

California On-Site Water Recycling: Policy Brief

A Study Conducted by:



California
Sustainability
Alliance

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The California Sustainability Alliance (the Alliance) is an innovative market transformation program funded by California utility customers under the auspices of the California Public Utilities Commission. The Alliance leverages action on environmental initiatives such as climate, smart land use and growth, renewable energy, waste management, water use efficiency, and transportation planning to help the State of California achieve its aggressive energy efficiency goals more effectively and economically. In partnership with public and private organizations throughout California, the Alliance precipitates widespread market transformation by tackling major barriers to sustainability.

For information about the California Sustainability Alliance, go to:

www.sustainca.org

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GLOSSARY

Blackwater – All outgoing wastewater from a building.

Effluent – Wastewater or other liquid, partially or completely treated or in its natural state, flowing from a treatment plant.

Greywater – Wastewater that drains into sewage, excluding that from kitchen sinks or toilets.

Groundwater – Water that occurs beneath the land surface, stored in the pore spaces of alluvium, soil, or rock formations. It excludes soil moisture.

Recycled water – Municipal, industrial, or agricultural wastewater which, as a result of treatment, is suitable for a direct beneficial use or a controlled use that would not otherwise occur.

Reuse – Generally used synonymously with “recycled water”. Water reuse can, however, include use of any water, treated to any level (primary, secondary, tertiary) or untreated.

Tertiary treatment – Wastewater treatment that includes the processes defined by primary and secondary treatment, plus an additional treatment phase, which may involve removal of additional nutrients and suspended organic matter, and/or additional disinfection.

Water Year (WY) – A 12-month period beginning October 1st and ending September 30th of the next year. This time interval is typically used in water supply planning and hydrological analyses in California.

ABBREVIATIONS AND ACRONYMS

AF – Acre foot (equivalent to 325,851 gallons)

AFY – Acre feet per year

AGWR – Australian Guidelines for Water Recycling

CCR – California Code of Regulations

CDPH - California Department of Public Health

CHSC – California Health and Safety Code

CPUC – California Public Utilities Commission

CWC – California Water Code

DWR – Department of Water Resources

RWQCB – Regional Water Quality Control Board

SCG – Southern California Gas Company

SFDBI – San Francisco Department of Building Inspections

SFDPH – San Francisco Department of Public Health

SFPUC – San Francisco Public Utilities Commission

SWRCB – State Water Resources Control Board

EXECUTIVE SUMMARY

In 2012, the California Sustainability Alliance (the Alliance) conducted a study of on-site water generation options, including recycled water, to understand the types of technologies available to provide on-site water generation, their costs, and primary market and regulatory barriers to technology adoption. Results of the case study of a city hall building complex in Huntington Beach, California, show that on-site recycled water systems can supply water at lower energy intensity than imported water and desalination in Southern California.¹ However, the Alliance also found that there are barriers to implementing on-site water recycling systems in commercial and office buildings in California that stem from the current frameworks for regulating wastewater treatment and use of recycled water. These barriers include:

- Lack of clear information about how to apply for permits;
- Expensive daily coliform laboratory sampling and analysis; and
- Stringent certification requirements for system operators.

In late 2012, the Alliance decided to further investigate these barriers to verify the list of key regulatory hurdles for on-site water recycling and to identify potential solutions for those hurdles that appeared significant.² In late November and early December of 2012, the Alliance team spoke to experts involved with recycled water at regulatory agencies, in academia, and in industry. To further the perspective of, and input from, experts in Southern California, Navigant spoke with additional experts in August of 2013.

The Alliance found the following for the key regulatory hurdles:

- **Information Asymmetry.** There is no one source in the State that directs potential customers to permitting information for on-site recycled water. In addition, there is significant uncertainty regarding permitting jurisdiction, even within key state agencies.
- **Daily Coliform Sampling Requirements.** Title 22, established by the California Department of Public Health, requires daily coliform sampling and analysis in an approved laboratory for every recycled water system in the State. While the Regional Water Quality Control Boards (RWQCB) have authority to relax daily sampling requirements, RWQCB staff is unlikely to do so for a newly commissioned system, and without system performance data. While the RWQCBs and the State generally have jurisdiction over on-site recycled water systems, other agencies are piloting new permitting models. For instance, the

¹On-Site Water Generation: An Analysis of Options and Case Study:

http://sustainca.org/sites/default/files/On-Site_Water_Generation-Final_Report.pdf

² While it is important to minimize regulatory challenges, it is only one element of moving the market along/advancing the opportunity for this application. Other barriers will still remain for on-site water recycling, including system economics and social acceptance, and differences in acceptance between local building departments.

San Francisco Public Utilities Commission has developed a new local model for permitting, with more flexibility, which may be applicable elsewhere in California. In addition, Australian regulators have developed a permitting framework with even more flexibility than what the San Francisco Public Utilities Commission has established to encourage on-site water recycling.

- **System Operator Requirements.** The Alliance Team was informed in late August by the SWRCB that new regulations in Chapter 23 of Division 3 of Title 23 of the California Code of Regulations, regarding wastewater treatment plant classification, operator certification, and contractor operator registration for the Wastewater Treatment Plant Operator Certification Program were released April 1, 2013. The revised regulations now include privately owned wastewater treatment plants under the code's jurisdiction. This expansion of jurisdiction may alter the Alliance's recommendations pertaining to this barrier. The Alliance decided to release the paper with this caveat, as this additional work would impede release of the rest of the analysis and recommendations.

The Alliance's recommendations as a result of this research are as follows:

1. **Raise Awareness.** Raise awareness with key agencies and experts in California of regulatory challenges faced by on-site water recycling.
2. **Develop Information Portal.** Develop an information portal to describe how to permit on-site water recycling in California. Target potential system developers and regulatory staff involved in permitting projects.
3. **Explore Alternative Regulatory Frameworks.** Explore new regulatory frameworks for on-site recycled water. This includes producing case studies on regulations that promote on-site recycled water and exploring the applicability of the more flexible Australian "fit for purpose" regulatory model to California. This model provides flexibility in technology and sampling frequency requirements while still managing human and environmental risks.
4. **Estimate Potential and Benefits.** Perform additional work to assess the market potential and the associated water, energy, and environmental benefits of on-site recycled water.
5. **Develop Pilots.** Initiate pilot activity in multiple contexts to generate performance and water quality data for on-site recycling systems, possibly on California college campuses.
6. **Work Towards Title 22 Exceptions for Daily Coliform Sampling.** Work towards an exception in Title 22 for on-site recycling projects, which currently requires daily coliform sampling and results in a significant on-going cost. An exception to this requirement, based on precedent elsewhere in the U.S. and globally, could reduce sampling requirements to a less frequent, but acceptable, regime in order to reduce the associated on-going costs.

7. **Develop Operator Guidelines.**³ Develop operator guidelines for (private) on-site water recycling systems so that the right skills are available to maintain a system, without encumbering the operating budget with expertise that isn't necessary.
8. **Promote Decentralization of Permitting.** Promote decentralization of permitting for on-site water recycling (e.g. San Francisco model) as a way of streamlining system permitting.

In summary, the Alliance team found there is an opportunity to take advantage of an additional and emerging water saving technology while being protective of public health, which is absolutely necessary. The objective of the recommendations made by the Alliance is to begin a conversation in California that eventually leads to regulatory modifications, which in turn encourage greater use of this technology, especially in areas of growing water scarcity, but without weakening public health protection. Deploying on-site water recycling could contribute to water, energy, and environmental goals in the State given the multiple benefits it offers, including: lower demand on scarce water systems, increased water supply reliability, reduced demand on wastewater treatment infrastructure, lower energy required for the water system (on the margin, through avoided imported water), and lower greenhouse gas (GHG) emissions related to this energy use.

³ The expansion of the California Code of Regulation's jurisdiction may alter this recommendation.

SECTION 1: INTRODUCTION

Background

In 2008, the Alliance published a report on recycled water that estimated the potential energy and carbon benefits of accelerating and increasing the development and use of recycled water in Southern California. Results of the study show up to 580,000 acre-feet of existing recycled water supply (generated by large centralized plants) in Southern California is currently being released to streams and the ocean without benefit. This supply could meet all of Southern California's projected increase in water use through 2030. However, a major barrier to implementing a successful recycled water system is the cost of distribution pipelines. Members of the Alliance's Water-Energy Committee recommended complementing the 2008 study with a study examining on-site water recycling. The Alliance understands conservation and efficiency are the most cost effective solution. Nevertheless, we also recognize they may not completely solve the problem. Alternate, sustainable water supplies must be considered.

With this advice, the Alliance conducted a study in 2012 of on-site water generation options, including recycled water, to understand the types of technologies available to provide on-site water generation, their costs, and primary market and regulatory barriers to technology adoption.⁴ The Alliance found that there are regulatory-based barriers to implementing on-site water recycling systems in office buildings in California. These barriers include:

- Lack of clear information about how to apply for permits;
- Expensive daily coliform laboratory sampling and analysis; and
- Stringent certification requirements for system operators.

Research Approach for the Policy Brief

As a follow-up to the Huntington Beach case study, in late 2012 the Alliance investigated further to verify the list of key regulatory hurdles for on-site water recycling and to identify potential solutions for those hurdles that appeared significant.⁵ In late November and early December of 2012, the Alliance team spoke to experts involved with recycled water at regulatory agencies, in academia and in industry. To further the perspective of and input from experts in Southern California, Navigant spoke with additional experts in August of 2013.⁶ While each conversation was tailored to the participant's background, the Alliance team focused on understanding the hurdles and

⁴ There are two primary technologies for on-site water recycling: constructed wetlands and membrane bioreactors. Both are described in more detail in Section 2.

⁵ While it is important to minimize regulatory challenges, it is only one element of moving the market along and advancing the opportunity for this application. Other barriers will still remain for on-site water recycling, including system economics, social acceptance, and differences in acceptance between local building departments.

⁶ See Appendix A for the names and roles of those interviewed and consulted.

identifying potential solutions. In this report, the Alliance summarizes findings from the interviews and highlights potential solutions and recommendations for increased installations of on-site water recycling systems in California.

Key Objectives of the Policy Brief

The intended outcomes of this document are to create awareness regarding the regulatory hurdles facing on-site water recycling system installations, identify potential solutions, and generate discussion at key forums to vet the findings in this document.

The Alliance hopes to generate discussion among the following government agencies with this policy brief:

- California Department of Public Health (CDPH)
- Regional Water Quality Control Boards (RWQCBs)
- California State Water Resources Control Board (SWRCB)
- Participating Agencies of the Water-Energy Team of the Climate Action Team (WET-CAT):
 - California Air Resources Board (CARB)
 - California Public Utilities Commission (CPUC)
 - California Energy Commission (CEC)
 - Cal/EPA
- San Francisco Public Utilities Commission (SFPUC)
- Local public health departments

In addition, the Alliance hopes to include in discussions the following potential supporters of increased on-site water recycling systems in California:

- Stanford University/ ReNUWit
- University of California, Davis
- California Association of Sanitation Agencies (CASA)
- Other organizations interested in promoting local water supply options in California
- Potential project developers, including real estate developers

Organization of the Policy Brief

The remainder of this report is organized in the following sections:

- Section 2 provides the context for on-site water recycling systems in California. It provides an understanding of how on-site water recycling system installations can play a role in reducing California's water supply uncertainties.

- Section 3 provides a description of the three regulatory hurdles. It provides an understanding of the technology, costs, energy uses, implementation requirements, and market barriers.
- Section 4, 5, and 6 detail each of the three regulatory hurdles as confirmed or verified by regulatory experts. In addition, potential solutions to overcoming each hurdle are also provided.
- Section 7 provides details on our recommendations.

Case studies throughout the paper highlight a handful of existing on-site water recycling projects that demonstrate the viability of the technology for use in multiple contexts. These examples all include blackwater recycling, which was a focus for the Alliance team in this analysis.

San Francisco Public Utilities Commission (SFPUC)
San Francisco, California

Case Study

Integrated into the lobby and outside landscaping of the SFPUC's LEED Platinum headquarters building is a premier example of a constructed wetland system. The Living Machine® from Worrell Water Technologies is expected to save the building approximately 750,000 gallons of water per year. Since its completion in 2012, the system has been recycling 5,000 gallons per day of the building's wastewater for reuse in flush toilets and irrigation.



Source: sustainablewater.com

SECTION 2: ON-SITE RECYCLED WATER CONTEXT

Between water years 2007 and 2009, the State of California faced its “12th driest three-year period in the state’s measured hydrologic record.”⁷ Even though Governor Jerry Brown officially proclaimed the end of that severe drought period in 2011, California continues to face various sources of uncertainty in changes to its water supply due to the following reasons:⁸

- The “severity, timing, and frequency of future droughts are uncertain;”⁹
- California population increases affect water demand. Projecting future changes in population and “water quality impacts” of population growth becomes “more uncertain [for the Department of Water Resources] with the time frame of the projection;”¹⁰
- Climate change presents uncertainties in snowpack, hydrologic patterns, rainfall intensity, and sea level rise that can affect the variability of water reserves;¹¹ and
- The aging water infrastructure reduces efficiencies in distributing water due to leaks. According to the California DWR, an average of 10 percent of total water supplied is lost, with leaks “invariably getting larger with time.”¹²

Drought and water scarcity are persistent long-term concerns in California, as they are across the western U.S. states.

Water recycling is emphasized in California policies and mandates as a strategy to alleviate some of these uncertainties. Specifically, the 2009 California Water Plan emphasizes the more efficient “use and reuse” of water in one of 13 objectives of water management strategies.¹³ In addition, the California Global Warming Solutions Act of 2006, also known as AB32, highlights water efficiency and water recycling as measures to reduce greenhouse gas emissions.¹⁴ California also has a Recycled Water Policy that aims to “increase the use of recycled water over 2002 levels by at least one million

⁷ Department of Water Resources. *California’s Drought of 2007-2009. An Overview*. Accessed from: <http://www.water.ca.gov/waterconditions/drought/docs/DroughtReport2010.pdf>.

⁸ Office of Governor Jerry Brown. “Governor Brown Ends State’s Drought Status, Urges Californians to Continue to Conserve.” News Release March 30, 2011.

⁹ Department of Water Resources. 2009 California Water Plan. [Box 5-3. http://www.waterplan.water.ca.gov/docs/cwpu2009/0310final/v1_all_cwp2009.pdf](http://www.waterplan.water.ca.gov/docs/cwpu2009/0310final/v1_all_cwp2009.pdf).

¹⁰ Department of Water Resources. 2009 California Water Plan. [Box 5-3. http://www.waterplan.water.ca.gov/docs/cwpu2009/0310final/v1_all_cwp2009.pdf](http://www.waterplan.water.ca.gov/docs/cwpu2009/0310final/v1_all_cwp2009.pdf).

¹¹ Department of Water Resources. 2009 California Water Plan. [Box 5-3. http://www.waterplan.water.ca.gov/docs/cwpu2009/0310final/v1_all_cwp2009.pdf](http://www.waterplan.water.ca.gov/docs/cwpu2009/0310final/v1_all_cwp2009.pdf).

¹² Department of Water Resources, “Leak Detection.” <http://www.water.ca.gov/wateruseefficiency/leak/>

¹³ Department of Water Resources. 2009 California Water Plan. http://www.waterplan.water.ca.gov/docs/cwpu2009/0310final/v1_all_cwp2009.pdf

¹⁴ California Air Resources Board. Climate Change Scoping Plan. December 2008. http://www.arb.ca.gov/cc/scopingplan/document/adopted_scoping_plan.pdf. Pg 65.

acre-feet per year (AFY) by 2020 and by at least two million AFY by 2030.”¹⁵ To support this end, two agencies (CDPH and SWRCB) and three codes (California Water Code (CWC), California Code of Regulations (CCR), and California Health and Safety Code (CHSC)) regulate production and use of recycled water.

These policies create many opportunities for increased use of recycled water in California.¹⁶ Wherever there is a wastewater treatment plant, there is an opportunity to generate a local, sustainable supply of recycled water. Furthermore, recycling water enhances water supply security by reducing reliance on imported water and reducing uncertainties in water supply. For example, the 2008 Alliance study found that “580,000 acre-feet of existing recycled water supply (generated by large centralized plants) in Southern California is currently being released to streams and the ocean without benefit. This supply could meet all of Southern California’s projected increase in water use through 2030” under a “medium” growth scenario.¹⁷ Recycled water can also be used to meet non-potable water demand, depending on the level of treatment of the wastewater. Many applications currently use potable water for non-potable uses (such as industrial cooling processes, landscapes, golf courses, food crop irrigation, and toilet flushing); in Southern California, more than 60% of urban water use is used for non-potable applications such as outdoor irrigation, toilet flushing, and cooling.¹⁸ Thus, potable water in these applications can be substituted with the appropriate quality of recycled water.¹⁹

Currently, most applications of recycled water are sourced from municipal-level wastewater treatment plants. The Alliance believes that on-site water recycling systems can complement these larger plants in cases in which developing recycled water distribution systems is expensive. In Southern California, it can cost as much as \$4 million per mile to construct recycled water distribution systems. On-site systems might be a better alternative for customers that live/work farther away from large-scale

¹⁵ California State Water Resources Control Board. Recycled Water – Adoption of a Policy for Water Quality Control. SWRCB Resolution No. 2009-0011. Adopted February 3, 2009.

http://www.waterboards.ca.gov/plans_policies/

¹⁶ This paragraph is referenced from the on-site water generation report conducted by the Alliance in 2012. More information can be found: California Sustainability Alliance. *On-Site Water Generation: An Analysis of Options and Case Study*. December 2012.

¹⁷ More information regarding this study and its results can be found at http://sustainca.org/programs/water_energy/overview?quicktabs_view_case_study_tabbed_display_block_1=3#quicktabs-view_case_study_tabbed_display_block_1.

¹⁸ Department of Water Resources (DWR). *California Water Plan Update 2009: Volume 5 - Technical Guide “Water Portfolio and Balance”*. 2009. Available at:

http://www.waterplan.water.ca.gov/docs/technical/data/2005_data_entry_3-10-11final_byPA.xlsx.

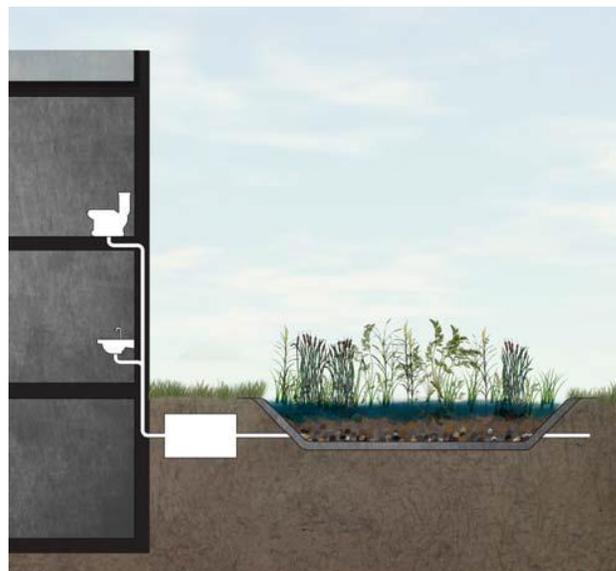
¹⁹ EPA. Water Recycling and Reuse: The Environmental Benefits. Accessed August 2012. Available at: <http://www.epa.gov/region09/water/recycling/index.html>.

wastewater treatment plants.²⁰ In addition, the 2012 Alliance study found that on-site recycled water systems can supply water at lower energy intensity than imported water and desalination in Southern California. The 2012 Alliance study also pointed out that on-site recycled water is a good match with commercial building water demands given the relatively high levels of blackwater produced (vs. greywater) and the relatively high demand for non-potable water (e.g., toilets, cooling, and irrigation).

There are two primary technologies in the market for on-site water recycling, constructed wetlands and membrane bioreactors (MBR), which can be a prepackaged technology solution.

A constructed wetland system treats wastewater by replicating “biological, chemical and physical processes that occur in natural wetlands.”²¹ Figure 1 shows an illustrative constructed wetland system. Wastewater (blackwater in the case of the example) is collected into a clarification tank underground to let solids settle; effluent is then fed into the constructed wetland that treats (but does not disinfect) the wastewater.

Figure 1: Illustrative Constructed Wetland System



Source: Cascadia GBC²²

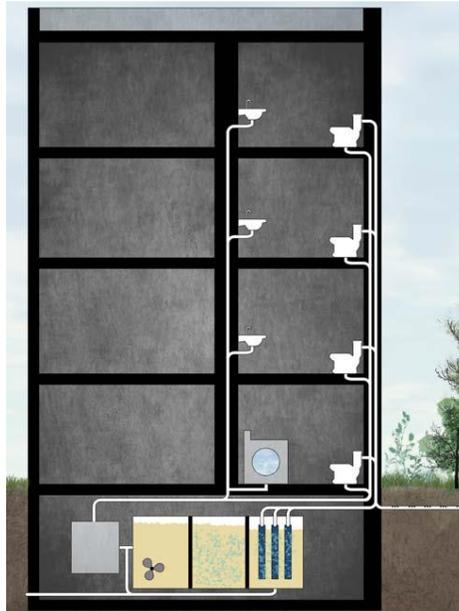
²⁰ California Sustainability Alliance. *On-Site Water Generation: An Analysis of Options and Case Study*. December 2012.

²¹ Cascadia Green Building Council. *Toward Net Zero Water: Best Management Practices for Decentralized Sourcing and Treatment*. March 2011. Accessed November 15, 2012 from <http://legacy.cascadiagbc.org/resources/TowardNetZeroWater.pdf>.

²² Cascadia Green Building Council. *Toward Net Zero Water: Best Management Practices for Decentralized Sourcing and Treatment*. March 2011. Accessed November 15, 2012 from <http://legacy.cascadiagbc.org/resources/TowardNetZeroWater.pdf>.

Alternatively, an MBR treats wastewater by using an activated sludge system (microbial biomass) in one aerated tank. As seen in Figure 2, wastewater (blackwater in the case of the example) is collected into one tank and then fed into the MBR tank with various components for separation, filtration, and treatment with microbial biomass.

Figure 2: Illustrative Membrane Bioreactor System



Source: Cascadia GBC²³

For more information on these technologies, please refer to the Alliance’s report, “On-Site Water Generation: An Analysis of Options and Case Study” published December 2012.²⁴

These on-site technologies can be a good fit for developers interested in reducing the water consumption of new commercial and municipal buildings. Through the interviews, the Alliance team heard that these types of on-site water recycling are appealing for areas like Southern California where water agencies are searching for additional sources of local supply in the face of persistent, long-term concerns of water scarcity, as on-site water recycling could become an additional real option for improving local water supply. In addition, the customization options of the systems are appealing, since water quality at the source and effluent can be fine-tuned. Finally, the cost of an on-site water recycling solution is incremental, as compared to larger municipal water

²³ Cascadia Green Building Council. *Toward Net Zero Water: Best Management Practices for Decentralized Sourcing and Treatment*. March 2011. Accessed November 15, 2012 from <http://legacy.cascadiagbc.org/resources/TowardNetZeroWater.pdf>.

²⁴ Available at: http://sustainca.org/sites/default/files/On-Site_Water_Generation-Final_Report.pdf

recycling and water desalination efforts, and so provides another approach to add into a portfolio of measures.

However, apart from managing the initial capital cost, developers confront a challenging regulatory environment – mainly that the environment is confusing and is not tailored for these small on-site water treatment facilities. One expert’s perspective was that on-site water recycling solutions turn buildings into small wastewater facilities, which clearly require more oversight than the traditional sewage connection. The regulatory perspective is that on-site water recycling solutions are biological in nature and require effort to maintain, and thus also raise an on-going public health concern that should be monitored. Figuring out who has jurisdiction over new ways of doing things such as this is also always tricky. In this case, and as will be highlighted later, many in the Water Quality Control Boards see their mission as protecting ambient water supply, with little visibility into water used within a building. Although this clear line is being blurred by the use of recycled water more broadly in California, these perspectives are useful in understanding why confusion does and will continue to arise with respect to how to permit on-site water recycling.

The next sections are dedicated to describing the regulatory challenges confronting on-site water recycling and laying out potential solutions and next steps.

SECTION 3: REGULATORY HURDLES

Based on the Alliance’s research and interviews with market experts, the Alliance has identified three main regulatory hurdles that potentially inhibit the development and/or reduce the attractiveness of on-site water recycling applications:

Regulatory Hurdle #1: Information Asymmetry

- There is currently a clear lack of information regarding the steps that need to be taken for the permitting process specifically for on-site, small-scale water recycling systems. There is no webpage that describes the process specifically for on-site water recycling systems either on SWRCB or CDPH websites.
- There is also uncertainty regarding agency jurisdiction for those developing on-site water systems in that it is unclear whether the primary regulatory contact is the local county health department or a Regional Water Quality Control Board.
- The lack of available information and process steps can impede potential market participants from pursuing on-site water recycling system installations.

Regulatory Hurdle #2: Daily Coliform Sampling Requirements

- According to the California Code of Regulations (CCR) Title 22, Division 4, Chapter 3, also known as California’s “Water Recycling Criteria,” most water recycled in commercial or municipal office buildings must be treated to disinfected tertiary levels.
- The criteria also states that “disinfected tertiary recycled water shall be sampled at least once daily for total coliform bacteria. The samples shall be taken from the disinfected effluent and shall be analyzed by an approved laboratory.”²⁵ This means that if water is recycled on-site at a commercial office building, daily sampling will have to take place in collaboration with an approved laboratory. In the example of the city of San Francisco, the daily laboratory rate for coliform testing is \$35 per daily test.²⁶ This adds an additional \$12,000 per year just for the cost of the testing, not including additional personnel resources that might be required to take the sample, transport the sample to the approved laboratory, and track results daily.
- Therefore, daily coliform testing creates an on-going expense and building operation consideration that reduces attractiveness of on-site water recycling to key stakeholders, including building owners and developers.

²⁵ CCR, Title 22 - Section 60321.

²⁶ SFPUC Water Quality Division. *Scope of Laboratory Services: Statement of Qualifications FY 10-11*. Provided by John Scarpulla at SFPUC via email correspondence in August 2012.

**Marine Corps Recruit Depot
San Diego, California**

Case Study

Completed in 2012, this Living Machine® system not only acts to reduce the base's water consumption and sewer discharge, but safeguards the landscape in times of drought. The constructed wetland system diverts sewage from an existing sewer line into the recycling system, which produces 10,000 gallons of water per day for onsite irrigation.



Source: sustainablewater.com

Regulatory Hurdle #3: System Operator Requirements²⁷

- According to CCR Title 23, Division 3, Chapter 26, titled “Classification of Wastewater Treatment Plants and Operator Certification,” on-site recycled water systems recycling less than 1 million gallons per day require at least a Level 2 operator in order to obtain and maintain a water recycling permit.²⁸
- Specific system operator certifications may not be required for on-site systems that recycle only 35,000 gallons per day due to technology monitoring capabilities and fewer technical considerations to maintain.
- However, if these stringent requirements do apply, they create on-going expenses and building operations considerations that reduce the attractiveness to building owners and developers interested in installing on-site water recycling systems.

²⁷ The expansion of the California Code of Regulation’s jurisdiction may alter this section.

²⁸ CCR, Title 23 - Section 3671.

SECTION 4: INFORMATION ASSYMETRY

Interview Findings

Key findings from the interviews on information asymmetry and permitting jurisdictional issues are summarized below.

There is no one source on a statewide basis that serves to disseminate information on on-site water recycling systems or directs to specific permitting information. While the RWQCBs are the first point of contact for any specific questions regarding permitting of on-site recycled water systems, there is no single portal or website that serves to educate and disseminate information about on-site water recycling systems and permitting requirements.

There is significant uncertainty regarding permitting jurisdiction. Interviews with regulatory agencies involved in developing the water recycling codes as well as those responsible for enforcing regulations (CDPH and RWQCBs) revealed that there is uncertainty about which agency (or agencies) in the State has jurisdiction over permitting on-site water recycling systems. For example, one RWQCB contact was certain that all water recycling systems are under the jurisdiction of the regional board. However, a RWQCB contact from another region and one CDPH contact stated that if recycled water is used within the building, it “might be” that local county health departments have permitting jurisdiction. Yet another CDPH contact stated with certainty that any on-site water treatment system questions need to be referred to local county health departments as it is not under CDPH “jurisdiction,” which would by default then make RWQCB the permitting agency.

Potential Solutions

The Alliance identified two potential solutions to improve the information barriers for the on-site water recycling market:

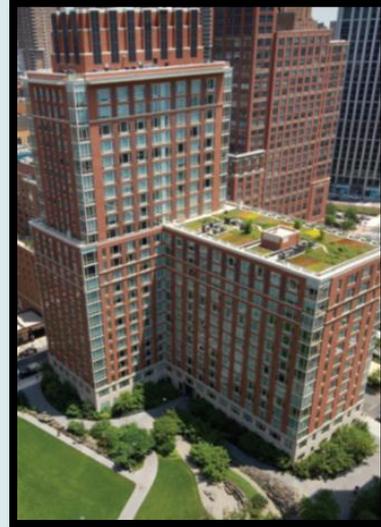
- **Develop a statewide portal to serve as a singular resource center on on-site water recycling systems and associated permitting requirements.** The portal would serve to link users to key resources and lay out process steps for permitting systems. Use SFPUC’s portal as an example, as it links key agencies (SFPUC, San Francisco Department of Building Inspections (SFDBI), and San Francisco Department of Public Health (SFDPH)), describes process steps for permitting, and provides key resource documents.²⁹

²⁹ SFPUC’s portal can be accessed at <http://sfwater.org/index.aspx?page=497>.

Solaire Luxury Apartment Tower
New York, New York

Case Study

The LEED Gold Solaire luxury high-rise in lower Manhattan has 293 units that have been recycling water since 2003. Every day, the membrane bioreactor system designed and built by American Water's Applied Water Management Group recycles 25,000 gallons of wastewater for reuse in flushing toilets, filling the cooling tower, and irrigating rooftop gardens.



Source: amwater.com

- **Increase awareness of staff in key agencies regarding jurisdiction.** Raise staff awareness within agencies regarding jurisdiction of RWQCB over on-site recycled water systems. The RWQCBs and SWQCB generally regulate water released into the natural environment (rivers, lakes, aquifers, and others). Confusion arose since on-site recycled water systems don't always discharge water into the environment but rather back into the sewage system, thus creating the possibility that RWQCBs wouldn't have jurisdiction. Nevertheless, the RWQCBs do regulate recycled water systems when the uses of that water are defined in Title 22.

SECTION 5: DAILY COLIFORM SAMPLING REQUIREMENTS

Interview Findings

Key findings from the interviews on daily coliform sampling requirements are summarized below.

While RWQCBs have authority to relax Title 22 daily coliform sampling requirements, staff is unlikely to do so immediately and without system performance data.

RWCQB has jurisdiction of water sampling requirements contained in a permit for a recycled water system:

“If a regional water board determines that it is necessary to protect public health, safety, or welfare, it may prescribe water recycling requirements where recycled water is used or proposed to be used,” regardless of end use (California Water Code Section 13523).³⁰

However, as part of the permitting process, RWCQB must consult with and receive approval from the CDPH for proposed recycled water systems (California Water Code Section 13523). CDPH in turn relies on Title 22 for water quality criteria and monitoring protocols:

“DHS (now known as CDPH) has promulgated regulatory criteria in Title 22, Division 4, Chapter 3, section 60301 et seq. of the CCR. DHS regulatory criteria include specified approved uses of recycled water, numerical limitations and requirements, treatment method requirements and performance standards.”³¹

Title 22 is firm about daily coliform sampling requirements for non-potable recycled water applications and will always be recommended by CDPH:

“...disinfected tertiary recycled water shall be sampled at least once daily for total coliform bacteria. The samples shall be taken from the disinfected effluent and shall be analyzed by an approved laboratory.”³²

According to interviews conducted by the Alliance, RWCQB has the authority to relax CDPH recommendations upon review of a recycled water system plan. The RWCQB determinations to vary from CDPH’s recommendations are made on a case-by-case basis with likely variability in decision-making across RWQCBs. Although RWQCB staff interviewed noted precedents for relaxing CDPH recommendations, RWCQB staff did indicate that it is unlikely they would deviate from CDPH’s recommendations for daily

³⁰ More information can be found at http://www.waterboards.ca.gov/water_issues/programs/grants_loans/water_recycling/overview.shtml

³¹ More information can be found at http://www.waterboards.ca.gov/water_issues/programs/grants_loans/water_recycling/overview.shtml

³² CCR, Title 22 - Section 60321.

coliform sampling without sufficient data on system performance and resulting water quality.

There are examples from other jurisdictions that have relaxed daily coliform testing requirements for on-site recycled water systems based on either the end-use or system performance. For example, the SFPUC, which circumvented the state's authority and developed a new jurisdictional model, worked with the SFDPH to limit sampling to days that buildings are occupied (and the system would be used). In addition, New York City, which supports on-site recycled water systems, gradually shifted from daily on-site coliform sampling to a monthly schedule over the course of a few years.

While the RWQCBs and the State generally have jurisdiction over on-site recycled water systems, SFPUC has developed a new local model for permitting with more flexibility that may be applicable elsewhere in California. In California it is possible to devolve permitting responsibility of on-site water recycling system at the municipal level. In 2012, the County and City of San Francisco used the flexibility within California state law to create a decentralized permitting model for on-site water recycling.³³ San Francisco's model incorporates more flexibility in determining the water testing requirements than offered by the State of California through the RWQCBs:

*"The Director (of Public Health) may modify permit requirements if evidence is presented to justify the public health benefit of such modifications."*³⁴

San Francisco is in a very unique position in that as a water and wastewater agency, SFPUC was able to combine forces with the SFDPH and SFDBI to develop a set of comprehensive requirements for on-site water recycling systems. While there may be opportunities to replicate this model, the model isn't widely applicable since most locations lack overlapping jurisdictions, as they exist in San Francisco.

In Australia, regulators developed a more flexible framework to encourage on-site water recycling. The Australian Guidelines for Water Recycling (AGWR), developed in 2006, incorporate 12 elements into one generic risk management framework that can be applied to any type and size of water recycling system.³⁵ These elements include

³³ RWQCB Order No. 96-011 that authorizes "producers" and "distributors" to deliver recycled water for reuse by "users." San Francisco's justification that the RWQCB doesn't have jurisdiction is that the order does not apply to individual, closed-treatment systems that produce recycled water for indoor uses, where the producer, distributor, and user are all one entity. Order No. 96-011 can be found at http://www.swrcb.ca.gov/sanfranciscobay/water_issues/programs/planningtmdls/basinplan/web/res/order96-011.pdf.

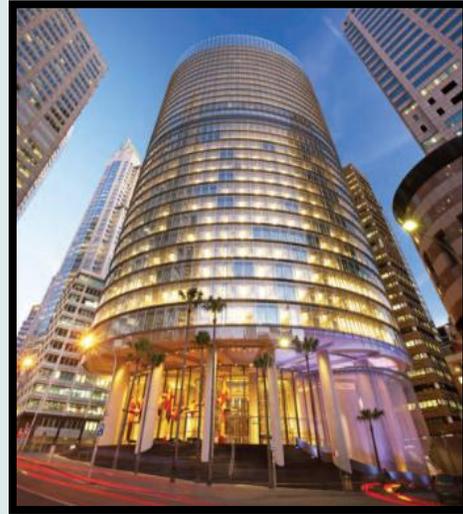
³⁴ San Francisco Department of Public Health. *Director's Rules and Regulations regarding the operation of on-site non-potable water treatment and reuse systems.* <http://sfwater.org/modules/showdocument.aspx?documentid=3065>.

³⁵ For more information regarding Australia's risk-management framework comprised in 12 elements, please visit <http://www.recycledwater.com.au/index.php?id=16>. All direct quotes are from "Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1). Sewage Effluent and Greywater."

1 Bligh Street Sydney, Australia

Case Study

Blackwater from the toilets and sinks of this 470,000 square foot tower are combined with additional sewage pumped out of an existing sewer line and passed through an Aquacell membrane bioreactor recycling plant onsite. The 26,000 gallons of water processed each day are reused for toilet flushing and cooling tower make-up water.



Source: dewater.com

monitoring requirements to validate the human and environmental safety of the recycled water systems, determine successful operations of the system, and verify recycled water quality levels. While the AGWR provides typical parameters, processes, and frequencies for monitoring, it notes flexibilities that aren't currently available for smaller, on-site systems in California:

- **Flexibility in monitoring.** The AGWR accepts that monitoring “every extremely small system can be impractical;” in such cases, it requests that “the overseeing agency should take representative samples from typical [systems] at the recommended frequencies through a centralized monitoring program.”³⁶
- **Flexibility in sampling frequency.** The AGWR states that “the range of parameters and frequency of testing included in monitoring programs will depend on a range of factors, including the size of the [system] and the potential exposure associated with the end use.”³⁷

³⁶ Environmental Protection and Heritage Council, the Natural Resource Management Ministerial Council, and Australian Health Ministers' Conference. *Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1). Sewage Effluent and Greywater*. 2006. Chapter 5.

³⁷ Environmental Protection and Heritage Council, the Natural Resource Management Ministerial Council, and Australian Health Ministers' Conference. *Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1). Sewage Effluent and Greywater*. 2006. Chapter 5.

Therefore, although the recommended typical sampling program for E. coli and coliphages is only weekly, the AGWR allows regional regulatory agencies to determine the appropriate frequency and whether ongoing monitoring is even required. (The latter assumes that water quality has been validated adequately and for enough time before it is publicly used.) As an example, New South Wales' guidelines state that ongoing monitoring of coliphages is "dependent on the outcomes of the validation monitoring," which occurs for a minimum of 12 weeks before the system supplies recycled water for its intended uses.³⁸ In addition, E. coli testing frequency is subject to review after 6 months of system operation.³⁹ With the flexibility clearly stated by the national and regional guidelines, developers and owners are more likely to plan for on-site water recycling systems.

Potential Solutions

The Alliance team identified four potential ways the burden of daily coliform testing for on-site water recycling could be reduced in California. These potential solutions are listed in this section in order of those that are relatively easy to implement in the short-term (i.e., good first steps) to those that are harder to implement and may take considerably more time and resources. For this reason, while possibly the most important, "Revise water recycling regulatory framework in California", is listed last. While this change would likely have the greatest impact on encouraging on-site water recycling, it is also the change that will take the most time and require the most amount of political will to achieve.

- **Increase RWQCBs' comfort with water quality produced by on-site recycled water systems, including development of pilots across the state.** In the short-term and within the current the regulatory framework, work could be done to raise the awareness of staff at the RWQCBs and at CDPH about the ability of on-site recycled water systems to consistently produce recycled water at the appropriate level of quality. First, case studies could be produced to highlight jurisdictions within which less frequent coliform sampling has been required. Second, staff could be made aware of certifications such as NSF/ANSI 350, which certifies onsite residential and commercial water reuse treatment systems after 26 weeks of testing turbidity, E. coli, and other parameters of water quality.⁴⁰ Pre-certified systems could provide sufficient confidence to reduce daily sampling requirements. Finally, efforts could be made within California to develop and publicize system performance data, including the results of daily

³⁸ New South Wales Government – Department of Water and Energy. *Interim NSW Guidelines for Management of Private Recycled Water Schemes*. May 2008. Chapter 7.

³⁹ New South Wales Government – Department of Water and Energy. *Interim NSW Guidelines for Management of Private Recycled Water Schemes*. May 2008. Chapter 7.

⁴⁰ For more information regarding technologies certified under NSF/ANSI 350 and its testing methodologies, visit http://www.nsf.org/business/wastewater_certification/standard350.asp?program=WastewaterCer.

coliform testing, for a variety of on-site recycled water systems. To the degree that sufficient or appropriate on-site water systems don't currently exist to provide opportunities for data acquisition, a series of pilots could be developed throughout the state, in multiple contexts, to prove out the technology and provide performance and water quality data. If results can demonstrate that systems consistently treat waste water to the quality required, the RWQCBs might be more likely to relax the daily coliform testing requirements, especially after an initial period of daily testing for new systems.

- **Replicate the City and County of San Francisco's and other decentralized permitting models.** The San Francisco Department of Public Health regulates all decentralized water treatment systems for the residents of the city and county. California counties and cities could proactively determine, with their RWQCBs, exceptions to Title 22. SFPUC set up its model as a blueprint for interested and able counties. Municipalities in California would be good fit for this model where there is overlapping jurisdiction of the water and wastewater department, the public health department, and the building department. There may be other lessons learned from devolving regulatory oversight from SWRCB and RWQCBs to a more local level for wastewater systems, such as with septic systems and greywater reuse⁴¹.

Joahlah Holiday Park
Durras North, Australia

Case Study

Nestled up against Murramarang National Park, Joahlah Holiday Park recycles almost 5,300 gallons per day for toilet flushing and irrigation. The Aquacell membrane bioreactor system draws wastewater from toilets, showers, and laundry, and has enabled the expansion of the waterfront property.



Source: dewater.com

⁴¹ Emergency Rule making: California Plumbing Code Graywater Systems (Title 24, Part 5, Chapter 16A, Part I): http://www.hcd.ca.gov/codes/shl/graywater_emergency.html

- **Develop exceptions to Title 22.** An exception to the daily coliform testing could be made within Title 22 for certain non-potable applications of recycled water, like water for toilet flushing or building cooling. While not easy to achieve, exceptions can be made and would permit CDPH staff to provide water testing recommendations to the RWQCBs below the current daily requirement. Such a change to Title 22 would require, at minimum, both additional system performance data as well as political and institutional will. The latter could be generated though interest in the state to meet additional goals with recycled water, such as carbon reduction as part of AB32. In addition, changes in Title 22 could be tied to certified technologies that are proven to consistently maintain low levels of coliform and/or include remote, real-time monitoring capabilities that constantly monitor for factors that can act as a proxy to coliform. Certification can come from various sources, including NSF/ANSI 350.
- **Revise water recycling regulatory framework in California.** While exceptions to Title 22 might meet today's needs for available on-site water recycling systems, a comprehensive forward-looking revision to the current regulatory framework is truly required. Models to emulate include AGWR, which focuses on a 12-point "fit for purpose" framework that provides flexibility in technology and monitoring requirements while still managing human and environmental risks.

SECTION 6: SYSTEM OPERATOR REQUIREMENTS

The Alliance Team was informed in late August by the SWRCB that new regulations in Chapter 23 of Division 3 of Title 23 of the California Code of Regulations, regarding wastewater treatment plant classification, operator certification, and contractor operator registration for the Wastewater Treatment Plant Operator Certification Program were released April 1, 2013. These new regulations appear to expand regulation of private on-site water recycling with regard to the operators of those facilities. This change in regulation may alter the solution we made based on findings from our interviews and research for this report, which were conducted before April 1. Since the expansion of the California Code of Regulation's jurisdiction may alter the Alliance's recommendations pertaining to this barrier, we've moved our previous analysis to Appendix B.

Blacktown Workers Sports Club Blacktown, Australia

Case Study

Blacktown's sports facilities feed blackwater into an Aquacell membrane bioreactor system. Almost 26,500 gallons of water each day are then reused to irrigate the sports fields.



Source: dewater.com

SECTION 7: CONCLUSIONS AND RECOMMENDATIONS

As discussed earlier in this report, on-site water recycling is an emerging technology with potential to play a role in helping manage California's increasing water scarcity. In addition to reducing the water consumption of a building with a heavy proportion of blackwater, this technology creates other benefits that can help California meet energy and environmental goals resulting from lower energy requirements for the water system and lower GHG emissions related to energy used in the water system. As technology improvements and cost reductions occur, on-site water recycling will likely become increasingly attractive over time.

Nevertheless, on-site water recycling faces significant challenges, many of which will take years to work through given that they are rooted in understandable public health concerns, the complexities of managing a wastewater system, and the new (and generally unprecedented) approach of wastewater management at a building level. All of these factors result in informational and regulatory challenges that will require focused attention to address.

The Alliance team lays out in the recommendations below a path toward greater stakeholder awareness and a regulatory environment that together would enable greater adoption of this technology where applicable. The Alliance team fully understands that this transformation could (and likely should) take years. It is precisely due to this realization that the Alliance team recommends immediate actions, including:

- Starting a conversation at the state-level about the next steps described in this policy brief;
- Performing additional work on potential regulatory models and to estimate benefits; and
- Initiating the development of pilots.

The recommendations, as they are laid out below, are the basis of a multi-year roadmap, and are listed generally in chronological order. The Alliance suggests that key stakeholders (such as those listed in Section 1) consider taking immediate action on recommendations 1-5, including initiating pilot activity. The Alliance's recommendations for addressing key regulatory-based barriers to on-site water recycling are as follows:

1. **Raise awareness with key agencies and experts in California of regulatory challenges faced by on-site water recycling.** Start by presenting this policy brief in a Webinar to those interviewed, including key state agencies, SFPUC, academic institutions, and industry. As part of this Webinar, ask participants how a better understanding on how to permit an on-site recycled water system could be developed across lead agencies, such as SWRCB, RWQCBs, and CDPH.

Then present this policy brief at key forums in the state, including at the AB32 water-energy working group (WET-CAT), California Association of Sanitation Agencies (CASA), and Re-inventing the Nation's Urban Water Infrastructure (ReNUWIt). Based on feedback received from presenting results to experts in the Webinar and at key forums, consider circulating this policy brief more widely within key California agencies and possibly key people in the legislature.

2. **Develop an information portal for disseminating technical and permitting information on on-site water recycling systems in California.** The web site should be designed so that potential developers of on-site water recycling systems and staff at key agencies have access to detailed information on the process for permitting on-site recycled water systems, including links to key agencies and documents. San Francisco has a good example of a portal for on-site water recycling.⁴² The site contains an overview of the non-potable water program, a water calculator to help potential users and developers assess viability of a project, a permitting guidebook, and links to applications and other key documents like ordinances and codes.
3. **Explore alternative regulatory frameworks that promote on-site recycled water.** Start by developing a set of case studies on how other jurisdictions have modified their regulatory frameworks to encourage on-site water recycling. Case studies could include the SFPUC, New York City, Port of Portland, Australia, Sydney, and Tokyo. Also consider speaking with developers and owners of on-site recycled water systems in California to better understand their challenges and the benefits they receive from their systems. Staff at the San Francisco Bay Area RWQCB told the Alliance team that there are wineries and resorts in California currently using on-site water recycling. In addition to case studies, the Alliance team suggests further exploration of the Australian Guidelines for Water Recycling, which promotes the use of on-site water recycling by providing flexibility in technology and monitoring requirements while managing human and environmental risks.
4. **Estimate potential for on-site water recycling and associated economics and benefits.** As suggested by interviewees, a next step in the analysis of on-site water recycling is to develop a market potential study along with a quantification of the economic cost and associated benefits, including lower demand on scarce water systems, increased water supply reliability, reduced demand on wastewater treatment infrastructure, lower energy required for the water system (on the margin – avoided imported water), and lower GHG emissions related to energy use.

⁴² This site can be accessed at <http://www.sfwater.org/index.aspx?page=497>.

5. **Develop pilot projects in multiple contexts throughout California.** Since staff at key agencies in California responsible for regulating on-site water recycling have little exposure to, and experience with, the technology, another goal of this recommendation is to develop a track record for the systems in California through the funding of pilots. A central focus of the pilot projects would be to develop a robust data set to capture system performance and water quality. Pilots could help key stakeholders develop confidence in the technology by letting it prove itself in multiple contexts. The Alliance team further recommends investigating the use of funding from Proposition 39 to fund on-site water recycling systems on university, college, and junior college campuses in California. Educational institutions may have access to Proposition 39 funding, and could also have faculty and students interested in conducting research on the systems and creating the desired data set.

6. **Work towards Title 22 exception for daily coliform sampling requirement.** While certainly a stretch goal, an exception in Title 22 to allow CDPH to relax the daily coliform testing requirement would be helpful for on-site water recycling system economics. As stated above in the document, getting an exception will likely require significant support from members of the legislature and within the CDPH.

7. **Develop operator guidelines for on-site water recycling systems.**⁴³ Develop standard guidelines and/or a certification program for on-site water recycling system operators. This could help the RWQCBs by developing a common understanding of what constitutes a “competent” system operator. To the degree possible, it would be beneficial to the system lifetime economics to identify how guidelines could be set so that building operators and maintenance staff could be trained to be the on-site system operators.

8. **Promote decentralization of permitting for on-site water recycling (e.g., San Francisco model).** The people responsible for creating the San Francisco model for permitting on-site water recycling view it as a possible blueprint for other jurisdictions. As a next step, the Alliance recommends identifying where in California this model might be applicable due to overlapping jurisdiction of a water and wastewater agency, a public health department, and a building department. Once potential locations for replicating the San Francisco model are identified, reach out to the jurisdictions to identify their level of interest to learn more.

⁴³ The expansion of the California Code of Regulation’s jurisdiction may alter the Alliance’s recommendations pertaining to this barrier.

APPENDIX A: EXPERTS INTERVIEWED

The Alliance interviewed the experts listed in Table 1 to understand the policy hurdles and identify potential solutions for increased on-site water recycling system installations.

Table 1. Experts Interviewed

Name	Role	Company/Organization
Blair Allen	Water Resources Control Engineer, Watershed Management Division	State Regional Water Quality Control Board, San Francisco Bay
Bruce Burton (with Mark Bartson)	Northern California Field Operations Branch Chief (Supervising Engineer)	California Department of Public Health
Elise Goldman	Water Conservation Program Specialist	West Basin Municipal Water District
Max Gomberg	Climate Change Mitigation Strategist	State Water Resources Control Board
Nigel Hughes	Associate Director, Construction Practice	Navigant Consulting
Gordon Innes	Senior Water Resources Control Engineer	State Water Resources Control Board
Mark Meredith	U.S. Manager	Aquacell
Sandy Robertson	Senior Research Engineer, ReNUWIt	Stanford University
John Scarpulla	Urban Watershed Management Program	San Francisco Public Utilities Commission
Neal Shapiro⁴⁴	Supervisor, Watershed Section, Office of Sustainability & the Environment	City of Santa Monica
Gary Stewart	Senior Water Resources Control Engineer, Permitting and Compliance Division,	State Regional Water Quality Control Board, Santa Ana
Marsha Sukardi	Masters Student	University of California, Davis
Cynthia Truelove	Director, Stanford University Water-Energy Research Initiative	Stanford University
Robert Wilkinson	Department of Environmental Studies	University of California, Santa Barbara

⁴⁴ Email exchange only.

APPENDIX B: SYSTEM OPERATOR REQUIREMENTS

On-site recycled water systems don't fall under Title 23 – wastewater system operator requirements – unless run by a municipal wastewater agency. This finding was significant because it implies that this regulatory hurdle doesn't appear to be as significant as the Alliance team initially thought. Through interviews, the Alliance team found that if an on-site recycled water system isn't municipally-owned or isn't regulated by the CPUC, then the RWQCB doesn't have jurisdiction to require system operator certification as required by Title 23. However, Regional Water Quality Control Boards can still make recommendations for operators of on-site water recycling systems using terms to describe an operator such as "competent." While operators don't need to be full-time, they still may be relatively expensive for an on-site water recycling project due to the relatively small group of people with the skills demanded by the Regional Water Quality Control Boards.

Interview Findings

Key findings from the interviews on system operator requirements are summarized below.

On-Site recycled water systems don't fall under Title 23 – waste water system operator requirements – unless run by a municipal wastewater agency. The most significant finding in this area is that this regulatory hurdle doesn't appear to be as significant as the Alliance team initially thought. Through interviews, the Alliance team found that if an on-site, recycled water system isn't municipally-owned or isn't regulated by the CPUC (pursuant to Sections 216 and 230.6 of, and Chapter 4 (commencing with Section 701) of Part 1 of Division 1, of the Public Utilities Code), then the RWQCB doesn't have jurisdiction to require system operator certification as required by Title 23.

RWQCBs make recommendations for operators of on-site water recycling systems during permitting process. The RWQCB can make recommendations about the operator of an on-site water recycling system during the permitting process. For example, San Francisco Bay Area RWQCB staff said that for on-site recycled water systems at private resorts and wineries, staff will require that operators are "competent, qualified and knowledgeable." The daily water sampling, which may still be required, doesn't need to be performed by a certified operator.

While operators don't need to be full-time, they still may be expensive. The Alliance Team found that on-site system operators don't need to be full-time employees nor on-site a significant amount of time, even under Title 23 requirements. This finding reduces the potential cost associated with hiring a "competent" operator. The operator position can be filled by someone that inspects the system daily or even just a few times a week, as long as that person fulfills the qualifications stated in the permit. With advances in remote monitoring capability, an operator could regularly review system

operations remotely. Even though operators don't need to be full time, thus lessening their economic burden on system economics, it may be challenging to find an operator with the correct skill set. If skills are in short supply for the standards of "competent" set by the RWQCBs, then the rates set by the potential operators might be relatively high.

Potential Solutions

While the operator requirements don't create as significant a barrier as the Alliance team initially thought, there are still ways to reduce the hurdles still remaining. These are listed below:

- **Raise awareness in industry regarding operator requirements.** As there appears to be some confusion in the industry as to whether or not a full-time on-site operator is required, it is important to communicate to potential owners and developers of on-site recycled water systems (that are not municipally-owned or regulated by the CPUC) that a full-time on-site system operator is not required.
- **Develop standard characteristics for a "competent" system operator.** Since language may be vague from RWQCBs, or interpretations may vary between regional offices, project developers are left with a fair amount of uncertainty about skills required for a "competent" system operator. It would be helpful to develop standard guidelines and a certification program for operators of on-site water recycling systems. These standards could take into account that building operation and maintenance staff could be trained to operate systems, thus further reducing the potential cost burden of on-site recycled water systems.
- **Create trainings for building operators so that they can meet the "competent" criteria.** Once standard guidelines are set of a "competent" system operator, training courses could be offered so that building operation and maintenance staff could get certified to run on-site water recycling systems.