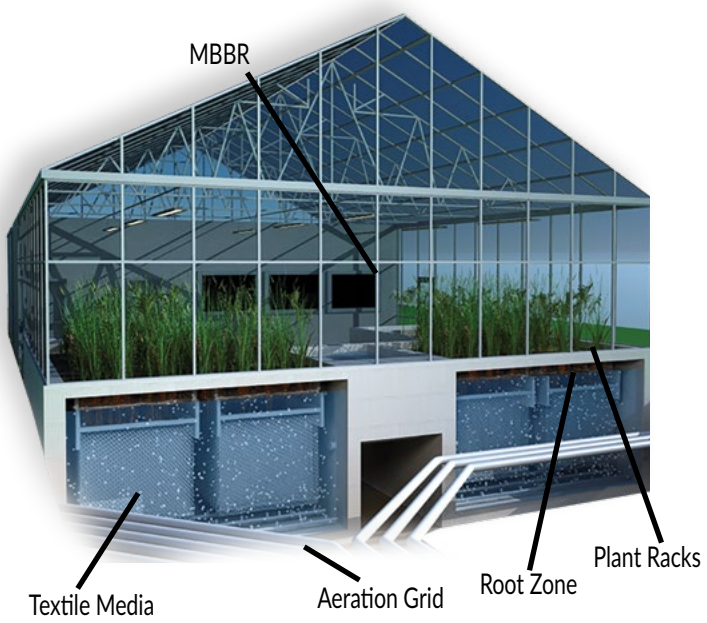
SUSTAINABLE WATER®
EXTENDING THE LIFE CYCLE OF WATER

FREQUENTLY ASKED QUESTIONS

THE WATERHUB®

HYDROPONIC TREATMENT SYSTEM



What is a WaterHub?

The WaterHub is an on-site water recycling system utilizing adaptive ecological engineering processes to clean wastewater and use reclaimed water for non-potable purposes. Using the right quality of water for the appropriate use is essential to a sustainable community. Every WaterHub is custom designed and reduces the demand of drinking water from local municipalities, thus creating a new, lower cost water supply to decrease utility costs to residents and businesses. The name 'WaterHub' itself is reflective of the system's role as the center of sustainable water management.

What is a hydroponic treatment system?

Hydroponic treatment systems are made-up of a series of inter-connected reactors that have an array of plant life growing above them. Plant root systems grow into the reactors and provide a natural habitat for fixed-film and suspended micro-organisms that break down pollutants in water. Sustainable Water designs most hydroponic systems to include artificial media (biomimicry) to support further fixed-film growth. Deep reactor vessels with high levels of biodiversity enable the treatment of larger volumes of wastewater under lower energy and physical footprint requirements.

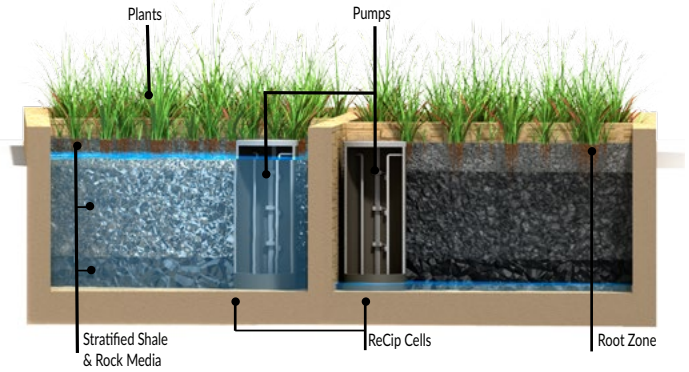
What is a reciprocating wetland?

Pioneered by the Tennessee Valley Authority (TVA), reciprocating wetlands consist of pairs of adjacent bio-cells that contain plants and rock media. Utilizing anaerobic, anoxic and aerobic environments—adjacent cells are alternately drained and filled with wastewater on a recurrent basis to mimic a tidal process. This fill-and-drain sequence facilitates control of microbial processes, such as nitrification and denitrification. By mimicking natural biological degradation, these systems treat water to reuse standards under a very low energy footprint relative to traditional biological treatment systems.

How is the WaterHub different from traditional biological wastewater treatment solutions?

The WaterHub relies on proven, adaptive ecological technologies that mimic nature as found in wetlands, tidal marshes and rivers. By creating a suitable habitat (such as plant roots) for various microorganisms, the WaterHub has higher levels of biodiversity compared to traditional technologies. Improving on nature with man-made engineering techniques, the WaterHub breaks down organic materials more efficiently and more completely than traditional activated sludge treatment systems. Ecological treatment systems also consume less energy and less chemicals during the treatment process. In addition, the odor-free, natural aesthetic supports a flexible design approach with regard to locating a WaterHub in urban areas.

RECIPROCATING WETLAND



What function do plants serve?

The primary function of the plants is to provide a habitat in their root zone for microorganisms that consume and break down waste. Plants do remove phosphorus (P) and nitrogen (N) as these are basic plant nutrients; however, the plant's contribution to P and N uptake is less significant than other components of the WaterHub.

> **"The WaterHub isn't a typical treatment facility. It filters wastewater through plant roots and microbes clean out organic material... A model for us all!"**
>
> — Gina McCarthy, Administrator of the U.S. Environmental Protection Agency

THE WATERHUB®

How does The WaterHub turn wastewater into clean water?

A WaterHub can utilize a variety of technologies. Whether reciprocating wetlands or fixed-film hydroponic systems, these technologies rely on an ecological process, mimicking nature, to maximize energy efficiency. Water circulates through biological reactors where microorganisms residing on both the surfaces and in the water break down organic waste. After initial biological treatment, water passes through a clarifier and then ultrafiltration – removing all solids, nutrients, and color from the water. After ultrafiltration, dual-stage disinfection (typically chlorine and ultraviolet light) provides safe recycled water.

How long does the treatment process take?

Depending on the system, the treatment process (hydraulic retention time) takes anywhere from 12 to 24 hours. Overall, treatment time depends on a number of factors including: influent quality, effluent requirements, and the specific technologies utilized. Since each WaterHub is custom-designed to meet siting, footprint, and aesthetic requirements, hydraulic-retention time can vary from site to site. Regardless of treatment time, each WaterHub is designed to provide reclaimed water on demand for end users on-site.

What is the design capacity of WaterHub reclamation systems?

Sustainable Water can design treatment systems that treat virtually any volume of water; however, we specialize in commercial scale systems ranging from approximately 25,000 – 2 million gallons per day.

How much design flexibility is there regarding footprint, aesthetics, etc.?

System design and footprint are highly flexible. Our technologies can conform to numerous siting constraints and are frequently designed with a compact footprint on previously undevelopable pieces of land. Overall design, layout and materials of construction can be customized to each application so that the WaterHub blends in to the existing community framework.

Are there any foul odors associated with the WaterHub?

No, the WaterHub has multiple odor control features to make sure no unpleasant odors can be detected. By design all treatment is carried out below the surface where odors are mitigated by covering and sealing tanks with vapor barriers, aggregate and natural vegetation. This layering effect acts as a natural filter against odors originating from the tanks. Most biological treatment systems are open-aired and do not have these inherent odor barriers. Furthermore, air handlers and carbon scrubbers are used to purify and remove vagrant odors from within the sealed reactor tanks and the mechanical room if necessary. In addition, special care is taken to seal all pipes and connections to ensure that no foul odors from mining or pumping wastewater are detected.

How can a WaterHub fit into dense, urban spaces?

The natural odor-free, vegetative-aesthetic can be incorporated into very dense, public settings without fear of a "not-in-my-backyard" backlash. Unlike traditional biological treatment plants, these systems are designed for human interaction via a safe, controlled environment.

Is a greenhouse necessary for the system & can a WaterHub be designed inside of a building?

Both hydroponic and reciprocating wetland systems can be entirely outdoor systems; or, if desired, housed in alternative structures that allow plentiful natural light. The WaterHub can be designed inside of a building as it treats water safely, securely, and beautifully, within any type of living or working environment, including building interiors and rooftops, gardens, cafes, or lobbies.

What happens to plants in the winter?

WaterHub facilities can operate in a variety of climates – cold or hot. Overall design is driven by anticipated climatic conditions. Areas with harsh winters will likely require an indoor system to maximize operational efficiency. For outdoor systems, plants may need to be trimmed in the winter as they go dormant. Replanting is typically not required in the spring as Sustainable Water uses native plants species that adapt to winter or seasonal temperature variations.

How long does construction typically take?

A WaterHub typically takes between 6 – 12 months to construct after the design process, depending on the site, permitting requirements, and the length of the reclaimed water distribution network. Once constructed, the system goes through a commissioning phase, in which populations of critical microorganisms are built-up and monitored, while extensive water quality testing is performed. Commissioning typically takes 2 – 4 months.

> **"This WaterHub will shine as a model for other universities, other governments, and commercial campuses to replicate. The benefits of this project are not theoretical or abstract, they're very real, very measurable, and they're very immediate."**
>
> — Douglas Hooker, Director of Atlanta Regional Commission

WATER REUSE: THE WATERHUB® SUSTAINABILITY & COMMUNITY IMPACT

How does the WaterHub improve resiliency?

The WaterHub provides a second source of water for critical operations, irrigation, and toilets i.e. non potable demand. In the event of a municipally supplied water service disruption, water can still be provided using a combination of stored clean water and the continuous daily reclamation process. By reclaiming water and using this water in place of potable water drawn from the community water source, the demand on the local water source is lessened, increasing overall sustainability. In addition, all water reclaimed in a WaterHub is water that does not go to the municipal sewer system, thereby reducing stress and improving sustainability on the community wastewater treatment facility.

How can the WaterHub be used as an educational facility?

The WaterHub can be designed to initiate or enhance academic research and community outreach activities. As a living, learning laboratory, the WaterHub can be used as a platform to expand research and develop grant opportunities for hands-on education. From chemistry to botany, the WaterHub is a perfect facility for immersion learning in a variety of subjects including, but not limited to: Water Quality and Treatment Systems, Adaptive Ecosystems, Microbiology and Environmental Sciences, Public Health Standards, Urban Planning and Development, Environmental Justice and Engineering.

THE WATERHUB® FINANCING & OPERATIONS

What is a Water Purchase Agreement (WPA) and how does it work?

A WPA is a financing vehicle that allows Sustainable Water to build turn-key water reclamation systems at no capital expense to the end user, similar to a Power Purchase Agreement (PPA). Water savings produced by the project are used to pay off the cost of the facility over time; meanwhile, the end-user receives substantial guaranteed savings beginning year 1 and lasting throughout the agreement term.

What are the operational requirements of a WaterHub?

With use of a sophisticated process control system, the WaterHub has a highly automated process from extracting wastewater to reactor oxygen diffusion and reclaimed water distribution. Increased levels of automation keep down operating expenses. While the WaterHub can be remotely operated 24/7, a certified wastewater treatment operator is required for system oversight and various mechanical/maintenance functions that range between 2-6 hours of work per day.

Who is responsible for operations and maintenance?

Under a WPA, Sustainable Water operates the WaterHub, performing all duties associated with producing a clean, safe and reliable source of reclaimed water. Sustainable Water will also operate and maintain the WaterHub outside of a WPA, or the client may elect to outsource operations to a licensed third party. Under a WPA, Sustainable Water will cover all operations and maintenance costs, including preventative and predictive maintenance.

THE WATERHUB® POLICY & GOVERNING REGULATIONS

What is the general governmental policy toward water reclamation & reuse?

The federal government, along with most state governments, recognizes water reclamation and reuse as an impactful water management strategy with numerous community benefits. The Environmental Protection Agency releases Guidelines for Water Reuse to help promote the implementation of water reclamation projects across the county. Federal and State governments even offer funding incentives for reclaimed water projects through revolving funds or grants.

Are there permitting requirements for water reclamation & reuse facilities?

Most states regulate minimum design and construction standards, along with operational requirements, for water reclamation plants to ensure public health and safety. Additionally, local municipal agencies may require permits for construction, wastewater pretreatment, or discharge. The WaterHub is designed in compliance with all state and local permitting requirements.

What does the Department of Energy think about this?

Since the 1950s, U.S. power producers have consistently utilized reclaimed water. As part of its effort to define challenges and opportunities surrounding the water-energy relationship, the Department of Energy recently stated, "A primary environmental benefit of distributed systems includes their greater efficiency compared to traditional approaches. Treatment close to the wastewater or stormwater source and reclaimed water reuse area requires less energy for conveyance. Additionally, urban reuse retrofits are more feasible and less disruptive."

WATER RECLAMATION & REUSE

What is water reclamation & reuse and how is it good for the environment?

Water reclamation is the process of treating wastewater (blackwater or sewage) so that it can be recycled or reused for some beneficial purpose. In essence, turning a waste into a resource. Distributed, or decentralized, water reclamation and reuse is the most impactful and sustainable water management practice available. Water reclamation and reuse reduces withdrawals from sensitive ecosystems, as well as wastewater discharge, gallon for gallon. On-site reuse systems also reduce the community's carbon footprint by reducing the embodied energy in water used, eliminating a significant portion of the water distribution system in a traditional centralized system.

How is reclaimed water used & is it safe?

Reclaimed water is typically used for non-potable purposes (e.g - water indirectly used by humans). Reclaimed water is safe and its uses normally include: irrigation, make-up water for HVAC/utility systems (chillers, cooling towers & boiler systems), energy production, industrial process water uses (rinsing, wash downs, etc.), decorative features (ponds & fountains), and cleaning purposes among other things. While it is not commonplace, a greater move to expand the uses of reclaimed water to direct uses is underway in many water-stressed areas.

What is the benefit of decentralized (satellite) water reclamation and reuse?

Satellite or on-site water reclamation provides a number of operational and economic benefits by localizing a cheap source of clean water near end-users. Reusing wastewater provides significant cost-savings by reducing potable water needs and potentially eliminating wastewater discharge. Having a local backup supply of water on-site provides security from drought or municipal service disruption. In addition, on-site water reclamation potentially provides numerous energy savings by eliminating long distribution lines for transporting clean water. Decentralized water reclamation reduces the load on municipal infrastructure, lessening the effect of combined-sewer overflows. Reducing the load ultimately expands the life of existing municipal water and sewer infrastructure.

GLOSSARY OF COMMON TERMS

Recycled Water:	Recycled water is water that is treated and recycled to be reused again—generally, but not always, for non-potable purposes.
Reclaimed Water:	Reclaimed water is wastewater that is treated and recycled to be reused again—generally for non-potable purposes.
Blackwater:	Blackwater is sanitary wastewater.
Greywater:	Greywater is the wastewater from non-sanitary sources, such as showers, sinks and washing machines.
Stormwater:	Stormwater is water from precipitation events, such as rain or snow. This water may be collected and cleaned for reuse.
Biofilm:	A biofilm is a layer of complex, adaptive ecosystems, which break down organic waste in water.
Non-potable Demand:	Non-potable demand is the need for water which is not necessarily of drinking water quality. Rather than use highly-treated potable water for heating and cooling, for example, this demand could be met by reclaimed water.
Purple Pipe:	Pipes which carry reclaimed water are always purple—this differentiates them from wastewater and drinking water.

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