DRINKING WATER

POINT-OF-USE POINT-OF-ENTRY REPORT

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

2023

Acknowledgments

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Definition of Terms

This Report includes the following defined terms.

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

"ANSI" or **"American National Standards Institute"** is a private, non-profit entity that administers and coordinates the U.S. voluntary standards and conformity assessment system. As it applies to POU/POE, ANSI is the body that accredits entities that currently provide performance standards, testing, and methodology for device certification and minimum requirements.

"**NSF International**" is an international body that develops public health standards and provides certifications that help protect food, water, consumer products, and the environment.

"**Capital costs**" means the costs associated with the acquisition, construction, and development of water system infrastructure. These costs may include the cost of infrastructure (treatment solutions, consolidation, etc.), design and engineering costs, environmental compliance costs, construction management fees, general contractor fees, etc.

"**Centralized treatment**" means drinking water treatment designed to reduce a target constituent from a water supply in a single, centralized location, prior to delivery or distribution to its customers.

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

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

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

"**Corrosion Control**" means drinking water treatment measures are in place to minimize corrosion of any internal plumbing or fixtures. At times, source water or a treatment strategy (e.g., reverse osmosis) may create a corrosive environment for internal plumbing or fixtures.

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

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

“Dual Distribution System” or “DDS” consists of potable and non-potable water sources distributed in two separate distribution networks utilizing a pressurized small-diameter pipe with treated water plumbed directly to each service connection which typically targets reducing a primary drinking water standard to provide safe water for human consumption. This small-diameter piped distribution system works in conjunction with the original distribution system.

“Drinking Water Needs Assessment” or **“Needs Assessment”** is a State Water Resources Control Board annual report and visualization that are designed to support the prioritization of funding and technical assistance.

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

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

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

“**Local Primacy Agency**” means a local health officer that has applied for and received a primacy delegation pursuant to Section 116330 of Health & Saf. Code

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

“**Micrograms per liter”** or “**µg/L**” is used to define concentrations of constituents within one liter of water, also known as “parts per billion” or “ppb”.

“**Milligrams per liter”** or “**mg/L**” is used to define concentrations of constituents within one liter of water, also known as “parts per million” or “ppm”.

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

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

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

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

“Point-of-entry” or **“POE”** means a treatment device applied to the drinking water entering a house or building to reduce contaminant levels in the drinking water distributed throughout the house or building.

“Point-of-use” or **“POU”** means a treatment device applied to a single tap to reduce contaminant levels in drinking water at the treated tap.

“**Primary drinking water standard**” means treatment techniques and primary standards, both chemical and bacteriological, are met (and are legally enforceable for public water systems). Groundwater treatment techniques are specified in Article 3.5, Chapter 15, Division 4, Title 22 of the California Code of Regulations (CCR), and surface water treatment techniques are specified in Chapter 17, Division 4, Title 22 of the CCR. Bacteriological maximum contaminant levels are specified in Article 3, Chapter 15, Division 4, Title 22 of the CCR while chemical contaminant levels are found throughout Chapter 15, Division 4, Title 22 of the CCR.

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

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

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

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

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

“**Sanitary Seal**” or “**Upper Annular Space**” means the “well casing and the wall of the drilled hole, often referred to as the annular space, shall be effectively sealed to prevent it from being a preferential pathway for the movement of poor-quality water, pollutants, of contaminants, as defined in Section 9 of the California Well Standards, Bulletin 74-81 and 74-90, combined[1].

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

“**Self-supplied system**” refers to a water system, not under the jurisdiction of a state or local health agency, installed for households and others with domestically used water (e.g., dish washing, showering, drinking, cooking) on their wells and surface water supplies. This expands on a related definition, Self-Supplied Communities, in Department of Water Resources, Drought and Water Shortage Risk Scoring: California’s Small Water Supplier and Self-Supplied Communities (2021)[1].

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

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

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

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

“**State small water system**” or “**SSWS**” means a system for the provision of piped water to the public for human consumption that serves at least five, but not more than 14, service connections and does not regularly serve drinking water to more than an average of 25 individuals daily for more than 60 days out of the year. (Health & Saf. Code, § 116275, subd. (n).) Typically, a state small water system is under the regulatory jurisdiction of the County in which it is located. While minimum regulatory requirements exist, broader implementation is based on County ordinances and enforcement capacities.

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[1] California Combined Well Standards, Part II. Water Well Construction
https://water.ca.gov/Programs/Groundwater-Management/Wells/Well-Standards/Combined-Well-Standards/Water-Construction

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

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

EXECUTIVE SUMMARY

In 2016, the State Water Board adopted a Human Right to Water Resolution making the Human Right to Water (HR2W), as defined in Assembly Bill 685, a primary consideration and priority across all the state and regional boards' programs.[2] The HR2W recognizes that **"every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes."**

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

In 2021, the State Water Board completed its first Drinking Water Needs Assessment report[3] designed to help inform the prioritization of available state funding and technical assistance within the Safe and Affordable Drinking Water Fund (SADWF) Fund Expenditure Plan (FEP). While consolidation with a larger water system is typically considered the most sustainable long-term solution, geographic distances can make that economically infeasible. The initial Needs Assessment showed that POE/POU treatment is potentially the most affordable solution for approximately 100 community water systems and K-12 schools. The Needs Assessment also estimated that 303 state small water systems and 37,000 domestic wells may require the installation of POU/POE as a long-term treatment. Additionally, POU/POE treatment units may be necessary for interim solutions in some locations while a permanent solution is being developed.

The State Water Board recognizes that POU/POE devices are needed to meet the goals of the HR2W legislation, particularly in rural areas, and that there are significant obstacles to the successful implementation of POU/POE as a drinking water solution. In alignment with the

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[2] State Water Board Resolution No. 2016-0010

https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2016/rs2016_0010.pdf

[3] 2021 Drinking Water Needs Assessment

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

Fiscal Year 2021-22 FEP[4], this POU/POE Report (Report) outlines the technological, regulatory, performance certification and testing, installation challenges, reliable O&M, and socioeconomic, and sociocultural challenges that often accompany POU/POE implementation. Accordingly, this Report:

- Documents the current state of POU/POE usage in California
- Catalogs stakeholder input on POU/POE
- Shares project case studies
- Identifies opportunities and challenges
- Develops recommendations
- Proposes pilot studies to better inform the successful implementation of POU/POE

This Report will be shared through a public webinar and posted on the State Water Board's website to assist in statewide education on POU/POE issues and to further enhance collaboration with PWSs, local agencies, counties, community partners, manufacturers, and other stakeholders. Using the results of this Report, the State Water Board also intends to develop additional web-based education and materials to support continued education.

Given the large number of proposed POU/POE treatment units forecasted for use in California, this Report also evaluates equity factors in the distribution and use of POU/POE devices across the state. This equity component is particularly important because it is generally recognizes that POU/POE is a less sustainable water treatment alternative and should typically only be utilized where other options have been exhausted and are not economically or technically feasible. Therefore, the State Water Board seeks to ensure that programmatic decisions regarding the use and funding of POU/POE devices in California foster environmental justice rather than unintentionally exacerbate existing socio-economic and racial inequities.

In the 2022 Drinking Water Needs Assessment, six contaminants were identified as the top contaminants contributing to higher risk designations in domestic wells and state small water systems, including nitrate, arsenic, 1,2,3-trichloropropane (TCP), gross alpha, uranium, and hexavalent chromium. As new tools become available, including the 2022 Aquifer Risk Map[5], a more comprehensive picture emerges that outlines the density of domestic wells in relation to contaminants present in drinking water sources. This tool will likely assist collaborators, including state and local agencies, environmental justice groups, and technical assistance providers in prioritizing resources and efforts to support vulnerable populations with drinking water solutions.

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[4] State of CA FY 2021-22 Fund Expenditure Plan
https://www.waterboards.ca.gov/water_issues/programs/grants_loans/sustainable_water_solutions/docs/2021/final_2021-22_sadwfep.pdf

[5] 2022 Aquifer Risk Map (ca.gov)
https://gispublic.waterboards.ca.gov/portal/apps/webappviewer/index.html?id=17825b2b791d4004b547d316af7ac5cb

There are currently 122 public water systems currently permitted to use or proposing to use POU/POE treatment. This includes community (C), non-transient noncommunity (NTNC), and transient noncommunity (TNC) classifications, shown in Table 1.

Table 1: Estimated Systems to Implement POU/POE

System Type	# of Systems Evaluated	POU/ POE
HR2W list	305	106 (35%)
At-Risk SSWS	455	303 (67%)
At-Risk Domestic Well	62,607	36,911[6] (59%)

The State Water Board estimates approximately 64% of public water systems currently utilizing or proposing to meet compliance through POU/POE treatment devices provide water to a DAC or SDAC community. Furthermore, 58% of California public water systems currently utilizing or proposing to meet compliance through POE/POU treatment serve water to homes where the primary race is Hispanic.

The State Water Board conducted four stakeholder outreach sessions to contribute to this report. The four sessions were split into technical assistance providers, local government, community-based organizations, and the water industry. Challenges to implementing successful POU/POE programs highlighted in the stakeholder outreach sessions were:

Technical Assistance Providers

- A loss of community confidence if treatment devices fail
- Property value decreases related to water contamination
- Financial assistance is key to maintaining devices
- Lack of master template contract for operations
- Coping with bacteriologically contaminated sources

Local Government and Agencies

- Difficulty to get customers/homeowners, regulatory authorities, service providers (operators, samplers, laboratories, manufacturers), funding sources, etc. to cooperate
- Customer confidence
- Cumbersome processes
- Third-party assistance difficulties
- Variable water quality within a community
- Compliance reporting hurdles

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

Community-Based Organizations

- Consistent engagement
- Ongoing treated water testing
- Better specific language and communication
- Build trust and confidence in impacted communities

Water Industry and Manufacturers

- Lack of customer access to identify appropriate devices
- Lack of certifications available for PFAS compounds, 1,2,3-TCP, hexavalent chromium, uranium for POE devices, and problematic bacteriological water quality
- Lack of NSF/ANSI 53 Drinking Water Treatment Units – Health effects, compliant POE media, and concerns about device failure
- Funding for use of POU/POE units should be expedited

Equity and environmental justice are of concern in implementing POU/POE treatment in California. The State Water Board seeks to ensure that low-income communities and people of color are not disproportionately provided POU/POE treatment instead of more robust solutions. The State Water Board, environmental justice groups, and community partners have all expressed the desire to see POU/POE treatment in California utilized in an equitable and just way.

The State Water Board recognizes that the following challenges impact residents accessing safe water through POU/POE devices: 1) the presence of untreated water in the home, 2) shifting responsibility to residents, 3) reliability of POU/POE units, 4) performance indication devices and failure alarms, 5) wastewater production, and 6) community trust. These challenges may have additional burdens on disadvantaged communities and residents with language barriers.

PUBLIC WATER SYSTEM CHALLENGES

Engineering Firm Experience

Assistance from an engineering firm is often required for small water systems implementing POU/POE treatment. A professional engineer may complete a study demonstrating that centralized treatment is not economically feasible, recommend appropriate POU/POE treatment units, prepare a pilot study protocol, oversee the pilot study, prepare the report, conduct the customer survey, and prepare permit application documents.

Coordinating Professional Services

Installation and maintenance require an operator to coordinate professional services. Master contracts to encompass all POU/POE services may offer a more coordinated and streamlined approach.

STATE SMALL WATER SYSTEM AND SELF-SUPPLIED CHALLENGES

Assessment of Water Quality at Private Homes

The State Water Boards' 2021 Drinking Water Needs Assessment outlines the water quality risk assessment methodology estimated at 77,973 domestic wells and 611 State Small Water Systems in California in the high-risk category. The state-wide characterization approximates the risk and assists tremendously with identifying potentially vulnerable regions in the State. However, water quality specific to a source is imperative to making informed treatment decisions.

Assessment of Treatment Needs at Private Homes

There can be constituents present in source water that may affect the overall treatment approach. The type of contaminant and overall water quality determines structured treatment approaches. The large number and individuality of each water source require enormous resources to properly assess individual needs.

Lack of Programs/Resources in Place

The State Water Board has made funding available to Counties and Regional partners to implement programs to address water shortage and address water quality issues for private wells and self-supplied households. Few Counties and NGOs (less than 25% of the State) have expressed interest, received funding, and are currently implementing these programs.

Better Support and Guidance to Residents/Counties/TA Providers

Because many private wells potentially benefit from a POU/POE solution, an in-depth water quality analysis is less viable than a public water system application. The State Water Board should work with partners to develop and make available best practices and guidance on POU/POE implementation.

Initial and On-going Sampling

Each private well and/or self-supplied household requires initial sampling to understand water quality. Ongoing water quality sampling is required to ensure POU/POE devices are functioning well and removing contaminants as expected.

RECOMMENDATIONS

Based on the identified deficiencies, this report recommends the following pilot studies to gather information and experience to inform gaps in the implementation of POU/POE as a drinking water solution.

1. **Educational Strategy and Materials** – Develop a strategy and materials to better educate individuals and implementation partners on POU/POE treatment, in multiple languages. Because greater individual involvement is needed for success, a broad educational and marketing strategy is needed, along with the associated resources to fund it.

2. **Performance Certification** – Establish performance certifications in conjunction with NSF/ANSI for 1,2,3-TCP, hexavalent chromium, uranium, and high concentrations of nitrate applicable for POU and/or POE devices.

3. **POU/POE Operator Education Cohort and Workforce Development** – Launch an educational curriculum and program for individuals to effectively implement POU/POE treatment in impacted communities. Provide a salary or stipend for these individuals to participate in the program and develop needed skills. The purpose would be to create job opportunities and develop the skills necessary for community outreach, trust building, installation, technical aspects, and operation and maintenance. This program would operate primarily in low-income areas where POU/POE treatment usage is likely to be significant.

4. **Bacteriological Contamination in Domestic Wells** - Pilot UV disinfection and/or other disinfection technology in combination with POU/POE treatment at residences that use domestic wells and individual surface water intakes. Gather data to determine real-world pathogen reduction and best practices for implementation of POU/POE treatment. Determine limitations, if any, that may be due to raw water quality problems that prevent the ability to produce a safe supply.

5. **POU/POE installations using Smart Technology** – Pilot POU/POE treatment devices equipped with smart technology to demonstrate their efficacy and ease of use. Smart technology should allow for continuous performance monitoring and less intrusive O&M. Gather data on real-time device performance, optimize O&M costs and practices, and if it results in an increase in individual and community trust.

6. **POU vs. POE** - Determine if POE usage at individual homes is superior to POU treatment when analyzing ease of installation, resident perception, ease of operation and maintenance, ease of access, and treatment effectiveness. The focus of these pilots should be to ensure equitable access to water that meets drinking water standards to enhance the public health of residences across all racial and socioeconomic communities where these devices are used.

INTRODUCTION

BACKGROUND

In 2016, the State Water Board adopted a Human Right to Water Resolution making the Human Right to Water (HR2W), as defined in Assembly Bill 685, a primary consideration and priority across all the state and regional boards' programs.[7] The HR2W recognizes that **"every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes."**

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

In 2021, the State Water Board completed its first Drinking Water Needs Assessment report[8] designed to help inform the prioritization of available state funding and technical assistance within the Safe and Affordable Drinking Water Fund (SADWF) Fund Expenditure Plan (FEP). **While consolidation with a larger water system is typically considered the most sustainable long-term solution, geographic distances can make the solution economically infeasible. The initial cost estimate in the 2021 Needs Assessment indicated that POU/POE treatment was the most affordable and sustainable solution for approximately 100 community water systems and K-12 schools. The Needs Assessment also estimated that 303 state small water systems and 37,000 domestic wells may require the installation of POU/POE as a long-term treatment.** Additionally, POU/POE treatment units may be necessary for interim solutions in some locations while a permanent solution is being developed.

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[7] State Water Board Resolution No. 2016-0010
https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2016/rs2016_0010.pdf

[8] 2021 Drinking Water Needs Assessment
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2021_needs_assessment.pdf

PURPOSE OF THE REPORT

The State Water Board recognizes that POU/POE devices are needed to meet the goals of the HR2W legislation, particularly in rural areas, and that there are significant obstacles to the successful implementation of POU/POE as a drinking water solution. **In alignment with the Fiscal Year 2021-22 FEP[9], this POU/POE Report (Report) outlines the technological, regulatory, performance certification and testing, installation challenges, reliable O&M, socio-economic, and sociocultural challenges that often accompany POU/POE implementation.** Accordingly, this Report:

- Documents the current state of POU/POE usage in California
- Catalogs stakeholder input on POU/POE[10]
- Identifies gaps in certification for equipment and standards for service providers
- Shares project case studies
- Highlights opportunities and challenges
- Develops recommendations
- Proposes pilot studies to better inform the successful implementation of POU/POE

This Report will be shared through a public webinar and posted on the State Water Board's website to assist in statewide education on POU/POE issues and further enhance collaboration with PWSs, local agencies, counties, community partners, manufacturers, and other stakeholders. Using the results of this Report, the State Water Board also intends to develop additional web-based education and materials to support continued education.

Given the large number of proposed POU/POE treatment units forecasted for use in California, this Report also evaluates equity factors in the distribution and implementation of POU/POE devices across the State. The equity component is particularly important because it recognizes that POU/POE is considered one of the less sustainable water treatment alternatives and is typically utilized when other options are deemed to be uneconomical. Therefore, the State Water Board seeks to ensure that programmatic decisions regarding the use and funding of POU/POE devices in California foster environmental justice rather than unintentionally exacerbate existing socio-economic and racial inequities.

TYPES OF WATER SYSTEMS

There are more than 7,300 active water systems, 1,300 state small water systems, and more than 300,000 known domestic wells in California. The State Water Board classifies water systems into different water system "types" or "classifications", which often correspond to different regulatory requirements both for the water systems and for the governing requirements of POU/POE. Table 2 presents a breakdown of California's active water system

[9] State of CA FY 2021-22 Fund Expenditure Plan https://www.waterboards.ca.gov/water_issues/programs/grants_loans/sustainable_water_solutions/docs/2021/final_2021-22_sadwfep.pdf

[10] Appendix E: Stakeholder Engagement: Includes notes from the four stakeholder outreach webinars and the county survey

classifications. A flowchart diagram for water system classifications is in Appendix A: Water System Classification Guide.

Table 2: DDW Regulated Public Water System Classifications

Water System Type	Definition[11]	# of Active Systems[12]
Public Water System (PWS)	A system for the provision of water for human consumption through pipes or other constructed conveyances that has 15 or more service connections or regularly serves at least 25 individuals daily at least 60 days out of the year.	7,323
Community Water System (CWS)	A public water system that serves at least 15 service connections that are used by yearlong residents or regularly serves at least 25 yearlong residents of the area served by the system.	2,866
Non-Community Water System (NCWS)	A public water system that is not a community water system.	4,457
Non-Transient, Non-Community Water System (NTNC)	A public water system that is not a community water system and that regularly serves at least 25 of the same persons over six months per year (e.g., K-12 school, year around business, etc.).	1,485
Transient, Non-Community Water System (TNC)	A public water system that does not meet the definition of a community water system or non-transient, non-community water system, which serves 25 or more people at least 60 days out of a year or there are 15 or more service connections that are not used by yearlong residents (e.g., restaurants, gas stations, parks, etc.).	2,972

[11] California Health and Safety Code Section 116275.

[12] Values obtained from 2022 Needs Assessment report.

Table 3: Other Water Purveyors

Water System Type	Definition[13]	# of Active Systems[14]
State Small Water System (SSWS)	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.	1,316[15]
Domestic Well (DW)	A groundwater well is used to supply water for the domestic needs of an individual residence or a water system that is not a public water system and that has no more than four service connections. (Health & Saf. Code, § 116681, subd. (g).)	312,187[16]
Private Intake	A surface water source or groundwater under the direct influence of surface water is used to supply water for the domestic needs of an individual residence or a water system that is not a public water system and that has no more than four service connections.	

WHAT IS POU/POE TREATMENT?

POU and POE devices are water treatment units that remove contaminants from the water served to only one home or building and are not used to treat irrigation water. While POE devices treat the water supply for an entire building or 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. For this reason, POE devices are generally preferred over POU devices whenever they are cost-effective.

Both POU and POE devices have significant technical and maintenance limitations to their use. Therefore, while this Report focuses on POU and POE devices it also recognizes that they are generally considered less sustainable than more conventional solutions like connecting with a nearby municipal water provider, obtaining a new source with acceptable water quality, or installing centralized treatment. POU and POE devices can also be used

[13] California Health and Safety Code Section 116275.

[14] Values obtained from 2022 Needs Assessment report.

[15] The 2022 Needs Assessment analyzed 1,273 state small water systems where data was available.

[16] This represents the number of domestic well records identified using the Department of Water Resources Online System for Well Completion Reports (OSWCR). The actual count and location of active domestic wells is currently unknown.

instead of bottled water as an environmentally conscious interim measure until a long-term sustainable solution is in place.

TREATMENT OVERVIEW

As previously mentioned, POU means a treatment device applied to a single tap to reduce contaminant levels in drinking water at that tap. Generally, systems install POU treatment at a kitchen sink tap for consumption, cooking, and dishwashing.

POU treatment systems may include one or more of the following treatment processes: Reverse Osmosis (RO), Granular Activated Carbon (GAC), sediment filters, ion exchange (IX), and adsorptive media. A typical installation for POU discussed in this Report includes a POU treatment system installed under the sink in a household (Figure 1) or installed on any single fixture. With properly configured treatment units and adequate bacteriological water quality conditions, RO, IX, GAC, and adsorptive media treatment systems are designed to reduce contaminants such as nitrate, arsenic, lead, and others.

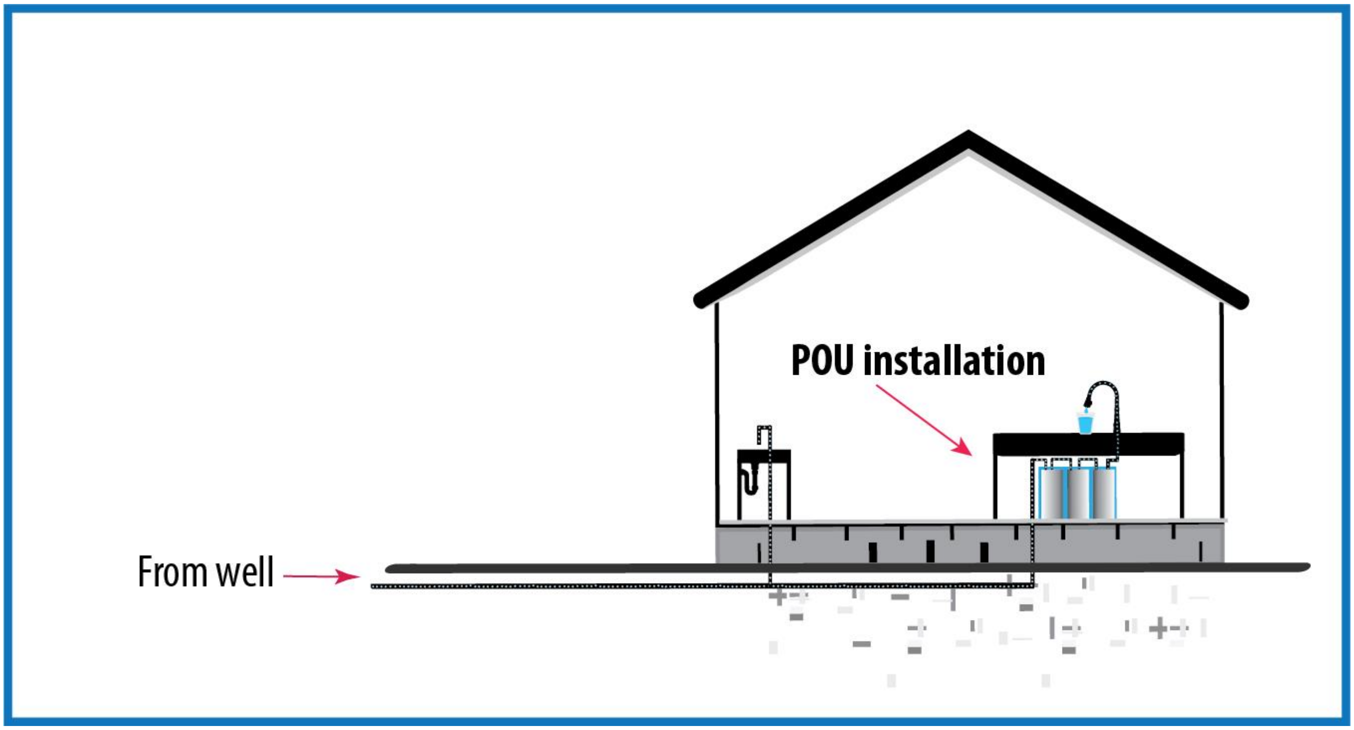

Figure 1: Typical POU Device Configuration

POE means a treatment device applied to the drinking water entering a house or building to reduce contaminant levels in the drinking water distributed throughout the house or building, as shown in Figure 2. For contaminants with an inhalation hazard, a POE device is strongly recommended over a POU device to improve water quality at all taps, particularly in showers where hot water may increase the volatility of contaminants. Examples of contaminants with inhalation hazards include VOCs and radon. POE treatment typically includes IX or GAC filtration. For Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS compounds) and hexavalent chromium, single-pass IX could be a potential treatment option.

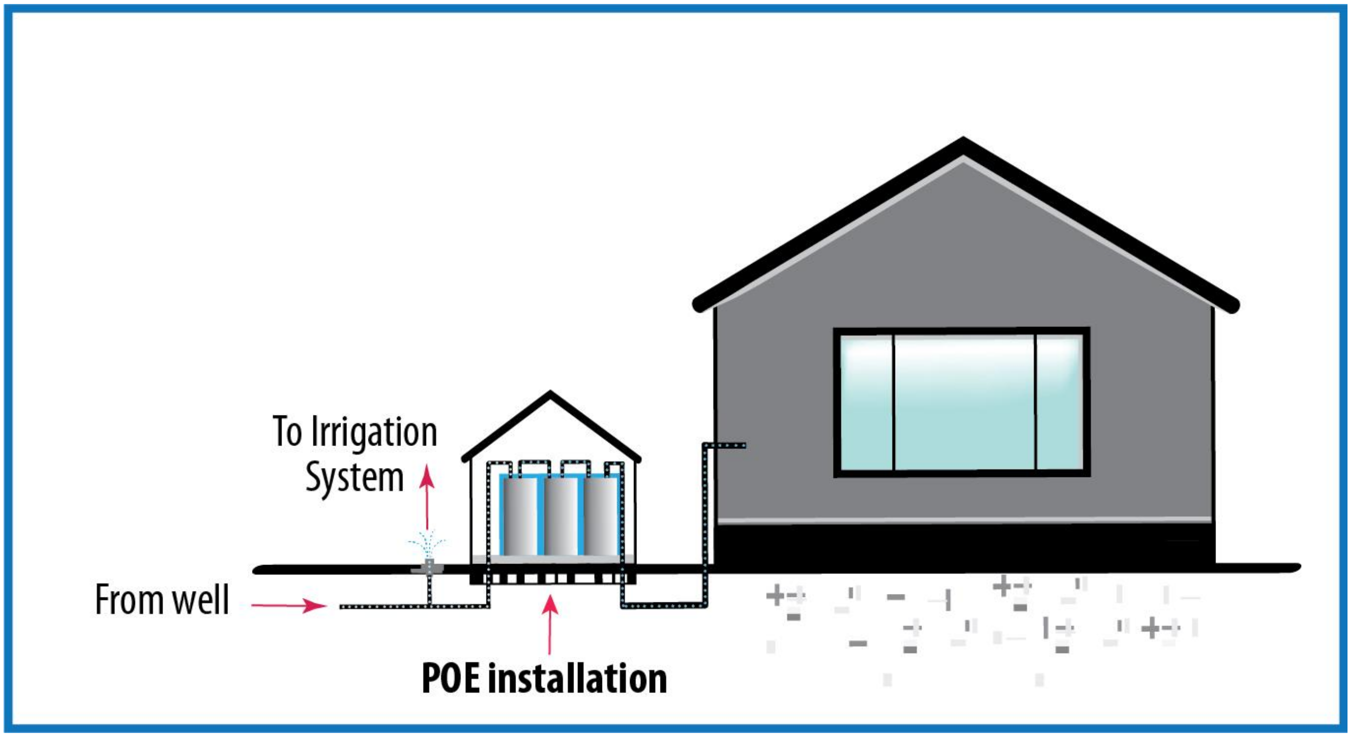

Figure 2: Typical POE Device Configuration

If POU/POE is chosen as the preferred solution for a water system, POE is preferred if it's affordable, as all household taps after treatment provide compliant water—versus a single compliant tap with POU. Implementation of POE treatment is generally more expensive than POUs because more water is treated. Due to higher treatment capacity, service frequency may also be less often than using a small-capacity POU. Additionally, accessibility requirements may be simplified as the POE device could be installed outside the home or inside a garage.

POE should be implemented with significant engineering consideration to avoid problems such as corrosion of household plumbing, inappropriate disposal of brine or treatment residuals, and lack of POE devices meeting all drinking water certifications and standards. The cost-effectiveness and ability of the homeowner to detect treatment issues are also important and may be more problematic than with POU.

TREATMENT TECHNOLOGIES

The sections below provide additional treatment information on commonly encountered POU/POE treatment systems.

Reverse Osmosis

In POU/POE applications, RO treatment systems use pressure and a semi-permeable membrane to filter out contaminants. Some RO devices can remove ionic species with low molecular weight, viruses, bacteria, and colloids (see Figure 3) but it largely depends on the device used. It should be noted that the State Water Board does not recommend or allow RO as a means of disinfection and virus removal. The percentage of the influent water to the membrane portion of the system that is available to the user is known as the recovery rating[17], and waste is an important consideration in the treatment designs. With RO, there is an (often significant) waste stream associated with this treatment, and the unit's efficiency (percent recovery) is an important design consideration, along with the endpoint or destination of the waste stream. Service life can depend on the type of semi-permeable RO membrane material. The RO membrane cartridges are replaced and subsequently tested to ensure proper operation.

There is no POE standard for RO due to concerns of corrosion and proper design requirements to prevent lead and copper contamination, or premature corrosion of plumbing.

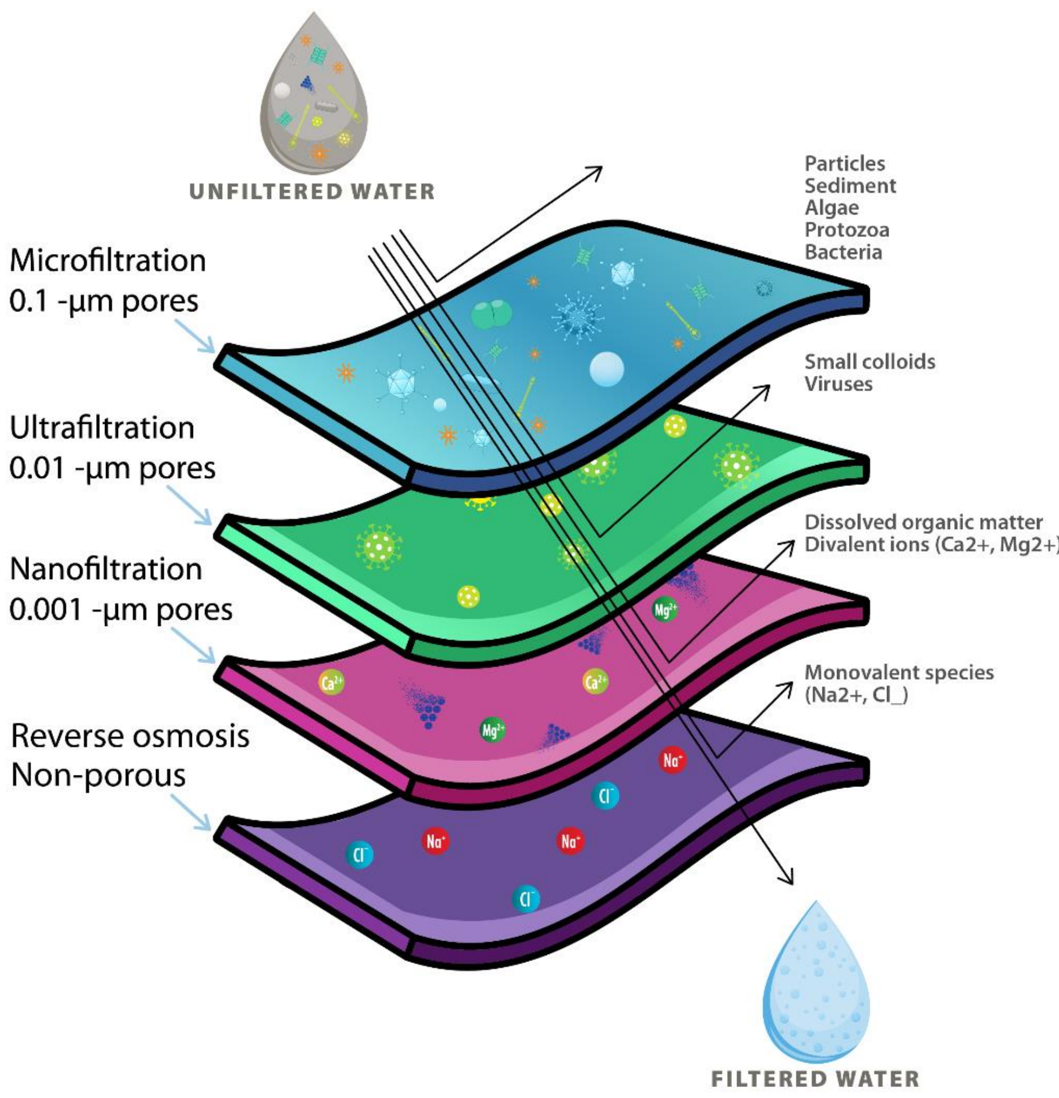

Figure 3: Removal by Different Filters

[17] NSF/ANSI 330 – 2019, Definition 3.155.4

Ion Exchange

IX treatment systems remove targeted dissolved ions that may cause health or aesthetic concerns. Ions in the solid phase, stored in an ion exchanger (or resin), are used to exchange targeted dissolved ions. Depending on the contaminant of concern, a cationic (positively charged) or anionic (negatively charged) should be carefully chosen.

Typically, IX is used for water softening and the reduction of fluoride, barium, radium, arsenic, perchlorate, chromate, or nitrate. At times, another ion can displace a target ion due to selectivity, or preference to bind with a site on the resin before other competing ions. For example, sulfate ions can interfere with nitrate or arsenic reduction in an anion exchange resin. Once a resin is exhausted, it must be regenerated to restore its function. The regeneration process can be repeated until the life of the resin is depleted. It's critical to weigh chemical costs, waste, pre-treatment, and water quality when designing an IX system.

There are also single-pass IX uses that are operated similarly to adsorptive media, where no regeneration is conducted. The spent vessel(s) are hauled off-site and replaced with a new vessel(s).

Adsorptive Media

Adsorptive media treatment can reduce target constituents by passing water through adsorptive granular media contained in a vessel. As the water passes through the media, target constituents will "stick" (or adsorb) to the surface of the media. Examples of different adsorptive media available include GAC, synthetic polymeric adsorbents, activated alumina, titanium-based, zirconium-based, and iron-based media. The used media within the vessel is hauled off-site and replaced with fresh media.

Granular Activated Carbon

GAC treatment, a frequently used subset of the adsorptive media, provides a surface by which contaminant concentrations, including taste & odor, organics, disinfection byproducts, pesticides, and other synthetic organic compounds (SOCs) can be reduced through adsorption. For POU/POE applications, GAC can be a solid block or granular media. GAC for POU/POE is configured in two ways: single-pass and reactivated. There are different variations of GAC which are created from different materials, (e.g., coconut shell, petroleum-based, etc.) that must be chosen based on the activation process, water quality needs, treatment capacities, and characteristics.

Ultraviolet (UV) Light Disinfection (Class A & B)

UV Disinfection technology exists to provide treatment of microorganisms, including bacteria, viruses, *Cryptosporidium* oocysts, and *Giardia* cysts. NSF/ANSI 55 establishes two classes of UV systems: A and B.

Class A systems are intended to inactivate microorganisms, including bacteria, viruses, *Cryptosporidium* oocysts, and *Giardia* cysts in contaminated water. However, these systems are not intended for the treatment of water that has an obvious source of contamination, such as raw sewage (Class A systems are not intended to convert wastewater to drinking water). The systems are intended to be installed on visually clear water (uncolored, cloudy, or turbid).

Claims of reduction of *Cryptosporidium* oocysts and *Giardia* cysts may be made on Class A systems.

Class B UV systems are for supplemental bactericidal treatment of disinfected public drinking water or other drinking water that has been tested and deemed acceptable for human consumption by the state or local health agency having jurisdiction. These systems are intended to reduce normally occurring non-pathogenic nuisance microorganisms only. Class B systems are not intended for the disinfection of microbiologically unsafe water. Individual or general cyst reduction claims may not be made on Class B systems, nor can microbiological health effects claims be made.

The operations and maintenance requirements for UV treatment technologies include descaling UV sensors, cleaning and replacing sleeves, replacing UV bulbs, fuse replacements, flow meter sensor replacements, and replacing O-rings and other fittings at the manufacturer-specified frequencies.

PREREQUISITES

Alternatives such as connection to a nearby community water system, a new source, centralized treatment, or a dual distribution system should be thoroughly considered and exhausted as potential solutions before POU/POE device installation because they are considered more sustainable and equitable solutions. Therefore, we have provided some guidance materials and techniques below to support these evaluations.

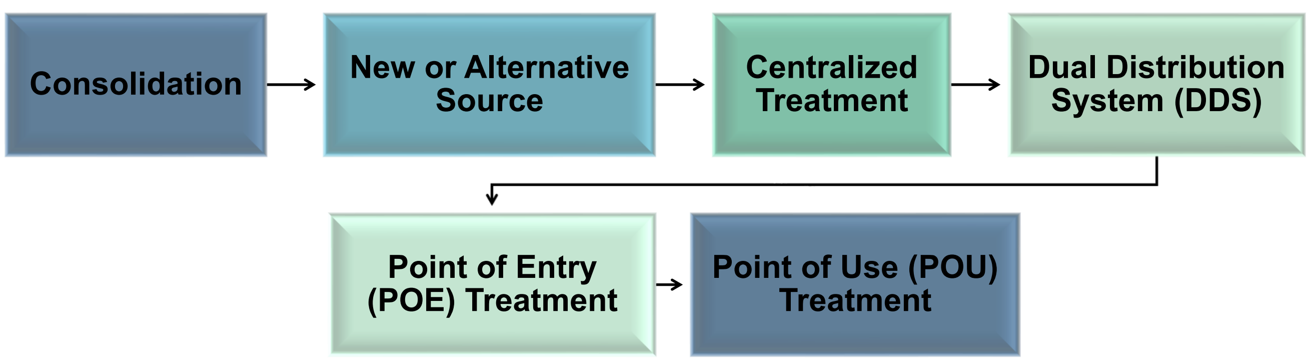

Figure 4: Preferred Alternative Flow Chart for Water Quality Compliance

Alternative Options to Consider

Connection to a Community Water System: The geographical boundaries of water systems can be found through the Drinking Water System Outreach Tool website[18] to help residents determine if a connection to a community water system may be feasible; the State Water

[18] Drinking Water System Outreach Tool https://gispublic.waterboards.ca.gov/portal/apps/webappviewer/index.html?id=70d27423735e45d6b037b7fbaea9a6a6

Board has specialized staff[19] to assist in this effort. Grant funding programs that prioritize connection to community water systems, including for non-disadvantaged homeowners (up to 150% State-wide median household income) are available through the Division of Financial Assistance (DFA).

Viability of a New Well Source: There is a Combined Risk Map for Domestic Wells and State Small Water Systems[20] that look at both potential water quality risks and water shortage risks available through the State Water Boards. For domestic well owners and state small water systems, the map may be used as a source of information regarding the potential viability of a new well source. Information for public water systems on water quality in their area may be obtained on the State Water Board's GeoTracker website by selecting "Public Water Wells".

Centralized Treatment: Centralized treatment provides a robust treatment solution if the use of a contaminated source is necessary. However, centralized treatment is often economically infeasible for very small communities due to high operation and maintenance costs as smaller communities do not benefit from the economy of scale that larger communities enjoy. In California, irrigation use ranges between 42 to 64% of the total domestic water received by a single-family household throughout the year[21].

Dual Distribution System (DDS): A DDS would consist of a potable water supply being delivered through a small, pressurized distribution system to a residence or business for potable water use or "human consumption". This small, pressurized distribution system would be plumbed in addition to the existing distribution system which may not meet regulatory compliance for a contaminant.

The DDS concept is new and has not been used in the State at this point. Other States use the concept of small-diameter distribution systems connected to centralized treatment to provide only potable water to homes. This concept would likely address the O&M, customer acceptance, and compliance requirements. The DDS concept needs to be further developed by the State Water Board, as there is no framework currently in place. It's important to note that DDS may not be feasible to implement for systems with contaminants with inhalation risk, but may be particularly useful in small-scale, single-owner water systems such as schools or mobile home parks.

POU/POE General Prerequisites

When the other Alternative Options discussed above or an alternative to bottled water is not feasible while infrastructure projects are being completed, several prerequisites should be

[19] Engagement Unit – Support Contact Map
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/docs/2022/eu-map-6-22.pdf

[20] Combined Risk for Domestic Wells and State Small Water Systems
https://gispublic.waterboards.ca.gov/portal/apps/webappviewer/index.html?id=122823a570424891986ff72846b37b83

[21] CALIFORNIA SINGLE FAMILY WATER USE EFFICIENCY STUDY
https://cawaterlibrary.net/wp-content/uploads/2019/07/California-Single-Family-Home-Water-Use-Efficiency-Study-20110420.pdf

considered to determine if POU/POE should be implemented. It's important to note that POE is preferred over POU treatment. Prerequisites/considerations prior to implementation include:

- How long will it take for a permanent solution to be implemented?
- For a public water system, is it understood that regulations only consider POU/POE as an interim solution, and the permit allowing the use of POU/POE must be renewed every 3 years?
- What is the contaminant to be treated? What is the concentration of the contaminant?
- What is the likely effectiveness and ease of implementation of the POU/POE devices?
- Will a site-specific pilot study be required?
- Can the water system reliably and responsibly operate POU/POE treatment units throughout the community?
- What is the level of consumer acceptance of POU/POE treatment?

The success of POU/POE treatment devices can be limited by site-specific sanitation and water quality conditions, and it is beyond the scope of this Report to address each one. The general prerequisites listed above are further discussed in this Report, and details of the technical prerequisites can be found in the "Opportunities and Challenges - Technical" section.

REGULATORY FRAMEWORK, STANDARDS, & CERTIFICATION

REGULATORY FRAMEWORK

There are major differences in the applicability of regulations between a public water system and state small water systems and domestic wells. Public Water Systems must follow the permitting and regulatory processes which are discussed below. A state small water system is a system 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, and they are regulated primarily by county programs as specified in Title 22, Chapter 14, Article 3. While the State recommends state small water systems follow the regulatory requirements of public water systems, these county programs may have less-stringent regulations in place regarding the implementation of POU/POEs, as regulations and processes are implemented at the discretion of the county. Regulation of self-supplied residences varies by county, as shown in Table 4 on the following page.

Table 4: POU/POE Regulatory Jurisdiction for System Classification

Classification	Regulatory Jurisdiction	Are POU/POE regulations applicable?
Public Water Systems	State Board[22] and in some cases County[23] for ≤200 connections	Yes
State Small Water Systems	County	At the discretion of the county and recommended by the State
Self-supplied Systems	Dependent on the County; may be unregulated	No

Regulatory Framework for POU/POE for Public Water Systems

Effective in 2015, the California legislature enacted statutes in Section 116380 and Section 116552 of the California Health and Safety Code that requires the State Water Board to adopt regulations to govern the use of POU/POE treatment by public water systems. After emergency regulations were created, the permanent regulatory requirements were adopted in 2018, providing requirements for implementing a POU or POE program for a public water system in California. A full description of the POU and POE requirements are in Title 22, Chapter 15, Article 2.5, and Article 2.7 of the California Code of Regulations, respectively.

A public water system cannot consider the use of a POU/POE program when addressing microbial contaminants and POU cannot be considered for contaminants that pose an inhalation risk. After conducting a feasibility study to determine alternative treatment strategies or other options that are not economically feasible, the public water system begins implementation of requirements to ensure that public health will be adequately protected using a POU/POE device. These requirements include a pilot study phase, submitting detailed monitoring programs, public education, and public hearings. The requirements are summarized in Figure 5. The State Water Board developed a POU/POE Implementation Guidance Checklist, located in Appendix B: POU/POE Implementation Framework, which tabulates regulatory requirements for public water systems to implement POU/POE.

[22] CA Health & Safety Code Section 116271 and Section 116325

[23] CA Health & Safety Code Section 116330

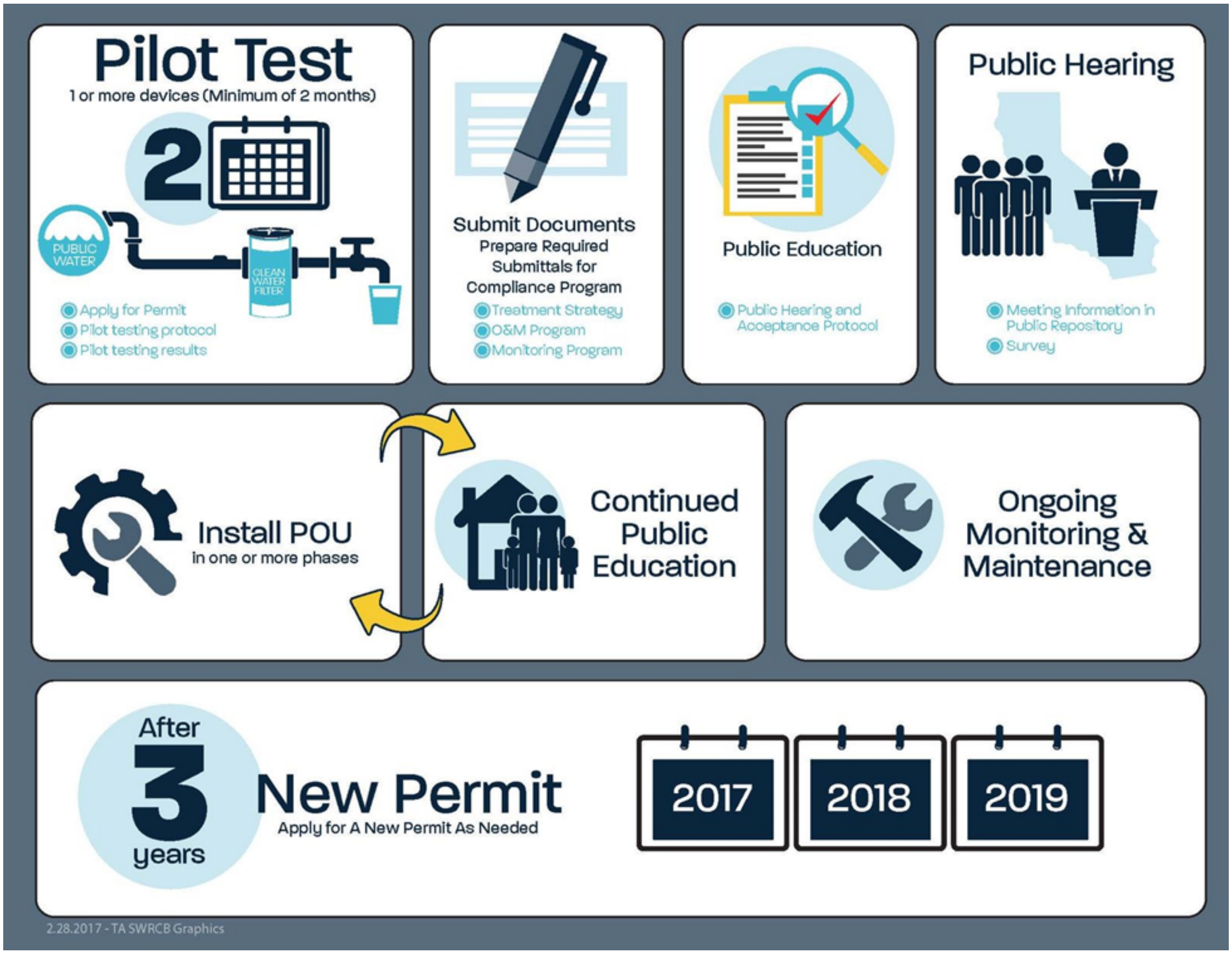

Figure 5: POU/POE Regulatory Framework

POU/POE Monitoring Program

The POU/POE Monitoring Program agreed upon by the DDW District Office or LPA and the PWS must include the following:

1. Source Water Monitoring – minimum of quarterly (with samples collected during the same month (first, second, or third) of each calendar quarter);
2. POU/POE Effluent – initially (with samples collected as soon as possible but no later than 72 hours after a device is installed); and
3. POU/POE Effluent – ongoing (with a minimum of one-twelfth of all units sampled monthly on a rotating basis. This may be reduced pending SWRCB approval).

After completion of one year of monitoring and DDW District Office or LPA approval, a PWS may alternatively monitor one-quarter of all units each calendar quarter provided that monitoring results do not exceed 75% of a contaminant's MCL. For a contaminant other than nitrate, nitrite, nitrate plus nitrite, or perchlorate (acute contaminants) and after no less than one year of monitoring, a PWS may request a reduction of monitoring frequency with the DDW field office or regulating LPA. To be clear, all monitoring requirements are subject to the applicable DDW/LPA permit governing the use of specific POU/POE as drinking water treatment.

STANDARDS AND CERTIFICATION

A standard can be defined as a set of technical definitions and guidelines usually by a national trade organization. They provide “how-to” instructions for designers, manufacturers, and users. Standards promote safety, reliability, productivity, and efficiency in almost every industry that relies on engineering components or equipment. Standards are a vehicle of communication for producers and users. They serve as a common national language, defining quality and establishing safety criteria.[24]

Drinking water treatment units for POU/POE applications must be certified as meeting an NSF/ANSI standard in California for public water systems. Product certification consists of documentation by a third party that confirms rigorous testing is performed to ensure contaminant reduction claims for a treatment device and that no other potential contaminants are introduced. Certification is critical, as it demonstrates the devices are safe, reliable, and meet claims for specific applications. The independent party, or an accredited certifier, reviews the documentation to ensure that products pass performance tests and quality assurance tests or qualification requirements.

POU/POE devices that are certified to meet one of the national organization standards can apply to the State Water Board to be included in the California Water Treatment Devices Registration Program. The independent certification results are reviewed by State Water Board staff and if approved, the POU/POE device(s) is added to the State Water Board’s website[25] for legal sale in California. Additional pilot studies at individual locations are required by regulation for PWS and support more local applications when the incoming water quality varies from the water quality used during the certification process.

Standards

NSF/ANSI-53 and 58 are the most common standards in the POU/POE industry for certification. Specifically, NSF/ANSI-53 specifies that filters are certified to reduce a contaminant with a designated health effect. Health effects are set in this standard as regulated by the U.S. Environmental Protection Agency (USEPA) and Health Canada. Both standards 42 and 53 cover adsorption/filtration which is a process that occurs when liquid, gas, or dissolved/suspended matter adheres to the surface of, or in the pores of, an adsorbent media. Carbon filters are an example of this type of product. NSF/ANSI-58 specifies that RO systems incorporate a process that uses reverse pressure to force water through a semi-permeable membrane. Most RO systems incorporate one or more additional filters on either side of the membrane. These systems reduce contaminants that are regulated by Health Canada and USEPA. It’s important to note that custom-filled POE devices are outside of the

[24] Standards & Certification - FAQ | ASME - ASME
https://www.asme.org/codes-standards/publications-information/faq

[25] Residential Water Treatment Devices | California State Water Resources Control Board
https://www.waterboards.ca.gov/drinking_water/certlic/device/watertreatmentdevices.html

scope of NSF/ANSI 53 standards, and additional implementation and service standards must be developed to make this feasible. A list of all applicable NSF/ANSI performance standards related to POU/POE can be found in Appendix C: Standards Information.

The International Association of Plumbing and Mechanical Officials (IAPMO; ASSE joined IAPMO in 2012) provides an important standard related to POU/POE treatment. ASSE 1087-2018 provides certifications for commercial water treatment equipment used in POE and POU applications connected to building plumbing to improve the water quality characteristics of potable water. The certification includes both the individual components and complete systems for the following: connections, flow rate, pressure drop testing, back-siphonage for systems that regenerate, structural integrity (via pressure loss, water hammer, hydrostatic testing, and cycle tests), material safety, and literature/documentation requirements. **However, this certification does not apply to electrical compliance or contaminant reduction performance.** ASSE may develop reduction performance standards in the future if the industry can develop realistic, widely available testing protocols and other reduction standards available to companies who want to associate removal claims with their products.[26]

Certifications

Certified devices reduce the need for pilot studies and therefore reduce the overall cost and time required to implement POU/POE treatment. Certification ensures multiple elements of standardized testing have been conducted and reliability has been demonstrated to the certifying organization. The following elements are generally evaluated: materials, structural integrity, performance, instructions, etc.

The NSF Drinking Water Treatment Unit certifications are contingent upon the following:

- Influent water quality
- Similar testing and operational conditions
- Devices or units are regularly maintained
- Original manufacturer parts are used

Once a product is certified, a certification mark can be placed on that label or product. Examples of third parties that certify drinking water products include the Water Quality Association (WQA), Underwriters Laboratories (UL), CSA Group (CSA), International Association of Plumbing and Mechanical Officials (IAPMO), and NSF International.

California registration requires devices sold in California that make health-related claims to have been tested and certified by an independent, accredited certification organization. This certification includes extensive water quality testing in accordance with national standards and collaboration with SWRCB's Residential Water Treatment Devices Registration Program. Accreditation means that the organization and its testing laboratory have the proper ability, personnel, and equipment to fully evaluate these devices. The websites of the following independent certification organizations provide helpful information on water treatment device certification.

[26] ASSE 1087 Overview | Water Quality Products (wqpmag.com) https://www.wqpmag.com/services/product-testing-certification/article/10955882/asse-1087-overview

- IAPMO R&T
- NSF International
- UL
- Water Quality Association
- CSA Group

Manufacturers that wish to have their devices registered for sale in California must provide proof of independent certification and other information on each device model. The California Registration program is designed to verify this certification and ensure that the literature provided with each model adequately informs the customer. The registration program monitors the marketplace for illegal sales of devices as well as misleading advertisements for any water treatment device[27].

[27] Waterboards Registered Water Treatment Devices
https://www.waterboards.ca.gov/drinking_water/certlic/device/watertreatmentdevices.html

CURRENT STATE OF POU/POE

CURRENT USAGE OF POU/POE

The introduction of POU/POE treatment for regulated water systems in California began with Assembly Bill 434 and the adoption of emergency regulations in 2016 (see Regulatory Framework in the previous section). State Water Board Division of Drinking Water District Offices and local primacy agencies review and approve proposed POU/POE treatment systems for public water systems.

Through Section 116330 of the California Health & Safety Code and delegation agreements, local primacy agencies have primacy and are responsible for oversight of State Small Water Systems. Each local primacy agency determines the requirements in place associated with POU/POE treatment for State Small Water Systems. There are no POU/POE regulatory requirements associated with self-supplied systems, including domestic wells and private intakes.

In the 2022 Drinking Water Needs Assessment, **six contaminants were identified as the top contaminants contributing to higher risk designations in domestic wells and state small water systems, including nitrate, arsenic, 1,2,3-TCP, gross alpha, uranium, and hexavalent chromium**. As new tools become available, including the 2022 Aquifer Risk Map[28], a more comprehensive picture emerges that outlines the density of domestic wells in relation to contaminants present in drinking water sources. This tool will likely assist collaborators, including state and local agencies, environmental justice groups, and technical assistance providers in prioritizing resources and efforts to support vulnerable populations with drinking water solutions.

PUBLIC WATER SYSTEMS

Statewide, the top contaminants that contributed to a higher proportion of public water systems failing to provide safe drinking water (HR2W list in 2021) were: arsenic, 1,2,3-TCP, and nitrate/nitrate + nitrite for primary MCL violations; and manganese (Mn) and iron (Fe) for secondary MCL violations, as shown in Figure 6 on the following page.

[28] 2022 Aquifer Risk Map (ca.gov)
https://gispublic.waterboards.ca.gov/portal/apps/webappviewer/index.html?id=17825b2b791d4004b547d316af7ac5cb

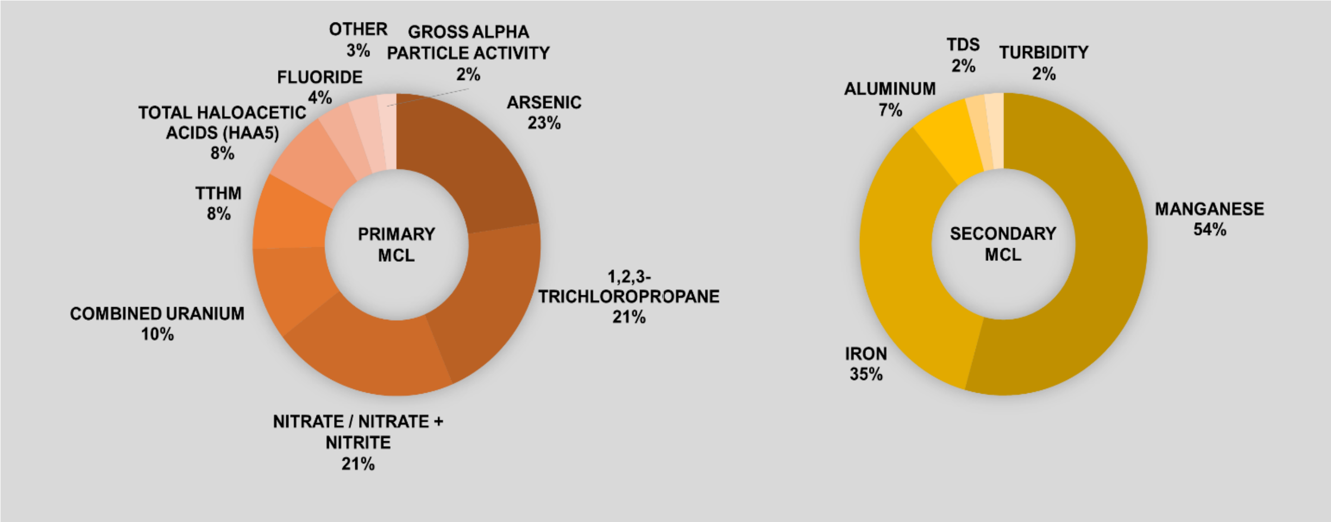

Figure 6: PWS – Primary and Secondary MCL Violation Contaminants

There are currently 122 public water systems currently permitted to use or proposing to use POU/POE treatment. This includes community (C), non-transient noncommunity (NTNC), and transient noncommunity (TNC) classifications. Figure 7 shows the distribution of POU/POE public water systems throughout California by public water system classification. A comprehensive table of POU/POE public water systems in California is listed in Appendix D: POU/POE Public Water System List in California.

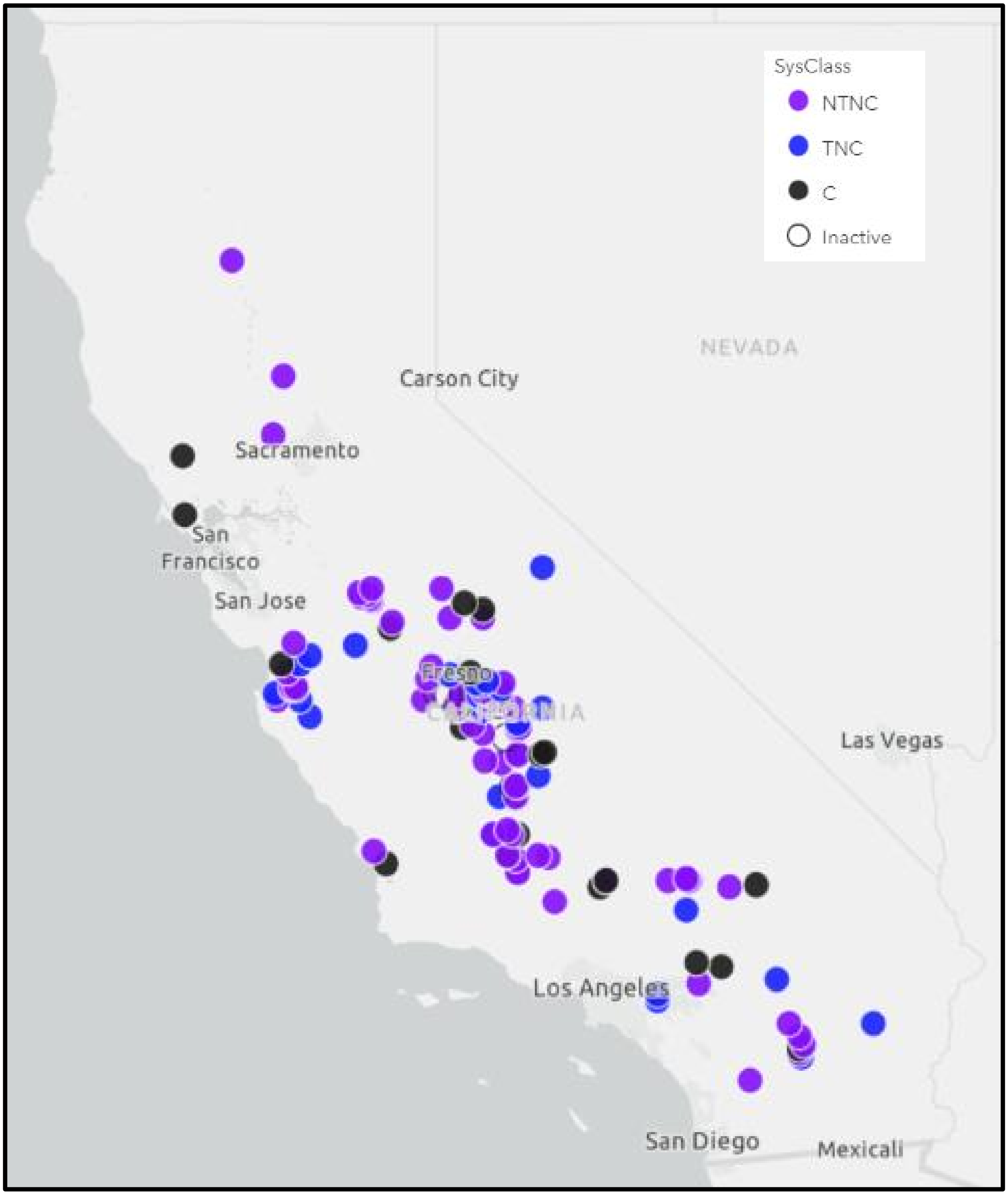

Figure 7: Distribution of POU/POE public water systems in California by classification, including Community (C), Non-transient Non-community (NTNC), and Transient (TNC)

The majority of the POU and POE installations at public water systems are classified as non-transient non-community water systems (see Table 5). Community public water systems include a total of 26 systems with POU/POE treatment. Non-transient public water systems include a total of 70 systems with POU/POE treatment, and 7 of these systems are K-12 public schools. Transient public water systems include a total of 27 systems with POU/POE treatment. Businesses and schools may use POU/POE more often because they often have a single owner which allows for more streamlined installation and maintenance compared to community water systems with multiple homeowners.

Table 5: Installations by PWS Classifications[29]

PWS Classification	Number of POU Installations	Number of POE Installations	Number of Combined POU and POE Installations	No Specific Data
Community	17	6	2	1
Non-transient non-community	43[30]	16	5	5
Transient	16	8	3	0

As Figure 8 below depicts, there are 69 RO, 13 absorptive media, 11 GAC, and 11 IX devices installed for POU/POE treatment approaches.

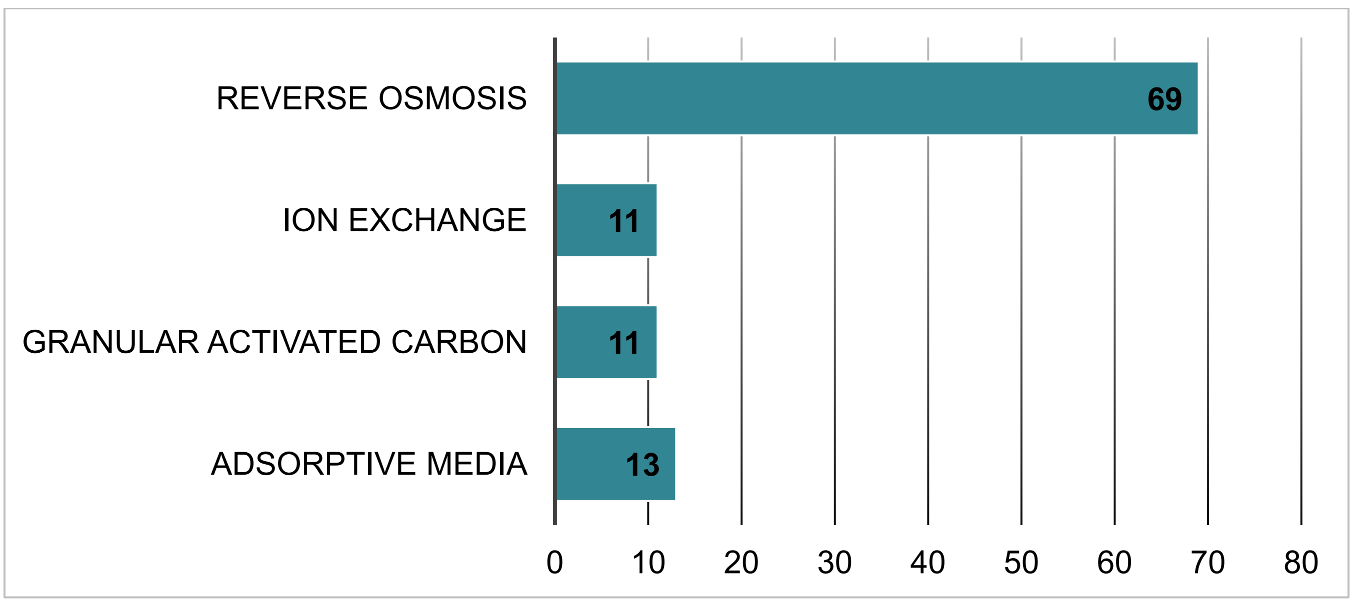

Figure 8: Number of existing POU/POE Public Water Systems in CA by Treatment Approach

[29] Inactive systems are not included in the table.

[30] There are seven schools that have POU devices installed, and they are located in Kern, San Diego, Monterey, Madera, and Santa Clara counties.

Treatment strategies for POU/POE in public water systems are in place to address a variety of contaminants, including nitrate, arsenic, 1,2,3-TCP, radionuclides, cadmium, dibromo chloropropane (DBCP), fluoride, and perchlorate. Table 6 describes the concentration range in source water for all the POU/POE public water systems in California for each contaminant and the corresponding maximum contaminant levels.

Table 6: Contaminant Levels in California for POU/POE Public Water System Installations

Contaminant	Minimum Concentration	Maximum Concentration	Maximum Contaminant Level
Nitrate (as N)	Non-detect	82.7 mg/L[31]	10 mg/L
Arsenic	Non-detect	130 µg/L	10 µg/L
1,2,3-TCP	Non-detect	0.4 µg/L	0.005 µg/L
Uranium	11 pCi/L	90 pCi/L	20 pCi/L
Cadmium	Non-detect	21 µg/L	5 µg/L
DBCP	Non-detect	1.9 µg/L	0.2 µg/L
Fluoride	1.4 mg/L	9.4 mg/L	2.0 mg/L
Gross Alpha	14 pCi/L	30 pCi/L	15 pCi/L
Perchlorate	6 µg/L	13 µg/L	6 µg/L

EQUITY IN PUBLIC WATER SYSTEMS, STATE SMALL WATER SYSTEMS, SELF-SUPPLIED RESIDENCES, AND DOMESTIC WELLS

The disadvantaged status of communities served by public water systems that currently use or propose to use POU/POE treatment is shown in Figure 9, while Figure 10 provides a breakdown by majority race for the same water systems. Figure 11 shows the distribution of POU/POE public water systems in percentages by majority race. The disadvantaged status and majority race are based on census block group data.

[31] We recommend only using CA-registered certified devices for nitrate concentrations of up to 25 mg/L (as N) public water systems pilot selected devices to ensure nitrate reductions are successful. However, some treatment strategies for higher levels may include nitrate-selective IX resins, lead-lag configurations, or increasing the pressures at the device to improve nitrate reductions through RO treatment. This is further discussed in subsequent sections of the report.

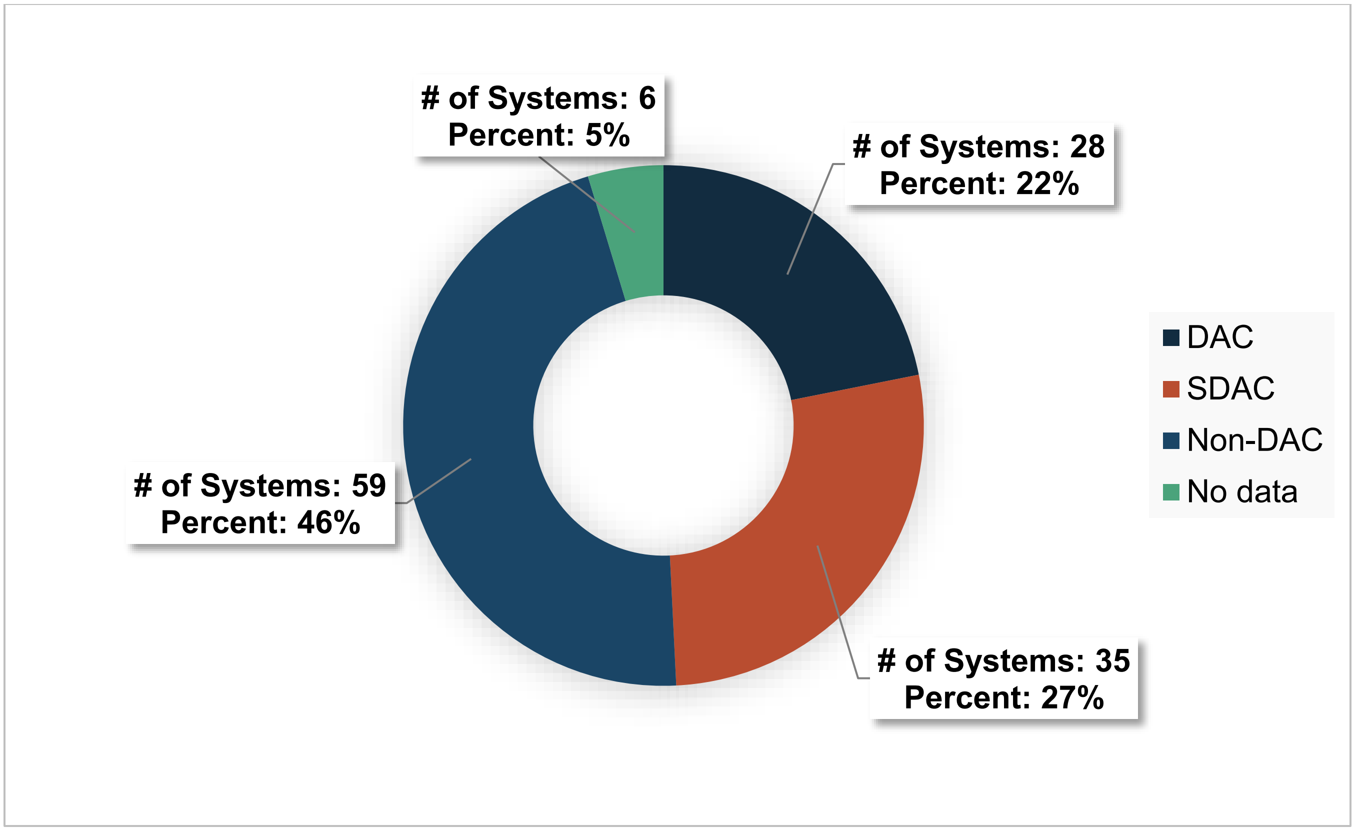

Figure 9: Disadvantage Status for POU/POE Systems

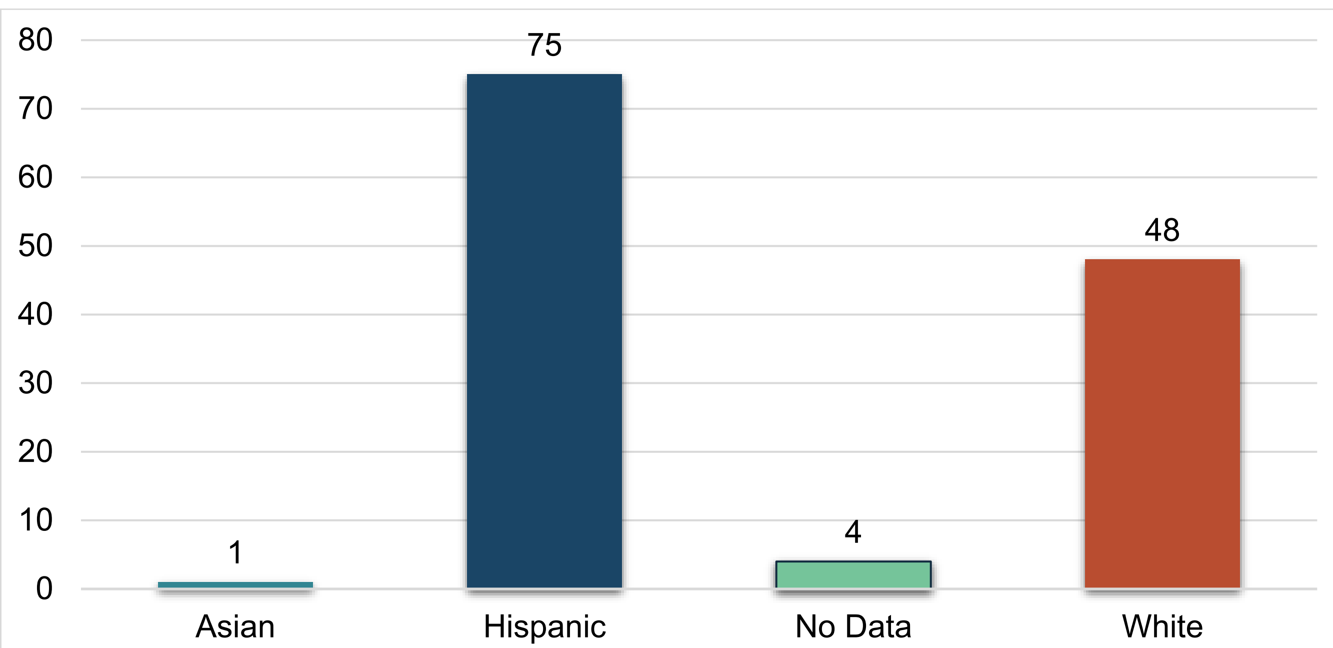

Figure 10: Number of POU/POE Treatment Systems by Majority Race

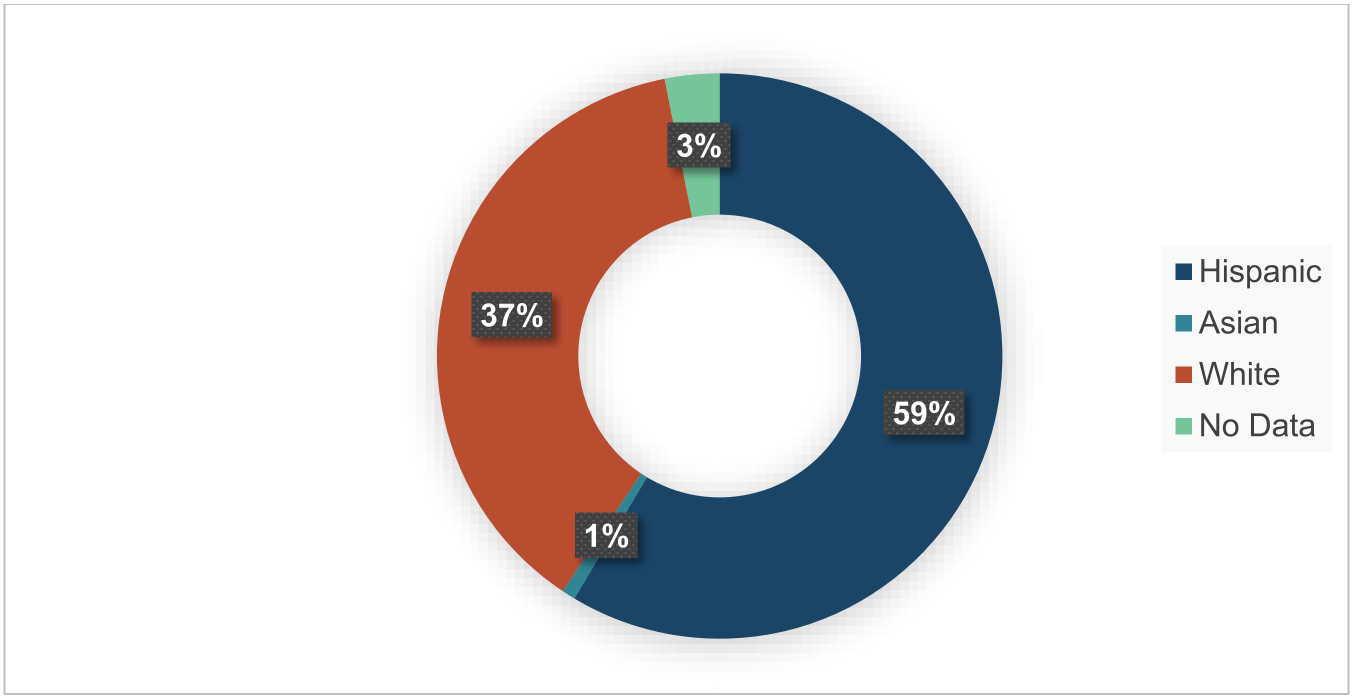

Figure 11: Distribution of POU/POE Public Water Systems by Majority Race

Figure 12 shows the CalEnviroScreen 4.0[32] score percentile range (in 20 percent increments) for water systems that currently use POU/POE treatment. CalEnviroScreen scores represent a combined measure of pollution and the potential vulnerability of a population to the effects of pollution. Higher scores represent an increased overall pollution burden and related public health concerns.

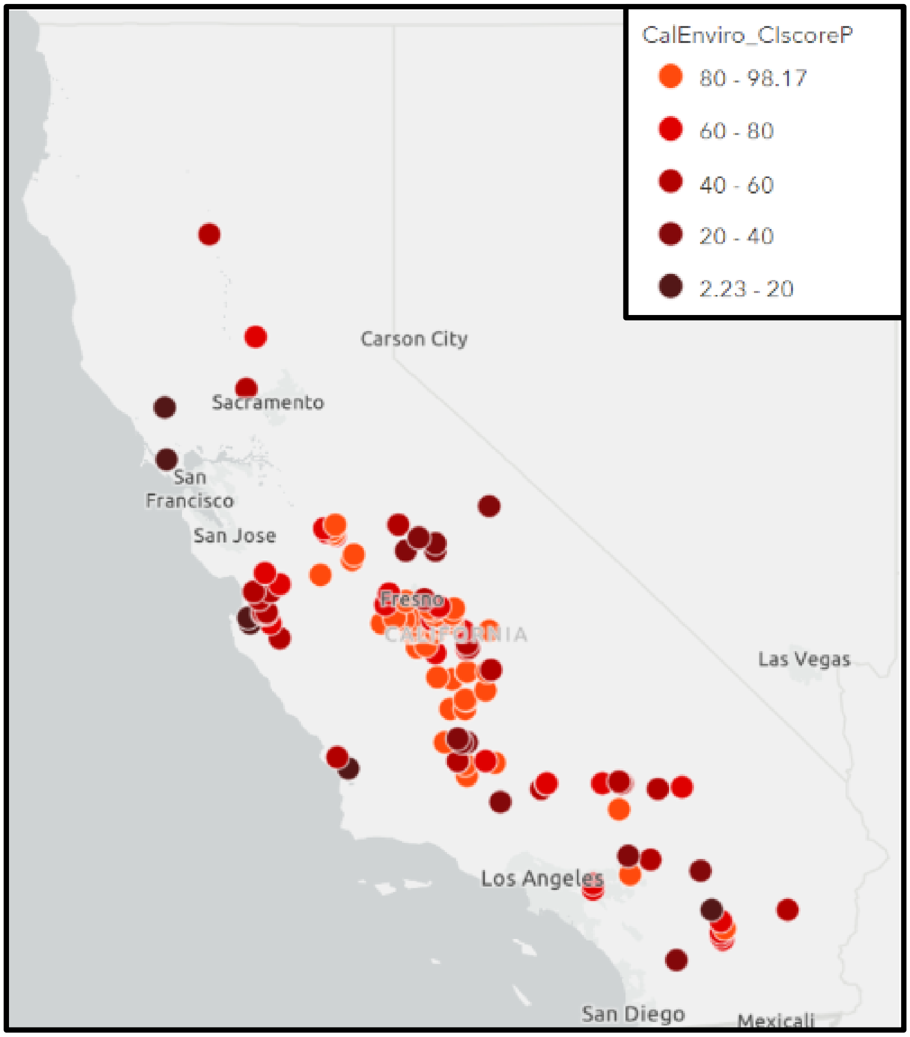

Figure 12: CalEnviroScore 4.0 Percentile for POU/POE Systems in California

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32 CalEnviroScreen 4.0 data[32] is from California Office of Environmental Health Hazard Assessment. Data available from CalEnviroScreen 4.0, specifically CES 4.0 Score and Percentile, were identified for each POU/POE water system. The score and percentile represent pollution burden (exposures and environmental effects) and population characteristics (sensitive populations and socioeconomic factors). The CalEnviroScreen 4.0 data is listed both as a score and percentile, with **higher scores and percentiles representing an increased overall pollution burden and related public health concerns**. The pollution burden includes factors such as pesticide use, drinking water contamination, groundwater threats, and more. Population characteristics include factors such as cardiovascular disease, linguistic isolation, poverty, unemployment, and more.

OEHHA CalEnviroScreen
https://oehha.ca.gov/media/downloads/calenviroscreen/report/calenviroscreen40reportf2021.pdf

The State Water Board estimates approximately 64% of public water systems currently utilizing or proposing to meet compliance through POU/POE treatment devices provide water to a DAC or SDAC population. Furthermore, 58% of California public water systems currently utilizing or proposing to meet compliance through POE/POU treatment serve water to homes where the primary race is Hispanic.

POU/POE treatment can present challenges in any community; these challenges may be exacerbated in disadvantaged communities and where linguistic isolation occurs. POU/POE treatment may also be utilized when other solutions are deemed “not cost-effective”. Therefore, it is particularly important to ensure that equity issues are considered in policy discussions regarding how cost-effectiveness is defined, tracking demographics where POU/POE devices are used across California, and addressing equity barriers and challenges in cases where POU/POE devices are utilized.

STATE SMALL WATER SYSTEMS, SELF-SUPPLIED RESIDENCES, AND DOMESTICS WELLS

Statewide, the top contaminants that contributed to higher risk designations in domestic wells and state small water systems are nitrate, arsenic, 1,2,3-TCP, gross alpha, uranium, and hexavalent chromium. Figure 13 shows the proportion of domestic wells in high water quality risk areas where the contaminant may exceed drinking water standards. Note that multiple contaminants may exceed drinking water standards at a single location.

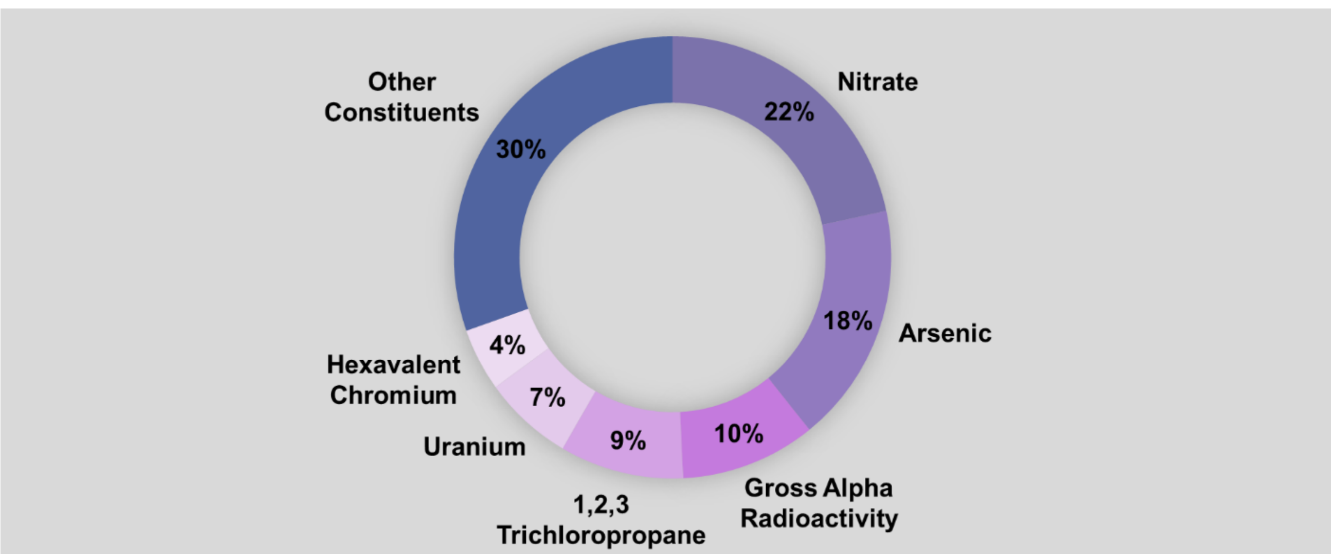

Figure 13: Constituents Contributing to Shallow Water Quality Risk

According to Table 23 in the Water Board’s 2022 Drinking Water Needs Assessment Report, there are 706 state small water systems in a water quality risk category and 141 state small water systems that were not assessed. From Table 2 of the 2021 Drinking Water Needs Assessment, POU/POE was modeled as a long-term solution for approximately 303 at-risk State Small Water Systems. More information about the modeled solution can be found in the “Future Needs for POU/POE” section of this Report.

According to Table 24 in the Water Board's 2022 Drinking Water Needs Assessment Report, there are 109,713 domestic wells in the water quality risk category and 68,192 domestic wells that were "not assessed". These "not assessed" sources are candidates for water quality testing. **From Table 2 of the 2021 Drinking Water Needs Assessment, POU/POE was modeled as a long-term treatment solution for approximately 59% (or 36,911) of at-risk domestic wells**. Other solutions for at-risk domestic wells modeled included physical consolidation.

SURFACE WATER IN SELF-SUPPLIED RESIDENCES

The Needs Assessment does not account for untreated surface water for self-supplied residences where POU/POE may be utilized to provide better quality water to residences. However, the water provided typically does not meet potable water standards. Based on the research collected for this Report there are at least 3,500 self-supplied homes utilizing raw untreated surface water sources in California. Approximately, 3,000 of these residences occur in Imperial County (further discussed below and in Appendix H: Case Study #3 (Imperial County: Homes on IID Canal)) and 493 residences in Lake County as documented in the California Water: Assessment of Toxins for Community Health (Cal-WATCH[33]) project underway in Lake County, CA. The State Water Board is also aware of additional self-supplied surface water intakes in rural areas throughout the State.

EQUITY IN STATE SMALL WATER SYSTEMS & SELF-SUPPLIED RESIDENCES

The State Water Board does not have direct jurisdiction over state small water systems and self-supplied residences. Thus, there is currently limited information available on the locations where POU/POE devices are used across the State. Therefore, no statistics are available to understand equity impacts on self-supplied residences. This is an area that warrants additional research.

COUNTY PROGRAMS & SURVEY

In May and June 2022, the State Water Board surveyed county environmental health departments to better understand the local-level support for POU/POE treatment as an option for addressing deficiencies in public water systems, state small water systems, and domestic wells. **Out of 46 County responses received, the following six counties reported that they have a POU/POE treatment program: Imperial, Kern, Kings, Monterey, Riverside,**

[33] CalWATCH Project - Tracking California

https://trackingcalifornia.org/calwatch/calwatch-project

The CalWATCH project is a collaboration between the Big Valley Band of Pomo Indians, Tracking California, and partner agencies; the Cal-WATCH team identified 493 households around Clear Lake in the first year not served by public water systems and are therefore likely to be served by untreated surface water. Based on targeted water quality sampling efforts, contaminants (bacteria, pesticides, cyanobacteria cells, and cyanotoxins) were detected at some of the project household taps. In response to the cyanotoxin levels, Lake County's public health officer issued an emergency Do Not Drink advisory to these shoreline self-supplied homes. Two local public water systems, Golden State Water Company, and Mt. Konocti Mutual Water Company, made fill stations available to impacted self-supplied systems. Members of the Cal-WATCH team are partnering with Golden State Water Company to explore potential long-term drinking water solutions. Although the efficacy of POU/POE treatment is still being explored, POU/POE may provide a solution, or at least play a role, for these self-supplied homes.

and Yolo. Other counties are not believed to use POU/POE devices widely for regulatory compliance. A breakdown of the responses is shown in Figure 14 below:

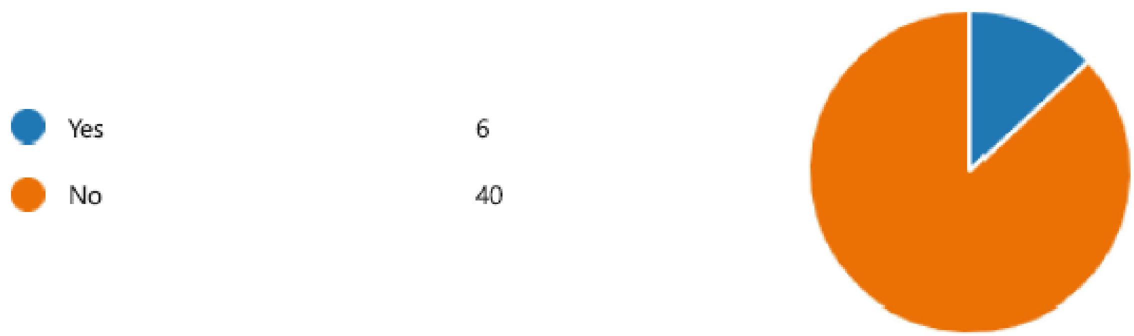

Figure 14: County Responses: Is there a POU/POE Treatment Program in place?

Based on the County survey responses, the most common water quality issues addressed by POU/POE devices are arsenic, nitrate, fluoride, organic chemicals, bacteria, and metals. As shown in Figure 15 below.

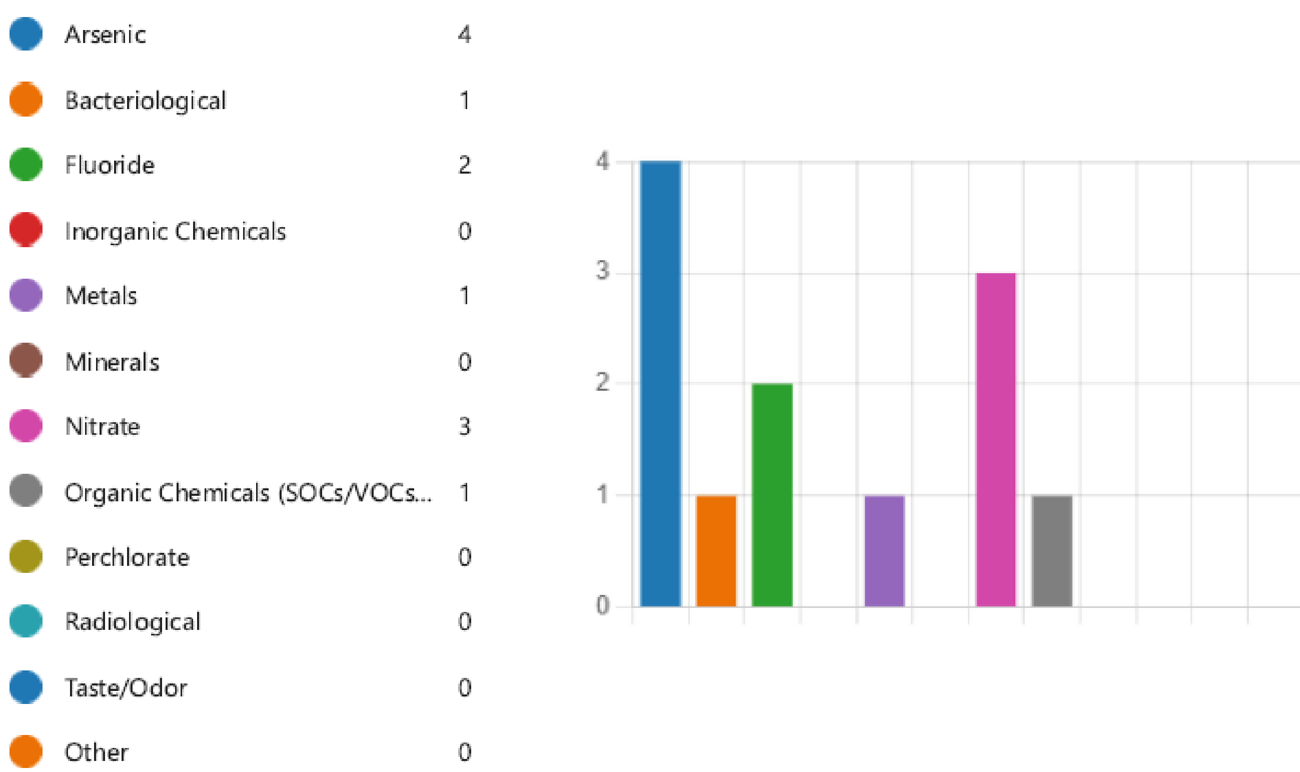

Figure 15: Most Common Contaminants Treated within County by POU/POE

The 46 counties that responded indicated they have not developed POU/POE outreach materials to describe available resources, technology, and/or funding options. Four of the six counties with POU/POE treatment programs offer operations and maintenance guidance, inspections, and/or technical assistance for installed POU/POE systems.

NATIONAL EFFORTS & LITERATURE REVIEW

This Report reviewed policies by other states concerning POE/POU devices, performed a national literature review of POE/POU, and outreached to water research organizations and industry associations, and the USEPA to support knowledge sharing. The results of the research are provided below.

States: Efforts and Determinations

Massachusetts permits approval[34] for vending machines and POU/POE devices that have been previously approved by a third party. They also guide[35] households and public water systems for POU/POE treatment.

Maryland (GAC for petroleum contamination) – A POE factsheet[36] is provided for properties contending with petroleum contamination in the source water.

Minnesota – POU/POE treatment is not used by public water systems for compliance with Minnesota drinking water regulations, but the Minnesota Department of Health provides step-by-step POU/POE treatment guidance for people who obtain drinking water from private wells.[37]

New Hampshire (petroleum contamination) – A study[38] has been completed for POE systems (including aeration followed by GAC) to treat petroleum contamination in the source water.

New York – Department of Health – brief POU/POE guidance[39] is provided to private well owners.

[34] WS 31: New Technology - Vending Machines, POU/POE Devices
https://www.mass.gov/how-to/ws-31-new-technology-vending-machines-poupoe-devices

[35] Home Water Treatment Devices - Point of Entry and Point of Use Drinking Water Treatment
https://www.mass.gov/service-details/home-water-treatment-devices-point-of-entry-and-point-of-use-drinking-water-treatment

[36] Facts About: Granular Activated Carbon (GAC) at Petroleum Contaminated Properties
https://mde.maryland.gov/programs/LAND/OilControl/Documents/Fact_Sheet_GAC_System_Revised_2.26.20_2pgs.pdf

[37] Home Water Treatment Fact Sheet- EH: Minnesota Department of Health (state.mn.us)
https://www.health.state.mn.us/communities/environment/water/factsheet/hometreatment.html

[38] Point-of-Entry Treatment of Petroleum Contaminated Water Supplies on JSTOR
https://www.jstor.org/stable/25044276

[39] In-home Water Filtration Options for Household Drinking Water (ny.gov)
https://www.health.ny.gov/environmental/water/drinking/pou/

Vermont – Guidance[40] for residents to perform water quality monitoring and POU/POE treatment systems has been developed.

Washington – POU/POE treatment is not an option for compliance with Washington drinking water rules and standards[41]. According to the Washington State Department of Health, POU/POE treatment is incompatible with state rules, makes compliance too difficult, and cannot be permitted due to private property access issues.

Literature Review

A study[42] looked at the experiences, perceptions, and beliefs of 17 households on private wells in North Carolina; the study highlights the following issues:

- POU water treatment interventions can reduce vulnerability to well water.
- Need to strengthen private well support programs for both testing and treatment.
- Lack of knowledge and skills prevents the adoption of POU treatment.
- Perceptions of water treatment also influence intended well-testing behavior.

"Potable Water Alternatives for an Extraterritorial Jurisdiction Community in Wake County, North Carolina[43]" estimated costs associated with water service extension, water filtration, and bottled water for a community with bacteriological issues. In this study, the water filtration solution (including whole house UV disinfection) was lower ($9,000 per connection) relative to either the water service extension ($14,000 per connection) or bottled water ($27,000 per connection) when evaluated over 30 years.

A study[44] completed in New Hampshire compared the life cycle costs of centralized and POU systems to treat per- and polyfluoroalkyl substances. Bixler, et al. (2021) found a combined POU treatment scenario, GAC, and IX, to have the lowest environmental and human health impacts and a relatively low economic impact. This conclusion is based on current health information available and may change when data associated with other exposure routes such as dermal absorption and inhalation are considered.

[40] Residential Drinking Water Treatment | Vermont Department of Health
https://www.healthvermont.gov/environment/drinking-water/residential-drinking-water-treatment

[41] Point-of-Use or Point-of-Entry (wa.gov)
https://doh.wa.gov/sites/default/files/legacy/Documents/Pubs/331-358.pdf

[42] Mulhern, R., Grubbs, B., Gray, K., and Gibson, J.M., 2022. User Experience of point-of-use water treatment for private wells in North Carolina: Implications for outreach and well stewardship. Science of the Total Environment. 806 (2022) 150448

[43] Benavides, B. "Potable Water Alternatives for an Extraterritorial Jurisdiction Community in Wake County, North Carolina," M.S. Thesis, Environmental Sciences and Engineering Department in the School of Public Health, University of North Carolina at Chapel Hill, 2019.
https://cdr.lib.unc.edu/concern/masters_papers/j9602245w

[44] Bixler, T.S., Song, C., & Mo, W. (2021). Comparing centralized and point-of-use treatments of per- and polyfluoroalkyl substances. *AWWA Water Science*, e1265.
https://doi.org/10.1002/aws2.1265

Industry Studies and Research

Water Quality Research Foundation

The Water Quality Research Foundation is sponsoring a project to develop a database of case studies of public water systems that use POU and POE water treatment for Safe Drinking Water Act compliance. A team of researchers from the University of Arizona and Georgia Southern University will review POU/POE use for compliance nationwide, determine its challenges and benefits, and share the lessons learned.[45]

Work on the approximately year-long project began in October 2021. Researchers will interview at least one key person from each state's local primacy agency by telephone or video conference. In the states that allow POU/POE use, PWS managers will also be interviewed about their experiences using this strategy for compliance.

American Water Works Association

American Water Works Association publishes POU/POE-related manuscripts in their journals. Example publications include reports on POU bacteria colonization[46] in 1985 and comparing centralized and POU/POE treatments for per- and polyfluoroalkyl substances[47] in 2021.

Water Quality Research Foundation on behalf of the Water Quality Association

The Water Quality Research Foundation sponsors research to address gaps in the water industry. In 2002, the Water Quality Association sponsored NSF/WHO to assess health risks associated with heterotrophic plate count (HPC) bacteria in domestic treatment devices. The results from this effort stated, "increases of HPC (microorganisms) (due to growth) in these (domestic water devices, including water softeners, carbon filters, etc.) therefore, do not indicate the existence of a health risk."

USEPA Treatment Examples and Activities

In 2006, the USEPA provided a policy/guidance document[48] that presents specific maintenance requirements for each type of treatment, treatment configuration, descriptions for some POU/POE applications, and specific POU examples of treatment approaches to specific contaminants with more in-depth treatment descriptions. This guidance includes adsorptive media for arsenic and selenium (Section 3.2.1.1), IX for inorganic constituents, radium, and uranium (Section 3.2.1.2), and RO for inorganic constituents, radium, and uranium (Section 3.2.1.3). Section 3.2.2 of the USEPA guide describes a GAC treatment approach to synthetic

[45] WQRF funds study of POU/POE role in SDWA compliance
https://www.wqa.org/resources/news-releases/id/320/wqrf-funds-study-of-poupoe-role-in-safe-drinking-water-act-compliance

[46] Edwin E. Geldreich, Raymond H. Taylor, Janet C. Blannon, Donald J. Reasoner. (1985) *Bacterial Colonization of Point-of-Use Water Treatment Devices.* Journal of American Water Works Association, v77, issue 2

[47] Taler S. Bixler, Cuihong Song, Weiwei Mo. (2021) *Comparing centralized and point-of-use treatments of per- and polyfluoroalkyl substances.* AWWA Water Science, v3, issue 6

[48] U.S. EPA 815-R-06-010 (April 2006) *Point-of-Use or Point-of-Entry Treatment Options for Small Drinking Water Systems*
https://www.epa.gov/sites/default/files/2015-09/documents/guide_smallsystems_pou-poe_june6-2006.pdf

organic compound contaminants. Finally, Section 3.2.3 of the USEPA guide describes treatment approaches for POE for volatile organic compounds and radon.

In January 2022, USEPA issued a Notice of Intent (NOI) to develop a WaterSense specification for POU RO systems to reduce water waste and recognize the most efficient technologies available[49]. In developing a potential specification, USEPA's goal is to encourage the production and adoption of more efficient RO systems where the installation and use of the technology are appropriate.

CERTIFIED DEVICES

WEBSITE APPROVED MODELS

The State Water Board currently maintains a list of approved POU/POE models for arsenic, chromium, lead, and nitrate and has them on the website: https://www.waterboards.ca.gov/drinking_water/certlic/device/watertreatmentdevices.html

The goal of the State of California Water Treatment Device Registration Program is to ensure that devices sold in California have been independently evaluated and tested to reduce 'health-related' contaminants as claimed by the packaging. Manufacturers must request to be placed on the list of CA-certified devices. Health-related contaminants include:

- Nitrate
- Arsenic
- Organic chemicals

Table 7 and Table 8, below, show the current NSF/ANSI performance standard certifications for POU and POE treatment for various constituents, respectively.

Table 7: POU NSF/ANSI performance standard certifications by Constituent

Contaminant	NSF 53	NSF 58
Arsenic	Yes	Yes
Nitrate	No	Yes
Radium	No	Yes
1,2,3-TCP	Available standard, no devices currently	Available standard, no devices currently
Hexavalent Chromium	No	Too high
PFAS Compounds	Yes	No

[49] WaterSense® Notice of Intent (NOI) to Develop a Draft Specification for Point-of-Use Reverse Osmosis (RO) Systems
https://www.epa.gov/system/files/documents/2022-01/ws-products-ro-systems-noi.pdf

Table 8: POE NSF/ANSI performance standard certifications by Constituent

Contaminant	NSF 53	NSF 58[50]
Arsenic	Yes	-
Nitrate	No	-
Radium	No	-
1,2,3-TCP	Available, no devices currently	-
Hexavalent Chromium	No	-
PFAS compounds	Yes	-

DEVICE LIMITATIONS

POU/POE treatment units have limitations related to treatment technology and source water quality. Water quality limitations of each treatment technology are presented in Table 9, below:

Table 9: Comparison of Water Quality Limitations of POU/POE[51]

Technology	Issue
Ion Exchange*	Fouling, Competing Ions, Brine Waste, Breakthrough/Exhaustion,
Adsorptive Media	Interfering/Competing Ions; Sloughing; Breakthrough/Exhaustion
Reverse Osmosis*	Fouling; variable membrane pore sizes; corrosivity
Granular Activated Carbon	Clogging of adsorption sites; Sloughing; Exhaustion
All	Bacteriological Growth

** pH change / potentially aggressive water*

Arsenic

There are two forms of arsenic typically encountered in groundwater: arsenic (III) and arsenic (V). In well water, arsenic is typically found in both forms. However, the amount of each form in well water varies based on location. Both forms of arsenic are a potential health concern. However, arsenic (III) is much more difficult to remove from the water. Most water treatment devices are certified to remove arsenic (V) but may provide some removal of arsenic (III). When addressing arsenic contamination, testing should be conducted to determine arsenic speciation before a treatment solution is selected.

Nitrate

Generally, POU/POE treatment is effective in removing nitrate at concentrations no greater than 25 mg/L (measured as N). When using RO POU treatment, a water supply pressure of at

[50] There are no NSF 58 certifications for POE due to corrosion control concerns of internal plumbing.

[51] Adapted Exhibit 3.3 from EPA 815-R-06-010 (April 2006)

least 40 psi is required for effective operation. Regular testing of the treated water by a State-certified testing laboratory is recommended to verify performance. Some manufacturers provide a home test kit that can also be used to evaluate the performance. However, periodic laboratory testing is needed to be sure that nitrate is being effectively reduced. Performance verification is especially important because of the acute health effects of nitrate.

NOTE: Nitrate, the most widespread chemical contaminant posing an acute health risk, does not have a performance-based certification standard for POE treatment.

FUTURE NEEDS AND OUTLOOK FOR POU/POE

As required under California statute[52], the State Water Board annually develops a Needs Assessment to provide foundational information and recommendations for policy development. The initial report supported the 2021-2022 Fiscal Year policy which was released in April 2021. The Needs Assessment is comprised of Risk Assessment, Affordability Assessment, and Cost Assessment components[53]. Four different water supply types: public water systems, tribal water systems, state small water systems, and domestic wells are analyzed within the Needs Assessment. The Needs Assessment identifies water systems that are failing (HR2W systems) and those that are At-Risk of failing to provide safe and affordable drinking water. The results of the assessment also show possible interim and long-term solution pathways and cost assessments to address the identified challenges.

Although methodology changes occurred between the 2021 and 2022 Drinking Water Needs Assessments, both assessments acknowledge that there will be an increase in the number of PWS, SSWS, and Self-Supplied Communities requiring POU/POE treatment as interim and long-term solutions. This section of the Report summarizes the findings from the 2021 and 2022 Needs Assessment as they apply to POU/POE treatment. Table 10 provides an overview summary of predicted POU/POE treatment needs.

Table 10: Long-Term and Interim Solution Predictions for POU/POE Treatment[54]

System Type	Long-Term, Total # Analyzed	Interim, Total # Analyzed	Long-Term Solutions: POU and POE	Interim Solution: POU, POE, and POU+POE
HR2W list	305	343	106 (35%)	196 (57%)
At-Risk SWSS	455	496	303 (67%)	473 (95%)
At-Risk Domestic Wells	62,607	59,366	36,911 (59%)	55,888 (94%)

[52] California Health and Safety Code Section 116769 (b) states "The fund expenditure plan shall be based on data and analysis drawn from the drinking water needs assessment...

[53] DDW - Needs Assessment Website
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/needs.html

[54] 2021 Needs Assessment Report
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2021_needs_assessment.pdf

RISK ASSESSMENT SUMMARY

In the 2022 Needs Assessment[55], the State Water Board identified the top contaminants impacting public water systems, state small water systems, and domestic wells. Public water systems that are on the HR2W list for known water quality violations are considered separately from state small water systems and domestic wells because municipal supply wells access a deeper portion of the groundwater's resources when compared with domestic wells. This deeper groundwater is typically less affected by contaminants introduced at the ground surface than shallower groundwater. As a result, the use of data from municipal wells would likely result in a systematically low bias for an estimate of contamination in the shallower groundwater typically accessed by domestic wells.

The Risk Assessment methodology developed for state small water systems and domestic wells in 2022 is designed to identify areas where groundwater is likely to be at high risk of drought impacts and/or containing contaminants that exceed safe drinking water standards. POU/POE treatment devices are not considered to be good candidates for solutions where inadequate water capacity is anticipated.

[55] 2022 Needs Assessment Report
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2022needsassessment.pdf

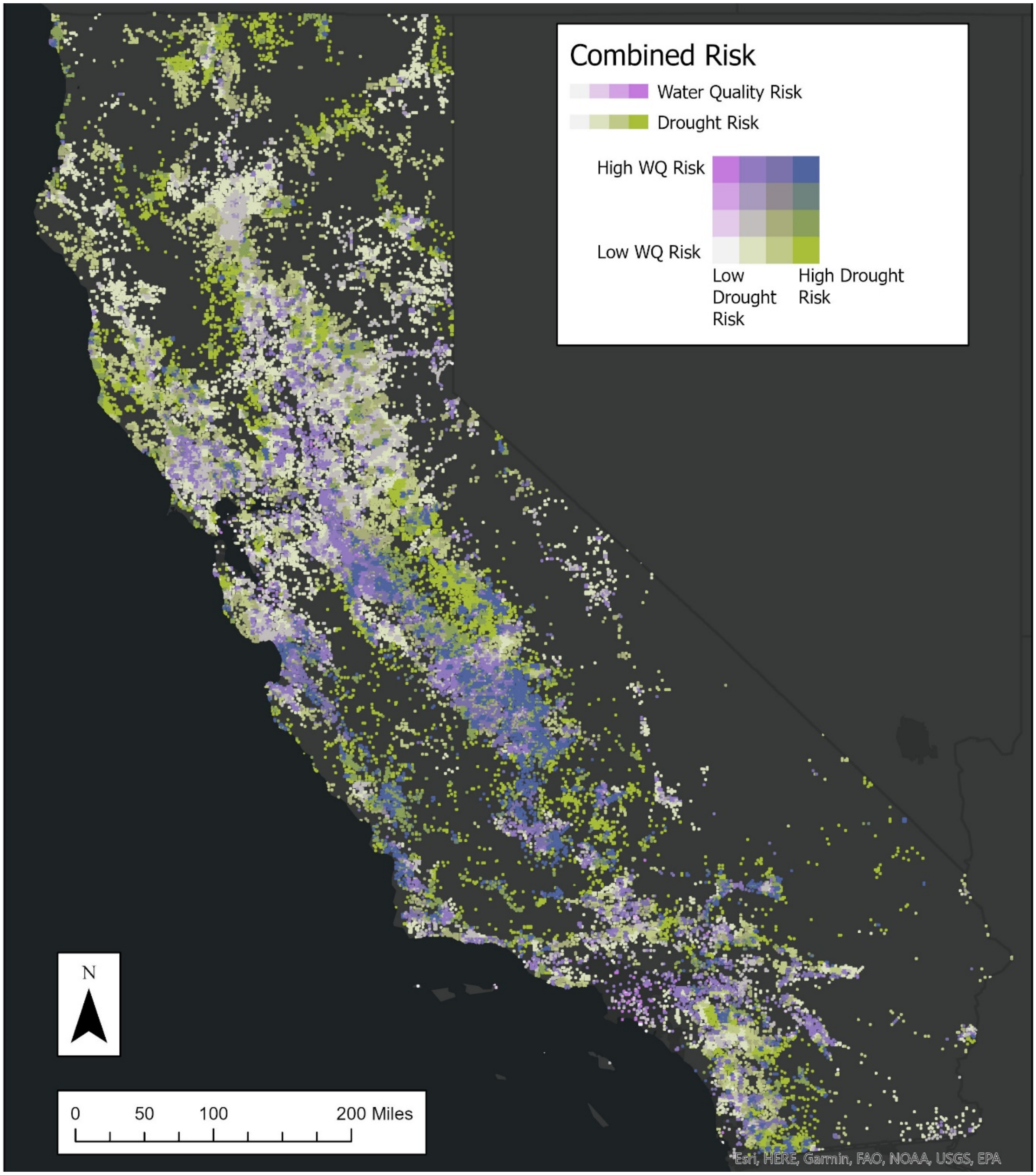

Figure 16: Combined Water Quality Risk Percentile for Domestic Wells and State Small Water Systems (Census Block Groups)

COST ASSESSMENT SUMMARY

MODELED SOLUTIONS

The 2021 Needs Assessment report contained two generated models, one for long-term solutions and one for interim solutions. Scores were generated using a sustainability and resiliency assessment and were compared against solution costs to select a modeled solution for each system. The cost methodologies provided in the 2021 Needs Assessment report are currently being re-evaluated and the numbers provided in this section may change based on differences in the model assumptions.

Physical consolidation, centralized treatment, and POU/POE treatment, all supplemented by other essential infrastructure (OEI) & technical assistance (TA), were potential long-term solutions. The model typically assumed that physical consolidation and centralized treatment were more sustainable and preferred if they appeared to be viable and cost-effective. Interim solutions were also modeled, and it was assumed that 6 years of interim solutions are necessary for HR2W failing systems (to allow for adequate time to obtain funding and install long-term solutions) and 9 years for those domestic wells and state smalls utilizing POU/POE treatment solutions.

Long-Term Modeled Solutions

Of the 305 community water systems and schools on the HR2W list approximately 35%, or 106 water systems, were modeled for POU/POE treatment because consolidation and centralized treatment were unlikely to be cost-effective. Furthermore, approximately 300 state small water systems and 37,000 domestic wells, that were at risk for having contaminants in their aquifer above the respective maximum contaminant level, were modeled for POU/POE use. A higher percentage of state small water systems and domestic wells were modeled for POU/POE because their geographic isolation and lack of economies of scale make consolidation and centralized treatment less cost-effective. Additional details of the methodology and the model solution selection criteria can be found in the 2021 Needs Assessment.[56]

Table 11: Count of Selected Modeled Long-Term Solutions

System Type	# of Systems	Centralized Treatment	POU/ POE
HR2W list	305	138 (45%)	106 (35%)
At-Risk[57] PWS	630	N/A	N/A
At-Risk SSWS	455	N/A	303 (67%)

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

[57] The At-Risk number for the purposes of the cost analysis included some Expanded HR2W list systems because for costing purposes they modeled more closely to the At-Risk systems methodology (e.g., significant monitoring and reporting violations).

System Type	# of Systems	Centralized Treatment	POU/ POE
At-Risk Domestic Well	62,607	N/A	36,911[58] (59%)

Interim Modeled Solutions

As interim measures, POU/POE devices and bottled water were considered for their potential use while permanent solutions such as centralized treatment and consolidation were designed and constructed. Due to sustainability concerns, bottled water was only assigned in the cost estimation modeling as an interim solution if POU/POE was deemed infeasible from a treatment or monitoring standpoint. The full list of contaminants for which these treatment technologies were deemed sufficient for water quality compliance was manually determined in conjunction with State Water Board staff, and the list is provided in the 2021 Needs Assessment Report. For example, high concentrations of nitrate (above 25 mg/L) cannot be effectively removed to regulatory standards by POU devices. Bacteriological growth, hard water, or the presence of iron or manganese precluded the use of POU treatment in some cases.

For HR2W list systems, POU, POE, or a combination of the two technologies was assigned in cases where these technologies were appropriate, and the system had 200 connections or fewer. At-Risk SSWSs and domestic wells were assigned a bottled water interim solution only if POU or POE was infeasible from a treatment standpoint.

Based on the model decision criteria outlined above, nearly 43% of HR2W list systems were assigned bottled water as an interim solution in the Cost Assessment. However, only 4% - 5% of At-Risk SSWSs and domestic wells were assigned bottled water as an interim solution. A summary table is provided below.

Table 12: Interim Solutions Estimated by System[59]

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

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

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

COST ASSESSMENT

The 2021 Needs Assessment established a Cost Assessment Model for both centralized and POU/POE treatment, implementation, and O&M. The Cost Assessment results detailed in this Report illustrate that there are relatively higher per connection costs associated with bringing small water systems into compliance, and thus there are advantages to economies of scale whenever possible.

Estimated Centralized Treatment Costs

The 2021 Needs Assessment provided a cost analysis for centralized treatment and can be referenced for the cost analysis methodology. Potential water treatment solutions may vary considerably based on site-specific considerations. In some cases, water systems that have multiple wells install water treatment systems on only the wells that were impacted by contaminants that pose a threat to human health. In other cases, if multiple wells in a water system were impacted by the same contaminant(s), pumping the impacted groundwater to a centralized treatment facility may be more cost-effective. Due to the lack of individual well-location data, this methodology did not develop such ancillary costs associated with centralized treatment.

The methodology of the cost model did consider the fact that treatment costs were generally non-linear as a function of source capacity where the unit cost of water produced tends to increase as production capacity decreases. Some of the other factors that may influence the capital cost associated with installing new treatment systems include:

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

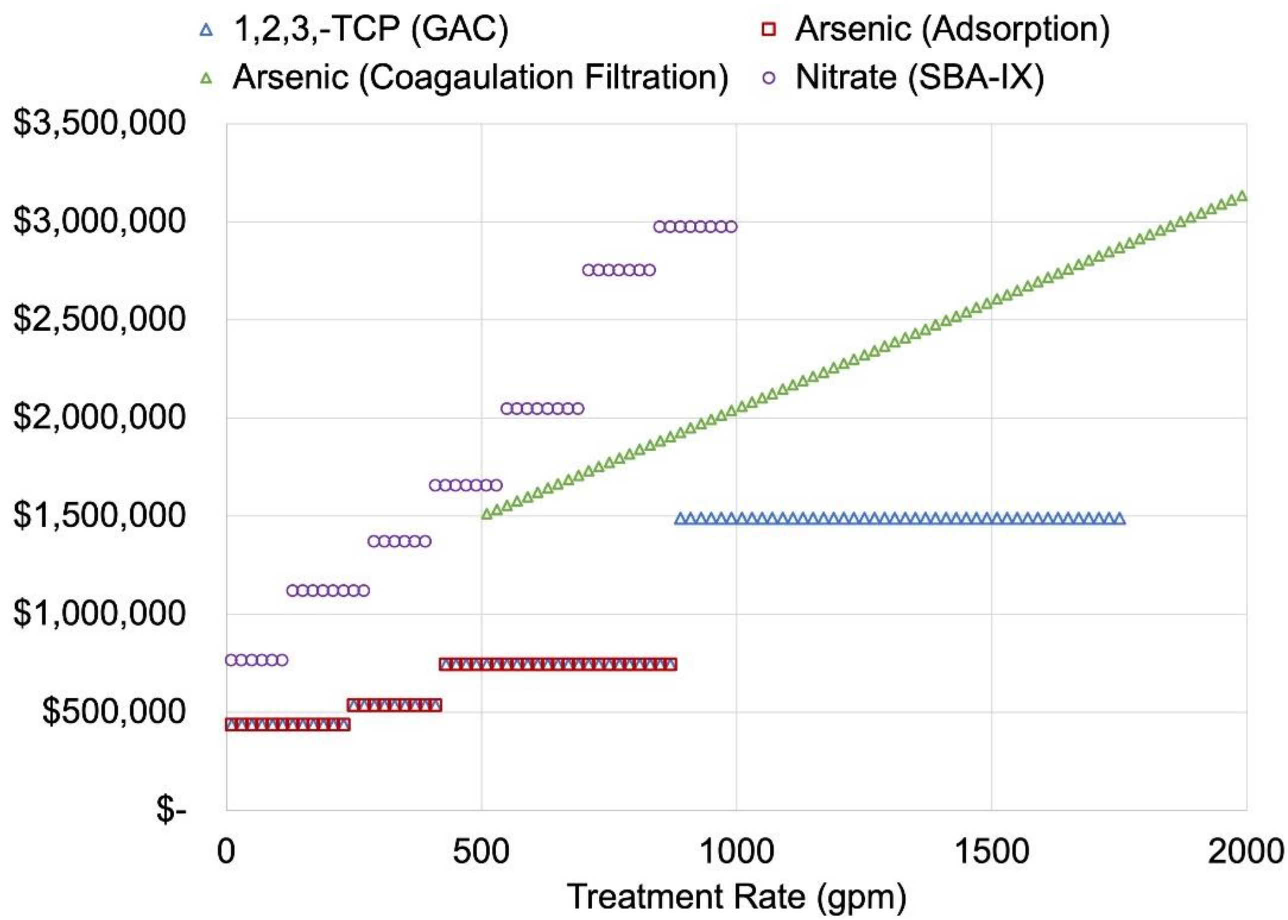

Figure 17: Installed Treatment Capital Cost Comparison Between Common Contaminants

While capital costs were an important factor to consider in the evaluation of water treatment solutions, it was also important to understand the expected annual costs to operate and maintain a water treatment system. Operational costs for consumables were typically driven by the volume of water that required treatment annually and the expense of having a certified operator oversee the treatment process. Examples of operational costs considered included the following:

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

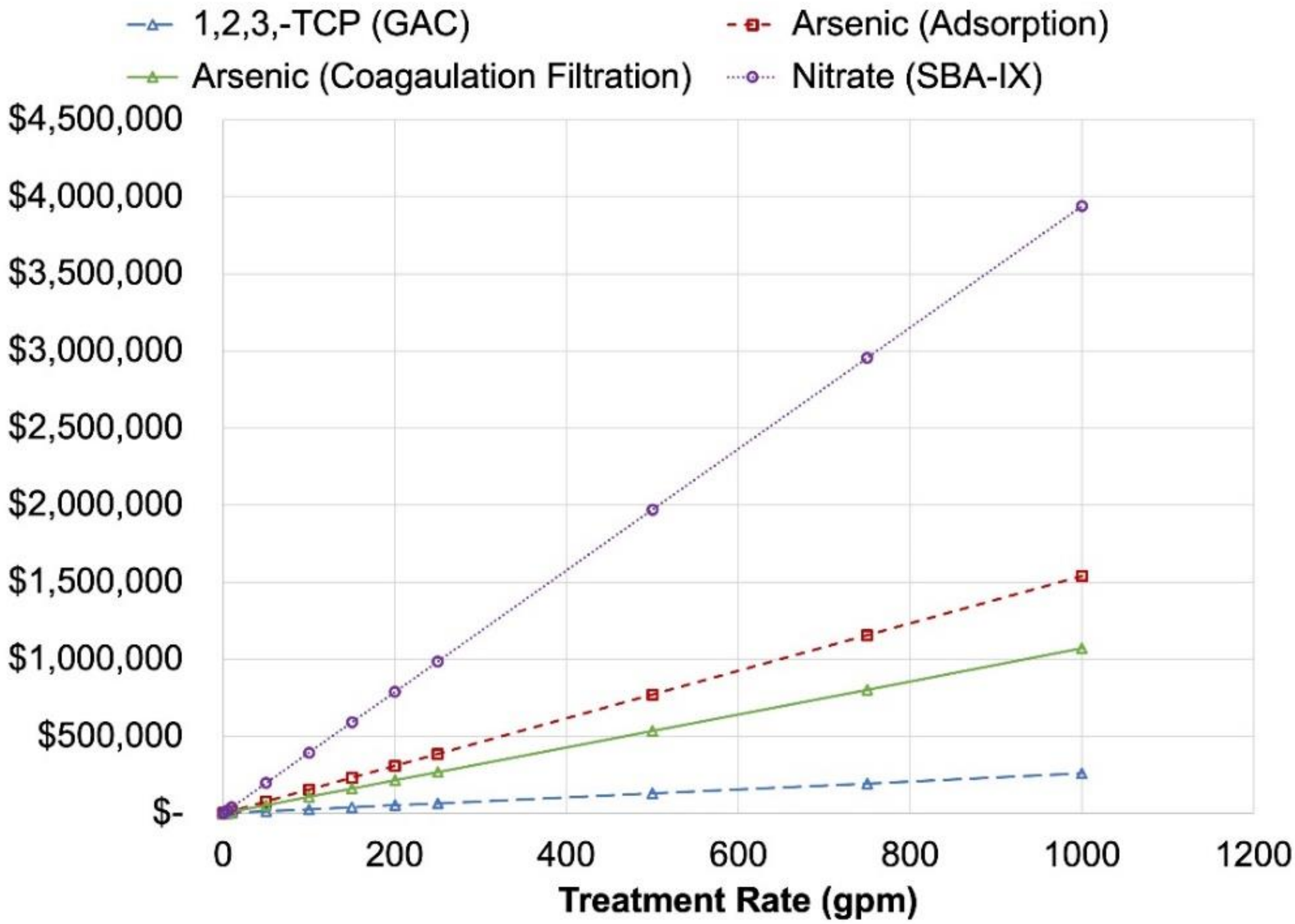

Figure 18: Comparison of Annual O&M Consumable & Disposal Costs by Treatment

Table 13: Operator Salary and Benefits by Certification Levels

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

Operator certification requirements were determined by the State Water Board, and for this model, the operator certification requirements were assumed as shown in Table 14. For budgeting purposes, operator labor cost was estimated by bins. Costs were binned by probable operator certification requirements and how much labor was required for each type of treatment. For example, both surface water treatment and nitrate treatment were considered to take 25% of a full-time operator. Surface water treatment was assumed to need a T4 operator, while nitrate treatment was assumed to need a T2 operator. Originally a T3 operator was specified for a water system with multiple contaminants, but the operator labor is associated with each treatment type specified, so systems with multiple contaminants have operator labor accounted for with each treatment unit, rather than one T3 operator labor rate.

Table 14: Annual Operator Labor Cost Estimate

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

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

General Estimated POU/POE Costs

The 2021 Needs Assessment indicated that criteria for POU or POE treatment were considered an option for public water systems with less than 200 connections (due to the complexity of monitoring and addressing units within individual residences), state small water systems, and domestic wells. POE GAC treatment was considered in the case of 1,2,3-TCP, or other volatile organic compounds to address inhalation risk. POU treatment was considered for the most commonly occurring inorganic contaminants (for example nitrate or arsenic). POU was not recommended for nitrate over 25 mg/L[60] as nitrogen or for wells with bacteriological problems.

While installations of this type of treatment have been completed in California, the costs have not always been adequately documented. The costs of POU and POE treatment were developed based on projected costs detailed in the tables below. The methodology assumed full replacement of the POU or POE treatment unit at 10 years.

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

Table 15: Estimated Capital Cost for POE and POU Treatment

Treatment	Capital Cost per Connection	Installation Labor cost per Unit ($100/hr.)	Admin/Project Management	Communication Cost
POE GAC Treatment	$3,700[61]	$1,000	$1,000	$300
POU RO Treatment	$1,500[62]	$200	$1,000	$300

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

Table 16: Estimated Annual Operations and Maintenance (O&M) for POE and POU Treatment

Treatment	Annual O&M per Connection	Operator and Communication Labor ($100/hr.)	Analytical	Total
POE GAC Treatment	$410 (Prefilter and GAC Replacement 2x/year[63])	$300	$250 ($1,252x/ year[64])	$960
POU RO Treatment	$100 (Prefilter and Membrane Replacement 2x/year[65])	$300	$40 - $110 (2x/yr[56])	$440 - 510

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

[62] Vendor provided costs.

[63] Based on vendor recommendations and pricing.

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

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

Long-Term Cost Analysis

The capital cost range for long-term modeled solutions POU/POE is shown below. Other Essential Infrastructure needs costs were applied to *the entire* HR2W list. Table 18 shows the average cost per connection for the selected modeled solutions.

Table 17: Selected Modeled Solution Costs, Excluding O&M, by System Type (in $ Millions)

System Type	Centralized Treatment	POU/POE
HR2W	$201 - $802	$9 - $37
At-Risk PWS	N/A	N/A
At-Risk SSWS	N/A	$9 - $37
At-Risk Domestic Wells	N/A	$148 - $592
TOTAL:	**$201 - $802**	**$9 - $592**

Table 18: Selected POU/POE Solution Average Costs per Connection

System Type	Centralized Treatment	POU/ POE
HR2W	$9,430 - $37,700	$8,730 - $34,900
HR2W Annual O&M	$388 - $1,600	$727 - $2,900
At-Risk PWS	N/A	N/A
At-Risk SSWS	N/A	$3,790 - $15,200
At-Risk Domestic Wells	N/A	$1,000 - $4,000

Interim Cost Analysis

Interim solution costs were calculated for a six-year term for populations served by HR2W list systems, and a nine-year term for At-Risk SSWSs and domestic wells.[66] Table 19 shows the estimated costs of providing interim solutions to all populations served by HR2W list systems, At-Risk SSWSs, and domestic wells (including both bottled water and POU/POE). The total Net Present Worth cost for the entire population in need is estimated at nearly $1.6 billion, with over $1 billion in cost for HR2W list systems alone. Estimated annual interim solution costs for bottled water are $850.00 per residential connection and $54.00 per person in school settings.

Table 19: Total First Year and NPW Cost of Interim Solutions[67] ($ in Millions)

System Type	Total Systems Analyzed	Total First-Year Cost Estimate	NPW Cost of Duration of Interim Solution
HR2W list	343	$216 M	$1,000 M
At-Risk SSWS	496	$18 M	$35 M
At-Risk Domestic Wells	59,370	$280 M	$547 M
TOTAL:		**$514 M**	**$1,580 M**

DUAL DISTRIBUTION SYSTEM (DDS) IMPLEMENTATION

REGULATORY FRAMEWORK AND COST ASSESSMENT

A DDS is widely considered a more preferred option than POU/POE as it provides long-term compliance with reduced O&M. However, implementation requirements have not been considered by the State of California. The State Water Board should explore the development of a regulatory framework for DDS as an alternative option to address water quality issues.

A DDS would provide a smaller-scale centralized treatment in tandem with a small-diameter pressurized distribution system which would provide each service connection with a point of compliant water for human consumption while minimizing the water treated for non-consumption purposes. The regulatory framework should address bacteriological sampling requirements, system design requirements, treatment requirements, O&M frequencies, sampling frequencies and requirements, separation standards, cross-connection considerations, and more. The construction of a DDS requires the laying of both a potable and non-potable water distribution line that may effectively double the cost of installing and maintaining the distribution system.

Furthermore, a cost assessment for the development and implementation of a DDS, consisting of a small-scale centralized treatment and pressurized distribution system should be

[66] The six-year interim period for HR2W lists was chosen to allow adequate time for water systems to obtain funding and to return to compliance. The nine-year term for At-Risk SSWS and domestic wells was assumed to be the full length of the SADWF program.

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

conducted by the State Water Board as part of one of the recommended pilot studies in this Report to determine if this method of solving compliance issues is feasible.

SUMMARY OF STAKEHOLDER OUTREACH

The State Water Board underwent an effort to better understand the challenges, needs, and knowledge gaps involved in implementing POU and POE drinking water solutions. This effort has informed this Report which documents current work in this space, details outstanding challenges, and then proposes pilot project(s) to gather missing knowledge and develop solutions for identified challenges. There was a series of four zoom meetings conducted to solicit input from stakeholders. These meetings were grouped into four stakeholder categories (recognizing that many stakeholders fit into multiple categories), summarized in Table 20.

Table 20: Stakeholder Outreach Meetings

Stakeholder Outreach Meeting	Date
Technical Assistance Providers	December 9, 2021
Local Government & Regulatory Agencies	January 13, 2022
Community-Based Organizations	January 28, 2022
Water Industry & Manufacturers	March 23, 2022

TECHNICAL ASSISTANCE PROVIDERS

This workshop focused on gaining POU/POE knowledge, insight, and perspective from predominantly technical providers in California. Topics discussed included social, technical, and financial challenges encountered with implementing POU/POE treatment solutions.

Examples of the challenges highlighted included:

- A loss of community confidence if treatment devices fail
- Property values related to water contamination
- Financial assistance is key to maintaining devices
- Lack of master template contract for operations
- Operators and water system personnel may lack POU/POE treatment experience
- Coping with bacteriologically contaminated sources

A summary of most challenges discussed in this workshop is documented in Appendix E: Stakeholder Engagement. Two of the organizations involved in this event agreed to provide case studies to incorporate into this Report, which are summarized below.

CASE STUDIES

Pueblo Unido CDC – State Small Water System Projects

Pueblo Unido Community Development Corp (Pueblo Unido) provides the State Water Board technical assistance (TA) and outreach to the unincorporated communities of Thermal, Oasis, and Mecca within Riverside County. Pueblo Unido began a pilot program in 2010 that consisted of installing POU devices under the sinks of mobile homes. These POU devices treated primarily arsenic and fluoride produced by onsite domestic supply wells which exceeded the regulatory MCL. These pilot projects are intended as interim solutions to the water contamination issue until the small mobile home parks, known as “Polanco” parks, can be consolidated into Coachella Valley Water District. The pilot program was specifically developed to assist farmworkers and low-income households lacking municipal water services. The participation rates of the Polanco Park project implemented by Pueblo Unido now exceed 300 units with a 95% participation rate.

Pueblo Unido determined that POU using RO was the most cost-effective solution and reached out to manufacturers and vendors to obtain devices for the projects but found that most units were designed primarily for commercial applications within urban areas. A manufacturer named Nimbus Water Systems, located in Temecula, CA was contacted and now provides the POU RO treatment units which are certified to remove arsenic and fluoride for the initial pilot project serving twelve (12) units in Oasis. These devices have proven to be effective based on water samples collected and a review of the analytical results. The primary issues faced during the piloting process were installations involving older cabinetry and needing to request internal plumbing modifications and repairs to complete the installation.

The piloting process required trust and relationship building within the community. The outreach and community organization provided by Pueblo Unido was instrumental in providing awareness and education, as well as acceptance of the treatment technologies. A community-driven approach including ongoing public meetings to address water quality issues plaguing the communities was instrumental in customer participation. The public meetings were used to describe the components of the treatment technology and to show how and where the units would be installed.

Individual appointments were made with households to complete the installation, provide instructions for operation, and collect samples for laboratory analysis. The lab analysis is shared with households to verify the removal of contaminants. Pueblo Unido developed a schedule of annual maintenance which includes the inspection of a unit and the replacement of membranes and sediment filters. The units are maintained by Pueblo Unido staff and labor costs are not incurred by homeowners.

Moving forward, Pueblo Unido plans to use forms provided by USEPA with greater detail and to record activities at each home. The units have an initial cost of approximately $350 and a membrane and sediment filter cost $65 and $20, respectively. According to Pueblo Unido, the main factor in the success of this project is education, as it demystifies any misinformation related to the POU units. More information on this case study can be found in Appendix F: Case Study #1 (Pueblo Unido CDC).

Self-Help Enterprises Case Study – Two Twenty Four Mobile Home Park

Self-Help Enterprises (SHE) provided an email summary of a POU pilot project to determine the most viable interim solution for uranium and gross alpha contamination at Two Twenty Four Mobile Home Park (224 MHP). 224 MHP is classified as a community water system and is in Madera County which serves 15 service connections and a population of approximately 35 people. In accordance with an approved Pilot Study Protocol, SHE installed the Hague WaterMax RO and the Culligan Aqua-Cleer filtration devices at two separate mobile homes within the 224 MHP. SHE will conduct an 8-month Pilot Study and has enlisted Moore Twining Associates, Inc. laboratory to analyze bi-weekly filtered water samples. SHE collects water samples from both POU treatment units and has been completing a tracking spreadsheet of the results over a period of 8 months. In addition, the flow meters and treatment equipment are inspected by SHE during every visit.

SHE will conduct a comparison between the two POUs to determine which filtration device was the most effective in treating the uranium and gross alpha contamination issues. SHE will prepare a POU Final Report and submit it to SAFER and DFA for review once the pilot has been completed. The POU device determined to achieve better performance will be selected as an interim solution for 224 MHP. SHE will proceed with executing the POU Pilot Study Scope of Work under the Regional Household Well Assistance Program (RHHWAP) Grant.

Community Water Center Case Study – Disadvantaged Community (DAC) Households in Northern Monterey County

Community Water Center (CWC) conducted a POE pilot project in Northern Monterey County for households experiencing 1,2,3-TCP contamination. The full case study (including tables) is in Appendix I. The CWC pilot project focused on the treatment of only 1,2,3-TCP, as the community was receiving bottled water to reduce exposure to nitrate and other contaminants that are not of concern for inhalation exposure. The pilot project was funded over three years (2020-2023) through a supplemental environmental project (SEP) undertaken in 2020 as part of a settlement that was reached under an enforcement action brought by the Central Coast Regional Water Quality Control Board against Monterey Mushrooms, Inc. and Spawn Mate, Inc. The enforcement action was brought for unauthorized discharges of process wastewater and polluted stormwater in 2017. It is expected this pilot project will be continued for three additional years with funding from the SWRCB.

1,2,3-TCP poses health risks when inhaled or ingested. Despite the availability of bottled water, no solution was currently available in the community to prevent exposure to 1,2,3-TCP via water vapor while showering. In February 2019, residents in the area north of Moss Landing in Monterey County formed the El Comité para Tener Agua Sana, Limpia, y Economica (El Comité). El Comité has been working together with CWC to support drinking water solutions for their community. Because community members were concerned about their exposure, CWC, and El Comité sought funding for POE treatment to reduce exposure to 1,2,3-TCP for indoor water uses for which bottled water could not be used.

The project consisted of the following participants: (1) Community Partners (property owners/landlords/residents with 1,2,3-TCP contamination in their drinking water); (2)

Community Water Center (CWC); (3) Weber, Hayes & Associates (WHA); (4) Culligan QWE Commercial Systems (Culligan); and the (5) Technical Advisory Committee (TAC).

Source Water Quality

The source water quality from the domestic wells where treatment systems were installed is summarized in Table 1 (see Appendix I); including regulated contaminants and parameters that can affect the treatment of 1,2,3-TCP with granular activated carbon (GAC), the treatment method used in the project. All wells had nitrate above the MCL, and two-thirds of them had nitrate at levels exceeding the level that state-certified residential treatment devices are certified to treat. One site also exceeded the MCL for hexavalent chromium. Many wells also had very high levels of total dissolved solids and hardness, as well as substantial concentrations of non-volatile organic carbon and iron.

Domestic Well Water Systems – Condition and Repairs

The condition of domestic wells and water systems varied among the households considered for inclusion in the project. Many systems had deficiencies resulting in potential contamination routes, such as cracks or openings in well heads, cracked concrete well pads, unsealed perforations or cracks in storage tanks, and poorly fitting storage tank lids. Total coliform bacteria were detected in samples collected at the POE of many households considered for the project, and E. coli was detected in a few cases. Regardless of whether total coliform or E. coli bacteria were detected, CWC and WHA worked with households to eliminate potential contamination routes through the high-priority well and water system repairs described in Table 2 (see Appendix I). After repairs, the systems were disinfected as needed. Repairs and disinfection were done directly by homeowners or residents or paid for by CWC using either SEP funding or supplemental grant funding.

Households where E. coli was detected during site assessments were not included in the project due to concerns of E. coli contamination reoccurrence. However, E. coli was detected and confirmed at two sites after treatment systems were already installed. The Challenges Encountered section of the full case study (see Appendix I) provides more details on how bacteriological contamination was addressed.

Treatment System Design

The Request for Proposals (RFP) for this project specifically requested that the consultant's design use granular activated carbon (GAC), the only best available technology for 1,2,3-TCP according to California water code (Title 22 CA Code of Regs 64447.4). The RFP also included carbon specifications, which were developed with input from the TAC and are available upon request. In most cases, one POE treatment system was installed at the point of entry to one household to treat only the water used indoors by that household, as treating water for outdoor uses unnecessarily expends the GAC’s capacity.

The water passes through two tanks of GAC in series, a lead tank, and a lag tank. Once the GAC in the lead tank’s capacity to remove 1,2,3-TCP is expended and 1,2,3-TCP is detected downstream of the lead tank, the lag tank is moved into the lead position, and the GAC in the lead tank is replaced. The lead-lag design reduces the risk of 1,2,3-TCP breaking through to the lag tank effluent.

The treatment system is also equipped with: a pre-filter to prevent sediment from entering into the GAC tanks; post filter to filter out any GAC that might come out of the tanks; flow restrictors to prevent the flow through the system from exceeding its maximum design flow of 9 gallons per minute; flow meter to measure how much water is treated; pressure gauges to measure the pressure loss through the treatment system; and taps to collect water samples upstream of the system, after the lead GAC tank, and after the lag GAC tank. Three different sizes of treatment systems were installed in the project to test the costs and benefits of larger and smaller systems. All systems had a maximum design flow of 9 gallons per minute. Specifications of each type can be found in Appendix I.

Steps to Implement the Project:

1. **Needs Assessment and Initial Community Outreach:** CWC initially began organizing in low-income areas served by domestic wells where Monterey County data and other assessments have indicated high levels of nitrate and other contaminants in the groundwater. During this outreach, CWC connected residents with free well testing programs in their area, primarily the Central Coast Regional Water Quality Control Board's program. Some well testing results showed high levels of nitrate, hexavalent chromium, and 1,2,3-TCP in drinking water.
2. **Community Residents Form El Comité and Identify Need:** After learning about 1,2,3-TCP through CWC's outreach and education, community residents identified 1,2,3-TCP as a health concern and requested support in finding a solution.
3. **Funding Source:** CWC obtained funding from the SEP issued in May 2020 to fund the current pilot project and has received approval for SWRCB funding to extend the project to 2026.
4. **Pilot Project Outreach:** CWC developed information - in Spanish and English - about the pilot project, and shared it with community partners, property owners, and others relying on drinking water wells contaminated by 1,2,3-TCP. CWC met with residents and property owners at households with 1,2,3-TCP contamination to inform them about the project and ask if they would be interested in participating.
5. **Site Assessments:** If residents and property owners expressed interest in the project and signed participation agreements, WHA conducted site assessment visits to evaluate if and where a POE treatment system could be installed for the household. WHA also collected water samples from the well to confirm the presence of 1,2,3-TCP and test the water for other parameters that can affect 1,2,3-TCP treatment, such as total coliform and E. coli bacteria, iron, manganese, and total organic carbon.
6. **Well or Water System Repairs:** As described previously in the "Domestic Well Water System Condition and Repairs" section, in most cases, before the treatment system could be installed, repairs had to be made to the well or water system to eliminate routes through which bacteria or other microbes could enter the water system.
7. **Installation:** If WHA and CWC determined that a treatment system could be installed on the property, and the residents and property owner agreed, CWC, the residents, and the property owner signed an Implementation Agreement detailing how the system would be installed, maintained, and monitored. Once this agreement was signed,

Culligan installed the treatment system, which included flushing the GAC media. WHA collected water quality samples immediately following installation.

8. **Monthly Monitoring:** After installation, WHA visited the treatment systems monthly to inspect them and collect water samples. WHA collected 1,2,3-TCP samples each month between the lead and lag tanks and after the lag tank to confirm that the treatment system was removing 1,2,3-TCP to below the MCL. Initially, only the sample collected between the lead and lag tank was analyzed. If 1,2,3-TCP was detected in that sample, the sample collected after the lag tank would also be analyzed. A 1,2,3-TCP sample was also collected upstream of the treatment system every 3 months to monitor the 1,2,3-TCP concentration in the well. Samples were also collected monthly for total coliform, E. coli, and heterotrophic plate count bacteria upstream and downstream of the treatment system. Sample results were reported to community partners.
9. **Operation and Maintenance (O&M):** Community residents reported small issues related to system function including leaks to CWC and/or WHA. During the monthly visits, WHA also identified any problems with the treatment system, such as leaks or clogging of the pre and post-filters, and worked with Culligan to resolve the problems. The project also included a budget to replace the GAC once its capacity to remove 1,2,3-TCP was depleted and to backflush the GAC tanks if the GAC became clogged and excessive water pressure was required to move water through the tanks. GAC was replaced during the project in two systems due to E. coli contamination, but not due to pressure loss or 1,2,3-TCP detection downstream of the lead tank. All project repairs and maintenance were documented in an O&M log, which is available upon request.

1,2,3-TCP Treatment Effectiveness

Throughout the project, all treatment systems in operation have been effective at reducing the concentration of 1,2,3-TCP to levels below the MCL (0.005 ug/L) and below the detection limits (typically <0.0006 ug/L). 1,2,3-TCP has not been detected in any samples collected downstream of the lead tank. Treatment systems have been in operation on average for 9 months (ranging from 1 to 20 months).

Project Costs

Costs through late 2022 for the treatment project are summarized in Tables 4 and 5 of Appendix I. Due to the relatively short duration of this pilot project, long-term operation and maintenance costs, including the frequency of GAC replacement, are unknown. Outreach, coordination, project management, and monitoring make up a substantial portion of the project costs. While some of these costs may be lower for a larger-scale implementation than for this project, outreach to individual households including the signing and negotiation of implementation agreements, site assessments for individual water systems, and regular monitoring will always be critical for the effective and reliable implementation of POE treatment. Installation costs are higher, as expected, for the larger systems. For each system, site assessment and installation costs ranged between $9,359 and $25,912; monthly monitoring costs between $452 and $759; and minor maintenance costs between $0 and $428. GAC has only been replaced in two systems due to bacteria contamination, but budgeted costs for replacing GAC in lead tanks range between $771 and $2,915.

Challenges Encountered

CWC identified the following challenges during the piloting process:

1. Some systems have so far been in operation for only a short amount of time because CWC chose to implement this project in phases in order to learn from the first systems before installing additional ones. It is expected this pilot project will be continued for three additional years with funding from the SWRCB.
2. In some cases, residents were interested in the pilot but landlords did not want to participate due to potential visual disturbances to their property and/or due to the limited timeframe for funding (April 1, 2021 to June 30, 2023) for O&M. Longer-term funding from the SWRCB was pursued and the existing Implementation Agreements include stipulations for CWC to remove the treatment equipment at the end of the project if property owners request removal.
3. In some wells, 1,2,3-TCP was detected in one sample and not detected in follow-up sampling. Residents expressed confusion about the health implications of water with changing water quality. Ongoing monitoring is important, and system installation was prioritized for sites with consistent 1,2,3-TCP contamination.
4. Coliform bacteria were present in roughly 78% of domestic water systems considered for the pilot. This created an additional workload to address the bacteriological issues and a need for additional grant funding from outside the SEP to fund some well and water system repairs.
5. Many sites had challenging source water quality, with high hardness and total dissolved solids (TDS), and significant concentrations of non-volatile organic carbon. Source water quality has so far not limited the GAC's ability to remove 1,2,3-TCP. However, high levels of hardness would need to be considered in the design of UV disinfection if it is added in the future.
6. A shortage of water system contractors in the area delayed repairs and necessitated additional outreach to contractors by WHA and CWC.

LOCAL GOVERNMENT & REGULATORY AGENCIES

This workshop focused on gaining POU/POE knowledge, insight, and perspective from predominantly county governments in California. Topics discussed included social, technical, and regulatory challenges encountered with implementing POU/POE treatment solutions.

Examples of the challenges discussed during the workshop included:

- Difficulty to get customers/homeowners, regulatory authorities, service providers (operators, samplers, laboratories, manufacturers), funding sources, etc. to cooperate
- Customer confidence
- Cumbersome processes
- Third-party assistance difficulties
- Variable water quality within a community
- Compliance reporting hurdles

A summary of the specific challenges discussed is documented in Appendix E: Stakeholder Engagement. Additionally, Monterey County attempted to adopt a POU/POE ordinance[68] that referenced California's POU/POE regulatory framework that would apply to state and local small water systems which had its challenges and were discussed.

CASE STUDIES

Monterey County- Community Water System POU/POE Treatment for Nitrate and 1,2,3-TCP

Monterey County is working with Encinal Rd WS #01 to address elevated concentrations of nitrate and 1,2,3-TCP in water from a single groundwater source that supplies a community of 91 people. Given the inhalation risk associated with 1,2,3-TCP, a lead/lag POE treatment system with GAC was installed. To reduce nitrate concentrations, RO POU devices were installed. The proposed POU/POE public water system is still required to post Do Not Drink notices until the system obtains permit approval. A more detailed description of this case study can be found in Appendix G: Case Study #2 (Monterey).

Imperial County Division of Environmental Health – Homes on Imperial Irrigation District Canals

A unique POE device program is being piloted by Imperial County's Division of Environmental Health (DEH) to provide low-income households with POE treatment using Imperial Irrigation District's (IID) raw canal water. DEH has initiated two phases of this project and is currently in the process of requesting funding from the State Water Board for Phase 3 of the project. The project includes targeted outreach, agreements, site evaluation, source sampling, POE installation, 2 years of O&M, and resident education and empowerment.

To participate in the POE pilot project, interest letters were delivered to the residences that use canal water for domestic purposes and qualified for IID's Residential Energy Assistance Program (REAP). Once the qualifying candidates were selected, the participants were given three agreements detailing:

- Project vendors/contractors
- Labor compliance associated with the project
- Objectives, outcomes, and the overall process moving forward.

Once agreements were signed, site evaluation and source sampling were conducted to determine the best form of treatment (package filtration versus RO) depending on what contaminants were present in the raw water, as further discussed below. Once the POE treatment was installed, the performance of the POE treatment units was confirmed by bacteriological sampling. Two years of free O&M services were provided after device performance was confirmed.

The treatment technologies used in each POE treatment project include an HC-3 Multimedia Filter (20 microns), Big Blue Cartridge Filter (5 microns), Harmsco Muni-40 Filter (1 micron),

[68] Point of Use and Point of Entry Requirements and Implementation (monterey.ca.us)
https://www.co.monterey.ca.us/home/showdocument?id=67294

and a Viqua UV light and ballast. The O&M services consist of monthly site visits to the residence to take treated water bacteriological samples, conduct hand-held turbidity tests from pre- and post-treatment water, record readings of pre- and post-filtration pressure gauges, collect water usage data, ensure UV light is on, and record remaining life on the UV bulb, and address any special occurrences on-site. Once a quarter a pre-treated raw water *E. Coli* sample is collected and analyzed using the Quanti-Tray method. The results of the site visits are logged in a database. Annual visits are conducted to replace water system equipment (cartridge filter, Harmsco, and UV light lamp) and perform chemical water quality monitoring for nitrate (as N) and some locally used organic compounds that are herbicides, including atrazine, simazine, alachlor, molinate, thiobencarb, and glyphosate. If organic chemicals are discovered in the raw water, Imperial County intends to implement RO in the treatment processes to remove them.

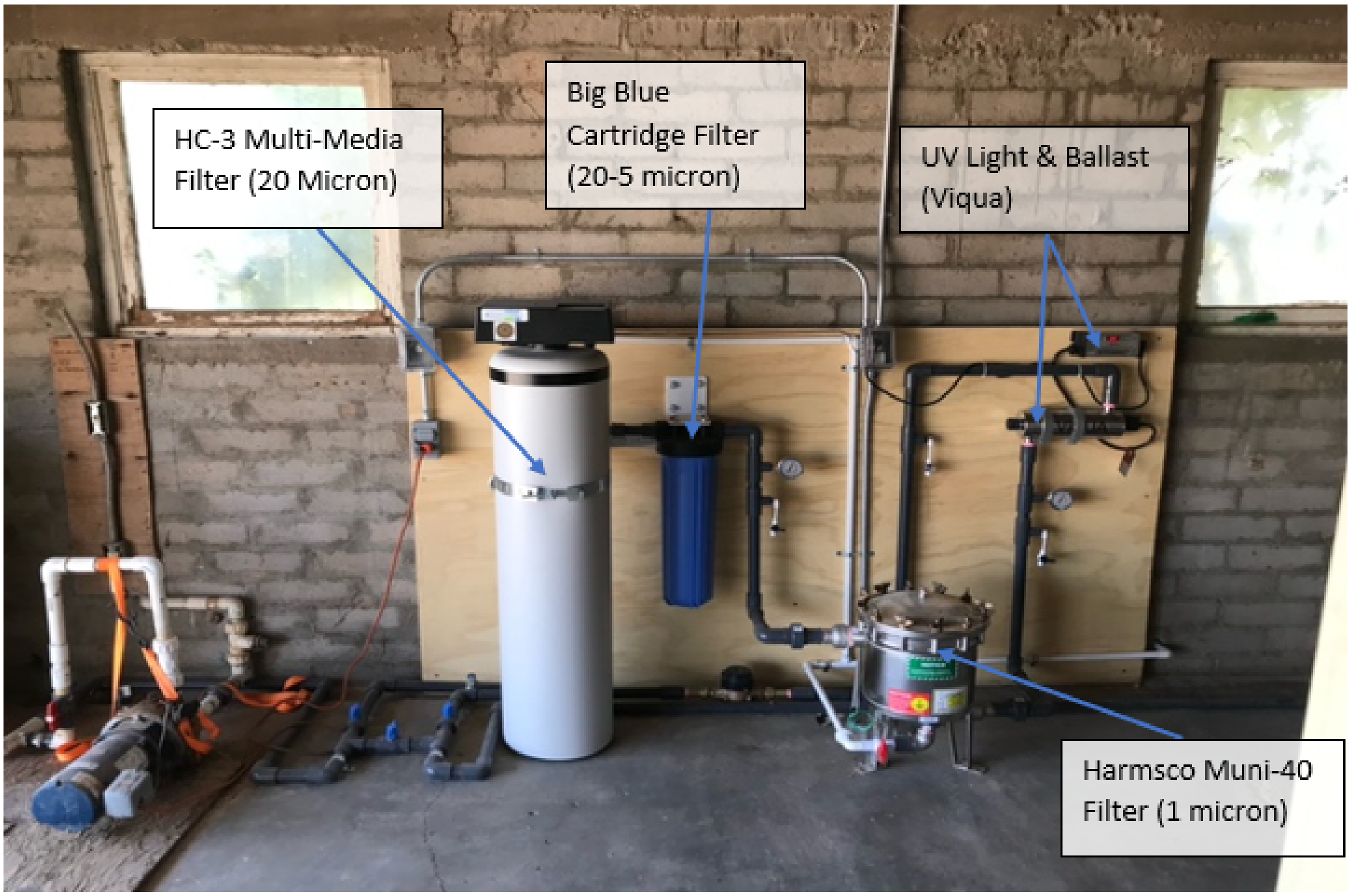

Figure 19: Typical Indoor IID Pilot POE Configuration

The final step of the POE pilot project is to ensure the education of the residents on maintaining the units and providing resident empowerment. This is accomplished by requesting the project applicant or household representative accompany DEH and the contractor for a mock changeout on the 23rd site visit. This is an opportunity for the household representative to learn how to operate and maintain the system, review system components, as well as ask questions before the final visit. The 24th, or final visit, consists of the household representative doing the hands-on installation of the replacement equipment. DEH leaves the household representative with guidance via a laminated O&M manual, created in English and

Spanish. The O&M Manual is provided to each home and includes details of each POE component, how to maintain them, and provides estimates of costs for purchasing POE replacement components. The manual also includes a resource list where POE equipment can be purchased.

There are special implications for this project, however. The first is that the POE treatment does not treat the canal water to potable/drinking water quality, and there is no assurance of this claim in accordance with State regulations due in part to the lack of daily testing and chlorination. Results show the removal of approximately 98% of bacteria post-treatment, however, there is no virus removal credit for the Harmsco filter. The second is that homes, even with a POE treatment device installed, must purchase potable hauled water as a requirement to obtain IID's raw canal water at the home for showering, hand washing, etc. Third, is that this project may not be a viable long-term solution as ongoing O&M costs may not be feasible for individual households. The cost for O&M over two years is estimated at approximately $8,000 per home, which includes two equipment change-outs and annual chemical sampling. The funding program specifically designed for disadvantaged residents is not approved indefinitely, and the program does not act as a permanent solution for the nearly 3,000 residential homes pulling raw water from IID's canals.

Aside from this project specifically, Imperial County only requires one initial round of sampling from an installed treatment unit to obtain approval for receiving IID canal water. However, there is no verification of water quality achieved by the treatment installed at homes after the initial testing has been completed and approvals to use canal water are received. The addition of sampling annually for certain organic compounds and flexibility of POE treatment options if detections are found was triggered by a study from Agua y Salud[69]. The study sampled 35 households using IID canal water and found that the contaminants atrazine and simazine were found in 6 of 35 samples in October 2010. All subsequent testing by DEH has been non-detect for organic compounds, but plans remain ready to implement for alternative treatment for homes with herbicide contamination. For more information can be found in Appendix H, Case Study #3 Imperial County: Homes on IID Canal.

[69] Agua y Salud: Water Quality & Environmental Health Community Study (CSU San Marcos/National Latino Research Center)
https://www.csusm.edu/nlrc/documents/2012/tcwf_ic_water_quality_report_2012.pdf

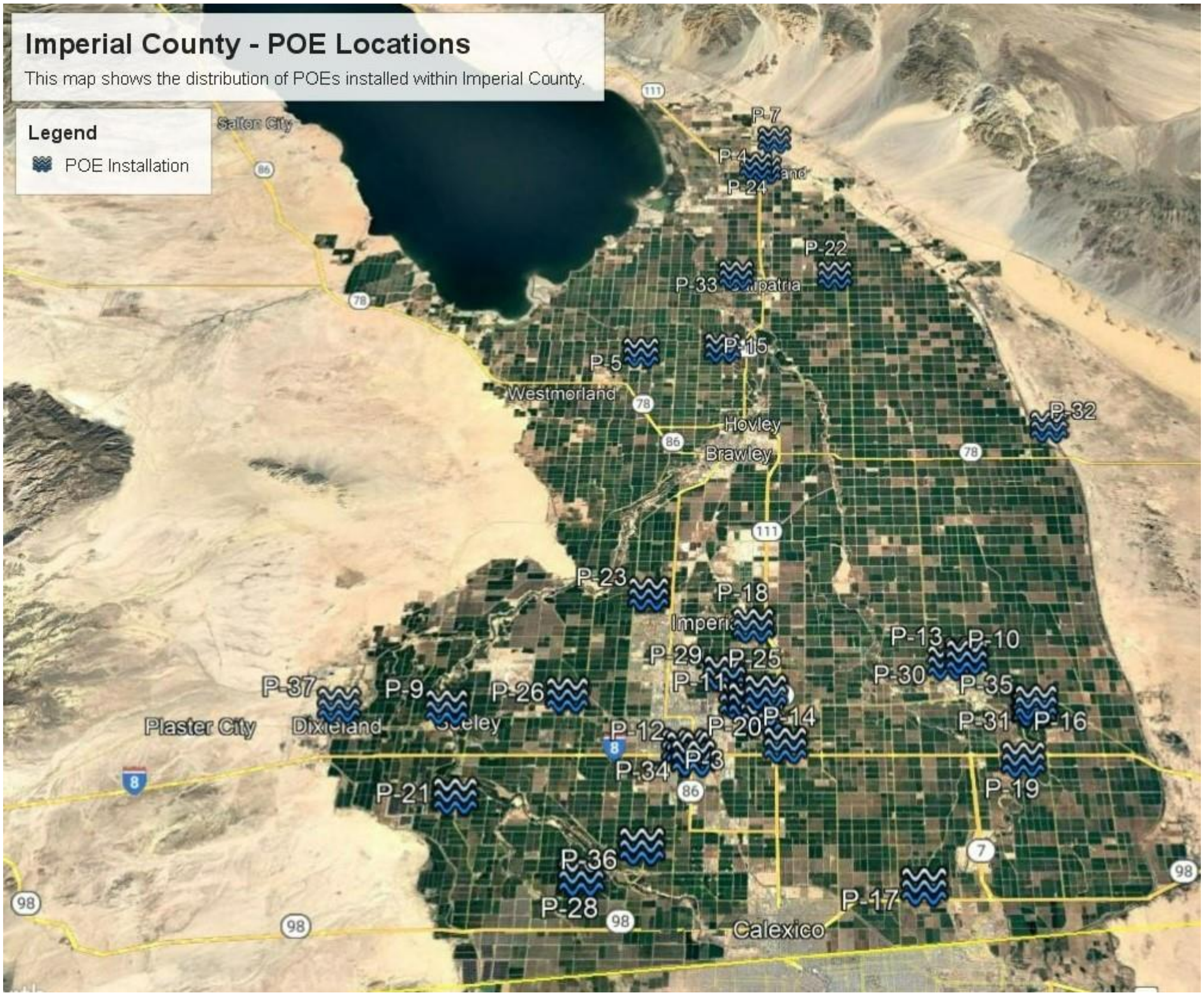

Figure 20: POE Project Installations by DEH in Imperial County

COMMUNITY-BASED ORGANIZATIONS

This workshop focused on gaining POU/POE knowledge, insight, and perspective from predominantly community-based and environmental justice organizations in California. Topics discussed included technical, social, and regulatory challenges encountered with implementing POU/POE treatment solutions.

Examples of the challenges discussed during the workshop included the need for:

- Consistent engagement
- Ongoing treated water testing
- Better specific language and communication
- Building trust and confidence in impacted communities

A summary of the specific challenges discussed is documented in Appendix E: Stakeholder Engagement.

WATER INDUSTRY AND MANUFACTURERS

This workshop focused on gaining POU/POE knowledge, insight, and perspective from industry organizations. The topics discussed were primarily technical. After introducing this Report's effort and a presentation of three case studies, four topics were discussed: (1) Gaps in POU/POE Certification Standards, (2) Gaps in Certified Treatment Equipment, (3) Lack of Availability of POE Treatment Equipment, and (4) Development of Complete Service Providers.

Some examples of the challenges discussed during the workshop included:

- Lack of customer access to identify appropriate devices
- Lack of certifications available for PFAS compounds, TCP, hexavalent chromium, uranium for POE devices, and problematic bacteriological water quality
- Lack of NSF/ANSI 53 Drinking Water Treatment Units – Health effects, compliant POE media, and concerns about device failure
- Funding for use of POU/POE units should be expedited

Participants indicated there is a lack of funding by manufacturers, industry professionals, and regulators for POE devices where high contaminant levels exist. This was because most POE devices focus on aesthetics rather than contaminant removal due to the low return on investment (ROI) for this scenario.

Those that participated in the POU/POE Outreach Workshop for Industry Professionals also proposed that there be the incorporation of a searchable mechanism on websites so that customers could easily identify appropriate devices for a particular contaminant. However, any mechanisms created by manufacturers would lead to costs passed to the consumer. It was recommended that California could harness the registration process and evaluate devices needed for California-specific constituents; then, that information could be shared with consumers. A summary of the specific challenges discussed during the workshop is documented in Appendix E: Stakeholder Engagement.

OPPORTUNITIES & CHALLENGES

EQUITY

Equity and environmental justice concerns have been raised regarding the implementation of POU/POE treatment in California. The State Water Board seeks to ensure that low-income communities and people of color are not disproportionately provided POU/POE treatment instead of more reliable, robust, and resilient solutions.

EQUITY CHALLENGES

The State Water Board, environmental justice groups, and community partners have universally expressed the desire to see POU/POE treatment in California utilized in an equitable and just way. The State Water Board has received comment letters discussing this issue and they are provided in **Error! Not a valid bookmark self-reference.**.

The State Water Board recognizes that the following challenges may impact residents accessing safe water through POU/POE treatment devices: 1) the presence of untreated water in the home (POU applications), 2) shifting responsibility to residents, 3) the reliability of POU/POE treatment units, 4) certification device knowledge for POU/POE treatment units, 5) performance indication devices and failure alarms, 6) wastewater production, and 7) community trust. These challenges may have additional burdens on disadvantaged communities and residents with language barriers.

Untreated Water in the Home – When POU treatment devices are used, household water taps that are not connected to a POU device will continue providing untreated water. People may be exposed to contaminants from these taps when drinking, brushing their teeth, making ice, preparing baby formula, etc. Multiple POU devices may be needed in homes to avoid incidental exposure. This may be especially important in homes with children, or in locations where residents are burdened by multiple sources of pollution. Children may experience increased toxicological effects from contaminants, and it may be more difficult to educate them about the importance of only drinking water from one location.

Shifting Responsibility to Residents – Households with POU/POE treatment systems must provide access to water system personnel for monitoring and maintenance. This may be a major investment of time on the part of the resident that is not required when a centralized treatment approach is used, resulting in a shift in active responsibility from the water system to the residents. Additionally, some residents may not allow access to their homes for various reasons. For public water systems, failure to obtain 100% compliance results in water systems remaining in non-compliance and may result in fines being assessed against the water system. Homeowners may also become responsible for additional costs related to the disposal of wastewater from treatment devices, as further discussed below.

Reliability – The reliability and robustness of POU/POE treatment systems is a major concern. Some of the reliability concerns stem from POU/POE treatment systems being installed within homes where access for monitoring, maintenance, and repairs may be limited. Residential plumbing inconsistencies and deficiencies can also affect performance. Frequent changes in home ownership and occupancy, such as rental properties, can also introduce additional complexities in education and access.

Performance Indication Devices and Failure Alarms – Notification regarding POU/POE treatment device failure is of vital importance, particularly for acute contaminants such as nitrate. Laboratory analysis of grab samples is inadequate for this purpose. Performance indication devices and failure alarms are required to prevent exposure. However, for many contaminants, performance indication devices may be costly, difficult to maintain, or do not exist. If performance indication devices are available and a failure is observed, a rapid response is required and linguistic barriers to obtaining technical assistance should be eliminated. If there are a significant number of false alarms, residents will not trust the operator who services their device, or if there are other barriers, people may ignore performance device alarms.

Wastewater Production - Some POU/POE treatment systems produce large volumes of wastewater, for example, RO devices. This can increase water costs and cause additional hydraulic loading on septic systems and leach fields that may have pre-existing performance issues.

Community Trust – Due to concerns regarding reliability and exposure, residents may not trust POU/POE treatment devices to satisfy their drinking water needs. These residents will often purchase bottled water for use in their homes, which may not be safer and is an additional financial burden on the household, which may disproportionally impact disadvantaged communities.

EQUITY OPPORTUNITIES

POU/POE devices used as an interim measure may provide water quality solutions for communities that would otherwise be waiting for years during the planning and construction processes of implementing a long-term solution. Bottled water, in addition to being environmentally unsustainable, can also create a long-term perception for residents that bottled water is the only safe solution. Bottled water in California does not undergo the same monitoring requirements as public water systems and is significantly more expensive. The perception that only bottled water is safe can create ongoing financial burdens for residents, even after long-term solutions are completed and the delivered water is safe.

POE devices are particularly important to develop from the equity perspective. POE devices treat water in the entire home decreasing non-ingestion exposure pathways. Additionally, POE devices continue to use water from the existing taps, which should decrease the possible association with bottled water as being the best source of water. Where there are no other cost-effective solutions, there should be a programmatic shift away from POU and toward POE in low-income communities, historically marginalized communities, and areas with high pollution burdens.

POE devices are particularly important to develop from the equity perspective. POE devices treat water in the entire home decreasing non-ingestion exposure pathways.

It may also be necessary to consider higher funding thresholds for low-income communities, historically underinvested communities, and/or areas with high pollution burdens to ensure that POU/POE treatment alternatives are distributed equitably when determining, programmatically, where to use POU/POE treatment devices. Transparency and funding guidance around this issue could be done through annual monitoring of where POU/POE treatment is utilized in California along with demographics such as disadvantaged community status, majority race, and Cal EnviroScreen score.

Concerns about shifting responsibility to residents could be addressed, at least in part, through shared administration of operation and maintenance services – particularly for households using POU/POE treatment for domestic wells. Consolidation of these services across counties or larger regions would be efficient and likely result in greater reliability of treatment devices. Such an approach would probably require financial support from the State Water Board.

SOCIAL

A public water system provides water via a distribution system that is operated, maintained, and monitored by certified professionals, and households reliably connect to the supplied water, typically at their property line. In parallel with a public water system, the broad installation of POU/POE treatment within a community requires individual household participation, property access, and routine operation and maintenance activities undertaken within the households.

DRINKING-WATER QUALITY PERCEPTION

A recent study led by the University of North Carolina at Chapel Hill[70] explores the experiences, perceptions, and beliefs of 17 households on private wells in North Carolina that participated in a pilot-scale POU water treatment intervention to better understand the drivers and barriers of POU treatment adoption among well users. Questionnaires administered before and after the intervention showed a significant decrease in participants' perceived vulnerability to well water contamination, with 77% feeling vulnerable to poor well water quality before, compared to 23% after the filter was installed.

[70] User experience of point-of-use water treatment for private wells in North Carolina: Implications for outreach and well stewardship, University of North Carolina at Chapel Hill, et. al, https://pubmed.ncbi.nlm.nih.gov/34563909/

For example, in one survey of private well users affected by nitrate contamination in Minnesota, 74% of respondents (total n = 471) reported that they would install some form of water treatment if unsafe nitrate levels were detected in their well, but only 27.8% of those affected by nitrate and aware of the problem did so (Lewandowski et al., 2008).

> *"A questionnaire was used to evaluate the study participants' perceptions about their well water and POU water treatment before and after the study. The questionnaire was first administered to each household on the day that the filter was installed (the "pre-test") and again on the day the study was concluded (the "post-test"). Participants responded to the post-test after having received the results (see Section 3.1.6 regarding the effect of the report-back on users' perceptions). All adult members of each household were invited to complete the questionnaire. The main factors evaluated were perceived vulnerability to drinking water exposures through well water; perceived benefits of POU treatment; perceived self-efficacy in implementing POU treatment, including the ability to acquire reliable information, research available products, select a device, seek help, and install a filter; intent to purchase bottled water, well testing, and POU treatment in the future; and other perceived barriers to POU treatment."*

ASPECTS OF IMPLEMENTATION

Participation

In many cases, the installation of POU/POE treatment devices is an individual household decision that is driven by a variety of factors, including water quality awareness, funding for installation and maintenance, understanding the treatment technology, and, typically, partnering with an external entity that will be entering private property.

An individual household may choose to install POU/POE treatment devices at any time and at their own expense to enhance their water quality whether supplied by a public water system, a state small water system, a domestic well, or individual surface water intake. For communities dealing with consistent water quality issues from the same source, a feasible option may be a collaborative effort for the broad installation of POU/POE treatment devices to bring a drinking water system into compliance. It may be difficult to get consensus participation within a community when faced with the common barriers of funding, technical understanding, operation and maintenance, and property access. If the majority of a community chooses to participate in coordinated POU/POE treatment installations, it may be possible to leverage funding options and coordinate routine maintenance assistance.

In residences occupied by a renter, the renter may need to request approval for the POU/POE treatment installation from a landlord. Depending on the relationship with the landlord, there may be hesitancy to request approval due to fear of retaliation or other unintended consequences. Additionally, landlords may be reluctant to disclose water quality issues to potential tenants.

A water quality analysis is required for any participating household to identify the water quality issues and demonstrate the effectiveness of the treatment system post-installation. Some households may be reluctant to officially document water quality issues because it may become associated with the house for future disclosures during a property sale.

Education and Outreach

The successful implementation of POU/POE treatment within a community may begin with a strategic education and outreach plan to assist households with a better understanding of the water quality issues experienced, treatment technologies effective for the contaminants, assistance available, and the installation process. A well-planned education and outreach effort need to be developed at the local level to address the primary concerns of the community and to better understand community concerns. Education materials need to reflect the languages spoken by the community and be written without technical jargon. The group leading the education and outreach must develop a relationship with the residents and ensure that trust is established and maintained.

Successful POU/POE treatment programs establish regular community meetings with trusted individuals that provide education, answer questions, and dispel any concerns regarding the treatment devices. These regularly scheduled public meetings should serve as educational opportunities to provide O&M training, maintenance guidance, and sampling guidance, and act as reminders for regular servicing.

Installation

The installation of POU/POE treatment requires a professional installer to access the property. The installer will typically work outside the house for a POE installation while access inside the house is required for POU installation. Either scenario may be uncomfortable for a household, especially in more rural communities where people often seek privacy and seclusion.

A household may be reluctant to participate in a POU/POE treatment program out of fear that an official representing the county or local community who participates in the interior or exterior installation may be privy to any code violations or poor living conditions.

There may be a variety of barriers to the installation of the system due to unique plumbing issues and/or physical space limitations for a system that must be addressed by an installer. Case-by-case situations can be challenging for installation, increase costs, and complicate routine maintenance as a result of unique configurations.

Ongoing Access Requirements

When a community collaborates on POU/POE treatment installation or receives support through a funding program, there will likely be a third-party organization responsible for overseeing the success of the installations. The third-party organization may require ongoing access to the POU/POE treatment installation over several years or indefinitely to confirm the treatment system is operating correctly, to complete maintenance, and collect water quality samples. The routine internal access can be a barrier for some households to participate in the installations.

If an installation is completed, the third-party organization may find it difficult to gain access to the system because of a lack of cooperation or active participation from the household resulting in an inability to schedule a visit. Additionally, the same concerns regarding officials identifying sub-standard living conditions remain a concern during the ongoing access.

Hesitancy to Replace Bottled Water

The State Water Board acknowledges that many customers are hesitant to implement POU/POE treatment and instead prefer bottled water. It is important to note that the actual POU/POE treatment devices may not be the sole source of potable water once installed, for example when multiple contaminants exist, and only certain contaminants can be removed (e.g., high levels of nitrate). The USEPA does acknowledge that bottled water is a viable temporary solution, treatment of source water is required for all PWS.

> *"§ 141.101 Use of bottled water.*
>
> *Public water systems shall not use bottled water to achieve compliance with an MCL. Bottled water may be used on a temporary basis to avoid unreasonable risk to health."*[71]

POU/POE treatment is usually the preferred option for NTNC water systems that are required to return to compliance with drinking water standards, as very little of the water used is for domestic purposes, and most of the water is used for processing and irrigation.

ONGOING EDUCATION

The State Water Board and technical assistance providers have both made recommendations to involve the California Department of Education in discussions regarding the establishment of curriculum and educational opportunities in counties or communities where water quality issues may be present. The education efforts can be directed to both students in K-12, as well as adult-centric education when persistent water quality issues are plaguing a community. Further exploration, outreach, and discussions with the Department of Education need to be established to move forward with this plan.

LANGUAGE BARRIERS

Language barriers may exist between the regulatory staff, homeowners, renters, and other customers of water systems which may make it difficult to communicate necessary information with all appropriate parties. Relaying information regarding the necessity for POU/POE treatment due to water quality contamination, the O&M processes, and interactions with those maintaining the systems is a difficulty encountered by regulators, operators, and community stakeholders.

[71] eCFR :: 40 CFR 141.101 - Use of bottled water
https://www.ecfr.gov/current/title-40/chapter-I/subchapter-D/part-141/subpart-J/section-141.101 water.

OWNERSHIP CHANGES

According to the State of California, Department of Real Estate[72], the Real Estate Transfer Disclosure Statement (TDS) describes the condition of a property and, in the case of a sale, must be given to a prospective buyer as soon as practicable and before the transfer of title. The overall intention is to provide meaningful disclosures about the condition of the property being sold or transferred. The statement must specify environmental hazards of which the seller is aware (e.g., asbestos, radon gas, lead-based paint, formaldehyde, fuel or chemical storage tanks, contaminated soil, or water, etc.).

A property owner may be reluctant to participate in a POU/POE treatment installation program because the process may discover an issue or formalize awareness of water quality issues that must be disclosed during a future real estate transaction.

FINANCIAL

The 2021 Needs Assessment report produced Long-Term and Interim Solution projections for POU/POE treatment, which were subsequently used in the Cost Assessment predictions. The data has been simplified in Table 21, below. This data shows the potential widespread use of POU/POE treatment statewide with up to 106 water systems and on the order of several hundred thousand homes needing POU/POE treatment.

Table 21: Modeled Long-Term and Interim Solutions for POU/POE Treatment

System Type	Long-Term, Total # Analyzed	Interim, Total # Analyzed	Long-Term Solutions: POU and POE	Interim Solution: POU, POE, and POU+POE
HR2W list	305	343	106 (35%)	196 (57%)
At-Risk SWSS	455	496	303 (67%)	473 (95%)
At-Risk Domestic Wells	62,607	59,366	36,911 (59%)	55,888 (94%)

POU/POE TREATMENT COST MODEL ESTIMATIONS

The 2021 Needs Assessment methodology for the tables below was discussed in the section Cost Assessment, above. The information in the following tables is presented to provide context for the following section of the Report.

[72] State of California, Department of Real Estate, Disclosures in Real Property Transactions, https://www.dre.ca.gov/files/pdf/re6.pdf

Table 22: Estimated Capital Cost for POE/POU Treatment

Treatment	Capital Cost per Connection	Installation Labor cost per Unit ($100/hr.)	Admin/Project Management	Communication Cost
POE GAC Treatment	$3,700[73]	$1,000	$1,000	$300
POU RO Treatment	$1,500[74]	$200	$1,000	$300

Table 23: Estimated Annual Operations and Maintenance (O&M) for POE/POU Treatment

Treatment	Annual O&M per Connection	Operator and Communication Labor ($100/hr.)	Analytical	Total
POE GAC Treatment	$410 (Prefilter and GAC Replacement 2x/year[75])	$300	$250 ($1,252x/ year[76])	$960
POU RO Treatment	$100 (Prefilter and Membrane Replacement 2x/year[77])	$300	$40 - $110 (2x/yr[56])	$440 - 510

There are significant costs associated with installing POU/POE treatment devices. **The Needs Assessment estimated that between $166 million and $666 million, excluding O&M, was needed for POU/POE treatment in California.**[78] Additional complexities beyond the amount of funding include successfully getting funding to disadvantaged domestic wells owners and state small water systems since the State Water Board typically does not typically enter into funding agreements with these entities. The State Water Board is currently trying to develop funding methods for these purposes through its County-wide and Regional Funding Program.[79] However, it is possible that demand both in terms of technical assistance capacity and program funding may outpace supply.

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

[74] Vendor provided costs.

[75] Based on vendor recommendations and pricing.

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

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

[78] Page 77, Needs Assessment: https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2021_needs_assessment.pdf

[79] https://www.waterboards.ca.gov/safer/funding_solicitation.html

TECHNICAL

TECHNICAL PREREQUISITES

The technical success of POU/POE treatment devices can be limited by site-specific sanitation and water quality conditions. General technical concerns for all water system types using POU/POE treatment devices include, but are not limited to:

- Source water supply is of adequate production
- Source water supply is bacteriologically safe
- Changes in source water quality
- Registration and Standards Issues, for new or emerging contaminants and POE units
- Waste disposal is efficient, available, and cost-effective
- Nitrate concentrations are low enough to ensure consistent treatment
- Well construction has an adequate sanitary condition, including a proper sanitary seal
- No excess level of competing ions or foulants exist (GAC or adsorptive media)
- Total dissolved solids (TDS) are less than 500 mg/L for RO applications.

REGISTRATION AND STANDARD ISSUES

Several contaminants regularly found in California do not have NSF/ANSI performance standards or the available standards do not directly correspond to California's more restrictive maximum contaminant levels. Some examples of these include:

- High concentrations of nitrate in source waters
- 1,2,3-TCP[80]
- Hexavalent chromium[81]
- PFAS compounds
- Manganese

Additionally, there are challenges with the lack of available certified POE devices due to perceived poor manufacturer return-on-investment, lack of certification alternatives for custom-filled POE devices, poor reliability of equipment, and the need for standardized models that include performance-indicating devices and extended battery life.

Opportunities exist in the Registration and Standardization sector that include new standards being developed by USEPA for requiring higher water efficiency, new NAMA-certified[82] vending machines for use in schools and businesses, and new countertop units that simplify operations. The subsequent sections provide more detail on some of these challenges and opportunities.

[80] Only POE should be utilized for 1,2,3-TCP due to inhalation risks. No POE standard exists for the California MCL.

[81] Current standards exist for the less restrictive Federal total chromium level of 100 μg/L.

[82] National Automatic Merchandising Association (NAMA) Machine Evaluation Program website: https://namanow.org/voice/machine-evaluation/

Nitrate – Lack of POUs for High Concentrations

A treatment gap currently exists for high levels of nitrate found throughout California, as California-registered devices are only considered effective to treat source nitrate (as N) levels up to 25 mg/L. Nitrate is a primary contaminant that requires immediate treatment and action to ensure public safety, specifically for pregnant and nursing women and infants[83]. Unfortunately, nitrate is ubiquitous in the Central Valley and Monterey County, as well as other parts of the State due to its widespread use as a fertilizer. Nitrate levels in California can range from non-detect (ND) to as high as 204 mg/L, as shown in Figure 21 below. Approximately half the counties in California have at least one water system and domestic well that potentially exceeds the ability to use existing POU/POE treatment technology for nitrate. A significant barrier in technology exists between the highest nitrate levels that can be treated and existing drinking water treatment.

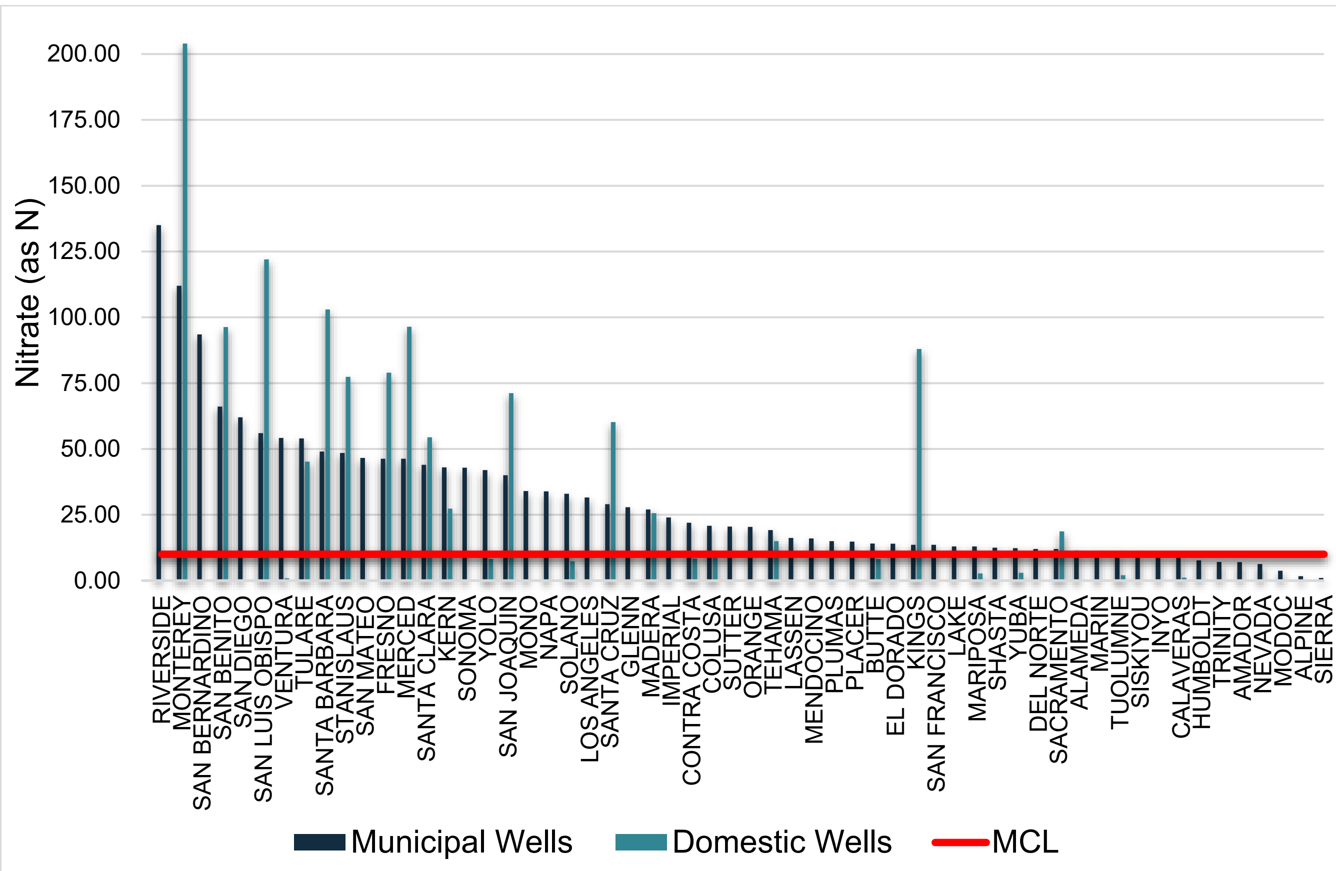

Figure 21: Highest Nitrate Concentration by County[84]

[83] Nitrate Factsheet and Information on Blue Baby Syndrome
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/nitrate/fact_sheet_nitrate_may2014_update.pdf

[84] Appendix J: Nitrate Data by County Methodology

1,2,3-TCP Treatment – No POE / Custom-Filled GAC

Only POE should be utilized for 1,2,3-TCP due to inhalation risks. California adopted a California-specific maximum contaminant level for 1,2,3-TCP and began implementation in January 2018[85]. The NSF Joint Committee adopted criteria for the addition of 1,2,3-TCP reduction claims under the 2021 edition of NSF/ANSI 53, unfortunately, the threshold is well above California's MCL. Furthermore, 1,2,3-TCP has low to moderate adsorption capacity for GAC and may require larger GAC treatment systems. To date, there are limited certified devices[86] available on the market to address volatile organic chemicals and there are no certified devices available on the market to address 1,2,3-TCP. Technically, it may be feasible to custom-fill a treatment vessel with GAC. However, there is no performance standard for custom-filled vessels, therefore 1,2,3-TCP treatment reliability cannot be ensured. There are plans to adopt 1,2,3-TCP testing into NSF/ANSI 53[87].

Hexavalent Chromium – No POU/POE Standard for California Regulatory Levels

NSF/ANSI Standard 58-2020 RO Drinking Water Treatment Systems[88] outlines the contaminant reduction requirements for several constituents, including hexavalent chromium in RO devices. However, the maximum treated water constituent levels for certification can be as high as 100 µg/L for total chromium which includes hexavalent chromium, which is the same as the federal MCL. This concentration is an order of magnitude higher than the proposed MCL of 10 µg/L in the State of California.

Per- and Polyfluoroalkyl substances (PFAS) Compounds Treatment

The PFAS compounds treatment field is rapidly developing and changing. Activated carbon, reverse osmosis, or anion exchange treatment can be effective in reducing concentrations of PFAS compounds in drinking water. Testing is ongoing to certify that available POU and POE treatment devices meet the minimum requirements of NSF/ANSI 53 and 58, however, the treated water constituent levels for certification are still changing as more is learned about these constituents.

Uranium Treatment

A presentation by USEPA[89] showed that a 99% reduction in Uranium was achieved by many off-the-shelf POU RO devices. However, there are currently no units NSF-certified specifically to reduce uranium. However, many RO systems and salt-based softeners are certified to reduce a byproduct of decaying uranium known as radium 226/228. Systems certified for the reduction of radium may also be effective at reducing uranium, but customers must have

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[85] California Code of Regulations, Section 64444 was adopted for 1,2,3-TCP in 2017.

[86] On June 21, 2022, Aquion, Inc. (3 Rainsoft devices at a flowrate of 8.6 gallons per minute)

[87] Andrew, 2022
https://wcponline.com/2022/03/14/123-trichloropropane-reduction-under-nsf-ansi-53/

[88] NSF/ANSI 58-2020 - Reverse Osmosis Drinking Water Treatment Systems
https://webstore.ansi.org/Standards/NSF/nsfansi582020

[89] Uranium Occurrence and NSF/ANSI Standards for POU Systems
https://cfpub.epa.gov/si/si_public_file_download.cfm?p_download_id=532936

samples of the treated water collected and verified by a state-accredited laboratory to determine if removal is occurring. [90]

Manganese Treatment

In 2023, a proposed revision to the notification and response level was initiated by the SWRCB[91] to change the notification level (NL) to 0.02 mg/L (currently 0.5 mg/L). In addition, the proposal includes changing the response level (RL) to 0.2 mg/L (currently 5 mg/L).

A manganese (Mn) secondary maximum contaminant level of 0.05 mg/L has been established to address aesthetic (discoloration) issues. In addition, there is a health-based notification level of 0.5 mg/L based on neurotoxic risk at higher concentrations. Similar advisory levels for manganese have been established by the US EPA, which has a manganese health advisory level of 0.3 mg/L (USEPA, 2004), and the World Health Organization, which has a manganese health guideline level of 0.4 mg/L (WHO, 2004).

Manganese can cause fouling and scale on RO and aeration equipment. In GAC treatment units, manganese can compete for adsorption sites that are needed for the removal of other contaminants. Manganese is naturally prevalent in two oxidation states, Mn^{2+} or manganous ion, and MnO_2(s) or manganese dioxide. NSF/ANSI 42 Drinking Water Treatment Units– Aesthetic Effects includes test protocols and criteria for verifying the effectiveness of manganese treatment systems. These protocols address all forms of treatment for iron and manganese, including the typical oxidation and filtration technologies, and any others that might be used. Although NSF testing methodologies are available for both POU and POE systems, the vast majority of systems being used for the treatment of iron and manganese are POE due to aesthetic purposes (staining). The testing methodologies of this certification differ from the NSF/ANSI performance standard certifications involving health-related effects.

A recent study determined whether POU devices are efficient at reducing dissolved manganese concentrations in drinking water. The study concluded that pour-through filters (which cannot be used for compliance) were identified as the most promising POU devices with removal greater than 60% at 100% rated capacity, and greater than 45% at 200% rated capacity under influent manganese concentrations of 1 mg/L. Under-the-sink filters using cationic exchange resins (i.e., water softeners) were also efficient at removing dissolved manganese but over a shorter operating life. Manganese leaching was also observed beyond their rated capacity, making them less robust treatments.[92]

POE Standards - NSF/ANSI DWTU and ASSE

There are no federal regulations for residential water treatment filters, purifiers, and RO systems. Organizations create voluntary national standards and protocols that establish

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[90] Drinking Water, Plumbing, Pools, Wastewater FAQs | NSF
https://www.nsf.org/knowledge-library/faq-water

[91] Drinking Water Notification Levels | California State Water Resources Control Board
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/NotificationLevels.html

[92] Annie Carri?re, Manon Brouillon, Sébastien Sauvé, Maryse F. Bouchard & Benoit Barbeau (2011) Performance of point-of-use devices to remove manganese from drinking water, Journal of Environmental Science and Health, Part A, 46:6, 601-607, DOI: 10.1080/10934529.2011.562852

minimum requirements for the safety and performance of these products to treat drinking water. As previously discussed, NSF and IAPMO are the two primary ANSI-accredited agencies that currently provide standards, testing, and methodology for device certification.

POE treatment units obtain certification through various NSF/ANSI performance standards depending on the component of the treatment, as previously discussed in the Report. A cross-reference was established for NSF/ANSI 61 and NSF/ANSI DWTU to extend the coverage from material safety of treatment units, media, and housing to provide certification for POE treatment. These changes included the removal of the exclusion of POE drinking water treatment devices and the creation of new exposure protocols for POE media, non-media components, and systems based on a combination of aspects. This cross-referencing establishes that units certified under NSF/ANSI 61 certification for materials safety may not necessarily be certified for contaminant reduction or structural integrity performance.

ASSE has created new listing criteria that include aspects of performance testing but may not include implementation procedures, requirements of installation by a trained professional, and/or monitoring requirements to ensure no adverse effects of treatment. A few examples of the expanded listing criteria include the following:

- ASSE LEC 2006 - 2020 Point of Entry Reverse Osmosis Systems
- ASSE LEC 2008 - 2021 Point of Entry Anion Exchange – Nitrate Reduction
- ASSE/IAPMO IGC 370 - 2021e Point of Entry Regenerable Well Water Filtration Systems

IAPMO and ASSE have recognized the deficiencies related to performance certifications and have begun collaboration with industry professionals to begin establishing POE performance standards more explicitly. The SWRCB continues to collaborate with the certifying bodies to ensure that standards and certifications are created and implemented with public health as the primary objective.

Lack of Certified POE Devices – Scaling Up and Reliability

In addition to a lack of certified treatment units for hexavalent chromium, POE treatment capabilities are lacking for high flowrates and high contaminant level scenarios for commonly treated contaminants. Most POE applications have historically been designed and focused on mainly aesthetic characteristics (softening, taste, etc.) and not on chemicals with health effects regulated by the State of California. For example, nitrate, arsenic, and radiological treatment technologies have relatively low thresholds for treatment flows and constituent levels compared to the high values found throughout California.

Applicability of Drinking Water Treatment Unit Standards to Custom-Filled POE Devices

Only a small number of POE units are certified for organic reduction. These vessels must be maintained correctly. According to “Section 4 – Materials” in NSF/ANSI Standard 53-2020, POE drinking water treatment units shall conform to the protocol in NSF/ANSI/CAN 61. This applies to materials that come into contact with drinking water, including the vessels and media contained in the vessel. However, ensuring proper operation of the material contained within the vessel after the media is spent and replaced is critical. Based on conversations with certifiers during a POU/POE Outreach Workshop with industry professionals, stakeholders explained that professionals are likely servicing the units and are aware of the media specifications; further, audits are conducted annually by certifiers to verify certified products. Stakeholders suggested media certification could best be verified by monitoring manufacturing procedures.

WATER EFFICIENCY OF EQUIPMENT

California Drought and USEPA WaterSense

POU/POE treatment is primarily focused on water quality issues, and not drought-related challenges. However, the drought has led to degraded water sources which may cause fluctuating or worsening water quality in the State. On March 28, 2022, Executive Order N-7-22 was signed by Governor Gavin Newsom, proclaiming states of emergency across all counties of California, due to extreme and expanding drought conditions. Executive Order N-7-22 calls for water conservation, using water more efficiently both indoors and out.

SaveOurWater[93] and WaterSense educate on ways to conserve water. WaterSense is a voluntary partnership program sponsored by the USEPA. It's a resource for the general public and a label for water-efficient products. SaveOurWater contains guides with tools and tips on various water conservation topics and news.

In January 2022, USEPA's WaterSense issued a Notice of Intent to Develop a Draft Specification for POU RO Systems[94]. RO systems can generate a significant amount of water waste. USEPA's WaterSense plans to build on existing standards to encourage consumers to install more efficient RO systems. According to the USEPA:

> *"While RO systems can improve water quality, these systems can also generate a significant amount of water waste to operate. For example, a typical POU RO system will generate four gallons or more of reject water for every gallon of permeate produced. Some inefficient units will generate up to 10 gallons of reject water for every gallon of permeate produced. In recent years, membrane technology has improved and some POU RO systems have been designed to operate more efficiently, with some manufacturers advertising a 1:1 ratio of permeate to concentrate production, meaning only one gallon of reject water is generated for each gallon of treated water. Because there is a range of water efficiencies represented within the RO system market, EPA believes these systems could be a suitable product category for WaterSense labeling. As with all WaterSense labeled products, an RO system that bears the WaterSense label would be required to meet prescribed performance standards (e.g., minimum contaminant removal rates) to ensure the product performs as well or better than typical, less efficient RO systems.*

[93] SaveOurWater
https://saveourwater.com/

[94] U.S. EPA 815-R-06-010 (April 2006) *Point-of-Use or Point-of-Entry Treatment Options for Small Drinking Water Systems*
https://www.epa.gov/sites/default/files/2015-09/documents/guide_smallsystems_pou-poe_june6-2006.pdf

There are no current federal requirements that regulate the water efficiency of POU RO systems. Due to the water-intensive nature of RO, WaterSense does not intend to promote the installation of RO systems for all applications or encourage their use over other water treatment technologies that do not waste as much water (e.g., filtration systems). However, WaterSense recognizes that RO systems might be appropriate in certain applications, depending on the user's desired water quality, characteristics of the incoming water supply, and consumer perception and preferences. In these instances, WaterSense intends to help consumers identify and purchase more water-efficient models, thereby contributing to water and cost savings for users. As described in the NOI, WaterSense estimates that replacing a typical POU RO system with a more efficient system can save approximately 4,000 gallons of water per household per year."

The WaterSense standards initiated by the USEPA present an excellent step towards greater water efficiency applicable to POU and POE treatment systems, particularly in California's drought-prone environment. ASSE created certification standards related to the water efficiency of RO treatment to aid in conservation efforts (ASSE 1086-2020[95]). This certification is meant to determine if the products are effectively minimizing the amount of rinse water typically sent to drains during RO treatment. The membrane life test ensures that the flow through a system does not decrease and performs for up to one year. ASSE is currently working with USEPA to possibly add or require this certification standard for RO systems under the WaterSense program.

Nitrate at Schools – Water Fountains and Bottled Water Filling Stations

Drinking water fountains and bottled water filling stations at schools can be equipped with POU and POE technologies to remove nitrate, arsenic, etc. contaminants from the source water. A struggle with school-related water quality treatment is the necessity to post signage that is understood by the population and has methods to disable access to drinking fountains and sinks which may cause negative health effects. As a result, the SWRCB requires all domestic water supply locations to be equipped with POU/POE treatment; some of these include bathroom sinks, classroom sinks, breakroom sinks, drinking fountains, and cafeteria facilities. These units also require ongoing monitoring because usage of the POUs at drinking fountains is highly variable depending on the season and school population in attendance.

There is a need for these treatment units to provide adequate capacity, testing, and ease of access to provide ongoing treatment objectives at schools. According to industry experts, there has been a shift and broader demand to increase the capacity, removal efficiencies, and availability of these units.

Countertop Pump-Assisted RO Units – Efficiency and Performance

As previously mentioned, there are multiple variations of POU units available for home installations. Historically, POU units were installed under the sinks with the existing piping. However, new technology in the form of a countertop unit is available that only requires a connection to a standard kitchen faucet tap and they have more efficient removal due to small-

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[95] ASSE Standard #1086-2020 (Download) - ASSE International Webstore
https://assewebstore.com/asse-standard-1086-2020-download/

scale pumps being added to the units. In addition, these countertop units are easier to maintain and install. These units could be more desirable for domestic homeowners and water systems that don't want to pay for under-sink installations, and they may have an easier time maintaining and operating them with low technical expertise (e.g., may not require a plumber). The countertop units are a bit larger than a standard-size coffee maker and can treat the same contaminants as the under-sink units.

Figure 22: AquaTru Countertop RO Unit (Non-Plumbed)[96]

RESILIENCY OF EQUIPMENT AND NOTIFICATION

In addition to other concerns around standards and certifications, there are also issues with ensuring the resiliency of the equipment and proper notification of treatment failures. If notifications are inadequate or fail to work properly, the water may become contaminated, and the residents are unaware of the unacceptable water quality. If notifications are too frequent, residents may be tempted to ignore them.

Identification of a Device Failure or Breakthrough

Identifying when a POU/POE treatment device has failed is paramount to a successful implementation of POU/POE treatment. Currently, performance indication devices use totalizing flowmeters in coordination with estimated breakthrough and total dissolved solid/electroconductivity meters as their levels should correlate with contaminant removal. Treated water samples must be collected to confirm performance indicators reflect actual treated water quality.

[96] This product is pictured for visualization-purposes only and SWRCB does not endorse any products shown.

Registered products typically can treat a specified volume of raw water at a specified contaminant concentration and instantaneous flow rate. Challenges persist with POU/POE treatment failure and timely identification of those failures due to the following:

- The unit has not been sized correctly or short-circuiting/channeling occurs causing bypassing of the media
- Issues with backwash/regeneration processes of IX resulting in less capacity than anticipated
- The timing of laboratory sample gathering
- Competing constituents adsorb/exchange
- Changes in raw water contaminant concentrations
- Quick fowling of RO membranes due to influent water quality (e.g., hard water)

Lack of a Standard Performance Indication Device

Many POU and POE units lack an integrated performance indication device (PID). These PIDs are required by regulation, specifically §64418.2. (4) (5) states:

> *"(4) be equipped with a mechanical warning (e.g., alarm, light, etc.) that alerts users when a unit needs maintenance or is no longer operating in a manner that assures the unit is producing effluent meeting state and federal drinking water standards unless the device is equipped with an automatic shut-off mechanism that prevents the flow of water under such circumstances; and (5) be equipped with a totalizing flow meter if:*
>
> > *(A) the POU's treatment efficiency or capacity is volume-limited; or*
> >
> > *(B) if requested by the State Board following a determination that information about the quantity of water treated by the POU is necessary to assess POU efficiency."*

The State Water Board and stakeholders recognize the important role of PIDs when using POU/POE treatment. Progress is being made in new PID technology. A new PID technology of particular interest is cloud-capable technologies allowing POU and POE devices to communicate TDS, flows, and time-based maintenance and service reminders to customers. It was indicated during stakeholder outreach that this new technology has an estimated cost of $5 per device for cloud connectivity and provides reliability previously unavailable for homeowners, customers, and service providers by offering a full-time data stream.

Cloud technologies can be implemented via a QR code that connects a data logger to either a Wi-Fi router or to a cellphone via Bluetooth for transmission to the cloud service provider. Programming will allow adjustable parameters, low battery alarms, reminders to connect devices, provide low voltage warnings, and fault warnings, and provide data to operators that would previously require entry to the home or business. The POU/POE treatment vendors indicate that the new cloud-based technologies are an important improvement in PIDs.

Notification methods can be programmed through the cloud and provide notifications (via an application) on smartphone devices, sent via text messages, or emailed to the interested party. The interested parties can also be programmed to receive what kind of notification, method of notification, and who specifically receives the notification in the cloud—making ongoing maintenance and operations easier in areas where there is access to the internet and cellular connectivity. This technology may be problematic in remote rural areas with no internet connectivity.

EC Meter and Totalizers – Short Lifespan and Battery Issues

POU devices, as mentioned above, are required to be equipped with PID devices. However, these components are subject to problems with battery life and component failures in the field because the devices are generally battery-operated and not equipped with physical connections to the power supply of a home or building. This operational need could be addressed using cloud technology. Cloud capability could aid in the reliability of POU/POE treatment by better communicating performance and maintenance needs, as well as providing a picture of the current operational efficiencies of the units.

PUBLIC WATER SYSTEM CHALLENGES

Engineering Firm Experience

Assistance from an engineering firm may be beneficial for some small water systems implementing POU/POE treatment. Although not explicitly required, a professional engineer may complete a study demonstrating that centralized treatment is not economically feasible, recommend appropriate POU/POE treatment units, prepare a pilot study protocol, oversee the pilot study, prepare the report, conduct the customer survey, and prepare permit application documents.

Before contracting with an engineering firm, a careful review of qualifications and POU/POE treatment experience is recommended. Knowledge of POU/POE treatment regulations and local water quality problems should be verified. Reviewing previous projects and contacting references can be important steps in the selection process. Small water systems that have less than 200 connections often have limited experience with resolving water quality problems.

Coordinating Professional Services

After pilot approvals are obtained from the State Water Board, there are still logistical challenges associated with implementing POU/POE treatment projects. Specifically, installation and maintenance require a certified operator to coordinate professional services. The TA Outreach opportunity highlighted that there is a need for “master contracts” to encompass all of the POU/POE treatment services to make them more streamlined.

STATE SMALL WATER SYSTEM AND SELF-SUPPLIED CHALLENGES

Assessment of Water Quality at Private Homes

The State Water Boards’ 2021 Drinking Water Needs Assessment outlines the water quality risk assessment methodology for State Small Water Systems and Domestic Wells on Page 63. There are an estimated 77,973 domestic wells and 611 State Small Water Systems in California in the high-risk category. The top three counties in the high-risk category for domestic wells are Fresno, Stanislaus, and Sonoma. The top three counties in the high-risk category for State Small Water Systems are Monterey, Riverside, and Kern Counties. The state-wide characterization approximates the risk and assists tremendously with identifying potentially vulnerable regions in the State. However, as stated in the report, "these proxy data do not assess the compliance of any individual well or system. The purpose of this risk map analysis is to prioritize areas that may not meet primary drinking water standards to inform additional investigation and sampling efforts." Knowing water quality specific to a source is imperative to making informed treatment decisions.

Assessment of Treatment Needs at Private Homes

There are hurdles in assessing the treatment required to reduce a target contaminant in private homes once a target contaminant is identified. There can be other constituents present (e.g., iron, manganese, silica, or others) in source water that may affect the overall treatment approach selected. The type of contaminant (e.g., inhalation risks) may also play a role in the selected treatment approach. The resources needed may increase due to an increase in the number of domestic wells potentially in need of treatment causing a lack of capacity to complete assessments and implement treatment.

Lack of Programs/Resources in Place

The State Water Boards have made funding available to Counties and Regional partners to implement programs to address water shortage and address water quality issues for private wells and self-supplied households. A few Counties and NGOs have received funding and are currently implementing these programs at the local level. However, these current programs exist in less than 25% of the counties in the State. Counties and other partners are needed in the impacted areas where programs do not yet exist.

Better Support and Guidance to Residents/Counties/TA Providers

For POU/POE treatment applications in public water systems, the State Water Board's permitting process requires an in-depth individual system analysis to determine compliance with drinking water regulations. Due to a large number of private wells potentially benefiting from a POU/POE treatment solution, the same in-depth analysis required for the public water system is not viable. The State Water Board should work with partners to develop and make available best practices and guidance on POU/POE treatment implementation.

For the operation and maintenance of POU/POE treatment devices, a shared service administration approach should be considered. Such a strategy may reduce the burden on residents and help to address certain equity concerns associated with POU/POE treatment. The success of shared operation and maintenance would depend upon effective community outreach, the use of qualified professionals, and careful management. Adequate financial support (possibly from the State Water Board) would be essential.

Need Initial Testing and Follow-Up Sampling

Each private well and/or self-supplied household requires initial sampling to fully understand raw water quality. Ongoing water quality sampling is required to ensure POU/POE treatment devices are functioning well and removing contaminants as expected. Due to a large number of private wells and self-supplied households potentially needing POU/POE treatment to correct water quality issues, the cost and time needed to conduct the sampling balloon quickly.

Alternatively, less sampling could be undertaken but this may reduce the overall robustness of the treatment.

Stakeholders suggested a regional sampling approach which could reduce the number of samples necessary while having minimal negative impact on the reliability of the treatment. Further discussion and thought are needed to determine if any plans for reduced sampling could maintain reliability and treatment performance.

REGULATION & LEGAL

REGULATORY CHALLENGES

The adoption of the POU/POE treatment regulations in 2016 gave the State Water Board and public water systems further tools to address compliance. The regulations outline a robust process to ensure the successful and sustainable implementation of POU/POE treatment.

Regulation of water systems with POU/POE treatment units can be challenging due to a variety of issues, notably: the piloting process, data management complications, follow-up and communication with operators, response to exceedances, multiple treatment plants (number of installed treatment devices), enforcement, community outreach, acceptance, and permitting. **During the local government workshop, participants expressed concern that the permitting process can be cumbersome and, as a result, potentially delay access to safe potable water.**

The regulations require continual supervision of each treatment unit within a public water system. During the piloting phase, monitoring a unit's treatment efficacy is challenging due to the necessity of constant communication between the water system, residents, and regulators. Water systems that install POU/POE treatment are less than 200 service connections, as required by regulation, but each unit is treated as an individual treatment plant requiring thorough oversight and a range of program tracking including water quality monitoring, monitoring frequencies adjustments, O&M, and response to any abnormal performance.

Figure 23: Regulatory Challenges Diagram

County Programs – Regulatory Developments

While the state adopted POU/POE treatment regulations in 2016 for public water systems, the state small water systems and self-supplied systems do not have a framework in place to ensure successful POU/POE treatment implementation. We are aware of two counties that are engaged in efforts to address this gap, including Placer and Monterey County.

Monterey County is working on an ordinance, that if approved, would allow for POU/POE treatment implementation with a local framework for state small water systems (with 5 to 14 connections) and local small water systems (with 2 to 4 connections).

The existing Placer County Code (PCC) allows for the installation of individual domestic wells for lot creation. During the initial Environmental Review for projects utilizing domestic wells as the water supply source, wells are required to be installed and tested. If water quality testing results do not meet state and county public health standards, and the applicant is unable to resolve the water quality issue (without treatment), then the applicant is required to drill another well on the proposed lot and wells on all other proposed lots with additional water quality testing for each well to ensure water quality standards are met. If the applicant is unable to demonstrate adequate water supply on each of the proposed lots, then the project application would be deemed incomplete by the Environmental Review Committee, and the project would be unable to move forward.

A recent project in a major subdivision encountered elevated levels of arsenic and nitrates above water quality standards within an individual well. The applicant proposed the use of individual water treatment devices to reduce chemical concentrations to meet water quality standards. Placer County Code does not provide approval criteria for use of individual water treatment devices and the project was deemed incomplete due to a lack of evidence of well water adequate for domestic use. The determination was appealed and denied by the Planning Commission and then appealed and denied by the Board of Supervisors (BOS). At the BOS hearing, staff was directed to return to the Planning Commission to present alternatives to the existing County requirements to allow for the use of individual water well treatment devices to meet water quality standards for lot creation.

In response to the BOS guidance, county staff is currently proposing PCC amendments to its ordinances. A summary of the proposed PCC amendments is as follows:

- Require deed restrictions for lots that do not meet water quality standards, including:
  - Written notification to future property owners about the specific water quality contaminants and related health concerns
  - Requirement for an individual POE water treatment device to be installed, tested, and approved by Environmental Health to address site-specific contaminants before approval of a building permit
  - Requirement for property owners to conduct ongoing operation and maintenance of the treatment device and recommendations for routine water quality testing.
  - The requirements of the deed restriction shall be binding for all future property owners
- Chapter 13 allows Environmental Health, on a complaint basis, will enforce the installation and maintenance of a well and water treatment device consistent with the deed restriction
- Require a well on 10% of proposed lots for Major Subdivision projects with 4.6 acres or greater average size lots to determine the adequate water supply for tentative map approval creating new lots. Previously, all proposed lots potentially required a well to be drilled with no guarantee of project approval if water quality results didn’t meet water quality standards
- Adjust the requirement for well construction, beyond the initial 10% if applicable, to align well construction to take place along with other property improvements at the final map or improvement plan approval stage
- Amend minor subdivision provisions to be consistent with major subdivision requirements
- General language clean-up to add consistency and clarity. For example, lot size adjustments to be consistent with zoning code (square feet converted to acres), clarifying existing terms such as public health standards, and state or county-regulated water system

The proposed process to demonstrate water supply when contaminants are present includes:

- Installation and sampling of wells required at Environmental Review
- If a well has contaminants greater than the Maximum Contaminant Levels (MCLs), then the owner can opt to a utilize treatment unit
- If the treatment device reduces contaminants below the MCL, the project may proceed to the Tentative Map approval
- Conditions of Tentative Map approval are set to require wells and testing on all parcels before the Final Map or Improvement Plans (whichever comes first)
- Lots with supply wells that require treatment will have deed restrictions to notify future owners of the treatment requirements

The proposed PCC changes were presented to the Placer County Planning Commission on June 9, 2022, and will be presented to the Board of Supervisors in the coming months for final approval and adoption.

LEGAL CHALLENGES

POU implementation can only proceed if 50% or more of the customers support the treatment approach but compliance is not achieved until 100% of the customers participate. Public water systems are currently encountering challenges in obtaining 100% participation. These challenges may be associated with a lack of authority (e.g., access agreements, local ordinances, or bylaws) to require access to the home[97] to install, maintain, and monitor the POU treatment. As a result, some public water systems without legal resources and proper authorities in place struggle to implement a POU/POE treatment solution to achieve and maintain compliance. As part of the implementation of a POU treatment program, a public water system is required to adhere to.

Specifically, sections 64418.3(a)(3) and 64418.3(a)(7) of the California Code of Regulations state the following:

> *Section 64418.3(a)(3) of the California Code of Regulations states, "The public water system's authority to require customers to accept POUs in lieu of centralized treatment and to take an action, such as discontinuing service, if a customer fails to accept POUs"*
>
> *Section 64418.3(a)(7) of the California Code of Regulations states, "The authority, ordinances, and/or access agreements adequate to allow the public water system's representatives access to customers' premises for POU installation, maintenance, and water quality monitoring, as well as the surveys necessary to meet paragraph (a)(2)"*

This is one of the most significant hurdles to POU/POU treatment and the requirement is based on USEPA mandates. When compliance is not achieved and the water system faces penalties for failing to respond, it often brings up legal and ethical questions about disconnecting residents that refuse to participate in the program or fining specifically those

[97] Washington does not permit POU/POE treatment solutions due to compliance issues but also due to the legal issues associated with private property rights when entering a private owner's home.

homes that fail to participate after multiple attempts as education. There are additional regulatory hurdles discussed in the next section.

RECOMMENDATIONS

The recommendations developed below are based on stakeholder outreach, literature research at both a national and state level, and a survey of California counties on their experiences with POU/POE treatment devices. These recommendations are designed to assist in the development of a statewide POU/POE treatment device program that is equitable, sustainable, and can expeditiously meet the health needs of public water systems, state small water systems, and domestic well owners.

Table 24: Summary of POU/POE Program Recommendations

#:	Topic:	Description:
1	Inclusion of Equity Assessment on POU/POE Treatment Implementation	In disadvantaged communities, historically marginalized communities, and communities with high pollution burden (e.g. high CalEnviroScreen scores), any State grant-funded feasibility study that proposes POU/POE treatment as its solution should also include an equity assessment. The equity assessment will evaluate if larger investments, beyond current funding limits for alternative solutions, may be more appropriate for the community.
2	POU/POE Treatment Demographics	The State Water Board should continue to monitor and annually publish on its website the locations and demographics of where POU/POE treatment is utilized for public water systems.
3	Prioritize POE Treatment for CWS	Implement a programmatic shift to prioritize POE over POU treatment for communities where it is anticipated that the POU/POE treatment devices could be in place as a de facto long-term solution. This is particularly important for communities that are in areas with high pollution burdens (e.g., high CalEnviroScreen scores). This recommendation must be coupled with subsequent Technical Recommendations that develop additional resources to increase the availability of certified POE treatment devices in California for all needed contaminants.

#:	Topic:	Description:
4	Lack of Educational Materials	An appropriate variety of educational materials should be developed and made available to those who will manage or be associated with POU/POE treatment systems.
5	Educational Materials for School-Aged Children	School-aged children may be best served by educational materials prepared in multiple languages in collaboration with the California Department of Education and existing environmental programs in the State, such as the CalRecycle initiative known as the California Education and the Environment Initiative (EEI).
6	Regularly Scheduled POU/POE Stakeholder Meetings	Regularly scheduled community meetings should be established with trusted individuals that can provide education, answer questions, and dispel any concerns regarding the treatment devices. These meetings may include materials developed in previous recommendations and should be performed in a way to address any language barriers.
7	Develop Cohorts for CWS	A shift toward POE devices is recommended to facilitate harmonious resident and water system personnel interactions. Additionally, the education and development of cohorts of specially trained operators are recommended. These cohorts of operators ideally would be selected from local communities where large numbers of POU/POE treatment devices are present to develop the local workforce and help to overcome potential cultural and linguistic barriers.
8	Elimination of the California-Registration Process	For contaminants that have a federal maximum contaminant level that is equivalent to a state maximum contaminant level, the national standard and certification process is recommended to be directly accepted in California. This would eliminate the California registration process and those resources would be diverted and supplemented toward a standard and certification process for California-specific maximum contaminant levels. The first four contaminants bulleted above would be the State Water Board's priority, while subsequent contaminants would be reprioritized depending on future regulatory development but are currently recognized needs.
9	Focus Standards, Certification, and Development of POE Devices	The State Water Board recommends substantial focus be placed on developing standards and/or certifications for POE devices for use in California and elsewhere. The following issues should be considered: NSF/ANSI-61 certification, contaminant reduction, best practices for

#:	Topic:	Description:
		custom-filled devices, and water efficiency, particularly for reverse osmosis products.
10	Assess Disinfection Alternatives	An assessment of the effectiveness of disinfection alternatives, such as UV disinfection, is recommended to address pathogenic contamination as a potential barrier to POU/POE treatment usage.
11	Enhancement of POU/POE Performance Indication Devices	Additional development support for products that enhance POU/POE treatment performance indicators, including new Bluetooth services that enable real-time performance data logging, is recommended to provide customers with a higher level of trust in their water quality and minimize operator maintenance.
12	Separate Technical and Regulatory Processes for Interim and Long-Term Solutions	The creation of two separate technical and regulatory processes should be considered for interim measures and longer-term compliance solutions. For interim solutions, limited planning and piloting would be performed but enhanced monitoring would be required of operational devices. For longer-term solutions, standard planning, piloting, and community development work would be required and existing information from any data gathered during the interim phase could be utilized.
13	Streamline Funding Processes for Interim Solutions	Although funding programs exist, there is a need to expedite and streamline the process, particularly for interim measures. The State Water Board is currently reviewing its funding process and its interaction with its regulatory program to seek time efficiencies. It is recommended that this work continue and address interim measures.
14	Expand County-wide and Regional Programs	It is recommended that continued outreach be performed to ensure that the entire State is covered through either a County-wide program or a Regional Program.
15	Pilot Projects for Funding Programmatic Support Needs	Funding for programmatic support needs such as standardization and certification of devices, performance indication device research, and workforce development are recommended to be addressed through pilot projects subsequently discussed in the report.

#:	Topic:	Description:
16	100% Compliance in Community Water Systems	USEPA should amend the Code of Federal Regulations to allow partial implementation using POU/POE treatment to allow more expansive applications and encourage implementation when other methods are not feasible as an interim solution. There should be language included to disqualify users who refuse to participate in a POU/POE treatment strategy from the overall compliance calculation. This could allow homeowners of CWS that refuse the installation or compliance protocols of POU/POE treatment to sign an affidavit confirming: a. <u>The water received fails to meet State and Federal drinking water standards, and</u> b. <u>They assume liability for the health of persons accessing water at the service connection</u>
17	Constructed Conveyances – Amendment to Water Code Section 106.4(b)	It is recommended that Section 106.4 (b) be amended to prohibit new residential development in locations where surface water sources are not treated by a public water system (e.g., constructed conveyance, lakes, etc.).
18	Installation of POU/POE Treatment as an "Emergency Response"	Create an expedited or alternative process that enables a PWS to issue a temporary permit or conditional use allowance for the installation of California-registered POU/POE treatment units as an emergency and/or interim solution when a primary MCL is exceeded.
19	State Water Board Workload Due to Triennial Permit Issuance	For permitting POU/POU treatment in a Public Water System, change the frequency of the permit renewal process from once every 3 years to once every 6 years.
20	Application for Funding Currently Required for all System Classifications	This section of the Title 17 Code of Regulations should be amended to only require Community Water Systems to apply for funding from an agency to correct the system's violations and allow non-transient noncommunity and transient noncommunity water systems to bypass the application for funding requirement if they choose. These systems are not precluded from the submission of a funding application, but it is not required as a part of the State Water Board permitting process.
21	Consideration of Consolidation as an Alternative to Centralized Treatment	The language in this section should also be modified to remove the word "immediately" from immediately economically feasible. Water systems should be required to look at the long-term implications of treatment

#:	Topic:	Description:
		selection, not "immediate" solutions unless they are utilized for the purposes of an interim emergency solution.
22	Dual Distribution Systems – Regulatory/Policy Framework Establishment	The SWRCB should support efforts and create a timeline for development of a framework, including regulations and policies for implementation of DDS as a long-term solution.
23	State Small and Domestic Well Programs	Local ordinances should be explored and established to create requirements similar to Public Water System requirements for State Small Water Systems to better ensure the successful implementation of POU/POE solutions and provide a more robust water quality solution.
24	Collaboration with States	California should initiate ongoing communication with other States to share information and strategies on the efficacy of POU/POE treatment.

Table 25: Summary of Pilot Study Recommendations

#:	Topic:	Description:
1	Education Strategy and Materials	Develop a strategy and materials to better educate individuals and implementation partners on POU/POE treatment, in multiple languages. Because greater individual involvement is needed for success, a broad educational and marketing strategy is needed, along with the associated resources to fund it.
2	Performance Certification	Establish performance certifications in conjunction with NSF/ANSI for 1,2,3-TCP, hexavalent chromium, uranium, and high concentrations of nitrate applicable for POU and/or POE devices.
3	POU/POE Operator Education Cohort and Workforce Development	Launch an educational curriculum and program for individuals to effectively implement POU/POE treatment in impacted communities. Provide a salary or stipend for these individuals to participate in the program and develop needed skills. The purpose would be to create job opportunities and develop the skills necessary for community outreach, trust building, installation, technical aspects, and operation and maintenance. This program would operate primarily in low-income areas where POU/POE treatment usage is likely to be significant.

#:	Topic:	Description:
4	Bacteriological Contamination in Domestic Wells	Pilot UV disinfection and/or other disinfection technology in combination with POU/POE treatment at residences that use domestic wells and individual surface water intakes. Gather data to determine real-world pathogen reduction and best practices for implementation of POU/POE treatment. Determine limitations, if any, that may be due to raw water quality problems that prevent the ability to produce a safe supply.
5	POU/POE Installations using Smart Technology	Pilot POU/POE treatment devices that are equipped with smart technology to demonstrate their efficacy and ease of use. Smart technology should allow for continuous performance monitoring and less intrusive O&M. Gather data on real-time device performance, optimized O&M costs, and practices, and if it results in an increase in individual and community trust.
6	POU vs. POE	Determine if POE usage at individual homes is superior to POU treatment when analyzing ease of installation, resident perception, ease of operation and maintenance, ease of access, and treatment effectiveness. The focus of these pilots should be to ensure equitable access to water that meets drinking water standards to enhance the public health of residences across all racial and socioeconomic communities where these devices are used.

EQUITY

Inclusion of Equity Assessment on POU/POE Treatment Implementation

POU/POE treatment drinking water solutions are less resilient than consolidation into a large water system or centralized treatment. Careful analysis of available alternatives for each system is paramount before POU/POE treatment is implemented. POU devices in particular do not provide the same level of public health protection as consolidation or centralized treatment because of potential contaminant exposure through other non-ingestion pathways.

RECOMMENDATION 1: *In disadvantaged communities, historically marginalized communities, and communities with high pollution burden (e.g. high CalEnviroScreen scores), any State grant-funded feasibility study that proposes POU/POE treatment as its solution should also include an equity assessment. The equity assessment will evaluate if larger investments, beyond current funding limits for alternative solutions, may be more appropriate for the community.*

POU/POE Treatment Demographics

Transparency of POU/POE Treatment implementation throughout the State should be tracked and published to ensure that equity remains at the forefront of policy considerations. The demographic information should include at a minimum: disadvantaged community status (based on median household income), majority race, and CalEnviroScreen score.

RECOMMENDATION 2: *The State Water Board should continue to monitor and annually publish on its website the locations and demographics of where POU/POE treatment is utilized for public water systems.*

Prioritize POE Treatment for Community Water Systems

There is currently concern about inhalation issues at Community Water Systems that have only implemented POU treatment. This is particularly important for communities that are in areas with high pollution burdens (e.g., high CalEnviroScreen scores). This recommendation must be coupled with subsequent Technical Recommendations that develop additional resources to increase the availability of certified POE devices in California for all necessary contaminants.

RECOMMENDATION 3: *Implement a programmatic shift to prioritize POE over POU treatment for communities where it is anticipated that the POU/POE treatment devices could be in place as a de facto long-term solution. This is particularly important for communities that are in areas with high pollution burdens (e.g., high CalEnviroScreen scores). This recommendation must be coupled with subsequent Technical Recommendations that develop additional resources to increase the availability of certified POE treatment devices in California for all needed contaminants.*

EDUCATION AND INFORMATION AVAILABILITY

Lack of Educational Materials

There is currently a lack of developed materials for POU/POE treatment. Different education materials should be developed depending on the audience and key stakeholders should be included in the development of the materials, including:

- regulators and local agencies,
- water system staff, plumbers, certified operators,
- technical assistance providers,
- trained samplers, and
- consumers of various age/education levels and at various POU/POE treatment stages.

While the State Water Board staff can prepare some of these materials, **some audiences may be best served through outside specialists preparing plain language materials. These specialists could also support the development of a strategy to reach wider audiences such as domestic well owners and state small water systems residents. Education materials should be prepared in multiple languages, as appropriate for the intended audience.**

RECOMMENDATION 4: *An appropriate variety of educational materials should be developed and made available to those who will manage or be associated with POU/POE treatment systems.*

Educational Materials for School-Aged Children

Non-transient non-community water systems currently make up the largest number of public water systems using POU/POE treatment, this classification includes K-12 schools. Collaboration should be made with the California Department of Education and CalRecycle, which already operates the curriculum for California Education and the Environment Initiative (EEI), which would be well suited to address educational needs based on grade level and may have other recommendations on how to integrate these efforts into the existing curriculum.

RECOMMENDATION 5: *School-aged children may be best served by educational materials prepared in multiple languages in collaboration with the California Department of Education and existing environmental programs in the State, such as the CalRecycle initiative known as the California Education and the Environment Initiative (EEI)*.

SOCIAL

Regularly Scheduled POU/POE Stakeholder Meetings

POU/POE treatment shifts some responsibility from water professionals to the residents. Therefore, early in the POU/POE treatment program development process, there should be consideration of regularly scheduled POU/POE treatment stakeholder meetings to discuss the implementation process, concerns, etc. These meetings may include materials developed in previous recommendations and should be performed in a way to address any language barriers.

RECOMMENDATION 6: *Regularly scheduled community meetings should be established with trusted individuals that can provide education, answer questions, and dispel any concerns regarding the treatment devices. These meetings may include materials developed in previous recommendations and should be performed in a way to address any language barriers.*

Develop Cohorts for Community Water Systems & Prioritization of POE Treatment

Many residents are reluctant to allow property access, especially to the interior of their homes. Language and cultural differences may exist between residents and water operators, and present additional obstacles to implementing POU/POE treatment. Frequent change-over in staff serving POU/POE treatment devices also can create concern on the part of residents. As previously discussed in cases where POU/POE treatment devices are a de facto long-term solution. The development of a specialized person intended for interaction with the community, or cohort, could receive training in operator certification, plumbing requirements, and community engagement.

RECOMMENDATION 7: *A shift toward POE devices is recommended to facilitate harmonious resident and water system personnel interactions. Additionally, the education and development of cohorts of specially trained operators are recommended. These cohorts of operators ideally would be selected from local communities where large numbers of POU/POE treatment* *devices are present to develop the local workforce and help to overcome potential cultural and linguistic barriers.*

TECHNICAL

Elimination of the California-Registration Process

Several contaminants found in California do not have NSF/ANSI standards or the available standards do not directly correspond to California's more restrictive maximum contaminant levels, including:

- High concentrations of nitrate in source waters
- 1,2,3-TCP
- Hexavalent chromium
- Uranium
- PFAS compounds
- Manganese

RECOMMENDATION 8: *For contaminants that have a federal maximum contaminant level that is equivalent to a state maximum contaminant level, the national standard and certification process is recommended to be directly accepted in California. This would eliminate the California registration process and those resources would be diverted and supplemented toward a standard and certification process for California-specific maximum contaminant levels. The first four contaminants bulleted above would be the State Water Board's priority, while subsequent contaminants would be reprioritized depending on future regulatory development but are currently recognized needs.*

Focus Standards, Certification, and Development of POE Devices

As previously discussed, POE treatment solutions are a better alternative from both an equity perspective and to increase the likelihood that sustained long-term operations and maintenance occur. Moreover, they decrease health exposure from non-ingestion pathways. Regulators, certifying entities, manufacturers, service providers, and others need to coordinate on performance standards for these devices.

RECOMMENDATION 9: *The State Water Board recommends substantial focus be placed on developing standards and/or certifications for POE devices for use in California and elsewhere. The following issues should be considered: NSF/ANSI-61 certification, contaminant reduction, best practices for custom-filled devices, and water efficiency, particularly for reverse osmosis products.*

Assess Disinfection Alternatives

Approximately one-third of domestic wells are believed to contain bacteriological contamination. Most POU/POE treatment devices require bacteria-free water to be effective. Application of POU/POE treatment at sources with bacteriological contamination may increase exposure to bacteriological contaminants and cause illness.

RECOMMENDATION 10: *An assessment of the effectiveness of disinfection alternatives, such as UV disinfection, is recommended to address pathogenic contamination as a potential barrier to POU/POE treatment usage*.

Enhancement of POU/POE Performance Indication Devices

Consumer trust has been noted by all parties as the most important element in successfully implementing a POU/POE treatment device program. Technological advancements should be made toward maximizing the trust between customers, service providers, and water quality.

RECOMMENDATION 11: *Additional development support for products that enhance POU/POE treatment performance indicators, including new Bluetooth services that enable real-time performance data logging, is recommended to provide customers with a higher level of trust in their water quality and minimize operator maintenance.*

Separate Technical and Regulatory Processes for Interim and Long-Term Solutions

A public health tension exists between the desire to ensure consistent 100% safe water and quickly installing POU/POE treatment devices for interim solutions. Failure to quickly act results in a longer exposure time to contaminants in an interim treatment setting but using those same devices without adequate study and planning can result in future failures, including trust breaches that may be difficult to overcome at a later date. While this is more fully developed in the Legislative, Regulatory, or Policy recommendations, it is also important to consider the technical recommendations. Regulatory compliance would only be considered achieved when all longer-term requirements are completed and fully functional.

RECOMMENDATION 12: *The creation of two separate technical and regulatory processes should be considered for interim measures and longer-term compliance solutions. For interim solutions, limited planning and piloting would be performed but enhanced monitoring would be required of operational devices. For longer-term solutions, standard planning, piloting, and community development work would be required and existing information from any data gathered during the interim phase could be utilized.*

FINANCIAL

Financial barriers to a successful POU/POE treatment program include both resources to obtain and maintain POU/POE treatment devices by the residents and the programmatic needs such as certifying new devices, training operators, etc. The first two recommendations below address the needs of public water systems and state small water systems & domestic well residents, respectively. The final recommendation speaks to the programmatic needs to move POU/POE treatment device development forward within the State.

Streamline Funding Processes for Interim Measures

The State Water Board has long-standing grant and loan programs eligible for most community water systems and non-transient non-community K-12 schools. Solutions for these types of public water systems are often grant-based for small communities addressing public health concerns.

RECOMMENDATION 13: *Although funding programs exist, there is a need to expedite and streamline the process, particularly for interim measures. The State Water Board is currently reviewing its funding process and its interaction with its regulatory program to seek time efficiencies. It is recommended that this work continue and address interim measures*.

Expand County-wide and Regional Programs

For domestic wells and state small water systems, the State Water Board has developed a new County-wide and Regional Funding Program that can financially support County staff or technical assistance providers that directly outreach and fund POU/POE treatment to disadvantaged domestic well and state small water system residences.[98]

RECOMMENDATION 14: *It is recommended that continued outreach be performed to ensure that the entire State is covered through either a County-wide program or a Regional Program.*

Pilot Projects for Funding Programmatic Support Needs

Funding needs to be explored for increasing support for POU/POE treatment, certification measures, device research, and workforce development via pilot projects and other measures.

RECOMMENDATION 15: *Funding for programmatic support needs such as standardization and certification of devices, performance indication device research, and workforce development are recommended to be addressed through pilot projects subsequently discussed in the report.*

LEGISLATIVE, REGULATORY, OR POLICY

PUBLIC WATER SYSTEMS

100% Participation Requirements in Community Water Systems

The USEPA's Safe Drinking Water Act Section § 141.100 Criteria and procedures for public water systems using point-of-entry devices (specifically 40 CFR 141.100(e)) states that,

> *"**All consumers shall be protected.** Every building connected to the system must have a point-of-entry device installed, maintained, and adequately monitored. The State must be assured that every building is subject to treatment and monitoring, and that the rights and responsibilities of the public water system customer convey with title upon sale of property."*

Additionally, the California Health and Safety Code §64418/64419 states that,

> ***"(a)(6) the public water system ensures that each building and each dwelling unit connected to the public water system has a POU/E installed pursuant to this Article.***
>
> *(b) With State Board approval and without having to meet the requirement of paragraph (a)(6), a public water system may utilize POU/Es in lieu of centralized treatment for the*

[98] https://www.waterboards.ca.gov/safer/funding_solicitation.html

purpose of reducing contaminant levels, other than microbial contaminants, volatile organic chemicals, or radon, to levels at or below one or more of the maximum contaminant levels or action levels in this Title, in the water it supplies to some or all of the persons it serves, but the public water system will not be deemed in compliance without meeting the requirement of paragraph (a)(6)…."

The Health and Safety Code requires a Public Hearing and Acceptance process for the implementation of POU/POE treatment within a CWS. These regulations deem that a customer survey must be conducted to prove there is no substantial community opposition and states, "(1) the sum of customers who are non-voting and against POU is less than half of the total customers and (2) no more than 25 percent of the total number of customers voted against POUs, then POU/POE treatment devices may be considered in lieu of centralized treatment."

SWRCB has received complaints pertaining to the requirement of 100% participation of all service connections within a CWS. A regulatory nuance exists where even if the majority of homeowners in the PWS install and maintain adequate POU/POE treatment devices, the PWS cannot be returned to compliance with drinking water regulations, and hence removed from the HR2W Failing List when there is not 100% installation and participation within a community. This requirement has frustrated water systems seeking a viable solution to return to compliance with drinking water regulations. Certain members of a CWS may not agree to allow the installation of POU/POE treatment devices in their home or after installation may refuse to allow operators or service technicians within their home for sampling or maintenance activities.

Recommendations to remedy the compliance-related issue include:

RECOMMENDATION 16: *USEPA should amend the Code of Federal Regulations to allow partial implementation using POU/POE treatment to allow more expansive applications and encourage implementation when other methods are not feasible as an interim solution.* There should be language included to disqualify users who refuse to participate in a POU/POE treatment strategy from the overall compliance calculation. *This could allow homeowners of CWS that refuse the installation or compliance protocols of POU/POE treatment to sign an affidavit confirming:*

a. The water received fails to meet State and Federal drinking water standards, and
b. They assume liability for the health of persons accessing water at the service connection

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Constructed Conveyances – Amendment to Water Code Section 106.4(b)

Counties throughout the State have constructed conveyances moving untreated water for multiple uses (e.g., agriculture, irrigation, industrial, etc.). These constructed conveyances currently have no limitations on the addition of new service connections or residential growth. Some Counties may have minor requirements requiring one set of initial samples of an installed treatment system to ensure water quality is acceptable. The lack of sampling, O&M, and oversight of private homes obtaining water from the constructed conveyances result in uncertainty regarding the quality of the water received by a connection.

The California Water Code, Division 1, Chapter 1, Section 106.4(b) requires that, *“A city, including a charter city, or a county shall not issue a building permit for the construction of a new residential development where a source of water supply is water transported by a water hauler, a water-vending machine, or a retail water facility."*

RECOMMENDATION 17: *It is recommended that Section 106.4 (b) be amended to prohibit new residential development in locations where surface water sources are not treated by a public water system (e.g., constructed conveyance, lakes, etc.).* The level of technical difficulty required to properly treat surface water cannot be adequately addressed at a state small water system or individual homeowner level.

Installation of POU/POE Treatment as an “Emergency Response”

As previously mentioned in this Report, there are regulatory criteria that must be addressed before the implementation of POU/POE treatment. These regulatory challenges often hinder a PWS’s ability to quickly implement or alleviate water quality concerns during emergencies.

RECOMMENDATION 18: *Create an expedited or alternative process that enables a PWS to issue a temporary permit or conditional use allowance for the installation of California-registered POU/POE treatment units as an emergency and/or interim solution when a primary MCL is exceeded.*

State Water Board Workload Due to Triennial Permit Issuance

The California Health and Safety Code §116552 states that,

“The department shall not issue a permit to a public water system or amend a valid existing permit to allow the use of POU treatment unless the department determines, after conducting a public hearing in the community served by the public water system, that there is no substantial community opposition to the installation of POU treatment devices. The issuance of a permit pursuant to this section shall be limited to not more than three years or until funding for centralized treatment is available, whichever occurs first.”

RECOMMENDATION 19: *For permitting POU/POU treatment in a Public Water System, change the frequency of the permit renewal process from once every 3 years to once every 6 years.*

Making this regulatory change would accomplish the following:

1. This would better reflect the fact that long-term solutions often take more than 3 years to implement.
2. This would reduce the POU/POE treatment regulatory workload associated with re-permitting by State Water Board’s district staff, allowing them to focus on more significant violations.
3. While the POU/POE treatment solution is working properly, it increases the time available for a PWS to determine an alternative or long-term permanent solution.
4. The 6-year renewal period would cover two compliance periods of monitoring; this would remain within the bounds of the 9-year compliance cycle.

Application for Funding Currently Required for All System Classifications

The California Code of Regulations Sections *§64418. General Provisions (a)(2)(A) and §64420(a)(2)(A)* state that,

> *"(a) Except for a proposed new community water system that does not have a domestic water supply permit, a public water system that meets the requirements of Health and Safety Code section 116380(a) may be permitted to use POU/POEs in lieu of centralized treatment for the purpose of complying with one or more maximum contaminant levels or action levels in this Title, other than for microbial contaminants, volatile organic chemicals, organic chemicals that pose an inhalation risk, or radon, and as allowed under the state and federal Safe Drinking Water Acts, if:*
>
> (1) *the public water system meets the requirements of this Article and any applicable statutory requirements;*
>
> (2) *the public water system has:*
>
> (A) ***applied for funding from any federal, state, or local agency to correct the system's violations, and***
>
> (B) *demonstrated to the State Board that* ***centralized treatment*** *for achieving compliance is not immediately economically feasible, as defined in section 64418.1;"*

RECOMMENDATION 20: *This section of the Title 17 Code of Regulations should be amended to **only** require Community Water Systems to apply for funding from an agency to correct the system's violations and allow non-transient noncommunity and transient noncommunity water systems to bypass the application for funding requirement if they choose. These systems are not precluded from the submission of a funding application, but it is not required as a part of the State Water Board permitting process.*

Consideration of Consolidation as An Alternative to Centralized Treatment

As shown above, *Section §64420(a)(2)(B)* requires water systems to demonstrate that centralized treatment for achieving compliance is not immediately economically feasible. In some cases, consolidation with another system may be economically feasible but because it is excluded from the language in the regulation, it limits this as an option that could be assessed.

RECOMMENDATION 21: *The language in this section should also be modified to remove the word "immediately" from immediately economically feasible. Water systems should be required to look at the long-term implications of treatment selection, not "immediate" solutions unless they are utilized for the purposes of an interim emergency solution.*

Dual Distribution Systems (DDS) – Regulatory/Policy Framework Establishment

Small-diameter pressurized distribution systems are used in other States to provide water for human consumption to homes, businesses, and other service connections by utilizing centralized treatment, while the existing distribution system not meeting MCLs would still be used for other purposes. DDS has not been implemented in the State, and questions remain regarding the logistics for implementation, sampling, O&M, costs, etc. The DDS framework has been discussed by SWRCB management and is widely accepted as a preferred solution as a long-term approach versus POU/POE treatment.

RECOMMENDATION 22: *The SWRCB should support efforts and create a timeline for development of a framework, including regulations and policies for implementation of DDS as a long-term solution.*

STATE SMALL AND DOMESTIC WELL PROGRAMS

Local ordinances could require POU/POE implementation for State Small Water Systems to mirror the POU/POE regulatory framework outlined for public water systems. Local ordinances could also be established to apply similar requirements to domestic wells applications.

RECOMMENDATION 23: *Local ordinances should be explored and established to create requirements similar to Public Water System requirements for State Small Water Systems to better ensure the successful implementation of POU/POE solutions and provide a more robust water quality solution.*

COLLABORATION WITH STATES

There has been minimal correspondence and coordination between the SWRCB and other State drinking water programs regarding POU/POE treatment. Other States may provide valuable information to continually improve the implementation of POU/POE treatment.

RECOMMENDATION 24: *California should initiate ongoing communication with other States to share information and strategies on the efficacy of POU/POE treatment.*

PILOT STUDY

Based on the data collected in this report, the following pilot studies are recommended to gather information and experience to inform gaps in the implementation of POU/POE treatment as a drinking water solution.

1. **Educational Strategy and Materials** – Develop a strategy and materials to better educate individuals and implementation partners on POU/POE treatment, in multiple languages. Because greater individual involvement is needed for success, a broad educational and marketing strategy is needed, along with the associated resources to fund it.

2. **Performance Certification** – Establish performance certifications in conjunction with NSF/ANSI for 1,2,3-TCP, hexavalent chromium, uranium, and high concentrations of nitrate applicable for POU and/or POE devices.

3. **POU/POE Operator Education Cohort and Workforce Development** – Launch an educational curriculum and program for individuals to effectively implement POU/POE treatment in impacted communities. Provide a salary or stipend for these individuals to participate in the program and develop needed skills. The purpose would be to create job opportunities and develop the skills necessary for community outreach, trust building, installation, technical aspects, and operation and maintenance. This program would operate primarily in low-income areas where POU/POE treatment usage is likely to be significant.

4. **Bacteriological Contamination in Domestic Wells** - Pilot UV disinfection and/or other disinfection technology in combination with POU/POE treatment at residences that use domestic wells and individual surface water intakes. Gather data to determine real-world pathogen reduction and best practices for implementation of POU/POE treatment. Determine limitations, if any, that may be due to raw water quality problems that prevent the ability to produce a safe supply.

5. **POU/POE installations using Smart Technology** – Pilot POU/POE treatment devices equipped with smart technology to demonstrate their efficacy and ease of use. Smart technology should allow for continuous performance monitoring and less intrusive O&M. Gather data on real-time device performance, optimized O&M costs, and practices, and if it results in an increase in individual and community trust.

6. **POU vs. POE** - Determine if POE usage at individual homes is superior to POU treatment when analyzing ease of installation, resident perception, ease of operation and maintenance, ease of access, and treatment effectiveness. The focus of these pilots should be to ensure equitable access to water that meets drinking water standards to enhance the public health of residences across all racial and socioeconomic communities where these devices are used.

CONCLUSIONS

The State Water Board identified that POU/POE treatment devices will be critical to help the State meet the goals of the Human Right to Water, particularly when other solutions are not viable alternatives. The 2021 Needs Assessment[99] estimated that the cost associated with potential POU/POE treatment devices in California ranges from $166 million to 666 million dollars in capital costs alone. Given the large number of devices estimated and the high statewide programmatic costs, this report has presented an analysis of programmatic efforts to ensure the widest access of desirable POU/POE treatment filtration options are available and that their use would be sustainable.

SUSTAINABILITY OF POU/POE TREATMENT IN CALIFORNIA

All stakeholders and partners in the preparation of this report emphasized community and individual resident trust as the cornerstone to effective POU/POE treatment implementation. Developing and maintaining that trust for POU/POE treatment devices includes devoting significant resources to community outreach and understanding. Some states do not allow the use of POU/POE treatment as a compliance solution citing the difficulty of implementation and ongoing regulatory oversight. Given the large number of locations in California that currently have no other cost-effective solution, this report proposes that the State Water Board invest significant effort to streamline and conscientiously develop POU/POE treatment devices as a solution rather than remove them from the water treatment toolbox.

Sustainable POU/POE treatment filtration devices used in California will need to address several areas, including equity and social concerns, technical challenges, financial barriers, and streamlined legislative and regulatory conditions. Overcoming key equity and social concerns include ensuring that POU/POE treatment filtration is not used as an inexpensive fix to address historically marginalized communities and communities with high pollution burdens where larger investments are warranted to address equity issues. The programmatic shift away from POU towards POE in long-term applications is another critical element of ensuring equity as well as increasing the ease of maintenance in public water system applications. Education materials and regulatory direction, particularly for state small water systems and domestic wells are lacking based on the results of the County survey conducted for this report

[99] 2021 Needs Assessment: https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/2021_needs_assessment.pdf

(Appendix E). Education materials need to be prepared in multiple languages and be easy to access.

Operators installing and maintaining POU/POE treatment devices need to be trained differently than other water treatment and distribution system professionals. In addition to standard water treatment and distribution knowledge, these operators must have expertise in internal household plumbing and developing trust within communities, particularly communities that may represent different cultures and languages across the State. Ideally, these operators should be well integrated into the community and likely to continue working for long time periods to help facilitate resident trust.

Even with optimal outreach, education materials, and specialized operators, POU/POE treatment filtration cannot be augmented unless there are available devices that have standards and are accordingly certified. Currently, most POU/POE treatment standards and certifications are developed to meet federal needs, not California-specific maximum contaminant levels. Several key examples of contaminants that lack appropriate standards or certifications include:

- High concentrations of nitrate
- 1,2,3-TCP[100]
- Hexavalent chromium[101]
- PFAS compounds
- Manganese

California-specific standards and certification should be rapidly developed to allow for clearly approved CA POU/POE treatment devices to address California's maximum contaminant levels that deviate from federal standards. Contaminants that have identical federal and state standards should be able to use national organization standards without additional registration steps to expedite their use in California. Approximately one-third of domestic wells are believed to have bacteriological contamination.[102] This high number of potentially bacteriologically compromised domestic wells indicates that additional UV disinfection or well reconstruction may frequently be necessary. Research is also needed to improve monitoring systems and their accessibility to help ensure trust in the systems. The development of more POE models available in California is needed to address equity concerns.

Financial barriers include both resources to obtain and maintain POU/POE treatment filtration devices by the residents and programmatic needs such as certifying new devices, training operators, etc. For the former, the State Water Board has long-standing grant and loan programs eligible to most community water systems and non-transient non-community K-12 schools. Solutions for these types of public water systems are often grant-based for small communities addressing public health concerns. For domestic wells and state small water systems, the State Water Board is standing up for new County-wide and Regional Funding

[100] Only POE should be utilized for 1,2,3-TCP due to inhalation risks. No POE standard exists for the California MCL.

[101] Current standards exist for the less restrictive Federal total chromium level of 100 µg/L.

[102] https://www.usgs.gov/mission-areas/water-resources/science/domestic-private-supply-wells

Programs that can financially support County staff or technical assistance providers that directly outreach and fund POU/POE treatment to disadvantaged domestic well and state small water system residences.[103] Funding for programmatic support needs such as research, workforce development, and device certification is proposed through pilot projects previously discussed in the report.

Finally, there are several legislative and regulatory changes proposed in this report. Many of these legislative and regulatory recommendations seek to address the tension between ensuring public health at all times and the health benefits of getting POU/POE treatment expeditiously installed in as many residences as possible when contaminants are known to present. Some of the proposed changes are minor such as including consolidation in the evaluation of “treatment alternatives” to more complex recommendations like addressing the federal requirement for 100% participation to obtain compliance.

NEXT STEPS

Ensuring sustainable POU/POE treatment filtration device use in California can only be accomplished by addressing several areas highlighted in this report, including equity and social concerns, technical challenges, financial barriers, and streamlining legislative and regulatory conditions.

The State Water Board will continue to monitor and annually publish on its website the locations and demographics of where POU/POE treatment is utilized for public water systems across the state to ensure that equity remains at the forefront of policy considerations. The State Water Board will also annually provide a status update on its website of the actions taken to advance the recommendations from this report and seek needed legislative or regulatory changes, as appropriate. State Water Board had two webinars in November 2022 to share the results of this report and seek public comment. State Water Board Staff will have community outreach workshops once additional POU/POE treatment education materials are developed to foster additional information sharing across the State to continue to advance the goals of the Human Right to Water.

[103] https://www.waterboards.ca.gov/safer/funding_solicitation.html

APPENDIX A: WATER SYSTEM CLASSIFICATION GUIDE

Placeholder for Appendix A (Separate PDF document to be attached).

APPENDIX B: POU/POE IMPLEMENTATION FRAMEWORK

COMMUNITY WATER SYSTEM CHECKLIST

System Name:________________________________

System No.__________________________________

Type of System: ☐ Residential ☐ Business ☐ School Contaminant(s):___
____

I. FEASIBILITY ANALYSIS

This phase of work will determine if POU/POE implementation is a viable option for the Water System. During this phase, the water system will evaluate the economic feasibility of this interim solution and will begin providing public education to community members.

☑	Completion Date	Action Items	Contact
☐		Demonstrate that centralized treatment is not economically feasible • Determine the Median Household Income (MHI) of customers • Provide the annual cost of centralized treatment per household • Provide the median annual water bill over the most recent 12 months • Compare life cycle costs for centralized treatment versus POU/POE treatment over a similar period	District Staff
☐		Selection of certified POU/POE device(s) for piloting: • Meets NSF/ANSI Standard 53 or 58; or is a California Registered Water Treatment Device. • Equipped with a mechanical warning indicator (e.g., alarms, light, etc.) • Include mechanical performance indicators (e.g., flow meter, TDS/EC meter, etc.)	

		• Piloting multiple and different types of POU/POE devices is recommended	
☐		Develop a Public Outreach Plan (Recommended)	SAFER Staff

FEASIBILITY ANALYSIS - continued

☑	Completion Date	Action Items	Contact
☐		**Submit a package to DDW that includes:** • Findings from the economic feasibility analysis • POU/POE(s) Performance Data Sheet • POU/POE(s) Manufacturer's Specifications/Owner's Operation Manual	
☐		Schedule a meeting with DDW staff to discuss package submittal	District Staff
☐		Plan and conduct community meeting(s) to discuss the proposed POU/POE project. Consider the following: • Feasibility of installing devices at every customer's kitchen sink • Find volunteers to participate in the POU/POE pilot study	SAFER Staff
☐		**Begin process to submit an application through the Financial Assistance Application Submittal Tool (FAAST)**	District Staff

PILOT STUDY

Following approval by DDW, the water system will need to pilot their selected POU/POE device(s) within the community. It is recommended that two or more POU/POE devices be piloted during this phase of work.

☑	Completion Date	Action Items	Contact
☐		**Develop and submit a Pilot Testing Protocol to DDW for review/approval** (See *Attachment A*)	
☐		If approved by DDW, install selected POU/POE device(s) along with associated performance indicators that include: • Inline flow meter • Inline TDS/EC meter (for RO devices only) *A licensed plumber is recommended for POU/POE installation.	
☐		**Submit pictures of installed pilot POU/POE device(s) to the DDW**	
☐		Pilot test each POU/POE device (minimum 2 months or until target flow volume is achieved, whichever is greater). During the Pilot testing: • Record all data in a monitoring log (See *Attachment B*) • Determine the devices usage limitations • Determine the Operations and Maintenance Criteria • Verify the device produces effluent that meets drinking water standards	
☐		**Summarize the pilot study findings and submit to DDW for review/approval**	
☐		Following DDW Approval: Begin on-going monitoring at the approved installation site(s) (See Section V)	

II. COMMUNITY ACCEPTANCE

Water systems are required to hold a community Public Hearing to discuss the water system's Public Acceptance Protocol. To help ensure community acceptance, it is recommended to hold multiple meetings leading up to the Public Hearing. Following the Public Hearing, the water system will conduct a survey for acceptance or opposition to POU/POE implementation. The results from the survey will determine if the water system moves into the next phase.

☑	Completion Date	Action Items	Contact
☐		**Submit a Public Acceptance Protocol to DDW for review and approval that includes the following information:** • Draft POU/POE Treatment Strategy (See *Attachment D*) • Adverse health effects associated with the contaminant(s) of concern • Sections from both the Operation & Maintenance Program and Monitoring Program requiring customer coordination (See *Attachments E and F*) • Estimates of any increased costs to water bills associated with POU/POEs • Provide supporting documentation, assumptions, and calculations used to determine the increased costs to water bills • Proposed Public Hearing Notice (See *Attachment G*)	
☐		Schedule meeting with DDW Staff to discuss Public Acceptance Protocol and future community meetings	District Staff
☐		Hold Pre-Public Hearing meeting(s) for public education (Recommended)	SAFER Staff

☑	Completion Date	Action Items	Contact
☐		Thirty Days Prior to the Community Public Hearing - For residential communities or businesses/schools with residential communities: • Provide public access to information that will be shared at the public hearing, including but not limited to, the information in the Public Acceptance Protocol. • Provide Public Hearing Notice to customers about the scheduled public hearing, either virtual or in-person meeting (See *Attachment G*) • The information package must include language stating POU/POE devices are to be owned and maintained by the Water System, not by the customer. - For schools: Provide public education for school staff, students, and parents	District Staff
☐		Conduct a Community Public Hearing with Coordination with the Division	
☐		Conduct a customer survey for acceptance/opposition (See *Attachment H*). The following criteria must be met for DDW approval of POU/POE installation: • Each service connection represents a single customer and receives one vote • No more than 25% of total customers voted against POU/POE installation • The sum of the number of non-voting customers plus the number of customers voting against POU₩POE is less than half the total number of service connections. (See *Attachment H*)	
☐		**Submit all customer surveys to DDW for review and approval**	

☐		If a community majority is reached for acceptance, submit the following: • **Revised POU/POE Treatment Strategy** (Attachment D) • **Operations & Maintenance Program** (Attachment E) • **Monitoring Program** (Attachment F)	
☐		**Apply for a Permit Amendment to DDW** (See *Attachment C*)	
☐		DDW will issue a Permit Amendment for the approved POU/POE device	District Staff

III. POU/POE INSTALLATION

Water systems will need to have DDW approval prior to moving into this next phase. It is recommended that a licensed plumber perform the POU/POE installations. To comply with Drinking Water Regulation, all devices will need to be tested for chemical of concern shortly after installation.

☑	Completion Date	Action Items	Contact
☐		Contact DDW staff for the creation of PS Codes for each installed device	District Staff
☐		Install the same POU/POE device at all service connections at the specified location (i.e., kitchen sink or a DDW approved designated sink). A licensed plumber is recommended for installations. • Water samples must be collected and analyzed for the contaminant of concern, no later than 72 hours after installation of the device • Samples must be taken to a certified lab for analysis	
☐		**Submit pictures of each POU/POE installation** (Pictures should be added to the O&M Program document)	

IV. MONITORING

Following installation, the water system will be required to (1) conduct on-going monitoring of the source water and at each POU/POE device in accordance with an approved Monitoring Plan and (2) maintain the approved O&M program.

☑	Completion Date	Action Items	Contact
☐		In accordance with the approved Monitoring Program, each month: • At minimum, sample 1/12th of all devices on a rotating basis. • Sample(s) must be taken to a certified lab for analysis • Field monitoring must also be performed at all devices (i.e., flow meter reads and TDS/EC meter reads) • Field monitoring can be provided by homeowner by picture or via text • Inspect unit for leaks	
☐		Designated person/Operator/Vendor must conduct inspection of unit for proper function once of year, at minimum, in accordance with an approved O&M Program	
☐		Record all readings (lab & field) in a monitoring log (See *Attachment B*) and include: • Source water samples collected: quarterly • Treated water samples collected: monthly, or as required • Field readings (Flow and TDS/EC) collected: monthly, or as required	
☐		**Each month, submit a water quality report to DDW by the 10th day with results from the previous month that includes:** • Cover letter with summary of issues experienced, change-outs that occurred and a summary of the sample results. • Monitoring log	

☐		Water System's MCL violation(s) may be Returned to Compliance based on the water quality data results following 100 percent installation within the community.	District Staff

Attachment A	Pilot Testing Protocol Template
Attachment B	Monitoring Log Template
Attachment C	Application for a Domestic Water Supply Permit Amendment
Attachment D	POU/POE Treatment Strategy Template
Attachment E	Operation and Maintenance (O&M) Program
Attachment F	Monitoring Program
Attachment G	Public Notice/Agenda for Community Public Meeting Template
Attachment H	Customer Acceptance Survey Template

Attachments above available upon request, please contact the DDW – SAFER - Rural Solutions Unit.

APPENDIX C: STANDARDS INFORMATION

In this industry application, standards provide the criteria to promote sanitation and the protection of public health and the environment. Through California regulation, guidance, policies, and recommendations, public water systems adhere to specific standards referenced depending on the application. Several standards in the drinking water treatment industry apply to POU treatment devices. Section 2.1 of the USEPA POU/POE 815-R-06-010 document (2006) states, "If the American National Standards Institute (ANSI) has issued product standards for a specific type of POU or POE treatment unit, then only those units that have been independently certified according to these standards may be used as part of a compliance strategy." Some examples of drinking water treatment unit standards include:

NSF International/ANSI 42, 44, 53[104], 55, 58[105], 61, 62, 177, 244, P231, P473, P477, NSF/JWPA P72 - NSF International is accredited by the American National Standards Institute (ANSI) and has developed drinking water treatment unit standards 42 (aesthetics), 44 (softeners), 53 (health effects), 58 (RO), 61 (contact), 62 (distillation), 401 (emerging compounds/incidental contaminants) and p231 (microbial), P473 (PFAS compounds protocols), and P477 (microcystin), each of which is summarized below. **For the purposes of this Report, NSF/ANSI Standard 53 and 58 will be the central focus.** The scope for Standard 53 considers reducing specific health-related contaminants in water supplies while the scope for Standard 58 considers the performance of RO drinking water treatment systems, a popular POU device for homes with chemical contaminants.

Table D1: NSF/ANSI Standards Relevant to POU/POE devices

Applicable Standard:	Standard Description:
NSF/ANSI 42	Filters are certified to reduce aesthetic impurities such as chlorine and taste/odor. These can be POU (under the sink, water pitcher, etc.) or POE (whole house) treatment systems.
NSF/ANSI 44	Water softeners use a cation exchange resin that is regenerated with sodium or potassium chloride. The softener reduces hardness caused by calcium and magnesium ions and replaces them with sodium or potassium ions.
NSF/ANSI 53	Filters are certified to reduce a contaminant with a health effect. Health effects are set in this standard as regulated by the U.S. Environmental Protection Agency (EPA) and Health Canada. Both standards 42 and 53 cover adsorption/filtration which is a process that occurs when liquid, gas, or dissolved/suspended matter adheres to the surface of, or in the pores

104 **https://www.nsf.org/knowledge-library/nsf-ansi-42-53-and-401-filtration-systems-standards**

105 https://www.nsf.org/knowledge-library/nsf-ansi-58-reverse-osmosis-drinking-water-treatment-systems

Applicable Standard:	Standard Description:
	of, an adsorbent media. Carbon filters are an example of this type of product.
NSF/ANSI 55	Ultraviolet treatment systems use ultraviolet light to inactivate or kill bacteria, viruses, and cysts in contaminated water (Class A systems) or to reduce the amount of non-disease-causing bacteria in disinfected drinking water (Class B).
NSF/ANSI 58	RO systems incorporate a process that uses reverse pressure to force water through a semi-permeable membrane. Most RO systems incorporate one or more additional filters on either side of the membrane. These systems reduce contaminants that are regulated by Health Canada and EPA.
NSF/ANSI 61	Drinking-Water System Components – Health Effects is an American National Standard that establishes minimum health-effects requirements for the chemical contaminants and impurities that are indirectly imparted to drinking water from products, components, and materials used in drinking water systems. This standard does not establish performance, taste, odor, or microbial growth support requirements for drinking water system products, components, or materials. This standard is intended to cover specific materials or products that come into contact with drinking water, drinking water treatment chemicals, or both. The products and materials covered by the scope of this standard include but aren’t limited to: • Protective barrier materials (types of cement, paints, coatings) • Joining and sealing materials (gaskets, adhesives, lubricants) • Mechanical devices, including treatment products (water meters, valves, filters) • Pipes and related products (pipes, hoses, fittings) • Plumbing devices (faucets, drinking fountains) • Process media (filter media, IX resins) • Nonmetallic potable water materials
NSF/ANSI 62	Distillation systems heat water to the boiling point, and then collect the water vapor as it condenses, leaving behind contaminants such as heavy

Applicable Standard:	Standard Description:
	metals. Some contaminants that convert readily into gases, such as volatile organic chemicals, can carry over with the water vapor.
NSF/ANSI 244	The filters covered by this standard are intended for use only on public water supplies that have been treated or that are determined to be microbiologically safe. These filters are only intended for protection against intermittent microbiological contamination of otherwise safe drinking water. For example, prior to the issuance of a boil water advisory, you can be assured that your filtration system is protecting you from intermittent microbiological contamination. The standard also includes material safety and structural integrity, similar to other NSF/ANSI drinking water treatment unit standards. Manufacturers can claim bacteria, viruses, and cysts reduction for their filtration system.
NSF/ANSI 401	Treatment systems for emerging contaminants include both POU and POE systems that have been verified to reduce one or more of 15 emerging contaminants from drinking water. These emerging contaminants can be pharmaceuticals or chemicals not yet regulated by the EPA or Health Canada.
NSF International P231	Microbiological water purifiers are certified for health and sanitation based on the recommendations of the EPA's Task Force Report, Guide Standard and Protocol for Testing Microbiological Water Purifiers (1987) (Annex B).[106]

[106] https://www.nsf.org/consumer-resources/articles/standards-water-treatment-systems

APPENDIX D: POU/POE PUBLIC WATER SYSTEM LIST IN CALIFORNIA

A list of POU/POE public water systems was compiled in June 2022 by Division of Drinking Water, SAFER by reaching out to Division of Drinking Water field offices and local primacy agencies. The POU/POE list was combined with CalEnviroScreen 4.0 data and demographic information (see Table below). The table below contains repeated information (system number and system name) with demographic information and POU/POE specifics, including treatment approach, contaminants, range of contaminants, and device manufacturer/model.

CalEnviroScreen 4.0 data[107] is from California Office of Environmental Health Hazard Assessment. Data available from CalEnviroScreen 4.0, specifically CES 4.0 Score and Percentile, were identified for each POU/POE water system. The score and percentile represent pollution burden (exposures and environmental effects) and population characteristics (sensitive populations and socioeconomic factors). The CalEnviroScreen 4.0 data is listed both as a score and percentile, with higher scores and percentiles representing an increased overall pollution burden and related public health concerns. The pollution burden includes factors such as pesticide use, drinking water contamination, groundwater threats, and more. Population characteristics include factors such as cardiovascular disease, linguistic isolation, poverty, unemployment, and more[108].

Demographic data (household size, linguistic isolation, poverty, majority race, and disadvantage status) included in the list below were from two sources: (1) CalEnviroScreen 4.0 population characteristics and (2) community disadvantage statuses from 2022 GAMA data available by census block groups. The demographic information presented in the tables below may not represent the actual population served by the public water system because data is collected at the census block group or census tract level.

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

[108] Page 21-24, https://oehha.ca.gov/media/downloads/calenviroscreen/report/calenviroscreen40reportf2021.pdf

*Placeholder for PDF documents.

APPENDIX E: STAKEHOLDER ENGAGEMENT

WORKSHOP #1 – TECHNICAL SERVICE PROVIDERS' SUMMARY

This workshop focused on gaining POU/POE knowledge, insight, and perspective from predominantly technical providers in California. The workshop was approximately 90 minutes, and the format included a brief explanation of the Report effort and an open discussion with prompt questions, as needed. The contents are summarized below.

Prompt Questions Discussed during Workshop

1. For Public Water Systems, what prevents the successful application of POU/POE as a compliance solution?
2. For State Small Water Systems, what successes have you seen and/or what challenges have you faced?
3. For Public Water Systems, State Small Water Systems, and Domestic Wells, what innovation or change could speed/ease the POU/POE compliance process?
4. For Public Water Systems, State Small Water Systems, and Domestic Wells, how could a pilot study support additional knowledge or innovation?
5. What specific action(s) can the Waterboards take to better support communities implementing POU/POE?

Challenges and Solutions:

Table E1:Challenges Discussed with Potential Solutions

Topic	Challenges	Potential Solutions
Operators	• At times, there can be language barriers • Non-local operators; no trust • Certified Operators may lack POU/POE-specific knowledge	Train local operators
Outreach	Educate families on maintenance of equipment	
Multiple Contaminants Present in Source Water	• POU devices are only equipped to handle specific contaminants, difficult when multiple different types of contaminants present • For state smalls and domestic wells, bacteriological issues are	Install multiple devices to handle multiple contaminants

Topic	Challenges	Potential Solutions
	more prevalent and, at times, require costly repairs	
Operations & Maintenance	• Systems go unmaintained without financial assistance • Community loses confidence	Streamline the process to minimize loss of confidence
Contracts	A master operations contract would be helpful	
Notifications	Maintenance is critical	UCLA has sensors on the water tap connected to smart phone
Sale of House in POU/POE community	Homeowners do not want to share requirements if selling their house	
Landlord/Tenant Relationship	Lack of trust; not wanting knowledge of potentially contaminated water because may impact property value; liability for renters	
Access	POU devices require maintenance by a certified individual	
Status Quo	Already purchase bottled water and don’t want it to change; currently receiving free water, why change?; learning how to maintain another house appliance/treatment system	
Multigenerational/Large Families	Living within a home may have a single point of contact for large families	Best communication practices to/with head of household

WORKSHOP #2 – LOCAL GOVERNMENT SUMMARY

This workshop focused on gaining POU/POE knowledge, insight, and perspective from predominantly county governments in California. The workshop was approximately 90 minutes, and the format included a brief explanation of the Report effort and an open discussion with prompt questions, as needed. The contents are summarized below.

Prompt Questions:

1. For public water systems, is the permitting process too cumbersome? If so, what information or resources could DDW provide to local government to ease permitting and implementation of POU/POE as a drinking water solution?
2. What does a County/Regional program using POU/POE to address domestic wells and state small water systems look like?
3. What resources do Counties or local agencies need to implement a POU/POE program for domestic wells and state small water systems?
4. Thinking about a POU/POE program for domestic wells and state small water systems, would the County or local agency choose to implement the program with County/Agency staff or contract with others? Or a combination?
5. Do Counties or Local Agencies currently have a program in place? Or has a similar program that can be added too?

Challenges and Solutions:

Table E2: Challenges discussed with Potential Solutions

Topic	Challenges	Potential Solutions
Customer confidence	• Customers may not necessarily believe water is safe • Especially true if boiling water or problems with reverse osmosis treatment	Build confidence during outreach; education
Source Capacity	Reverse Osmosis waste stream can be high and has created problems for systems with low source capacity	
Routine maintenance	12-month inspections, testing on effluent, and recordkeeping are likely challenging	
Mixed-use	Difficult to get everyone to cooperate	Citing for partial installations

Topic	Challenges	Potential Solutions
Education	Need customer education at schools for parents	
Paperwork	3rd party assistance is available but still difficult to navigate	
Funding application Requirement	The overall process is difficult to navigate and expensive	
Overall process	Cumbersome	
Providers	DDW recognizes that providers could be a challenge; Monterey and Tulare County indicated providers are available	
Accessing Home	People don't want operators in their homes to maintain equipment	Monterey County is trying to implement an ordinance[109]; accessing the home is not required for POE
Water Quality is not homogenous	Water quality is not the same across a community	While expensive, education is key; good opportunity for SAFER involvement; the alarm light system is very helpful
Bacteriological	DDW recognizes that bacteriological concerns exist for domestic wells	Imperial County described a comprehensive POE program[110]
Plumbing Code	During the installation process, recognizing some homes are not up to code	
Regional Drinking Water Program	Accessing resources to support programs is difficult; challenging to be the go-between	DFA started coordinating efforts with DWR and looking to regional development programs or partnering with a

[109] https://www.co.monterey.ca.us/home/showdocument?id=67294

[110] https://www.icphd.org/environmental-health/point-of-entry-pilot-project/

Topic	Challenges	Potential Solutions
		non-profit to implement across jurisdictions
Monthly reporting	Once devices are in place, reviewing a ton of different reports is time-intensive	Develop uniform reporting

WORKSHOP #3 – COMMUNITY & ENVIRONMENTAL JUSTICE GROUP

This workshop focused on gaining POU/POE knowledge, insight, and perspective from predominantly Community and Environmental Justice Groups in California. The workshop was approximately 90 minutes, and the format included a brief explanation of the Report effort and an open discussion with prompt questions, as needed. The contents are summarized below.

Challenges and Solutions:

Table E3: Challenges discussed with Potential Solutions

Topic	Challenges	Potential Solutions
Devices	• Lack of certified devices • No POE RO devices certified • Water Discharge Issues • Food in the drain with POU waste	• POE blend with groundwater might be possible • Consider POE demonstration project/use for irrigation or toilet / look at mass balance
POE	Perchlorate and 1,2,3-TCP treatment solutions are not available	1,2,3-TCP added to the standard to NSF
Communication	Need better more specific language for everything POU/POE	
DAC communities	Need constant engagement and consistent retesting of water; not eligible for rebates	Regional programs will likely be able to serve the needs
Community engagement	Trust / Confidence / language / access	Support local resources / start communication early / include education and outreach after installation / continued communication – are people using the device(s) or bottled water? / Conduct surveys / Involve community leaders/taste better than bottled water

Topic	Challenges	Potential Solutions
Solar	2 liters of water per 8 hours	Increase photovoltaic capacity
Arsenic	POU/POE solutions available?	Contact other USEPA/other states about POU/POE solutions
Participation	Getting 100% participation is difficult	
Sustaining Customer Confidence	How do we sustain customer confidence?	Circuit rider programs to test the water daily / demonstrate performing with tests and TDS / replace membranes annually
Polanco Parks	POU cannot keep up with the demands	Culligan LC Series (RO) produces up to 200 gpd
RO	No fixed regulations on efficiency	

WORKSHOP #4 – WATER INDUSTRY/TRADE GROUPS SUMMARY

This workshop focused on gaining POU/POE knowledge, insight, and perspective from predominantly those in the industry and trade groups. The workshop was approximately 4 hours and the format included presentations, case studies, a combination of open dialogue, with prompt questions and polls, and four breakout rooms focused on the following: (1) gaps in POU/POE certification standards, (2) gaps in certified treatment equipment, (3) lack of availability of POE treatment, and (4) streamlining the process. The contents are summarized below.

Intended Audience/Stakeholders:

Certification Standards for POU/POE Devices

NSF/ANSI Drinking Water Treatment Units Standards

ANSI Accredited Certifying Organizations

POU/POE Equipment (and Accessories) Manufacturers

POU/POE Technical Assistance and Service Providers

Table E4: Presentations and Case Studies

Topic	Content	Presenter(s)
Introduction	SWRCB Organization POU/POE regulations POU/POE steps	Eugene Leung, SWRCB, DDW
POU/POE SAFER Activities	Background on POU/POE Report; described the SAFER program and purpose of Report	Chad Fischer, SWRCB, DDW
Case Study #1	Ideal POU case with several obstacles; 29 families; contaminants: arsenic, nitrate, uranium; pilot – 1 year; GAC-RO-GAC; no built-in TDS monitoring	Kevin Berryhill, Provost & Pritchard
Case Study #2	Monterey County domestic wells with nitrate (~50 mg as N/L) and 1,2,3-TCP (inhalation risk); POE at 10 homes; still provided bottled water for cooking and drinking; automatic shut-off; improvement: continuous TDS monitoring; built-in PID; other PIDs; increase communication with automated features: dial-up or an app that can inform service providers and homeowners; UV devices for DWs	Heather Lukacs, Community Water Center *presented by Chad Fischer*

Topic	Content	Presenter(s)
	with total coliform; infrastructure improvements were needed before POE installation; certifications for off-the-shelf POE systems; PFAS compounds, chromium-6, uranium, 1,2,3-TCP at levels applicable in CA	
Case Study #3	SE Arizona region; 120 residences with elevated arsenic; chlorination system; manager resp. for daily operation; community program/town hall critical to success; partial participation; education on installations was required; PIDs on RO; community influencers can assist with 100% participation	Shannon Murphy, Pacific Water Quality Association

Table E5: Challenges and Solutions Discussed in Main Session

Topic	Challenges	Potential Solutions
Pilot Testing	Knowing which devices to test	
Built-in flow & TDS monitoring	Few readily available; poor quality	
Disinfection	Rarely performed	
As(III) vs. As(V)	Typically more difficult to remove As(III)	An oxidative filter may assist / some ROs can reduce As(III)
Nitrate Sloughing		
GAC vs. GAC/RO		
Bacteriological Concerns	Uncertainty when present / POU/POE applications assume bacteriologically safe water/barrier for systems with bacteriological issues	UV disinfection treatment
Corrosivity	Batteries wear quickly	
Sales	Obtaining factual specification information associated with a device	

Topic	Challenges	Potential Solutions
Certification	Original products are certified and re-branded; are these still certified?	
Pilot Study	Bottled water to those without devices caused confidence issues	
Maintenance	Accessing home	
Liability	Operator safety; water damage to the residence	
Nitrate	Elevated nitrate is difficult to treat with POU / no cheap nitrate online analyzer available	Bottled water for those with nitrate above 27 mg as N/L
1,2,3-TCP	Present with nitrate; inhalation risk	POE
Devices	• Malfunctioning devices • Devices already present	• Automatic shutoff; TDS monitoring; an app to notify service provider or homeowner • Remove and replace with certified devices
PID	PIDs are not built-in / can cause more issues than solve	If STD 58 had a capacity requirement, may be able to forgo PID / totalizers might be more robust
POE	There are no certifications available for PFAS compounds, TCP, hexavalent chromium, uranium	
Community Engagement	Some members have been drinking water for extended periods and did not understand the health issue	Town Hall meeting
Installation	Local plumber hired and wasn't sure on how to install devices	Train on installations

Topic	Challenges	Potential Solutions
Brine disposal for IX	Cannot discharge brine into a septic system	Offsite regeneration

Breakout Room Discussions:

Table E6: Breakout Group No. 1 – Certification Standards

Topic	Challenges	Potential Solutions
Membrane capacity	No capacity requirements for membrane treatment	Review STD 58 and include membrane capacity requirements instead of PID requirements
Monitoring	TDS has little to do with contaminants	
Pressure	Homes have inconsistent pressure and associated inconsistent performance	
NSF/ ANSI Standard 58	Should include a requirement to perform change-outs in manuals (e.g., POU for PFAS compounds) / there's no stated capacity	Small volume challenges discussed and possible test strips
PID	PID definition is critical	When RO leaks TDS, implies a leak of the contaminant of concern; no data; perhaps pilot test to determine relationship / already done in a protocol for NSF/ANSI 58 & NSF/ANSI 62 uses for heavy metals
State vs Fed MCLs	Difficult to find which devices meet state MCL requirements / adding a searchable field increases cost of product / potentially confuses the customer	Hexavalent chromium *and many VOCs/SOCs* are examples/reviewed during the CA registration process / searchable field on certifier websites or direct URL link
Finding certified products	Many people limit their search to the NSF website only	
Finding PID equipment	PID equipment is not included with POU/POE devices	

Topic	Challenges	Potential Solutions
Refilling carbon vessels	Potentially a 3rd party refilling carbon vessels/need QC on those vessels/audits are in place	Have manufacturers verify media / Water Boards would need to monitor at the manufacturer level

Table E7: Breakout Group No. 2 – Installation and Implementation

Topic	Challenges	Potential Solutions
PIDs and Maintenance	TDS may be a faulty indicator, PIDs are often battery-powered or unreliable. Knowing when to service units is difficult.	Cloud-based and hardwired PIDs are being developed to promote better tracking of data, quicker replacements, and means of notifying operators/service providers if there is an issue.
Certified Devices and Testing	POU totalizing flow meters are less accurate than the relative POE devices, and certification of units can be done using capacity (flow).	Greater promotion and quicker certification of POE units (or POU units) which use flow as the primary means towards certification.
Amount of Service Connections Requiring Treatment	The more service connections requiring treatment, the harder it is to maintain (both regulatory and via O&M).	Create regulations further limiting (from 200 service connections) the total number of households allowed for POU/POE implementation to be considered.
New Certification Required for Small Changes	A regulatory barrier to certification exists if even a small component of something that "doesn't work well" is changed.	Working with device certifiers to address which parts of units did *not* change versus what *did* change and limiting the scope for re-certifying the products.
Opportunities for Higher-Capacity Devices	There is a lack of high-capacity (flow and concentration) devices that are certified. The technology exists but the piloting process of larger treatment units is very costly because	Create funding for certification of larger-scale devices that DDW deems to be more useful for specific cases.

Topic	Challenges	Potential Solutions
	double the amount of water 'treatable' is required.	
State Small and Domestic Homeowner Education – Who Provides?	There is no clear guidance on who should provide education to SSWS and Domestic homeowners once treatment is installed and implemented. Do manufacturers have guides on how to maintain and operate devices that are not regulated by DDW?	Create "Ambassador Programs" or something similar with influencers of each community to promote the addition and education of the devices installed. There is also a component where esthetics have played a role in the upkeep of O&M.
How long until a POU/POE Unit becomes obsolete?	POU/POE units generally have a useful lifespan (housing) of approximately 5 years. Some service providers promise service for up to 10 years.	Promote American-made products because replacement parts (e.g., filters, housings, etc.) are kept in stock longer than foreign-made products.
How are users with POU/POE handling source water quality with bacteriological contamination?	Some source waters in California have a natural presence of total coliform or have poor construction causing an issue.	Installation of Class-A UV disinfection devices; and solving issues with good construction.

Table E8: Breakout Group No. 3 – POE Treatment

Topic	Challenges	Potential Solutions
Performance Certification	There is no performance certification barrier and manufacturers don't understand the demand for the certification	
Performance Indication	Hard to obtain accurate data	Automatic shutoffs or bypass
Certifying POE	Why would a company get a device certified if the state would pilot test it anyway (only applicable to PWS)?	

Topic	Challenges	Potential Solutions
Waste	Will RWQCB allow for discharge of brine to a septic system for RO treatment case	The homeowner uses a test strip (both arsenic and nitrate)
Ion Exchange Media	IX media is typically comingled in large batches	Quality control around regeneration
RO treatment	Corrosion control management downstream of the RO treatment	A company in Michigan has an app that monitors commercial operations
Anion Exchange	Do the same vendors and manufacturers have existing QC on the industrial/commercial side that doesn't apply to residential	SWRCB needs to communicate issues to the industry adequately; more education; recommend going to vendors
Vendor Contacts	Access to a technically knowledgeable individual	Provide a list of needs to the industry
Whole System Certification	How would a whole system be certified at a domestic well	The inventory would be certified; however, no certification standard for portable regeneration; certification should be required but manufacturers haven't seen it demonstrated
HPC testing	Unclear what to communicate to customers when HPC tests are elevated	
GAC media	Full-scale requirements (e.g., not mixing GAC) will not translate for small systems	
Scale	It is not feasible to shrink a municipal system to the residential level; breakthrough study for individual homes is extremely challenging	

Topic	Challenges	Potential Solutions
Manufacturers	Provide a list of needs to the manufacturers so they can respond	
Beyond NSF/ANSI 61 certification	Manufacturers do not see the benefit of getting certified beyond NSF/ANSI 61	

Table E9: Breakout Group No. 4 – Need for a Streamlined Process

Topic	Challenges	Potential Solutions
Funding	Difficulty obtaining funding	New Regional Drinking Water Programs could likely assist
	Delayed reimbursement	
Service Provider/Operators	• Licensed contractors should be used for repairs but not always the case • How are installers selected? Certification process	• WQA has a certified program
Pilots	Customers wait for health benefit	
TMF capacity	Small water systems with low TMF capacity can inadequately maintain POU devices	
Certification	Units are no longer certified if not maintained with equivalent components	
Bacteriological Issues in domestic wells	At times UV treatment is applied but not the preferred solution; want to identify the source of the deficiency	
GAC media replacement	How do we ensure POE units are filled with NSF/ANSI 53 compliant media	Manufacturers should handle refills, not the dealer, as dealer refills can lead to inappropriate media; however, more

Topic	Challenges	Potential Solutions
		costly to have manufacturer fill; introduce safety factors
Certifying professional/technicians	Not adequate certification in place to ensure proper maintenance and repairs	Potentially piggyback backflow testing or another certification program; an ad hoc committee would be needed; a one-page program description would be needed

Pilot study recommendation from Breakout Room #4:

1. Clifford Faschacht, CA Groundwater Association recommended looking at the lifespan of membrane treatment systems to determine when they will need servicing/replacing.

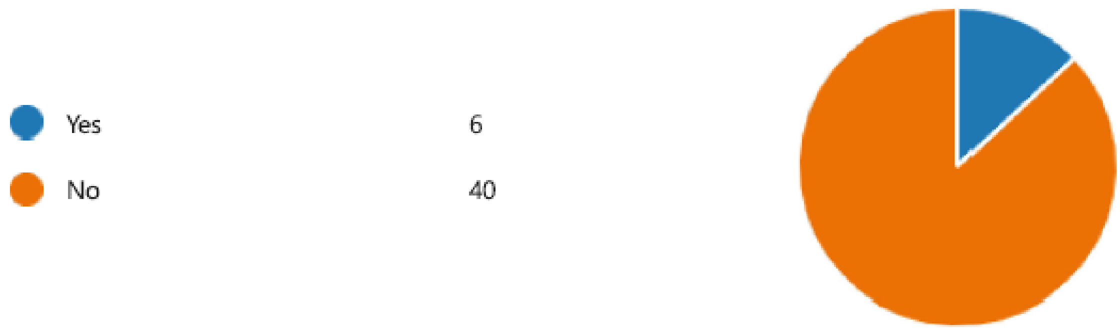
COUNTY SURVEY RESULTS

Counties responding to the survey included:

Amador, Butte, Calaveras, Contra Costa, El Dorado, Fresno, Glenn, Humboldt, Imperial, Kern, Kings, Lake, Lassen, Los Angeles, Madera, Marin, Mendocino, Merced, Mono, Monterey, Napa, Nevada, Orange, Placer, Plumas, Riverside, Sacramento, San Bernardino, San Diego, San Francisco, San Joaquin, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Shasta, Sierra, Solano, Sutter, Tehama, Tulare, Ventura, Yolo, and Yuba.

Questions in the survey:

Q1: Does the county have a POU/POE program for Public Water Systems, State Small Water Systems, or domestic wells, or any resources dedicated to support POU/POE implementation?



Q2: How many county staff person-years (PYs) do you estimate are annually dedicated to support POU/POE education, implementation, and/or maintenance in your county?

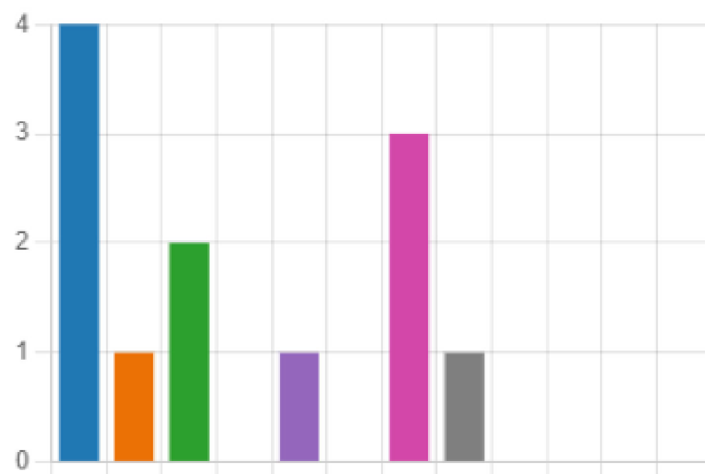
Q3: Does the county maintain or know where to access a list of approved or recommended POU/POE devices to address the water quality issues in your county?

Q4: Does the county provide assistance or resources for individual households to test self-supplied drinking water?

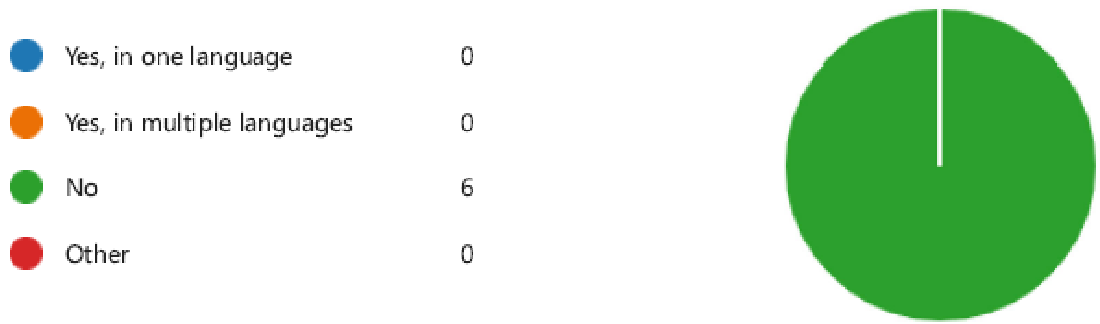
Yes	4
No	2

Q5: Please identify the most common water quality issues addressed by POU/POE devices in the county (check all that apply): arsenic, bacteriological, fluoride, inorganic chemicals, metals, minerals, nitrate, organic chemicals (SOCs/VOCs/1,2,3-TCP), perchlorate, radiological, taste/odor, and other.

Arsenic	4
Bacteriological	1
Fluoride	2
Inorganic Chemicals	0
Metals	1
Minerals	0
Nitrate	3
Organic Chemicals (SOCs/VOCs...	1
Perchlorate	0
Radiological	0
Taste/Odor	0
Other	0



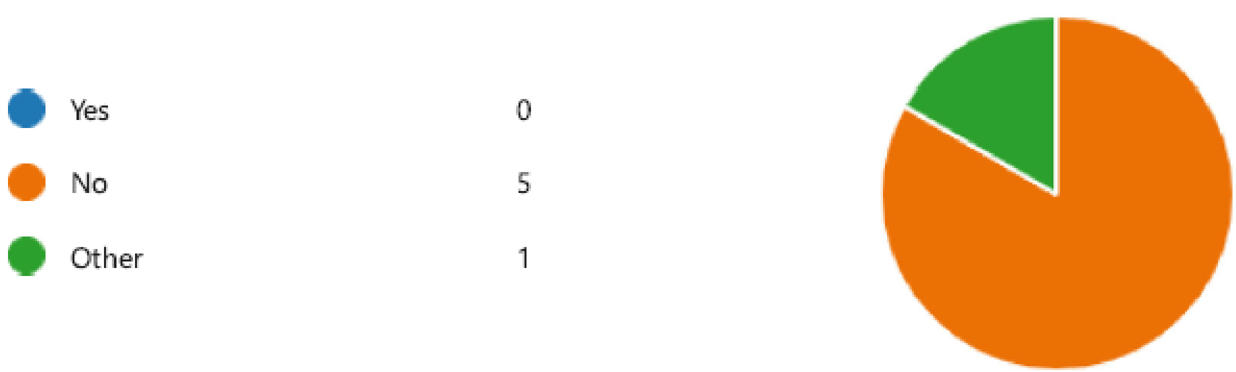
Q6: Has the county developed POU/POE outreach material describing available resources, technology, and/or funding assistance options (from the county, state, or elsewhere)?



Q7: Please briefly describe the POU/POE outreach material the county developed and how it is shared (mail, email, website, door-to-door, etc.) with the community.

Q8: Does the county offer operations and maintenance guidance, inspection, and/or technical assistance for installed POU/POE systems?

Q9: Does the county offer any funding assistance for the implementation, operation and maintenance, and/or monitoring of POU/POE installations?

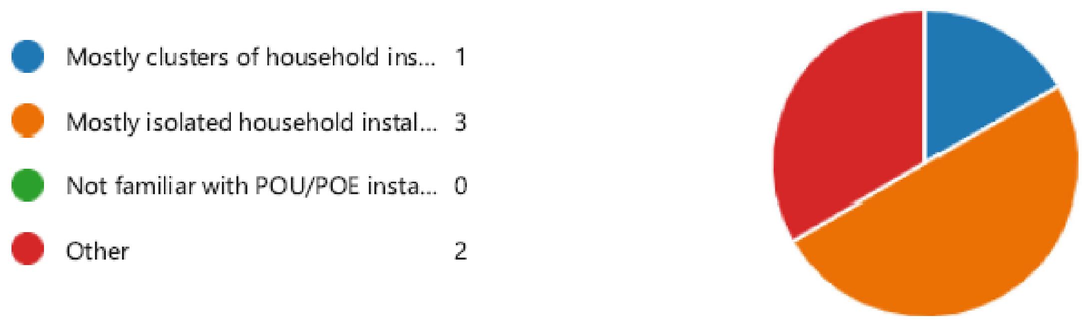


Q10: Can you describe generally the POU/POE installations within your county?

Blue: Mostly clusters of household installations

Orange: Mostly isolated household installations.

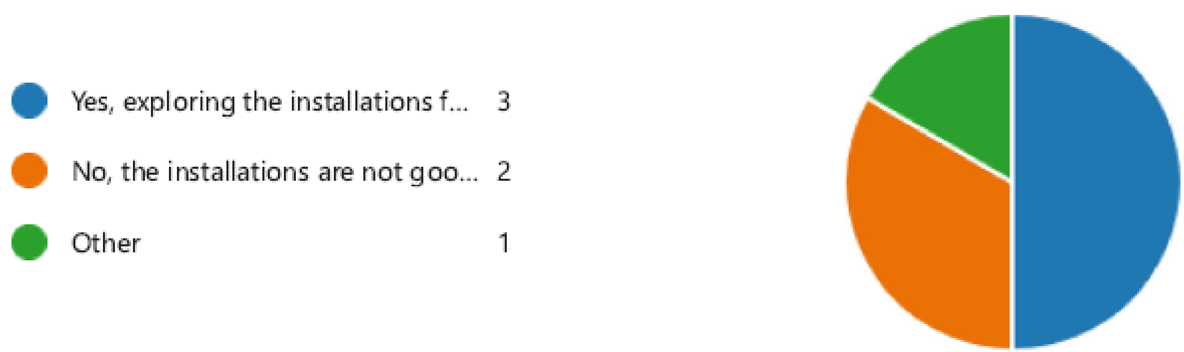
Green: Not familiar with POU/POE installations.



Q11: As part of the statewide assessment of POU/POE, would the installations in the county be good candidates for exploring successes or failures around the installation, maintenance, and/or treatment results?

Blue: Yes, exploring the installations further would be valuable. Please reach out to me for additional information.

Orange: No, the installations are not good candidates.



Q12: Please share any additional insights on the success or failures of the POU/POE program in your county.

Q13: If there is no POU/POE program in your county, are there intentions to begin a program or evaluate the potential establishment of a program?

Blue: Yes, we are considering the establishment of a POU/POE program in the near future.

Orange: No, we have no plans to establish a program.

APPENDIX F: CASE STUDY #1 (PUEBLO UNIDO CDC)

Pueblo Unido CDC Case Study – Riverside County

Prepared by Sergio Carranza,
Pueblo Unido CDC

Important Sections:

1. **OVERVIEW**
   a. Overview of Items Covered below

2. **WHERE IS THE PROJECT AND WHAT WAS THE NEED FOR POU/POE TREATMENT?**
   a. Where (geographically), demographics, describe the case study and purpose for implementation of the solution for providing treated water to homes/schools/businesses, any potential contaminants (before treatment) and the current logistics for the users.

   The project provides Technical Assistance to the unincorporated communities of Thermal, Oasis, and Mecca, Riverside County. Pueblo Unido CDC started a pilot program in 2010 that consisted of installing POU Reverse Osmosis Water Filtration units under the sink at mobile homes. The contaminants targeted include arsenic and fluoride that exceed the regulatory MLC. The pilot program has been specifically developed to assist farmworker and low-income households lacking municipal water services. The source of water contaminants are onsite water wells which provide domestic water to the residents.

   b. Discuss what they were trying to do before to fix the contamination issue (if anything?)
      i. New well, centralized treatment, consolidation, etc.?

   Prior to this pilot program, there were no alternative solutions tried or developed. Basically, residents were aware of water contamination, and resourced to buy bottled water for their drinking water needs.

3. **CHOSEN SOLUTION**
   a. Describe the solution (POU/POE device selected, PIDs, etc.)

   Due to the lack of available financial resources, Pueblo Unido CDC researched for potential cost-effective water filtration solutions to address water contamination. The research process included other technologies such as water absorption, IX and coagulation and filtration technology. Once reverse osmosis technology was identified, Pueblo Unido CDC reached out to different *manufacturers that will support this effort in rural communities. Most manufacturers were focused on commercial applications in urban areas. However, Nimbus Water Systems, a manufacturer in Temecula, California offered its Nimbus Water Maker 5, certified to remove arsenic and fluoride. Pueblo Unido CDC ordered the first generation of POUs in 2010 and installed twelve (12) units in the unincorporated community of Oasis. After collecting water samples and obtaining water lab results, the technology proved to be an effective approach to removing arsenic.*

i. Interim or permanent?

The program is intended to be an interim solution to water contamination until water consolidation with a municipal service is available. The units are installed at existing state small water systems (small mobile home parks known as "Polanco" parks).

b. 50%+ Voting, public meetings, etc.?
Prior to propose the installation, water sampling was obtained at the onsite wellhead to verify arsenic levels at the site. The process followed by organizing several community meetings and introduce the POU as interim alternative solution for drinking water. Through a community consensus and buy in, Pueblo Unido CDC proceeded to install the units at each mobile home.

IMPLEMENTATION PROCESS/ROLLOUT & PARTICIPATION RATES

c. Discuss the implementation process
   i. Describe the rollout processes

The process has been established through working and trusting relationship with the community. Outreach and community organizing has been instrumental to provide awareness and education. Additionally, Pueblo Unido CDC uses a community-driven approach where ongoing community meetings take place to find viable solutions for water contamination. This approach facilitates the buy in from the community. Also, community network provides awareness of the pilot program and validate the effective implementation of the units.

ii. Was guidance for customers provided?

At community meetings, Pueblo Unido CDC displayed the POU units, and explain the different components of the technology, as well as showing how and where they are installed. Once the introduction was complete, Pueblo Unido CDC's staff make appointments with individual households to complete the installation and to provide final instructions for operations. Staff returned after few days to collect water samples for lab analysis. Water results are shared with households to verify optimal removal of water contaminant.

iii. Installation requirements (spatial constraints, plumbing, etc.)

Despite of confined spaces under the sink at some mobile homes, the installation of units has been successful. In some cases, additional plumbing work is required including replacing old valves, hoses, and other devices to accommodate the connection of the POU unit.

iv. Any issues?

The most challenging issue is related to old and distressed cabinetry where the unit is to be placed. In some cases, staff has requested the homeowner to do some repairs prior to the installation of the unit.

d. Participation Rates

After the installation of over 300 units at different households at Polanco parks, it has been determined that the program has a 95% of participation rate.

e. Overall response/feeling?

The response has been unanimously positive, with some residents declining to participate. A key motivation is the involvement of state and federal government which makes them aware of non-compliance issues. Additionally, some tenants dislike the maintenance and monitoring of the system because the invasion of privacy.

4. OPERATION AND MAINTENANCE

a. Ongoing Maintenance Aspect

i. How are they being maintained?

PUCDC has developed a schedule of annual maintenance including inspection of unit for any leak, and replacement of membranes and sediment filters. PUCDC is adopting new tracking forms provided by USEPA which increase the level of detail and recording of activities at each participating household's system.

ii. Any issues?

PUCDC notify in advance the residents to avoid any issues and to conduct the scheduled maintenance. Issues reported are related to household's plumbing and clogging. No issues are reported in relation to the POU units.

b. Overall response/feelings?

The response from the residents is overwhelmingly positive. Resident's feedbacks include good water taste.

5. COST (INITIAL COST, O&M)

a. What was the initial cost of the units?

The initial approximate cost of the unit is $350.00

b. What is the water rate before and after POU/POE?
   Normally, water charges include the cost of membrane estimated at $65.00 and sediment filter estimated at $20.00 a year. Rents includes onsite water system maintenance.

c. How much funding/funds are required to replace units?
   As stated above, $350 is required to purchase the POU unit, and $85 per year for part replacement. We are in the process of installing POE units which are estimated at $12,000 with an estimated annual maintenance of $245.00

d. What is the cost for labor to maintain these units?
   PUCDC's staff provide labor to maintain the units.

e. Are they meeting TMF?
   The water systems are classified as state smalls and do not require compliance with TMF.

f. Overall response/feeling?
   No applicable

6. PUBLIC EDUCATION

a. What was developed (materials, outreach opportunities)?
   PUCDC is currently developing materials. However, our outreach program and technical assistance provide information to educate the residents about the POU unit, proper operation and maintenance, and interpretation of water sampling reports.

b. What was the method of outreach to provide education?

   PUCDC has established a database of participants and created a geographical map to schedule outreach activities. Monthly meetings are also held to provide education regarding the overall drinking water program.

c. How did the public benefit from the education?
   Education is the best tool to demystify any misinformation related to the POU units. Additionally, the interpretation of water reports is beneficial to build trust towards the units.

d. Was it successful?
   The established trusting relation with the residents is the best indication of the success of the outreach activities

7. LESSONS LEARNED/DIFFICULTIES:

a. Discuss any difficulties encountered

There are no substantial difficulties with the program. Some of the issues involve contacting the residents for the unit maintenance or monitoring. This is due to households leaving to work out of the area or when they are on vacation.
One learning experience involved trusting a resident to collect the water for analysis. The resident mistakenly took the sample from the tap water instead of the unit goose neck faucet that created wrong water analysis results.

b. Recommendations for changes in regulations, processes, etc. to make POU/POE more accessible/an easier option

The existing regulations are adequate to successfully implement the POU unit. The expediting of funding agreements is recommended to increase access to these units.

c. Staff-level difficulties?
No staff level difficulties at this point.

APPENDIX G: CASE STUDY #2 (MONTEREY)

Reduction of Nitrate and 1,2,3-TCP at a Community Water System with POU/POE in Salinas Valley

Encinal Rd WS #01 community public water system is located southeast of the City of Salinas in Monterey County. The public water system serves 91 people through 9 service connections. It has not yet been permitted by the county and Do Not Drink notices are posted throughout the facility. The service area is a mixture of homes and agricultural facilities with offices and onsite housing. It has one groundwater source with nitrate concentrations (ranging from 21 to 71.3 milligrams per liter (mg/L)) and 1,2,3-trichloropropane (1,2,3-TCP) concentrations (ranging from non-detect to 184 nanograms per liter (ng/L)). The maximum contaminant levels for nitrate and 1,2,3-TCP are 10 mg/L and 5 ng/L, respectively. If confirmed nitrate samples are above the maximum contaminant level and untreated, the water system is in violation. The maximum contaminant level for 1,2,3-TCP is based on a quarterly running annual average; however, if any sample would cause the running annual average to exceed the MCL, the water system is immediately in violation. For Encinal Rd WS #01 water system, the samples were immediately causing violations and requirements to treat the source water. Monterey County took enforcement action to ensure the public water system addressed the source contaminants. The well concentrations for nitrate and 1,2,3-TCP are as follows:

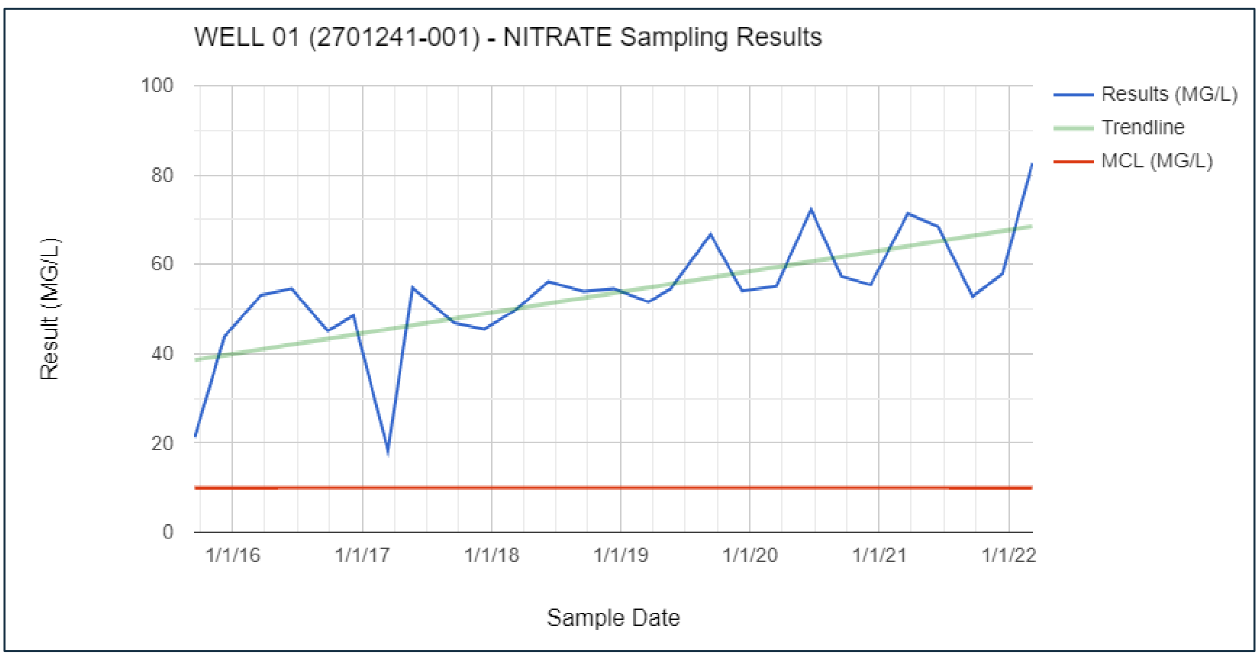


Figure G1. *Nitrate concentrations (in mg/L) at Well 01 from September 2015 to March 2022 are increasing over time.*

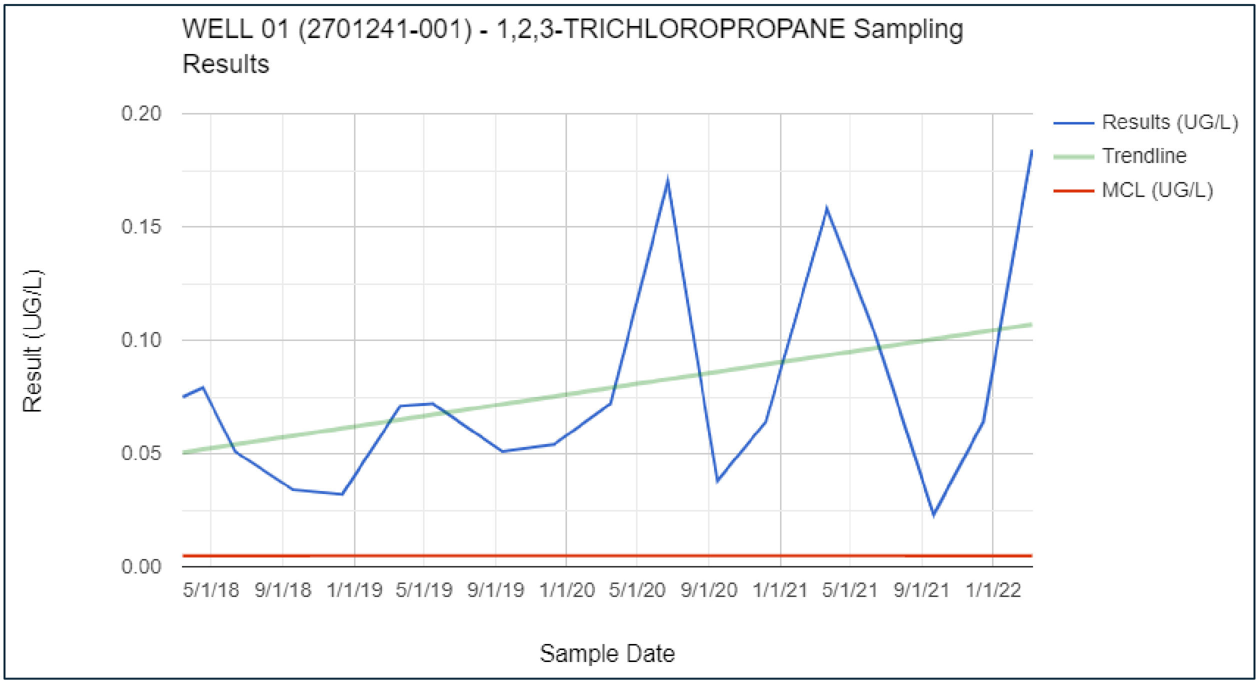


Figure G2. *1,2,3-trichloropropane concentrations (in micrograms per liter, ug/L) from March 2018 to March 2022 are fluctuating and increasing over time.*

Through coordination with Monterey County, Encinal Rd WS #01 was able to implement a POU and POE treatment system.

POE TREATMENT

The parcels with agricultural use have separated out the domestic water and the POE is installed on the entry to each domestic system. The POE installation (see Figure X) included two 18 x 65” vessels (8.8 cu. ft.) in a lead / lag configuration. The vessels contain Calgon Carbon Filtersorb 400, agglomerated bituminous coal-based GAC. The units were designed for 6.5 gallons per minute flow with 10 minutes of empty bed contact time in each vessel.

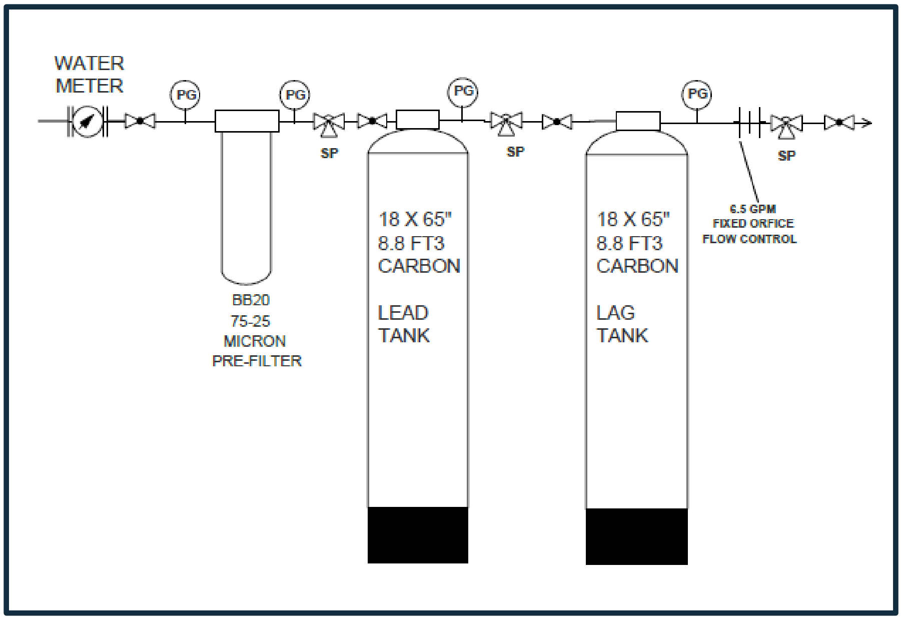


Figure G3. *The POE treatment installation.*

The POE pilot study results were as follows:

Table G1. *Average influent and effluent concentrations for 1,2,3-TCP during the pilot study*

Average Influent 1,2,3-TCP Concentrations, ng/L and Range (Minimum – Maximum)	Average Effluent 1,2,3-TCP Concentrations, ng/L and Range (Minimum – Maximum)
107 (19 – 350)	Non-detect[111]

Concentrations of 1,2,3-TCP fluctuate in source water. There were four 1,2,3-TCP detections in finished water and the elevated concentrations in finished water were attributed to a bypass valve (not shown in schematic) in the open position; the operator removed the handle to that valve. Further, other detections were attributed to mis-labeling of samples by the sample collector. To date, the GAC media has not been changed and finished water monitoring continues with no detections in finish water.

Table G2. *Each POE Unit reduced the concentration of 1,2,3-TCP as depicted in the table below.*

Average Influent 1,2,3-TCP Concentrations, ng/L	Units	Average Effluent 1,2,3-TCP Concentrations, ng/L	Average % Reduction
44	1	Non-detect	-89%
No data	2	Non-detect	n/a
No data	3	Non-detect	n/a

[111] All detections in finish water were reported to be due to either an incorrect sample label or a bypass line being open; all finish water results following the pilot continue to be non-detect.

POU TREATMENT

Many of the sites require multiple POU units since there could be multiple offices and homes. It is estimated between 20 and 30 total devices would be required for the 9 connections. Culligan AC30 Platinum RO POU units were installed (estimated to cost $500/unit plus labor), and the performance of the unit was tested for 8 months. Each unit was also equipped with a booster pump (to ensure 80 psi pressure was applied), a flowmeter, and a pre-/post-TDS monitor. The performance of the POU RO unit during the pilot study was as follows:

Table G3. *A POU Unit reduced the concentration of nitrate as depicted in the table below during the pilot study.*

Average Influent Nitrate Concentrations, mg/L (Minimum – Maximum)	Average Effluent Nitrate Concentrations, mg/L (Minimum – Maximum)	Average % Reduction
57.8 (46.0 – 68.7)	6.1 (0.9 – 8.8)	-89%

The performance of the units since the pilot study were as follows:

Table G4. *Each POU Unit reduced the concentration of nitrate as depicted in the table below.*

Average Influent Nitrate Concentrations, mg/L (Minimum – Maximum)	Units	Average Effluent Nitrate Concentrations, mg/L (Minimum – Maximum)	Average % Reduction
56.7 (40.2 – 66.5)	1	6.2 (0.9 – 18.4)	-89%
3.0 (0.5 – 5.5)	2	Non-detect	-97%
57.9 (57.2 – 58.6)	3	4.6 (0.4 – 9.2)	-92%
No data	4	5.2 (4.3 – 6.8)	n/a
No data	5	6.9 (4.5 – 8.5)	n/a
No data	6	7.2 (5.0 – 8.7)	n/a
No data	7	6.2 (4.0 – 9.1)	n/a

While not anticipated, an elevated nitrate concentration, 18.4 mg/L, was measured at the effluent of one the homes after the pilot test was completed. Monterey County has not approved the use of these devices and the public water system is still required to post Do Not Drink notifications throughout the facility. Monterey County indicates that this elevated nitrate value is likely due to low use through the POU device. There were no daily TDS readings available during this sampling event.

Lessons Learned

- It takes considerable effort to inform the responsible party and third-party representatives of the requirements associated with POU/POE installations for public water systems.
- Bypass lines should not be installed for lead/lag vessel configurations. If they are installed to allow maintenance, they should be locked so it cannot be turned on by mistake.
- Commercial and residential demands are markedly different from one another; there should be separate design considerations for GAC vessels, pending demands for each building. There are still two homes that require treatment to be fully compliant. The installation cost for each GAC unit costs approximately $9,000 and these units are likely oversized for the demand associated with each home. Monterey County is working directly with the public water system to facilitate a potentially smaller GAC vessel installation which would include piloting, additional monitoring, and separate O&M plan for sampling and media changes.
- Complex compliance requirements and costs result in the need for close monitoring of the public water system.
- Systems with extremely high raw water levels may need increased sampling frequency.
- RO systems should not remain unused for an extended period of time or the nitrate concentration in finished water may increase. Some connections may still choose to use bottled water in lieu of the treated water so routine operation instruction should include briefly running the RO unit each day. Maintaining a pre-/post- TDS/EC daily log may help ensure the system is checked/run daily.

APPENDIX H: CASE STUDY #3 (IMPERIAL COUNTY: HOMES ON IID CANAL)

Water Treatment Challenges with Local Solutions:
Imperial County's POE Pilot Project

Prepared by the Imperial County Public Health Department,
Division of Environmental Health

Preface

Imperial County is an agricultural region covering more than 4,284 square miles in the southeast corner of California, sharing a southern border with Mexico. The Imperial Valley, a region within the irrigated lands in central Imperial County, is traversed by a network of 1,600 miles of open canals operated by the Imperial Irrigation District (IID) over a water service area of nearly a half million acres. These canals supply untreated Colorado River water for agricultural use – the base economy for the region, industrial use, for potable water use by 47 public water systems and to approximately 2,700 rural residential homes for domestic use.

Although IID supplies surface water to the 2,700 rural residential homes without access to treated water supplies, a 1993 court case established that IID was exempt from the designation of a public water system under the purview of the Safe Drinking Water Act (*Imperial Irrigation District v. U.S. Environmental Protection Agency*, 1993). Nonetheless, as a part of a compliance agreement with the State Water Board (originally with CDPH) following the court ruling, the IID ensures annually that homes receiving canal water also maintain an active account to receive their drinking and cooking water from a licensed bulk haul potable water supplier.

However, canal water entering a rural home's plumbing system remains untreated. Even though residents are notified by the IID that the water is non-potable, and the water is not used for drinking, water is nevertheless used for bathing and washing, and is usually left untreated, unless a household can afford to install a POE water treatment system (or equivalent). In Imperial County, approximately 75% of unincorporated households (including rural households) are considered lower income, earning less than 80% of the average median income (Source: 2015-2019 American Community Survey) compared to urban households. With an average per capita income in Imperial County of $18,064, many households cannot afford to purchase a surface water treatment system.

Even though most rural households have been receiving untreated canal water for over a century in the Imperial Valley, it was widely unknown what contaminants, other than bacteria, were entering homes. In 2012, the National Latino Research Center at the University of San Marcos, in conjunction with Comite Civico Del Valle, Inc., released a non-peer reviewed study titled ***Agua y Salud: Water Quality & Environmental Health Community Study*** (Appendix A). The study analyzed water quality at rural residential homes in Imperial County that receive canal water for domestic use. Findings from the study reported that pesticides and bacteria (including *e. Coli*) were detected in some homes using at-home water test kits that were supplied by the study's proponents.

The accuracy of these at-home test kits were uncorroborated by state or local agencies due to a gap in water quality data from canals supplying water directly to rural homes. This was primarily due to the absence of a regulatory oversight program for rural home connections and the fact that local public water systems, in lieu of sampling from their treatment plant intake location, collectively share annual source water monitoring data (through a Joint Monitoring Program) that historically collected only from the four major arterial canals, which include the All-American, East Highline, Central Main and Westside Main canals (in 2018, the Joint Monitoring Program was revised and expanded to include an additional 22 sampling sites, including some, but not all, plant intake locations).

In recognition of the data gap and the need to authenticate some of the study's findings, the Imperial County Public Health Department, in collaboration with IID, decided to conduct a similar outreach campaign with rural residential homes. As a result, the elected bodies of both agencies approved funding for the POE Pilot Project in order to achieve two objectives: 1) provide income qualified residents with a surface water treatment device that would provide safer domestic water, and 2) assemble a database of lab certified water quality test results from the lateral canal system. Both agencies agreed to an equal contribution to fund the project, with the Imperial County Public Health Department, Division of Environmental Health (DEH), tasked with developing and implementing the pilot project. In April 2018, the Imperial County Board of Supervisors approved the establishment of the POE Pilot Project, and several months later, in December 2019, the first POE was installed.

The following narrative describes the steps taken by DEH and our partners in creating and implementing the POE Pilot Project in a manner that increased access to the human right to water for some of Imperial County's most vulnerable residents, all while working within strict budget constraints. The ability to provide a technologically advanced POE system free of charge to residents has been a great benefit to the public health of the community. In addition, two years of operation and maintenance provided by DEH and our partners ensured the POEs verifiably provided safer water. DEH was also able to develop a robust database of the POE treatment capabilities and of local water quality conditions. It should be noted that the POE Pilot Project is currently ongoing, with new POEs planned for installation for the next several months. And lastly, as noted later in this document, additional sources of funding being targeted could potentially extend the project for several years to come.

Project Framework

As work began to develop the framework for the pilot project, DEH consulted with the State Water Board, Division of Drinking Water (DDW), early in the process. DDW played a critical role in helping select the most appropriate surface water filtration system and in establishing the water quality parameters for sampling and monitoring.

Water Quality

Due to the raw nature of the canal water source, bacterial removal was considered the primary objective for filtration and disinfection. In order to determine if households with installed POEs were receiving safer water, the pilot project framework was developed to include monthly bacteriological samples of total coliform at each site to ensure the POE system continually provided safer water, free of pathogens. Quarterly source water samples of *e. Coli* were also included.

Chemical monitoring was also implemented in the project framework. The monitoring schedule for chemicals consisted of source water samples taken prior to the installation of the POE (Table H1) and a smaller subset of the source samples that are taken annually from a post-filtration sampling location (Table H2). The source sample set was developed by closely imitating monitoring requirements for public water systems under Title 22, California Code of Regulations, and then was pared down to include only general mineral, general physical, and a subset of inorganic and Synthetic Organic Chemicals (SOC). The SOC's selected were targeted based on the following: Glyphosate was chosen due to heavy use in local fields (based on local usage data from the County Ag Commissioner) and Atrazine and Simazine (along with other SOC's in the USEPA Test Method 507) were sampled due to their detections in the 2012 study mentioned earlier. It should be noted that all water quality samples are analyzed by an ELAP certified laboratory.

Table H1: Source Samples (Pre-Filtration)

Type of Test	Constituent				
General Mineral/Physical	Color	Odor	Bicarbonate	Carbonate	Hydroxide Alkalinity
	Calcium	Chloride	Copper	Foaming Agents	Iron
	Magnesium	Manganese	pH	Sodium	Sulfate
	Specific Conductance	Total Dissolved Solids	Zinc		
Inorganic Chemicals	Aluminum	Arsenic	Barium	Cadmium	Chromium
	Lead	Mercury	Nitrate (as NO3)	Nitrite (as Nitrogen)	Selenium
	Silver	Fluoride			
Synthetic Organic Chemicals	Atrazine	Simazine	Alachlor	Molinate	Thiobencarb
	Glyphosate				

Table H2: Annual Samples (Post Filtration)

Type of Test	Constituent			
Inorganic Chemical	Nitrate (as Nitrogen)			
	Atrazine	Simazine	Alachlor	Molinate

Synthetic Organic Chemical	Thiobencarb	Glyphosate	

In addition to the bacteriological and chemical monitoring, other operational parameters are also captured and recorded to demonstrate the effectiveness of the filtration process, as outlined in Table H3. This information is captured monthly and is stored in an electronic database.

Table H3: Operating Metrics

Type of Reading	Metric	
Turbidity (hand-held device)	NTU Pre	NTU Post
Pressure (psi)	Pre	Post
UV Light	On	Off
	Days Remaining	
Water Flow (from meter)	Total Gallons	

POE Design

For the process of selecting the filtration technology, Guy Schott, P.E., an Associate Civil Engineer with the Santa Rosa District, was consulted. At Mr. Schott's request, samples of local raw canal water were sent to his office for particle and filter analysis. Based on his analysis, Mr. Schott recommended five filtration technologies, with only two being *approved* alternative surface water filtration technologies. These were the Rosedale and Harmsco LT2 filters (Appendix B). Based on the results of the filter analysis and the overall equipment and maintenance costs, the Harmsco LT2 filter was selected as the preferred choice of technology for the POE design.

The final POE design (Appendix C) for the project consists of the following equipment, with actual installations demonstrated in Figures H1 and H2, as shown below:

<u>Pre-Treatment:</u>
Consists of one HC3-Multi-Media filter that contains approximately 30" of Garnet, filter sand and Anthracite media and can filter out particles bigger than 20 μm. The filter has a diameter of 12" and measures 48" in height. The life span of the filter media, when backwashed frequently, can last 20+ years. An automatic electric valve on top of the pre-filter automatically backwashes on a pre-determined cycle. Backwash water is utilized on-site as irrigation water. The second filter in the pre-treatment process is a 20" Big Blue cartridge filter that can filter out particles bigger than 10 μm. Cartridges normally last one year and when changed out, are discarded, and replaced by a new cartridge. The unique wrench used to open and change out the cartridge filter is provided to each resident when they exit the project.

<u>Primary Treatment:</u>

The Harmsco MUNI housing with one LT2 filter can filter out particles bigger than 1 µm. This unit is a State approved alternative filtration technology approved for surface water treatment. The Harmsco unit contains several butterfly nuts on its lid that are easily opened to expose the cartridge filter for visual inspection, maintenance, or replacement. No tools are required to maintain the filter. The filter is replaced once a year (per manufacturers recommendation) and can be discarded in the trash.

<u>Disinfection:</u>
The project utilized the Viqua VH200 UV light, which is NSF approved for residential use. The UV bulb last for one year and can be replaced by disconnecting the power supply to the unit and removing the bulb from the inside of the unit. No tools are required for the bulb replacement.

The final POE design was collaboratively designed by DEH and our primary contractor for the project, SoCal Water Solutions, Inc (C-55 License# 989996), a locally owned, minority/woman business.

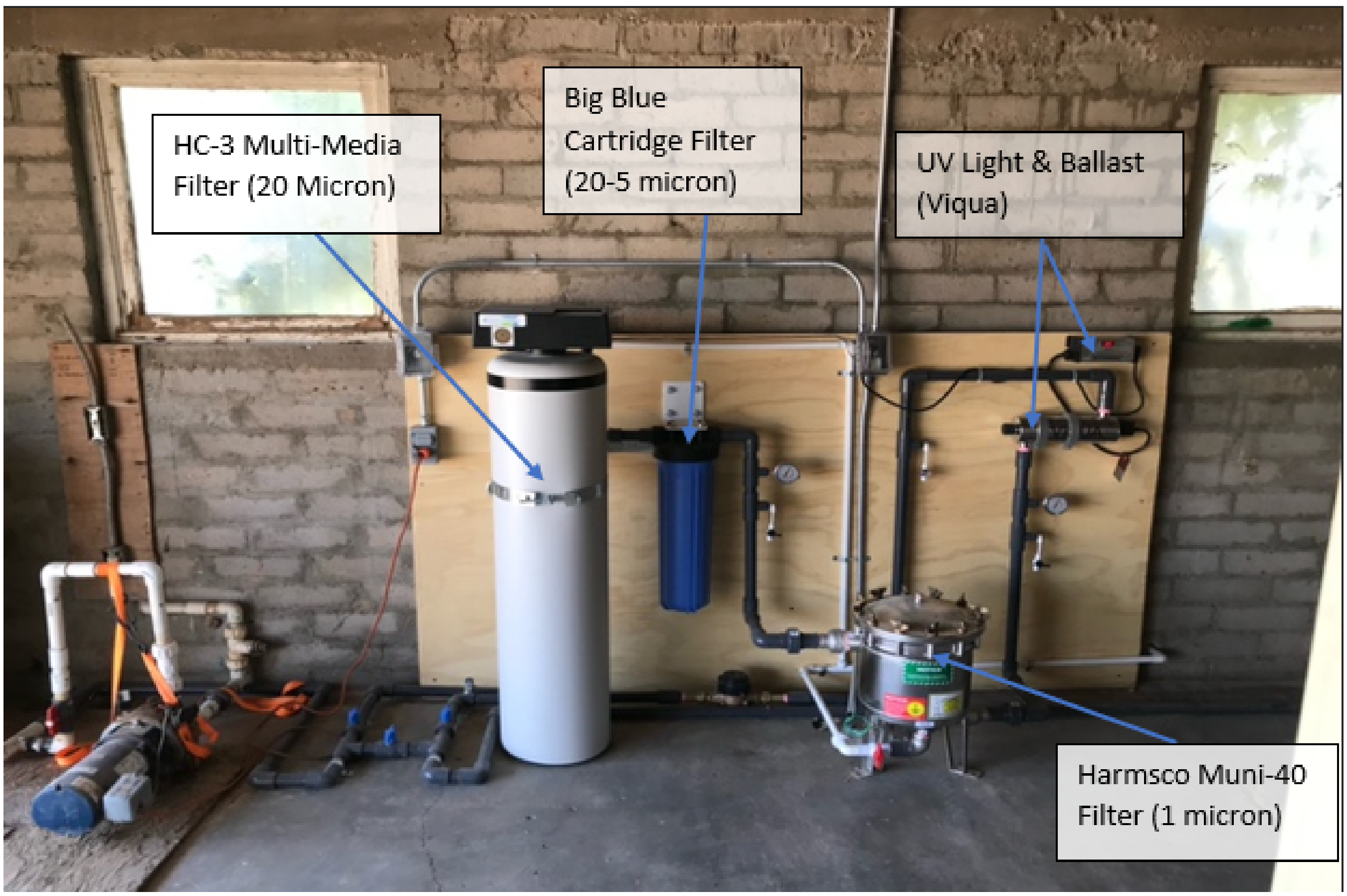


Figure H1: Typical POE Design – Installed within a Garage (POE# P-20)

Figure H2: Typical POE Design – installed outdoors (POE# P-31)

Targeted Outreach & Implementation

In order to target specific households that would benefit the most from the installation of a POE system, the IID and DEH implemented the following criteria to establish participant eligibility:

- Residents of a household must obtain canal water for domestic use; and,
- Residents of a household must be enrolled in IID's Residential Energy Assistance Program (REAP).

The REAP program is administered by the IID and provides energy and drinking water costs subsidies to qualified households based on the income and size of the household. Upon a query by the IID, it was determined that a total of about 200 households met these criteria. This group of 200 were mailed an “interest to participate letter”, in English and Spanish, to notify them that they would qualify for a voluntary POE Pilot Project for the installation of POE system (Appendix D). Due to the limited funding, interested households that contacted DEH to express their interest to participate in the program were placed in order by when they called. Within a few days of mailing the letter, several households interested in the program contacted DEH, exceeding the available funding.

Agreements

A total of three agreements were necessary for the project. The first two were with the project vendors, including the primary contractor (SoCal Water Solutions, Inc.) and the labor compliance consultant (Labor Compliance Consultants of Southern California). These were one-time (updated for Phase II) agreements that covered the whole period of the project. The third agreement, between the residents of the qualifying household and DEH, were administered for each home. DEH and residents meet to discuss the overall objectives of the project, the role of each of the three partners (DEH, contractor, and household), collect verbal baseline water quality information, understand the existing water system setup, to answer any questions residents may have, and review and sign the agreement. From here, the site evaluation, testing and installation proceeded.

Site Evaluation & Source Sampling

With a signed agreement, DEH proceeded with a site evaluation at the selected home in order to examine the unique characteristics of each property. Even though most rural homes share similar traits as it relates to their water system setup, such as having a water cistern for raw water storage with a pump and pressure tank connected, there are always unique factors at each property. The site evaluation is used to check the location of the pump and its relation to the main water line feeding the house, the existing and potential electrical connections needed for the UV light and the automatic flushing valve, the potential siting location of the POE such as a garage, shed, or if a concrete slab is necessary, a location where the ground is level, and the site security.

Also conducted during the site evaluation is the source water sampling. Source samples are typically taken from an outdoor spigot at the residence. These source samples are used to determine if a more robust treatment system, such as RO, is necessary. If source samples were to detect a chemical exceedance, followed by a confirmation sample, a RO system would be installed instead of the Harmsco filter setup. To date, no chemical has been detected above their established Maximum Contaminant Levels (MCL).

POE Installation

The POE installation usually takes one full day to complete. In order to avoid interruptions of water flow to the home throughout the installation day, a main-line by-pass is always constructed while the POE conveyance system is being setup. Once installed, a treated water bacteriological sample is taken to ensure the system is working properly. The date of installation triggers the start date for the two-year O&M period.

2-Years of Operation and Maintenance

Each POE is maintained and sampled for two years following installation. DEH (Phase II) or the contractor (Phase I) conducts monthly site visits to take treated water bacteriological samples, conduct hand-held turbidity tests from pre and post treatment, record readings of pre and post filtration pressure gauges, collect water usage data, ensure UV light is on and record days remaining on the UV bulb, and note any special occurrences observed during the site visit. All results are electronically recorded in the field using an electronic form on the Microsoft 365 Platform, where they then get stored in a SharePoint database. The bacteriological sample is tested for the presence/absence of total coliforms and is analyzed by an ELAP Certified laboratory. Additionally, once every quarter, a pre-treated raw water *e. Coli* sample is taken and analyzed using the Quanti-Tray method. The bacteriological results also are manually entered into the SharePoint database with the other monthly results collected.

In addition to the monthly visits, annual visits are conducted to replace water system equipment and perform chemical water quality testing. At the end of year one and two, each system has their cartridge filter, Harmsco filter and UV light lamp replaced. For the chemical testing, treated water samples are taken of the chemicals outlined in Table 2.

Resident Empowerment

Prior to the end of the two years of operation and maintenance, residents are instructed on the operation and maintenance of the POE. The project applicant and/or a household representative, are asked to join DEH on the 23rd monthly site visit in order to complete a mock equipment change out, review the different POE components and answer any questions about the program or the POE. Then, on the 24th and final month of the program, the household representative, DEH, and the contractor are present to do the final equipment change out. The contractor supplies the household with brand new filters (cartridge and Harmsco LT2) and a UV lamp bulb replacement. The contractor provides guidance on how to perform the change outs, while the residents are tasked with doing the actual change-out. This provides real hands-on learning, and it allows for any questions to be discussed and answered.

Also, during the last site visit, households are provided with an operations and maintenance manual (Appendix E). The manual, both in English and Spanish, details each of the POE components, how to maintain them, and provides estimated costs for purchasing POE components. The manual also provides a resources list where POE equipment can be purchased. The manual is bound and laminated, and households are advised to keep it with the POE system so that it is easily accessible when work on the POE is performed. Residents are also advised that DEH remains a resource should they have any questions or issues with their POE.

Funding & Project Costs

To date, two funding sources have been utilized for the pilot project. The initial source was from the Public Health Department and the IID. Both agencies contributed $200,000 each that funded 20 POE installations. To date, all 20 POE's have been installed, with four households having completed the two years of O&M. The funding from the agencies covered the cost of sampling, design, equipment, construction, and O&M.

The second source of funding was from a Supplemental Environmental Project (SEP) stemming from a Settlement Agreement and Stipulation for Entry of Administrative Civility Liability Order between the California Regional Water Quality Control Board, Colorado River Basin, and the IID. The total SEP amount is for $549,000 and will fund approximately 25 POE installations, including the design, sampling costs and the O&M, as described earlier. The SEP became active in September 2021 and is currently being implemented by DEH and our partners. As of this writing, Phase II had 11 of the 25 POE's installed.

Sampling Costs

Source samples, which are completed prior to the installation of the POE and are taken from an outdoor spigot of the untreated water source, range in cost from $1,200 to $1,400. Annual sampling, which are taken post-treatment, range in cost from $350 to $450. All project samples are analyzed by an ELAP certified laboratory. For a list of source water and annual samples, see Table 1 & 2, respectively.

Design, Equipment, Construction Costs

The bulk of the costs for the project are related to the design, equipment, and construction of the POE. Based on available data, this portion of the project usually accounts for at least 50% of all costs per household and costs about $10,000 on average. Prior to any work, the contractor provides a project cost estimate, which is followed by a Notice to Construct by DEH.

O&M Costs

The second highest cost is the operations and maintenance performed over two years for each system. The O&M, as previously described, includes monthly visits by a technician to take water samples and collect operational data. The percentage of the total costs for O&M range between 40%-45% of total costs and average about $8,000 per home. It should be noted that the two equipment change outs, at the end of year one and two, along with the annual chemical sampling, is included in this cost.

Lessons Learned

Although the project has been able to achieve several significant milestones in the short time it has been operational, there are still elements of the project that continue to evolve. As with most pilot projects, challenges and success were encountered along the way. Below are a few descriptions of those findings.

Challenges

As the pilot project work continues and additional households receive a POE system, DEH recognized challenges along the way that should be highlighted. A major challenge being faced is the unknown ability of a household to maintain their POE system once they exit out of the program. Since all the POE recipients were income qualified, their ability to maintain the system could be limited. With only a handful of residents recently exiting the program as of this writing in 2022, it is still unknown if residents will be able to maintain their system in the years to come (note that an equipment replacement project is seeking funding to assist households that participated in the POE Pilot to replace their annual equipment).

Another challenge is the cost of the approved surface water filtration technology. Although the Harmsco LT2 filter provides superior filtration ability, the cost of the filter housing is relatively expensive. Based on our analysis of approved surface water filtration technologies that were scalable for POE use, there were few options available. In order to utilize funding efficiency for the purpose of providing additional options to residents and agencies, we look to DDW and the business industry to find surface water treatment system alternatives that are economically feasible and can provide comparable filtration performance. There should also be recognition that smaller units may not need to undergo the rigid testing requirements placed on the alternative filtration technology approval process if these are not intended for municipal or commercial use. These requirements may have the potential to make these technologies more expensive, and therefore less economically viable to households in disadvantaged communities. A hand-in-hand economic and filtration performance analyses of viable surface water POE technologies, including those that meet applicable NSF standards, should be explored for the purpose of identifying affordable smaller units.

Due to the relatively high cost of the POE system, which limited funds, the project was only able to utilize one type of surface water filter. Due to the limited funds and the urgent need in the community, DEH was not able to research the feasibility of other filters to provide effective surface water treatment.

Furthermore, once-a-month pre and post turbidity spot checks in the pilot project is a major monitoring challenge that limits the process of benchmarking the filtration performance. The use of an on-line turbidimeter would have provided continuous data collection for benchmarking the filtration process. However, the use of online turbidimeters would have been cost prohibitive in the pilot project, since these are expensive and incur costly programming, calibration, and troubleshooting expenses. Instead, the approach was limited to the once-a-month pre and post turbidity spot check.

Successes

One of the real successes of this project was its ability to target households that have greatly benefited, in multiple ways, from having a POE installed. Those that received a POE system would not have likely been able to afford purchasing the quality of POE provided through the project. All the homes that had a POE installed did not have a filtration system. Only a few had previously had a filtration system, but all those systems were either removed, not functioning, or not being maintained. In order to gain a better understanding of residents' ability to maintain their POE systems after they exit the program, DEH is in the process of deploying a survey to understand this dynamic and gather additional information on the resident's experience participating in the project.

Another program highlight was the performance results of the POE system. The way the POE was designed most similarly resembled a direct filtration water system, but without the use of a coagulant injection process. This is important to note, particularly when turbidity data is examined and benchmarked against filtration performance standards under Title 22, California

Code of Regulations for public water systems. Based on monthly readings from over 340 site visits (and counting), the average pre-filtration turbidity was 2.3 NTUs, while the POE system was able to achieve an average post-treatment turbidity of 0.55 NTUs. Although this number is above the 0.3 NTUs required by most surface water filtration systems, the POE system clearly provided a much more filtered water supply.

And as the water began to get filtered more effectively, a close examination of the bacteriological data indicates that the treated water supply also began to become safer. According to pre-treatment samples collected, total coliforms were detected in 91% of the samples taken, while *E. coli* was detected in 65% of the samples taken. *But the post-treatment samples detected the absence of bacteria in 98% of the samples taken.* And when there was a detection of total coliforms (never *E. coli*) in the treated water supply, confirmation samples were always collected and follow up test results always confirmed bacteria was no longer present in the water.

As for the chemical monitoring that was conducted, the data resembled those of the canal samples collected by the Joint Monitoring Program used by the public water systems treating surface water. No chemical was detected above their MCL. Moreover, the annual samples taken from the POE treated water supply also did not display any detections (for SOCs) and were well below the Nitrate MCL.

Moving Forward

Based on the two objectives of the POE Pilot Project, which were 1) provide income qualified residents with a surface water treatment device that would provide safer domestic water, and 2) assemble a database of lab certified water quality test results from the lateral canal system, DEH can definitively state that both objectives were met. However, the fact remains that qualified households that are interested in a POE, far exceed the available funding.

In order to expand POE installations, DEH is working with the State Water Board, SAFER Unit, to potentially fund the installation of 50 additional POEs. But in addition to the new installations, some of the funding is being requested for supplying equipment replacement components (cartridge filter, Harmsco filter and UV lamp) for all POE Pilot Project participants. By providing the replacement equipment, households would ensure their POE system effectively operates for additional time.

DEH is also looking to administer a survey with all POE recipients in order to understand the strengths and weaknesses of the program and to document the changes water users were able to experience first-hand. These survey's may be able to provide information for operational changes or confirm elements of the program that are working.

The project has also provided DEH with a standardized POE design for new local land use projects looking to connect to a canal supply as a source for their domestic water. If requested by county leadership and elected officials, DEH would be able to provide minimum design requirements for a proven POE system.

Appendices[112]

Appendix A – Agua y Salud: Water Quality & Environmental Health Community Study

Appendix B – Approved Alternative Filtration Technology

Appendix C – POE Treatment Train Schematic

Appendix D – Outreach Letter

Appendix E – POE Pilot Project Maintenance Manual

[112] References for the IID case study may be requested from SAFER – Rural Solutions Unit (RSU) staff.

APPENDIX I: CASE STUDY #4 (COMMUNITY WATER CENTER (CWC) CASE STUDY)

1,2,3-TCP Treatment Pilot Project for Disadvantaged Community (DAC) Households in Northern Monterey County

Prepared by the Community Water Center (CWC)

Introduction:

The 123-TCP Treatment Pilot Project for Disadvantaged Community (DAC) Households in Northern Monterey County is taking place in unincorporated areas where residents rely on domestic wells with high levels of 1,2,3-Trichloropropane (123-TCP). The Project was funded through a supplemental environmental project (SEP) undertaken as part of a settlement that was reached under an enforcement action brought by the Central Coast Regional Water Quality Control Board against Monterey Mushrooms, Inc. and Spawn Mate, Inc. The enforcement action was brought for unauthorized discharges of process wastewater and polluted stormwater in 2017.

The Project goals were to:

- Conduct a pilot project to implement 123-TCP Point-of-Entry (POE) household-level water treatment at up to 20 households supplied by domestic wells or small water systems that results in effectively treating 123-TCP to levels below the California Maximum Contaminant Level (MCL) and reducing participants' exposure to 123-TCP.
- Monitor and document the project process, costs and results to inform statewide efforts to effectively and economically implement 123-TCP treatment for domestic wells and state small and local small water systems.

All households participating in the project also had levels of nitrate exceeding the MCL, and some households had exceedances of other primary and secondary MCLs. This pilot project was intentionally focused on treatment of only 123-TCP because delivered bottled water (that households were already receiving) provides the most reliable source of safe water for drinking and cooking for project participants who rely on wells with acute contaminants such as nitrate that are not of concern for inhalation exposure. Additionally, most households considered for the project had nitrate at levels exceeding the level that state-certified residential treatment devices are certified to treat.

The SEP-funded project will continue until July 2023. It is expected this pilot project will be continued for three additional years with funding from the SWRCB.

Origins of the Project

This project was the result of community members' concern about their exposure to 123-TCP via water vapor while showering, and the long timeframe necessary to develop and fund long-term solutions. CWC began community organizing in low-income areas with high levels of nitrate found in small water systems. CWC helped identify households with high levels of 123-TCP and other contaminants by connecting local residents to a free drinking water well testing program and also through the GAMA Groundwater Information System. In February 2019, residents in north Monterey County in the area north of Moss Landing formed the El Comité para Tener Agua Sana, Limpia, y Economica (El Comité). El Comité has been working together with CWC to support drinking water solutions for their community, including successfully advocating for a free delivered bottled water program funded by a Cleanup and Abatement grant administered by Pajaro Sunny Mesa Community Services District. Households outside the El Comité area that participated in this POE treatment project were also receiving bottled water through either the Regional Bottled Water Program for Central Coast Households funded by the State Water Board's SAFER program or through a program funded by the Salinas Valley Replacement Water Settlement.

123-TCP poses significant health risks when inhaled or ingested. Despite the availability of bottled water, no solution was currently available in the community to prevent exposure to 123-TCP via water vapor while showering. Because community members were concerned about their exposure, CWC, and El Comité sought funding for POE treatment to reduce exposure to 123-TCP for indoor water uses for which bottled water could not be used.

Voices from the Community: Testimonials from Project Participants

Reasons for interest in the project:

- "For my children's health, they can't shower comfortably. It would relieve my stress to get [the 1,2,3-TCP] treated."
- "To help this study and help elevate [the need] and make the machines less expensive so that people can afford it."
- "Because our health and the health of our kids and grandkids matters greatly to us."
- "To try to make things better for everyone and to improve the water system."

Thoughts on 1,2,3-TCP and other contamination in drinking water:

- "I am tired of it. I lived here for the last 40 years. I am 67 years old now. I cannot do anything else to make this right. It's hard! It's hard living here."
- "It scares me that it's in such high concentrations in my water and the steam."

Implementation of the Project

Project Participants

Community Partners: All partners rely on domestic wells with 123-TCP contamination exceeding the MCL and are located in or near northern Monterey County. Partners agreed to the installation of a POE treatment system at their property and/or residence and to allow contractors and CWC to access the system for installation and monthly monitoring, operation and maintenance over the course of the study. Partners also agreed that all project data could be shared with the public through a water system ID (e.g. DWMC-01). In many cases, partners also made repairs to their water systems that were required in order for the 123-TCP treatment systems to be installed.

Community Water Center (CWC): Experienced environmental justice organization that provides technical assistance to implement interim and long-term solutions for low-income households with contaminated drinking water. CWC serves as the project lead, responsible for outreach and enrollment of pilot project participants, convening and facilitation of the Technical Advisory Committee (TAC), selection and management of contractors, and all project deliverables.

Weber, Hayes & Associates (WHA): Watsonville-based environmental consulting, engineering, and water systems operation firm. WHA leads the design (with input from CWC and TAC), installation, operation, maintenance, and monitoring of the treatment systems.

Culligan QWE Commercial Systems (Culligan): Culligan, located in Salinas, was subcontracted by WHA to provide and install the POE treatment systems. Culligan also provides certain repairs (covered under warranty) and maintenance activities such as carbon replacement.

Technical Advisory Committee (TAC): Made up of technical and implementation experts from the State Water Board, the Monterey County Environmental Health Bureau, other technical assistance providers, consulting firms, and the research community. The TAC provides guidance and feedback on project design and implementation on a voluntary basis.

Source Water Quality

The source water quality from the domestic wells where treatment systems were installed is summarized in **Table 1**, including regulated contaminants and parameters that can affect the treatment of 123-TCP with granular activated carbon (GAC), the treatment method used in the project. All wells had nitrate above the MCL and one site also exceeded the MCL for hexavalent chromium. Many wells also had very high levels of total dissolved solids and hardness, as well as substantial concentrations of Non-Volatile Organic Carbon and Iron.

Table 1: Contaminants and parameters relevant to 123-TCP treatment in the nine domestic wells where treatment systems were installed.

	Units	**MCL** (Secondary MCLs are shown in italics)	Min[1]	Max[1]
123-TCP	ug/L	0.005	0.00879	0.128
Nitrate	mg/L	10	10.2	67.3
Hexavalent Chromium	ug/L	10[2]	1.9	13.3
Arsenic	ug/L	10	<0.038	5.9
Perchlorate	ug/L	6	<0.77	4.5
Total Coliform Bacteria	CFU/100 mL	<1.0[3]	<1.0	308
E. coli Bacteria	CFU/100 mL	<1.0	<1.0	<1.0
Non-Volatile Org. Carbon	mg/L	n/a	<0.30	1.40
Hardness (as CaCO3)	mg/L	n/a	140	1,000
Total Dissolved Solids	mg/L	*1,000*	289	1,800
Iron	mg/L	*0.3*	<0.03	0.59
Manganese	mg/L	*0.05*	<0.004	0.017
Turbidity	NTU	*5*	<0.1	4.1

[1] For wells where more than one sample was collected, the highest concentration of a constituent measured at a well was considered when calculating the minimum and maximum across the nine wells.

[2] 10 ug/L is the proposed MCL of for Hexavalent chromium in drinking water, which is currently under review.

[3] If total coliform bacteria is detected in more than one sample in a regulated water system, the State Water Board requires that the water system conduct an assessment of the water system and take action to address any problems identified. The presence of total coliform alone is not an MCL violation.

Domestic Well Water System Condition and Repairs

The condition of domestic wells and water systems varied among the households considered for inclusion in the project. Many systems had deficiencies resulting in potential contamination routes, such as cracks or openings in well heads, cracked concrete well pads, unsealed perforations or cracks in storage tanks, and poorly fitting storage tank lids. Total coliform bacteria were detected in samples collected at the POE of many households considered for the project, and E. coli was detected in a few cases. Regardless of whether total coliform or E. coli bacteria were detected, CWC and WHA worked with households to eliminate potential contamination routes through the high priority well and water system repairs described in **Table 2**. Systems where total coliform or E. coli had been detected were also disinfected after the repairs. Depending on the case, repairs and disinfection were done directly by homeowners or residents, or paid for by CWC using either SEP funding or supplemental grant funding.

Based on TAC feedback, households where E.coli was detected during site assessments were not included in the project due to concerns that even with repairs the E. coli contamination could reoccur. However, E. coli was detected and confirmed at two sites after treatment systems were already installed. At one site (DWMC-14), this contamination was addressed by re-inspecting the system and not finding any potential contamination routes, replacing the GAC and disinfecting the treatment system, confirming that E. coli was no longer present, and placing the treatment system back online. At the other site (DWMC-19) the GAC was replaced and the treatment was disinfected, and the system will be put back online after the repairs described in **Table 2** are completed. More details on how bacteria contamination was addressed are provided in the Challenges section of this summary.

Table 2: Summary of well or water system repairs completed or planned.

System ID and Repair Status	Well or Water System Repairs Made or Planned	Who Made Repairs	Funding	Cost (includes WHA coordination but not CWC coordination)
DWMC-01 (completed)	Initial unsuccessful disinfection of well. Lift well head to more thoroughly disinfect the well. Replace concrete well pad and install new well cap.	Well contractors	Supplemental Grant	$6,957
DWMC-02 (completed)	Tank repairs (seal crack; replace lid; remove old ozonator; replace cracked drain valve; install screened vent and overflow; replace electrical junction box). Replace leaking irrigation pipe. Replace leaking fittings at pressure pump discharge.	WHA	Homeowner	$700 (discounted rate)

	Disinfect tank and distribution piping.			
DWMC-09 (completed)	Seal tank lid. Install screened vent and overflow on tank. Install check valve on well discharge.	Homeowner	Homeowner	Unknown
DWMC-10 (completed)	Tank repairs and improvements (replace lid and float valve; seal and move electrical conduit; install screened overflow and vent)	Well contractor	Supplemental Grant	$2,375
DWMC-15 (planned)	Lift the well head and disinfect well. Well repairs and improvements (Install new well cap, pressure relief valve, sample tap, and pump-out valve; re-plumb discharge piping; replace concrete pad; repair electric supply conduit).	Well contractor	SEP ($5,500) and Supplemental Grant ($2,166)	$7,666 (estimated)
DWMC-19 (completed)	Tank repairs and improvements (seal/move electrical conduit; install overflow and vent). Install sample tap between well and tank.	Well contractor	Supplemental Grant	$1,462
DWMC-19 (planned)	Lift well head and disinfect well. Install new control box and electrical conduit near well.	Well contractor	Supplemental Grant	$2,475 (estimated)

Treatment System Design

The Request for Proposals (RFP) for this project specifically requested that the consultant's design use granular activated carbon (GAC), the only best available technology for 123-TCP according to California water code (Title 22 CA Code of Regs 64447.4). The RFP also specified the carbon specifications, which were developed with input from the TAC and are available upon request.

In most cases, one POE treatment system was installed at the point-of-entry to one household to treat only the water used indoors by that household. Treating water for outdoor uses unnecessarily expends the GAC's capacity. However, in two cases, one treatment system was installed to treat water for two households on the same property served by the same well. At one site (DWMC-01), a tap was installed upstream of the treatment system and residents were encouraged to use untreated water from that tap for outdoor use. At the other site (DWMC-09) a tap was installed upstream of the treatment system; however, the distance from the residences to the upstream tap is too great for practical outdoor use. Outdoor use at DWMC-09 was estimated to be low.

The water passes through two tanks of GAC in series, a lead tank, and a lag tank. Once the GAC in the lead tank's capacity to remove 123-TCP is expended and 123-TCP is detected downstream of the lead tank, the lag tank is moved into the lead position, and the GAC in the lead tank is replaced. The lead-lag design reduces the risk of 123-TCP breaking through to the lag tank effluent.

The treatment system is also equipped with:

- Pre filter to prevent sediment from entering into the GAC tanks
- Post filter to filter out any GAC that might come out of the tanks
- Flow restrictors to prevent the flow through the system from exceeding its maximum design flow of 9 gallons per minute
- Flow meter to measure how much water is treated
- Pressure gauges to measure the pressure loss through the treatment system
- Taps to collect water samples upstream of the system, after the lead GAC tank, and after the lag GAC tank

Three different sizes of treatment systems were installed in the project to test the costs and benefits of larger and smaller systems. All systems had a maximum design flow of 9 gallons per minute:

- 24-cubic-foot, 20-minute empty bed contact time (EBCT): The first three systems installed in the project have four GAC tanks each, with two parallel trains of lead and lag tanks. The tanks have a total of 24 cubic feet of GAC.
- 7.2-cubic-foot, 6.0-minute EBCT: Three systems installed later in the project have two GAC tanks each, one train consisting of a lead tank and a lag tank. The tanks have a total of 7.2 cubic feet of GAC.
- 4.0-cubic-foot, 3.3-minute EBCT: Three other systems installed later in the project also have the same two tank design as the 7.2-cubic-foot systems, except they only have a total of 4.0 cubic feet of GAC.

Photos of the 24-cubic foot and 7.2-cubic foot systems are shown below in **Figure 1**.

Figure 1: Project participants in front of a 24-cubic foot system (DWMC-09) near Salinas (left), and a CWC staff member next to a 7.2-cubic foot system, DWMC-19 in Royal Oaks (right).

Steps to Implement the Project

Step 1: CWC identifies low-income areas of Monterey County with contaminated domestic wells based on available data and conducts preliminary outreach to community members

Step 2: Community residents form El Comité, identify 123-TCP as a health concern, and request support in finding a solution

Step 3: CWC identifies SEP funding to ensure community drinking water needs are addressed

Step 4: Pilot project outreach

CWC developed information - in Spanish and English - about the pilot project, and shared it with community partners, property owners, and others relying on drinking water wells contaminated by 1,2,3-TCP. CWC met with residents and property owners at households with 1,2,3-TCP contamination to inform them about the project and ask if they would be interested in participating.

Step 5: Site assessments

If residents and property owners expressed interest in the project and signed participation agreements, WHA conducted site assessment visits to evaluate if and where a POE treatment system could be installed for the household. WHA also collected water samples from the well to confirm the presence of 123-TCP and test the water for other parameters that can affect 123-TCP treatment, such as total coliform and E. coli bacteria, iron, manganese, and total organic carbon.

Step 6: Well or water system repairs (in some cases)

As described previously in the “Domestic Well Water System Condition and Repairs” section, in most cases, before the treatment system could be installed, repairs had to be made to the well or water system to eliminate routes through which bacteria or other microbes could enter the water system.

Step 7: Installation

If WHA and CWC determined that a treatment system could be installed on the property, and the residents and property owner were in agreement, CWC, the residents, and the property owner signed an Implementation Agreement detailing how the system would be installed, maintained and monitored. Once this agreement was signed, Culligan installed the treatment system, which included flushing the GAC media. WHA collected water quality samples immediately following installation.

Step 8: Monthly Monitoring

After installation, WHA visited the treatment systems monthly to inspect them and collect water samples. WHA collected 123-TCP samples each month between the lead and lag tanks and after the lag tank to confirm that the treatment system was removing 123-TCP to below the MCL. Initially, only the sample collected between the lead and lag tank was analyzed. If 123-TCP was detected in that sample, the sample collected after the lag tank would also be analyzed. A 123-TCP sample was also collected upstream of the treatment system every 3 months to monitor the 123-TCP concentration in the well. Samples were also collected monthly for total coliform, E. coli, and heterotrophic plate count bacteria upstream and downstream of the treatment system. Sample results were reported to community partners.

Step 9: Operation and Maintenance (O&M)

Community residents reported small issues related to system function including leaks to CWC and/or WHA. During the monthly visits WHA also identified any problems with the treatment system, such as leaks or clogging of the pre and post filters and worked with Culligan to resolve the problems. The project also included a budget to replace the GAC once its capacity to remove 123-TCP was depleted, and to backflush the GAC tanks if the GAC became clogged and excessive water pressure was required to move water through the tanks. GAC was replaced during the project in two systems due to E.coli contamination, but not due to pressure loss or 123-TCP detection downstream of the lead tank. All project repairs and maintenance were documented in an O&M log, which is available upon request.

Systems Installed

The nine systems installed during the project are summarized below in **Table 3**.

Table 3: Systems Installed (through December 2022)

System ID	Households Served	Location[1]	Time System has Been in Service (days)	Source Water 123-TCP Range (ug/L)	Average Volume Water Treated (gal/day)	Volume of Carbon (cubic feet)	Number of Carbon tanks
DWMC-01	2	Moss Landing	35	0.062-0.109	591	7.2	2
DWMC-02	1	Moss Landing	567	<0.0006-0.017	132	24	4
DWMC-04	1	Moss Landing	532	0.019-0.070	123	24	4
DWMC-09	2	Salinas	544	0.031-0.074	445	24	4
DWMC-10	1	Salinas	244	<0.0006-0.128	40	4.0	2
DWMC-14	1	Royal Oaks	90	0.081-0.128	160	7.2	2
DWMC-15 (offline)[2]	1	Royal Oaks	0	0.014-0.021	N/A	4.0	2
DWMC-19 (offline)[2]	1	Royal Oaks	37	0.0066-0.10	N/A	7.2	2
DWMC-21	1	Moss Landing	247	0.048-0.066	154	4.0	2

[1] This location indicates the general geographic area in which treatment systems are located. All systems are located on or near households served by private drinking water wells in unincorporated areas.

[2] DWMC-15 and DWMC-19 were installed but are currently offline until high priority well repairs can be made to eliminate potential microbial contamination routes.

Project Results

1,2,3-TCP Treatment Effectiveness

Throughout the project, all treatment systems in operation have been effective at reducing the concentration of 123-TCP to levels below the MCL (0.005 ug/L) and to below the detection limits (typically <0.0006 ug/L). 123-TCP has not been detected in any samples collected downstream of the lead tank. Treatment systems have been in operation on average for 9 months (ranging from 1 to 20 months).

Project Costs

Costs through late 2022 for the treatment project are summarized in **Tables 4 and 5** below. Due to the relatively short duration of this pilot project, long-term operation and maintenance costs, including the frequency of GAC replacement, are unknown. Outreach, coordination, project management, and monitoring make up a substantial portion of the project costs. While some of these costs may be lower for a larger-scale implementation than for this project, outreach to individual households including the signing and negotiation of implementation agreements, site assessments for individual water systems, and regular monitoring will always be critical for the effective and reliable implementation of POE treatment.

Table 4 illustrates the implementation costs through November 2022 of all nine installed systems. Installation costs are higher, as expected, for the larger systems. In addition, some of the higher costs are due to the following:

- The DWMC-09 installation cost was higher due to the need to install a variable frequency drive and controller on the well pump so that the treatment system could be located directly downstream of the well and serve both households on the property.
- Shade structures were installed at DWMC-01, DWMC-09 and DWMC-15 to protect the treatment systems from direct sunlight, to prolong the life of plastic plumbing components and prevent high temperatures which could promote microbial growth in the GAC.
- The higher monthly monitoring costs for DWMC-14 and DWMC-19 represent only two and one month of monitoring, respectively, and thus may not be representative of long-term monitoring costs.
- The high average monthly minor maintenance cost for DWMC-14 includes WHA’s time to inspect the water system after E. coli was detected following installation and is also averaged over only two months so is likely not representative of long-term costs.

Table 4: Implementation Costs (through November 2022)

System ID	Volume of Carbon (cubic feet)	Site Assessment and Installation (WHA and Culligan)	Months in Service	Average Monthly Monitoring Cost to Date (WHA and Lab)	Average Monthly Minor Maintenance Costs (WHA and Culligan)	GAC Replacement Costs to Date[1] (WHA and Culligan)	
						To Date	Budget to Replace Lead tank(s)
DWMC-01	7.2	$16,591	1	$488	N/A	N/A	$1,317
DWMC-02	24	$12,233	20	$474	$30	N/A	$2,915
DWMC-04	24	$16,216	16	$537	$14	N/A	$2,915
DWMC-09	24	$25,912	17	$581	$162	N/A	$2,915
DWMC-10	4.0	$11,735	7	$552	$0	N/A	$771
DWMC-14	7.2	$10,295	2	$759	$428	$2,228	$1,317
DWMC-15	4.0	$13,401	0	N/A	N/A	N/A	$771
DWMC-19	7.2	$9,882	1	$752	$34	$2,293	$1,317
DWMC-21	4.0	$9,359	7	$452	$36	N/A	$771
12 Sites where treatment was not installed		$14,092 (site assessment only)	N/A	N/A	N/A	N/A	N/A

[1] Because 123-TCP breakthrough has not occurred in any systems yet, GAC replacement frequency (and thus annual cost) is not yet known. The budgeted cost for replacing the lead tank(s) in each system is shown for reference. GAC in DWMC-14 and DWMC-19 lead and lag tanks was replaced shortly after installation to resolve E. coli contamination issues.

In addition to system implementation costs, there were additional costs for community outreach and education as well as project management and technical oversight (see **Table 5**). Project outreach, education and enrollment costs include the time spent connecting with households served by drinking water wells with 123-TCP contamination; drafting and signing of participation and implementation agreements; coordination of site assessments, monitoring, and other site visits; overall determination of feasibility of system installation on a case-by-case basis; and troubleshooting numerous issues with community partners as they arose based on the unique aspects of each site. The project outreach cost in Table 3 *does not* include time spent on outreach and recruitment for initial well testing of 211 wells facilitated by CWC (which identified 27 wells with 123-TCP) or CWC staff time -for extensive outreach and coordination to address bacteria contamination.

CWC also tracked staff time for direct project management and convening the TAC, including presentations at TAC meetings, TAC meeting minutes, and follow-up meetings with individual TAC members (see **Table 5**).

Table 5: Outreach, Management, Technical Oversight Costs (approximate costs through November 2022)

	Project Outreach, Education and Enrollment (CWC)	Project Management and Indirect Costs (CWC and WHA)	Study Design, Contract Oversight, Technical Advisory Committee (TAC) Convening (CWC)	Total Outreach, Management and Technical Oversight Costs
Total Cost	$41,768	$69,011	$52,000	**$162,779**
Average Cost per System Installed	$4,641	$7,668	$5,778	**$18,087**

Challenges Encountered

The systems have so far been online and treating 123-TCP for a relatively short amount of time due to the decision to implement this project in phases (in order to learn from the first three systems before installing additional systems) as well as the time required for system repairs, site assessments and installation.

It is expected this pilot project will be extended until 2026 with funding from the SWRCB to continue monitoring, operation, and maintenance of the existing systems, and install additional systems. This will help to better understand operation and maintenance costs and system effectiveness over this extended time period.

CWC was in contact with several interested community partners who had high levels of 123-TCP, but landlords declined to participate for a variety of reasons such as the limited duration of funding for operation and maintenance, the visual appearance of the system, disturbance of their yard/property, and concern that if they acknowledged contamination they could be held responsible to fix it.

CWC is actively working to secure longer-term funding for operation and maintenance. WHA and CWC worked with property owners and residents to limit any disturbance caused by the treatment systems. Implementation Agreements include a provision for CWC to use project funding to remove treatment systems at the end of the project if property owners want them to be removed.

Due to the variability of 123-TCP concentrations in groundwater, there were some sites where 123-TCP was detected at levels above the MCL in one initial sample but was not detected in follow-up sampling.

To maximize the benefit provided by the project, CWC prioritized sites with consistent 123-TCP contamination. However, the intermittent 123-TCP contamination presents a valid concern for homeowners and residents because their well had high levels 123-TCP at one time and then was not found in subsequent samples. Without regular monitoring of drinking water wells, community partners are left wondering if a toxic contaminant may resurface and cause health risks for their families.

The majority (78%) of the sites considered for or included in this project had source water contaminated with total coliform bacteria and in a few cases E. coli bacteria. The presence of these bacteria indicate that surface water or other contaminated water has entered the well or water system.

To address the challenge of bacterial contamination, based on TAC guidance:

- CWC and WHA worked with property owners to make repairs to wells and water systems to eliminate contamination routes and to disinfect the systems. Depending on the case, these repairs were paid for by property owners, with SEP funds, or with funding from other grants secured by CWC.
- In cases where total coliform contamination could not be eliminated, property owners and residents signed consent forms acknowledging the presence of total coliform bacteria, consenting to continue operation of the treatment systems despite the presence of coliform bacteria, and agreeing to use bottled water for drinking and cooking to protect themselves from exposure to nitrate and microbial contaminants.
- Systems were not installed at sites where E. coli was detected, If the presence of E. coli was detected and confirmed at a site where a treatment system was already installed, the treatment system was taken offline until the contamination had been addressed. Before placing the treatment system online again, the GAC was replaced and the treatment system was disinfected.
- CWC is planning to pilot the installation of UV disinfection as part of an extension of the project.

Many sites had challenging source water quality, with high hardness and total dissolved solids, and significant concentrations of non-volatile organic carbon.

Based on TAC guidance:

- Periodic backflush of the carbon tanks was included in the operations and maintenance budget in case biological growth or inorganic precipitates clogged the carbon bed and caused excessive pressure loss.
- CWC is aware that high hardness could hinder the effectiveness and reliability of UV disinfection and will take the hardness into account for any future piloting of UV disinfection.

It was difficult to secure the timely services of well or water system contractors to disinfect and repair wells and domestic water systems due to a shortage of contractors in the area.

- CWC and WHA were proactive in searching for available well/water system contractors and asking for secondary quotes when possible to ensure the proposed repairs were needed.

Recommendations

Based on the findings of this pilot project, CWC has developed the following recommendations for future work regarding point-of-use (POU) and POE treatment for domestic well households:

1. All POU and POE treatment projects for domestic well households should include sufficient budget for outreach to identify eligible households and assess the feasibility of the proposed treatment for each household considered for enrollment in the project. Prior to installation, inspect the well and water system and test the well for all contaminants that pose a risk to health and that could interfere with treatment. Any microbial contamination issues (the presence of total coliform or E. coli and/or potential contamination routes) should be addressed prior to installing treatment.
2. Use proven technology to reduce the concentrations of all harmful contaminants present in water to safe levels. Use a state-certified device when available and ensure that device is operated within the parameters of that device (e.g. level of total dissolved solids, pressure, contaminant level).
3. Closely monitor the performance of a newly installed treatment device to ensure it performs properly with the specific well’s source water quality. Continue regular monitoring after installation to ensure the device is working properly.
4. Develop a plan and budget for operation and maintenance, including unexpected repair of leaks and routine replacement of parts.
5. If a proven treatment technology cannot be properly implemented, monitored and maintained to treat all drinking water contaminants in a domestic well, residents should use bottled water for drinking and cooking.

6. Much remains to be learned about how to reliably implement POU and POE treatment for households supplied by domestic wells. More pilots should be implemented that should include comprehensive source water quality monitoring, regular monitoring to determine if and how long the system works with that particular source water quality, detailed documentation of costs, and support from a technical assistance provider for all aspects of the project to ensure quality and follow-up.
7. When possible, other more proven and robust long-term drinking water solutions such as consolidation with a public water system should be selected over POU/POE treatment.

CWC and partner organizations also provided more detailed comments regarding the State Water Board's Draft Point-Of-Use Point-Of-Entry Report on February 15 and December 8, 2022.

Next Steps

It is expected that this pilot project will be extended for an additional 3 years with SWRCB funding, to continue O&M and monitoring of installed systems, install a limited number of additional systems, and pilot disinfection. Extending the pilot project will provide continued reduction in residents' exposure to 123-TCP and documentation of long-term O&M costs (particularly carbon replacement) for the different sized treatment systems installed.

APPENDIX J: NITRATE DATA BY COUNTY METHODOLOGY

Method for Determining Highest Nitrate (as N) by County:

1. Grab all NO3N results on GAMA from DDW (municipal wells) and ILRP, GAMA_DOM, and LOCALGW (only keep domestic wells from these datasets) with a date cutoff of 1/1/2011 to 5/2022

2. Parse the data:
   a. Arrange results by date, and for each result calculate the multiplier between the previous result (x_prev) and subsequent result (x_next)
   b. Group by well and calculate well median, then calculate multiplier between each result and the well median (x_med)
   c. Group by county and by well type, and keep the top 5 maximum results per group

3. Manually flag potential errors by investigating results where x_prev and x_next are both large, and/or x_med or GM_RESULT is large
   - Real- result looks real based on surrounding samples (used NO3N graph on GAMA map to check)
   - Real?- the result is probably real but is a little suspicious
   - Unsure- the result could be real but is likely an error
   - Error- the result is an error
   - [blank]- did not investigate; x_prev, x_next, and x_med seemed fine

4. Calculate the true maximum per county by using "real", "real?" and [blank] results ("True Maximum" pivot table)

APPENDIX K: COMMENT LETTERS RECEIVED