WATER PETAL PERMITTING GUIDEBOOK

2019

LIVING BUILDING CHALLENGE[SM] 3.1

A Visionary Path to a Regenerative Future

INTERNATIONAL LIVING FUTURE INSTITUTE[SM]

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This guidebook can be used in conjunction with the Water Petal Handbook and the LBC Standard to help develop a strategy for the design and permitting of a Net Positive Water building. However, this guidebook in no way replaces the value of an experienced engineer that specializes in designing and permitting on-site water systems, nor does this guidebook replace the expertise of the project team in working with the local regulators and permitting agencies. Additionally, the use of this guidebook does not guarantee that the project will be permitted by the Authority Having Jurisdiction or certified by the International Living Future Institute (ILFI or the Institute).

WATER PETAL:
PERMITTING HANDBOOK

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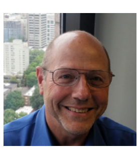
THANK YOU TO OUR GENEROUS CONTRIBUTORS:



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INTRODUCTION

The Living Building Challenge (LBC) is a certification program, advocacy tool, and philosophy defining the most advanced measure of sustainability in the built environment today. As a certification program, it addresses buildings, landscapes, and infrastructure projects at all scales and is a holistic tool for transformative design. Whether the project is a single building, a renovation, or a park, the Living Building Challenge (LBC) provides a framework for design, construction, and improvement of the symbiotic relationship between people and all aspects of the built and natural environment.

The Living Building Challenge is organized into seven Petals, or performance categories. These are: Place, Water, Energy, Health + Happiness, Materials, Equity, and Beauty. Within these seven Petals there are 20 Imperatives that describe the performance requirements that must be met in order to earn that Imperative.

This Water Petal Permitting Guidebook is a free addition to the LBC Water Petal Handbook and the LBC Petal Handbook Series, both of which are critical resources for project teams pursuing the Living Building Challenge. There is one Petal Handbook for each of the seven Petals. These handbooks, along with the LBC Standard, define the requirements for each Petal as of their date of issue. All of these resources can be found at: **living-future.org/lbc/basics**.

INTENT OF THIS GUIDEBOOK

This guidebook is a reference for project teams that are pursuing the Water Petal, or for any project team that is implementing on-site water capture, treatment, and reuse systems of any type or scale. This guidebook provides general guidance for the permitting process for each category of water system that your project may incorporate in pursuit of the Water Petal, as well as tips for working with local jurisdictions and regulators. Given the variation in local and state laws and interpretations around the country, as well as globally, this guidebook cannot be a definitive or comprehensive resource for all situations. Rather, it is meant to offer general guidance and tips for navigating the permitting process based on the experience of other project teams that have pursued the Water Petal.

HOW TO USE THIS GUIDEBOOK

This guidebook can be used in conjunction with the Water Petal Handbook to help develop a strategy for the design and permitting of a Net Positive Water building. However, this guidebook in no way replaces the value of an experienced engineer that specializes in designing and permitting on-site water systems, nor does this guidebook replace the expertise of the project team in working with the local regulators and permitting agencies. Additionally, the use of this guidebook does not guarantee that the project will be permitted by the Authority Having Jurisdiction or certified by the International Living Future Institute (ILFI or the Institute).

Project teams must follow all rules in place for the Water Petal at the time of project registration. Rules established after a project team's registration date may be followed at their discretion. Rules are established through the Standard, the Water Petal Handbook, and the Dialogue (which is available online at: **support.living-future.org/collection/43-dialogue**). The rules are consolidated in the Petal Handbooks at the date of issue. Project teams are encouraged to routinely check the Dialogue for postings after the issue date of the handbook in order to remain up-to-date on the program's rule set.

THE WATER PETAL

Note that the language in the first three subsections of this section is taken directly from the LBC Standard and the Water Petal Handbook. Those two documents are considered the definitive sources of the intent, requirements, ideal conditions, and current limitations.

WATER PETAL INTENT

The intent of the Water Petal is to realign how people use water and to redefine “waste” in the built environment so that water is respected as a precious resource.

Scarcity of potable water is quickly becoming a serious issue as many countries around the world face severe shortages and compromised water quality. Even regions that have avoided the majority of these problems to date due to a historical presence of abundant fresh water are at risk: the impacts of climate change, highly unsustainable water use patterns, and the continued drawdown of major aquifers portend significant problems ahead.

IDEAL CONDITIONS + CURRENT LIMITATIONS

The Living Building Challenge envisions a future whereby all developments are based on the carrying capacity of the site: harvesting sufficient water to meet the needs of resident population and users while respecting the natural hydrology of the land, the water needs of the ecosystem and its inhabitants, and those of its neighbors.

Indeed, water can be used and purified and then used again—with this cycle repeating. Currently, such practices are often illegal due to health, land use and building code regulations (or because of the undemocratic ownership of water rights) that arose because previously people were not properly safeguarding the quality of their water. Therefore, reaching the ideal for water use means challenging outdated attitudes, technology, and codes so as to allow decentralized site- or district-level solutions that are appropriately scaled, elegant, and efficient.

The Water Petal has only one Imperative — Imperative 05, Net Positive Water.

WATER

NET POSITIVE WATER

IMPERATIVE 05

IMPERATIVE 05: NET POSITIVE WATER

Project water use and release must work in harmony with the natural water flows of the site and its surroundings. One hundred percent of the project's water needs must be supplied by captured precipitation or other natural closed-loop water systems[1] and/or by recycling used project water and must be purified, as needed, without the use of chemicals.

All stormwater and water discharge, including grey and black water, must be treated on site and managed either through reuse, a closed-loop system, or infiltration. Excess stormwater can be released onto adjacent sites under certain conditions.

WHAT WE MEAN BY "NET POSITIVE" WATER

The Living Building Challenge does not require projects to produce more water than they use in the same way that it requires projects to produce more energy than they use under Imperative 06 (I06)— "Net Positive Energy." Instead, "Net Positive" refers to the Institute's tightly-held belief that the built environment can and should be a regenerative force in the natural environment. Buildings that achieve Net Positive Water return developed land areas —often paved or clear cut— to their pre-development hydrology. Water then flows within and through the site as a function of the larger watershed, thereby healing wounded wetlands and natural waterways, as well as replenishing depleted aquifers.

1 Refer to the Water Petal Handbook for clarifications and exceptions, such as allowances for a municipal potable water use connection if required by local health regulations.

SENSE OF URGENCY – WHY NOW?

Water is multifaceted, enigmatic, and constantly in motion. It can be a life-giving resource, a poetic inspiration, a commodity, a nuisance, or a powerful force. Water passes through our projects; arriving via the atmosphere, piped conveyance, natural watercourse, or subsurface flow. We don't own the water that passes through our projects we are its temporary caretaker, and we are responsible for its fate.

Water movement within a watershed is complex, with intertwining relationships across scale, geography, and time. These interrelationships create a unique hydrology for each natural watershed or urbanized basin that supports human and ecological communities. The unique hydrologies express themselves distinctly throughout nested watersheds, sub-watersheds, and project drainage areas. The hydrology of a watershed also varies within and between storms, across the seasons, and year-to-year, driven by a changing climate. Therefore, an optimized design solution to achieve similar goals for two similar projects in different watersheds or even different locations within the same watershed will necessarily be different.

> "By asking the right questions and deepening our understanding of the watershed at all relevant temporal and spatial scales, we can design optimal solutions to manage this precious resource to support life in all its resplendent forms, in perpetuity."

As water stewards, we are responsible for managing the water that interacts with our projects in a way that meets project needs, reflects a deep understanding of the project's context, and delivers the highest value for all communities. These solutions need to provide for a fair and equitable allocation of water resources among the project and communities both upstream and downstream. Our water systems need to be resilient and support overall community resiliency by continuing to deliver value through rapid and slow change. Our water systems also need to preserve and restore the health and vitality of the human and ecological communities that they serve.

CHRIS WEBB, Herrera Environmental Consultants

THE PERMITTING PROCESS RECOMMENDATIONS

The first step to permitting your project's water systems is to identify the current code landscape. This preliminary research will streamline your permitting process, ensuring that you use the right terms, get all the relevant people to the table, and understand the historical and current context that serves as a basis of decision-making for the regulators and permitting officials in your area.

IN THIS SECTION:

CENTRALIZED WATER MANAGEMENT: AN ORIGIN STORY

Crucially, your team must understand and be able to articulate the perspective of code officials tasked with preserving public health. In the past, some project teams have vocally disparaged their local water codes as too restrictive and the officials that uphold them as dogmatic. This perspective immediately puts the project team at odds with the regulators and code officials and sets them up for roadblocks.

It is essential to understand the origin of our current water regulations and their importance in protecting public health so that you can best address the central concerns of permitting officials. A main focus throughout each meeting with officials should be to preserve public health while addressing emerging concerns with centralized municipal infrastructure within the watershed and beyond.

A HISTORICAL PERSPECTIVE

In the late 1800s and early 1900s, small on-site decentralized systems were the norm in the United States. There was a patchwork of water sources, equipment, and methods for drinking water and wastewater treatment that provided varying levels of water quality. These systems triggered epidemics of cholera and typhoid in dense urban cities, creating a series of public health crises. In response to these crises, large centralized water and wastewater treatment systems were built in urban areas, replacing the motley assortment of unsafe systems and virtually eliminating these epidemics.

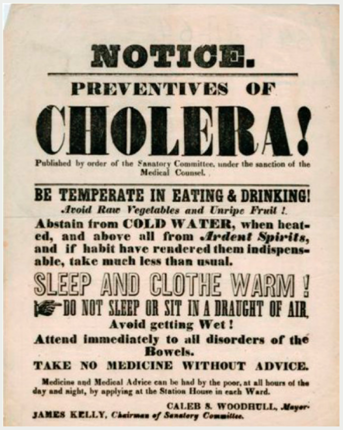
These large systems are now approaching over 100 years of age. Across the United States, billions of dollars of investment will be required every year for the next 50 years to replace this aging infrastructure. Replacement will cost significantly more than the original cost to build, even using inflation-adjusted dollars. Cost challenges today include minimal federal funding, requirements to use union labor or prevailing wages, and higher construction and safety standards. Additionally, today's rights-of-way are now filled with all kinds of infrastructure (including gas, cable, power and fiber lines) that weren't there when the original infrastructure was built. This adds significant cost to the design and construction of infrastructure replacement.

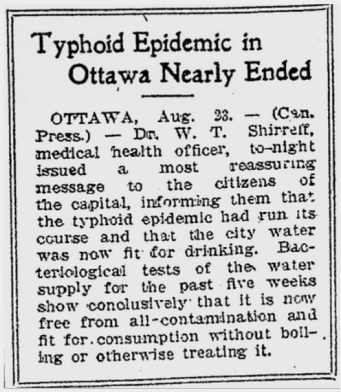
Modern emerging issues place additional stress on these existing systems. Increasing population is creating greater and greater demand for water, and there are a growing number of communities facing the potential of inadequate water supply. Additionally, climate change is reducing supply in many areas via loss of snowpack and evaporation, along with newly emerging precipitation patterns that are changing when rain falls, where it falls, and how much falls.

As we enter this major infrastructure replacement cycle, we have the opportunity to take a step back and re-evaluate how best to structure our systems. It is imperative to deliver these critical services in a way that addresses public health and safety, but also is more adaptive and resilient in the face of an uncertain future. This should be done in a way that considers and optimizes for local context factors to take advantage of a region's strengths and mitigates against their weaknesses.

Water is vital to maintaining healthy communities, vibrant economies, and a thriving natural environment. As we plan to replace large, aging water and wastewater infrastructure systems we should look at the possibilities of incorporating innovative strategies to conserve, reuse, and diversify our water supply. As technology advances, small, locally-distributed systems at various scales can be important players in making utility systems diverse, adaptable and resilient. These are not the decentralized systems of the early 20th century, but modern technological on-site treatment systems with proven technology to protect public health when implemented and maintained properly. By considering a new paradigm that incorporates public health and safety but also can address the emerging challenges of population growth, climate change and the need for more resilient and adaptable systems, many utilities can position themselves to successfully meet a more uncertain future.

MARK JAEGER,
National Blue Ribbon Commission for Onsite Non-potable Water Systems


NOTICE.
PREVENTIVES OF
CHOLERA!
Published by order of the Sanatory Committee, under the sanction of the Medical Counsel.
BE TEMPERATE IN EATING & DRINKING!
Avoid Raw Vegetables and Unripe Fruit!
Abstain from COLD WATER, when heated, and above all from *Ardent Spirits*, and if habit have rendered them indispensable, take much less than usual.
SLEEP AND CLOTHE WARM!
DO NOT SLEEP OR SIT IN A DRAUGHT OF AIR.
Avoid getting Wet!
Attend immediately to all disorders of the Bowels.
TAKE NO MEDICINE WITHOUT ADVICE.
Medicine and Medical Advice can be had by the poor, at all hours of the day and night, by applying at the Station House in each Ward.
CALEB S. WOODHULL, *Mayor.*
JAMES KELLY, *Chairman of Sanatory Committee.*


Typhoid Epidemic in Ottawa Nearly Ended
OTTAWA, Aug. 23. — (Can. Press.) — Dr. W. T. Shirreff, medical health officer, to-night issued a most reassuring message to the citizens of the capital, informing them that the typhoid epidemic had run its course and that the city water was now fit for drinking. Bacteriological tests of the water supply for the past five weeks show conclusively that it is now free from all-contamination and fit for consumption without boiling or otherwise treating it.


Aging pipes in need of replacement

The American Water Works Association (AWWA) released a report in 2012 warning that the cost of repairing and expanding U.S. drinking water infrastructure will top $1 trillion in the next 25 years. AWWA's $1 trillion estimate covered work until 2035. Over a 40-year period, through 2050, the needs exceed $1.7 trillion.

Source: www.allianceforwaterefficiency.org/uploadedFiles/Resource_Center/Landing_Pages/AWWA-BuriedNoLonger-2012.pdf

WATER PETAL
CASE STUDY

San Francisco Public Utilities Commission

The essential function of the San Francisco Public Utilities Commission (the Commission) is to provide drinking water, power, and sewer services to the City of San Francisco. Their mission, however, is to do so “in a manner that is inclusive of environmental and community interests, and that sustains the resources entrusted to our care”. It’s a charge they take seriously.

The Commission views conservation and water efficiency as their number one long-term water management strategy, and they aren’t afraid to experiment: their own building served as proof of concept to showcase reusing water onsite. An essential facet of their brand of progressivism is managing intersectional interests: the Commission must incorporate rigorous safety and public health standards into every proposed ordinance. Whilst navigating the complexities of changemaking, they have become experts in stakeholder engagement. To share their expertise, they have situated themselves at the nexus of a national conversation around decentralized water systems. Their collaborative approach has laid the groundwork for solutions-oriented water regulation around the country.

INNOVATIVE ORDINANCES

These four programs in San Francisco, taken as a whole, provide a code-compliant pathway for project teams to use all water resources available on site as efficiently as possible.

RECYCLED WATER ORDINANCE PUBLIC WORKS CODE, ARTICLE 22

EFFECTIVE DATE: NOVEMBER 7, 1991

New buildings and buildings undergoing major renovation over 40,000 square feet are required to use recycled water for all uses authorized by the State of California. When this ordinance was first introduced in 1991, California only allowed recycled water use for irrigation. It has since expanded to include applications such as toilet/urinal flushing, cooling and water features.

STORMWATER MANAGEMENT REQUIREMENTS PUBLIC WORKS CODE, ARTICLE 4.2 SEC 147-147.6

EFFECTIVE DATE: MAY 22, 2010; UPDATED 2016

Any properties that involve a disturbance of 5,000 square feet or more must manage stormwater using green infrastructure and maintain that green infrastructure for the lifetime of the project. A majority of the projects that have been affected by this ordinance have opted for rainwater harvesting, and are therefore also subject to the Non-Potable Water Ordinance.

NON-POTABLE WATER ORDINANCE PUBLIC WORKS CODE, ARTICLE 12C

EFFECTIVE DATE: SEPT 2012; UPDATED OCT 2013

This ordinance allows commercial, mixed-use and multi-family developments to collect, treat and use greywater, rainwater or foundation drainage sources for non-potable applications. In 2013, this ordinance was amended to allow for district-scale water systems for buildings of two or more to share non-potable water across property lines. Beginning November 1, 2016, any building over 250,000 square feet must evaluate the ability of all available on-site water supplies to meet and/or offset the building's irrigation and toilet water needs.

RAINWATER HARVESTING FOR POTABLE USE PILOT PROGRAM

EFFECTIVE DATE: TBD

In addition to these ordinances, the Commission is working on a pilot project with a local developer to determine how to safely collect and treat rainwater on site for potable use. To this end, they have convened a working group of relevant regulatory authorities having jurisdiction. The pilot, if effective, may result in a code variance for this project.

NATIONAL IMPACT

In order to disseminate knowledge that they've gained in applying ordinances safely across San Francisco, the Commission hosted the Innovations in Urban Water Systems Meeting May 29 – 30, 2014. This summit of water agencies, public health departments, research institutions, and other stakeholders from across North America resulted in the "Blueprint for Onsite Water Systems: A Step-by-Step Guide for Developing a Local Program to Manage Onsite Water Systems". This informative guide provides a broadly applicable regulatory framework, intended for implementation in deference to the local circumstances of communities across the nation.

The group also created the National Blue Ribbon Commission to Accelerate the Adoption of Onsite Water Reuse, and will release a document providing risk-based public health guidance and recommendations around water quality permitting and monitoring by the end of October 2016.

There are a great many lessons to be learned from the Commission's decades of implementing progressive water efficiency ordinances, as well as the countless conversations they have had with engaged stakeholders. The methods and strategies below represent a brief selection that both regulators and prospective projects can learn from.

LESSONS LEARNED

GET THE RIGHT PEOPLE AT THE TABLE

Who has regulatory jurisdiction? Engage them early and often to make sure their concerns are aired and addressed. In the case of San Francisco, the Commission created a forum for conversation with city, county, and state officials in order to move forward in a way that was collaborative and positive. It was clear from the outset that the goal was to implement important efficiency and conservation measures without subverting any critical regulatory priorities.

ACKNOWLEDGE LOCAL CONTEXT

Avoid prescriptive approaches that stifle the variety of strategies available to developers; instead, establish outcome-based requirements. Empower project teams to achieve these requirements using methods that make sense for their site, community, budget, and available resources.

TAKE A SOLUTIONS-BASED APPROACH

Acknowledge the priorities of all stakeholders, and identify common goals. Everyone can agree on the fact that safety is paramount, and most understand the importance of water efficiency. Work from there.

FIND YOUR “PERFECT STORM”

Around the same time that the Commission was considering water efficiency guidelines, developers began asking regulators at the City and County level for guidance with respect to permitting their decentralized water systems. This “perfect storm” of interest from the private developers created a collaborative partnership, and the Commission’s guidelines created a pathway for these early pilot programs.

LOCAL CONTEXT

In addition to the overall historical perspective on water management (above), your own city or region might have specific reasons that a certain code or regulation is in place. As an example, let’s look at the Living Certified Hawai’i Preparatory Academy (HPA) Energy Lab, located on Hawai’i’s Big Island, where the community depends on imported fossil fuel for potable water pumping and purification.

The Big Island’s Board of Water Supply is guided by both geography and topography in its approach to providing safe drinking water to its citizens. Many residents live far away from an organized water supply, so there is more regulatory flexibility around decentralized water sources. However, there are also two active volcanos on Hawai’i, one of which has been erupting continuously since 1983. These active volcanos produce “vog,” a form of air pollution that results from the combination of volcanic gas and sulphuric acid aerosol. Vog pulls zinc and cadmium out of steel roofs and lead out of the solder[2] – both materials commonly used in large rainwater catchment systems. In order to address this, local regulations specify that buildings must provide bottled water for occupants if there are more than 80 people per day using the building.

Even though the Energy Lab intentionally specified materials that are unaffected by vog for their entire catchment system, they were unable to convince local authorities to let them use rainwater as a primary source of potable water. Instead, the catchment system is used

2 https://pubs.usgs.gov/fs/fs169-97/

The roof and north facade of the Energy Lab at Hawai'i Preparatory Academy are designed to capture fog through condensation that flows to a gutter at the base of the facade wall and then to the 10,000-gallon cistern.

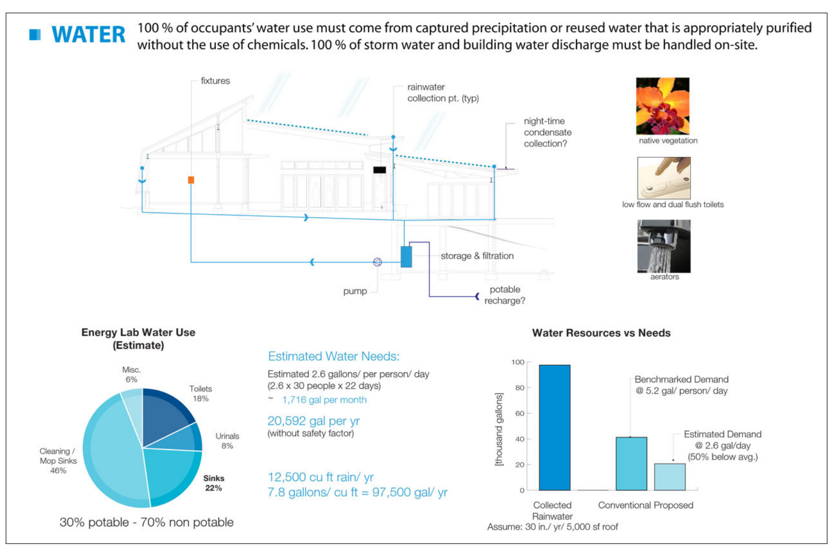
as potable water redundancy in the event that the mandated bottled water isn't available or the codes change. It has since become an emblem of resiliency: their 10,000 gallon cistern can provide water for their students for a year, which may prove crucial for an area that is vulnerable to earthquakes, tsunamis, and hurricanes.

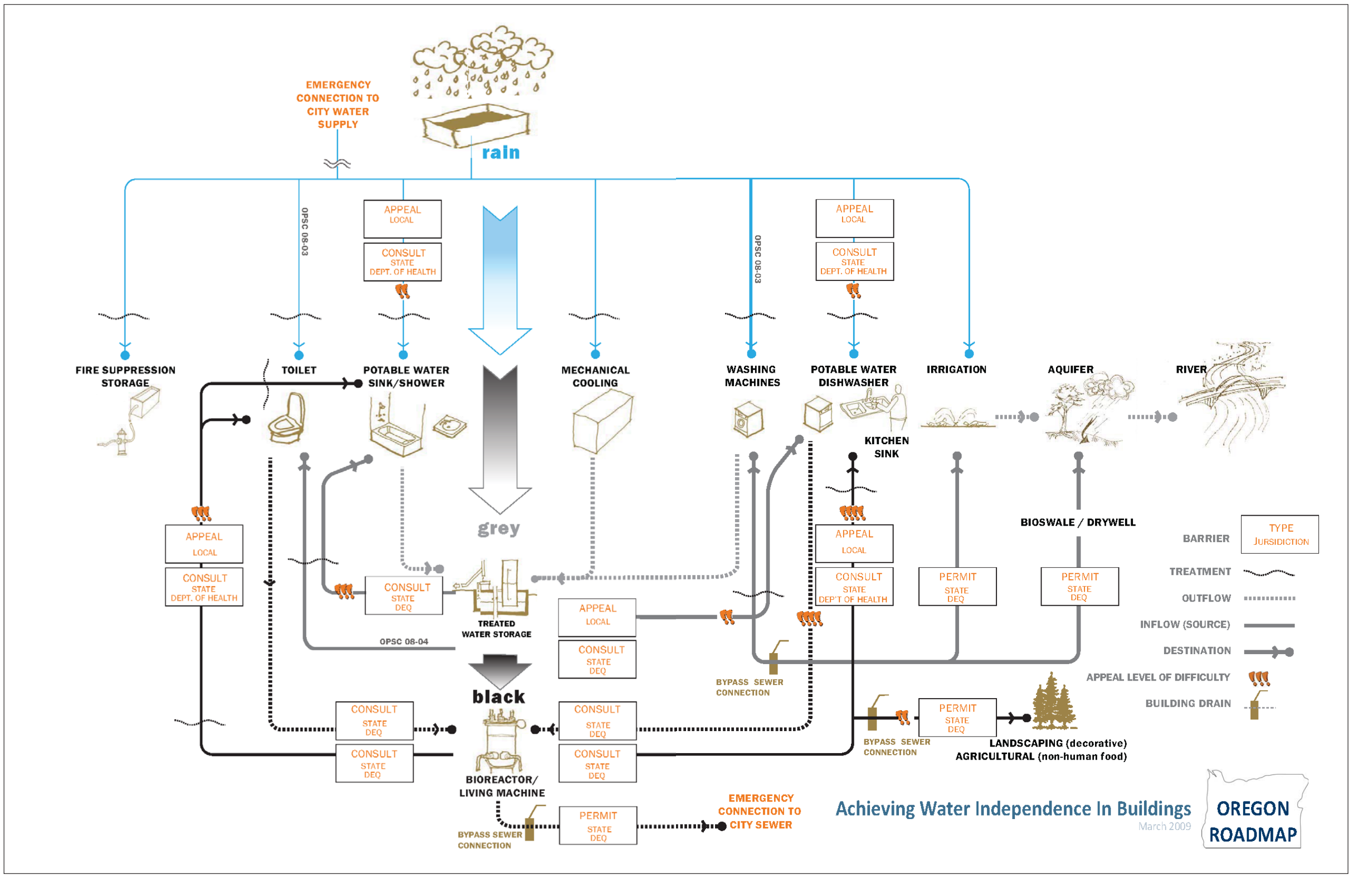
A similar local story lies at the root of the HPA team's struggle to achieve a greywater treatment permit. Despite the 200 students and teachers passing through the Energy Lab space every day, collective consumption reaches only eleven gallons of water per day. The project team proposed to use the very small amount of resultant greywater for irrigation and exterior dust control. However, the team was precluded from doing so by county regulations disallowing greywater reuse. In the 1970s, when this regulation was instituted, detergents contained phosphates high in naturally-occurring heavy metals. According to local officials, greywater infiltration subsequently transferred this toxic burden to food crops, resulting in cases of heavy metal poisoning.

Although the use of phosphates in detergents has since been phased out, the health officials were unwilling to revisit this law for a project of this scale, even though doing so may have opened up opportunities for other projects. Instead, the project team had to discharge this small amount of greywater to the three-part septic system they were already using for their blackwater. It should be noted that this project was built in 2010. Given changing attitudes, environmental conditions, information, and technology, it is possible that if this project sought these changes in code now, the answers would be different.

Though it might not be vog or concerns with phosphates in detergent, your local jurisdiction likely has some specific history that influences current regulations and codes. Identifying these factors will ensure that your proposed systems, and the information you provide about those systems, better address the specific concerns of your own local regulators and permitting authorities.

Diagram showing HPA's water use





The original permit pathway map for Oregon

MAP THE PERMIT PATHWAYS

The best approach that the Institute has found thus far to collect and track information about a local code landscape is to create a permit map. A permit map is a visual representation of the permit pathways and associated information for each individual water treatment system that a project will include. The map identifies the authority/authorities having jurisdiction, the relevant codes, and whether the pathway is viable or "blocked."

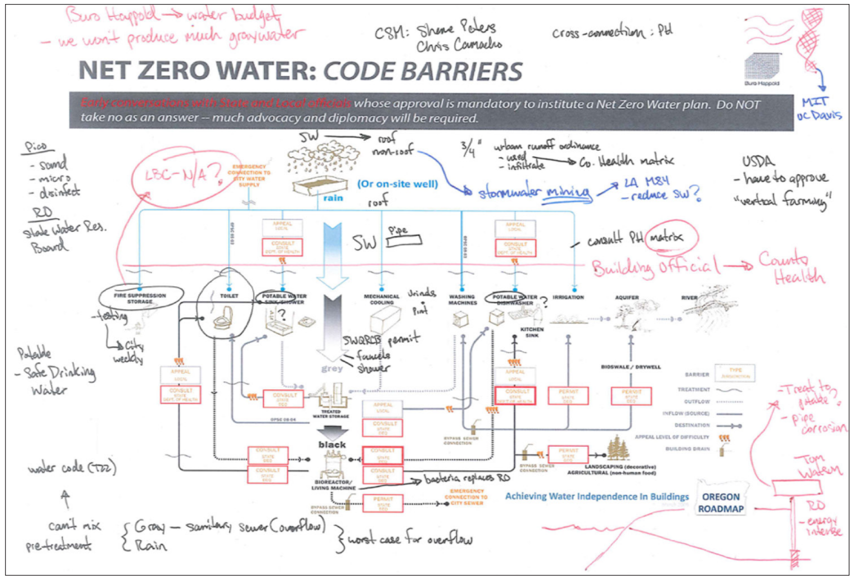
The first of these maps was created and published by Central City Concern[3] in 2009 within the report: *Achieving Water Independence in Buildings: Navigating the Challenges of Water Reuse in Oregon*[4]. The Cascadia Green Building Council, the predecessor organization to ILFI, was a project sponsor and contributor to this effort. The bulk of the content in the report, including the map located on pages 22 and 23, is licensed under a Creative Commons Attribution 3.0 License.[5] This license allows others to distribute, remix, tweak, and build upon this work, even commercially, as long as the original author and the report are credited for the original creation. At the time, the map was created as a visual way to communicate the regulatory pathways for commercial buildings in Oregon. The power of the tool quickly became evident as it enabled more and more people to better understand the code landscape and where the barriers occurred. The map made information visible and comprehensible that previously

3 www.centralcityconcern.org/research/

4 living-future.org/wp-content/uploads/2016/11/Achieving_Water_Independence_in_Buildings.pdf

5 www.creativecommons.org/about/licenses

had been confusing and difficult to navigate. Others started showing interest in creating similar maps for their own cities. A dramatic early example comes from the City of Santa Monica, under the leadership of Joel Cesare, Sustainable Building Advisor for the City. Joel used a printed copy of the Oregon Roadmap as a base map for visually capturing notes and discussions on permit pathways for water systems in Santa Monica and LA County during an early project charrette for the City Services Building, a project now under construction that is pursuing Living Certification under the Living Building Challenge.



Between 2011 and 2017, Architectural Nexus created similar maps for Utah and California[6] based on the original 2009 Oregon Roadmap, under the Collective Commons license. These examples and others, along with growing interest from project teams and jurisdictions alike, spurred ILFI and Recode (jointly funded by a grant from the Rosin Fund of the Scherman Foundation) to work together in 2018 to create instructions, tools, and templates for creating Water Permit Maps[7]. Since 2018, ILFI and Recode have been working with interested individuals, organizations, agencies, and firms to create an online library of Water Permit Maps that anyone can access and use. The key goals in doing so are building understanding, identifying barriers, sharing policy change successes and precedents, and helping to drive regulatory change in order to open pathways to permit Net Positive Water projects.

To make a permit map, you will need the spreadsheet (found at: **living-future.org/policy-advocacy/#on-site-water-reuse-permit-map**) and a strong commitment to research. Start by studying the local building codes and build up to the state codes. You'll want to investigate plumbing codes, building codes, and administrative codes, all of which may contain information about plumbing requirements, septic system requirements, and connection requirements.

Fill in the spreadsheet as best you can with the information you gathered, then start calling your local, and where relevant, state permitting officials and meeting with them individually. Bring along your draft spreadsheet, emphasizing that you are seeking their feedback. Carefully track their corrections and log the conversations that lead to changes. Ask each official to talk you through the other authorities having jurisdiction and meet with each of them individually as well. Once you've met with each official, consider inviting the whole group together to review the final map. Below is a list of a few departments/roles that are likely to be responsible for permitting one or more of the water systems.

- Plumbing Inspector
- Department of Health at County and/or State level
  - Drinking Water Division
  - Wastewater Division
- Department of Environmental Health
- Water and Sewer Utility
- Department of Environmental Quality

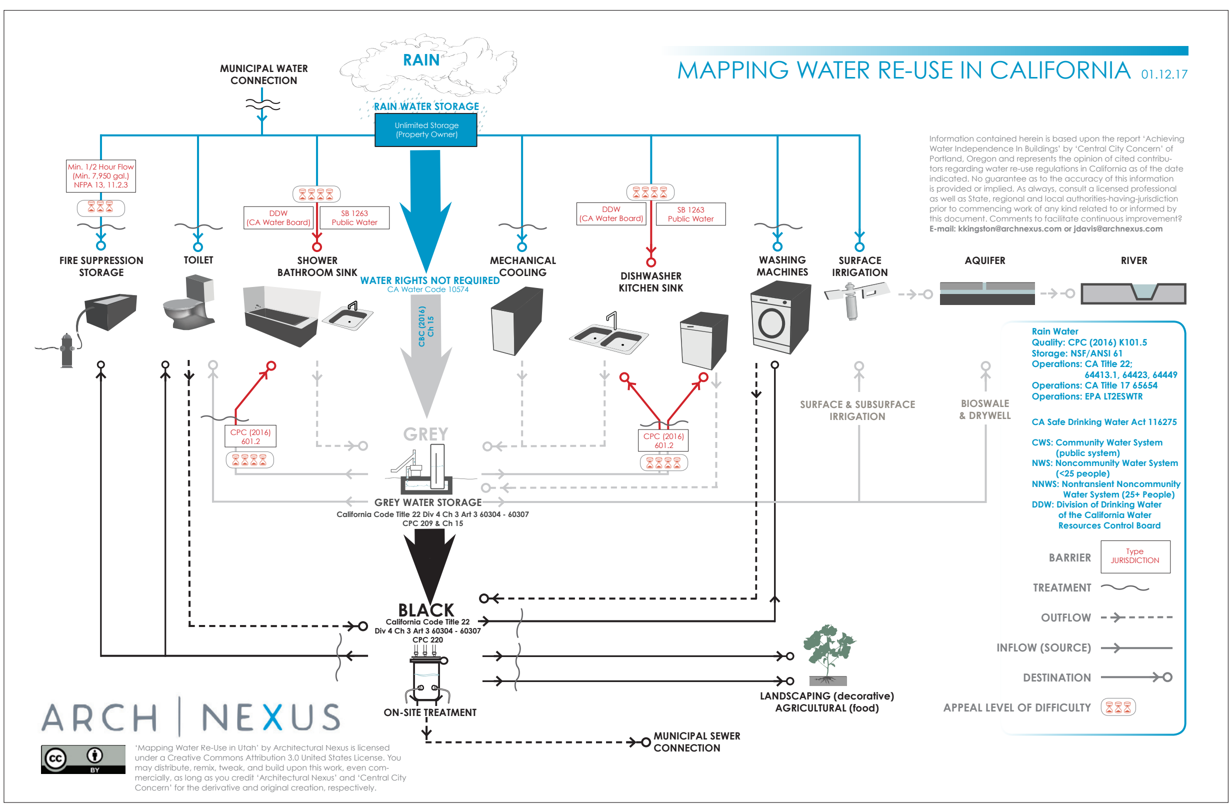
6 living-future.org/policy-advocacy/#on-site-water-reuse-permit-map

7 Make your own permit map at: living-future.org/policy-advocacy/#on-site-water-reuse-permit-map

The following are some questions that will help you start the conversation.

- Has the department permitted a system like this before?
- What are the priorities / values / obligations of the municipality?
- What historical need drove the creation of the current codes?
- Which water quality standards does the department use?
- Are there mandates to connect to municipal supply (even when it will not be used)?
- Under what conditions is municipal connection required?
- Are there fees for connecting to the municipality and could they be waived in the event of an on-site system?
- Does the project need to seek permission to operate a public water works within the utility's jurisdiction?

At the conclusion of this research effort, you should have a solid understanding of the permit pathways available for your project, along with the historical reasoning behind each code requirement, and a grasp of the possible barriers. From this basis, the project team can start to design a compliant system and gather background information to seek variances or new permit pathways when needed.



Sample Permit Map: California

STEP 2. DESIGN A COMPLIANT SYSTEM

There is no substitute for working with an engineer that specializes in designing water systems—the guidance below is meant only to help familiarize yourself with some design considerations and to help you avoid common pitfalls.

Fundamentally, I05 Net Positive Water requires Living Buildings to derive water input from resources on site and to manage water output on site. From a practical standpoint (in most circumstances), the technology and strategies necessary to achieve this Imperative are well understood and widely available.

ON-SITE WATER RESOURCES

The first step to designing a compliant Water Petal project is to assess the water resources available on site. Common on-site water resources include:

Rainwater: Capturing rainwater provides the project with a relatively clean and predictable source of water. It also reduces the negative impacts of stormwater runoff, wherein rainwater hits impermeable surfaces and carries toxins and chemicals into natural waterways or overflows combined sewer systems, releasing untreated wastewater into those same waterways. Rainwater can be harvested from roofs or from any impermeable surface. Codes often require all that surfaces involved in rainwater capture be NSF P151 and NSF 61 certified.[8] The team should avoid collecting rainwater from surfaces that might leach chemicals into the water over time, such as copper.

Groundwater: Accessing groundwater is a common strategy in rural areas. It is less common in dense urban environments that are served by centralized utilities and may have restrictions on new wells and/or contaminated groundwater (from pollutants and salt water intrusion). However, this important resource should not be overlooked. Additionally, nuisance groundwater from dewatering operations in urban locations may be a non-potable water resource for the project team after undergoing the appropriate treatment. Groundwater use is allowed under the Living Building Challenge, but the system must be designed to recharge the aquifer with an equal or greater amount of water as is withdrawn.

Recycled Water: Water recycling is perhaps more properly an efficiency strategy, as it is necessary to source the water from somewhere to begin with. However, once water has been used once for handwashing or showering, using it again to satisfy non-potable use is good practice and will reduce the draw on an on-site or municipal potable water source.

8 To ensure the health and safety of those using rainwater catchment to collect drinking water, the National Science Foundation created the NSF P150: Certification of Rainwater Catchment System Components Program. This program establishes testing guidelines for products that come in direct contact with rainwater that is used for drinking. These products include gutters, coatings and liners places on rooftops. NSF 61 focuses on the additional conveyance system components such as pipes, fittings, gaskets, sealants, cisterns/tanks, valves, pumps, and faucets or spigots. To learn more, see: https://industries.ul.com/wp-content/uploads/sites/2/2015/03/UL-WP-Rainwater_Catchment_Systems-v3A-FINAL1.pdf

STORAGE FOR RAINWATER CAPTURE

Precipitation is typically distributed seasonally; many climates experience substantial periods of low to no rainfall or droughts. Project demand for water, however, tends to remain more or less static throughout the seasons. Even if your location has evenly distributed seasonal rainfall, nonetheless it is important that a building relying entirely on site-harvested water ensures adequate supply throughout the entire year.

The best way to ensure consistent supply throughout the year is to correctly size the project's water storage equipment. The right amount of storage is unique to each project and is influenced by a variety of constraints. Fundamentally, it is a function of demand, the available catchment area, and the consistency of rainfall. A project with a large catchment area, consistent rainfall, and minimal demand will require a much smaller volume of storage than a project with a small catchment area and large demand, for instance.

There are other variables that will influence the appropriate storage size. Space and financial constraints are important considerations. Additionally, if groundwater proves viable, it can be pumped from the ground more or less on demand, minimizing the need for storage. Designing for possible changes in climate is also important as many areas are seeing dramatic changes in weather patterns that are likely to continue into the future.

A rain barrel

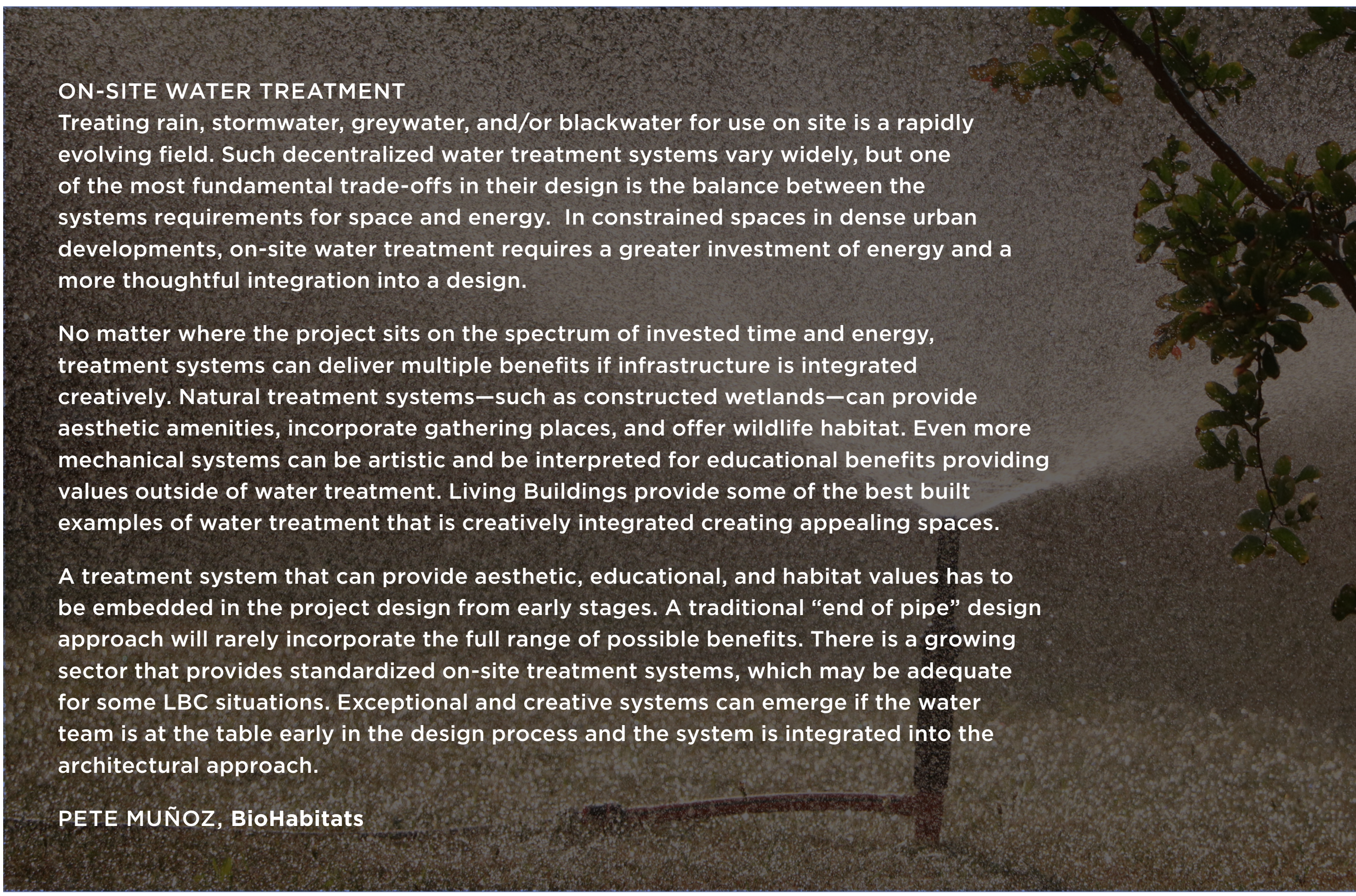
WATER CONSUMPTION

Water use can be minimized through the specification of best-in-class plumbing fixtures and appliances. Best-in-class fixtures generally carry the WaterSense label from the Environmental Protection Agency[9], or are entirely waterless such as waterless urinals or some composting toilets. In residential buildings, showers are one of the leading water demands, making up roughly 17 percent of indoor water consumption. Showerheads should not exceed a flow rate of 2.0 gallons per minute, while maintaining a pressure of 80 psi. High pressure ensures that users don't replace their showerhead with a high-flow unit, or take a longer shower to compensate. In commercial buildings, bathroom use (toilets, urinals, and sinks) make up about 60 percent of total water consumption. High-efficiency toilets, which use no more than 1.28 gallons of water per flush, can make a substantial impact on overall water demand in commercial settings. Dual-flush toilets (which allow users to choose between liquid and solid waste flush) or foam flush composing toilets (which use only three ounces of water and a biodegradable soap) reduce water use even further.

9 https://www.epa.gov/watersense

The project team can minimize irrigation water use by creating a landscape plan that includes native and/or naturalized plants (as described in the LBC Place Petal, Imperative 01) and specifically those plant species which require the least amount of water during establishment phases and, ideally, no irrigation once established or only irrigation from non-potable uses. Per LBC requirements, it is acceptable to use municipal water supply for temporary irrigation to establish plants before the 12-month performance period has begun. It is not acceptable to use municipal water supply to irrigate the plants after the 12-month performance period has started.

In general, the project team should strive to use “fit-for-use” water. Fit-for-use water matches the quality of the water source to an end-use for which that water quality is sufficient, and no more. For example, toilets do not need potable water to do their job and preserve public health. Thus, all of the energy and time used to treat water to a potable standard is wasted on a task for which it is not required. The same is true for irrigation, cooling towers, and clothes washing (in most cases). Consider the ways in which non-potable water can be harnessed from on-site sources and used for these tasks in order to drastically reduce potable and overall water consumption.



ON-SITE WATER TREATMENT

Treating rain, stormwater, greywater, and/or blackwater for use on site is a rapidly evolving field. Such decentralized water treatment systems vary widely, but one of the most fundamental trade-offs in their design is the balance between the systems requirements for space and energy. In constrained spaces in dense urban developments, on-site water treatment requires a greater investment of energy and a more thoughtful integration into a design.

No matter where the project sits on the spectrum of invested time and energy, treatment systems can deliver multiple benefits if infrastructure is integrated creatively. Natural treatment systems—such as constructed wetlands—can provide aesthetic amenities, incorporate gathering places, and offer wildlife habitat. Even more mechanical systems can be artistic and be interpreted for educational benefits providing values outside of water treatment. Living Buildings provide some of the best built examples of water treatment that is creatively integrated creating appealing spaces.

A treatment system that can provide aesthetic, educational, and habitat values has to be embedded in the project design from early stages. A traditional “end of pipe” design approach will rarely incorporate the full range of possible benefits. There is a growing sector that provides standardized on-site treatment systems, which may be adequate for some LBC situations. Exceptional and creative systems can emerge if the water team is at the table early in the design process and the system is integrated into the architectural approach.

PETE MUÑOZ, **BioHabitats**

Again, the guidance above does not replicate the benefit of working with an experienced engineer to design your system. Identify the constraints of your site and project—space, energy, cost, climate, and maintenance, for example—and work with the engineer to design a system that fits the project’s context and needs.

STEP 3. GET IT PERMITTED

Once you've designed an LBC-compliant system[10] and you are familiar with your permitting path—what's possible and what's possibly prohibited—you are ready to engage with the permitting process for your project. The Institute has created several tools to assist you with this process, which is essentially a coalition-building exercise towards a common goal of clean, healthy water for everyone and for the watershed, ongoing into the future.

GENERAL PROCESS RECOMMENDATIONS

The Institute recommends that the project team start the conversation with all relevant jurisdictional entities as soon as possible in the design process. Before meeting, the team should develop one or more high level schematic designs to present, so that they can show how the systems might work. It can be helpful to frame various systems in terms of how they might address the historic and current pressures on the watershed and goals of the agencies, as identified in Step 1. For example, a project team in Chicago might reference Chicago's Green Infrastructure for Clean Water Act,[11] which states that "rainwater harvesting and condensate recovery not only reduces potable water usage but protects, restores, and mimics the natural water cycle." Additionally, the city's Sustainable Chicago report[12] indicated their plan to replace 90 miles of water mains, replace or build 22 miles of sewer mains, re-line 53 miles of sewer mains, and re-line 14,000 sewer structures in 2016 alone. A building-scale water management plan for a project in Chicago would directly address these concerns and priorities stated by the City itself.

10 For the purposes of this guidebook, the permitting process follows the design process. While this phrasing may suggest that project teams should have their water system design complete before engaging with the permit authorities, the Institute recommends involving them very early in the design process, as explained further in this section.

11 www2.illinois.gov/epa/Documents/epa.state.il.us/green-infrastructure/docs/public-act-96-26.pdf

12 www.chicago.gov/content/dam/city/progs/env/Sustainable_Chicago_2012-2015_Highlights.pdf

Some general advice, collected from project teams that have been through the water permitting process is listed below.

- Involve permitting officials early, understand their goals, and be able to talk about how your proposal meets their goals.
  - No regulator will share your excitement about breaking or bending the code.
  - Instead of designing to the code, design to performance standards.
- Ask the permitting officials for their input and advice. Many have extensive experience with water systems and can provide valuable insights.
- Use precedent projects to demonstrate the success of similar water systems and signal your intent to use the same standardized equipment.
- People that approve your system may leave during the design and construction process – keep a paper trail of every meeting and decision.
- Don't take "No" for an answer – if someone says no, ask who else you can talk to.
- Redundancy is key – go above and beyond in your design in order to meet the intent of code.
  - In the worst-case scenario, any systems failure should automatically revert to convention.
- Know your local representatives and make it political – leverage their support and get them on board with the vision.
- When describing LBC to regulators, speak in terms of health, safety, care for the environment, and resiliency.
- Consider the process as ongoing: focus on educating officials and including them in the design, creating relationships, and setting future project teams up for success as well.
- Understand the regional context. What are the trends, what is the history, why are certain regulations the way that they are? This will allow you to make the case that you meet the intent, if not the letter of the codes.


Photo courtesy of Facing Homelessness

The BLOCK Project

In Seattle, a noteworthy process is under way to create a pilot program that will allow BLOCK Homes to be fully self-sustaining from a water standpoint and meet the requirements of the Water Petal in the Living Building Challenge. BLOCK Homes are a 125-square feet home design solution to help end homelessness and strengthen community, developed by BLOCK Architects and Facing Homelessness. The inventiveness and simplicity of the idea (a small home in the backyard of one house on every residential block in the city), coupled with its comprehensive community-based approach to serving the previously homeless resident, has garnered interest and support from citizens, industry professionals, government workers, and elected officials alike.

One such advocate is City of Seattle Councilmember Sally Bagshaw. With her commitment to community, people, and equity, as well as her ability to envision a future where all people are housed, she helped spearhead a process with BLOCK Architects, ILFI, and Herrera Environmental Consultants to convene all the key permitting stakeholders from the city, county, and state to work together to collaboratively develop an approach to successfully permit the project while meeting all agency's concerns. This approach gave everyone a voice, ensured that all ideas and concerns were heard, and allowed those involved to engage meaningfully in a process to address an important local and global issue. As this is not something that permitting officials and regulators often get to do, many were excited to use their experience and expertise in a positive way to craft a path forward.

As of the date of publication, the language for a proposed pilot program is being drafted for Council review and (hopeful) approval.

All in all, state and local codes often do not present an explicit obstacle to the implementation of water reuse strategies. However, since comprehensive performance requirements are not codified, project teams must be prepared to prove their safety and effectiveness on a case-by-case basis, likely involving multiple reviews, inspections, and tests from state and local plumbing and public health agencies.

POLICY TRACKING TABLE

The Policy Tracking Table is a useful tool for staying organized and proactive in your permitting process. It is available for free on the ILFI resources page,[13] along with the Water and Energy Tracking Tables. There are two tabs in the Policy Tracking Table—one for internal tracking and one for submitting to the Institute for our documentation.

The Internal Tracking Assistance tab is used to guide your advocacy process and record your progress as you embark on what may be a complex permitting process. This tab provides a list of potential hurdles, as well as questions to guide the conversation with authorities having jurisdiction. The Institute has provided a short list of common barriers, but each team should independently analyze other potential permitting barriers (as identified on the Water Permit Map if one is available for your area). Add policy issues as rows when they arise. Once you begin hosting meetings with relevant officials, use the questions from this page to guide the conversation, if helpful. You can use the “Approval Process Tracking” columns to take notes and keep track of next steps. Add columns as you engage in additional meetings with permitting agents and regulators. When your team reaches success or pursues the highest form of appeal short of a legal appeal, summarize and move this information into the “Final Policy Tracking” tab for submission to the Institute.

The primary purpose of the Final Policy Tracking tab is to identify regulatory resistance facing LBC project teams. By collecting your experience, we hope to disseminate successful strategies for overcoming barriers to future LBC project teams. The Institute is interested in all policies related to the project—not just barriers. If there was an incentive program, pilot program, or innovative code for which the team qualified and benefitted, please also enter that information in this form. These examples become important precedents for other projects in any jurisdiction to point to during their own permitting process.

WORKING COLLABORATIVELY

It’s crucial that you establish a good working relationship with the regulators that will be permitting your project. The following section will help you start off on the right foot to build and maintain a mutually-beneficial working relationship.

CREATING COMMON GROUND

The groundwork that you lay at the outset of your engagement with your local regulators can go a long way towards setting your team up for success. The following example comes from ILFI’s “Regulatory Pathways to Net Zero Water” report,[14] published in February 2011.

> Between December 2009 and October 2010, Cascadia[15] convened a series of three workshops that brought together key staff from the City of Seattle Department of Planning and Development (DPD), Seattle Public Utilities (SPU), King County Wastewater Treatment Division (KC WTD), Seattle/King County Department of Public Health, Washington Department of Ecology (WA DOE) and Washington Department of Health (WA DOH). The

13 living-future.org/lbc/resources/

14 living-future.org/wp-content/uploads/2016/11/Regulatory_Pathways_to_NetZero_Water.pdf

15 Cascadia Green Building Council, the predecessor organization to ILFI

The Bullitt Center

Cascadia Center for Sustainable Design and Construction,[16] a Living Building pilot project currently in the design and early permitting phase, served as the case study for exploring pathways for approval of net zero water buildings in Seattle. Attendance at the workshops was limited to regulators, water and wastewater utility representatives, and key members of the Cascadia Center's project team.

The primary objective of the workshops was to identify the city, county and state water use, reuse and treatment regulations relevant to a commercial or mixed-use project within the City of Seattle. The Cascadia Center for Sustainable Design and Construction was used as the platform for the discussion, allowing participants to discuss the regulatory pathways the project may seek for approval of its innovative water systems. It was acknowledged that obstacles within the current regulations may be outside the control of the local or state authorities responsible for implementing them and that some solutions will require broader policy changes through legislative efforts.

The workshops were not intended as a forum for any one group to advocate their specific positions on or changes to existing codes and regulations. Rather, the intended outcome was a shared understanding by each agency of the regulations that exist at the various jurisdictional levels and where conflicts or gaps present potential barriers for net zero water projects.

16 Now known as the Bullitt Center.

As part of laying the groundwork for discussion, the group agreed on the following shared goals and assumptions:

- All parties are committed to protecting public health and safety. Any solution to addressing current obstacles to net zero water projects must meet or exceed the intent of current regulations in place to protect public health.

- All parties are committed to a sustainable future with respect to our water resources. Solutions must support long-term resiliency of our water systems and address risks from an economic, environmental and social perspective.

- Pilot projects, such as the Cascadia Center for Sustainable Design and Construction, serve as important models for future sustainable development practices in Seattle.

These three bullets of shared understanding set the groundwork for a productive and ultimately successful permitting conversation for the Bullitt Center. Project teams around the world have reported similar results from early engagement and goal-setting. Though the exact language of these three goals is subject to change for each project, they do capture the essence of what most project teams and public agencies are jointly seeking.

DETERMINING PRECEDENT

Once you've established common goals and values, the discussions of the proposed systems can begin. In this context, your goal is to demonstrate that on-site water systems protect public health while providing a sustainable alternative within large-scale municipal systems. The intent is not to replace or supplant centralized systems, only to demonstrate that alternatives should be available when appropriate and that decentralized systems build redundancy and resiliency into the larger system. One of the most persuasive cases you can make to your local regulators is that another regulator has allowed it in the past without ensuing problems. In general, jurisdictions do not like to be the first to permit a new type of system, so providing them with examples of other successful projects—and even introductions to the permitting authorities—can go a long way.

There are a variety of approaches to and sources for finding examples of precedents. The following websites provide good resources:

Northwest EcoBuilding Guild's Code Innovations Database:
ecobuilding.org/code-innovations

Recode's NEW Nexus Toolkit: **recodenow.org/portfolio/new-nexus-toolkit**

ILFI's Water Policy Case Studies: **living-future.org/policy-advocacy/#tools-resources**

ILFI's Certified Living Buildings Case Studies: **living-future.org/lbc/case-studies**

US Water Alliance's Water Equity Clearinghouse: **uswateralliance.org/wec**

EPA's Case Studies of Individual and Decentralized Wastewater Management Programs:
epa.gov/sites/production/files/2015-06/documents/decentralized-case-studies-2012.pdf

EDUCATING + LEVERAGING

Pointing to precedent projects will help demystify these systems for your local regulators, but nothing will do that job better than seeing the systems in action. If there is a project nearby that uses the technology, take your local officials on a tour there, and/or bring representatives from the project to speak about their experience with the systems at your meetings. Find partners who are experts in their field (engineering, water reuse, utility planning, etc.) and ask them to share information about the importance of diversifying water management systems.

Part of this effort might include finding a champion or advocate that has credibility with the regulators. This may be someone within the health department or an elected official that directs their efforts. Reach out to the Director of Sustainability, if your city has one, or find local EPA officials that might advocate on your behalf. Skip Backus, CEO of the Omega Institute, had a personal connection to Robert Kennedy Jr. and asked him to make a statement of support to the local regulators for his on-site constructed wetland system—an influential move in his state of New York.

Identifying common goals, establishing precedent, educating stakeholders, and leveraging strategic advocates can help ensure a smoother procession of your permitting meetings.

PERMITTING POTABLE WATER SYSTEMS

The permitting path for your potable water system will vary in difficulty depending on the size of your system, the source of your water, and the project's distance from a municipal potable water and wastewater treatment system.

PUBLIC VS. PRIVATE WATER SYSTEMS

First, you will need to determine if your project would be classified as a private or public water system. According to the Environmental Protection Agency (EPA), a public water system provides water to an average of at least 25 people for at least 60 days a year. If your project serves less than 25 people for most of the year, it will be classified as a private water system, and your permitting path will be significantly easier.

Public water systems are further divided as follows, per the EPA:

Community Water System (CWS): A public water system that supplies water to the same population year-round.

Non-Transient, Non-Community Water System (NTNCWS): A public water system that regularly supplies water to at least 25 of the same people at least six months per year. Some examples are schools, factories, office buildings, and hospitals that have their own water systems.

Transient, Non-Community Water System (TNCWS): A public water system that provides water in a place such as a gas station or campground where people do not remain for long periods of time.

If your system is a public water system, it will be held to the standards outlined in the 1974 National Safe Drinking Water Act (SDWA).[17] All states except for Wyoming and District of Columbia have applied for "primacy" in overseeing their compliance—essentially, they have adopted the same standards as are written in the SDWA and manage and permit the public water systems in their state. These states outline a set of requirements around testing for contaminants, reviewing plans for improvements, conducting on-site inspections, and taking action against water systems not meeting standards. Your state likely has a Department of Drinking Water that handles this permitting process. They will be crucial partners.

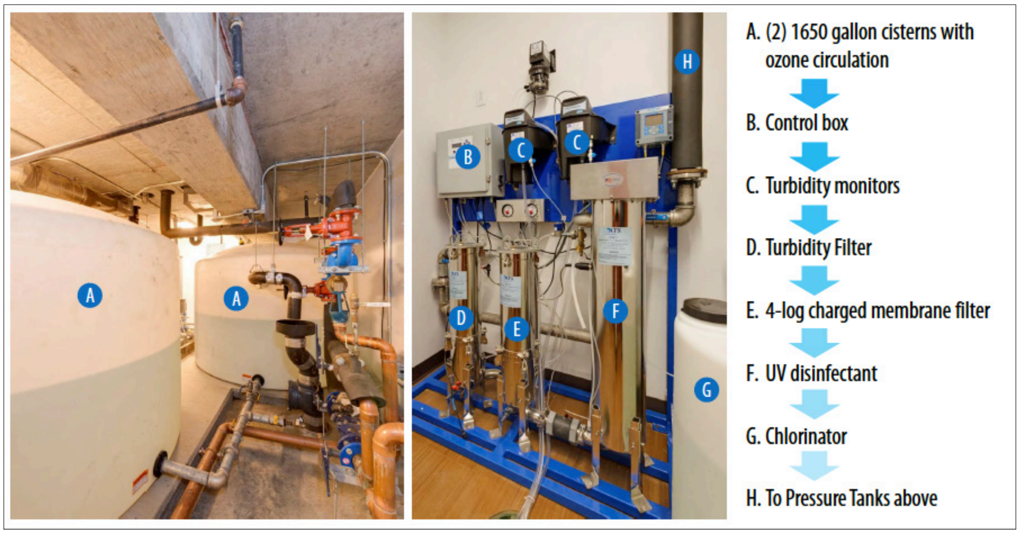
If you are looking to permit a private water system, your path may take a variety of different directions. Generally, counties assume responsibility for permitting private water systems. However, for certain systems (especially rainwater to potable systems), county agencies have been known to defer to the state for guidance. Though you may be working with the same departments for a private system, the testing and equipment requirements will likely be less stringent than for public systems.

17 www.epa.gov/sdwa

POTABLE WATER SOURCES

In general, LBC project teams source potable water from one of two places—precipitation and groundwater.

The permitting path for groundwater is relatively straightforward in rural areas, as it has been a water source for hundreds of years in this country. The two biggest hurdles are contamination and water rights. If your project is located in an urban environment, the aquifer is likely to be contaminated by toxins, an unavoidable obstacle. Work with a hydrogeologist to establish this likelihood early on.



The Brock Environmental Center potable water system

If your project is located in the Eastern United States, the water rights are likely governed by the riparian doctrine, which says if your project is near water, you may make reasonable use of it. If your project is in the Western United States, your access to water may be mitigated by the prior appropriation doctrine which says essentially "first in time, first in rights." This means whoever asked for water access first was granted access to it. In order to drill a new well for your project, you will be required to seek a water right through the state, usually the Department of Ecology. If prior water rights exist, you may not be able to access the ground or surface water.[18]

Harvesting condensate—usually rainwater—is likely to be a more difficult permitting path due to less familiarity with the applicable technology. These systems are more likely to be approved if they are private systems in rural locations or smaller systems in urban locations. Most jurisdictions will require a NSF P151 certified roof covering, NSF 61 pipes and cisterns, a first flush diverter and final chlorination. Work with your engineer to develop a treatment train that meets the requirements devised by your local jurisdiction. It's possible that there won't be any requirements currently in place. If this is the case, you may need to request a variance or pursue permitting through the alternate means and methods pathway.

LBC EXCEPTIONS

Acquiring a permit for potable water is often the most difficult barrier for project teams pursuing the Water Petal. For this reason, ILFI has developed a series of exceptions for project teams, listed below.

Note that the language contained within the following section is taken directly from the Water Petal Handbook. The Water Petal Handbook, in combination with the Dialogue, are considered the definitive sources of all current Exception language.

18 In some places, like Colorado, rainwater collected from rooftops can also be subject to water rights if it surpasses a certain quantity.

I05-E1 4/2010 MUNICIPAL POTABLE WATER SUPPLY

If health or utility regulations require a project to use municipal potable sources, it is allowed, but only for potable uses, including sinks, faucets, janitorial uses, and showers. Non-potable uses such as toilet flushing, clothes washing, irrigation, and equipment uses must use water sourced from the project site. While it is not required, the project is encouraged to include full rainwater harvesting capacity in anticipation of future regulatory acceptance of additional rainwater use.

To use this Exception, the project team must submit design drawings that comply with the requirements of this Imperative to the Authority Having Jurisdiction. Subsequently, if denied, the team must exhaust all regulatory appeals short of legal appeals.

I05-E3 7/2009 CHLORINE DISINFECTION

Chlorine disinfection for potable water uses on projects regulated as "public water systems" under the US Safe Drinking Water Act (or equivalent regulations outside of the US) is allowed. The US EPA defines public water systems as those that have at least 15 service connections, or regularly serve at least 25 individuals. For these projects, chlorine disinfection may be required for regulatory compliance. However, to use this Exception, the project must exhaust all regulatory appeals short of legal appeals. The chlorine added should be the minimum amount allowed by the code. In addition, the project must include and document point-of-use dechlorination with a 0.5-micron carbon block filter or other approved dechlorination method.

I05-E9 4/2017 MUNICIPAL SOURCE OFFSET

Connection to a municipal source is allowed for projects where all of the following conditions are met:

- Water capture and reuse, including rainwater harvest and greywater recycling, have been maximized (legally and technically).
- Water use has been minimized (e.g. best-in-class fixtures and demand-minimizing strategies).
- Ground/well water is not accessible due to contamination, technical, or legal reasons.

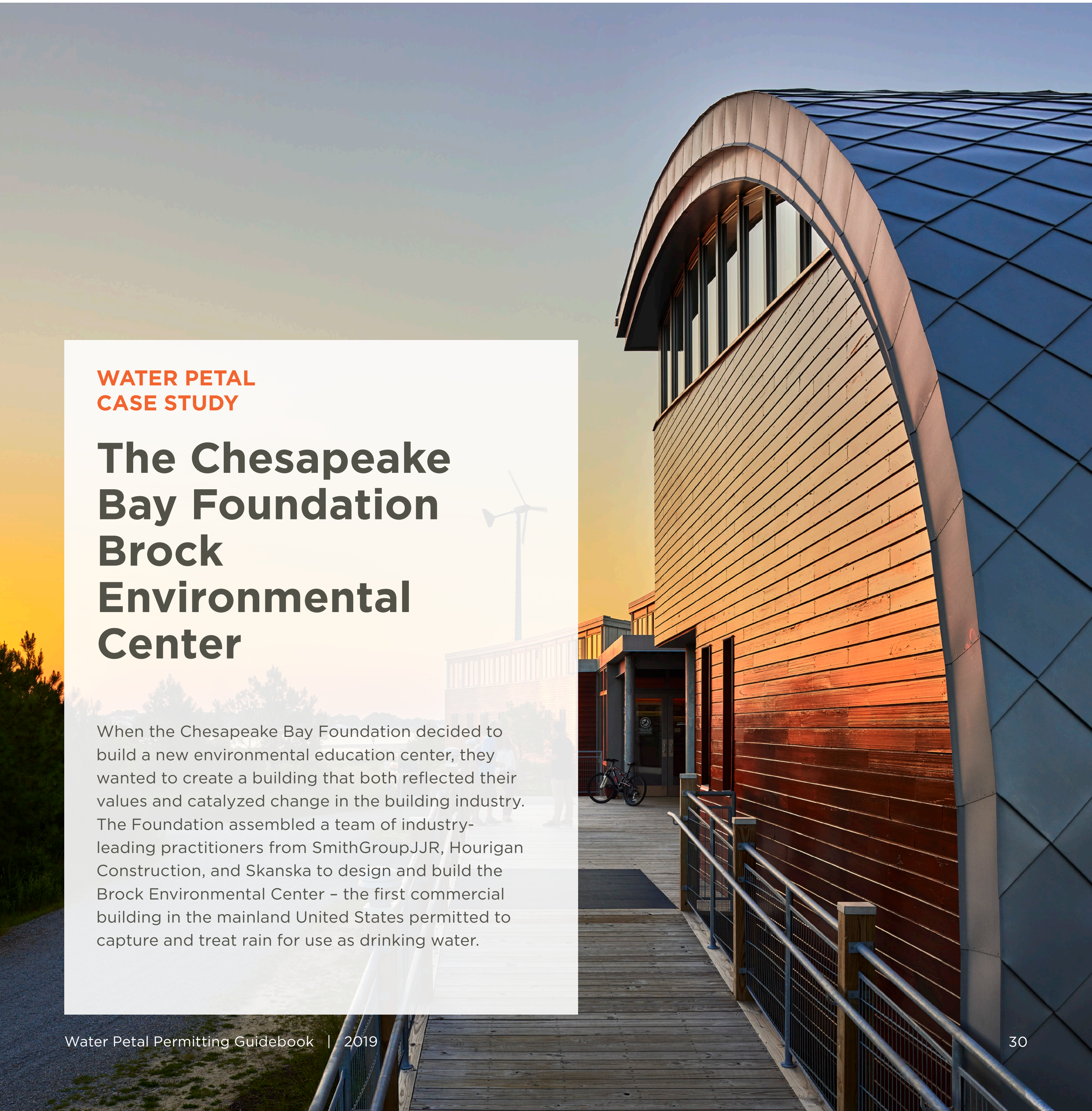
And the project team is able to do all of the following:

- Make a persuasive case that connection to the municipal source is the most sustainable option.
- Show that density, Transect, aquifer limitations, well salinity or contamination, climate, policy, or pollution levels may be contributing factors.
- Implement water efficiency measures in nearby buildings/infrastructure to demonstrate net positive water.
- Show that the resulting annual reduction in water use in the community offsets, at minimum, the project's annual water use so that the municipal use in balance is zero.

Other Exceptions include I05-E8 4/2017 Scale Jumping Within an Aquifer and I05-E2 11/2012 Municipal Water for Fire Protection. Please see the Water Petal Handbook and the Dialogue for a complete list of Exceptions and up-to-date language.

POTABLE WATER CASE STUDIES

The following are two excellent examples of Living Buildings that successfully achieved the Water Petal. In this case, one project team used the Municipal Potable Water Supply Exception and one project team did not use any Exceptions. Both teams met the intent of the Water Petal with creativity, a commitment to advocacy, and in a way that was appropriate to their jurisdiction and watershed.



WATER PETAL
CASE STUDY

The Chesapeake Bay Foundation Brock Environmental Center

When the Chesapeake Bay Foundation decided to build a new environmental education center, they wanted to create a building that both reflected their values and catalyzed change in the building industry. The Foundation assembled a team of industry-leading practitioners from SmithGroupJJR, Hourigan Construction, and Skanska to design and build the Brock Environmental Center – the first commercial building in the mainland United States permitted to capture and treat rain for use as drinking water.

SYSTEMS

RAINWATER HARVESTING

The design uses two standing seam metal roofs to capture rainwater in two 1,650-gallon cisterns (enough to withstand six weeks of drought). Rainwater is filtered through four log filters and disinfected by ozone and UV to supply all water for the building.

STORMWATER MANAGEMENT

Stormwater is managed entirely on site, without reliance upon municipal infrastructure. All hardscape is composed of permeable pavers and gravel, with adjacent raingardens and bioswales to treat and infiltrate runoff. Rainwater that is not captured for use within the building is diverted into raingardens for infiltration.

GREYWATER REUSE

Greywater from sinks and showers is piped to an elevated rain garden for treatment, raised above sea level to allow infiltration despite the high water table.

BLACKWATER TREATMENT

Composting toilets treat waste on site while reducing water demand to an absolute minimum. Composted solids are used on site, while liquid leachate is stored and sent to a local struvite reactor to be converted into fertilizer via secondary treatment.

LOCATION:
VIRGINIA BEACH, VA

TYPE:
OFFICE BUILDING + ENVIRONMENTAL CENTER

SIZE:
10,518 SQUARE FEET

DAILY OCCUPANTS:
27 FULL-TIME, 83 VISITORS

RAINWATER HARVESTED/YEAR:
15,600 GALLONS

WATER USE INTENSITY (WUI):
1.48 GALLONS/SF/YEAR

AVERAGE WUI:*
14.2 GALLONS/SF/YEAR

CLIMATE:
HUMID SUBTROPICAL
48 inches of rain/year
102 days of precipitation/year

**Average WUI by building type according to Seattle 2030 District data*

RAINWATER HARVESTING

Drinking water regulations in Virginia are predicated upon the federal Safe Drinking Water Act, but are implemented and enforced by the State's Department of Health. These regulations govern the design and operation of 'public water works', which serve several thousand people on average, but can serve as few as 25. Because of the Brock Center's projected occupancy, the project was compelled to register as a public water works in order to harvest rainwater for potable use on site. This designation requires a purification system and an operations plan that guarantees the safety of building occupants, visitors, and the general public.

In addition to the complexities of designing a public water works appropriate to the scale of the building, the operational component was also a significant hurdle. Receiving a permit to drink rainwater was unprecedented on a building scale, but devising a way to operate the water system that was cost-feasible for a system of this size initially seemed insurmountable. Virginia typically requires a certain class of operator be consistently present at water works; these operators are highly specialized and expensive to employ.

To reduce expense without sacrificing safety or quality, the project team pursued and was granted a variance that allowed a lower classification of operator to do daily and weekly testing at the Brock Center, supplemented by monthly testing to be conducted by a qualified professional. Their building operator completed coursework at a local university to receive the appropriate designation, and the Brock Center retained an external consultant to satisfy the requirements of the variance.

BLACKWATER TREATMENT

Blackwater treatment at the Brock Center is complicated by the delicate salty marsh ecosystem surrounding the building. The treatment process is fairly straightforward: composting units turn human waste into solid compost and liquid leachate, both of which are fantastic soil amendments.

The challenge at the Brock Center is using the liquid resources on site: the salty marsh ecosystem would be harmed by supplemental fertilization. Luckily for the team, there is a struvite reactor within five miles of the site that converts leachate into organic fertilizer. The project team designed a septic tank that stores the leachate until it can be trucked twice a year to the nearby struvite reactor.

PROCESS

The Brock Center project team realized early on that the regulatory hurdles to achieving net-zero water were significant and would require substantial lead time to overcome. They organized their first meeting with regulatory officials during early schematic design. As the team advanced into the design development phase and began to leaf through the 300-page document governing water works in Virginia, they decided it was time to bring in the experts.

They hired BioHabitats, a consulting firm rooted in place-based design and specializing in sound science and ecological democracy. BioHabitats was instrumental in finding and understanding the regulations that would impact their project. They are well-versed in regulatory jargon, which facilitated improved communication between regulatory authorities and members of the project team. The project team's early engagement paid off — the regulators, initially sceptical, now proudly host retreats at the Brock Center for drinking water officials from around the country.

LESSONS LEARNED

- Engage regulatory officials early in the design process
- Bring in experts who speak the same language as regulators, and may have pre-existing relationships
- Consider the financial implications to the long-term building operations

WATER PETAL
CASE STUDY

Arch|Nexus SAC

In February of 2017, Architectural Nexus moved in to its newly renovated office in Sacramento, CA, hoping to be the first Living Building certified in California. In response to California's recent and reoccurring droughts and energy crises, Arch|Nexus designed the building (dubbed Arch|Nexus SAC) to lay a framework for how to operate in such conditions. Through looking to nature for her concept and looking to place for her roots, the project is an educational and community asset for California. Though the team is still in the midst of their performance period, the project team is well on its way to meeting the Water Petal in the dry central valley of California, where the State legislature just mandated the consolidation of small water systems. As part of their advocacy process, the team found and customized a Water Permitting Map as a valuable visual tool to identify code barriers and generate solutions.

SYSTEMS

Arch|Nexus SAC is equipped to provide all of its own water from rain that falls on the roof. Additionally, any wastewater that is created is treated onsite.

RAINWATER HARVESTING

Rainwater runs off the roof into two large cisterns sunk into the ground and secured with helical piers. The system uses a Netafim microbial filter followed by Blue Future sand filtration system with Aquatec recirculation pump and a Viqua UV filter.

GREYWATER REUSE

All greywater remains in the building. After being treated via a Blue Future gravel and sand filtration systems with Aquatec recirculation pump, it's used to irrigate a green wall and to flush toilets. The water is then piped to the wastewater system leachate tank.

BLACKWATER TREATMENT

The project uses a Phoenix composter with wall mounted JETS vacuum flush toileting system. The in-ground leachate tank is produced by Oldcastle.

RAINWATER HARVESTING

Though California has made it slightly easier for project teams to permit grey and blackwater systems, the state has lagged in allowing for innovative potable water sources, specifically rainwater harvesting. The road became especially difficult when the California legislature passed a law in early 2017 forbidding the creation of a new water district within an existing water district. The law intends to consolidate the water districts so there are fewer jurisdictions to manage, and specifically targets very small cities. It does not take into account the existence of individual buildings that, due to the amount of people they serve, may be considered a "water district" and subject to the same rules.

Though it's currently connected to municipal drinking water, the Arch|Nexus team is collecting, treating and testing rainwater to accumulate a breadth of safe operating data to present to the state. Once it has a compelling case, the team will ask that state for permission to operate as a pilot.

LOCATION:
SACRAMENTO, CA

TYPE:
OFFICE

SIZE:
8,252 SQUARE FEET

DAILY OCCUPANTS:
30 FULL-TIME, 10 VISITORS PER WEEK

RAINWATER HARVESTED/YEAR:
26,624 GALLONS

WATER USE INTENSITY (WUI):
1.5 GALLONS/SF/YEAR

AVERAGE WUI:*
14.2 GALLONS/SF/YEAR

CLIMATE:
MEDITERRANEAN
20 inches of rain/year
40 days of precipitation/year

**Average WUI by building type according to Seattle 2030 District data*

PERMITTING GREYWATER + BLACKWATER TREATMENT SYSTEMS

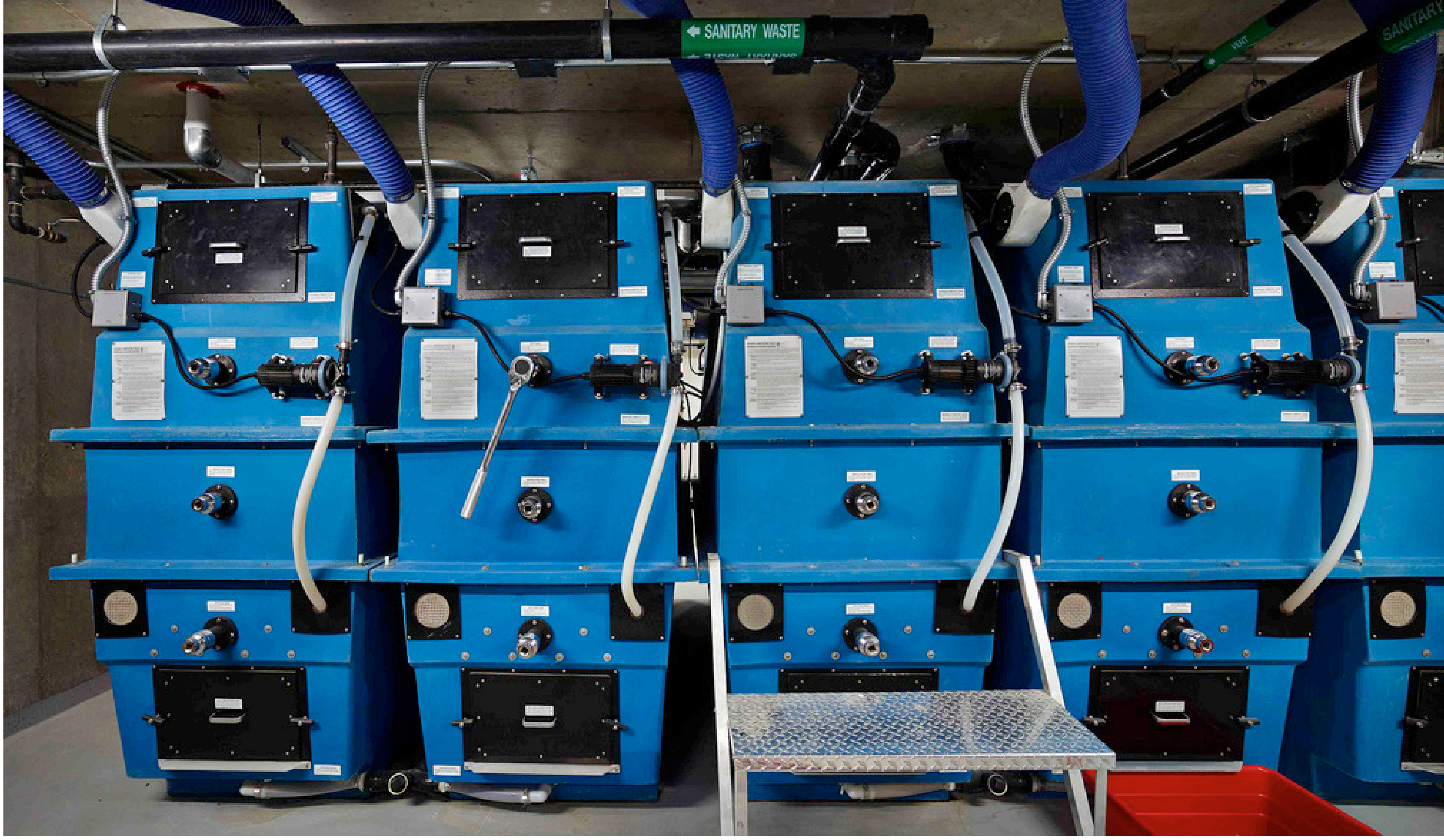
The permitting process of on-site treatment for both greywater and blackwater will depend on the system you use, as well as what you want to do with the treated water. In any case, you will have to ensure that the water you are reusing or returning to the ecosystem is not a public health risk.

CONSTRUCTED WETLANDS

On-site blackwater treatment has legally occurred for over a hundred years in the form of septic systems. Other blackwater treatment systems are essentially just variations on this approach. However, jurisdictions will often struggle to find a box to check for alternative systems, such as constructed wetlands. This means that your project team might bounce around various agencies as the city, county, and state debate the appropriate department.

For example, in 2003, the design team for the Willow School in Gladstone, New Jersey, took one of the first constructed wetland system proposals in the country to the New Jersey Board of Health. The regulators there were interested in the system, but unable to find an existing permitting path forward due to the lack of precedence. The Board of Health recommended that the team present their plan at the county level; unfortunately, they encountered the same situation. After months of working with interested, but ultimately powerless permitting agents, they landed at the Office of Alternative Treatment Systems within the New Jersey Department of Environmental Protection Division of Drinking Water, who agreed to hear their proposal.

The team brought in consultants from around the region to explain their proposed system to the 30 regulators assembled by the Office of Alternative Treatment Systems. The regulators approved the plan with some alterations, and ultimately were supportive enough to streamline their administrative process so that the team could meet their construction deadline. This advocacy effort created a permit pathway for other projects within the state of New Jersey and set a precedent for project teams around the country to reference.



Composting toilets at Bullitt Center. Photo by Benjamin Benschneider

COMPOSTING TOILETS

The difficulty with permitting composting toilets comes primarily from the maintenance and operations side. Permitting authorities want to ensure that the occupants will adequately service the composting system so that they don't expose themselves, building users, or neighboring properties to health risks. Your team will likely have to prepare a maintenance and operations plan to prove that you are prepared for the responsibility.

Additionally, you will need to develop a plan for the biosolids and leachate that are produced as a result of the composting process. Though rich in nutrients, these resources are often regarded as public health risks in disposal. Leachate is the extra liquid that results from all composting processes, including those within composting toilets. Biosolids are the stabilized, organic-based solids removed during the sewage sludge or domestic septage treatment process that have the potential for beneficial reuse. Biosolids are created in the process of blackwater treatment, both at a municipal scale and within composting toilets. Biosolids are classified by level of stabilization and pathogen reduction as either sewage sludge or domestic septage under Title 40 of the Code of Federal Regulations [CFR], Part 503 (or 'Part 503').[19] This regulation establishes requirements for the final use or disposal of biosolids when they are applied to land in order to condition the soil or fertilize vegetation grown in the soil.

To qualify to be land-applied within the United States, sewage sludge must not exceed the pollutant Ceiling Concentrations and Cumulative Pollutant Loading Rates or Pollutant Concentration limits listed in Part 503. However, as detailed below, domestic septage, though it is a type of sewage sludge, must conform to different regulations.

The output from composting toilets is considered to be domestic septage. Domestic septage is sewage sludge that has been removed from a septic tank cesspool, portable toilet, or a similar system that receives only household, non-commercial, and non-industrial sewage. The

19 www.epa.gov/biosolids/plain-english-guide-epa-part-503-biosolids-rule

regulations that govern the pollutant limits of domestic septage are, according to the EPA, "less burdensome but not less protective," than those for the remainder of sewage sludge.

However, these less burdensome regulations apply only when spreading domestic septage on "non-public contact sites," including agricultural land, forests, and reclamation sites. If spread elsewhere, domestic septage will be subject to the same pollutant concentration limits as sewage sludge. If your team is able to identify non-public contact sites to spread their septage, the biosolids will be considered a treated byproduct of domestic septage, and they will need to manage the biosolids according to the "less burdensome" pathogen reduction choices.

If your jurisdiction does not allow you to move forward with on-site use of biosolids as a soil amendment, it is also permissible under LBC requirements to work with a hauler to periodically remove the biosolids for off-site disposal. The Water Petal currently requires that the off-site use is within 100 miles of the project site and that the biosolids are used beneficially.

As an example, the leachate tanks in the Bullitt Center (a fully occupied six-story commercial office building in Seattle, WA) are pumped out roughly every 4 to 5 weeks. There are four leachate tanks, each with a 400 gallon maximum capacity. The leachate is used as fertilizer in a bird sanctuary restoration project. The biosolids remain in the composting unit for 18 months before they are sent to a nearby compost distributer called Loop,[20] where they are heated, mixed with sawdust, and sold commercially as fertilizer.

GREYWATER TREATMENT + REUSE

Greywater is lightly contaminated water from sinks and showers that requires minimal treatment before either being reintroduced to the ecosystem or reused for non-potable use, such as toilet and urinal flushing or irrigation. If you are struggling to meet your water balance, treating and using greywater for your non-potable needs could help you close the gap. Non-potable water accounts for 50 percent of residential water use and up to 95 percent of commercial water use. Toilet and urinal flushing alone can make up to 75 percent of a commercial building's water demand. This presents a massive opportunity to divert potable water resources, and rely instead on treated rainwater or greywater (water that has already been used for handwashing or showering).

In areas with Combined Sewer Systems,[21] collecting and reusing water more than once helps minimize the impact on municipal systems, reducing the instances of untreated overflow during storm events and maximizing the lifespan of the infrastructure itself. It also minimizes the demand on potable water resources, improving the health of the overall watershed and increasing stability in times of drought. Leveraging this bigger picture will help you make the case to the permitting authorities.

There are two organizations that have worked tirelessly over the past few years to create resources for project teams considering on-site non-potable water reuse: Urban Fabrick and the National Blue Ribbon Commission on Onsite Non-potable Water Systems.

20 www.loopforyoursoil.com/gardens-landscapes

21 Per the EPA: Combined sewer systems are sewers that are designed to collect rainwater runoff, domestic sewage, and industrial wastewater in the same pipe. Most of the time, combined sewer systems transport all of their wastewater to a sewage treatment plant, where it is treated and then discharged to a water body. During periods of heavy rainfall or snowmelt, however, the wastewater volume in a combined sewer system can exceed the capacity of the sewer system or treatment plant. For this reason, combined sewer systems are designed to overflow occasionally and discharge excess wastewater directly to nearby streams, rivers, or other water bodies. These overflows, called combined sewer overflows (CSOs), contain not only stormwater but also untreated human and industrial waste, toxic materials, and debris. They are a major water pollution concern for the approximately 772 cities in the U.S. that have combined sewer systems.

Urban Fabrick's Non-Potable Water Reuse Guide: The Non-Potable Water Reuse Practice Guide is written with practicing architects and other building design professionals in mind. It provides simple and powerful explanations of why you may want to consider whether non-potable water reuse makes sense for your commercial or residential project. It also offers easily accessible information and next steps for how to incorporate systems into project design and maximize their value.

You can download the Guide here: **www.collaborativedesign.org/water-reuse-practice-guide**

National Blue Ribbon Commission for Onsite Non-potable Water Systems: The National Blue Ribbon Commission advances best management practices to support the use of onsite non-potable water systems within individual buildings or at the local scale. They are committed to protecting public health and the environment, and sustainably managing water—now and for future generations. Resources include a risk-based framework to develop public health guidance for decentralized non-potable water systems, model state and local ordinances for on-site non-potable water systems, and a report on the business case for utilities to support these systems.

Find a list of their resources here: **www.uswateralliance.org/initiatives/commission/resources**

Once greywater has been reused (or even if it hasn't), it can be treated on site much the same way as blackwater - via a constructed wetland, septic field, or membrane bio-reactor. However, it will require less treatment than blackwater, so if you can treat them separately, you may save energy. In general, treating and using the greywater within the project envelope will reduce the permitting difficulty because it will remain under one jurisdiction (usually local plumbing or local health agencies). If the treated greywater is to be used externally for irrigation, the State Department of Ecology or Environmental Health is likely to also get involved. For this reason, several Living Building project teams (including Arch|Nexus SAC in Sacramento, CA and the Bertschi School in Seattle, WA) have used an interior living wall as the terminus of their greywater treatment system. It improves occupant health, adds an element of biophilia to the space, and completes the final treatment for the greywater in the system before it is released to the air through evapotranspiration.

UTILITY CONNECTIONS + FEES

If you are within 200 feet of a municipal sewer system, it is very likely for both blackwater and greywater that your jurisdiction will require you to connect to the system as a back-up. This connection is often accompanied by an expensive fee, and your team should advocate strongly to the authority having jurisdiction for an exemption from hooking and/or paying the fee.

For example, the City of Virginia Beach usually charges a "line tap fee" to connect to their Sanitary Sewer System. For the Chesapeake Bay Foundation's (CBF) Brock Environmental Center in Virginia Beach, VA, that commercial fee was quoted at $382,000. This cost was based on the volume of sewage for a conventional building of that scale and type, as well as the projected added volume increase to the existing service. The project team applied to the permitting agency Hampton Roads Sanitary District (HRSD) for a waiver, providing information regarding its on-site systems. Since there was a plan to treat all the water on site, or take it off site for treatment, there would be no usage of the municipal sewer. HRSD agreed that usage would be minimal and only in the case of an emergency overflow of the leachate tank. As such, they allowed the project team to put in a residential-sized pipe that aligned with what the flow from the building would actually be if the municipal system needed to be used. The reduction in pipe size came with a reduction in the connection fee. The revised fee was $1,900. This saved the project over $380,000, which more than paid for their entire water system on the project.

Bertschi School Ecohouse and green wall. Photo by Ally Stoneham

Other projects have successfully negotiated a waiver of monthly usage fees since the projects are not actually using the municipal system.

If your team is forced to connect, you should refer to Exception I05-E5 9/2008 Municipal Sewer Overflow Connections, below for additional guidance.

LBC EXCEPTIONS

Acquiring a permit for on-site wastewater treatment can also serve as a barrier for project teams pursuing the Water Petal. In addition, ILFI recognizes that the most ecologically-responsible option for a project may not always be on-site treatment. For this reason, ILFI has developed a series of exceptions for project teams, listed below.

Note that the language contained within the following section is taken directly from the Water Petal Handbook. The Water Petal Handbook, in combination with the Dialogue, are considered the definitive sources of all current Exception language.

I05-E5 9/2008 MUNICIPAL SEWER OVERFLOW CONNECTIONS

If health or utility regulations require an overflow connection to the municipal sanitary sewer system, it is allowed if the team:

- Exhausts all regulatory appeals short of legal appeals.
- Installs a manual valve control that is designed to remain closed.
- Provides a signed statement that the overflow connection was not used during the performance period.

I05-E6 3/2015 MUNICIPAL SEWAGE CONNECTION

Projects in all Transects are allowed to connect to local municipal sewage treatment plants if

all of the following conditions are met:

The treatment plant must:

1. Have a biologically based treatment process with no chemicals.
2. Be within 0.5 km of, and in the same watershed as, the project.
3. Treat water to tertiary levels and return water back to the project for use.

The project must:

4. Have a balance of sewage going out and water returning from the plant.
5. Not overtax an existing combined sanitary/storm system.
6. Not be separated from the plant by a lift station.
7. Include in its energy production, both a prorated amount of energy (i.e., kWh per gallon) from the plant treatment system, and all pumping energy required to move the sewage/ returned water to and from the project.

The team must demonstrate compliance with the above. At a minimum, the narrative must address 1, 3, and 5 above; the data must address 4, 5, and 7; and design documents must address 2, 3, and 6.

I05-E6 11/2014 BLACK WATER TREATMENT FOR MULTI-FAMILY AFFORDABLE HOUSING

Multi-family affordable housing projects of three stories or more are allowed to connect to a municipal sewer system for black water treatment. All project grey water must be treated on site or by Scale Jumping to adjacent sites

GREYWATER + BLACKWATER CASE STUDIES

The following case studies—one from upstate New York in 2005 and one from Pittsburgh nearly ten years later—offer beautiful examples of integrating on-site greywater and blackwater treatment into the site in a way that's beautiful and regenerative, offering multiple benefits to people and the environment.

WATER PETAL
CASE STUDY

Omega Institute Center for Sustainable Living

It was 2005 and Skip Backus, chief executive officer at the Omega Institute, was facing an impending wastewater problem. Located on the hillside of a lake in Rhinebeck, NY, the Omega Institute campus relied on an aging septic system established in 1982. Skip knew that the system would begin to fail in the coming years, a dilemma that he framed as an opportunity for Omega to demonstrate its commitment to environmental systems thinking and public education. Rather than replacing the septic system with a newer model, he and his team began thinking of ways to treat this water as a resource. They wanted a system that was low energy, accessible to visitors and free from chemicals. The Eco Machine™ they constructed not only meets these criteria; the Omega Center for Sustainable Living (OCSL) that they built to house the system has come to define the values of the Omega Institute as a whole and is a shining example of Net Positive Water.

SYSTEMS

POTABLE WATER
Potable water for the OCSL and the rest of the Omega Institute is collected from private wells located on the campus. Demand reduction in OCSL is achieved via low-flow fixtures and a waterless urinal.

RAINWATER HARVESTING
Rainwater is harvested and treated on-site before it is used for the OCSL toilets and hose bibs.

GREYWATER + BLACKWATER TREATMENT
The OCSL facility treats the wastewater of their own building, along with the wastewater from the rest of the Omega Institute campus using an Eco Machine™. The system has a capacity of 52,000 gallons per day and is powered 100% by solar energy generated on-site. The water is purified via microscopic algae, fungi, bacteria, plants, and snails before it is returned to the aquifer. The system consists of six stages:

1. Solid Settlement Tanks
2. Equalization Tanks
3. Anoxic Tanks
4. Constructed Wetlands
5. Aerated Lagoons
6. Land Application

LOCATION: RHINEBECK, NY

TYPE: EDUCATION CENTER

SIZE: 6,250 SQUARE FEET

DAILY VISITORS/DAY: 6 - 30

WATER TREATED/DAY:
APPROX. 25,000 GALLONS

CLIMATE:
HUMID CONTINENTAL
44 inches of rain/year
83 days of precipitation/year

POLICY PROCESS

Permitting the wastewater treatment system was a tedious but ultimately rewarding process for the team. From the outset, they needed to make the case to replace a system that wasn't broken. The Omega Institute had not yet received any Health Code violations for their existing septic system, and regulators were unwilling to modify a currently working system. At the time, there were very few examples of successful on-site waste management in New York, let alone an innovative system like the Eco Machine™.

The team approached each agency and meeting with a collaborative problem-solving mentality. Though they had a plan in mind, they laid out their site context and goals at each meeting, and allowed the regulators to work with them to arrive at the same solution. This strategy put them all on the same team, and helped to form lasting relationships.

WASTEWATER TREATMENT

Ultimately, because the existing code requires that projects with the ability to connect to municipal wastewater do so, the OCSL was permitted under an alternate compliance route. As a commercial facility, the primary licensing agency responsible for issuing this permit was the New York Department of Environmental Conservation.The team submitted their licenses and were approved, but the required water quality testing was no longer funded by the county due to budget cuts.

The Omega Institute agreed to fund this testing, an operational cost that added to an already expensive process. They found that most of the agencies they worked with were under-resourced and understaffed, resulting in additional costs for the team. They were required to pay for an engineer review at the city, county and state level, and they ended up providing additional educational resources to those unfamiliar with their specific technology.

CONTINUED IMPACT

All of the testing and effort paid off. The OCSL consistently hosts tours for the public and project teams looking to replicate their success. The Omega Institute now holds seven years' worth of water quality testing results without a single violation - valuable performance data for regulators and project teams around the world.

WATER PETAL
CASE STUDY

Phipps Center for Sustainable Landscapes

The Phipps Conservatory has been a staple of Pittsburgh's cultural and architectural circuit since 1893, bringing visitors together to discover the beauty of native and exotic botany. In recent years, Phipps has expanded their vision to include displays of the world's most advanced green building technologies and innovative water systems. Jason Wirick was hired onto the Phipps team as the Director of Facilities and Sustainability Management just before the Center for Sustainable Landscapes (CSL) broke ground as the centerpiece of Phipps' focus on regenerative infrastructure. As they delivered the project through permitting, construction and operation, Jason and the rest of the Phipps team pushed the envelope of wastewater treatment while developing strong partnerships with their regulatory agencies.

LOCATION: PITTSBURGH, PA

TYPE: OFFICE + EDUCATION

SIZE: 24,350 SQUARE FEET

DAILY OCCUPANTS:
40 - 50 FULL-TIME

VISITORS PER YEAR: 250,000

RAINWATER HARVESTED:
500,000 GALLONS/YEAR

CLIMATE:
HUMID CONTINENTAL
38 inches of rain/year
80 days of precipitation/year

SYSTEMS

The focal point of the CSL water system is undoubtably the constructed wetland and lagoon, which together capture and treat the site's stormwater and wastewater. This water, along with captured rainwater, offsets 93% of Phipps' municipal water use.

RAINWATER HARVESTING

Rainwater is harvested from the roof, treated via UV filter and used for toilet flushing, as well as interior irrigation and maintenance as required. Any excess rainwater is stored in a 60,000 gallon storage tank.

STORMWATER MANAGEMENT

Any stormwater runoff from the site is captured by a lagoon system, which replicates the natural processes of local wetlands and marshes. It's treated to tertiary non-potable standards and is stored in the rain tank for irrigation.

WASTEWATER TREATMENT

All wastewater from the CSL and the adjacent maintenance building is treated with a constructed wetland and additional sand filtration. A UV filter further disinfects the water to greywater standards. Excess treated sanitary water is redirected to an Epiphany solar distillation system, which uses solar energy to distill the water to pharmaceutical grade for use in watering orchids.

WASTEWATER TREATMENT

The Center for Sustainable Landscapes is situated on a former brownfield that had leaking underground storage tanks and highly compacted soil. Part of designing a Net Positive Water project involved cleaning and restoring the soil, so that the water that is infiltrated back into the aquifer is not contaminated.

After remediation was complete, the team's design started to evolve based on conversations with the Pennsylvania Department of Environmental Protection. In 2012, the DEP published its "Reuse of Treated Wastewater Guidance Manual," which Jason and his team used as a permitting guide. However, this document never formally recognizes greywater – any potable water that has been used is considered blackwater and subjected to more stringent treatment processes. This prevented the team from using treated greywater for anything other than toilet flushing and irrigation, and also increased the cost of treatment.

Additionally, as with many Net Positive Water projects, Jason and his team struggled with issues of scale. As a public education center, they are larger than a private residence or office but much smaller than a municipality or community. Unfortunately, most regulatory agencies (including Pennsylvania) will defer to the larger of the two options, which makes treatment and operation costs unreasonable for mid-sized publicly accessible institutions like Phipps. Fortunately, the Phipps team found a lawyer that was willing to negotiate these conditions down pro bono, creating a precedent for future projects.

THE RIGHT ATTITUDE

In the process of permitting and operating the Center for Sustainable Landscapes, Jason Wirick picked up a few winning strategies. Respect and communication were essential to forging a mutually productive partnership. Jason and his team recognized that the regulators they worked with had years of experience with the status quo keeping people safe. They brought code officials out to the site throughout the design process to create a more collaborative process.

PERMITTING STORMWATER SYSTEMS

A NATURAL SYSTEMS APPROACH TO WATER MANAGEMENT

Every facet of life, from water bodies to occupiable wildlife habitat, is affected by stormwater runoff. Pollutants carried by that runoff adversely affect the health of our watersheds. Taxpayers are required to pay additional taxes to operate the water or sewage treatment plants that remove these pollutants prior to the water being distributed to homes or discharged back into the system. The degradation caused by urban stormwater pollution has become a costly issue and is only growing in the age of climate change. Any increase in impervious surfaces leads to flooding, erosion, habitat destruction and lower water quality. In 2017, flooding from major storm events cost over $306 billion dollars in property damage in the U.S. alone. These costs do not even begin to consider the impacts on human health and habitat destruction. The Living Building Challenge seeks to replicate natural systems by encouraging green infrastructure, bioretention and on-site treatment, thus reducing the impact on aging infrastructure and lowering the probability of flooding. A 2017 study released by the Urban Land Institute demonstrates that this approach to stormwater management actually grows the value of a building and its site.[22]

SEEK SUPPORT - DON'T TAKE NO FOR AN ANSWER:

Permitting and public works agencies are in the business of regulating. They are typically not in the business of promoting innovation or making exceptions to rules. Since the industrial age, they have mostly existed for the purpose of aligning standard processes and procedures based on engineered systems, rather than bioengineered strategies. The best way to make progress when seeking success for the Water Petal as it relates to stormwater may be in expanding the conversation to a wide range of governance agencies in the business of putting the environment and natural systems first.

If you are seeking to permit an integrated on-site stormwater management system, you first want to identify progressive supporters; e.g. natural resource officers, planning commissioners, watershed experts, city council members tasked with environmental portfolios and others who influence sustainability at a city, county or regional level. These individuals possess significant influence when it comes to actively seeking progress for the built environment as it relates to ecological performance.

22 https://americas.uli.org/wp-content/uploads/sites/125/ULI-Documents/HarvestingtheValueofWater.pdf

ACCESSING INCENTIVES:

Since the 1990s, when incentives for green building started popping up for various rating systems, there has been a substantial growth in voluntary sustainable development. Expedited permitting, reduced permit fees and stormwater utility fee reductions have helped move the dial in terms of building performance and the adoption of third-party rating systems, like the Living Building Challenge.

Although the mission of the International Living Future Institute and the Living Building Challenge is to create a market place for Living Buildings, it is also part of a broader network to address a sustainable future for all and to be present in a network of like-minded organizations leading the way. Nowhere is this more evident than in the City of Shoreline, Washington, a suburb of Seattle. With high land costs in Seattle, Shoreline experienced recent exponential growth. In 2017, leadership adopted a multi-tiered system that incentivizes the LBC as a top tier for permit fee reduction of up to 75 percent. In addition to cost incentives, other types of incentives such as additional floor area ratio (FAR) were also explored and encouraged. Increased FAR helps reduce building footprints and typically offers more efficient construction while maximizing square footage of leasable space in commercial development.

Local utility incentives are also a practical way to encourage stormwater management through the LBC. Longer term strategies such as reducing utility hookup fees and lowering the cost of utility rates can incentivize developers to consider implementing the Water Petal, as its returns are easily quantifiable. In the City of Bellevue, WA there is a stormwater utility incentive implemented by the Storm and Surface Water Utility, where fees are reclassified for individual parcels to the next lower level land use threshold. For instance, a 66,000 square foot lot is reclassified to a lot scale of 35,000 square feet and measured by its percentage of impervious surfaces and functional green infrastructure. The utility is authorized to defer charges on the "undeveloped" portion of the site and/or cap the utility hook up fee. Rates are escalated by the amount of pervious surfaces and also programmatic uses, such as light, moderate or heavy development tied to the building footprint.

A non-government example of stormwater incentives propelled by private/public/investment partnerships is The Nature Conservancy's (TNC) program in Washington D.C. As part of a campaign to reduce the stormwater pollution in the area, Prudential Financial invested $1.7 million into a partnership with TNC's NatureVest and Encourage Capital called District Stormwater LLC (DS). The pilot project is the driving force behind new strategies to sustain the first Stormwater Retention Credit (SRC) trading program in the U.S.

The new enterprise—jointly managed by NatureVest and Encourage Capital—will help finance the development of green infrastructure projects on properties across the city that measurably reduce stormwater run-off through proven distributed nature-based solutions. These investments will create credits to boost the SRC trading market. The SRC market enables developers, who are required to manage stormwater runoff on projects, to meet their mandated requirements by purchasing credits from offsite designs that reduce stormwater runoff, like rain gardens, green roofs, permeable pavement and other green infrastructure practices. This approach combines science, financing expertise and local relationship building to tailor solutions that will help make the SRC market function.[23]

ELLEN SOUTHARD, **Puget Sound Manager, Salmon-Safe**

23 http://www.naturevesttnc.org/investment-areas/green-infrastructure-for-cities/dc-green-infrastructure/

CONCLUSION + ADDITIONAL RESOURCES

This guide is deigned to prepare you and your project team to embark on a journey of education, collaboration and, hopefully, successfully permitting and certification of your Net Positive Water system. If you would like to learn more about these topics and other research that the Institute has completed, see below.

You can find more Water Policy Case Studies on our website, at: **living-future.org/policy-advocacy/#tools-resources**

The Institute has published many reports on water policy over the last ten years. These can be accessed at: **living-future.org/research/#water**

Our online learning center offers a wide variety of opportunities to continue your education, including our 5-Part Water Webinar Series. Learn more on our online learning page: **living-future.org/online-learning/**

For any additional questions, please email **lbc.support@living-future.org**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