BLUEPRINT for Onsite Water Systems

A Step-by-Step Guide for Developing a Local Program to Manage Onsite Water Systems

On May 29-30, 2014, the San Francisco Public Utilities Commission partnered with representatives from local, state, and federal public agencies across North America, along with research institutions to discuss onsite water systems at the ***Innovation in Urban Water Systems*** meeting. The purpose of the convening was to discuss the barriers, opportunities, and research needs for onsite water systems for non-potable applications.

The Blueprint for Onsite Water Systems is a result of the two-day meeting. We would like to thank all of the participants for their time and input.

We also thank the Water Environment Research Foundation and Water Research Foundation for funding this project and for recognizing the need for collaborative action on decentralized, onsite water systems.

San Francisco Water Power Sewer
Services of the San Francisco Public Utilities Commission

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INNOVATION IN URBAN WATER SYSTEMS

www.sfwater.org/np/iuws

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Create a New Water Paradigm

Water is vital to maintaining healthy communities, vibrant economies, and a thriving natural environment, but managing water is not an easy task. We face many challenges, including dwindling freshwater supplies, long-lasting droughts, and rapid urbanization. As the strain on our centralized water and wastewater facilities increase, many cities are looking for new ways to develop and manage local water resources.

We have the opportunity to create a new water management paradigm by incorporating innovative strategies to conserve, reuse, and diversify our water supply. One of those strategies is integrating smaller, decentralized, onsite water systems into our broader centralized systems. Today, buildings in New York, San Francisco, Santa Monica, Seattle, Tokyo, Sydney, and many other cities throughout the world are collecting and treating water onsite to serve their own non-potable needs in place of potable water.

The Blueprint for Onsite Water Systems was created to assist communities with developing a local program to manage and oversee onsite water systems that protect public health. A local program can build on existing plumbing, public health, and building standards and codes while addressing water, stormwater, and wastewater management programs in a coordinated and streamlined manner.

San Francisco Public Utilities Commission Headquarters, San Francisco

2001 Market Street, San Francisco, by BAR Architects

Build Water Resilience

Onsite water systems can be tailored to the needs of the local community and implemented at a variety of scales, including building, block, district, and region with the appropriate safeguards in place. These systems can be a valuable component of a broad strategy to create a new water paradigm and build water-resilient communities across the country.

Onsite water systems offer a broad range of benefits, including:

+ Augmenting existing water supply portfolios by treating alternate water sources for beneficial use
+ Treating water only as needed for its end use application
+ Reducing potable water consumption for toilet flushing and irrigation
+ Minimizing stormwater flows to combined and separate sewer systems and/or storm drains
+ Increasing resiliency and adaptability of our water and wastewater infrastructure

Onsite water systems in green buildings, suburban developments, and urbanized areas are often integrated with existing centralized water and wastewater infrastructure without negatively impacting centralized systems. Onsite water systems build water resilience as they help communities stretch drinking water supplies by decreasing demand on potable water sources and can help extend the life of centralized wastewater infrastructure by redirecting stormwater flows and relieving stress on the system.

Stay Ahead of the Curve

Developers and designers are incorporating innovative onsite water systems into their projects, such as treating graywater for toilet/urinal flushing and using rainwater and stormwater for irrigation. Throughout the world, onsite water systems have been successfully operating for decades.

Green building programs, like the LEED® rating system and Living Building Challenge™, often encourage onsite water systems as a sustainable water management tool. The proliferation of net zero and water neutral buildings emphasizes the need for a local oversight program to ensure consistency and safety, and improve the efficiency of implementing these systems.

Green buildings strategies and practices are the future of building construction. Developing a local program to promote the safe installation and operation of onsite water systems allows municipalities to adapt to local issues while proactively supporting the green building movement. Institutionalizing a process will help your community build a cohesive and collaborative initiative.

By developing programs to manage the implementation of these systems, local officials can stay ahead of the curve and create a process that helps streamline and scale onsite water projects. The remainder of this Blueprint is designed to serve as a step-by-step guide to help communities develop and launch local programs to manage onsite water systems.

San Francisco Public Utilities Commission Headquarters, San Francisco

10 Steps for Developing a Local Program

Developing a local program to manage onsite water systems offers a proactive way to increase water resiliency and promote green building practices while protecting public health. The development of a program should follow a sequence of steps and associated actions, which will inform critical decisions regarding the scope, structure, and implementation of the program.

1 **Convene a Working Group**

Establish a small working group to guide the development of the local program.

2 **Select the Types of Alternate Water Sources**

Narrow the specific types of alternate water sources covered in the program.

3 **Identify End Uses**

Classify specific non-potable end uses for your program.

4 **Establish Water Quality Standards**

Establish water quality standards for each alternate water source and/or end use.

5 **Identify and Supplement Local Building Practices**

Integrate your program into local construction requirements and building permit processes.

6 **Establish Monitoring and Reporting Requirements**

Establish water quality monitoring and reporting requirements for ongoing operations.

7 **Prepare an Operating Permit Process**

Establish the permit process for initial and ongoing operations for onsite water systems.

8 **Implement Guidelines and the Program**

Publicize the program to provide clear direction for project sponsors and developers.

9 **Evaluate the Program**

Promote best practices for onsite water systems.

10 **Grow the Program**

Explore opportunities to expand and encourage onsite water systems.

The State of Hawaii has established a collaborative working group to develop water quality standards for treated alternate water sources for non-potable applications. The working group includes members from the Governor's Office, public health officials, landowners, and union members.

Los Angeles Skyline by Telephoto on Wikipedia

The Los Angeles County Department of Public Health collaborated in a two-year process with the City of Los Angeles, the City of Santa Monica, and a number of environmental organizations led by Heal the Bay and TreePeople in the development of their "Rainwater Harvesting Matrix". Produced in 2011, the document establishes guidelines for harvesting rainwater, stormwater, and dry weather urban runoff for outdoor non-potable use within Los Angeles County. The document includes information on system requirements, water quality standards, and treatment processes.

STEP 1 Convene a Working Group

There is no single approach to developing a local program for onsite water systems; however, protecting public health is the essential foundation of any initiative. The chosen format of the program depends upon local circumstances and traditional levels of regulatory authority. Stakeholders that are likely to participate in program oversight need to be involved in its development. Engage a small group of public health, planning, and building officials along with water and wastewater utilities that have jurisdictional authority in your area.

The core group will guide how the program develops and unfolds. The group will also:

+ Identify roles and responsibilities of individual agencies
+ Evaluate existing authorities and potential policy or regulatory changes
+ Agree on water quality criteria, monitoring, and permitting requirements
+ Ensure the program reflects needs of its core members
+ Establish fees
+ Provide an identity for the program
+ Determine appropriate incentives

Private developers, non-profit organizations, or other non-governmental stakeholders that are heavily engaged in the local green building movement or water reuse can also be invited to participate or provide feedback.

STEP 1 Outcome

Establish a small working group to guide the development of the local program.

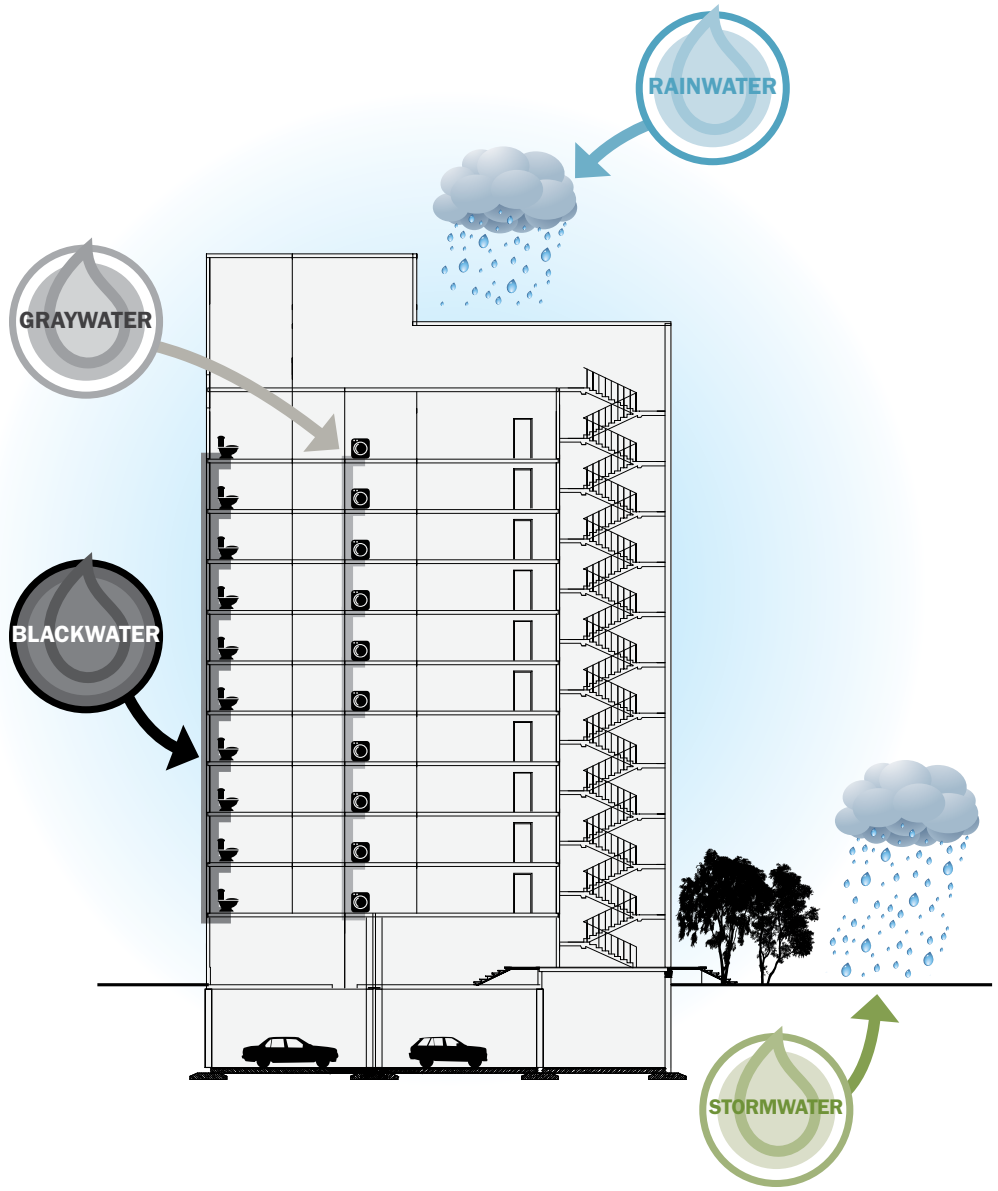
STEP 2 Select the Types of Alternate Water Sources

To establish manageable parameters for your program, identify the specific types of alternate water sources that will be approved for collection and treatment. The amount of resources and staff needed for a program can increase with the number of alternate water sources that are incorporated. Therefore, the selection of a single water source, such as rainwater, may be ideal for initiating a program with the potential to incorporate additional water sources as the program progresses.

Buildings, including commercial and multi-family residential buildings, generate a number of different types of alternate water sources. The most common types of alternate water sources produced by buildings include:

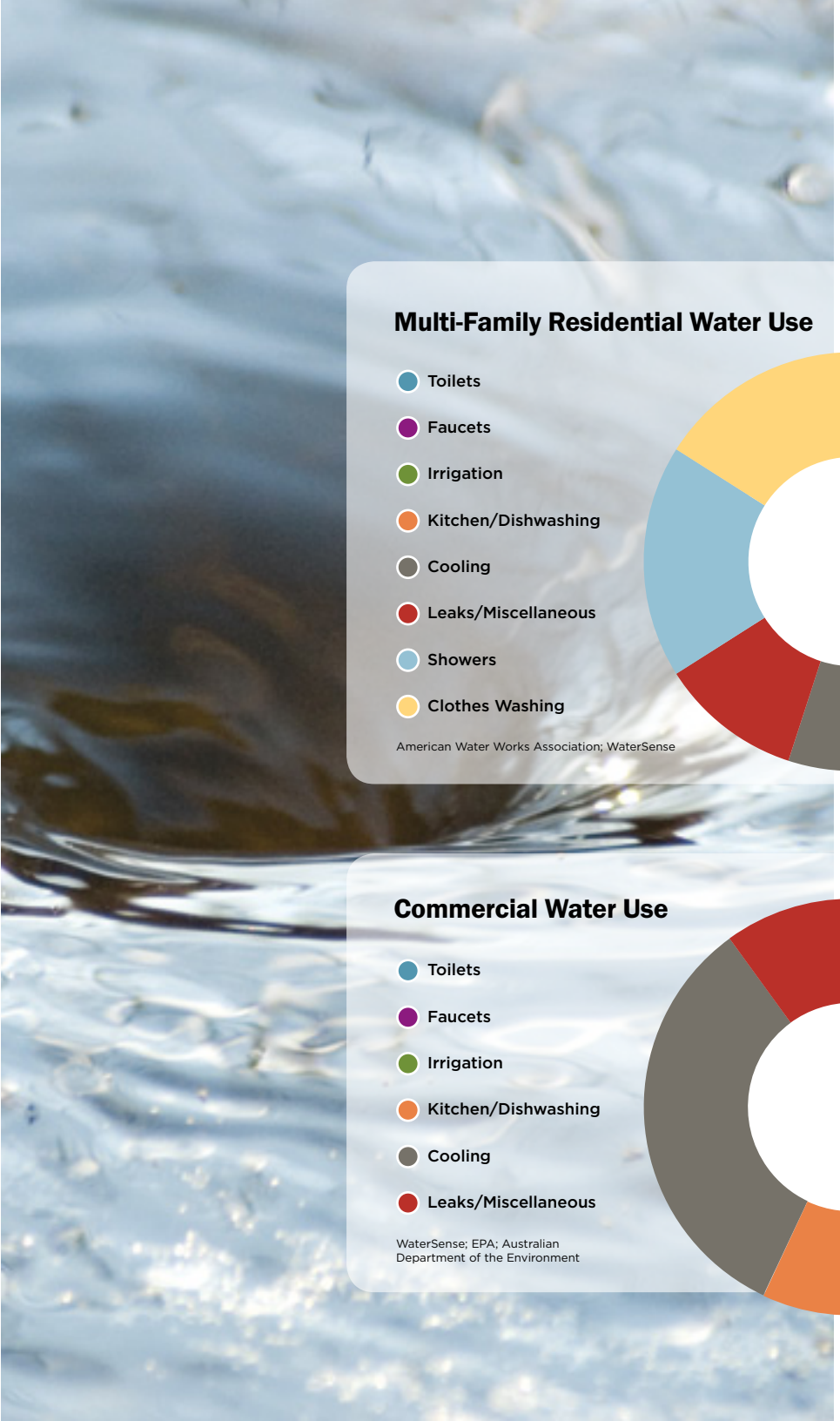
- **Rainwater** – precipitation collected from roofs;
- **Stormwater** – precipitation collected from ground plane;
- **Graywater** – wastewater from bathtubs, showers, bathroom sinks, and clothes washing machines; and
- **Blackwater** – wastewater from toilets, dishwashers, kitchen sinks, and utility sinks.

Terminology and definitions may vary across regions or sectors. When identifying the specific alternate water sources for your program, use the same terminology and definitions that are contained in the local building, plumbing, and health codes and guidelines that will regulate the onsite water systems. Using consistent definitions will help streamline implementation of the program and minimize confusion by developers.

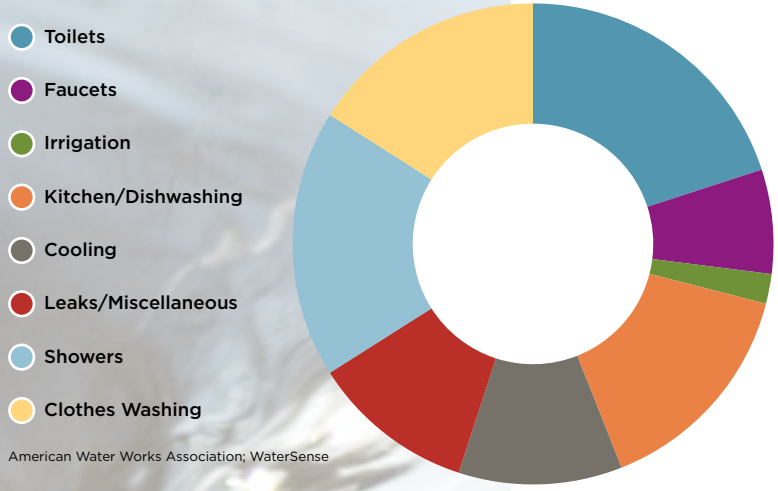


STEP 2 Outcome

Narrow the specific types of alternate water sources covered in the program.

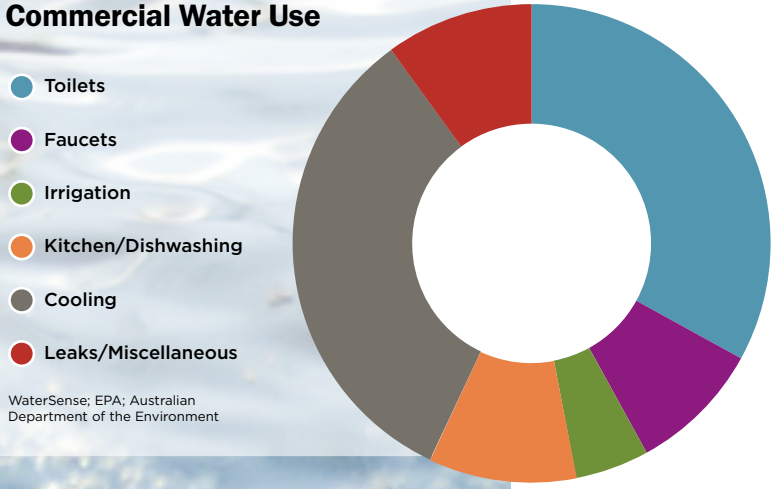


Multi-Family Residential Water Use



American Water Works Association; WaterSense

Commercial Water Use



WaterSense; EPA; Australian Department of the Environment

STEP 3 Identify End Uses

Alternate water sources can be used for a variety of non-potable uses within and outside a building. It is important to identify the specific non-potable end uses (e.g., irrigation) that will be allowed in the program and describe how and where the end use is allowed (e.g., spray or sub-surface irrigation).

The most common indoor use is toilet/urinal flushing, which can represent approximately 25% of the total water demand in a residential building and up to 75% of the total water demand in a commercial building (assuming no cooling demand). Other potential non-potable water demands include irrigation, clothes washers, cooling/heating applications, and process water. These additional applications can increase the non-potable water demand up to 50% for residential buildings and up to 95% for commercial buildings.

Incorporating multiple end uses may result in a more complex program structure but potentially more widespread application of non-potable water. The specific type of alternate water sources and end uses selected serve as the foundation of your program. As with alternate water sources, using consistent definitions will help streamline implementation of the program and minimize confusion by developers.

STEP 3 Outcome

Classify specific non-potable end uses for your program.

STEP 4 Establish Water Quality Standards

Once alternate water sources and allowed end uses are identified, the next step is to set water quality standards. Currently, there are no overarching national standards for water quality or required treatment for alternate water sources. Your state and county public health agencies may have applicable requirements. In addition, a number of plumbing codes, guidance documents, and policies can also assist you with developing your own water quality standards.

Plumbing Codes

Existing plumbing codes provide a context for a local program and identify the current requirements that can be built upon or expanded. The plumbing codes for most communities are modeled after the International Plumbing Code (IPC) or the Uniform Plumbing Code (UPC).

+ **IPC:** The IPC addresses graywater systems for flushing of toilets and urinals and for sub-surface landscape irrigation. The IPC also establishes the minimum acceptable level of safety to protect life and property from the potential dangers associated with supplying potable water and the conveyance of wastewater. (See Chapter 13, IPC 2012.)

+ **UPC:** The UPC addresses alternate water sources, including recycled water, rainwater, graywater, and onsite treated non-potable water for a number of identified non-potable applications. The UPC indicates that water quality standards should meet the applicable water quality requirements determined by the Public Health Authority Having Jurisdiction. (See Chapters 16 and 17, UPC 2012.)

The IPC and UPC have been amended by some states and local municipalities to establish their own laws, guidelines, and codes to further refine allowable uses, minimum water quality criteria, and treatment requirements. Some codes may not allow onsite water systems and will need to be amended before a local program can be implemented.

Water Reuse Standards

Absent the guidance of established overarching guidelines, setting water quality standards can be one of the most time consuming and challenging components of a program.

Additional resources that may be helpful to review when setting water quality standards include:

+ **EPA Water Reuse Guidelines:** The United States Environmental Protection Agency (EPA) developed water reuse guidelines (last updated in 2012) in support of local regulations and guidelines developed by states, tribes, and other authorities. While the water reuse guidelines provide direction at a national level, currently there are no federal reuse regulations or standards in the U.S.

+ **State Municipal Recycled Water Regulations:** Many states already have established water quality limits and monitoring requirements for producing recycled water from municipal wastewater for non-potable applications (e.g., Title 22 of the California Code of Regulations).

+ **NSF/ANSI Standard 350 and 350-1:** These standards establish material, design, construction, water quality, and performance requirements for onsite residential and commercial water reuse systems treating graywater and wastewater for non-potable uses.

+ **Rainwater Harvesting Potential and Guidelines for Texas:** The Texas Rainwater Harvesting Evaluation Committee paper presents the potential benefits and advantages that may be derived from rainwater harvesting and describes minimum water quality guidelines and treatment methods.

+ **Guidelines for Harvesting Rainwater, Stormwater, & Urban Runoff for Outdoor Non-potable Uses:** The Los Angeles County Department of Public Health developed water quality standards for exterior use of harvested rain and dry weather runoff (known as the Matrix).

+ **The Wisconsin Plumbing Code, SPS 382.70, Subchapter VII:** This subchapter establishes standards for plumbing systems that supply water including stormwater to outlets based on intended end uses and that is of a quality that will protect public health and the waters of the state.

STEP 4 Outcome

Establish water quality standards for each alternate water source and/or end use.

STEP 5 Identify and Supplement Local Building Practices

It is important to understand the steps of the building plan review, permitting, and construction inspection process in your community in order to integrate the process for review and installation of onsite water systems. For example, onsite water systems may be incorporated into current plumbing permits or may require additional types of applicable plan review and construction inspection procedures.

Some building and plumbing codes may require local amendments to allow for the installation of an onsite water system. Any additional construction requirements included in your program should be consistent with or incorporated into plumbing and building requirements.

Consider the following requirements for inclusion in your local program:

- **System Bypass:** ability to connect to municipal water and sewer services during onsite water system maintenance or outages.
- **Backflow Prevention Devices:** include approved backflow prevention devices on make-up water connections to the onsite water system.
- **Cross Connection Control:** perform cross connection tests to physically verify the potable and non-potable water systems are separate.
- **Storage Tanks:** ventilate storage tanks to prevent odors from entering into the building.
- **Non-potable System Identification:** identify system components by installing signage, valve tags, and purple pipe or other appropriate pipe identification scheme.

STEP 5 Outcome

Integrate your program into local construction requirements and building permit processes.

OHSU I, Portland, Oregon by M.O. Stevens on Wikipedia

The New York City Building Department's *Building Bulletin 2010-027* established water quality monitoring, reporting, and permitting requirements. The requirements apply to all alternate water sources and end uses except for harvested rainwater used solely for subsurface irrigation, drip irrigation, or washing of sidewalks, streets, buildings, or vehicles. All alternate water sources require monthly monitoring and annual reporting.

Lower Manhattan by Nosha on Flickr

The San Francisco Department of Public Health Director's *Rules and Regulations Regarding the Operation of Alternate Water Source Systems* established monitoring requirements for various alternate water sources. Rainwater, stormwater, and graywater require monthly monitoring and annual reporting. Blackwater requires daily monitoring and monthly reporting.

STEP 6 Establish Monitoring and Reporting Requirements

Most communities will find that standards and guidelines do not exist for the ongoing operation and maintenance of onsite water systems. Building codes, including the plumbing code, are generally enforced at the time of construction and are not intended to mandate or assure ongoing operation and maintenance. Establishing a monitoring regime and reporting requirements are critical to protecting public health and public water systems. The oversight authority may need to be identified or authorized to act.

Monitoring and reporting frequency can vary across alternate water sources and end uses due to different levels of water contaminants and public exposure. More frequent monitoring should be conducted during initial operational phases.

STEP 6 Outcome

Establish water quality monitoring and reporting for ongoing operations.

STEP 7 Prepare an Operating Permit Process

An effective local program should establish procedures for ensuring ongoing compliance with the monitoring and reporting requirements established for the program. Compliance is typically addressed through an operating permit for a treatment system that is administered by a local agency with authority to shut down the treatment system if it fails to comply with permitting requirements.

The operating permit process can include reviewing and approving an engineering or design report, issuing a permit, and reviewing monitoring data. An engineering report would detail the proposed collection of alternate water source(s), treatment system and process, end use applications, entities responsible for treatment system operations and maintenance, a monitoring and reporting plan, and emergency and maintenance procedures. The level of detail and length of the report will be dependent upon the complexity of a project.

Consider the following permit phases for your program:

Start-up Permit: During start-up (first 1-3 months), the alternate water source is treated and discharged to the sanitary sewer if applicable. Potable or recycled water may be supplied to the non-potable applications during this period. Monitoring is necessary on a regular basis until the system operations are fine tuned.

Temporary Use Permit: During temporary use (3-9 months), the alternate water source is treated and supplied to the approved non-potable end uses. Frequent monitoring is necessary and if all water quality requirements are met, a Final Permit may be issued.

Final Permit: Once all water quality standards are consistently met and the system is deemed to be fully operational, safe, and reliable, a final permit can be issued. Ongoing monitoring and reporting requirements are needed for the life of the system, but may be reduced after a period of successful operation.

STEP 7 Outcome

Establish the permit process for initial and ongoing operations for onsite water systems.

Battery Park, New York, by Gryffindor on Wikipedia

In New York, the Battery Park City Authority issued Environmental Residential Guidelines in 2000 which established goals and standards for the creation of environmentally-responsible buildings, including water reuse objectives that exceed LEED® requirements. In response, the NYC Building Department issued *Buildings Bulletin 2010-027* to establish alternative acceptance and maintenance criteria for onsite water recycling systems. The bulletin outlines the water quality requirements as well as the installation, certification, and maintenance requirements for such systems. The phased acceptance and permitting approach outlined in this bulletin has been used by others, like the City of San Francisco, in developing their programs.

Bullitt Center, Seattle, by Joe Mabel on Wikipedia

Market Street Place, San Francisco, by CRP/Cypress Market Street, LLC

STEP 8 Implement Guidelines and the Program

The ability to provide clear direction for project sponsors and developers—especially with respect to building standards, permits, fees, and operating requirements—will be a key strategy for any type of program. Clearly defining the process for design, construction, and operation of onsite water systems and determining the responsible agency for each program element are critical to program success. Developing educational materials, such as brochures or guidebooks, is an important part of communicating the objectives and requirements of your program. The outline below suggests various elements that can be incorporated into your program.

Design Phase Requirements:

+ **Application** - provides a basic overview of the proposed treatment of alternate water sources and end uses

+ **Engineering Report** - details design of treatment systems and means of compliance with water quality standards

+ **Construction Permits** - incorporates necessary local permits

Construction Phase Requirements:

+ **Treatment System Review** - confirms requirements, such as back flow prevention, are met

+ **Construction Certification** - verifies treatment systems were constructed per approved plans

+ **Cross Connection Control Test** - confirms no cross connection between potable and non-potable systems

Operation Phase Requirements:

- **Permit** - provides approval to operate an onsite water system
- **Monitoring** - establishes a protocol and schedule for ensuring that regular sampling is taking place and water quality standards are met
- **Reporting** - sets a schedule and framework for providing ongoing documentation certifying that public health is being protected

Implementing a local program can involve approval from city or state agencies having authority in the jurisdictional area. Identifying policy makers and political allies to champion the program will help to ensure successful implementation. Support can take the form of a general resolution, a specific ordinance, or planning policy.

STEP 8 Outcome

Publicize the program to provide clear direction for project sponsors and developers.

Exploratorium, San Francisco, by Amy Snyder © Exploratorium

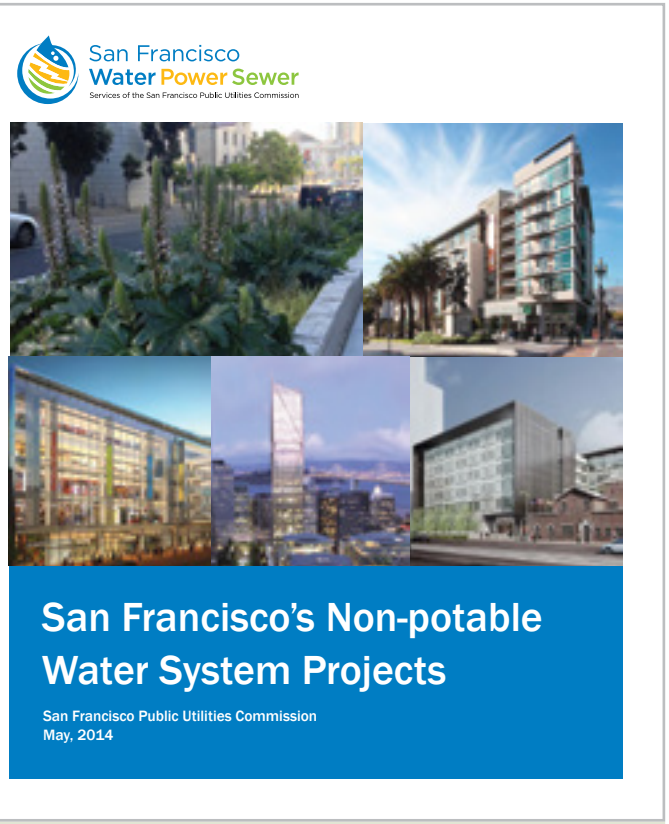
San Francisco's City Ordinance Streamlines Permitting Process

Water Department	Public Health Department	Building Department
Review onsite non-potable water supplies & demands	Issue water quality & monitoring requirements	Conduct plumbing plan check and issue plumbing permit
Administer citywide project tracking	Review and approve non-potable engineering report	Inspect and approve system installations
Provide technical support & outreach to developers	Issue permit to operate onsite systems	
Provide financial incentives to developers	Review water quality reporting	

STEP 9 Evaluate the Program

After your program has been established and several onsite water systems have been implemented, it is important to reflect on the effectiveness of the initiative, accomplishments, and lessons learned. Take time to assess and evaluate the program's achievements to determine if it is supporting the community's vision. This consideration can help you recognize needed adjustments and identify best practices for moving forward. Local programs should be dynamic and adapt over time to respond to the needs of the jurisdiction, evolution of treatment technologies, and changing water demands and supplies.

Monitor regulatory compliance of projects and collect data on the types and end uses of alternate water sources for inclusion in summary reports and status updates. This sort of documentation will allow you to continue to modify and improve the program over time, as well as provide a case study highlighting the number of buildings participating in the program, describing the types of technologies installed, and showcasing the water and cost savings achieved by the onsite water systems. Additionally, these reports can serve as promotional tools to garner additional interest in onsite water systems among community leaders, elected officials, the development community, and other stakeholders.



To track the effectiveness of onsite non-potable water use in San Francisco, the San Francisco Public Utilities Commission prepared the 2014 *San Francisco's Non-potable Water System Projects Report*. The report includes data on the potable water offset, capital costs, operation and monitoring costs, and project drivers.

STEP 9 Outcome

Promote best practices for onsite water systems.

STEP 10 Grow the Program

Local programs can be expanded by increasing the types of alternate water sources and non-potable applications, and by increasing the scale from a single building to a district or neighborhood level. Programs can also include financial incentives to encourage the proliferation of onsite water systems.

Types of Alternate Water Sources:

+ Rainwater
+ Stormwater
+ Graywater
+ Blackwater
+ Foundation drainage
+ Cooling tower blowdown
+ Condensate water

Types of Non-potable End Uses:

+ Toilet and urinal flushing
+ Irrigation
+ Cooling tower make-up
+ Clothes washers
+ Process water
+ Decorative fountains

Types of Incentives:

+ Reduced or waived permit fees
+ Property tax and/ or stormwater fee reductions
+ Water and sewer bill reductions
+ Loans or on-bill financing
+ Grants or rebates

STEP 10 Outcome

Explore opportunities to expand and encourage onsite water systems.

Santa Monica Pier, by Matthew Field www.photography.mattfield.com

Santa Monica waives building permit fees and New York City provides wastewater allowances to qualified properties with onsite water systems. San Francisco provides up to $250,000 for an individual building and up to $500,000 for multiple buildings implementing onsite water systems.

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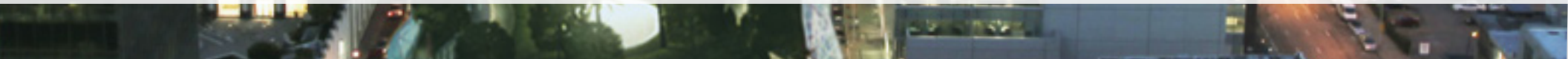
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