Reclaimed Water Infiltration Study

Task 4: Cost/Benefit Analysis

LOTT Clean Water Alliance

Study Framework

The key question that the overall study is intended to answer is:

What are the risks from infiltrating reclaimed water into groundwater because of chemicals that may remain in the water from products people use every day, and what can be done to reduce those risks?

The overall study has four main tasks designed to answer specific questions.

Task 1: Water Quality Characterization
What is the current quality of our local waters: groundwater, surface water, drinking water, wastewater, and reclaimed water?

Task 2: Treatment Effectiveness Evaluation
What happens to reclaimed water that is infiltrated to groundwater: where does it travel and how quickly, and how does the quality of the water change over time?

Task 3: Risk Assessment
What are the relative risks of replenishing groundwater with reclaimed water?

Task 4: Cost/Benefit Analysis
What are the costs and benefits of various approaches for treating and using reclaimed water?

Overview of Task 4

This fact sheet provides highlights of the fourth and final task of the Reclaimed Water Infiltration Study: Cost Benefit Analysis. For more details about the study, visit lottcleanwater.org.

The original study design included a cost benefit analysis focusing on advanced treatment technologies capable of reducing residual chemicals in reclaimed water. This focus was established before risk assessment work was complete, with the assumption that technologies such as reverse osmosis might be warranted to reduce risks from residual chemicals. Risks have since been identified as very low.

This Task 4 analysis considered the ability of various advanced treatment options to reduce the two chemicals of interest identified in Task 3: perfluoropentanoic acid (PFPeA) and N-nitrosodimethylamine (NDMA), as well as other residual chemicals. Alternatives to advanced treatment were also assessed.

Task 4 of the study focused on these questions:

- Are there advanced treatment technologies that could further reduce residual chemicals in reclaimed water?
- What is the cost of those treatment options?
- What is the risk reduction benefit of those options?
- What other actions could be taken to help reduce potential risks?

Key Findings

- Advanced treatment technologies are capable of further reducing levels of residual chemicals in reclaimed water.
- Costs of these technologies are substantial compared to their risk reduction benefit.
- Study findings indicate the current level of treatment results in a risk level that is very low.
- Other actions, such as targeted monitoring and source control, are appropriate next steps to further understand and address risks.

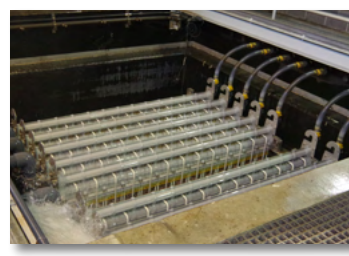
Advanced Treatment Options

The first step of the cost benefit analysis was to review the broad range of treatment technologies that can be used to remove residual chemicals. Four treatment options were identified for further analysis. These options range from a multi-step reverse osmosis treatment train to no additional treatment.

Reverse Osmosis (membrane, physical separation)

Ozone (oxidation)

Granular Activated Carbon (adsorption)



No Additional Treatment (existing membrane filtration)

- **Reverse Osmosis (RO) + Ultraviolet Light (UV) + Hydrogen Peroxide (H_2O_2)** is a combination of technologies that offer a multi-barrier system for removal of residual chemicals. RO uses pressure to force water through a membrane, leaving behind minerals, salts, and other compounds, including residual chemicals. The process requires high energy use and results in a concentrated brine that is challenging and costly to dispose of. UV and H_2O_2 break down chemicals not filtered out by RO. This multi-step system is effective at removing most residual chemicals from water.
- **Ozone + Biologically Activated Carbon (BAC) + Granular Activated Carbon (GAC)** is also a multi-barrier system. Ozone and BAC processes degrade many chemicals and GAC acts to adsorb chemicals that remain. It requires proper disposal of spent carbon, which is less challenging than RO brine disposal. This system is effective at removing many residual chemicals from water.
- **Granular Activated Carbon (GAC)** is a treatment technology that absorbs certain chemicals. GAC could be used as a stand-alone technology initially and be incorporated into a multi-step treatment train if warranted in the future. It is a targeted approach that addresses the two chemicals of interest, by removing PFPeA, the broader suite of PFAS chemicals, and chemicals that contribute to the formation of NDMA.
- **No additional treatment** is the option that would maintain the current level of treatment. Class A Reclaimed Water is produced at the Martin Way Reclaimed Water Plant using membrane bioreactor technology. Microorganisms break down compounds in the water before it is filtered through a membrane system and disinfected with chlorine. Class A Reclaimed Water meets high water quality standards and is approved by Washington State Departments of Health and Ecology for many uses, including groundwater replenishment. With study results indicating the risk of using this quality of water is very low, this remains a viable treatment option.

Treatment Options	Addresses Two Chemicals of Interest	Addresses Other Chemicals	Challenges	Capital and Operating Costs*
Reverse Osmosis Ultraviolet Light Hydrogen Peroxide	Yes	Most	• Cost • High Energy Use • Brine Management	$218.7 million
Ozone Biological Activated Carbon Granular Activated Carbon	Yes	Many	• Cost • Spent Carbon	$48.3 million
Granular Activated Carbon	Yes	PFAS Chemicals and some others	• Spent Carbon	$19.2 million
No Additional Treatment (beyond current level)	Partially	Partially	No Additional Challenges	$0 (no additional cost)

* Estimated 20-year costs to treat 5 million gallons per day

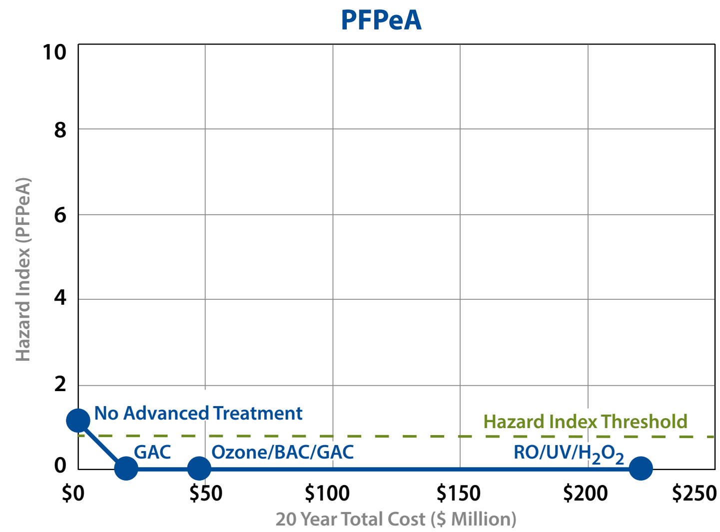
Comparison of Costs and Benefits

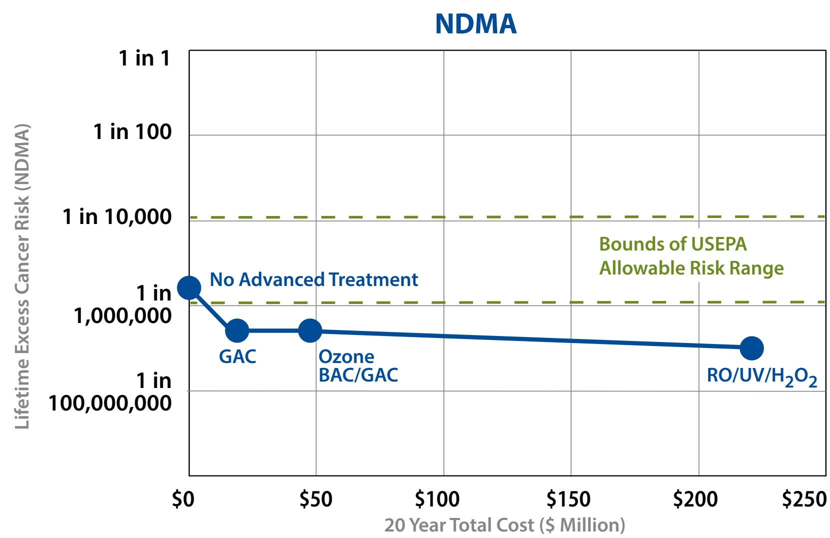
The benefit of adding advanced treatment is based on the premise that removing residual chemicals will reduce risk to human and ecological health. However, the risk level without advanced treatment has been identified as very low.

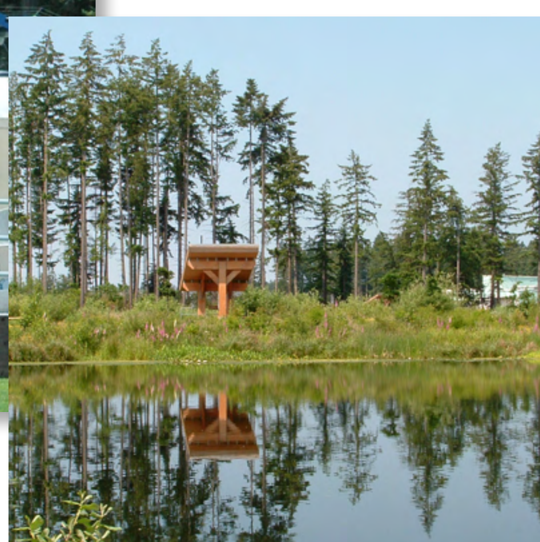
- PFPeA has a noncancer risk calculated as 1.3, slightly above the U.S. EPA hazard index threshold of 1.0. At a risk level this close to the threshold, risk assessment experts consider adverse health effects unlikely.
- NDMA has a lifetime excess cancer risk of 2.9 in 1,000,000, slightly above the threshold of 1 in 1,000,000, and well within the U.S. EPA allowable risk range.
- No negative affects to ecological health were identified.

These graphs show that all three advanced treatment options reduce risks for the two chemicals of interest to below risk thresholds for human health. Because the initial level of risk is very low, the relative value of investing in these technologies is uncertain.

Risk Reduction Comparison







LOTT's reclaimed water facilities include the Martin Way Reclaimed Water Plant, Hawks Prairie Ponds and Recharge Basins, and the Budd Inlet Reclaimed Water Plant.

Other Options for Addressing Risk

Building a more robust data set, identifying sources of chemicals of interest, and working to control inputs of these chemicals into the wastewater system are important next steps to better understand and address identified risks. These actions also help to ensure that future decisions are well informed. Recommended near-term actions include:

- **Continued monitoring of residual chemicals of interest.** Monitoring of NDMA, chemicals that help form NDMA, PFPeA, and the broader suite of PFAS chemicals will fill in several data gaps. Because NDMA was detected only some of the time, additional data is needed to clarify our understanding of potential risk. More data on PFPeA, and PFAS in general, can provide a head start for responding to future PFAS regulations expected at the state and federal levels.
- **Sampling efforts to pinpoint sources of residual chemicals.** Comparing residential wastewater effluent, commercial/industrial effluent, and landfill leachate may pinpoint contributions of residual chemicals. Additional sampling of groundwater, surface water, and septic effluent can also shed light on potential sources.
- **Source control efforts.** A refined understanding of sources will help identify which source control efforts can make the most difference in reducing inputs of residual chemicals into the wastewater system. These efforts could include:
    - Public outreach to raise awareness of consumer sources of residual chemicals and ways individuals can reduce their chemical footprints
    - Pretreatment outreach or regulations to address commercial or industrial sources
    - Support of broader efforts to regulate sources of residual chemicals

Information gathered through these near-term actions may indicate a future need to alter current practices. The addition of advanced treatment is one option. Other options include making operational adjustments to reduce the amount of water recharged at a particular location, or using more reclaimed water for reuse such as landscape irrigation. There are challenges to expanding reuse, however, including the high cost of developing reclaimed water pipelines to improve access to this resource.

Summary

Findings from Task 4, Cost Benefit Analysis, show there are a range of options for responding to risks from using reclaimed water to replenish groundwater. Advanced treatment would further reduce residual chemicals in reclaimed water, but this action is costly. The Peer Review Panel stated that risks from groundwater recharge are low and the water is safe under current practices. Conditions are likely to change over time as new chemicals come into use, others are phased out, and regulations are set in place. Continued monitoring, sampling, and source control efforts are key near-term actions to keep tabs on chemicals of interest and changing conditions.

What's Next?

Task 4, the final task of the study, will be followed by public engagement to share findings and ask for feedback on proposed next steps. Ultimately, study findings and feedback will inform long-term wastewater management options being considered through LOTT's master planning effort.

Get Involved!

- Learn more or sign up to receive email updates about the study:
  www.lottcleanwater.org
- Share questions or comments by email:
  reclaimedwaterstudy@lottcleanwater.org
- Give us a call:
  (360) 664-2333
- Send comments or questions by mail:
  Reclaimed Water Infiltration Study
  LOTT Clean Water Alliance
  500 Adams Street NE
  Olympia, WA 98501