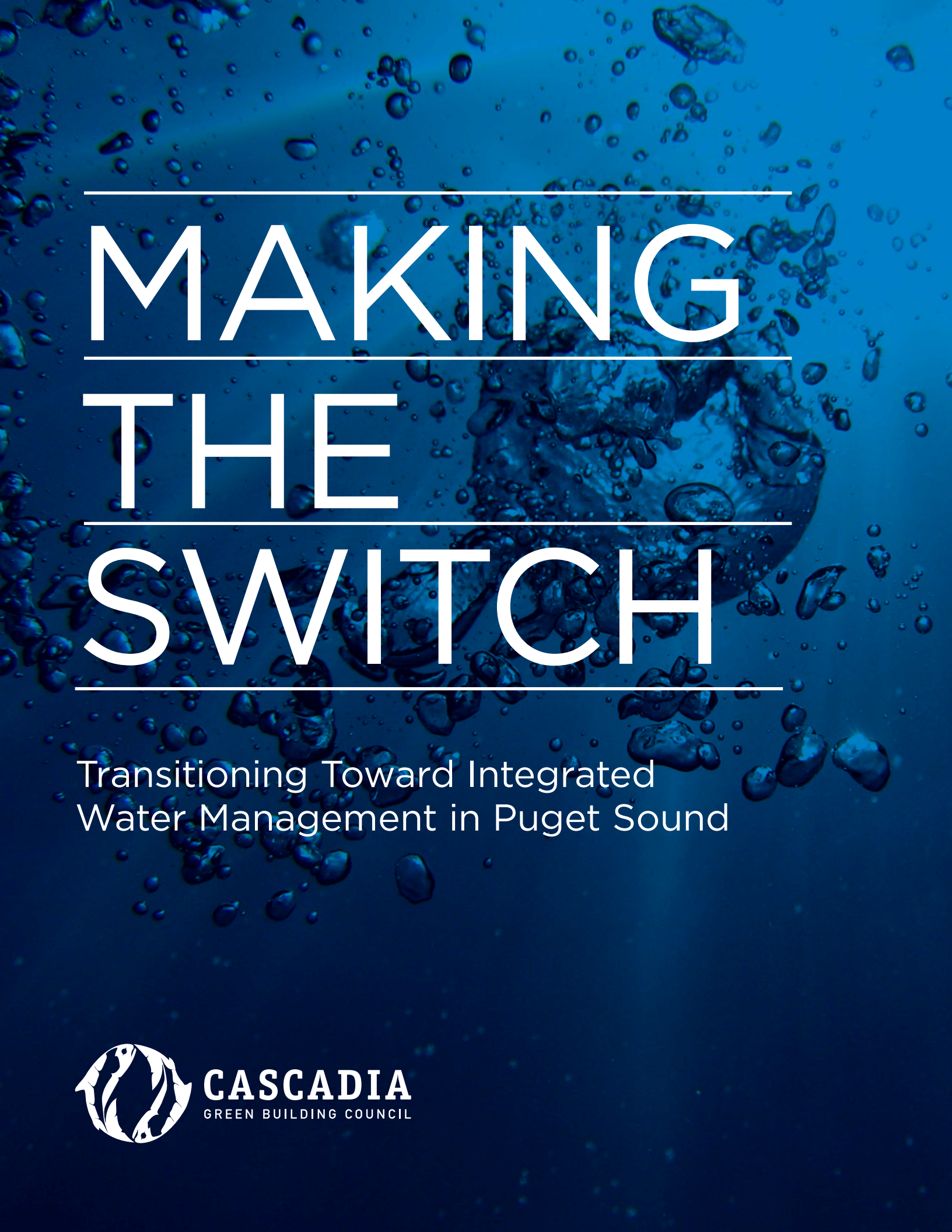

MAKING THE SWITCH

Transitioning Toward Integrated Water Management in Puget Sound

CASCADIA
GREEN BUILDING COUNCIL

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I INTRODUCTION & BACKGROUND

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Founded in 1999, the Cascadia Green Building Council is a chapter of both the Canada and the U.S. Green Building Councils. We promote the design, construction and operation of environmentally responsible, profitable and healthy buildings in Alaska, British Columbia, Washington and Oregon. Cascadia is a program of the International Living Future Institute and advocates for progressive policies at the local and state levels in support of LEED® and the Living Building Challenge℠. Cascadia provides valuable research to help policy leaders make informed decisions for the health of their communities and the environment.

Around the world communities are beginning to see the need to turn away from the conventional methods of water management and focus instead on integrated and decentralized water management. In the Cascadia bioregion we see great opportunity for this leadership. Indeed, here in the Puget Sound basin we should be on the cusp of a transformational change in our approach to water infrastructure.

For years, municipalities, utilities, green building professionals and community members have been talking about a new vision for water: seeking site-specific or small-scale systems that no longer require vast amounts of energy to pump water many miles away to a central treatment facility; ceasing to watch hundreds and hundreds of gallons of precious water disappear in leaking infrastructure; capturing nutrients literally flushed away and return them to otherwise nutrient-starved fields; refusing to invest more public money in a system that is no longer tenable; improving our community resilience and addressing the risks posed by a centralized system failure; and of course maintaining stringent health standards that keep our residents safe.

We have learned that most practitioners agree that the customary approach of managing our water supply and treatment no longer works and causes more problems than it solves.

Then, why are we stuck in the old paradigm?

The time for visioning is at an end. We must begin the transformation now. This report outlines a roadmap to change fundamentally our approach to water infrastructure, policy and economics.

Background

Our collective history of managing our waters is a tale of revulsion, marketing and habit. In 19th-century Puget Sound communities, early residents often collected their waste in wooden troughs and dumped it out the window to the street below or into local water bodies—both discharge points eventually leading back to Puget Sound. As concerns arose about sanitation and waterborne illnesses, such as cholera, dysentery and typhoid, these primitive decentralized systems were replaced by centralized systems.

Cultural perceptions soon began to mirror these technological advances, and our waste was deemed uncivilized. So-called 'enlightened' communities endorsed the indoor flush toilet and vast treatment plants—sending our waste away from our communities to a remote somewhere, anywhere else. In this way, 'out of sight, out of mind' became and remains the preferred model for wastewater management.

However, this historical mindset does not reflect the technical innovations of the past 200 years, nor does it acknowledge the true costs of maintaining a large, centralized sewage system. These associated problems have been addressed at length in other reports, but here is a reminder of a few critical and urgent issues:

Economic realities:

- Local governments are burdened with costs in the billions for maintaining an aging system, not to mention the added costs for expanding it to accommodate new development as it hooks into the sprawling network of pipes.
- As current business models are based on revenues from new sewer connection fees, the conventional approach of water management ties business survival to an ever-expanding network; decentralization is financially discouraged.

Social impacts:

- So long as we continue to rely on centralized systems we perpetuate risk to surrounding communities should the system fail as a result of storm events, earthquakes, disease outbreaks, or even terrorism; these system failures and their resulting catastrophic events, as we have seen time and again around the world, challenge a community's ability to be resilient.
- Because communities and businesses often argue against the placement of centralized treatment facilities in their neighborhoods, the reality is that these industrial sites are often built in areas populated by lower-income and disenfranchised residents and thereby submit its neighbors to the less-than-desirable view and smell as well as the associated lower property values.

Environmental costs:

- A true life cycle analysis of a centralized system and the energy expended in pumping water to and fro reveals enormous environmental impacts, often hidden by conventional analyses that fail to account for the total costs. In the United States, the Environmental Protection Agency (EPA) estimates that drinking water and wastewater systems account for approximately 4% of the country's total energy use and annually contribute at least 45 million tons of greenhouse gases. Locally, this energy use is magnified where we see upwards of 30% of total energy consumption by municipal governments used for treating drinking water and wastewater.

Changing Our Approach

Over the past several years, the Cascadia Green Building Council has sought to broaden the discussion around our transformed relationship with water. We continue to work with local partners within the bioregion to address some of the large-scale obstacles that stand in the way of this progress. As part of our "Call to Action" we have met with hundreds of stakeholders from around Washington and held multiple workshops to identify collective barriers and articulate a shared vision for designing, building and operating healthy and resilient water management systems.

Rather than a traditional model based on disconnection from the natural water cycle, overconsumption of precious resources and the production of pollution and wastes, Cascadia has encouraged a shift to the integrated approach articulated within the Living Building Challenge. We must move toward communities that operate efficiently within the resources available to them, are climate adapted and view waste as a resource.

Unfortunately, despite the goodwill generated during these past workshops, progress remains slow. Many jurisdictions around Puget Sound continue to face regulatory and other barriers. We must do more and faster—a major paradigm shift is needed when it comes to water and how we manage its supply, treatment and conveyance.

"Centralized municipal or regional waste treatment systems are not only far from being the ideal solution, but they are creating significant problems that can no longer be ignored."

JASON F. MCLENNAN

II OUTDATED THINKING

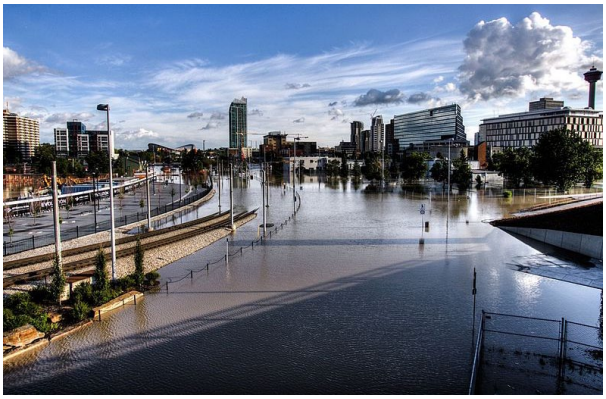
Local communities around the globe are facing a variety of water-related challenges that provide a sense of urgency to our Call to Action. Most recently we have seen the power of droughts and floods as they wrecked havoc on towns across America and Canada. The recent floods in Alberta, deemed by some officials to be the worst in the province's history, resulted in loss of life, devastation to thousands of homes, 27 local states of emergency declared and the evacuation of 75,000 residents in Calgary alone. Preliminary estimates suggest it will cost close to $4 billion Canadian dollars to repair the damage caused by this catastrophe.

As bad as these disasters have been, what is perhaps most worrisome is the changing reality in which we will see more and more of these type of disasters. As our weather patterns continue to shift in response to our changing climate, we are likely to see more extreme and more frequent storms and the damage they cause.

Compounding these challenges to our local and economic resilience is an aging infrastructure. Mostly designed and built over 100 years ago, our water supply and wastewater treatment infrastructure is in need of extensive and costly repairs or expansions simply to maintain the status quo. This expense increases when we consider the anticipated growth in population that it must be ready to accommodate. In the United States alone, engineering costs to upgrade the infrastructure are likely to exceed $250 billion, according to the American Society of Civil Engineers.

While many practitioners see the need for change, there remains a lack of priority in our collective effort. Indeed it is common to disassociate our society's daily activities—including our cultural disconnectedness from water itself—from the threats facing Puget Sound and other waterways' natural ability to achieve balance.

The June 2013 flood that severly damaged Calgary and surrounding areas.



What are the waters of Puget Sound telling us?

Puget Sound is an integral part of life for all of us in the area. Here we see salt water of the Pacific Ocean mingle with freshwater from our rivers and streams; we see mountains meet the sea; we see an economic powerhouse of approximately $370 million generated through trade, travel, shellfish and fish harvest alongside marinas, kayakers, recreational fishermen, and hundreds of thousands of watercraft each and every year.

Puget Sound is the second largest estuary in the United States. Approximately 3.5 million residents live in the Puget Sound region, with an estimated 2 million more living here by 2025. There are 15 tribal nations, 12 counties, and 115 cities in the region. Our industries, communities, agriculture and tribes all look to our local waters for economic prosperity, development opportunities, recreation and a critical human connection to our natural wildlife and beauty.

But, as is occurring on waterways the globe over, this close relationship between people and the Sound has come with a price. Many species on or near the water are threatened with extinction, and our day-to-day lives have polluted our waters with oil and waste. While we are not paying now for these costs, eventually this environmental bill will come due. Expansive development and suburban sprawl continues to take place across the region with severely damaging implications for our infrastructure, water scarcity, wildlife and carbon emissions.

On top of this damage, we are also seeing climate impacts across Puget Sound and the wider bioregion. The reduced snow pack has begun to lead to declining water supplies. While some local utilities and municipalities have been proactive in implementing water conservation and stormwater management programs to limit our demand for potable water, these programs are simply not enough to accommodate the changing water picture in Puget Sound. Indeed, meteorologist predictions indicate that our region will continue to experience drier summers and wetter winters.

We cannot wait any longer. In fact, the news that our global population recently topped 7 billion and atmospheric carbon crossed the 400 parts per million threshold is a reminder that the time for action yielding results in the fight against climate change is rapidly coming to an end.

The truth is that there is no absolutely need, in 2013, to continue to build, operate and maintain costly, risky and carbon inefficient systems. We could and should be instigating radical changes to our approach and instead promoting more integrated and decentralized systems that not only are cost effective but also contribute positively to our environment and communities.

Around the world and in Puget Sound, we simply must transition faster to integrated, sustainable water management—to address hundreds of years of discharge and improve the health of our beloved waterways; to accommodate development happening across the basin and support future resilient communities; and ultimately, to strike a necessary balance between our growing population and the nature that provides for us.

Best Practice

The good news is that technological innovation now offers us the chance to manage our water resources differently and more efficiently. Locally and further afield we can see new systems designed and implemented to value, conserve, reuse, recycle and return water within respective watersheds. Local experimentation is essential to achieve our new paradigm.

In the following case studies, local innovators have been experimenting with more resilient, integrated water management systems. With varying degrees of success, each community has attempted and is continuing to attempt to make the shift from the old, conventional ways of managing water to a more enlightened approach. But, as we will see, successful tranformation requires concurrent change at all levels. We can learn a lot from these local experiments in what instigated their transition, the policy structures that supported it (or not) and implementation thus far.

INTERNATIONAL CASE STUDIES

The Netherlands: IWRM

The Netherlands sits within the delta of three major European rivers and receives an average of 30 inches (76 centimetres) of annual rainfall. The majority of the country is subject to sea or river flooding, with increased risk resulting from climate change and associated sea level rise and increased storminess. The transition toward a more integrated approach has occurred over several decades.

Concepts of Integrated Water Resources Management (IWRM) were first introduced into national policy in the mid-1980s, but it was not until historical flooding during the following decade that of a sense of urgency instigated the transition. As noted by Dutch scholars, "The floods made instantly clear that the current water management strategies could not fully control the water. Thus, as a result of the floods, the regime had to abandon its dominant strategy" and began to adopt local experiments across the country.

The paradigm shift in the Netherlands involved an accumulation of knowledge amongst its water practitioners alongside a growing cultural awareness of flood risk and the need for action. As a result, the government of the Netherlands has shifted from a siloed engineering effort to a more participatory, holistic management approach. This new approach, IWRM, "gives full consideration to surface and ground water, to quantity and quality issues, to ecology, to the relation between land and water resources and to the different socio-economic functions of the watershed". Today, water has become a guiding factor for the Dutch in land use planning.

As we transition within the bioregion, we can learn from the Dutch experience. We see that it took a national crisis for the Netherlands to move away from their historical approach and adopt alternative approaches into their mainstream water management policies.

Here, in and around Puget Sound, will we wait for a catastrophe to force us to accept the facts and see that a new, more resilient and integrated approach is needed?

Water management style 20th century	Water management style 21st century
Command and control	Prevention and anticipation
Focus on solutions	Focus on design
Monistic	Pluralistic
Planning-approach	Process-approach
Technocratic	Societal
Reactive	Anticipative and adaptive
Sectoral water policy	Integral spatial policy
Pumping, dikes, drainage	Retention, natural storage
Rapid outflow of water	Retaining location-specific water
Hierarchical and closed	Participatory and interactive

Adapted from *The Transition in Dutch Water Management*, Rutger van der Brugge, Jan Rotmans, Derk Loorbach.

INTERNATIONAL CASE STUDIES

Australia: Federal Intervention

Communities across Australia rely on surface water sources for their water supply, and thus, as a predominantly arid country, Australia faces scarcity challenges. These challenges are exacerbated by global climate change, which is causing changes in rainfall patterns, increased evaporation rates and extreme droughts. Predictions suggest that the country's growing urban centers will suffer increased water shortages in the future. The Australian government has sought to address this vulnerability through innovative national policies.

In 2004, the federal government established the National Water Initiative. This initiative promotes the adoption of best practices in sustainable water management and creates new governance structures at the catchment level. These newly established "Catchment Management Authorities" oversee production of catchment strategies, implement floodplain management strategies and act as referral authorities for land-use and development applications. In this way, the Catchment Management Authorities seek to regulate projects that can impact on waterways.

The Australian government also implemented the Commonwealth Water Act in 2007 in order to require basin-wide plans outlining how to achieve sustainable levels of water caps and trades.

These federal measures seek to encourage a shift in the way water resources and water infrastructure are considered in the planning and design of cities and towns.

We see this transition happening in some Australian states and territories where Water Sensitive Urban Design is mandatory for certain scales and types of development. However, adoption of this innovative approach has been limited to a few projects. In response, the Australian federal government has published "Evaluating Options for Water Sensitive Urban Design" to provide guidelines and assistance for local jurisdictions to adopt the approach on a more widespread scale.

As in the Netherlands, we see in Australia an incremental transformation to more integrated, resilient water management. In Melbourne, for example, this change has been ongoing for more than 50 years. Starting in the 1960s, as a result of burgeoning social activism, the desired policy transition continues to evolve through new government policies and financing tools put forward in 2006.

Pressing development needs and a damaged ecosystem mean we cannot afford this type of slow change in Puget Sound.

Persistent drought conditions in Australia.

INTERNATIONAL CASE STUDIES

York Region, Canada: Soft Patch

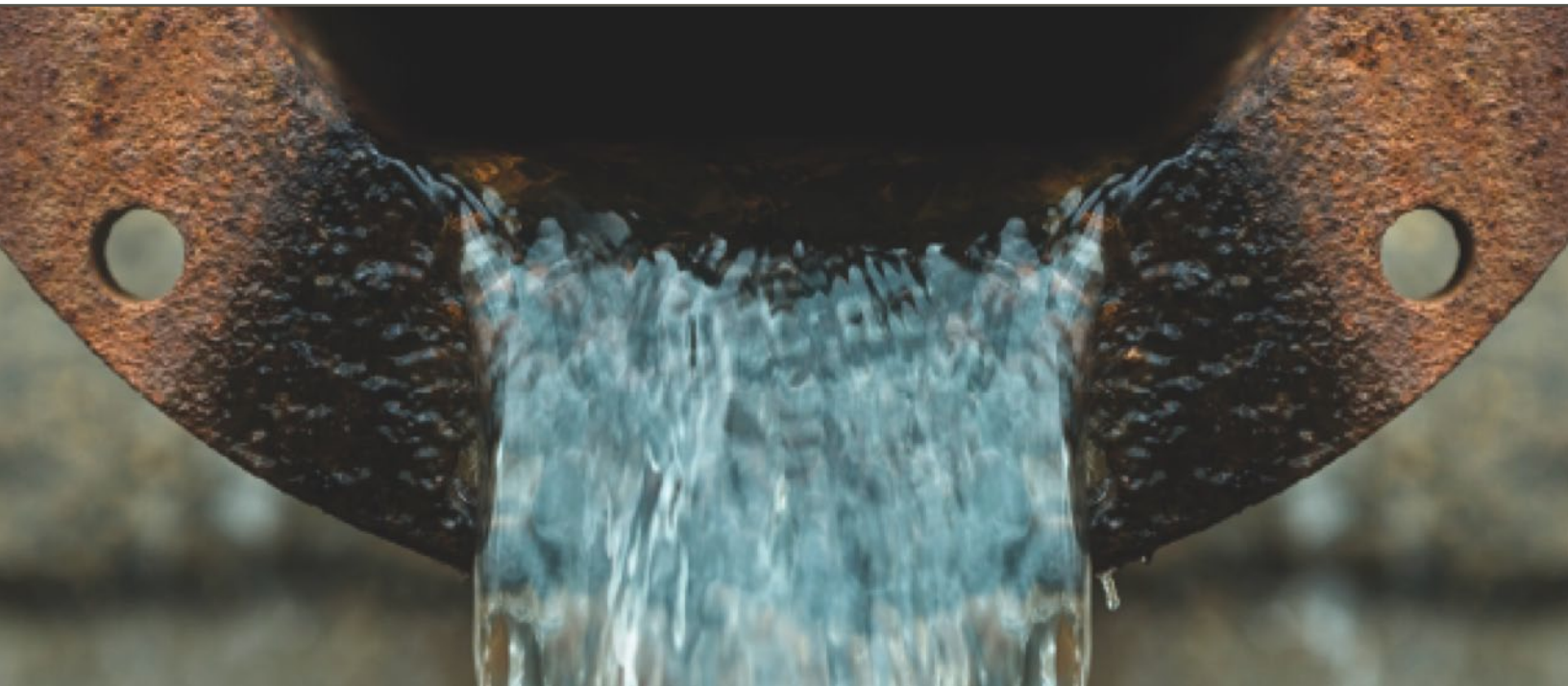
The York Region, located within the Greater Toronto Area of Ontario, covers 678 square miles (1,756 square kilometres). It includes nine local municipalities and is one of the fastest growing regions in Canada with population projections close to 2 million residents by 2051. Due to its rapid expansion and increasing pressure on water supply and wastewater treatment systems, the Region has implemented an ambitious Long Term Water Conservation Strategy focused on "Water for Tomorrow" through innovative water conservation and efficiency programs, water resource protection, energy conservation and greenhouse gas reduction.

As part of their strategic planning process, the York Region adopted a "Soft Path" approach to water management that differs fundamentally from a more conventional, supply-focused 'hard' infrastructure approach. This Soft Path focuses on holistic or integrated water management and seeks to take into account ecological limits. It establishes ways to meet water needs far into the future through new policies and strategies focused on conservation, efficiency and reuse at a local scale.

In order to develop a successful approach, the York Region has been proactive in engaging stakeholders throughout the area in developing a shared vision for their water future. The result is an aggressive target of "No New Water" by 2051, which uses a back-casting method to establish limits on total water used in 2051 that are equivalent to the Region's total consumption in 2011.

Implementation of this plan is ongoing. So far, the Region has implemented financial incentive and rebate programs for homeowners and businesses as well as amended provincial building codes and legislation to allow high efficiency plumbing fixtures. In future they will eventually require the use of reused water as a supply source for outdoor and non-potable uses, with an estimate start date of 2021. To date, the York Region has saved an estimated 6 million gallons (22.4 million liters) of potable water per day, enough to supply a community of 88,000 residents.

As a trailblazer in applying the Soft Path approach at such a large scale, the Region can instruct us on employing an iterative process so that learning can occur for the Region as well as its partner stakeholders involved in water management.



NATIONAL CASE STUDIES

Tucson, AZ: Rainwater Harvesting Ordinance

In 2010, the City of Tucson, Arizona instituted the country's first commercial rainwater harvesting ordinance. The ordinance mandates that all new commercial construction supply at least half of the water used for landscape irrigation with water harvested on-site. In addition, it requires commercial developers and property owners to prepare a site water harvesting plan, submit a water budget, meter their outdoor water use, and use high efficiency irrigation controls that respond to soil moisture conditions. The ordinance supports rainwater harvesting systems that channel runoff from commercial rooftops as well as parking lots.

This new ordinance is essential in helping the City of Tucson address water scarcity issues. On average, Tucson receives 12 inches (30 centimetres) of annual rainfall, and the majority of its water usage goes toward landscaping efforts. The rainwater harvesting ordinance helps to reduce the demand and costs for potable water and is a simple and effective method for water conservation.

In developing the ordinance, the City of Tucson convened a technical advisory group made up of landscape designers, civil engineers, maintenance workers, and others. This group created the development standards and technical specifications for the rainwater systems. Initially the City proposed a requirement for 100% rainwater capture; however, public input and technical feasibility studies influenced the requirement to be reduced to 50%. Some opposition came from apartment owners and large developers, who viewed the policy as an added cost in the design, implementation, and maintenance of their projects.

We can learn from the City as they continue to work with these stakeholders to address these concerns, to hold extensive public outreach and education events and to demonstrate the success of individual conservation projects.

An example of a rainwater harvesting system in a commercial project.

NATIONAL CASE STUDIES

Warren, VT: Decentralized Wastewater Systems with Centralized Management

Warren is a small ski town, roughly 40 square miles (104 square kilometres), located in rural Vermont. With a population of 1,700 year-round residents, most properties within the small town have their own well and septic system.

In the 1990s, Warren conducted a sewer feasibility study that proposed mandatory connection of all properties to one large centralized wastewater treatment system. This conventional proposal was rejected for a number of reasons, including the realization that the proposed treatment and dispersal field could not handle the wastewater flows from the village. In addition, limited outreach resulted in residential concerns about the financial impact of a centralized system. Still others were worried about potential alterations to the historic character of the village. Galvanized by a large flood event that exposed some of the town's existing septic systems along the riverbank, the town applied for an EPA grant to evaluate alternative systems.

Warren assessed existing conditions and concluded an analysis of future water needs. The result was a decentralized approach that included upgrades to some existing systems, replacement of onsite systems, and installation of two new cluster systems with demonstrations of innovative and alternative technologies.

Through strong community involvement and homeowner and regulator education, the community overwhelmingly passed a vote to issue bonds for the local share of funding to implement a centralized management program for the decentralized systems. Warren provides centralized management (town administrator, wastewater board and contract technicians) for the decentralized systems. This means that the city owns and manages the onsite and cluster system through their administrative staff and contracts with service provides. Warren also implemented a low interest loan program, funded through the Clean Water State Revolving Fund, for individual property owners' onsite system repairs and upgrades.

With communities around the country facing similar challenges related to water conservation and the conversion of onsite systems to centralized sewers, the lessons learned in Tucson and Warren can be applied to cities and towns within the Puget Sound basin and elsewhere.

STATE LEVEL CASE STUDIES

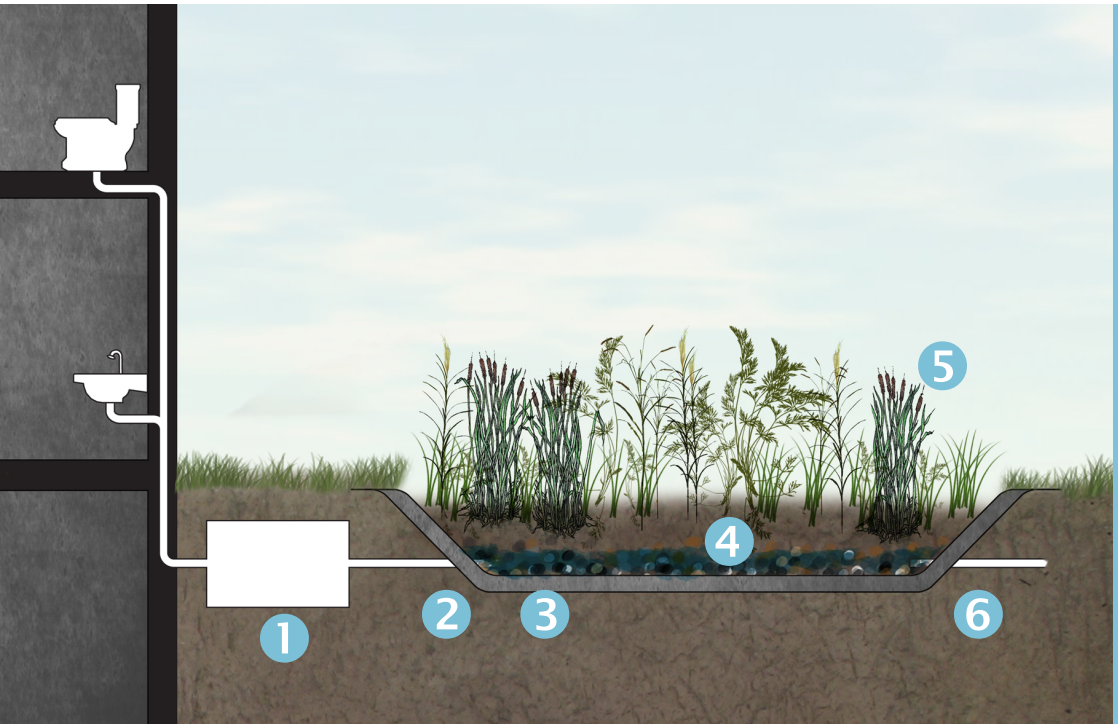
Washington State Greywater Rules

According to the State Department of Health, greywater makes up the largest portion of wastewater in Washington households, an estimated 40 gallons (151 litres) per person each day.

In 2011, Washington state adopted a new set of rules for using greywater for subsurface irrigation. The rules grant local health agencies jurisdictional authority to implement and regulate the new laws around greywater reuse. In addition, these rules establish new legal guidelines for how the valuable resource of greywater can be used to offset or eliminate the need for potable water for irrigation purposes during the dry summer season when irrigation is most needed in the Puget Sound region.

While the new greywater rules provide a big step forward for making greywater reuse legal in Washington state, they also highlight the challenges that remain for making greywater reuse a widespread practice.

Greywater irrigation systems are only allowed for temporary, seasonal irrigation. The rules require that the systems can only be installed where there is already a connection to an approved public sewer or other approved on-site sewage system. In addition, few local public health agencies have the financial or staff resources available to adopt and implement greywater programs at the local level, meaning that in most jurisdictions around Puget Sound greywater reuse remains illegal.



COMPONENTS OF A CONSTRUCTED WETLAND

1. Primary Clarification Tank
2. Inlet
3. Impermeable Liner
4. Planting Medium
5. Wetland Vegetation
6. Outlet

STATE LEVEL CASE STUDIES

Washington Stormwater Center and Low Impact Development Program

To address the impact of polluted stormwater runoff on Puget Sound and other waterways, Washington has been in the adoption and phase-in process of more stringent regulations around stormwater management for the past decade. The complexity of implementing the new regulations led to the collaboration of several businesses and stakeholder groups asking for the development of an organization that provides independent, non-regulatory assistance to the hundreds of businesses and municipalities charged with complying with the new laws.

In 2010, the Washington Stormwater Center was established to serve National Pollution Discharge Elimination System permittees and stormwater managers as they navigate the complexities and challenges of stormwater management. The Center provides assistance and training on stormwater management and serves as a gateway to research, information and emerging technologies.

The Center's Low Impact Development (LID) Research Program is one of the largest installations in the nation to focus on this rapidly expanding field of decentralized LID. The Center offers cutting edge research, on-the-ground demonstration projects and education, for example on rain gardens and pervious parking lots.

Despite these positive steps, adoption of stormwater regulations remains a challenge at the municipal level. More is needed to accomplish our desired transition to more integrated and resilient systems.

Stormwater Center's rain garden test cells.

NEIGHBORHOOD LEVEL CASE STUDY

Seattle 2030 District

The Seattle 2030 District provides an example of innovative experimentation at the neighborhood level. The 2030 District is an interdisciplinary public-private collaboration working to create a high-performance building district in downtown Seattle. Based on the performance goals of the Architecture 2030 Challenge, the District is developing measurable and innovative strategies to assist property owners, managers, and tenants within the downtown district in meeting aggressive goals that reduce environmental impacts related to energy and water.

The benefit of a district-wide approach is that it focuses less on individual buildings and more on solutions that address current market limitations on a broader scale and which may be better suited to the neighborhood level, such as district-wide heat recovery, distributed generation, and other district energy and water efficiencies.

The challenge states the following goals:

- Water use for existing buildings: A minimum of 10% reduction below the District average by 2015 with incremental targets, reaching a 50% reduction by 2030.
- Water use for new buildings, major renovations and new infrastructure: An immediate 50% reduction below the current District average.

In addition to these performance objectives, the 2030 District recognizes that stormwater management poses particular challenges for Seattle and is eager to support local efforts to address runoff issues. Where appropiate it will address the City of Seattle's recent initiative about as well as King County's program on green stormwater infrastructure.

The District's ability to address the economic and ecological challenges within potable water conservation may well offer an opportunity for integrated water management within the District's high performance buildings.

BUILDING SCALE CASE STUDIES

Bertschi School

The Bertschi School's Science Wing, located in an urban Seattle neighborhood and completed in 2011, was recently certified under the Living Building Challenge. The classroom building is designed to operate as a true "net zero water" demonstration, though current laws prohibit some of the planned strategies.

The building releases no water or waste to the city's sewer system. Instead it utilizes a micro-flush composting toilet and an interior greywater reuse system that eliminates the need to send wastewater offsite. Greywater from the classroom sink and lavatory is routed to an interior vegetated wall where it is evapo-transpirated.

Stormwater is managed onsite through captured precipitation and rain gardens designed into the landscape. Monitoring equipment allows the students to be involved in the building's integrated water management approach by tracking and studying the classroom's water use.

The building is also designed to harvest enough rooftop rainwater to meet all potable and nonpotable needs, yet current regulations make use of the water for potable purposes prohibitive. The building is now required to tap into the municpal water supply.

The building owner decided to install the potable rainwater system anyway (which uses UV disinfection) with the intention of providing ongoing monitoring of the water quality and in the hopes that regulations would change in the near future.

1 North, insulated glazing and operable windows provide daylighting and natural ventilation

2 2x12 wood framed, cellulouse insulated walls

3 SIPS panel roof

4 Hydronic radiant floor heating

5 Ventilation system with energy recovery

6 Operable skylight provides stack-effect ventilation and toplighting

7 Rain leaders to cisterns, exposed for education

8 Glass-covered interior runnel transports rain water to potable cistern

9 Exterior runnel transports excess rain water for potable use to irrigation cistern and rain garden for infiltration

10 Irrigation cistern

11 Rain garden

12 Stormwater control valves divert water from other campus property to irrigation cistern and rain garden

BUILDING SCALE CASE STUDIES

The Bullitt Center

Located in Seattle's Capitol Hill neigborhood, the Bullitt Center opened its doors on Earth Day 2013 as the world's first office building in an urban location seeking full Living Building Challenge certification. The building showcases a range of innovative water strategies at the urban scale.

The six-story, 50,000 square-foot class-A office building has composting toilets on each floor thus reducing the building's overall water use and eliminating the discharge of blackwater. The toilets create a foam using about 1 cup of rainwater and biodegradable soap that carries the blackwater to aerobic composting units housed in the basement.

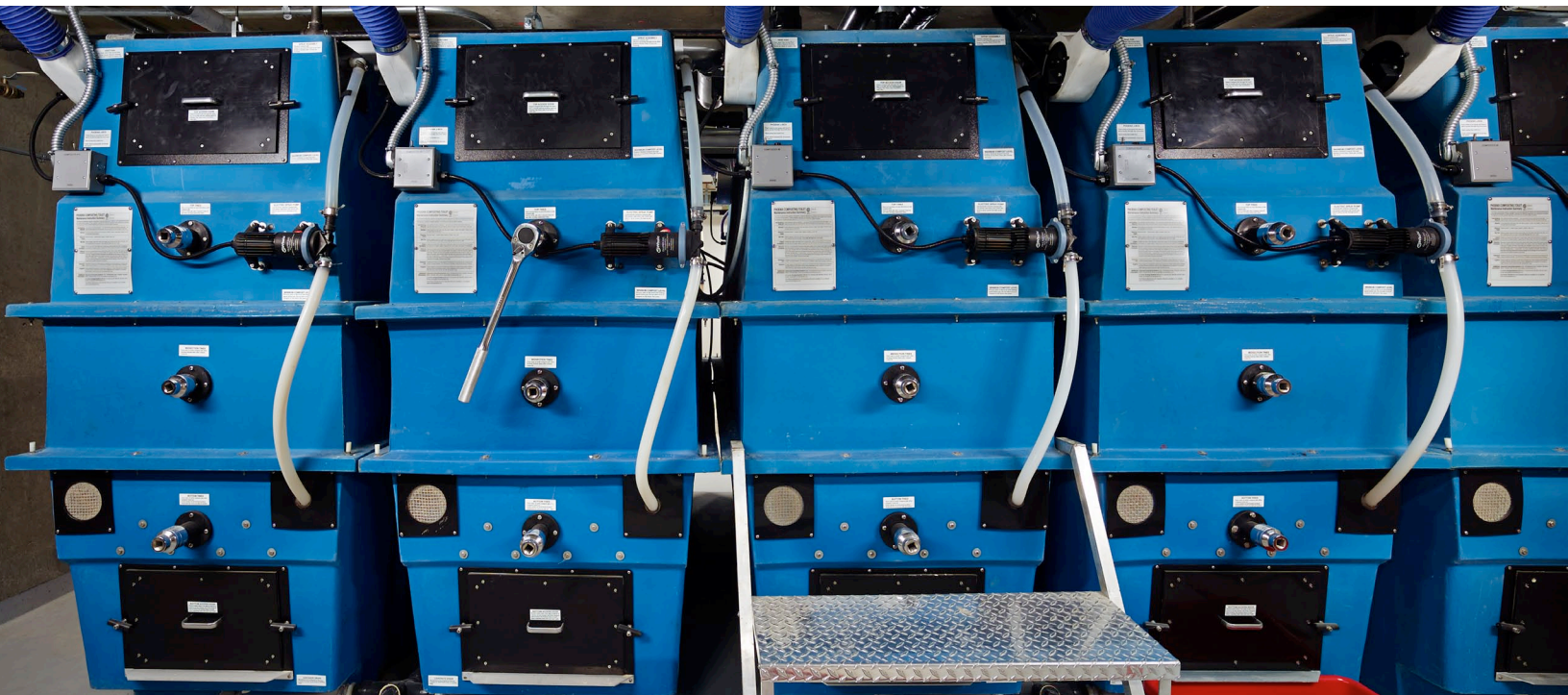
Greywater is collected from sinks and showers and pumped up to a recirculating constructed wetland located on the third floor roof that uses natural, chemical, physical and biological treatment processes to treat the daily greywater flows. Clean effluent from the greywater wetland is then injected into the ground in the public right of way in order to help recharge groundwater.

Like the Bertschi school, the Bullitt Center encountered similar regulatory obstacles related to the use of rooftop harvested rainwater for potable use. While permitting such a system was prohibitive and required them to tap into the municipal water supply, the owners decided to go ahead and install the rainwater system and to test and monitor it in order to provide feedback on the quality and viability of potable rainwater systems at the commercial scale.

Both the Bertschi School and the Bullitt Center are valuable experiments in helping to shift the current water paradigm. Their willingness to install decentralized systems might appear to be redundant under the current conventional view, but are in fact helping to alleviate future growth issues and piloting a new way of handling water more efficiently and elegantly.

These case studies demonstrate how there exists a local appetite for an integrated approach to water management. The time for regulatory and industry support for this transition is now.

The world's largest composting system of its kind located in the Bullitt Center.



III LESSONS LEARNED

"You never change things by fighting the existing reality. To change something, build a new model that makes the existing model obsolete."

R. BUCKMINSTER FULLER

Best practice from around the globe and more locally sheds a light on the challenges that we continue to face in making the transition to integrated, more decentralized water management. From the Netherlands to Australia, from York, Canada and back home again to the Cascadia bioregion, we see a tendency toward incremental change, not a fundamental paradigm shift.

Here in the Cascadia bioregion and around the globe we see a few individuals recognizing that urgent action is needed and beginning to explore approaches that question long-held assumptions. However, these bold innovators cannot establish a new paradigm on their own. They need to attract early adopters who are not only courageous and innovative, but also conservative and rigorous in their approach to providing answers and solving problems. Until this more conservative element is combined into the transition, our society will continue to resist the change, and in fact, even deny the need for it. This is especially true in the world of public health and infrastructure that combines no tolerance for failure with deep societal fears of disease.

Thus, while presenting unique and innovative approaches to integrated water management, and the technologies that support this transition, these case studies do not demonstrate outright success. Indeed, all of these locales are mid-progress along the path to decentralized and resilient water systems.

Science, engineering and technology do not change incrementally, but instead must take place in swift, revolutionary transformations. R. Buckminster Fuller reminds us that slight alterations to the existing model won't work; we need to supersede the old way with "a new model." Without it, new ideas struggle to gain traction because they are considered through the lens of the old paradigm. They cannot be fairly assessed because even the system of assessment reflects the current philosophy. In this way innovation is often stifled by the persistence of the old paradigm.

The Australian case study highlights how federal initiatives without widespread local implementation struggle to gain traction. This type of hesitancy about new policy ideas persisted in the Netherlands for many years despite the development of the Integrated Water Resources Management concept. Indeed, it took catastrophic floods to spur the integrated approach that we see active today, particularly within the sphere of land use planning.

Even those case studies that seem to reveal a sense of urgency, such as the York Region in Canada, are running into stumbling blocks to their holistic approach or Soft Path. Their efforts have identified the need for effective stakeholder engagement alongside cross-sector collaboration and multi-level governance in order to achieve the desired transition. Similarly, projects within Washington State demonstrate the need for policy support and implementation across all levels of government.

This global best practice mirrors what we have learned through our local engagement with practitioners across the bioregion. Our transition to integrated water management will not occur so long as we continue to think of water and wastewater in the same old way. A new approach cannot take hold without multi-level support and consistent governance. We cannot sit back and wait for a few innovators to do the work on behalf of all of us. Nor should we wait for catastrophic events, such as floods, to bring about the change we want to see. Supportive governance and regulatory pathways must combine with local experimentation and widespread public support to affect the transition that our communities urgently require.

IV ACTION LIST

The next step is action. The urgent and necessary paradigm shift requires all of us to begin the transition today. The following roadmap is written with Puget Sound in mind, yet relevant around the globe—wherever we recognize that our harmful, conventional approach needs to transform into an integrated, resilient water management system.

Barriers

Over the past several years, the Cascadia Green Building Council has focused its efforts on working with public and private sector partners to address some of the large-scale obstacles that stand in the way of more sustainable approaches to water management in the Puget Sound region.

In 2011, we convened a group of over 120 stakeholders from around the state to explore a collective vision. We continued this Call to Action by hosting in 2012 a series of smaller workshops with local Puget Sound municipalities. At these workshops we explored in more detail what integrated water management systems could look like in various locations.

In addition, completion and operation of Living Buildings® around the Puget Sound basin and internationally have provided useful experiments for accelerating the adoption of decentralized and more integrated water systems. Living Buildings supply all of their own water through captured precipitation or other onsite water sources, and manage and treat all stormwater and wastewater onsite without the need for relying on centralized infrastructure. The success of these projects and the technologies they utilize prove that barriers can be overcome, while also helping to surface persistent impediments.

Through the Living Building Challenge and our extensive engagement activity with water managers, we have identified four primary categories of barriers that continue to hinder the transition to integrated water management.

Regulation and Governance

Some of the most challenging barriers to the adoption of more decentralized and integrated water management systems relate to obstacles within the regulatory system. Permitting for water supply, wastewater treatment, greywater reuse, reclaimed water, wetland and shoreline protection and stormwater management may involve a complicated and lengthy series of

siloed approvals from local, state and national agencies. In Washington, for example, water is regulated across multiple jurisdictions: local and state health departments, state-wide departments such as ecology, local building departments, land use agencies, utilities and others.

In communities where municipal water supply and wastewater treatment systems exist, navigating through the process of approvals to utilize alternative systems can be fraught with costly delays and challenges. This is particularly true if there is not a willingness on the part of the regulatory agency to consider infrequent management approaches.

Gaps, overlaps and conflicts in the various codes around water systems can result in barriers during the approvals process by not providing a clear pathway for permitting. In addition, greater adoption of distributed systems will require utilities to develop new governance models and fee structures, shifting from our current supply-side water management to more integrated approaches.

Over the years Cascadia's Call to Action has helped to explore these various regulatory barriers and provided valuable research aimed at policy-makers and local communities wishing to transform their water management approach. This whitepaper suggests a pathway for moving this transition forward and recommits Cascadia to be part of this ongoing partnership work critical to achieving a Living Future.

Technology

Technological innovation in managing water offers great opportunity for assisting our transformation to more integrated, decentralized systems. Our work on the Living Building Challenge demonstrates that project teams can access water-saving technologies and incorporate them into sustainable buildings that meet the net zero water and ecological water flow Imperatives. In addition, the Declare® program continues to inspire manufacturers to avoid Red List materials such as polyvinyl chloride (PVC) in their products.

While the Living Building Challenge is helping to advance market transformation, such innovation continues to be hindered by limited availability of sustainable products. New technologies struggle to be absorbed into the widespread market as a result of lack of familiarity with the products and systems.

The types of technology that dominate the market continue to waste tremendous amounts of water as well as energy during the pumping and transporting of water over many miles. As the market continues to support these conventional technologies, we see a limited selection of off-the-shelf and affordable options for alternative methods.

The unfortunate reality is that so long as these innovative technologies remain rarely used, they will continue to be priced beyond the average consumer. We need to end the vicious circle so that consumers no longer pay substantially more for sustainable products simply because of their limited market availability.

Culture and Behavior

Public perceptions about the safety of decentralized systems can stand in the way of more widespread acceptance of innovative systems. As mentioned above, these fears are rooted in our historical understanding of water borne disease and illnesses. Past practices of improper water management resulted in frequent and deadly outbreaks of disease. Over the past century, the response to these medical concerns was to provide large-scale, energy intensive centralized infrastructure meant to 'flush away' water and waste and thus safeguard public health.

We continue to see public hesitation as utilities embark on resource capture through biosolid and water re-use programs. Much education and awareness building is required for broader cultural acceptance of modern decentralized systems so that they are viewed not as a step backward to more primitive times, but as the ever-evolving technology of the future. For instance, public perceptions of composting toilets still conjure up images of old outhouses and rustic pit toilets still used in much of the world. Even modern-era 'low flow' or 'waterless' fixtures are met with skepticism, as some people believe them to be less effective or unsanitary.

Our collective attitudes about water and waste need to change in order to reflect modern technological and medical advancements as well as the current reality of the worldwide water crisis and our role in it.

Finance

Financial barriers are those that provide a financial disincentive, or at least no financial encouragement, for transforming how we manage our water. This lack of financial support manifests itself in many forms. For example, new and cutting-edge technologies often carry an upfront premium and can be deemed a risky investment. Also, unique systems will likely have a much more difficult time gaining regulatory approval, sometimes requiring costly appeals, additional permitting or consulting fees. Developers who propose decentralized alternatives to municipal water and sewer systems habitually shoulder these costs along with traditional utility connection/service fees, thus potentially paying twice as much.

At the community level, shifting toward decentralized or more integrated systems may require infrastructure investment with burdensome upfront costs, even though the new system may cost less over time. As a result, it can prove challenging for these projects to obtain buy-in from community members to carry the financial burden.

In addition, artificially low water rates mean that investments in water-conserving fixtures and greywater and rainwater reuse systems often have a long payback period. Current lending approaches, appraisal protocols and valuation models tend to be weighted in favor of the status quo and fail to incentivize investments in future sustainability. As highlighted in our "Economics of Change" project, the true environmental and social costs of our conventional water infrastructure are not reflected in real estate investment or the rates we pay. So long as sustainable water management is seen as an 'extra' affordable only to the most wealthy, and so long as business models continue to rely on new connections, these financial barriers will persist.

Financial disincentives will continue to affect the perceived viability of environmentally sound projects, slow technological innovation, discourage market transformation, and hinder our transition to integrated water management.

Principles of Change

These regulatory, technological, cultural and financial barriers are complex and challenging to address—certainly—but they are not insurmountable. Indeed, we see glimpses of progress in the many actions taken here and there by jurisdictions, communities, project teams and utilities. Unfortunately, these actions tend to be isolated and do not yield the transformation that is so urgently needed. Before we take action, we need to embrace a philosophy of change.

To accomplish the transition toward integrated water management will require:

Visionary leadership

We should implement a 'new model' in which we respect water as a precious resource and use it differently within the built environment; we need to embrace best practices for treating and reclaiming water and waste; we can no longer ignore our unsustainable water use patterns and instead must achieve equality between water supply volume and building demand; we should continue to prioritize public health while allowing scale-appropriate regulations, technologies and management to keep us safe.

Demonstrations of success

We should build pilots and help the public interact with them; we need to help people see and touch the 'new' in order to understand and support change; we must connect people to the impacts of their daily water use and then help them see the benefits of a new approach; we need to take our past education and data efforts to the masses; we should go beyond awareness and achieve rallying support for decentralized and integrated water systems.

Resolve

We should be ready for the uncertainty and resistance that accompanies change; we need to prepare for tough conversations and repeatedly, doggedly point out the failures of our current water management paradigm; we must gather more followers and more collaborators; for Puget Sound and our waters everywhere, we can never yield.

What needs to change?

In order to tackle the barriers that continue to hinder our transition we must embrace these principles of change. Only when we demonstrate fortitude, passion, vision, honest engagement, leadership and what is possible will we be equipped to undertake the necessary actions. Again, this list is compiled with the Puget Sound basin in mind but these changes are widely needed in many communities and jurisdictions around the world.

Regulatory Actions:

1 RECLAIM OUR FUTURE

The recycling of greywater plays a key role in our transition from a conventional to a more integrated water management approach. Nonetheless, as discussed above, we see limited greywater reuse around Puget Sound, despite statewide legislation passing in 2011 that makes seasonal greywater reuse legal for exterior irrigation.

As a first step, local jurisdictions need to adopt greywater programs and provide a permitting process for this specific reuse. By working collaboratively across jurisdictional boundaries and with public health agencies, educational institutions and community organizations, local government can begin to prioritize this work. Together, jurisdictions and others can pool funding, staff resources, research and engagement efforts in order to implement state law in a way that continues to prioritize public health whilst also supporting local management efforts. This partnership approach can also yield creativity and greater opportunity for identifying best practice.

Adoption of local greywater reuse programs will stop us wasting vast amounts of drinking water to irrigate our landscapes that simply do not require such energy-intensive water.

2 SUPPORT A FRUITFUL HARVEST

Consistent, scale-specific regulations are needed to support rainwater harvesting. Current state policies regulate drinking water for large projects such as commercial property, multi-family buildings, etc. Local public health agencies regulate potable systems at the single-family residential level. In some jurisdictions, rainwater harvesting is allowed for potable use at the residential building scale; in others, it is not.

In order to eliminate the current problem of confusion and exacerbated permitting delays and costs, municipalities should provide a consistent regulatory path for rainwater harvesting systems. Local examples should serve as test models, and through collaborative engagement, best practices need to be refined into a statewide law regulating rainwater harvesting for potable use at the building scale.

Development of state-level standards for rainwater harvesting will both encourage efficiency through residential capture as well as maximize opportunities for closed-loop systems and achieving net zero water.

3 INNOVATE MANAGEMENT

The transformation to integrated water management offers opportunities to utilities in how they manage their systems and to communities looking to update their infrastructure. We should not default to the customary conversion of septic systems to conventional centralized management. Communities should instead explore opportunities to transition to decentralized systems such as composting toilets, greywater reuse and onsite wastewater treatment, as we saw in some of the case studies above.

Utilities need to embrace this transformation and present innovative management techniques, whereby they manage centrally a distributed system. In this way, utilities can continue to be financially viable while helping to address the historical reliance on individual maintenance, which risks hindering decentralized systems. Where appropriate, centralized management should also support rigorous monitoring and regulation of public health standards. This balanced centralized-and-decentralized approach needs to benefit from best practice models developed in other industries, for example elevator maintenance services.

By developing innovative management services, utilities will remain relevant, even essential, to our future of integrated water management.

4 ELIMINATE THE HURDLES

At a minimum, regulation needs to stop acting as a hurdle to sustainable projects. Building proposals that incorporate a system outside of the norm—hooking up to existing pipes—generally encounter a lengthy and costly permitting process. Should there be a need for an appeal, this process necessitates even greater expense on behalf of the project team for studies, consultant fees, etc. These financial impacts are often enough to discourage a project from transitioning to integrated water management. These hurdles also exist for homeowners wishing to install rainwater and greywater reuse systems.

Jurisdictions need to do more to streamline the process so that additional costs are minimized for alternative proposals. Where a jurisdiction has yet to encounter a net zero water building, for example, officers should shadow with another jurisdiction regulating a project through the permitting process. And where local approval is achieved, the process needs to be documented and shared for the benefit of future projects, officer learning and code updates. Jurisdictions also need to explore opportunities for same-day or over-the-counter simplified permits for homeowner applications. Existing good practice should be discussed collaboratively across jurisdictional boundaries to capture lessons learned and explore possible regulatory improvements.

Proactive effort by local government to support alternative water management techniques will help to reduce permitting costs and instead encourage more sustainable development to occur within their respective jurisdictional boundaries.

5 ASPIRE FOR INTEGRATION

The international case studies explored within this whitepaper demonstrate the power of vision to inspire big policy efforts. The state of Washington should challenge itself to put forward state-wide ambitions for integrated water management. Working with local jurisdictions, utilities, project teams, community groups and others, the State needs to establish a future water vision with aggressive targets. It should backcast in order to establish the policies and programs that will get us there. These goals should stretch all related industries to strive for a more sustainable, resilient, distributed water management approach.

Within the Cascadia bioregion we possess amazing technical expertise in water-related industries as well as shining examples of local innovation. With policy leadership from the State, we will address the urgent needs of Puget Sound and other water bodies and successfully transition to integrated water management.

6 GROW THROUGH ADAPTABILITY

The Puget Sound basin is experiencing tremendous growth and as it does so, pressure builds to expand our big-pipe water infrastructure. This conventional approach perpetuates the status quo and does little to encourage alternative approaches focused on site-specific water needs. A moratorium should be established on all such expansions. Instead, 'just in time' distributed approaches should be explored and implemented in growing communities.

Before considering hooking up to big-pipe infrastructure, projects should be required to evaluate the viability of smaller-scale systems for their site. This approach to development should require cooperation among state and local jurisdictions and utilities as they work on future growth management plans. No longer should we grow further outwards with a reliance on anever-expanding network of pipes to convey our water to and fro. New development needs to embrace the responsibility and opportunity of managing their water differently.

This moratorium should form part of the State's ambitious goals for the future of water management. Leadership and creativity in encouraging adaptable scale-appropriate approaches will dramatically transform how communities, developers, building operators and jurisdictions think about water.

Technological Actions:

7 CLOSE THE GAP

Across the building industry we see pockets of activity around integrated water management—

architects exploring reuse methods in their designs, companies prototyping new gadgets, utilities contemplating water efficiency systems, research centers investigating and compiling resources, developers discussing potential opportunities for growth—we should join up these efforts. As manufacturers develop new technologies, local projects need to serve as testing grounds where we can track and monitor them from modeling through performance. All partners need to come together to maximize these learning opportunities. Development and promotion of case studies, reports, brown bag lunches, webinars, virtual tours and trainings should help the building industry and its customers work more closely together to develop innovative and effective technologies that support our transition toward more resilient, distributed water management systems.

This collaboration will in turn encourage further industrial innovation, a greater number of pilots and increased awareness and support—thus achieving even more innovation.

8 INNOVATE THROUGH FAMILIARITY

Local practitioners need increased understanding of existing technologies in order to incorporate them into their work. We need to work together to offer technical training on decentralized systems to designers and other professionals within the building industry. In addition, we need to connect practitioners and local experts at the early stage of project development so as to improve the likelihood of success, for example, through selection of appropriate plants for new rain gardens.

We should design local training programs in order to support continuing education credits. We need to encourage participation in pilot projects, for example through shadowing opportunities as the projects go through design, permitting, construction and operation phases. As new technologies are developed, professionals should have opportunities to familiarize themselves with their specifications and performance.

Improved understanding of current systems will encourage our professional colleagues both to employ them in their work as well as to innovate and redesign for the next generation of technologies.

9 CULTIVATE TECHNICAL PROWESS

More expertise and experience is needed in working with and installing integrated water management systems, such as residential rainwater harvesting and greywater irrigation. This action is related to practitioner familiarity above, by complementing professional exposure with technical proficiency. Alternative techniques for capturing, treating and reusing water as a resource should no longer be seen as atypical. They need to be incorporated into common curricula, for example part of the local plumbing trades. Collaboration with local universities, colleges and technical institutions should be sought to encourage widespread training.

As technical expertise is encouraged across building-related industries, we will see greater uptake and encouragement for integrated water management techniques.

10 LOOK OUT FOR UPGRADES

Water audits and benchmarking should be common practice. Much like energy audits, a water audit should identify opportunities for greater efficiency—such as leaky fixtures or equipment—and make recommendations for how to address the problem. In addition, an integrated water audit needs to highlight possible system improvements and upgrades that would result in a more distributed, resilient water management approach. Opportunities should be explored for tying the audits to a low interest loan program or offsetting costs through the water utility.

By learning from experience with energy retrofit programs, an effective water audit program will meet user and utility needs while maximizing opportunities for achieving efficiencies.

Behavioral Actions:

11 CHANGE THE RULES

Just because our society has lived with certain water management rules for years and years

does not mean that they are correct for our time and place. We should question our conventional system of managing water, which was borne of an era when there was little to no regulation of water procurement or wastewater discharge. We need to reconsider the perceived necessity to send wastewater through miles and miles of pipe. Such societal attitudes came about in response to the past medical needs of that era and advertisements by early flush toilet manufacturers convincing us to be ashamed of our waste. Like our predecessors did, we need to formulate rules and structures appropriate to our time.

By reassessing our cultural norms, we will develop a new approach that fits our present-day medical, technological, regulatory and social advancements.

BUILD WHAT WORKS...

...and show it to people! While it seems obvious, new and successful technologies are commonly out of reach to the public. Pilot projects and demonstration systems can be located far from metropolitan areas, on private property or simply placed in a hard-to-reach area within the building itself. People need to see in operation the various technologies, such as composting toilets, water reuse systems, rainwater harvesting techniques, constructed wetlands, biofilters and bioreactors.

Pilot projects, research centers, treatment facilities and local and international design competitions need to open their doors to the public—allow people in to see and interact with alternative methods of managing our water and wastewater. These demonstrations need to demystify public conceptions of integrated water management.

When we increase public interaction with safe, innovative techniques for integrated water management, we will alter not only public perception but also the nature of the discussion—thus moving us forward in our transformation.

PROMOTE 'IN SIGHT AND IN MIND'

For many of us we continue to go about our daily lives with little understanding of where our effluent goes or from where our potable water comes. Our current infrastructure requires little effort from the majority of the population—we simply turn on the faucet or flush the toilet and our water needs are met.

Municipalities, utilities, developers, charities and community scientists need to adjust this attitude in favor of an 'in sight and in mind' relationship with water (no longer 'out of sight, out of mind'): organizations need to join up their educational efforts and cease communicating in isolation; politicians need to incorporate water management into their policy agendas and publicly talk about our collective responsibilities to our water infrastructure; and the media needs to investigate and promote stories that help the public understand the environmental impacts of our conventional systems as well as the benefits of a more integrated approach.

Increased dialogue about and understanding of how our daily actions affect our local waters and environment will yield a change in people's attitudes and behaviors. No longer will the general public be able to ignore their role in our water management.

DO MORE WITH LESS

We need to design, build and operate more pilot projects. Our transition requires more and more demonstrations showing how integrated and distributed water management not only works in effectively managing our water but also does so in a way that continues to safeguard public health. We need to see more project teams embracing boldness, stretching themselves and aspiring for more sustainable, living buildings. The fear of failure should not stop innovation before it has even begun. More demonstrations of effort and success need to incorporate the less: diminished costs for sustainable technologies; less regulatory and permitting delays; an end to the use of Red List materials; limited community opposition to local change and NIMBYism; and reduced energy consumption.

By using less and demonstrating more, our transformative projects will encourage market momentum toward true sustainability.

15 BROADEN THE DEBATE

Often times it is the usual players seated around the table discussing water management. The success of our transition to integrated water management relies on public participation—to understand the risks of maintaining the status quo, to instill a sense of public responsibility for our collective water management, to encourage people to modify how they use water and to empower development of unique, innovative ideas. Therefore, the public should be brought to the table. New and more inclusive engagement techniques—such as interactive roadshows and social media campaigns—need to be employed in order to gather input and engender community support for decentralized systems. As stated above, this outreach effort needs to avoid jurisdictional silos and instead be coordinated and collective.

Public participation in the transition to integrated water management will ensure that we incorporate local knowledge, creativity, resources and ultimately, support in how we go about implementing change.

Financial Actions:

16 RATE FOR INNOVATION

Current financial mechanisms need to change in order to incentivize integrated water management. Connection fees need to be eliminated when centralized systems are only used as emergency or back-up systems. (And these fees should kick in at the moment the centralized systems are used, if ever.)

Alternative rates should be explored and put into practice to reflect each building's water and wastewater use. For example, for some properties it may be appropriate to disconnect water and wastewater utility bills. While some utilities are proactively initiating and participating in conversations to implement such policies, others are not. We need greater and more productive engagement so as to ensure that all utilities are supporting and helping to shape the future of integrated water management.

When we implement fair and consistent rates for water, we will encourage the use of onsite water systems and thus support the transition to a new paradigm of management.

17 CHANGE THIS OLD RETROFIT

As we achieve greater public and professional awareness of and support for distributed water systems (discussed above), more residents and businesses are likely to seek water retrofits for their buildings. While improved technical expertise (again, see above) is likely to make retrofit costs somewhat less expensive, financial support is needed in order to enable the majority of customers. It is true that some water-related incentives already exist; however these programs can be very challenging for consumers to identify and utilize.

We should learn from programs that exist to support energy retrofits: for example, low interest loans should be offered; revolving loans need to allow savings funds to be used for additional renovations; on-bill recovery financing programs should be offered with a current charge on utility bills and the repayment amount based on projected savings on water bills. Banking institutions, credit unions and utilities need to be brought together to make these financial incentives accessible to all.

Collaborative and innovative thinking about financial stimuli will yield mechanisms that support bottom-line economics for the companies and customers involved as well as encourage greater market uptake and thus decreased costs of integrated water management techniques.

18 REWARD EFFICIENCY – BUILDING PERFORMANCE

As we have seen many times throughout the environmental movement, sustainable customer behavior often requires monetary rewards in order to become common practice. Regarding water management, we need to incentivize efficient design and performance. Cooperation between local planning departments and utilities is needed to decrease permitting fees and utility connection charges for new or remodeled buildings with integrated water systems.

As these structures continue to demonstrate reduced water use, the local jurisdiction should look to offer ongoing remuneration or other benefits to their owners. These rewards should prioritize those structures that improve the overall water management picture – for example, for buildings that improve community resiliency through flood management or address local overflow issues. There is great opportunity to maximize these incentives where municipalities have pilot ordinances that support Living Buildings achieving net zero water alongside the other Imperatives.

Incentivizing effective building performance will encourage development that supports resilient, integrated water management both within the urban core and in more suburban and rural areas.

19 REWARD EFFICIENCY – CONSUMER BEHAVIOR

Alongside building performance, it is essential that we encourage occupant behavior that supports integrated water management. Like we see with energy efficiency programs, local water use programs are needed to reward reduced use through reduced cost. While we do not suffer from persistent drought conditions as much of the country and indeed the world does, we need to do more to reduce our water consumption. Residents and businesses should be encouraged to use low-flow or waterless fixtures through rebates and feebates. Manufacturers, utilities and local jurisdictions need to include no-/low-cost explanations for developers and tenants so that such equipment is used and maintained appropriately.

Likewise, more complex systems such as composting toilets, constructed wetlands, recirculating biofilters, living machines and other technologies should be encouraged through discounted training sessions for residents and monitoring staff. Knowledgeable users of such techniques should be cultivated in order to demonstrate how these systems can be implemented successfully and without any negative health impacts.

By taking action to learn from other programs and implementing local, proactive rewards, communities in the Puget Sound basin will achieve greater efficiency and contribute to sustainable, integrated water management.

20 MAKE THE PRICE RIGHT

Full cost accounting is needed to transition toward integrated water management. As discussed above, we currently do not pay a true price for our water. Indeed, our water costs are relative cheap compared to most of the country and certainly when compared to costs across the globe. Costs should be adjusted to take account of the economic burden of maintaining our current water infrastructure, the resulting social impacts and the damage to our local environment and global climate.

Our economic model needs to support more efficient use of our valuable water resource to encourage 'decoupling' of rates from sales volumes and to no longer rely on new sewer connection fees. In addition, more accurate accounting needs to be applied to cost-benefit analyses of alternative technologies and decentralized systems. Paying full price for water should make payback on investments quicker, incentivize the use of sustainable materials and reward energy and water conservation.

Development of an economic model that takes account of externalities will support more accurate accounting for each and every drop of water we use, treat, waste and redistribute.

Conclusion

To move toward integrated water management will require collective effort across sectors and levels of government. This whitepaper sets a roadmap for next steps. It articulates a challenge to all of us to cease incremental change and strive, instead, for the new vision that is so urgently needed. These 20 actions are a starting point—to start conversations where they have been missing and to continue collaboration where progress has slowed. With your help we will transform the way we manage water. Let's get to work.

V APPENDIX

Research

The Cascadia Green Building Council has been at the forefront of raising awareness and advancing the conversation around more sustainable approaches for managing water and waste in the built environment. In 2006 Cascadia launched the Living Building Challenge, the world's most rigorous performance standard for the built environment and a call to action to accelerate the adoption of buildings, infrastructure and communities that are in connection with the natural world rather than superimposed on it.

We encourage you to read this report alongside our library of partnership research projects on sustainable, integrated water management:

Clean Water, Healthy Sound: A Life Cycle Analysis of Alternative Wastewater Treatment Strategies in the Puget Sound Area, 2011.

Local Ordinances Related to the Living Building Challenge, 2012.

Policy-Making for Healthy, Resilient Water Systems in the Puget Sound, 2011.

Regulatory Pathways to Net Zero Water: Guidance for Innovative Water Projects in Seattle, Phase 2 Summary Report, 2011.

Toward Net Zero Water: Best Management Practices for Decentralized Sourcing and Treatment, 2011.

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