SEATTLE 2030 DISTRICT | BOEING

Harnessing the Rain for Building Performance

Rainwater Harvesting and Reuse Report

Harnessing the Rain for Building Performance

June 2020

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Seattle 2030 District
PO Box 21726
Seattle, WA 98102
Phone: 206.877.2400
www.2030districts.org/seattle

INTRODUCTION

The Seattle 2030 District is an interdisciplinary public-private collaborative working to create a groundbreaking high-performance building district in downtown Seattle. With the Architecture 2030 Challenge for Planning providing our performance goals, we develop realistic, measurable, and innovative strategies to assist district property owners, managers, and tenants in reducing environmental impacts of building construction and operations.

In 2014, the District acknowledged the impact the rate of development was having on the levels of impervious surface and the corresponding increase in stormwater runoff. This runoff creates two problems: it directly washes toxins, nutrients, sediment, and bacteria into our waterways (52,000–66,000 lbs/day into Puget Sound); and contributes to overwhelming our combined sewers which lead to overflows of untreated sewage and stormwater (148 times in 2017 resulting in 150 million gallons being released).

In order to challenge the built environment to rectify and improve the situation, the District added stormwater runoff to our potable water goal, combining the two into a “water intensity” metric whereby buildings are committed to reducing potable demand and stormwater runoff by a combined 50% from their baselines. Please visit our website for more information on the water goal and baseline.

The District has since been working to identify strategies and resources that help our members and the greater community incorporate green stormwater infrastructure (GSI) into projects in an effort to meet our ambitious goal. This paper aims to highlight rainwater harvesting and reuse as an important strategy to engage existing building owners in solving stormwater runoff while improving their overall water performance.

Stormwater Design Competition

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In the summer of 2019, the District in partnership with the Boeing Corporation created a design competition that challenged participants to utilize the rooftop of an existing building to improve water performance. To ensure feasibility for our members, the prompt asked contestants to use the headquarters of Expeditors International Inc. as the opportunity site. Submissions were judged on creativity, relevance and feasibility to building owners/managers with an emphasis on long-term solutions that take into account maintenance and precipitation patterns.

The top design ideas varied in functionality, ranging from public demonstration, seismic protection, and modular systems that could be implemented over time. All ideas harnessed the opportunity rainwater presented to a building’s functionality. The winning idea was chosen for an innovative approach that could be enhanced over time in line with capital budgets. It also dramatically improved recreational space for tenants. Click here for more information on the winning submissions.

CHALLENGES TO DENSE GSI

A benefit of green stormwater infrastructure (GSI) solutions is the additional ecosystem benefits that are created. In addition to the water filtration and retention qualities, natural systems provide habitat, reduce urban heat islands, improve air quality, mitigate flooding, and have been shown to increase mental health. There is also the relatively low cost to install compared to traditional grey infrastructure. However, there are challenges to incorporating GSI:

The required space for installation can be a significant problem in dense urban environments with rising real estate costs and where historical development was built to the lot line. This leaves few chances and high opportunity costs to incorporate green space in Seattle's downtown core.

The majority of lots were built before stormwater code was strengthened to reflect the rising importance of managing runoff on-site, meaning the vast majority of our building stock have minimal, if any, stormwater management infrastructure in place. These buildings will not trigger the updated codes unless they undergo retrofits or significant alterations, leaving the increased flows to be dealt with by aging municipal infrastructure.

A current lack of incentives to encourage investment from existing building owners and the engineering community at-large. Current programs are limited in scope by applying only to specific best management practices and in overflow basins. This restricts the private sector from innovating in both stormwater management strategies and locations.

Split Incentives: The structure associated with common commercial and residential leases results in the building owner being responsible for making water conservation investments while the savings flow to tenants in the form of lower water bills. This discourages owners from undertaking expensive retrofits as the financial return goes to the tenants.

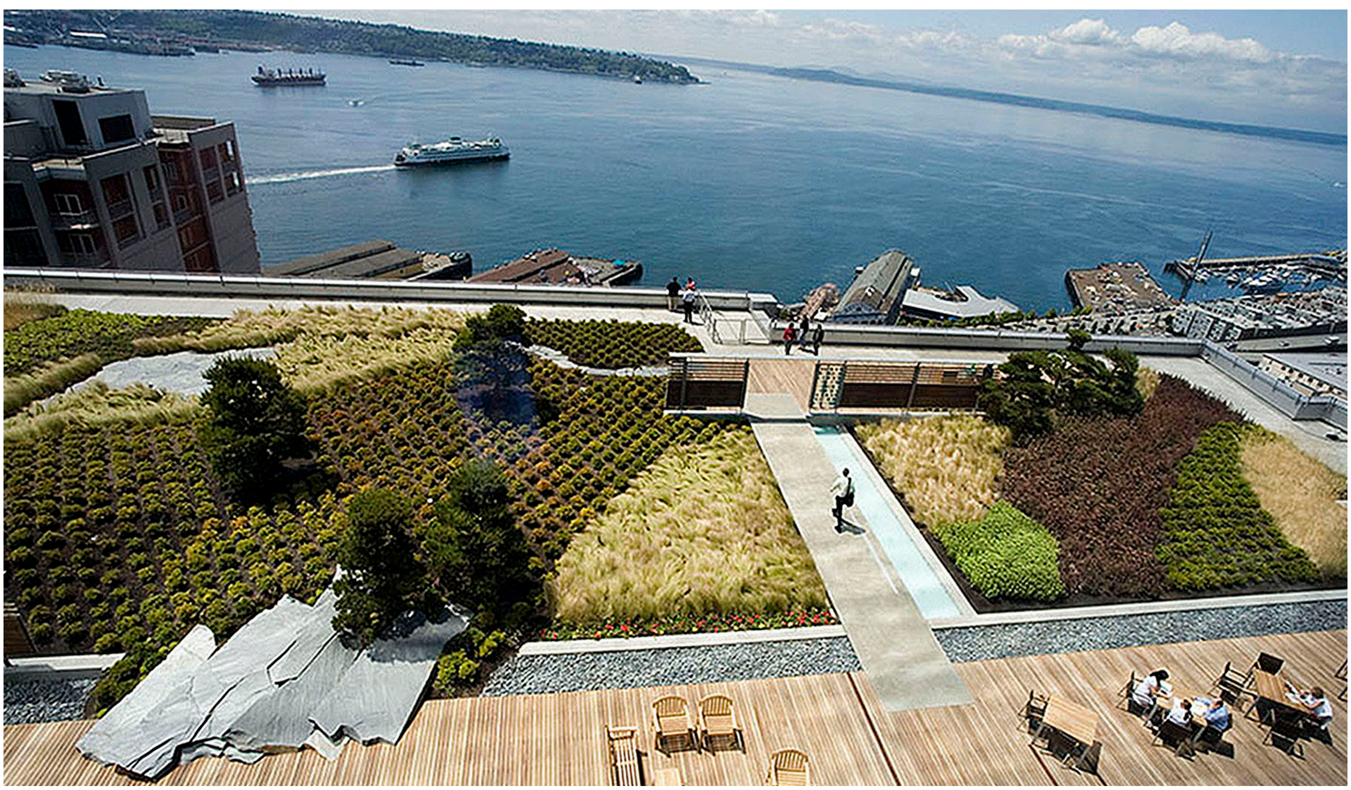
Capital vs. Operating Budgets: Conservation investments that rely on continual reductions in utility bills for the payback can also run into the problem of a disconnect between a building's capital and operating budgets. The initial project requires investment from the capital budget, but the savings are returned in the operating budget over the life of the building.

LOOKING TO THE ROOF

The improvements of green and blue roof technologies have increased their performance and therefore their adoption. Adding vegetation helps manage rainwater flows, increases habitat for migratory species, and can even be utilized as tenant space or urban agriculture. Blue roofs increase the temporary storage for rainwater to mitigate runoff impacts and can be used in reuse strategies or storage for the green roofs irrigation needs. Furthermore, these technologies have an impact on the heating and cooling of the building by helping to trap heat internally in the winter and reflecting sunlight in the summer.

One consideration of green roofs, especially thinking holistically about water conservation, is the potential added water demand from the vegetation in the summer months. In climates like Seattle's, this can be a handicap for the water performance of the building. Additionally, a building owner needs to consider structural load capabilities with these solutions and longevity of the roof itself. The timing may not work if a roof replacement is due in the near future.

However, the opportunity to utilize the capture area may not need additional infrastructure on the roof itself due to already having one critical piece, drainage. The drainage system collects the rainwater and routes to a central pipe or location inside the building. By leveraging this feature of rooftop design, we can gather rainwater and create a usable input for the building's operations.



Pictured: The Russell Investments Center (formerly owned by Washington Mutual Bank) is one of the largest green roof installations in Seattle. Offering sweeping views of the Olympic Mountains, Mount Rainier, and Elliott Bay, the 17th floor green roof features predominantly native, drough-resistant planting and transformed a previously windowless lunchroom into one of the best tenant spaces in the City and helps manage their stormwater runoff.

MAKING THE CASE FOR REUSE

The necessary ingredient to make rainwater capture strategies relevant both for the building's performance and capital costs is reuse. As Seattle's precipitation patterns generally rules out reuse for irrigation, one of the best demand cases is water for toilets and urinals. However, this requires the use of purple pipes which can significantly increase the cost of plumbing infrastructure. For the life of a building in new construction, this additional investment makes sense as water rates will continue to rise, and it will significantly lower utility costs and improve the building's water performance. Advancements in both plumbing and health codes as well as greater understanding of the permitting path are required to catalyze greywater reuse in new construction, but projects should invest the time to explore it in project design if water performance is an important objective.

When considering existing buildings, the category that needs the most improvement, the cost and logistics of installing purple pipes is a likely a non-starter unless the building has a central drainage system with bathroom layouts adjacent. Therefore, the best use case currently in existing buildings is cooling towers and heat pumps, particularly ones that service non-tenant functions (machine or engineering rooms, IT rooms, elevators, etc.) which produce heat all year around. The water demand for these cooling functions will absorb all the rainwater a building can capture and store, reducing the stormwater runoff from a site while also lowering the potable consumption for the building.

As innovations in HVAC systems continue to hit the market, particularly water-sourced heat pumps, and water stressors continue to impact supply, the inclusion of rainwater harvesting and greywater reuse to offset the water demand will become a more common strategy especially if the benefits to the wastewater infrastructure system through reductions in total flows are taken into account. There is more information on this topic in the WET transaction chapter to follow.

The Inclusion of Purple Pipes

In order for maintenance and utilty workers to safely interact with reclaimed water, pipes colored purple have become commonplace and are now synomous with recycled water. The main roadblocks for their wider adoption are costs and permitting. It is a separate pipe so it dramatically increases the piping length required and the space to install. Saftey concerns are also a top priority as plumbing and health regulators practice caution with new strategies that could risk the chance of contamination with potable supplies.

Although purple pipes are frequently utilized in arid climates, the water performance and financial impact associatd with long-term reuse is advancing research and testing of these methods and therefore adoption throughout the built environment in more temperate climates. When considering a 30-year time horizion in new projects and market demands for green building operations, we hope the inclusion of purple pipes will become standard over time even in environments like Seattle.

FEASIBILITY & PROJECT FLOW

1 Confirm the applicability of your building by identifying reuse demand. Does your building's HVAC system feature cooling towers and heat pumps? Are there maintenance demands such as power washing or some irrigation needs? Does your building have other non-potable demand cases?

2 Determine the location for storage and pretreatment. As the design and location of drainage infrastructure varies building by building, identifying a strategic location for collection presents an initial engineering challenge. The goal is to collect and treat the rainwater as close to the area where it will be reused as possible. A successful scenario has been multiple smaller cisterns in a machine or engineering room directly underneath the roof. This reduces the distance between storage and potential reuse locations which helps eliminate complications and added costs to the project.

3 Clean the water before it enters the mechanical systems of the building. It is important to note that the level of treatment is reduced when utilizing non-potable reuse sources and the water is not as contaminated as road runoff but it still requires some pretreatment. Utilizing a system that features a porous filter, 30- and 5-micron filters, UV treatment, and an option for pH adjustment should be enough to adequately treat the water for non-potable uses. District member Wright Runstad and Company extensively studied their rainwater before building an applicable system and can be utilized as a resource.

4 Install a meter to monitor the amount of water captured and reused. This is necessary to determine the amount of stormwater prevented from reaching the sewer (and potable gallons saved) which will help the Utility understand the value to the wastewater treatment system.

Pictured: Wright Runstad & Company's rainwater capture and reuse system at their 1201 3rd location in downtown Seattle. The engineering team at the site creatively solved their water challenges by piloting both groundwater and roofwater capture and reuse to offset the building's irrigation and cooling tower needs, collectively saving on average 864,000 gallons of water per year. The project was awarded the 2018 Vision Awards Water; more info can be found here.

DISTRICT SCALE

An integral part of the 2030 District model is the focus on individual building performance while promoting the collective District goal. We know that some buildings will be able to achieve higher performance than others, and performance will average out over the geography of a city. One building achieving high-performance will not solve the water challenges, but collective action by every building will start to make an impact. A study conducted by Magnusson Klemenic Associates found that if buildings in the Belltown neighborhood were to harvest and reuse 50% of the rainwater that fell on its rooftop, stormwater runoff would be reduced by an estimated 24% in the Vine Street Basin. If we apply this across the entire downtown core, the municipal infrastructure would benefit greatly and free up capacity for other flow inputs, especially during heavy precipitation events.

As eco-district and decentralized utility strategies become more popular, reuse systems will also increase in value as they can help connect buildings and share resources. We are already seeing this in the energy sector with renewable energy being put back on the grid and heat sharing between buildings. While the idea has been explored in the water sector, namely with large institutions like stadiums that use significant amounts of non-potable water for cleaning and irrigation, the relative cost of water locally has restricted the financial feasibility of these larger projects so far.

BUILDING CERTIFICATIONS & PILOTS

Stormwater management and water conservation have become pillars of building performance programs like Living Building Challenge, 2030 Challenge Pilot, Salmon-Safe and LEED. The new standards of Living Building Pilot for example require no potable water for non-potable uses. The 2030 Challenge requires a 50% reduction in water intensity (potable water consumed and stormwater runoff reduced) from a building's baseline. Rainwater harvesting and reuse is an integral strategy to achieving these ambitious standards, especially meeting the supply needs for non-potable water. These programs also offer significant incentives for buildings, such as additional FAR and height above zoning, which is another way to accelerate the return on investment for the project.

Pictured: The Watershed project by District members Weber Thompson and Stephen C. Grey & Associates which went through the Living Building Pilot program and will harvest and recycle 150,000 gallons rainwater annually. In addition, the project treats 300,000 gallons of runoff from the Aurora Bridge and connects to the Data 1 swales on the adjacent site.

BUILDING & FINANCIAL PERFORMANCE

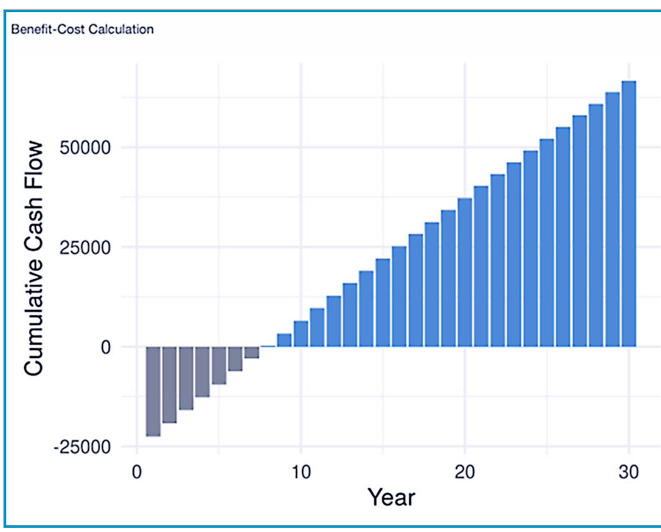
In collaboration with Earth Economics, the District built a water reuse calculator to explore the economics behind investing in rainwater and greywater reuse systems.

The calculator takes into account building square footage, water use, estimated capture capacity, and reuse potential along with the best current available date for incentives and water rates. It also makes initial assumptions on storage and reuse potential based on your building characteristics and water use breakdown. The tool will be used with members and other stakeholders to explore the potential for reuse without investing significant dollars in project discovery.

The feasibility for this strategy is centered on long term operational performance in a rising rate situation. Even without strong incentives or rebates currently, the project can generate a consistent cash flow through the reduced water demand if the split incentive is addressed.

Once the project has recuperated the costs, the building benefits from lower operating bills year after year, an impact that will increase as water rates continue to rise, by an average of 7.5% in 2020 alone.

While new incentives or business models need to be developed to shorten the payback period, there are current opportunities to receive support for the project. In Seattle, you can apply for a stormwater facility credit which lowers the drainage fees applied to your annual property tax bill issued by King County. If you are in a RainWise basin, you can talk to the program managers about applying for their rebate that provides up to $4/sq. foot of rooftop runoff controlled. SPU also offers a 10 percent discount for any new or remodeled commercial buildings that utilize a rainwater harvesting system that involves indoor use cases and meets stormwater and drainage code requirements. For more details see “special programs” here.



Output	Value
Total Water Consumption (CCF/Year)	6,200
CCF of Water Captured by Rainwater System	120
System Cost (Capital) - After Rebates	$25,824
System Cost (O&M) Per Year	$150
Avoided Drinking Water Cost	$735.60
Avoided Sewer Cost	$1,866
Avoided Drainage Fee	$773
Percent Reduction in Water Use	2%
Net Present Value	$66,659.11

Pictured: The Water Reuse Calculator Report for a sample building in Seattle. The intention of the tool is to help building owners explore the feasibility of reuse without investing significant dollars in project discovery. The tool will be updated as new rates and resources are released.

STRATEGIES TO INCREASE REUSE OPPORTUNITIES

Reuse is not only critical for the financial feasibility of these projects but also to create benefits to the municipal infrastructure system that manages stormwater flows. In order to catalyze investment across the built environment and create system-wide benefits, the number of buildings with reuse opportunity needs to expand. Part of the solution is policy advancements that encourage reuse, such as non-potable use programs and expanding the availability of toilet and urinal flushing. Another potential tool is the contract structure described below that factors in both the grid level benefits that result from decreasing potable supply and mitigating stormwater discharges to the sewer system, and captures the cashflows normally associated with the water bill "savings."

The structure was developed by the Seattle 2030 District and the Metered Energy Efficiency Transaction Structure (MEETS) Coalition to eliminate the split incentive for building owners when investing in water preformance retrofits and to create a performance driver for buildings to mitigate rainwater discharge. While the contract is based on existing energy programs in Seattle, the terms and organization still need to be finalized with private and public stakeholders.

LEVERAGING SUCCESSFUL MODELS FROM ENERGY

The Energy Efficiency as a Service (EEaS) program currently underway through Seattle City Light can be adapted to this use case in order to provide the necessary investable cash flow to implement the capture and reuse of water.

EEaS is Seattle City Light's rollout of the Metered Energy Efficiency Transaction Structure (MEETS), which was originally piloted at the Bullitt Center. We have adapted that approach and call it the Water Efficiency Transaction, or WET.

A WET transaction is structured as follows:

1. A "Water Tenant" (the project developer) signs a long-term rental agreement with the building owner. Under that agreement the Water Tenant:
   a. pays for and maintains the water efficiency improvements in the building.
   b. pays the building owner rent for the right to harvest the water savings. This rent is negotiated by the parties. A portion can be shared with the tenants if desired.

The Water Tenant uses either their own capital or third-party capital to finance the improvements.

The building owner can play this role if so desired.

2. The water efficiency is metered, using agreed upon third-party metering. For instance:
   a. the number of CCFs diverted from the sewer via capture and reuse on-site.
   b. the reduction in the number of CCFs the building owner demands from the Utility, thereby leaving those CCFs in the reservoir.

3. The monthly reading of the WET meter is sent to the utility.

4. The utility pays the WaterTenant a pre-agreed upon price, under a long-term Water Contract for:
   a. the water savings in CCF
   b. the system capacity benefits provided by reducing peak discharges and the quantity of wastewater needed to be treated.

5. The water utility applies the same meter reading

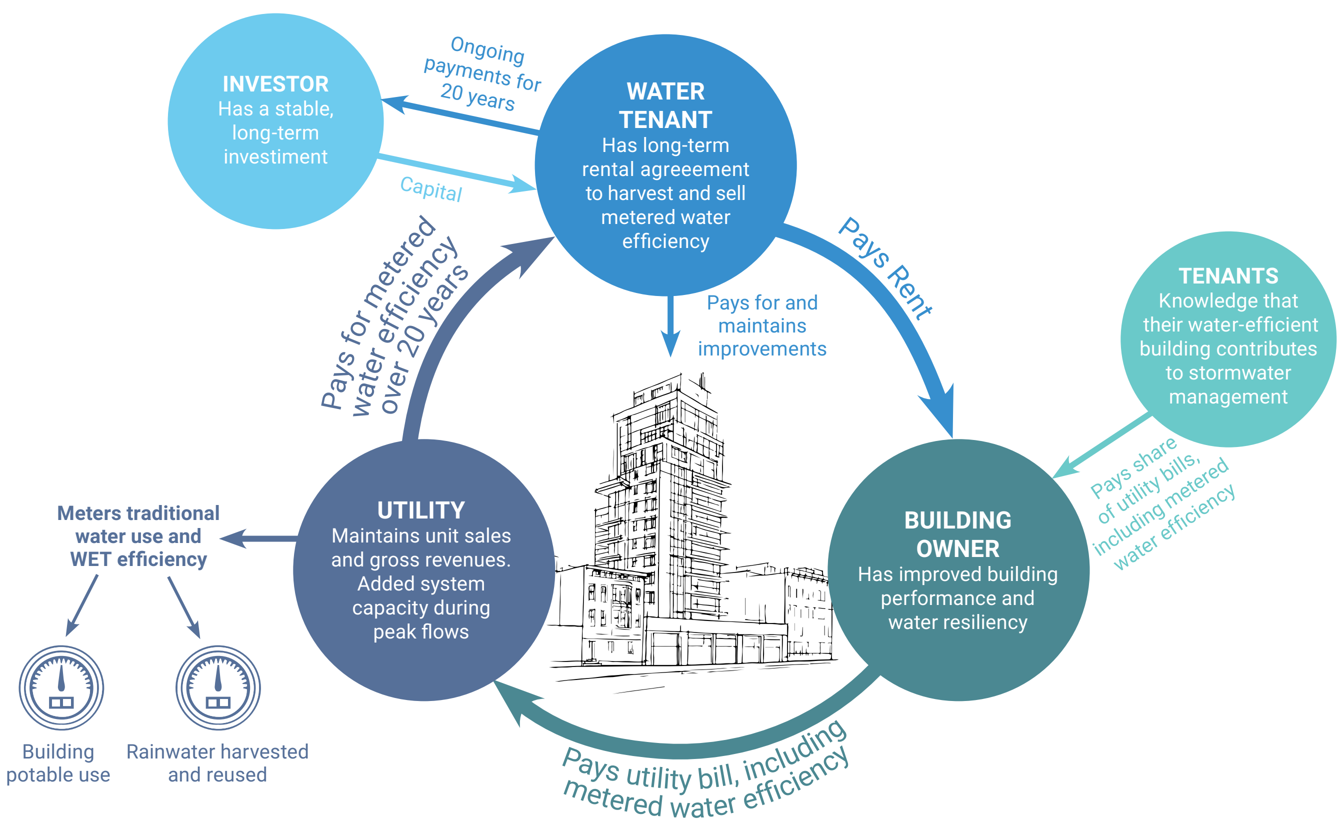
to the building's water bill(s), along with the meter read for the standard utility water meter. The "efficiency CCFs" are billed at retail, just like other CCFs. (The building owner agrees to this as part of the contracting process.) The result is that:

a. the water savings measures do not reduce utility unit sales or gross revenues. The utility is selling both traditional CCF and WET (efficiency) CCF.
b. the building's water bill remains what it would have been without the improvements.

6. The building owner pays the water bill and allocates the water bill charges to all tenants as they currently do. This eliminates the "split incentive" between building owners and tenants.

Investors have a long-term contract with the water utility (via the WaterTenant) on which to base their investment decisions. This will result in significantly larger investments at lower costs.

How A Water Efficiency Transaction (WET) Works



STAKEHOLDER IMPACT

Water Tenant

Receives capital from the investor to install and maintain the efficiency upgrades in a building. Signs a long-term rental agreement with the building owner to harvest and sell the metered efficiency to the Utility. The WaterTenant can be the building owner or developer who also owns the site, if they wish to play this role.

Building Owner

Building owners are able to leverage outside capital to improve the water performance of their building. If the building owner is the Water Tenant or investor, the WET PPA with the utility creates a powerful cash flow that increases the Net Operating Income of the building. If the buildng owner is not the Water Tenant or investor, the rent paid by the Water Tenant increases the Net Operating Income of the building. Either of these scenarios increases the residual value at the point of sale as well as the improvements to the building. Furthermore, the sustainability improvements and contributions to reducing stormwater pollution improves the rentability of the space with future tenants.

The Water Tenant improves the building using standard tenant improvement accounting. Because the improvements are done at the Water Tenants costs but are attached to the building, they immediately belong to the building owner in exchange for the long-term rental agreement with the Water Tenant. Hence the Water Tenant is an asset, not a liability on the building owner’s books.

Owners also eliminate the split incentive that occurs when making an investment in the building where the cash flow used to return to the tenants in the form of lower utility bills. This has been a major barrier to making improvements historically.

Tenants

Tenants are able to enjoy a high-performance building that contributes to managing stormwater pollution and improving water conservation without an increase in monthly costs.

Utilities

The Utility enters into a power purchase agreement with the WaterTenant. WET allows the utility to sell the “nega-CCF” that would normally result in reduced unit sales. Because the WET CCF are sold as units, at retail, the utility unit sales and gross revenues remain intact. The storage function from harvesting greatly reduces peak flow during heavy precipitation and alleviates combined sewer overflow events. The cost and carbon emissions associated with transporting and treating wastewater flows are also reduced.

Investors

Investors are presented with a stable, long-term, ESG oriented investment, based on a utlility contract. The investor can be the building owner or developer who owns the site if they wish to play this role.

Ratepayers

As the Utility bills for CCFs consumed and efficiency CCFs gained, ratepayers avoid the downward spiral of higher rates to offset revenue and unit sale loss from lower demand. The improved infrastructure capacity also prevents costly infrastructure investments and helps minimize future rate hikes.

CONCLUSION

The Pacific Northwest is one of the leading sustainability hubs in the United States but our water rich environment has so far restricted widespread interest in water reuse. Our biggest water issue is having too much of it flowing through our system, not the need to conserve and recycle. However, conservation presents an interesting opportunity to engage building owners to help with the task of managing polluted stormwater flows, particularly building owners who manage sites that haven't triggered stormwater code. These buildings have limited to no space and minimal incentives that would encourage them to invest. Rainwater harvesting and reuse is the only GSI best management practice that improves the potable water performance of the site and reduces operational costs. Furthemore, the reduction on utility bills creates an investment opportunity that can catalyze the demand for these projects throughout Seattle.

The implications of rainwater harvesting across the District can have significant impacts on total discharges to the sewer infrastructure, but the immediate impact will be the performance and return on investment for the buildings that implement these measures. In order to achieve large benefits systemwide, the number of buildings utilizing water reuse will need to dramatically increase. This will require a greater understanding of health and plumbing codes, adoption of purple pipes in new construction, and a performance driver that focuses on discharges to the sewer. Currently, the drainage fees for rainwater discharge are placed on the site's property tax bill issued annually by King County—completely removed from the monthly utility metrics that maintenance and engineering teams use to evaluate the building's performance.

The WET framework was designed to value conservation and a building's performance in limiting sewer discharges in order to provide a financing cash flow. This will generate an opportunity for third-party providers to engage in water reuse services and provide a cashflow from these investments to the benefit of all stakeholders. For buildings struggling to reduce their potable demand and stormwater runoff, or sites that are pursuing advance certifications like the Living Building Pilot and 2030 Challenge, the WET framework can help overcome the financial barrier.

Finally, our industry needs to take into account future climate impacts and the resiliency of our infrastructure. Although there is a water-rich environment today, this supply cannot be taken for granted and the costs and energy required to treat our wastewater need to be factored into our decisions. Exploring water reuse strategies now will ensure we are creating the necessary innovations to properly address any supply stress situations in the future. It also increases the resiliency of our buildings if a utility disruption were to occur.

If you have any questions on the water reuse calculator, the WET framework, or the other Seattle 2030 District programs and resources, please contact seattle@2030districts.org.

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