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Technical BRIEF

INNOVATIVE RESEARCH FOR A SUSTAINABLE FUTURE

Onsite Non-Potable Water Reuse Research

Advancing the safe adoption of smaller scale systems for recycling locally collected water

Background

Increasing pressures on water resources has led to greater water scarcity and a growing demand for alternative water sources in many parts of the United States. In response, many communities have initiated or are developing treatment systems for planned reuse of stormwater runoff, and various domestic/municipal wastewaters.

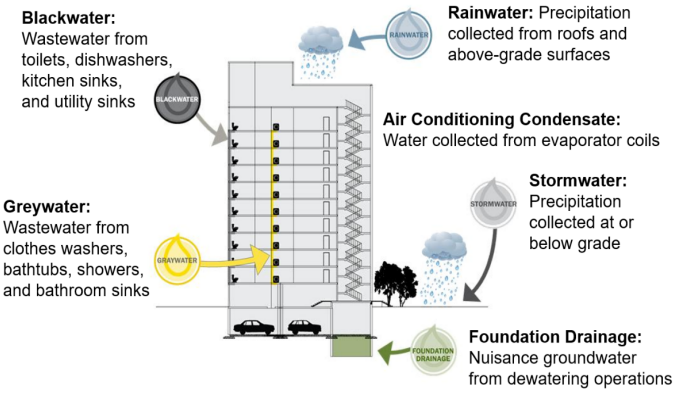
Although there are several types of water reuse, this fact sheet is focused on EPA's onsite non-potable water reuse research. This fit-for-purpose water reuse is one solution that can help communities collect, treat and reuse water for non-drinking water purposes. Onsite non-potable water reuse systems (ONWS), such as the one shown on Page 2, capture, treat, and reuse water at a building or district scale. The treated water is then used onsite or in a local area for non-drinking water purposes, such as toilet flushing, clothes washing, and ornamental plant irrigation.

Collaborative Efforts

EPA is collaborating with states and utilities who are facilitating the development of ONWS to define treatment and monitoring approaches that will ensure adequate safety and to build the utility business case for implementing such systems. EPA researchers are committed to active engagement with various partners and stakeholders to ensure that water reuse practices are protective of public health. One of these partners, the National Blue Ribbon Commission (NBRC) for Onsite Non-Potable Water Systems, is a nationwide group of utilities, state and local public health agencies, and federal agencies interested in advancing the use of ONWS at the building- or district-scale to recycle various types of locally collected water, such as wastewater, source separated graywater, stormwater runoff, and rainwater.

Defining Challenges

Initial partnership meetings identified a definition of appropriate water quality "criteria" that indicated adequate treatment and the associated monitoring approach to verify on-going performance of the system as key roadblocks to responding to the increasing number of requests to permit ONWS. While existing criteria and monitoring guidelines did exist for some reuse options, guidance varied greatly from state to state.



Within a building, several water sources are generated that can be treated and used onsite or in a local area for non-drinking water purposes, such as toilet flushing, clothes washing, and ornamental plant irrigation.

In addition to the need for standardization, the existing approaches for setting and monitoring treatment performance were not risk-based. In other words, the level of the water quality parameters used to verify safety was not based on a quantitative assessment of the exposure risk to pathogens during the projected reuse. A systematic evaluation of exposure risks for the range of locally collected wastewaters for different non-potable end uses was clearly needed to provide a basis for defining treatment and monitoring. Finally, while utilities identified several drivers for implementing ONWS, ranging from addressing water scarcity to the development of green space within urban areas, quantifiable data was needed on the life cycle impacts and costs to build the business case for implementation.

Research Focus

EPA's onsite non-potable water reuse research is focusing on three areas: (1) risk-based modeling to define the necessary level of treatment to safely reuse locally collected wastewater for non-potable purposes in and around buildings; (2) describing and quantifying the microorganisms, both bacterial and viral, found in these wastewaters to define improved targets for monitoring

treatment performance; and (3) life cycle assessment (LCA) and life cycle costing to understand relative cost/benefits of various forms of ONWS.

Risk Based Modeling

EPA researchers are conducting risk-based modeling to define the necessary level of treatment to safely reuse several locally collected wastewaters for non-potable uses in and around buildings. Specifically, quantitative microbial risks assessment (QMRA) models were developed to define the level of potential risks from using locally collected wastewaters for non-potable purposes. The models also predict the level of pathogen removal that would be required to achieve acceptable risk benchmarks. The reduction targets for each of the three major groups of waterborne pathogen risks (viruses, bacteria and protozoans) provide specific performance metrics for treatment systems. This research also includes evaluation of the initial concentrations of pathogens in the different wastewaters and the risks associated with ONWS cross-connections.

Recent Research Publications:

- Human health impact of non-potable reuse of distributed wastewater and greywater treated by membrane bioreactors (2018)
- Human health impact of cross-connections in non-potable reuse systems (2018)
- Risk-based enteric pathogen reduction targets for non-potable and direct potable use of roof runoff, stormwater, and greywater (2017)
- Simulation of enteric pathogen concentrations in locally-collected greywater and wastewater for microbial risk assessments (2017)
- Review of pathogen treatment reductions for onsite non-potable reuse of alternative source waters (2017)

Monitoring of Treatment Performance

A critical component of ONWS is the need for identification of indicators that can be used to monitor treatment effectiveness with regard to the reduction of microbes. To address this, research was done to identify common gray water contaminants, including bacteria, viruses, and human mitochondrial DNA, and evaluate the impact of treatment on these potential indicators. The goal of this work is to define improved targets for monitoring treatment performance.

Recent Research Publications:

- Reducing inherent biases introduced during DNA viral metagenome analyses of municipal wastewater (2018)
- Characterization of the relative importance of human-and-infrastructure-associated bacteria in grey water: a case study (2015)
- Human mitochondrial DNA and endogenous bacteria surrogates for risk assessment of greywater reuse (2014)

Life Cycle Assessment (LCA)

From the perspective of the local utility or government, the implementation of ONWS must account for the costs of installing and operating the ONWS relative to the benefits derived. To provide insight from a system level perspective, life cycle costs and environmental impacts were assessed for ONWS of various scales and types.

Recent Research Publication:

- Energy and greenhouse gas life cycle assessment and cost analyst of aerobic and anaerobic membrane bioreactor systems: Influence of scale, population density, climate, and methane recovery (2018)

Additional Information

Websites:

- EPA's Onsite Non-Potable Water Reuse epa.gov/water-research/onsite-non-potable-water-reuse-research
- National Blue Ribbon Commission for Onsite Non-Potable Water Systems uswateralliance.org/initiatives/commission

Guidelines:

- EPA's 2012 Guidelines for Water Reuse nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P100FS7K.txt
- 2018 Guidebook for Developing and Implementing Regulations for Onsite Non-Potable Water Systems uswateralliance.org/sites/uswateralliance.org/files/nbrc%20guidebook%20for%20developing%20onws%20regulations.pdf
- 2017 Risk-Based Framework for the Development of Public Health Guidance for Decentralized Non-Potable Water Systems nwri-usa.org/pdfs/SIWM10C15_Decentralized-Non-Potable-Water-Systems.pdf

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ONWS: Hassalo on 8th Wastewater Treatment & Reuse System in Portland, Oregon