Guide for Developing Onsite Water Systems to Support Regional Water Resilience

Cora Snyder, Heather Cooley, and Anne Thebo

PACIFIC INSTITUTE

January 2023

Guide for Developing Onsite Water Systems to Support Regional Water Resilience

JANUARY 2023

AUTHORS
Cora Snyder
Heather Cooley
Anne Thebo

Suggested citation: Snyder, Cora, Heather Cooley, and Anne Thebo. 2023. "Guide for Developing Onsite Water Systems to Support Regional Water Resilience." Oakland, Calif.: Pacific Institute.

Pacific Institute
344 20th Street
Oakland, California 94612
Phone: 510.251.1600

Cover Photo: ©SundryPhotography/iStockphoto

ABOUT THE PACIFIC INSTITUTE

The Pacific Institute envisions a world in which society, the economy, and the environment have the water they need to thrive now and in the future. In pursuit of this vision, the Institute creates and advances solutions to the world's most pressing water challenges, such as unsustainable water management and use; climate change; environmental degradation; food, fiber, and energy production for a growing population; and basic lack of access to fresh water and sanitation. Since 1987, the Pacific Institute has cut across traditional areas of study and actively collaborated with a diverse set of stakeholders, including leading policymakers, scientists, corporate leaders, international organizations such as the United Nations, advocacy groups, and local communities. This interdisciplinary and independent approach helps bring diverse groups together to forge effective real-world solutions. More information about the Institute and our staff, directors, funders, and programs can be found at www.pacinst.org.

About the Authors

CORA SNYDER

Cora Snyder is a Senior Researcher at the Pacific Institute, where she works on Western US water policy, urban water efficiency and reuse, corporate water stewardship, global water governance, and more. Much of her work supports the California Water Action Collaborative and the UN Global Compact CEO Water Mandate. Her interests are centered on creative solutions that balance the social, environmental, and economic dimensions of water. Cora's past work has focused on environmental water markets, Western US water law, LEED green building certification, and behavioral science techniques to encourage residential water conservation. Cora holds a bachelor's degree in Environmental Studies with a minor in Spanish from the University of California, Santa Barbara. She also holds a master's degree in Environmental Science and Management from the Bren School at UCSB, where she was a Sustainable Water Markets Fellow.

HEATHER COOLEY

Heather Cooley serves as Director of Research at the Pacific Institute. She conducts and oversees research on an array of water issues, such as sustainable water use and management, the connections between water and energy, and the impacts of climate change on water resources. Prior to joining the Pacific Institute, she worked at Lawrence Berkeley National Laboratory studying climate and land use change and carbon cycling. Heather received a bachelor's degree in Molecular Environmental Biology and a master's degree in Energy and Resources from the University of California, Berkeley. She has served on the California Commercial, Industrial, and Institutional Task Force, the California Urban Stakeholder Committee, and the California Urban Water Conservation Council's Board of Directors.

ANNE THEBO

Dr. Anne Thebo is a Senior Researcher at the Pacific Institute. Her research uses spatial analysis and modeling to assess the benefits and trade-offs of integrated water management, water reuse, and alternative supplies in the urban and agricultural sectors. Prior to joining the Pacific Institute, Anne worked as a researcher and a water resources engineer focused on watershed planning, green infrastructure, and water and sanitation in the United States and abroad. Anne holds a doctorate in civil and environmental engineering from the University of California, Berkeley, where she focused on de facto water reuse in agriculture and was supported by a US Environmental Protection Agency Science to Achieve Results Fellowship and the International Water Management Institute. She also holds a master's degree in environmental engineering from Stanford University and bachelor's degrees in civil engineering and environmental science from Ohio State University.

Acknowledgements

This work was supported by Google, the Cargill Global Partnerships Fund, and the Target Foundation. We thank them for their generosity. We also thank our reviewers for providing valuable input on the draft report: Aaron Tartakovsky, Amelia Luna, Dennis Murphy, Hossein Ashktorab, Melissa Gunter, Michael Steiger, Paula Kehoe, Pedro Hernandez, Sasha Harris-Lovett, Taylor Nokhoudian, Tom Francis, and Rob Greenwood. We also thank all the participants of the Silicon Valley Onsite Water Reuse Working Group (listed in Appendix B). Lastly, we thank the Pacific Institute's communications team for assistance with layout and release of this report. All conclusions and recommendations expressed in this report and any errors or omissions are those of the authors.

Table of Contents

Figures and Boxes

EXECUTIVE SUMMARY

Across the United States, urban communities face growing water challenges, from water scarcity to flooding, pollution, aging water infrastructure, and more. These challenges present risks, but also an opportunity to rethink how we manage water, including adopting circular approaches in new buildings that reduce their water footprint and improve urban water resilience. Onsite water systems, for example, collect, treat, and reuse water from onsite sources, including wastewater, rainwater, and stormwater, for non-potable water uses like toilet flushing, outdoor irrigation, and cooling.

Onsite water systems have the potential to provide multiple benefits for a site, water and wastewater systems, ecosystems, and communities. They can, for example, help companies mitigate water-related risks, like water shortages that threaten to disrupt business operations, and support corporate water stewardship goals. For communities, onsite water systems can enhance water supply reliability, improve water quality, reduce localized flooding, and increase urban green space. The realization and magnitude of benefits will vary with the type of system, scale of adoption, and other context-specific factors.

This guide helps site developers consider **how onsite water systems can be planned, designed, and operated to provide multiple benefits, and contribute to planning and designing onsite water systems that advance water resilience, support equity, support the environment, and protect public health** at the site, water system, and community scales. For each of these outcomes, the guide provides sample questions to consider, stakeholders to engage, resources to examine, and analyses to perform.

ADVANCE WATER RESILIENCE

Onsite water systems can enhance water resilience for the site, as well as for water systems and the larger community. By diversifying water sources, for example, onsite water systems can reduce vulnerability to drought and other water supply constraints. Likewise, onsite water systems can provide operational flexibility and redundancy for the centralized water system.

What water sources are available for the site?

Most sites in urban areas rely on potable water delivered by local water providers, each of which has a unique mix of water sources. Some sites may also have access now or in the future to non-potable recycled water delivered through a separate "purple pipe" distribution system. What type of water reuse (e.g., onsite water systems or "purple pipe") makes the most sense for a site depends on a range of factors, such as the quantity and quality of supplies available and the ease of accessing these sources.

How could onsite water systems reduce vulnerability to drought and other water supply constraints?

Water availability is a growing concern in communities across the Western United States and is especially acute during droughts, which are becoming more frequent and severe due to climate change. An onsite water system provides a reliable water source for the site. This could allow the building to avoid mandatory cutbacks imposed during a drought or other water shortage, and can reduce demand on the water system, improving water reliability for the community. In areas or at times when water supplies are limited, an onsite water system could also help improve public opinion or even facilitate approval of a new development.

How could onsite water systems support wastewater management?

Most onsite water systems capture and reuse wastewater generated on the site, reducing the amount of wastewater collected and treated by the centralized wastewater system. When deployed at scale, this can defer capital costs for new wastewater treatment infrastructure but can also concentrate wastewater and water quality constituents. Onsite water systems can also allow buildings to continue operating if the centralized wastewater system is damaged by a storm or other hazard. The effects of onsite systems on municipal wastewater systems are highly site specific.

How could onsite water systems support stormwater management?

By incorporating rainwater and stormwater as water sources, onsite water systems can help developers meet or even exceed local stormwater requirements. By reducing stormwater runoff, an onsite water system can reduce pressure on stormwater infrastructure, reduce localized flooding, and improve water quality in nearby waterways. Stormwater runoff from urban areas is a major source of pollution in waterways and contributes to surface flooding in low-lying areas.

SUPPORT EQUITY

Water challenges disproportionately affect low-income and marginalized communities. Active consideration of equity, social responsibility, and community perception can help onsite water systems support equity outcomes at the site and in surrounding areas and help boost the developer's reputation. However, equity considerations of onsite water systems have not been deeply explored yet.

How can onsite water systems help address equity concerns in nearby communities?

While the nexus between equity and onsite water systems is not well understood, three issues typically arise with respect to water and urban development: water affordability, green space and urban heat, and job opportunities. The equity issues a developer may face are unique to the site and local circumstances, and they should be identified through meaningful and effective community engagement early in the planning process.

Who are the communities around the site, and what are their primary concerns?

Meaningfully engaging with local communities and understanding their concerns can help build goodwill and support for a project. It may also generate new ideas for ways that an onsite water system could be designed and operated to provide additional benefits to the surrounding area.

What equity or social responsibility goals does the company have, and how might onsite water systems help achieve them?

Corporate social responsibility is increasingly important for both investors and consumers, and many companies are adopting social responsibility goals and targets. Engaging with surrounding communities and exploring local equity issues associated with onsite water systems may contribute to a company's social responsibility goals.

SUPPORT THE ENVIRONMENT

Local ecosystems in urbanized areas are suffering from habitat loss and fragmentation, air and water pollution, and dramatic losses in biodiversity. In addition, the watersheds from which many communities draw water supplies—sometimes from hundreds of miles away—are over-tapped. Those ecosystems, too, are in decline. As climate change increases extreme weather events, ecosystems will face even greater challenges.

How could onsite water systems support local ecosystems?

Many waterways, wetlands, open spaces, and other habitats have been destroyed or degraded due to urbanization. Onsite water systems could help restore ecosystem and environmental health in the communities where they are built by reducing wastewater discharges to oceans and bays and providing water for urban green space and local wetlands.

How could onsite water systems support source watersheds?

In arid regions like much of the Western United States, watersheds are suffering from unsustainable withdrawals to meet water demands. Onsite water systems provide a local, circular water source that can reduce reliance on stressed source watersheds, which provides benefits for the freshwater ecosystems that depend on them.

How could onsite water systems support resource recovery?

The concept of a circular economy—recovering and reusing resources—has emerged as a popular paradigm for companies to reduce their environmental impacts, operational waste, and costs through more efficient use of expensive resources. An onsite water system represents a circular approach by recovering water from wastewater, but there are additional opportunities to recover other resources, including heat and nutrients, to increase the environmental benefits and cost effectiveness of onsite water systems.

PROTECT PUBLIC HEALTH

Public health is of utmost importance in the provision of water and wastewater services, including for onsite water systems. Developers and operators of onsite water systems must keep everyone on and around the site safe and demonstrate good stewardship of water resources. Developers can meet the public health imperative through achieving and exceeding regulatory compliance, supporting public education about onsite water systems, and planning for the long term.

What is the regulatory context for onsite water systems at the site?

Any developer considering an onsite water system must understand all relevant requirements for the design, construction, and operation of the system, including how those requirements may be changing. Long-term operations, maintenance, monitoring, and reporting plans should meet or exceed local requirements.

How can the site support data sharing about onsite water systems?

Given the relative novelty of onsite water systems and ongoing regulatory transitions, developers can be leaders in data management and sharing for onsite water systems. Collecting and sharing accessible, usable data on onsite water systems' water volumes and water quality can help ensure that public health is protected, support responsible management of water and wastewater flows, increase data transparency, and help inform other developers considering onsite water systems.

What is the plan for ongoing operation and ownership of the onsite water system?

One of the major concerns about private development and ownership of onsite water systems is the question of who assumes responsible for its long-term operations and maintenance. Government agencies charged with protecting public health must be confident that onsite water systems will be operated safely, and the general public must share this confidence for developers to have social license to operate them. To this end, it is critical that onsite water systems have long-term operations and ownership plans. There are several different possible arrangements for onsite water systems project delivery, many involving partnership with various companies, organizations, and/or agencies.

This guide aims to support the development of onsite water systems that provide benefits to the site, water and wastewater systems, and the surrounding community. Additional effort is needed to increase uptake of multi-benefit onsite water systems. Developers can support greater implementation and integration of onsite water systems in the following ways:

- Creating case studies about onsite water systems that other developers can learn from.
- Collecting and sharing data and information from onsite water systems with water and wastewater providers, onsite water systems practitioners, and academic researchers.
- Supporting regional, statewide, and national policies that enable and/or incentivize implementation of onsite water systems.

About This Guide

The goal of this guide is to help site developers plan, design, and operate onsite water systems that provide multiple benefits and contribute to improved outcomes for the site, water systems, and nearby communities. The guide is structured around four desired outcomes: advance water resilience; support equity; support the environment; and protect public health. It builds on the Pacific Institute's past work assessing the role of onsite water systems in advancing water resilience in Silicon Valley (Cooley et al. 2021). That study highlighted the multiple benefits that onsite water systems can provide and also discussed how the realization and magnitude of benefits will vary with the type of system, scale of adoption, and other context-specific factors.

Valuable guidance to support site-level decision-making is already available, and developers typically work with consultants to navigate the relevant design, permitting, and engineering considerations for their site (see Appendix A). This guidance seeks to go beyond the site boundaries to consider how onsite water systems can provide benefits to water and wastewater systems and nearby communities to support the overarching goal of regional water resilience for all.

The target audience for this guide is site developers. These developers may be from either the public or private sector and may ultimately be the occupant of the site or may sell or lease it to another occupant. Decisions about whether and how to build an onsite water system may lie with the developer and/or the site occupant, and this guide is intended for the stakeholder(s) involved in those decisions. We note that a growing number of companies, including technology companies, are investing in onsite water systems in support of their sustainability goals and water stewardship efforts more broadly.

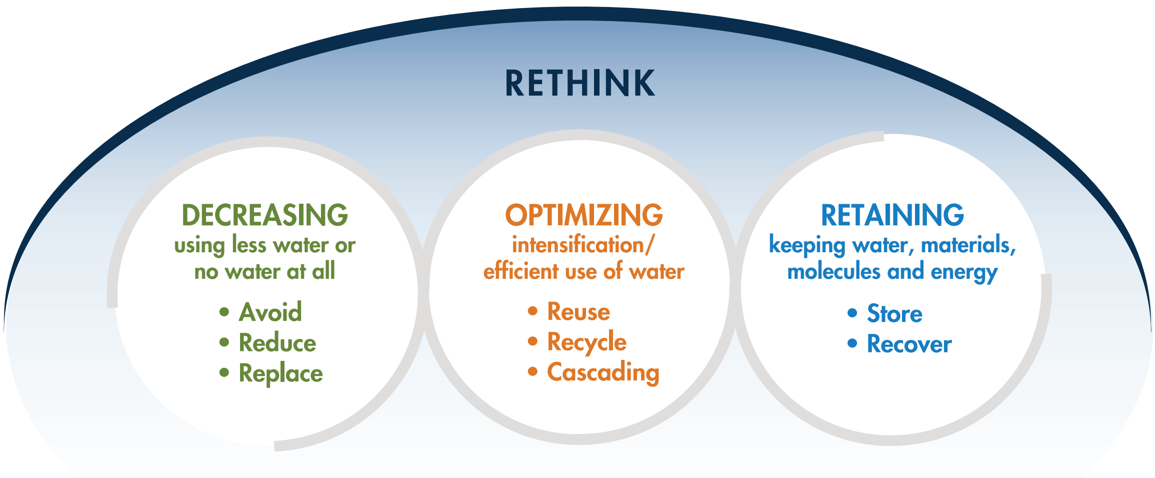
Throughout the guide, we provide specific questions and examples for those companies to consider. Regardless of whether a site is built and occupied by a public or private entity, developers need support from city and county governments, water and wastewater utilities, and local regulators to successfully implement onsite water systems. These public sector stakeholders may also find this guide useful. Additionally, this guide is designed for a context in which onsite water systems are allowed and encouraged but not required. We recognize that additional effort is needed in many urban areas across the United States to improve the enabling environment for onsite water systems implementation, integration, and scaling. While this is largely outside of the control of developers, they can play an important role in advocating for policies and processes at local or state levels to improve onsite water system feasibility.

This guide was developed through engagement with the Silicon Valley Onsite Water Reuse Working Group. The goal of the cross-sector working group was to help ensure that investments in onsite water systems are informed by local water context and aligned with public water management goals to generate economic, environmental, and social benefits for communities, including increased water resilience to climate change and other stressors, while also providing benefits for the site. While the guide is applicable for urban areas across the United States, it draws from insights and examples from the San Francisco Bay Area through this working group. See Appendix B for more detail on the group, including a stakeholder list.

INTRODUCTION

Across the United States, urban areas face increasing water-related challenges, from water scarcity to urban flooding, water pollution, aging water and wastewater infrastructure, and more. These challenges present risk, but also an opportunity to rethink water management approaches, including adopting circular approaches to reduce the water footprint of new developments and improve urban water resilience (see Figure 1).

FIGURE 1. STRATEGIES FOR THE CIRCULAR ECONOMY OF WATER



Adapted from: Morseletto, Mooren, and Munaretto 2022

This guide focuses on onsite treated non-potable water systems, referred to throughout as onsite water systems. These systems collect, treat, and reuse water from a variety of sources, including wastewater, rainwater, and stormwater, for non-potable water uses like toilet flushing, outdoor irrigation, and cooling (see Box 1). A growing number of developers are investing in onsite water systems. For example, leading technology companies in Silicon Valley are investing in onsite water systems at new office and campus developments.[1]

Onsite water systems have the potential to provide multiple benefits for the site, water and wastewater systems, ecosystems, and communities. Potential benefits include enhancing communities' water supply reliability, improving surface water quality, reducing localized flooding, increasing urban green space, and advancing water technology innovation. Onsite water systems can also help companies mitigate water-related risks, like supply shortages that could disrupt business operations, and contribute to corporate water stewardship goals. Finally, onsite water systems

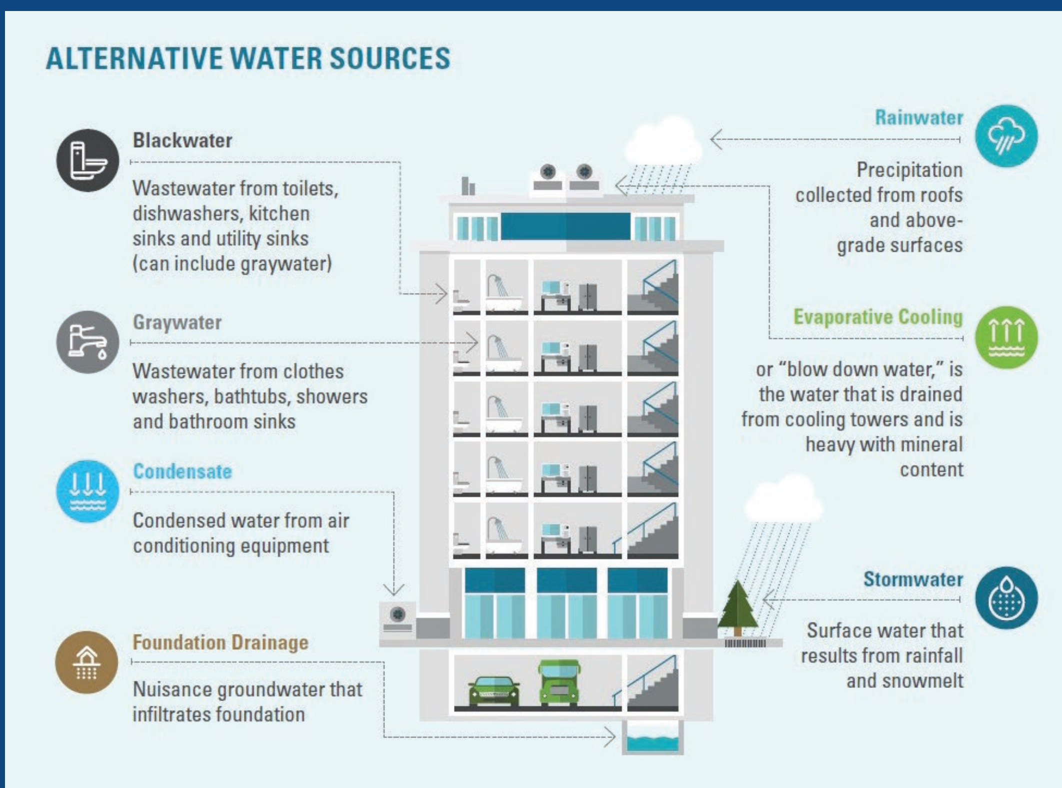
1 See, for example, a case study about Google's Bay View Campus in Santa Clara County: https://www.spur.org/sites/default/files/2022-04/SPUR_Watershed_Moments_Case_Study_3.pdf

provide opportunities for developers to demonstrate that they care about—and are contributing to—community sustainability and resilience. This has reputational and—increasingly—financial benefits, as green buildings are valued at a premium (Oyedokun 2017).

Realizing these benefits—and avoiding unintended consequences—requires meaningful collaboration between public agencies and developers. Distributed and centralized systems can complement one another to create more resilient communities if onsite water systems are deliberately

BOX 1. What are Onsite Water Systems?

Onsite water systems capture and treat alternative water sources from a building site and reuse them for non-potable water needs. Onsite water systems can use water from a variety of sources, including rainwater, stormwater, graywater, blackwater, and foundation drainage. The water generated can be used to meet water demands such as toilet and urinal flushing, landscape irrigation, building cooling, process water, clothes washers, cleaning outdoor surfaces, and construction uses. In multi-family residential buildings, toilet and urinal flushing and clothes washing alone constitute up to 40% of indoor water use; in commercial buildings, toilet and urinal flushing comprise up to 75% of indoor water use. In both residential and commercial buildings, additional non-potable water demands include irrigation and cooling towers. Irrigation water needs can make up half of a site's total water demand.



This diagram shows the main alternative water sources available in a typical urban building.

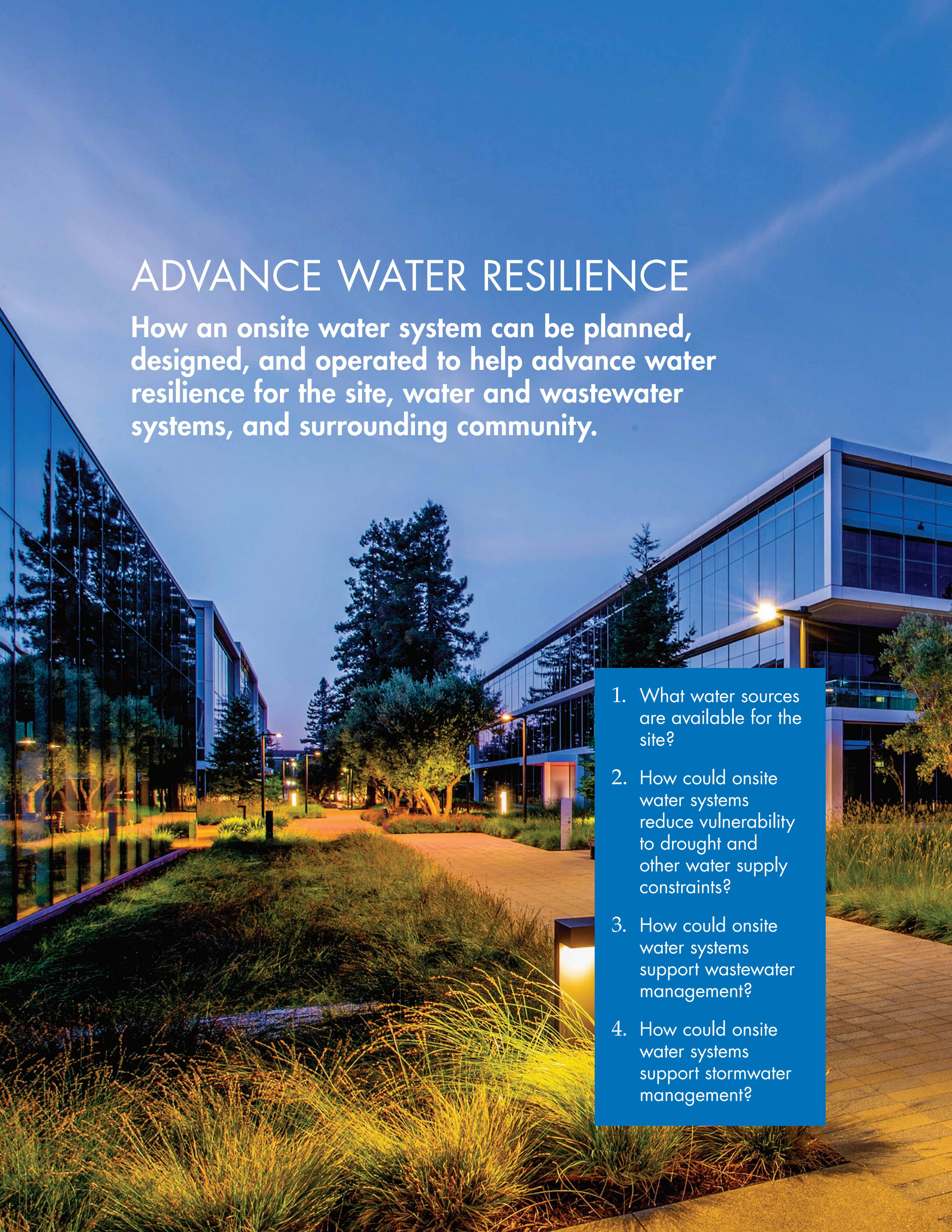
Source: William J. Worthen Foundation 2018 sited and effectively integrated into the broader water network, with explicit acknowledgement and management of the interconnections. This guide is intended to inform and empower developers to plan, design, build and operate onsite water systems collaboratively with consultants and public sector counterparts, to ensure the onsite water systems can provide multiple benefits and avoid unintended impacts within and beyond site boundaries.

Onsite Water Systems Decision Support Guide

In the following sections, we provide decision factors for planning, designing, and operating onsite water systems that help achieve four critical outcomes:

1. **Advance water resilience.**
2. **Support equity.**
3. **Support the environment.**
4. **Protect public health.**

Each section is paired with sample questions to consider, stakeholders to engage, resources to examine, and analyses to perform.



ADVANCE WATER RESILIENCE

How an onsite water system can be planned, designed, and operated to help advance water resilience for the site, water and wastewater systems, and surrounding community.

1. What water sources are available for the site?
2. How could onsite water systems reduce vulnerability to drought and other water supply constraints?
3. How could onsite water systems support wastewater management?
4. How could onsite water systems support stormwater management?

Many water and wastewater systems have been built and operated under an assumption of stationarity, i.e., that the past is a good predictor of future weather patterns and water risks. This assumption is no longer valid as the future is increasingly variable and uncertain due to climate change and other stressors and shocks. In response, there is growing interest in improving water resilience. Water resilience is the ability of water systems to function so that nature and people, including those on the frontlines and disproportionately impacted, thrive under shocks, stresses, and change (Brill et al. 2021). Resilience is marked by six characteristics: robustness, redundancy, flexibility, integration, inclusivity, and justice and equitability.

Onsite water systems can enhance water resilience for the site, water systems, and the community in several ways. By diversifying water sources, for example, onsite water systems can reduce community-wide vulnerability to drought and other water supply constraints. Likewise, onsite water systems can provide operational flexibility for centralized systems. However, onsite water systems must be intentionally designed, built, and operated to realize these benefits. This section explores decision factors that determine the extent to which onsite water systems can advance water resilience for the site and beyond.

1. What water sources are available for the site?

Most sites in urban areas rely on potable water delivered by local water providers, each of which has a unique mix of water sources. In Silicon Valley, for example, most rely on imported water from the San Francisco Public Utilities Commission (SFPUC) Regional Water System, the State Water Project, or the Central Valley Project. Many water providers supplement imported water with local water sources, including groundwater, local surface water, and recycled water.

Some sites may also have access today or in the future to non-potable recycled water delivered through a separate "purple pipe" distribution system. For an existing building, recycled water is most easily used for landscape irrigation, as replumbing the building to use this water inside the building is likely to be cost prohibitive. However, a new building may have dual plumbing that would allow for regional recycled water to be used for non-potable purposes inside *and* outside the building.

A new development could support expansion of the regional recycled water system. In late 2016, for example, Apple opened a second campus in Cupertino, California that comprised 2.8 million square feet and accommodated 12,000 employees. Through a public-private partnership with local water agencies, Apple contributed $4.8 million to lay more than 13,300 feet of purple pipe and build a new pump station to bring recycled water to its campus and other potential recycled water customers in the area (Love 2015).

Onsite water systems can use water from a variety of sources to meet onsite non-potable demands (see Box 1). Developers should work with consultants or an in-house technical team to develop a site water balance to determine which demands can be met by onsite sources, as they vary throughout the day and year.[2] For example, stormwater and rainwater flows are available during the winter months, whereas outdoor demand peaks during the dry summer months. The water balance should also include installation of water-efficiency measures to reduce water demands, e.g., by selecting climate-appropriate plants for the landscape and installing efficient irrigation systems and water-efficient appliances and fixtures, to right-size the system and reduce construction, operation, and maintenance costs.

Onsite water systems may also be able to meet non-potable water demands in the surrounding area. For example, the Moscone Center Expansion has a district-scale onsite system that treats and reuses rainwater, condensate from the building's cooling system, and foundation drainage. This facility offsets about 15 million gallons per year of potable water for use in toilets and urinals, landscape irrigation, and to refill street-cleaning trucks (Moscone Center n.d.).

Diversifying local and regional water supplies is a key strategy for enhancing water resilience. To determine the water sources available to meet onsite water demands, developers should work with their local water and wastewater providers. The following questions can help to guide those discussions:

- Is recycled water produced by a municipal water provider currently available for the site? If so, is the quality of the recycled water adequate for the potential uses on the site, and/or can the landscaping be adapted to match the recycled water quality?3

- Are there plans to bring municipal recycled water to or near the site? If so, when and what is the distance to the site? Are there opportunities to co-invest in bringing municipal recycled water infrastructure to or near the site?

- At what scale of adoption would onsite water systems affect existing municipal recycled water commitments or future plans?

In California, answers to the questions above can often be found in Urban Water Management Plans, which are developed by urban water providers every five years and contain information about their water recycling plans.[4] Texas similarly requires water providers to submit Water Conservation Plans every five years. Other states have similar water planning documents at water provider, city, region, and/or county scales that contain information about existing and planned water supplies, including recycled water.

2 Resources such as the Water Audit Guidance for Commercial Buildings and the US EPA Non-Potable Enironental and Economic Water Reuse (NEWR) Calculator can help with assessing the site's water balance.

3 The University of California, Davis offers guidance on plant selection for recycled water irrigation here: https://slosson.ucdavis.edu/Landscape_Plant_Selection_Guide_for_Recycled_Water_Irrigation/

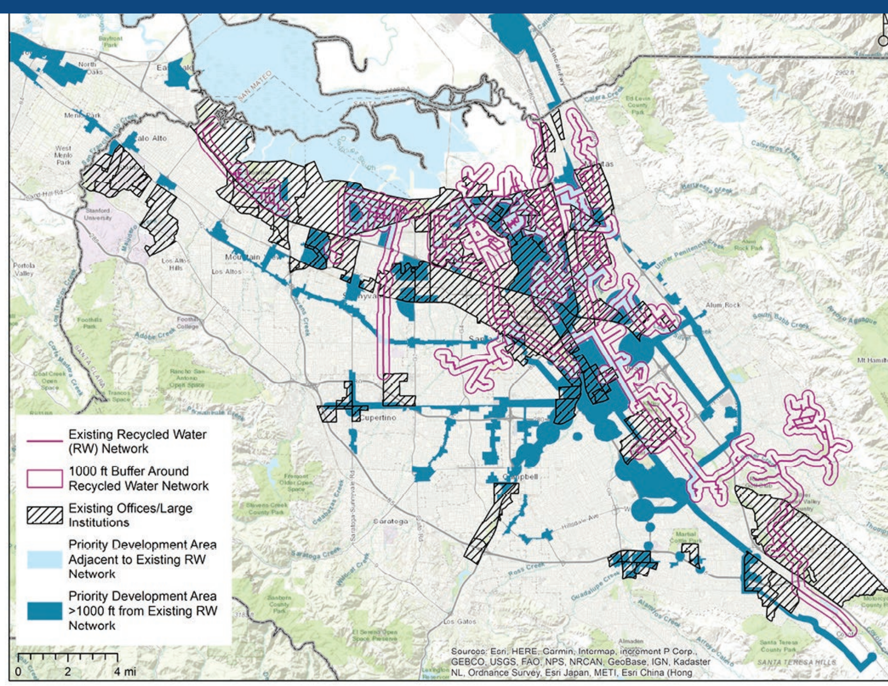
4 For developments in California, look on the water provider's website for a copy of their latest Urban Water Management Plan. You can also find them at https://wuedata.water.ca.gov/uwmp_plans.asp?cmd=2020.

2. How could onsite water systems reduce vulnerability to drought and other water supply constraints?

Water availability is a growing concern in communities across the Western United States. In Silicon Valley, for example, less water may be available from the Tuolumne River and the Sacramento-San Joaquin Delta due to the declining health of these ecosystems and efforts to protect and restore them. Concerns about water availability are especially acute during a drought, which are becoming more frequent and severe due to climate change. Finally, continued growth and development and higher temperatures due to climate change are putting upward pressure on water demand.

BOX 2. Mapping Recycled Water Systems in Santa Clara County, CA

In 2021, Pacific Institute researchers mapped the existing regional recycled water networks in Santa Clara County, California. The map below shows the regional recycled water networks, with a 1,000-foot buffer around each pipeline, in purple. In blue are the priority development areas for the region. Areas slated for priority development that are not currently served by the regional recycled water network could be well-served by onsite water systems. Analyses such as these can help companies, and water/wastewater providers, determine where onsite water systems might be most beneficial. Long-range or master planning documents can provide insights into planned expansions of existing recycled water systems.



Source: City of San Jose Open Data Platform, Metropolitan Transportation Commission Open Data Platform, Valley Water District Draft

Source: Cooley et al. 2021

An onsite water system provides a reliable water source for the site, reducing the risk of water shortage. This could help the building avoid mandatory cutbacks imposed during a drought or other water shortage. In areas or at times when water supplies are limited, an onsite water system could also help improve public opinion or even facilitate approval of a new development. To encourage support for a new development—and reduce the potential for public backlash—developers should avoid installing a lush landscape with water-intensive plants. Instead, they should install a landscape with low water-use plants and an efficient irrigation system. It is also important to educate the community and install signage about the use of an onsite water system and its role in supporting the sustainability of the site and the region.

An onsite water system can also support a company's water stewardship efforts. Many companies have set water-related targets around good water stewardship practices, such as reducing and reusing water onsite and/or offsetting the site's water footprint. The contribution of onsite water systems to reduced potable water demand may help the company meet its water stewardship targets. This not only helps achieve internal goals but also demonstrates the company's commitment to sustainability to investors, customers, staff, and the community.

With adequate planning, an onsite water system can support water reliability and other regional goals. By reducing reliance on the potable water system, for example, an onsite water system can leave water for other uses or allow it to be left in storage for later use. Depending on the scale of onsite water systems implementation, onsite water systems may also reduce the need for water providers and developers to develop new water sources and/or expand treatment or distribution systems—all of which typically require expensive capital projects and ongoing operations and maintenance costs. However, realizing these regional benefits, and minimizing or avoiding unintended consequences, requires careful planning and coordination with water and wastewater utilities.

Developers should work with their local water providers to assess the potential for an onsite water system to reduce vulnerability to drought and other water supply constraints. The following questions can help to guide those discussions:

- How could an onsite water system make the site less vulnerable to drought or other water supply constraints?
- At what scale of adoption would onsite water systems make the region less vulnerable to water supply constraints?
- What are the recent and projected future trends for water supplies and demands? Do these projections incorporate the potential for onsite water systems?

For example, in its 2020 Urban Water Management Plan update, the SFPUC estimated the expected potable water demand reductions from buildings that install and operate onsite water reuse systems. Based on water budget applications submitted to the SFPUC and assumptions about future projects, they estimated that voluntary and mandatory onsite water reuse projects will reduce potable water demand by 1.3 million gallons per day by 2040 (San Francisco Public Utilities Commission 2021). By integrating these projects into their water demand forecasts, SFPUC can adjust their infrastructure investments accordingly. While water providers may have not yet done these analyses, it is important to start that conversation to ensure that onsite water systems are being adequately incorporated into water management and planning efforts.

Further, a growing number of cities have developed climate action plans, many of which have at least one section on water. Given water challenges across the nation and the exacerbating effects of climate change, climate action plans likely contain water efficiency and reuse goals. An onsite water system may contribute to the achievement of these goals. In Silicon Valley, for example, the cities of San Jose, Sunnyvale, Mountain View, and Redwood City have water goals in their plans. Check the local climate action plan to determine if and how an onsite water system could contribute to water-related goals. You can find these plans on local government websites or on the Zero Energy Project website.[5]

BOX 3. Onsite Water System Nutrient Recovery at NEMA, San Francisco, CA

NEMA, a residential high-rise building in San Francisco, piloted a nutrient recovery system with the company Epic Cleantec. In this system, solids are filtered out of the wastewater stream and converted into a high-quality soil product. This reduces solid waste discharge into the sewer system and creates a valuable by-product, which Epic Cleantec intends to use for public parks and direct sales to consumers.

Source: Kehoe et al. 2022
Photo credit: Wikimedia Commons

5 Look up city climate action plans here: https://zeroenergyproject.org/all-cities-with-climate-action-plans/.

3. How could onsite water systems support wastewater management?

Most onsite water systems capture and reuse wastewater generated on the site. This can allow the building to continue operating if the centralized wastewater system is damaged by a storm or other hazard. In 2012, for example, Hurricane Sandy caused widespread damage to wastewater treatment systems in New York and New Jersey, but more than 80 distributed and onsite water systems remained operational, continuing to provide essential water and wastewater services.

An onsite water system reduces the amount of wastewater collected and treated by the centralized wastewater system. When deployed at scale, these systems can defer capital costs for new wastewater treatment facilities or distribution systems by extending the life of existing wastewater systems or reducing the size of new wastewater treatment facilities.

As onsite water systems divert wastewater flows from centralized water systems, they can also concentrate wastewater flows and water quality constituents. More concentrated wastewater flows can, for example, corrode the wastewater collection system, increase blockages, and cause odor concerns, potentially requiring changes in maintenance procedures and treatment processes or accelerated replacement of pipelines. Periodic release of non-potable water from the onsite water system or municipal recycled water to flush the sewer system could help mitigate some of these impacts.

To better understand the effects of onsite systems on the wastewater system, the SFPUC's water and wastewater divisions collaboratively developed a process for assessing impacts on flow and odor. In particular, wastewater hydraulic analyses evaluate potential impacts, of each proposed development and across the city, from significant expansion of onsite systems. Model results have shown that the impacts of odor and flow issues on the wastewater system were minimal (Kehoe and Nokhoudian 2022).

Additionally, there is growing interest in recovering and reusing biosolids generated from onsite water systems to reduce potential adverse impacts on wastewater systems (see the Support the Environment section in this report for more detail). Even with a biosolids recovery system, onsite water systems in most urban areas will be required to connect to the municipal wastewater system. This connection can serve as an important back-up should the onsite water systems need to be taken offline, ensuring resilience of the whole system. There is also likely to be a readiness-to-serve fee to cover costs for building and maintaining the infrastructure, along with a volumetric charge based on an estimate of the amount of wastewater generated.

The effects of onsite systems on regional wastewater systems are highly site specific. To understand the potential impacts of an onsite system on wastewater systems, developers should meet with their local wastewater providers, and/or with wastewater industry groups, such as the Bay Area Clean Water Agencies in California. The following questions can help to guide those discussions:

- Are parts of the municipal wastewater collection system serving the building at or near capacity, now or in the future? Are there known maintenance problem spots nearby?

- Has a hydraulic study evaluated the effect on wastewater flows and odors through the existing municipal sanitary sewer system of the proposed onsite water system or from increased implementation of these systems?
- What are the expected concentrations or loading rates of water quality parameters of concern (e.g., salinity, nitrogen, biochemical oxygen demand) from the onsite system to the municipal wastewater collection system?
    - Can the onsite water systems be designed and operated to minimize any adverse effects, for example, through onsite management of biosolids or periodic release of non-potable water to flush the sewer system, or operated to complement the municipal wastewater treatment or collection system?
- In what ways will an onsite water system be connected to the existing wastewater system? What are fair capacity fees and rate structures for those connections?

BOX 4. Onsite Stormwater Systems at the Bill Sorro Community in San Francisco, CA

The Bill Sorro Community—an affordable housing development in San Francisco owned by Mercy Housing—installed a 3,000-gallon cistern to collect rainwater from its 8,800 square-foot roof. In accordance with San Francisco's stormwater management ordinance, the cistern was sized to hold the required average annual detention volume associated with the design storm event. Rainwater is treated using particulate filters to remove the suspended solids and ultraviolet (UV) disinfection prior to being used for flushing toilets throughout the building, reducing the project's potable water use by approximately 10%.

Source: Kehoe et al. 2022 *Photo credit: ©Bruce Demonte*

4. How could onsite water systems support stormwater management?

Stormwater runoff from urban areas is a major source of pollution in waterways and contributes to surface flooding in low-lying areas. New developments are required to comply with local stormwater management ordinances, and developers can meet or even exceed local stormwater requirements by incorporating rainwater and stormwater as water sources. These systems can effectively reduce pressure on stormwater infrastructure, reduce localized flooding, and improve water quality in nearby waterways.

Developers should work with consultants or an in-house technical team to identify the opportunities for integrating stormwater and rainwater capture using green infrastructure and other low-impact development practices into the project design.[6] They should also assess the extent to which onsite water systems can help the site meet or exceed local stormwater management ordinances.

The effects of onsite systems on stormwater management depend on local conditions. To examine the potential impacts of an onsite system on stormwater systems, developers should meet with flood management districts and entities responsible for the local municipal separate storm sewer system (MS4) permit. The following questions can help to guide those discussions:

- Does the area around the site face flood management challenges currently or in the future due to climate change impacts?
- Can an onsite water system help to satisfy or go beyond existing stormwater management requirements?
- How can stormwater capture and reuse contribute to water quality regulatory compliance?
- What opportunities exist to capture rainwater and/or stormwater to offset potable water demands?
- How could managing rainwater and/or stormwater onsite provide benefits to nearby communities (e.g., flood mitigation, water pollution reduction)?

6 Online tools such as the GreenPlanIT tool can help companies get started with exploring onsite green infrastructure opportunities: https://greenplanit.sfei.org/.

SUPPORT EQUITY

How onsite water systems can be designed, built, and/or operated to help support equity at the site, within water and wastewater systems, and for the surrounding community.

1. How can onsite water systems help address equity concerns in nearby communities?
2. Who are the communities around the site, and what are their primary concerns?
3. What equity or social responsibility goals does the company have, and how might onsite water systems help achieve them?

Water challenges disproportionately affect low income and marginalized communities. Just and equitable treatment and protection for all people are key characteristics of resilient water systems (Brill et al. 2021). However, water projects can sometimes lack effective community engagement and equitable, transparent decision-making. And equity considerations of onsite water systems have not been deeply explored yet; there is little to no guidance or academic literature on the topic.

This section summarizes some of the potential equity issues related to onsite water systems and describes how companies can address them. Active consideration of equity, social responsibility, and community perception can help onsite water systems to support equity outcomes at the site and in the surrounding areas and help boost the developer's reputation.

1. How can onsite water systems help address equity concerns in nearby communities?

While the nexus between equity and onsite water systems is not well understood, three issues typically arise with respect to water and urban development: water affordability, green space and urban heat, and job opportunities. The equity issues a developer may face are unique to the site being considered for development and local circumstance and should be identified through meaningful and effective community engagement early in the process.

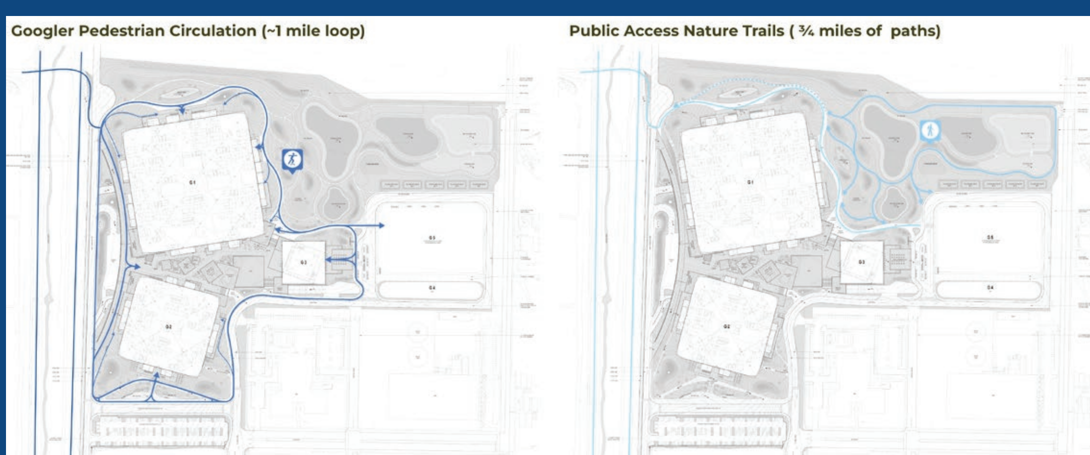
First, onsite water systems may be able to provide water affordability benefits to people served by regional water and wastewater providers, if implemented in collaboration with those providers. Developers are making water infrastructure investments, reducing or delaying the need for regional water providers to make larger capital investments and raise water rates to pay for it. Keeping water bills affordable, especially for low-income communities, is a key water-related equity issue and connects to realizing the human right to water. However, the development of onsite water systems can cause real or perceived risks of corporate divestment from water systems. There is concern that sites with their own water supplies and wastewater treatment capacity would pay less to public water and wastewater service providers. This could have the unintended impact of shifting the burden of paying for the water system onto a smaller pool of water users and ratepayers, including those who can least afford it.

Second, onsite water systems can support additional climate-appropriate green space on the site and/or nearby. More green space—especially in areas with low existing tree canopy—can help reduce the urban heat island effect, which disproportionately affects lower-income communities (Anderson and McMinn 2019). This is increasingly important as climate change is leading to more extreme-heat days in many cities. Beyond mitigating urban heat, green space has other documented community livability benefits, including improved air quality, absorption of traffic noise, increased sense of well-being, and improved opportunities for physical exercise (Spotswood et al. 2019). However, there are real and perceived risks of increased green space exacerbating gentrification. New green space often increases property values which—if not mitigated—can lead to displacement of lower-income residents in the area. This is predominantly a concern for parks and green corridors in residential areas, but there is risk of "green gentrification" for commercial developments too, especially if housing is part of the development. Fortunately, there are actions that developers can take to avoid or mitigate this risk (Hart, Du, and Coccoli 2019; Rigolon and Christensen 2019). Those include:

- Engage with community members and community-based organizations early in the planning process. This can create opportunities for these people and groups to help educate the developer, development partners, and local government stakeholders on risks of green gentrification and ways to prevent it.
- Provide public access to some or all green spaces on the development. Consider accessibility of these areas via public transit, as well. This can help ensure that community members, including lower-income people, can share in the benefits of added urban green space.
- Consider including affordable housing in the new development, or financially supporting the development of green space in the surrounding community. This helps ensure low-income communities have direct access to the green space created. For example, research in Texas has shown that incorporation of onsite water systems can, in fact, improve housing affordability (Losoya et al. 2022).

BOX 5. Public Green Space at the Google Bay View Campus in Mountain View, CA

Google's latest Silicon Valley development, the Bay View campus, contains plans for onsite water systems that will capture, treat, and reuse both stormwater and domestic wastewater. Pictured below are design drawings for publicly accessible nature trails that weave through the nature-based treatment ponds that are part of the onsite water systems, which includes stormwater retention ponds and wastewater polishing ponds.



Source: Email communications with Google staff.

Third, development of onsite water systems can create new jobs in construction, operations, and maintenance of these systems. There is an opportunity for those investing in onsite water systems to simultaneously support water sector job training and workforce development, as there is a significant need for qualified onsite water system operators and related roles. Workers in the water sector earn competitive wages, face lower educational barriers to entry, and develop transferrable knowledge and skills. A developer may consider specific certification requirements when hiring for an onsite water system project to ensure a qualified and diverse group of operators and other workers for the system. The National Blue Ribbon Commission on Onsite Non-potable Water Reuse is developing an operator certification program that provides the training and skills needed to safely operate and maintain onsite water systems, building out workforce capacity for onsite water systems operators (National Blue Ribbon Commission for Onsite Non-potable Water Systems 2021).

Here are some questions for developers to consider when it comes to equity and onsite water systems:

- For water and wastewater providers: What is a fair connection fee for a development that includes an onsite water system?
- For water providers: How are onsite water systems, including the onsite water systems on the site, being incorporated into regional water demand planning?
- What are the current landscaping plans for the site, and could the site provide green space that is open to the public?
- What steps is the company taking to understand and address gentrification risks and the associated equity impact?

2. Who are the communities around the site, and what are their primary concerns?

Meaningfully engaging with local communities and understanding their concerns can help build goodwill and support for a project. It may also generate new ideas for ways that an onsite water system could be designed and operated to provide additional benefits to the surrounding area. In addition, many green building certifications—LEED, WELL, ENVISION, Living Building Challenge, and others—require stakeholder engagement as part of the certification process. The Alliance for Water Stewardship standard requires stakeholder engagement as well. These sustainability certifications are quickly becoming the norm for Bay Area developments due to local ordinances as well as expectations from employees, communities, and investors. On the other hand, failing to meaningfully engage with local communities can lead to mistrust, ill will, and even active opposition to a project.

The first step to robust community engagement is to know who the communities are and what they care about. The issues they care about may be directly related to the onsite water systems (drought and water reliability), indirectly related to onsite water systems (water costs, access to green space, urban heat, and gentrification), or wholly unrelated to the project. Regardless of the topics that arise, listening to community concerns is a critical step towards ensuring just outcomes and gaining community support for an onsite water system (and the development more broadly). It is important to note that robust community engagement takes time, persistence, active listening, and consideration of alternative viewpoints; failing to consider that in planning timelines could lead to project delays and/or rushing of the engagement process.

To meaningfully engage communities around the site, here are three key questions to start with:

- Who are the residents of the surrounding area?
- What organizations and community groups are working with residents in the surrounding area and what issues are they concerned about?
- How can the planning, development, and operation of the onsite water system engage and inspire employees, customers, and the community?
    - o Are there mechanisms for soliciting and incorporating community feedback on the project?

Other useful resources for community engagement include the Five-Step Approach to Stakeholder Engagement from BSR (Taylor et al. 2019), the topic brief on getting communities engaged in water and sanitation projects from Water and Sanitation for the Urban Poor (Keatman 2013), and the Public Participation Guide from the United States Environmental Protection Agency (US EPA 2014).

3. What equity or social responsibility goals does the company have, and how might onsite water systems help achieve them?

Corporate social responsibility is increasingly important to both investors and consumers, and many companies are adopting social responsibility goals and targets. Engaging with surrounding communities and exploring local equity issues associated with onsite water systems may contribute to a company's social responsibility goals. For example, Target set a specific goal around community vitality and resilience for the communities they serve.[7] This goal is about how Target shows up locally—not just through philanthropy and volunteering but also capital investments on their sites.

If there are connections between a company's social responsibility goals and onsite water systems, highlighting them internally and externally can help the company, development, and uptake of onsite water systems elsewhere. For example, companies can:

- Share the story of how onsite water systems contribute to its corporate social responsibility agenda;
- Show progress towards specific social responsibility goals; and
- Potentially unlock internal funding for increased community engagement.

While it is beneficial to the company, development, and uptake of onsite water systems generally to communicate about connections between onsite water systems and social responsibility, it is important to support those claims with clear evidence and transparent discussion of any challenges or trade-offs to reduce risks of greenwashing. Here are some questions to consider about connections between corporate social responsibility and onsite water systems:

- What existing corporate social responsibility programs and commitments does the company have, and are there connections to water security, community livability, or other potential benefits of onsite water systems?
- Can the company support social responsibility claims related to an onsite water system with reliable public information or a third-party certification?
- What sustainability certifications has the company received (or what sustainability certification programs are they participating in)? What are the water related commitments in the program(s)?
- Would investments in onsite water systems bolster the company's reputation or differentiate its brand?

7 https://corporate.target.com/sustainability-esg/strategy-target-forward

SUPPORT THE ENVIRONMENT

How onsite water systems can be designed, built, and/or operated to support the environment at the site, for water and wastewater systems, and for the surrounding community.

1. How could onsite water systems support local ecosystems?
2. How could onsite water systems support source watersheds?
3. How could onsite water systems support resource recovery?

Local ecosystems in urbanized areas are suffering from habitat loss and fragmentation, air and water pollution, and dramatic losses in biodiversity. In addition, the watersheds from which communities draw their water supplies—sometimes from hundreds of miles away—are often over-tapped. Those ecosystems, too, are in decline. Many species are threatened with extinction, and as climate change increases the frequency and severity of extreme weather events and natural disasters, ecosystems will face even greater challenges. This section explores how onsite water systems can help support the environment locally and in source watersheds.

1. How could onsite water systems support local ecosystems?

Many waterways, wetlands, open spaces, and other habitats have been destroyed or degraded due to urbanization. In this section, we explore three ways in which onsite water systems could help restore ecosystem and environmental health in the communities where they are built, including by:

- Reducing wastewater discharges to oceans and bays;
- Providing water for urban green space; and
- Providing water for local wetlands.

Onsite water systems may be able to help reduce harmful wastewater discharges into local waterways. Despite careful regulations and environmental protections, municipal wastewater discharges are the primary pollution pathway for nutrients and contaminants of emerging concern entering water bodies in many urban areas, including the San Francisco Bay (San Francisco Estuary Institute 2019). In coastal urban areas that discharge treated wastewater to oceans and bays, onsite water systems may provide environmental benefits by not contributing to wastewater discharges and the associated pollutants. However, reduced wastewater discharge could reduce water inflows to the receiving water body and negatively impact associated freshwater and estuarine ecosystems. More conversation and exploration among wastewater managers and developers is needed to better understand the impacts of onsite water systems on wastewater discharges and supporting ecosystems.

Onsite water systems could be used to support additional green space onsite, providing health and well-being benefits for people and creating habitat for plants and animals. There are few documented examples of onsite water systems supporting green space for urban habitat, but there is increasing interest in their use to revitalize natural spaces in communities. For example, Bay Area Greenprint is an interactive mapping tool for visualizing the location and extent of critical habitats, habitat corridors, and a host of other metrics relevant to water and ecosystems in the Bay Area.[8] Similarly, research from the San Francisco Estuary Institute specifically explores how increased green space could help create habitat corridors to support ecosystem health in Silicon Valley (Spotswood et al. 2019).

8 https://www.bayareagreenprint.org/

In certain areas or at certain times of year, onsite water systems may produce water that could be used for wetlands or other environmental purposes. The use of water from an onsite water system for ecosystem water augmentation is relatively novel. It has been explored in King County, Washington. The King County Department of Natural Resources and Parks evaluated the potential for centralized and decentralized recycled water to enhance wetlands, lakes, and rivers in the county, and identified two areas with high potential for wetland enhancement or streamflow augmentation (Tolzman 2012). Here are some considerations for developers when exploring the potential for onsite water systems to support local ecosystems:

- Do the current domestic wastewater discharges negatively impact ecosystem health, such as through the introduction of pollutants, shifting the receiving water body's salinity, or changing the ambient temperature?
- Would the reduction of wastewater flow due to the onsite water systems negatively impact ecosystems benefiting from current wastewater discharges?
- Does the regional wastewater provider have plans to decrease wastewater discharges in the future? How might an onsite water system support those efforts?
- Are there critical habitats or habitat corridors within or adjacent to the site?
- Are there local needs for environmental flows that the onsite water systems could provide?
- Is the timing and quality of the water available consistent with the environmental needs?
- Can water be effectively conveyed to areas that would benefit from increased flows?

Local agencies tasked with environmental protection will often have this information. Another good starting place for a high-level understanding of local environmental water conditions is the US EPA's How's My Waterway[9] tool, which allows users to plug in location information and view the status of streams in that area.

2. How could onsite water systems support source watersheds?

In arid regions like much of the Western United States, source watersheds are suffering from unsustainable withdrawals. For example, in California, water withdrawals to support communities in the San Francisco Bay Area and Southern California are contributing to severe environmental damage to major river systems like the Sacramento and San Joaquin rivers and their tributaries. Onsite water systems provide sustainable, local water sources that can reduce demands on over-tapped source watersheds.

9 https://mywaterway.epa.gov/

Programs directly connecting water saved by onsite water systems, while appealing, have yet to be implemented. But there is a rise of "net zero" or "offset" approaches both in corporate water stewardship (UN Global Compact CEO Mandate n.d.) and in public water management (Alliance for Water Efficiency n.d.). These approaches could include onsite water systems as one solution for water-neutral or water-positive development. In exploring the feasibility of such an approach, developers can consider questions such as:

- What are the major source watershed(s) for the region, and what is the status of ecosystems in those watersheds?
- Are there efforts in the city or region to reduce water withdrawals from source watersheds that the flows from an onsite water system can support?
- Does the company's corporate water stewardship strategy include water offset, water neutral, or water positive goals?

Information about the sources of a site's water supplies, including source watershed locations, can be found in water provider planning documents. Water conservation and/or watershed protection departments that sit within water provider, city government, and/or county government structures will have information about existing efforts to protect source watershed flows. Environmental organizations are another good source of information for answering these questions, and in some cases may be leading efforts to restore source watersheds.

BOX 6. Onsite Water Systems Supporting Urban Habitat in Orange County, CA

Great Park in Orange County, California is a public-private partnership between the City of Irvine and private developer Five-Point. The park has onsite water systems that capture, treat, and reuse stormwater onsite for a variety of uses, including to provide ecosystem benefits. The park includes areas off-limits to humans to provide safe habitat corridors for wildlife and areas with native plants to create different habitats throughout the park. Additionally, wetlands that are part of the stormwater treatment system provide habitat for aquatic plants and animals. There are also public education elements of the park design that allow visitors to view and learn about wildlife in the park.

Source: ©Eli Pousson/Flickr

3. How could onsite water systems support resource recovery?

The concept of a circular economy—recovering and reusing resources—has gained increasing popularity as a paradigm for companies to reduce their environmental impacts, operational waste, and costs through more efficient use of expensive resources (Atasu et al. 2021). Leading companies, and society as a whole, are reconsidering definitions of "waste" and "resource." An onsite water system represents a circular approach by recovering water from wastewater, but sites can go even further to recover additional resources, including heat and nutrients, to increase the environmental benefits and cost effectiveness of onsite water systems.

Heat Recovery

Onsite water systems can be designed to capture and reuse heat from wastewater for other building heating needs, such as hot water heating. Heat recovery provides a renewable energy source that can help reduce a site's carbon footprint, especially in regions with carbon-intensive energy grids. It can also improve the cost-effectiveness of an onsite water system. On average, heat recovery to offset natural gas and electricity use reduces onsite water systems life cycle costs (in dollars per gallon of water) by 8–10% (Arden et al. 2021). Heat recovery is typically most viable in residential developments, where hot water demands are higher than in commercial developments.

Nutrient Recovery

Onsite water systems can also be designed to capture nutrients, such as nitrogen, phosphorous, or even solid waste byproduct, from treated wastewater. These resources can be converted into fertilizer or soil, which can be sold offsite to generate revenue or used for onsite landscapes to offset landscaping costs. The removal of nutrients from onsite water systems' wastewater streams also helps mitigate water quality and solids management challenges for the wastewater system, as described in the Water Resilience section.

While these resource recovery systems have the potential to improve both the economic and environmental returns of an onsite water system project, it is important to understand how such systems fit into the broader development early in the planning process. If not considered at the early stages of a project, the addition of resource recovery systems can delay timelines and add unexpected costs.

BOX 7. Heat Recovery from Onsite Water Systems at the Solaire in New York City

The Solaire, a luxury apartment building located on the waterfront in Battery Park, New York City, has an onsite water system that treats 25,000 gallons per day and is used for flushing toilets, cooling tower make-up, and landscape irrigation. The system offsets the site's potable water use by 50%.

The onsite water system has a heat recovery system that extracts heat from the wastewater and uses it to pre-heat the building's hot water. This has resulted in net energy-neutral onsite water systems operation. The heat recovery reduces the building's carbon footprint and increases the efficiency of the cooling tower because it results in cooler make-up water.

Source: © Maciej Bledowski | Dreamstime.com

PROTECT PUBLIC HEALTH

How onsite water systems can be designed, built, and/or operated to protect public health for the site, water and wastewater systems, and surrounding community.

1. What is the regulatory context for onsite water systems at the site?
2. How can the site support data sharing about onsite water systems?
3. What is the plan for ongoing operation and ownership of the onsite water system?

Public health is of utmost importance in the provision of water and wastewater services, including for onsite water systems. Public health concerns are elevated when non-potable water is used for purposes with greater potential for human contact, such as irrigation or toilet flushing. Developers and operators of onsite water systems must keep everyone on and around the site safe and demonstrate good stewardship of water resources. This section explores how developers can meet this imperative through achieving and exceeding regulatory compliance, supporting public education about onsite water systems, and planning for the long term.

1. What is the regulatory context for onsite water systems at the site?

Any developer considering onsite water systems must understand all relevant requirements for the design, construction, and operation of onsite water systems—including how those requirements may be changing. Long-term operations, maintenance, monitoring, and reporting plans should meet or exceed local requirements. These requirements may vary by jurisdiction at state, county, or even city scales. Some water-stressed cities—like San Francisco, California and Austin, Texas—have developed their own programs to promote and regulate onsite water systems. Austin's program includes incentives up to $500,000 for developers to include onsite water systems in their projects (Austin Water n.d.), whereas San Francisco requires onsite water systems for new developments of 100,000 square feet and larger (San Francisco Public Utilities Commission n.d.).

BOX 8. Emerging Onsite Water System Regulations in California

In 2018, California passed SB 966, which requires the State Water Resources Control Board (SWRCB) to establish uniform risk-based water quality standards for the onsite treatment and reuse of water, and requires municipalities to establish their own local programs in compliance with the state's new standards. The SWRCB has until December 2022 to publish the standards, and the California Department of Housing has until December 2023 to develop any associated updates to building standards. A key component of SB 966 is local authority, with either cities or counties responsible for creating their own programs, which differs from the existing approach of permitting onsite water systems through the regional water quality boards housed within the State Water Resources Control Board.

LEARN MORE about California's developing onsite water system regulations here. https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/onsite_nonpotable_reuse_regulations.html

In light of growing interest, many states and regions are in regulatory transition periods with onsite water systems, developing new or revising existing policies to adapt to increased onsite water systems adoption. For example, the State of California recently passed legislation requiring a local approach to onsite water systems permitting that is expected to result in the development of water quality standards implemented through city, county, or regional programs.

BOX 9. Onsite Water System Education at the Exploratorium in San Francisco, CA

The Exploratorium is an internationally renowned museum of science, technology, and arts located at Pier 15 in San Francisco. The museum captures and reuses rainwater onsite for toilet flushing and uses non-potable water directly from the San Francisco Bay for its cooling system. As a museum, public outreach and education is central to the Exploratorium, and it has a particular focus on sustainability education. Having a building with onsite water systems helps demonstrate the museum's sustainability commitment and serves as an example for how buildings can be more resilient to stressors like climate change and water scarcity. Providing signage and public outreach about their toilets flushing with rainwater, for example, helps advance public knowledge and acceptance of onsite water systems.

Source: Kehoe et al. 2022 *Photo credit: Wikimedia Commons*

Developers should consult with regulators early in their planning process to ensure all relevant regulations are incorporated into the project from the beginning, which will not only ensure public health protection but can also reduce the likelihood of permitting delays. Developers can proactively understand—and support—onsite water system regulations by considering the following questions:

- What are the existing regulations—including wastewater permits, buildings codes, environmental health standards, and other requirements—that an onsite water system must follow?
- Are there regulations, policies, or programs for onsite water systems currently under consideration or development at the city, county, or state level?
- Could the company play a role in the development and adoption of robust and effective onsite water system regulations for the area, to help support the enabling environment for onsite water systems development at this site and others?

2. How can the site support data sharing about onsite water systems?

Existing onsite water system regulations have basic requirements for monitoring and sharing data, although these requirements may vary by site and regulatory jurisdiction. However, given their relative novelty and ongoing regulatory transitions in places like California, developers can be leaders in data management and sharing for onsite water systems. Collecting and sharing accessible, usable data on onsite water systems' water volumes and water quality can help ensure that public health is protected, support responsible management of water and wastewater flows, increase data transparency, and help inform other developers considering onsite water systems.

Developers investing in data systems can also help advance much-needed innovation in the water tech space. Monitoring and data collection technology for onsite water systems, and water and wastewater systems more broadly, have significant room for improvement to make data management and sharing easier, faster, and less costly. Innovative technologies already exist to address this problem but need more testing and greater adoption. Private developers can often move faster and try new things more easily than the public sector, which can help advance the space by testing and adopting tools that could be adopted by other wastewater treatment facilities, not just onsite water systems.

Data sharing can also support public outreach and education. While water and wastewater utilities have been increasing and improving public education about (and acceptance of) recycled water broadly, public understanding of onsite water systems is limited. There is an opportunity for developers to contribute to outreach, communication, transparency, and education that can advance understanding and uptake of these systems.

Developers can consider questions such as:

- What monitoring and data management solutions are being considered for the site's onsite water systems?
- What systems are in place for monitoring and sharing of onsite water systems data regionally?
- What benefits would be generated from making the onsite water system's monitoring records publicly available?
- What types of public outreach and education (e.g., onsite signage) are needed for the onsite water systems?
    - What additional outreach can the company perform to publicly communicate about onsite water systems, including how they connect to corporate and community sustainability goals?
    - Who will be responsible for outreach and communication about the site's onsite water systems, both to people onsite and to the general public?
    - What outreach and communications strategies around recycled water have been successful for water and wastewater providers?

BOX 10. Public-Private Partnership for Onsite Water Systems at Allianz Field in Saint Paul, MN

Allianz Field, home to the soccer team Minnesota United FC, was built in 2019 and contains an onsite water system that captures rainwater and reuses it for laundry, irrigation, and toilet flushing. In addition to the field and stadium itself, the site contains 150,000 square feet of public green space irrigated with onsite water systems water. The site was built by a private developer, is owned and operated by the City of Saint Paul, and is used by the privately-owned Minnesota United FC soccer club. This operation and ownership approach is a simple example of a public-private partnership for onsite water systems.

3. What is the plan for ongoing operation and ownership of the onsite water system?

One of the major concerns about private development and ownership of onsite water systems is the question of who assumes responsibility for its long-term operations and maintenance. Government agencies charged with protecting public health must be confident that onsite water systems will be operated safely, and the general public must share this confidence for developers to have social license to operate them. To this end, it is critical that all onsite water systems have long-term operations and ownership plans.

There are several different possible arrangements for onsite water system project delivery; many involve partnerships across different companies, organizations, and/or agencies. Below are five common structures:[10]

1. **Design-Bid-Build (DBB) –** The owner decides on the project, secures financing, works with an engineer to develop plans, and solicits contractor bids to build it. Long-term operations are the responsibility of the owner, or a contract operator.
2. **Design-Build (DB) –** The owner decides on the project, secures financing, and hires a design-build contractor to build it. Long-term operations are the responsibility of the owner, or a contract operator.
3. **Design-Build-Operate (DBO) –** The owner decides on the project, secures financing, and hires a contractor to develop, design, build, and operate it. Long-term operations are the responsibility of the contractor who built the project, though the original owner retains ownership.
4. **Design-Build-Own-Operate (DBOO) –** The project is financed, developed, designed, built, operated, and owned by a single party with the intention of selling the resulting water to another party. This could look like:
    a. A contractor owns and operates the system and sells water to a developer.
    b. A developer owns and operates the system and sells water to a tenant.
    c. A developer owns and operates the system and sells water to the water/wastewater provider.
    d. A water/wastewater provider owns and operates the system and sells water to a developer.
5. **Design-Build-Own-Operate-Transfer (DBOOT) –** A variation of the DBOO approach, but with an agreement to transfer ownership of the system to the party purchasing the water at an agreed-upon date.

10 These water infrastructure ownership structures are adapted from Pacific Institute research on ownership models for desalination facilitation: https://pacinst.org/wp-content/uploads/2012/11/financing_final_report3.pdf (pages 22-28).

Public-private partnerships for water infrastructure are becoming more common and are a viable option for onsite water systems too. Such partnerships must be founded in a shared commitment to long-term, sustainable operation of the system. This may require developers to lengthen traditional corporate decision-making time scales. In the event that a company is not interested in, or able to, assume long-term responsibility over the onsite water systems, upfront contingency plans for shared or transferred ownership with the city or water/wastewater provider could help assuage concerns around sustaining environmental and public health protections, and other risks for water agencies. For some water/wastewater providers, ownership of onsite water systems built and/or operated by private partners can present them with revenue-generating opportunities (see Box 9).

When evaluating ownership and operations models for an onsite water system, consider the following questions:

- Does the company have interest and capacity for long-term water infrastructure ownership and the associated public health responsibilities?
- What shared responsibility and liability will the company have with the city or wastewater provider over the onsite water system?
- What is the process for protecting public health and maintaining accountability for the onsite water system?

CONCLUSION AND NEXT STEPS

The private sector is increasingly interested in circular water management approaches like onsite water systems to address mounting water challenges. Onsite water systems have the potential to provide numerous benefits if they are incorporated into project-scale and regional water planning and decision-making, but more cross-sector collaboration is needed. Great guidance already exists to support site-level decision-making; this guidance goes beyond site boundaries to help developers consider how an onsite system could interact with and support the communities and water and wastewater systems surrounding the site. By providing developers with this guidance, we hope to help advance private investments in onsite water systems that:

1. Advance water resilience;
2. Support equity;
3. Support the environment; and
4. Protect public health.

While this guide is an important step in support of private development of onsite water systems that provide benefits to the site, surrounding community, and regional water and wastewater systems, there is still much to be done to scale adoption of multi-benefit onsite water systems. As water challenges worsen, we need investments in alternative water solutions like onsite water systems at a greater pace and scale, and we need effective collaboration between private and public sectors to make it happen. Developers can help improve the enabling environment for scaled-up adoption of onsite water systems in the following ways:

- Develop case studies about onsite water systems that other companies can learn from.
- Collect and share data from onsite water systems with water/wastewater providers, onsite water system practitioners, and academic researchers.
- Support regional, statewide, and national policies that enable and/or incentivize implementation of onsite water systems.

References

Alliance for Water Efficiency. n.d. "Net Blue: Supporting Water-Neutral Growth." Accessed September 22, 2022. https://www.allianceforwaterefficiency.org/resources/topic/net-blue-supporting-water-neutral-growth.

Anderson, Meg and Sean McMinn. 2019. "As Rising Heat Bakes U.S. Cities, The Poor Often Feel It Most." NPR, September 3, 2019. https://www.npr.org/2019/09/03/754044732/as-rising-heat-bakes-u-s-cities-the-poor-often-feel-it-most.

Arden, Sam, Ben Morelli, Sarah Cashman, Xin (Cissy) Ma, Michael Jahne, and Jay Garland. 2021. "Onsite Non-Potable Reuse for Large Buildings: Environmental and Economic Suitability as a Function of Building Characteristics and Location." *Water Research* 191 (March): 116635. https://doi.org/10.1016/j.watres.2020.116635.

Atasu, Atalay, Celine Dumas, and Luk N. Van Wassenhoven. 2021. "The Circular Business Model." *Harvard Business Review* (blog). 2021. https://hbr.org/2021/07/the-circular-business-model.

Austin Water. n.d. "Onsite Water Reuse Systems." Accessed September 22, 2022. https://www.austintexas.gov/department/onsite-water-reuse-systems.

Brill, Gregg, Amanda Bielawski, Ashok Chapagain, Heather Cooley, Sarah Diringer, Peter Gleick, Shannon McNeeley, and Jason Morrison. 2021. *Water Resilience: Definitions, Characteristics, Relationships to Existing Concepts, and Call to Action for Building a Water Resilient Future.* Oakland: Pacific Institute. https://pacinst.org/publication/water-resilience/.

Cooley, Heather, Anne Thebo, Cora Kammeyer, and Darcy Bostic. 2021. *The Role of Onsite Water Systems in Advancing Water Resilience in Silicon Valley.* Oakland: Pacific Institute. https://pacinst.org/wp-content/uploads/2021/01/Role-of-Onsite-Water-in-Silicon-Valley-Jan-2021.pdf.

Hart, Maria, Jillian Du, and Caroline Coccoli. 2019. *How to Prevent City Climate Action from Becoming 'Green Gentrification.'* World Resources Institute. https://www.wri.org/insights/how-prevent-city-climate-action-becoming-green-gentrification.

Keatman, Tracy. 2013. *Getting Communities Engaged in Water and Sanitation Projects: Participatory Design and Consumer Feedback.* Water & Sanitation for the Urban Poor. https://sswm.info/sites/default/files/reference_attachments/WSUP%202013%20Getting%20communities%20engaged%20in%20water%20and%20sanitation%20projects.pdf.

Kehoe, Paula and Taylor Nokhoudian. 2022. *Onsite Water Recycling: An Innovative Approach to Solving an Old Problem*. San Francisco: SFPUC. https://sfpuc.org/sites/default/files/construction-and-contracts/design-guidelines/Onsite%20Water%20Recycling%20E-book_2022_Final.pdf.

Losoya, Jorge, Jennifer Walker, Amanda Fuller, and Jonathan Seefeldt. 2022. *Opportunities for Realizing Water Reuse in Affordable Housing*. National Wildlife Federation. https://texaslivingwaters.org/wp-content/uploads/2022/04/Opportunities-for-Realizing-Water-Reuse-in-Affordable-Housing.pdf.

Love, Julia. 2015. "Apple Campus 2: Massive Recycled Water Project Approved." *The Mercury News* (blog). March 24, 2015. https://www.mercurynews.com/2015/03/24/apple-campus-2-massive-recycled-water-project-approved/.

Miss, Mary. 2020. "Park as a Living Laboratory." http://marymiss.com/wp-content/uploads/2020/01/OC_ParkAsLivingLab_FinalBooklet.pdf.

Morseletto, Piero, Caro Eline Mooren, and Stefania Munaretto. 2022. "Circular Economy of Water: Definition, Strategies and Challenges." *Circular Economy and Sustainability*, March. https://doi.org/10.1007/s43615-022-00165-x.

Moscone Center. "Environmental Sustainability." n.d. Accessed September 22, 2022. https://www.moscone.com/guidelines/environmental-sustainability.

National Blue Ribbon Commission for Onsite Non-potable Water Systems. "National Blue Ribbon Commission for Onsite Non-potable Water Systems: Fact Sheet." 2021. https://watereuse.org/wp-content/uploads/2021/08/NBRC_Factsheet_FINAL.pdf.

Oyedokun, Tunbosun B. 2017. "Green Premium as a Driver of Green-Labelled Commercial Buildings in the Developing Countries: Lessons from the UK and US." *International Journal of Sustainable Built Environment* 6 (2): 723–33. https://doi.org/10.1016/j.ijsbe.2017.12.007.

Rigolon, Alessandro and Jon Christensen. 2019. *Greening without Gentrification: Learning from Parks-Related Anti-Displacement Strategies Nationwide.* UCLA Institute of the Environment and Sustainability and The University of Utah. https://www.ioes.ucla.edu/wp-content/uploads/Greening-without-Gentrification-report-2019.pdf.

San Francisco Estuary Institute. 2019. *The Pulse of the Bay 2019: Pollutant Pathways*. Richmond, CA: San Francisco Estuary Institute. https://www.sfei.org/sites/default/files/biblio_files/The%20Pulse%202019%2010_8_19%20print%20version%202.0%20medres.pdf.

San Francisco Public Utilities Commission. 2021. *2020 Urban Water Management Plan for the City and County of San Francisco*. San Francisco: San Francisco Public Utilities Commission. https://sfpuc.org/sites/default/files/programs/local-water/SFPUC_2020_UWMP2020_%20FINAL.pdf.

———. n.d. "Onsite Water Reuse." Accessed September 22, 2022. https://sfpuc.org/construction-contracts/design-guidelines-standards/onsite-water-reuse.

Spotswood, Erica, Robin Grossinger, Steve Hagerty, Micaela Bazo, Matthew Benjamin, Erin Beller, Letitia Grenier, and Ruth Askevold. 2019. *Making Nature's City*. Richmond, CA: San Francisco Estuary Institute. https://www.sfei.org/projects/making-natures-city.

Taylor, Alison, Charlotte Bancilhon, Cecile Oger, and Jonathan Morris. 2019. *Five-Step Approach to Stakeholder Engagement*. BSR. https://www.bsr.org/en/our-insights/report-view/stakeholder-engagement-five-step-approach-toolkit.

Tolzman, Steve. 2012. *Reclaimed Water Strategy Effects on Wetlands*. King County Department of Natural Resources and Parks. https://your.kingcounty.gov/dnrp/library/wastewater/rw/CompPlan/1203_ReclaimedWaterStrategyEffectsOnWetlands.pdf.

UN Global Compact CEO Mandate. n.d. "NPWI (Net Positive Water Impact)." Accessed September 22, 2022. http://ceowatermandate.org/resilience/net-positive-water-impact/.

US Environmental Protection Agency. 2014. "Public Participation Guide." Overviews and Factsheets. February 24, 2014. https://www.epa.gov/international-cooperation/public-participation-guide.

William J. Worthen Foundation. 2018. "Onsite Non-Potable Water Reuse Practice Guide." https://www.pankowfoundation.org/site/assets/files/1879/waterreuseguide_final.pdf

Appendix A: Key Resources, Guidance, and Tools for Onsite Water Systems

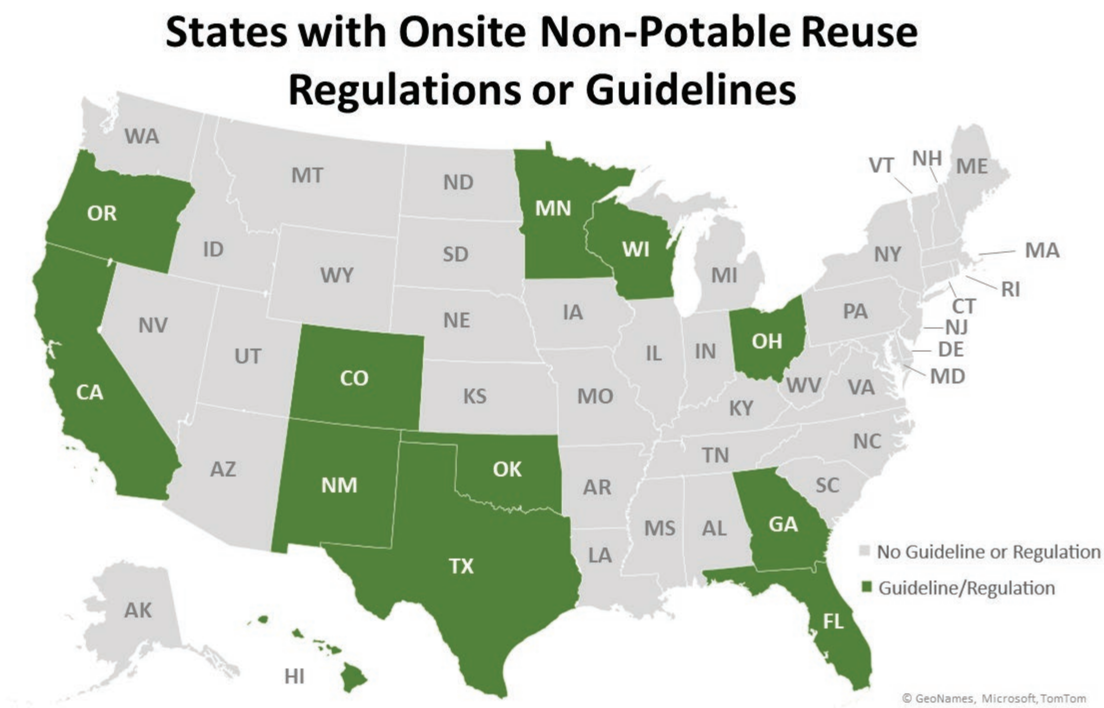
INITIATIVES AND ORGANIZATIONS ADVANCING REUSE AND ONSITE WATER SYSTEMS

National Blue Ribbon Commission for Onsite Non-potable Water Programs: Expert commission convened by the US Water Alliance and Water Research Foundation to develop resources to support collaboration, research, and development and dissemination of resources supporting onsite non-potable water programs. Specific resources developed by this commission are included in relevant sections below. For a complete list see: http://uswateralliance.org/initiatives/commission

United States Environmental Protection Agency: Multiple initiatives led by the US EPA are actively developing resources for onsite water systems. Four general initiatives/compendiums are included below while specific tools/resources are called out in subsequent sections.

- **National Water Reuse Action Plan (WRAP):** Collaborative, multi-year initiative aiming to drive progress on water reuse and develop resources to help overcome barriers. Comprised of over 50 specific actions organized by strategic theme area. https://www.epa.gov/waterreuse/water-reuse-action-plan
    - Two WRAP actions directly address onsite water systems while others address topics relevant across many types of reuse (e.g., stakeholder engagement best practices).
        - WRAP Action 2.18: Incorporate Onsite Reuse Research into Codes and Standards for Premise Plumbing. https://www.epa.gov/waterreuse/national-water-reuse-action-plan-online-platform?action=2.18
        - WRAP Action 3.4: Develop Research and Tools to Support Onsite Reuse. https://www.epa.gov/waterreuse/national-water-reuse-action-plan-online-platform?action=3.4
- **Regulations and End-Use Specifications Explorer (REUSExplorer):** Compilation and links to current state regulations on onsite non-potable water reuse. https://www.epa.gov/waterreuse/regulations-and-end-use-specifications-explorer-reusexplorer

FIGURE A1. STATES WITH ONSITE NON-POTABLE REUSE REGULATIONS AND GUIDELINES (AS OF SEPTEMBER 2022).



Source: US EPA

- **Summary of Current Onsite Non-Potable Water Reuse Research:** Current research initiatives within US EPA. Includes links to over 10 research publications, webinars, and other resources. Resource topics include risk-based modeling, monitoring of treatment performance, life cycle assessment, and collaborative efforts. https://www.epa.gov/water-research/onsite-non-potable-water-reuse-research
- **2012 Guidelines for Water Reuse:** Compendium of resources on water reuse, including some information on onsite water systems, links to state policy documents, and numerous case studies. https://www.epa.gov/sites/default/files/2019-08/documents/2012-guidelines-water-reuse.pdf

WateReuse Association: Trade association dedicated to advancing laws, policy, funding, and public acceptance of recycled water. Multiple conferences, webinars, and other resources on water reuse topics (including onsite water systems). https://watereuse.org/

DECISION SUPPORT TOOLS FOR ONSITE WATER SYSTEMS

Multiple models, tools, and resources have been developed evaluating wide-ranging tradeoffs in the design and siting of onsite water systems, and the role of these decisions in realizing their potential benefits. Several key references are listed below.

US EPA Non-Potable Environmental and Economic Water Reuse (NEWR) Calculator: Web-based tool for conducting screening-level assessments of non-potable onsite reuse source water options at the building scale. https://www.epa.gov/water-research/non-potable-environmental-and-economic-water-reuse-newr-calculator

NEWR Specific Resources:

> **Human Health, Economic and Environmental Assessment of Onsite Non-Potable Water Reuse Systems for a Large, Mixed-Use Urban Building.** Arden, Sam, Ben Morelli, Mary Schoen, Sarah Cashman, Michael Jahne, Xin (Cissy) Ma, and Jay Garland. 2020. *Sustainability* 12 (13): 5459. https://doi.org/10.3390/su12135459.
>
> **Onsite Non-Potable Reuse for Large Buildings: Environmental and Economic Suitability as a Function of Building Characteristics and Location.** Arden, Sam, Ben Morelli, Sarah Cashman, Xin (Cissy) Ma, Michael Jahne, and Jay Garland. 2021. *Water Research* 191 (March): 116635. https://doi.org/10.1016/j.watres.2020.116635.
>
> **Life Cycle Assessment of a Rainwater Harvesting System Compared with an AC Condensate Harvesting System.** Ghimire, Santosh R., John M. Johnston, Jay Garland, Ashley Edelen, Xin (Cissy) Ma, and Michael Jahne. 2019. *Resources, Conservation and Recycling* 146 (July): 536–48. https://doi.org/10.1016/j.resconrec.2019.01.043.
>
> **Life Cycle Assessment and Cost Analysis of Distributed Mixed Wastewater and Graywater Treatment for Water Recycling in the Context of an Urban Case Study.** Morelli, B., S. Cashman, Xin Ma, J. Garland, D. Bless, AND M. Jahne. US Environmental Protection Agency, Washington, DC, EPA/600/R-18/280, 2019. https://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryId=346484&Lab=NRMRL

Decision Support System for Selection of Satellite vs. Regional Treatment for Reuse Systems. Davis, Stephen E. 2009. Alexandria, VA: WateReuse Foundation. Link to spreadsheet-based tool and report: https://www.waterrf.org/research/projects/decision-support-system-selection-satellite-vs-regional-treatment-reuse

Spatial Optimization for Decentralized Non-Potable Water Reuse. Kavvada, Olga, Kara L Nelson, and Arpad Horvath. 2018. *Environmental Research Letters* 13 (6): 064001. https://doi.org/10.1088/1748-9326/aabef0.

Assessing Location and Scale of Urban Nonpotable Water Reuse Systems for Life-Cycle Energy Consumption and Greenhouse Gas Emissions. Kavvada, Olga, Arpad Horvath, Jennifer R. Stokes-

Draut, Thomas P. Hendrickson, William A. Eisenstein, and Kara L. Nelson. 2016. *Environmental Science & Technology* 50 (24): 13184–94. https://doi.org/10.1021/acs.est.6b02386.

The Role of Satellite and Decentralized Strategies in Water Resources Management. Gikas, Petros, and George Tchobanoglous. 2009. *Journal of Environmental Management* 90 (1): 144–52. https://doi.org/10.1016/j.jenvman.2007.08.016.

Assessing the Scale of Resource Recovery for Centralized and Satellite Wastewater Treatment. Lee, Eun Jung, Craig S. Criddle, Phil Bobel, and David L. Freyberg. 2013. *Environmental Science & Technology* 47 (19): 10762–70. https://doi.org/10.1021/es401011k.

An Integrated Planning Tool for Design of Recycled Water Distribution Networks. Lee, Eun Jung, David L. Freyberg, and Craig S. Criddle. 2016. *Environmental Modelling & Software* 84 (October): 311–25. https://doi.org/10.1016/j.envsoft.2016.07.004.

Decision Support Toolkit for Integrated Analysis and Design of Reclaimed Water Infrastructure. Lee, Eun Jung, Craig S. Criddle, Mengistu Geza, Tzahi Y. Cath, and David L. Freyberg. 2018. *Water Research* 134 (May): 234–52. https://doi.org/10.1016/j.watres.2018.01.037.

Decentralized Water Reuse Planning: Evaluation of Life Cycle Costs and Benefits. Yerri, Sreeganesh, and Kalyan R. Piratla. 2019. *Resources, Conservation and Recycling* 141 (February): 339–46. https://doi.org/10.1016/j.resconrec.2018.05.016.

DESIGN, REGULATORY, AND POLICY GUIDANCE

SFPUC and the Blue Ribbon Commission developed multiple implementation-oriented resources including design guides, guidance on the development of local onsite reuse programs, and model regulations.

Onsite Water Recycling: An Innovative Approach to Solving an Old Problem. Kehoe, Paula and Taylor Nokhoudian. 2022. San Francisco: SFPUC. https://sfpuc.org/sites/default/files/construction-and-contracts/design-guidelines/Onsite%20Water%20Recycling%20E-book_2022_Final.pdf.

Guidebook for Commissioning and Onsite Water Reuse System in San Francisco. San Francisco Water, Power, Sewer. 2022. San Francisco: SFPUC. https://www.sfpuc.org/sites/default/files/documents/CommissioningOnsiteWaterReuse_2022_Final.pdf.

A Guidebook for Developing and Implementing Regulations for Onsite Non-Potable Water Systems. National Blue Ribbon Commission for Onsite Non-potable Water Systems. 2017. Oakland, CA: US Water Alliance, Water Environment & Reuse Foundation, Water Research Foundation.

This guidebook develops consistent national guidance on the regulation and management of onsite water systems. It includes information on water sources, treatment standards, ownership models, regulatory and policy approaches. http://uswateralliance.org/sites/uswateralliance.org/files/NBRC%20GUIDEBOOK%20FOR%20DEVELOPING%20ONWS%20REGULATIONS.pdf.

Companion documents include:

- *Technical Appendix*
  http://uswateralliance.org/sites/uswateralliance.org/files/NBRC%20GUIDEBOOK_APPENDIX_FINAL.pdf
- *Model Language for State Regulations, Local Ordinances, and Program Rules*
  http://www.uswateralliance.org/initiatives/commission/resources

Blueprint for Onsite Water Systems: A Step-by-Step Guide for Developing a Local Program to Manage Onsite Water Systems. San Francisco: SFPUC, Water Environment & Reuse Foundation, Water Research Foundation. 2014.

The Role of Onsite Water Systems in Advancing Water Resilience in Silicon Valley. Cooley, Heather, Anne Thebo, Cora Kammeyer, and Darcy Bostic. 2021. Oakland: Pacific Institute. https://pacinst.org/wp-content/uploads/2021/01/Role-of-Onsite-Water-in-Silicon-Valley-Jan-2021.pdf.

Risk-Based Framework for the Development of Public Health Guidance for Decentralized Non-Potable Water Systems. Sharvelle, Sybil, Nicholas Ashbolt, Edward Clerico, Robert Holquist, Harold Leverenz, and Adam Olivieri. 2017. Alexandria, VA: Water Environment & Reuse Foundation. https://watereuse.org/wp-content/uploads/2019/11/Risk-Based-Framework-for-DNWS-Report_FINAL.pdf

OVERCOMING BARRIERS TO ONSITE WATER SYSTEMS

Onsite water systems face can face multiple barriers, but strategies exist to better understand, manage, and/or overcome many of them. The following resources highlight common barriers faced by onsite water systems and strategies, data, and information to help overcome them.

Making the Utility Case for Onsite Non-Potable Water Systems. National Blue Ribbon Commission for Onsite Non-potable Water Systems. 2018. Oakland: US Water Alliance and Water Research Foundation. http://uswateralliance.org/sites/uswateralliance.org/files/NBRC%20GUIDEBOOK_APPENDIX_FINAL.pdf.

Identifying and Overcoming Barriers to Onsite Non-Potable Water Reuse in California from Local Stakeholder Perspectives. Rupiper, Amanda M., and Frank J. Loge. 2019. *Resources, Conservation & Recycling: X* 4 (December): 100018. https://doi.org/10.1016/j.rcrx.2019.100018.

Institutional Barriers to On-Site Alternative Water Systems: A Conceptual Framework and Systematic Analysis of the Literature. Hacker, Miriam E., and Christian Binz. 2021. *Environmental Science & Technology* 55 (12): 8267–77. https://doi.org/10.1021/acs.est.0c07947.

Evolving Urban Water and Residuals Management Paradigms: Water Reclamation and Reuse, Decentralization, and Resource Recovery. Daigger, Glen T. 2009. *Water Environment Research: A Research Publication of the Water Environment Federation* 81 (8): 809–23. https://doi.org/10.2175/106143009x425898.

Key Criteria for Considering Decentralization in Municipal Wastewater Management. Bernal, Diana, Inés Restrepo, and Simón Grueso-Casquete. 2021. *Heliyon* 7 (3): e06375. https://doi.org/10.1016/j.heliyon.2021.e06375.

Appendix B: Silicon Valley Onsite Water Reuse Working Group

There is growing interest in distributed water systems to foster urban water resilience and protect natural resources. In 2020, the Pacific Institute developed a research report examining the opportunities and challenges for corporate investments in onsite water systems in Silicon Valley. The key conclusion of that research is that onsite water systems have the potential to provide numerous benefits, but only if they are incorporated into regional water planning and decision-making.

To date, there have been few attempts to bring water managers and the private sector together to develop a roadmap for how centralized and distributed systems can complement one another. This working group, led by the Pacific Institute and facilitated by Ross Strategic, brought together a diverse group of stakeholders in a working group to establish a shared understanding of the issue and develop a decision-support framework for strategic, coordinated investments in onsite water systems in Silicon Valley and other urban communities.

GOALS & OBJECTIVES

The goal of this working group was to help ensure that private investments in onsite water systems are informed by local water context and implemented in alignment with public water management goals, in order to generate economic, environmental, and social benefits for communities—including increased water resilience to climate change and other stressors.

The Pacific Institute, with support from Ross Strategic, convened four virtual meetings with regional stakeholders (i.e., companies, municipalities, local water utilities, regulators, and environmental and community groups) to foster dialogue and develop a shared understanding of challenges and opportunities around onsite water systems in Silicon Valley.

The group was guided by a set of seven co-developed objectives:

1. Support the planning and design phases of the onsite water system decision-making process.
2. Clarify expectations for onsite water systems implementers.
3. Create shared understanding of opportunities and challenges among onsite water systems stakeholders.
4. Promote collaboration among onsite water system stakeholders.
5. Integrate equity considerations into onsite water system decision-making.
6. Improve environmental outcomes of onsite water systems.
7. Help to maximize benefits and minimize unintended consequences of onsite water systems.

The outcome of these meetings was consultation, recommendations, and feedback on the development of a decision-support guide for onsite water system implementation in urban areas that draws on lessons learned from planning and development experiences in Silicon Valley.

WORKING GROUP MEMBERS

The group comprised over 20 local and regional decision-makers across industry sectors—from public agencies to private companies to NGOs—with interest in and influence over onsite water system development in Silicon Valley. While the composition of the working group was broad, we note that we did not have representation from some stakeholder groups, such as real estate developers or community-based organizations. All members were given the option to review this guide; however, the inclusion of working group members' names in this report does not imply their specific support or disagreement with any particular finding or recommendation.

Name	Organization
Aaron Tartakovsky	Epic Cleantec
Amelia Luna	Sherwood Design Engineers
Amit Mutsuddy	City of San Jose
Anne Thebo	Pacific Institute
Azalea Mitch	City of San Mateo
Christophe Labelle	Silicon Valley Leadership Group
Cora Snyder	Pacific Institute
Dennis Murphy	Sustainable Silicon Valley
Drew Wenzel	Google
Elizabeth Flegel	City of Mountain View
Eric Hough	Epic Cleantec
Felicia Marcus	Water Policy Group
Gary Flagg	Santa Clara County
Gregory Smith	San Mateo County Health
Heather Cooley	Pacific Institute
Hossein Ashktorab	Valley Water
Jennifer West	WateReuse California
Kyle Pickett	William J. Worthen Foundation
Lauren Swezey	Facebook
Lena Silberman	Supervisor Don Horsley, San Mateo County
Melissa Gunter	San Francisco Bay Regional Water Quality Control Board
Melody Tovar	City of Sunnyvale
Michael Alvarez	Santa Clara County
Michael Steiger	EKI Environment & Water, Inc.
Newsha Ajami	Stanford Urban Water Institute / SFPUC Commissioner
Paula Kehoe	San Francisco Public Utilities Commission
Pedro Hernandez	City of San Jose, South Bay Water Recycling
Rob Greenwood	Ross Strategic
Sarah Shadid	Ross Strategic
Sasha Harris-Lovett	UC Berkeley / Bay Area One Water Network
Taylor Nokhoudian	San Francisco Public Utilities Commission
Tom Francis	Bay Area Water Supply and Conservation Agency
Troy Parker	Santa Clara County
Warren Krause	Santa Clara County

Photo Credits

Cover - © SundryPhotography/iStockphoto

Page 4 - © Dreamstime

Page 8 - © Dreamstime

Page 10 - © Miguel Burna/Unsplash

PAge 14 - © iStockphoto

Page23 - © Phinehas Adams/Unsplash

Page 27 - © Shutterstock

Page 29 - © Tom Fisk/Pexels

Page 32 - © Eli Pousson/Flickr

Page 34 - © Dreamstime

Page 35 - © Dreamstime

Page 36 - © Shutterstock

Page 56 - © Anastasia Shuraeva/Pexels

Page 57 - © Cottonbro Studio/Pexels

Page 58 - © Dreamstime

PACIFIC
INSTITUTE

Pacific Institute
344 20th Street
Oakland, California 94612

510.251.1600 | info@pacinst.org

www.pacinst.org