an effort to apply the cost adjustments consistently across all modeled centralized treatment technologies, new cost multipliers were developed. In accordance with this change, the capital cost estimates and the regression equations to estimate capital cost at a given flow rate were revised. Learn more in Supplemental Appendix: Centralized Treatment Cost Estimate Methodology[113]
- Based on public feedback, the State Water Board developed an engineering multiplier for modeled physical consolidation, in consultation with internal expert staff. The engineering multiplier accounts for 15% of the total estimated physical consolidation construction cost and estimated project design costs.
- In the preliminary 2023 Cost Assessment Model, a 25% overhead multiplier was applied to the modeled centralized treatment capital cost estimates. Based on feedback from

[112] Caused by precipitation and deposition of molecules or particulates on the membrane surface or membrane pores.
[113] Cost Assessment Supplemental Appendix: Centralized Treatment Cost Estimate Methodology https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2024/2024costassessment-centralized-treatment.pdf

both internal and external stakeholders, the Cost Assessment Model's overhead multiplier was reconsidered, and additional research was conducted. Utilizing U.S. EPA's Drinking Water Work Breakdown Structure (WBS) Cost Model, the 2024 Cost Assessment Model's overhead multiplier was reduced from 25% to 15%.

- In the preliminary 2023 Cost Assessment Model, multipliers accounting for project costs associated with planning and construction, engineering services, and permitting/environmental were not considered for modeled decentralized treatment. Feedback received from both internal and external stakeholders indicated these cost adjustments should be included. Therefore, State Water Board staff conducted additional research to develop these multipliers for modeled decentralized treatment. The State Water Board utilized U.S. EPA's Drinking Water (WBS) Cost Model, to develop the following multiplier assumptions for modeled decentralized treatment: 3% for planning and construction to account for pilot testing costs, 15% for engineering services to evaluate compliance options and select suitable POU or POE treatment technologies, and 3% for permitting and environmental review required by local and/or state agencies.
- Based on external feedback on the preliminary 2023 Cost Assessment Model, all Other Essential Infrastructure (OEI) multipliers were revisited and adjusted where appropriate. State Water Board staff conducted internal research and audited several state Water Board funded projects and compared the multipliers used across all OEI items. For storage tanks: 20% for electrical, 10% for planning and construction, 15% for engineering, and 10% for overhead were recommended based on the research. For backup power: 5% for electrical fees to cover generator accessories power and 25% for contingency. For meters: 8% for engineering services fees to cover preliminary engineering report, construction, and post constriction phase services; as well as preliminary and final design phase services. Model meters also include 10% for contingency and a flat $4,000 estimate for CEQA Categorical Exemption/Environmental impact report filling.
- Based on external feedback on the preliminary 2023 Cost Assessment Model, new modeled public supply well multipliers have been revisited and adjusted where appropriate. State Water Board staff conducted internal and external research for several new well projects and compared the multipliers used across all these projects. The following multipliers were adjusted for modeled new public wells in the 2024 Cost Assessment Model: 20% for electrical, 10% for planning and construction, 15% for engineering, and 10% for overhead.

The tables below summarize the cost and methodology assumptions utilized in the 2021, 2023 preliminary, and 2024 Cost Assessment Models. **The highlighted rows indicate where that been a change from the preliminary 2023 Cost Assessment Model and the 2024 Cost Assessment Model.**

Table 23: Modeled Physical Consolidation Cost Assumptions (2021 – 2024)

Cost Component	2021 Cost Model	Preliminary 2023 Cost Model	2024 Cost Model
Pipeline ($/Lf)	$155	$220	$220

Cost Component	2021 Cost Model	Preliminary 2023 Cost Model	2024 Cost Model
Connection Fees ($/Joining system service connection)	$6,200	Averaging connection fees for Receiving systems for each scenario	Averaging connection fees for Receiving systems for each scenario
Service Line Cost ($/Project)	$5,000	$6,200	$6,200
Administrative Cost ($/Project)	$100,000	15% of total construction cost.	15% of total construction cost.
CEQA Cost ($/Project)	$85,000	Intersect systems = $25,000 Route systems = $100,000.	Intersect systems = $25,000 Route systems = $100,000.
Treatment Cost	Excluded	Included for Failing *Receiving* systems due to water quality issues.	Included for Failing *Receiving* systems due to water quality issues.
Additional Source (public supply well)	Excluded	Included for *Receiving* systems with single source of water supply.	Included for *Receiving* systems with single source of water supply.
Contingency	20% of total cost	20% of total cost	20% of total cost
Inflation	Excluded	3.7%	3.1%
Planning & Construction	Excluded	10% of total cost	10% of total cost
Regional Multiplier	Excluded	Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties
Engineering Services	Excluded	Excluded	15% Total cost

Table 24: Modeled Centralized Treatment Cost Assumptions (2021 – 2024)

Cost Component	Flow Rate (gpm)	2021 Cost Model	Preliminary 2023 Cost Model	2024 Cost Model
Granular Activated Carbon				
Treatment Vessel	1-250	$436,000	$505,000	$507,000
	251-425	$536,000	$621,000	$624,000
	426-875	$745,000	$863,000	$865,000
	876-1,750	$1,490,000	$1,726,000	$1,731,000

Cost Component	Flow Rate (gpm)	2021 Cost Model	Preliminary 2023 Cost Model	2024 Cost Model
Booster Pump		$71,000	156.63 x MDD in gpm + 43,709[114]	156.64 x MDD in gpm + 43,713[115]
Engineering Multiplier		2.36	2.36	Excluded
Regional Multiplier		Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties
Inflation		Excluded	3.7%	3.1%
Overhead		Excluded	25%	15%
Electrical		Excluded	Excluded	10%
Planning & Construction		Excluded	Excluded	20%
Engineering Services		Excluded	Excluded	20%
Legal & Admin.		Excluded	Excluded	10%
Contingency		Excluded	Excluded	25%
Permitting/ Environmental		Excluded	Excluded	2%
Adsorption				
Treatment Vessel	1-250	$436,000	$505,000	$507,000
	251-425	$536,000	$621,000	$624,000
	426-875	$745,000	$863,000	$865,000
	876-1,750	$1,490,000	$1,726,000	$1,731,000
Engineering Multiplier		2.36	2.36	Excluded
Regional Multiplier		Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties
Inflation		Excluded	3.7%	3.1%
Overhead		Excluded	25%	15%
Electrical		Excluded	Excluded	10%
Planning & Construction		Excluded	Excluded	20%
Engineering Services		Excluded	Excluded	20%

[114] Output is the equipment cost. The engineering multiplier is to be applied to convert to the installed capital costs.
[115] Output is the equipment cost. The cost adjustment multipliers are to be applied to convert to the installed capital costs.

Cost Component	Flow Rate (gpm)	2021 Cost Model	Preliminary 2023 Cost Model	2024 Cost Model
Legal & Admin.		Excluded	Excluded	10%
Contingency		Excluded	Excluded	25%
Permitting/ Environmental		Excluded	Excluded	2%
Coagulation Filtration				
Treatment Plant Capital Cost		1,095.59 (MDD in gpm) + 952,578	1,269.4 x MDD in gpm + 1E+06[116]	414.49 x MDD in gpm + 360,389[117]
Engineering Multiplier		3.06	3.06	Excluded
Regional Multiplier		Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties
Inflation		Excluded	3.7%	3.1%
Overhead		Excluded	25%	15%
Electrical		Excluded	Excluded	10%
Planning & Construction		Excluded	Excluded	20%
Engineering Services		Excluded	Excluded	20%
Legal & Admin.		Excluded	Excluded	10%
Contingency		Excluded	Excluded	25%
Permitting/ Environmental		Excluded	Excluded	2%
Filtration				
Treatment Plant Capital Cost		1,095.58 (MDD in gpm) + 845,445	1,255.8 x MDD in gpm + 816,958[118]	410 x MDD in gpm + 267,000[119]
Filter Vessel cost by flow rate range		Included in the treatment plant capital cost equation above.	401.17 x Flow Rate in gpm + 5,567.6	401.17 x Flow Rate in gpm + 5,567.6

[116] Output is the installed capital cost.
[117] Output is the equipment cost. The cost adjustment multipliers are to be applied to convert to the installed capital costs.
[118] Output is the installed capital cost.
[119] Output is the equipment cost. The cost adjustment multipliers are to be applied to convert to the installed capital costs.

Cost Component	Flow Rate (gpm)	2021 Cost Model	Preliminary 2023 Cost Model	2024 Cost Model
Backwash Reclaim System		Included in the treatment plant capital cost equation above	$126,000	$126,000
Chemical Feed System for Sodium Hypochlorite		Excluded	$29,000	$29,000
Engineering Multiplier		3.06	3.06	Excluded
Regional Multiplier		Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties
Inflation		Excluded	3.7%	3.1%
Overhead		Excluded	25%	15%
Electrical		Excluded	Excluded	10%
Planning & Construction		Excluded	Excluded	20%
Engineering Services		Excluded	Excluded	20%
Legal & Admin.		Excluded	Excluded	10%
Contingency		Excluded	Excluded	25%
Permitting/ Environmental		Excluded	Excluded	2%
Regenerable Resin Anion Exchange				
Treatment Plant Capital Cost		2021 U.S. EPA WBS Model	2023 U.S. EPA WBS Model	2023 U.S. EPA WBS Model
Regional Multiplier		Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties
Inflation		Excluded	3.7%	3.1%
Overhead		Excluded	25%	15%
Electrical		Excluded	Excluded	10%
Planning & Construction		Excluded	Excluded	20%
Engineering Services		Excluded	Excluded	20%
Legal & Admin		Excluded	Excluded	10%
Contingency		Excluded	Excluded	25%

Cost Component	Flow Rate (gpm)	2021 Cost Model	Preliminary 2023 Cost Model	2024 Cost Model
Permitting/Environmental		Excluded	Excluded	2%
Regenerable Resin Cation Exchange				
Treatment Plant Capital Cost		Excluded	2023 U.S. EPA WBS Model	2023 U.S. EPA WBS Model
Regional Multiplier		Excluded	Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties
Inflation		Excluded	3.7%	3.1%
Overhead		Excluded	25%	15%
Electrical		Excluded	Excluded	10%
Planning & Construction		Excluded	Excluded	20%
Engineering Services		Excluded	Excluded	20%
Legal & Admin		Excluded	Excluded	10%
Contingency		Excluded	Excluded	25%
Permitting/Environmental		Excluded	Excluded	2%
Single-Use Ion Exchange				
Treatment Plant Capital Cost	1 – 101	$356,888	$414,000	$455,232
	102 -225	$537,418	$623,000	$716,042
	226 -401	$712,949	$827,000	$991,078
	402 -627	$925,929	$1,073,000	$1,327,760
	628 -1,256	$1,851,857	$2,146,000	$2,655,520
Regional Multiplier		Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties
Engineering Multiplier		2.36	2.36	Excluded
Inflation		Excluded	3.7%	3.1%
Overhead		Excluded	25%	15%
Electrical		Excluded	Excluded	10%
Planning & Construction		Excluded	Excluded	20%
Engineering Services		Excluded	Excluded	20%
Legal & Admin.		Excluded	Excluded	10%

Cost Component	Flow Rate (gpm)	2021 Cost Model	Preliminary 2023 Cost Model	2024 Cost Model
Contingency		Excluded	Excluded	25%
Permitting/ Environmental		Excluded	Excluded	2%
Activated Alumina				
Treatment Plant Capital Cost	1 - 250	$833,000	$965,000	$1,597,343
	251 -425	$949,000	$1,100,000	$1,916,811
	426 -675	$1,029,000	$1,192,000	$2,136,271
	676 -900	$1,199,000	$1,389,000	$2,602,979
Regional Multiplier		Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties
Engineering Multiplier		2.36	2.36	Excluded
Inflation		Excluded	3.7%	3.1%
Overhead		Excluded	25%	15%
Electrical		Excluded	Excluded	10%
Planning & Construction		Excluded	Excluded	20%
Engineering Services		Excluded	Excluded	20%
Legal & Admin.		Excluded	Excluded	10%
Contingency		Excluded	Excluded	25%
Permitting/ Environmental		Excluded	Excluded	2%
4-log Virus Treatment				
Tank[120]		$7/gallon	$20/gallon	$20/gallon
Water Main		$115/linear foot (lf)	$220/lf	$220/lf
SCADA		Excluded	$18,000	$18,000
Chlorine Analyzer		Excluded	$4,000	$4,000
pH Analyzer		Excluded	$1,081	$1,081
Regional Multiplier		Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties
Engineering Multiplier		3.06	3.06	Excluded

[120] Included only for water systems with estimated flows of 700 – 2,100 gpm.

Cost Component	Flow Rate (gpm)	2021 Cost Model	Preliminary 2023 Cost Model	2024 Cost Model
Inflation		Excluded	3.7%	3.1%
Overhead		Excluded	25%	15%
Electrical		Excluded	Excluded	10%
Planning & Construction		Excluded	Excluded	20%
Engineering Services		Excluded	Excluded	20%
Legal & Admin.		Excluded	Excluded	10%
Contingency		Excluded	Excluded	25%
Permitting/ Environmental		Excluded	Excluded	2%
Surface Water Treatment Package Plant				
Filtration	1 - 175	$797,000	$266,000	$266,000
	176 - 300	$1,114,000	$372,000	$372,000
	301 - 700	$1,655,000	$553,000	$553,000
	701 – 1,400	$2,210,000	$738,000	$738,000
	1,401 – 2,100	$3,411,000	$1,139,000	$1,139,000
Handheld Turbidimeter		Excluded	$2,363/unit	$2,363/unit
Small-Scale SCADA		Excluded	$18,000/unit	$18,000/unit
Chlorine Analyzer for 4-log Virus Treatment Capital Cost		Excluded	$4,000/unit	$4,000/unit
Tank for 4-log Virus Treatment[121]		$7/gallon	$20/gallon	$20/gallon
Water Main Pipeline for 4-log Virus Treatment Capital Cost		$155/lf	$220/lf	$220/lf
pH Analyzer for 4-log virus inactivation		Excluded	$1,081	$1,081
Regional Multiplier		Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties
Engineering Multiplier		3.06	3.06	Excluded
Inflation		Excluded	3.7%	3.1%
Overhead		Excluded	25%	15%

[121] Included only for water systems with estimated flows of 700 – 2,100 gpm.

Cost Component	Flow Rate (gpm)	2021 Cost Model	Preliminary 2023 Cost Model	2024 Cost Model
Electrical		Excluded	Excluded	10%
Planning & Construction		Excluded	Excluded	20%
Engineering Services		Excluded	Excluded	20%
Legal & Admin.		Excluded	Excluded	10%
Contingency		Excluded	Excluded	25%
Permitting/ Environmental		Excluded	Excluded	2%

Table 25: Modeled Operational and Maintenance (O&M) Cost Assumptions

Cost Component	2021 Cost Model	Preliminary 2023 Cost Model	2024 Cost Model
Operator Labor			
T1	$97,353	$105,000	$105,000
T2	$105,092	$123,192	$123,192
T3	$132,463	$127,992	$127,992
T4	$163,937	$137,280	$137,280
Energy			
Electricity Cost Equation	(0.746 x flow x headloss x electrical rate) / (3,960 x pump efficiency x motor efficiency)	(0.746 x flow x headloss x electrical rate) / (3,960 x pump efficiency x motor efficiency)	(0.746 x flow x headloss x electrical rate) / (3,960 x pump efficiency x motor efficiency)
Flow in Million Gallons (MG)	Estimated annual production for each Failing system	Estimated annual production for each Failing system	Estimated annual production for each Failing system
Headloss (ft)	23.07	23.07	23.07
Electrical Rate	$0.1646/kWh	0.1646/kWh	0.30/kWh
Pump Efficiency	0.8	0.8	0.8
Motor Efficiency	0.9	0.9	0.9
Granular Activated Carbon (GAC)			
Virgin GAC	$2.02	$1.95	$1.95
Transportation	$0.29	$0.20	$0.20
Spent GAC Disposal	$0.036	Excluded	Excluded
Change-out Service	Excluded	$0.30	$0.30
Reactivation	Excluded	$0	$0

Cost Component	2021 Cost Model	Preliminary 2023 Cost Model	2024 Cost Model
Regional Multiplier	Excluded	Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties
Inflation	Excluded	3.7%	3.1%
Adsorption			
Operational Cost	$1.54/kgal-water production	$y = 2.4337\ x^{-0.259}$ [122]	$y = 2.4337\ x^{-0.259}$ [123]
Regional Multiplier	Excluded	Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties
Inflation	Excluded	3.7%	3.1%
Coagulation Filtration			
Operational Cost	$1.07/kgal-water production	$y = 11.432x^{-0.466}$ [124]	$y = 11.432x^{-0.466}$ [125]
Regional Multiplier	Excluded	Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties
Inflation	Excluded	3.7%	3.1%
Filtration			
Operational Cost	$1.07/kgal-water production	$1.24/kgal-water production	$1.24/kgal-water production
Regional Multiplier	Excluded	Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties
Inflation	Excluded	3.7%	3.1%
Regenerable Resin Anion Exchange			
Brine Disposal	$0.20/gallon	$0.35/gallon	$0.35/gallon
Regeneration Salt	$0.16/lb	$0.25/lb	$0.25/lb
Resin Loss	Excluded	$291/cf	$291/cf
Bed replacement	Excluded	$291/cf	$291/cf
Inflation	Excluded	3.7%	3.1%
Regional Multiplier	Excluded	Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties
Regenerable Resin Cation Exchange			

[122] Where, y = $/ kgal-water production per mg/L-arsenic removal; and x = Annual Production (kgal)
[123] Where, y = $/ kgal-water production per mg/L-arsenic removal; and x = Annual Production (kgal)
[124] Where, y = $/ kgal-water production per mg/L-arsenic removal; and x = Annual Production (kgal)
[125] Where, y = $/ kgal-water production per mg/L-arsenic removal; and x = Annual Production (kgal)

Cost Component	2021 Cost Model	Preliminary 2023 Cost Model	2024 Cost Model
Regeneration Salt	Excluded	$0.10/lb	$0.10/lb
Resin Loss	Excluded	$231.49/cf	$231.49/cf
Bed Replacement	Excluded	$231.49/cf	$231.49/cf
Spent Resin Disposal	Excluded	$112.16/ton	$112.16/ton
Wastewater Treatment Facility Discharge Fees	Excluded	$0.006/gallon	$0.006/gallon
Regional Multiplier	Excluded	Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties
Inflation	Excluded	3.7%	3.1%%
Single Use Ion Exchange			
Uranium-Selective Resin Replacement and Disposal Cost	$0.63/ kgal	$1/kgal	$1/kgal
Uranium-Selective Resin Replacement and Disposal Cost Equation	y = 631.10 + 0 where, y = Uranium-selective resin replacement and disposal cost ($) x = Annual production (in MG)	y = 1,002.7x + 0 where, y = Uranium-selective resin replacement and disposal cost ($) x = Annual production (in MG)	y = 1,002.7x + 0 where, y = Uranium-selective resin replacement and disposal cost ($) x = Annual production (in MG)
Perchlorate-Selective Resin Replacement and Disposal Cost	$115 /cf	$400/cf	$400/cf
Perchlorate-Selective Resin Replacement and Disposal Cost Equation	y = 115.21x + 0 where, y = Perchlorate-selective resin replacement and disposal cost ($) x = Annual production (in MG)	y = 186.56x + 25,253 where, y = Perchlorate-selective resin replacement and disposal cost ($) x = Annual production (in MG)	y = 186.56x + 25,253 where, y = Perchlorate-selective resin replacement and disposal cost ($) x = Annual production (in MG)
Regional Multiplier	Excluded	Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties
Inflation	Excluded	3.7%	3.1%
Activated Alumina			
Alkalinity (mg/L as CaCO3)	160	25	25
Assumed Initial pH	7.9	7.9	7.9

Cost Component	2021 Cost Model	Preliminary 2023 Cost Model	2024 Cost Model
Number of Bed Volumes	Excluded	1,150	1,150
Caustic Soda 50%	$0.23/gal	$0.32/lb	$0.32/lb
Sulfuric Acid 93%	$0.23/gal	$0.93/lb	$0.93/lb
Regenerative Activated Alumina	Excluded	$161.37/cf	$161.37/cf
Activated Alumina Replacement and Disposal Cost[126]	y = 68.73x + 0	y = 219.79x + 2,988.1	y = 219.79x + 2,988.1
Regional Multiplier	Excluded	Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties
Inflation	Excluded	3.7%	3.1%
4-log Virus Treatment			
Chlorine Analyzer Reagent	Excluded	$84	$84
12.5% Liquid Sodium Hypochlorite (NaOCl)	Excluded	$7.80/gallon	$7.80/gallon
Regional Multiplier	Excluded	Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties
Inflation	Excluded	3.7%	3.1%
Surface Water Treatment			
Coagulant	Excluded	$2.35/lb	$2.35/lb
Filter Aid - Nonionic Polymer	Excluded	$2/lb	$2/lb
Filter Media Replacement	Excluded	$220	$220
Pre/post Treatment pH Adjustment	Excluded	Sodium hydroxide (caustic) - $2.75/lb	Sodium hydroxide (caustic) - $2.75/lb
Turbidity Standards Calibration Kit	Excluded	$284	$284
Chlorine Analyzer Reagent for 4-log Virus Treatment	Excluded	$84	$84
12.5% Liquid Sodium Hypochlorite (NaOCl) for 4-log Virus Treatment	Excluded	$7.80/gallon	$7.80/gallon

[126] Where, y = Activated alumina replacement and disposal cost ($); and x = Annual production (in MG).

Cost Component	2021 Cost Model	Preliminary 2023 Cost Model	2024 Cost Model
Regional Multiplier	Excluded	Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties
Inflation	Excluded	3.7%	3.1%

Table 26: Modeled Decentralized Treatment Capital Cost Assumptions (2021 – 2024)

Cost Component	2021 Cost Model	Preliminary 2023 Cost Model	2024 Cost Model
Point of Use (POU)			
POU Device Cost per Unit	$1,500	$1,321	$1,321
Labor Cost per Unit Install	$200	$399	$399
Initial Water Quality Testing	Excluded	$194	$194
Administration/Project Management	$1,000	$551	$551
Community/Household Outreach and Communication Cost	$300	$631	$631[127]
Contingency	Excluded	5% ($155)	5% ($155)
Point of Entry (POE)			
POE Device Cost per Unit	$3,700	$1,700	$1,700
Labor Cost per Unit Install	$1,000	$1,000	$1,000
Initial Water Quality Testing	Excluded	$575	$575
Administration/Project Management	$1,000	$551	$551
Community/Household Outreach and Communication Cost	$300	$631	$631[128]
Contingency	Excluded	5% ($223)	5% ($223)

Table 27: Modeled Decentralized Treatment O&M Cost Assumptions (2021 – 2024)

Cost Component	2021 Cost Model	Preliminary 2023 Cost Model	2024 Cost Model
Point of Use (POU)			
Operator and Communication	$300	$300	$300
Annual Filter Replacement	$100	Multi-contaminant $321 Nitrate $123 Arsenic $189	$156 (static cost regardless of analyte)

[127] Excluded for high-risk state small water systems and domestic wells. This cost is estimated for modeled technical assistance.
[128] Excluded for high-risk state small water systems and domestic wells. This cost is estimated for modeled technical assistance.

Cost Component	2021 Cost Model	Preliminary 2023 Cost Model	2024 Cost Model
		Uranium $156 Fluoride $156	
Water Quality Sampling	Nitrate/Arsenic $40 Uranium $110 Fluoride $60	Nitrate $158 Arsenic $54 Uranium $54 Fluoride $54	$80 (static cost regardless of analyte)
Point of Entry (POE)			
Operator and Communication	$300	$300	$300
Annual Filter Replacement	$410	$84	$84
Water Quality Sampling	$250	DBCP/EDB $270 1,2,3-TCP $324 Other VOCs $614	$403 (static cost regardless of analyte)

Table 28: Modeled Other Essential Infrastructure Cost Assumptions (2021 – 2024)

Cost Component	2021 Cost Model	Preliminary 2023 Cost Model	2024 Cost Model
Additional Storage			
Storage Tank	$38,000 - $3.2 M	(1.2501) (GPD) + $69,752 *$70,000 - $19 M*	(1.2501) (GPD) + $69,752 *$70,000 - $19 M*
Upgraded Electrical per Site	$440,000	$440,000	20%
SCADA	$100,000	$73,403	$73,403
Land Acquisition	$150,000	Excluded	Excluded
Booster Pump	$39,000 - $2.7 M	($37,000 - $4.0 M)	($38,000 - $8.7 M)
Purchased sources	Excluded	Included	Included
CEQA	$85,000	$85,000	$85,000
Regional Multiplier	Excluded	Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties
Inflation	Excluded	3.7%	3.1%
Contingency	Excluded	Excluded	15%
Planning & Construction	Excluded	Excluded	10%
Engineering Services	Excluded	Excluded	15%
Overhead	Excluded	Excluded	10%

Cost Component	2021 Cost Model	Preliminary 2023 Cost Model	2024 Cost Model
Meters			
Equipment & Software	$29,000	$29,000	$29,000
1" Meters (drive by)	$825	$1,200	$1,200
Regional Multiplier	Excluded	Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties
Inflation	Excluded	3.7%	3.1%
Engineering Services	Excluded	Excluded	8%
Contingency	Excluded	Excluded	10%
Permitting/ Environmental	Excluded	Excluded	$4,000
Back-up Electrical Supply			
Generator	$30,134 + ($341 x MDD)	$30,134 + ($341 x MDD)	$30,134 + ($341 x MDD)
Regional Multiplier	Excluded	Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties
Inflation	Excluded	3.7%	3.1%
Electrical	Excluded	Excluded	5%
Contingency	Excluded	Excluded	25%
Permitting/ Environmental	Excluded	5%	5%
Sounder			
Sounder device	Excluded	$1,853	$1,853
Regional Multiplier	Excluded	Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties
Inflation	Excluded	3.7%	3.1%

Table 29: Modeled Additional Long-Term Solution Cost Assumptions (2021 – 2024)

Cost Component	2021 Cost Model	Preliminary 2023 Cost Model	2024 Cost Model
New Public Supply Well (1,000 ft)			
Well Drilling	$790,000	$2,500,000	$900,000
Upgraded Electrical per Site	$440,000	$440,000	20% Total Construction Cost

Cost Component	2021 Cost Model	Preliminary 2023 Cost Model	2024 Cost Model
SCADA	$100,000	$73,403	$73,403
Well Pump and Motor	($136.73 x Well Production (MDD)) + $116,448	($136.73 x Well Production (MDD)) + $116,448	226,500
Well Development Cost	($145.01 x Well Production (MDD)) + $32,268	($145.01 x Well Production (MDD)) + $32,268	$36,000
Land Acquisition	$150,000	Excluded	Excluded
Initial Water Quality Sampling	Excluded	$825	$3,030
Well Permitting	Excluded	2021 County Permitting Data	2021 County Permitting Data
CEQA	$85,000	$85,000	$85,000
Regional Multiplier	Excluded	Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties
Inflation	Excluded	3.7	3.1%
Contingency	Excluded	Excluded	15%
Electrical	Excluded	Excluded	20%
Planning & Construction	Excluded	Excluded	10%
Engineering Services	Excluded	Excluded	15%
Overhead	Excluded	Excluded	10%
New Private Well (500 ft)			
Well Drilling	Excluded	$65 ft	$65 ft
Electrical Component & Control Box	Excluded	$600	$600
Well Pump and Motor	Excluded	Domestic Well: $830 State Small: $1,120	Domestic Well: $830 State Small: $1,120
Water Sampling	Excluded	$400	$400
Connection/Casing Pipe	Excluded	$2,150	$2,150
Submersible Wire	Excluded	$5 ft	$5 ft
Pressurized Water Tank	Excluded	$400	$400
Well Permitting	Excluded	Included by County	Included by County
Destroy Old Well	Excluded	$3,300	$3,300
Additional Parts & Labor	Excluded	$3,500	$3,500

Cost Component	2021 Cost Model	Preliminary 2023 Cost Model	2024 Cost Model
Regional Multiplier	Excluded	Rural (0%); Urban (+32%); Suburban (+30%) Counties	Rural (0%); Urban (+32%); Suburban (+30%) Counties
Inflation	Excluded	3.7%	3.1%
Bottled Water (Long-Term)			
Cost per Gallon	$1.00/gallon	$1.25/gallon	$1.25/gallon
Volume per Connection	60 gallons per month	60 gallons per month	60 gallons per month
Delivery Fee per Connection (2x a month)	Excluded	$22 per month	$22 per month
Hand Pump per Connection[129]	Excluded	$11	$11
Inflation	Excluded	3.7%	3.1%

Table 30: Modeled Managerial Assistance Cost Assumptions (2021 – 2024)

Cost Component	2021 Cost Model	Preliminary 2023 Cost Model	2024 Cost Model
Technical Assistance			
Failing Systems – Physical Consolidation	$60,000/yr ($300,000 for 5 years)	$85,000/yr ($425,000 for 5 years)	$85,000/yr ($425,000 for 5 years)
Failing Systems – No Physical Consolidation	$60,000/yr ($300,000 for 5 years)	$85,000/yr ($425,000 for 5 years)	$85,000/yr ($425,000 for 5 years)
At-Risk Public Water Systems – Physical Consolidation	$12,000/yr ($60,000 for 5 years)	$85,000/yr ($425,000 for 5 years)	$85,000/yr ($425,000 for 5 years)
At-Risk Public Water Systems – No Physical Consolidation	$12,000/yr ($60,000 for 5 years)	$22,000/yr ($44,000 for 2 years)	$22,000/yr ($44,000 for 2 years)
High-Risk State Small Water Systems and Domestic Wells – Decentralized Treatment	Excluded[130]	Excluded[131]	$631/ service connection or well (for disadvantaged communities only)

[129] One time cost, calculated for modeled year 1.
[130] $300 of Community/Household Outreach and Communication cost was included as part of the capital cost per service connection or well in the 2021 Cost Assessment Model.
[131] $631 of Community/Household Outreach and Communication cost was included as part of the capital cost per service connection or well in the 2021 Cost Assessment Model.

Cost Component	2021 Cost Model	Preliminary 2023 Cost Model	2024 Cost Model
Administrator Assistance			
Failing Systems	Excluded	$733,000 (2 years)	$914,763 (2 years)
At-Risk Public Water Systems	Excluded	$733,000 (2 years)	$914,763 (2 years)

Table 31: Modeled Interim Assistance Cost Assumptions (2021 – 2024)

Cost Component	2021 Cost Model	Preliminary 2023 Cost Model	2024 Cost Model
Duration			
Failing *DAC* Public Water Systems	6 Years	3 Years	5 Years
High-Risk *DAC* State Small Water Systems	9 Years	3 Years	5 Years
High-Risk *DAC* Domestic Wells	9 Years	2 Years	2 Years
Bottled Water (Interim)			
Cost per Gallon	$1.00/gallon	$1.25/gallon	$1.25/gallon
Volume per Connection	60 gallons per month	60 gallons per month	60 gallons per month
Delivery Fee per Connection (2x a month)	Excluded	$22 per month	$22 per month
Hand Pump per Connection[132]	Excluded	$11	$11
Inflation	Excluded	3.7%	3.1%
Decentralized Treatment (Interim)			
Refer to modeled long-term decentralized treatment assumptions in Table 26 and Table 27			

[132] One time cost, calculated for modeled year 1.