



# Reclaimed Water and Infiltration Study Update

Presentation to the City of Olympia  
Utility Advisory Committee  
November 7, 2019









# Why Reclaimed Water?

## Public Values:

- Meet future wastewater needs
- Treat wastewater as a valuable resource
- Maximize benefits to the environment
- Provide multiple community benefits

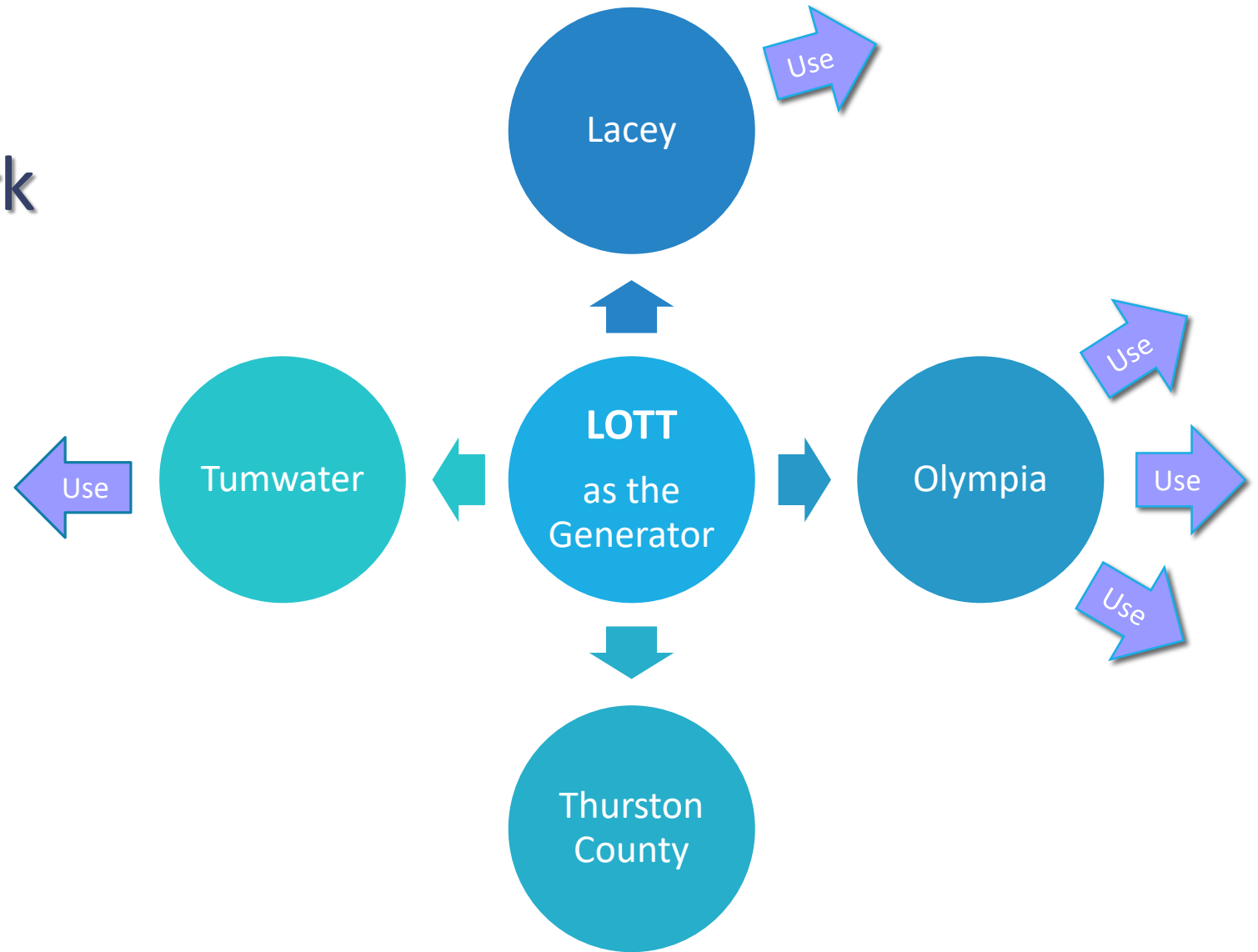
## Long-Term Strategy:

- Expand production and use of reclaimed water
- Use reclaimed water to replenish groundwater

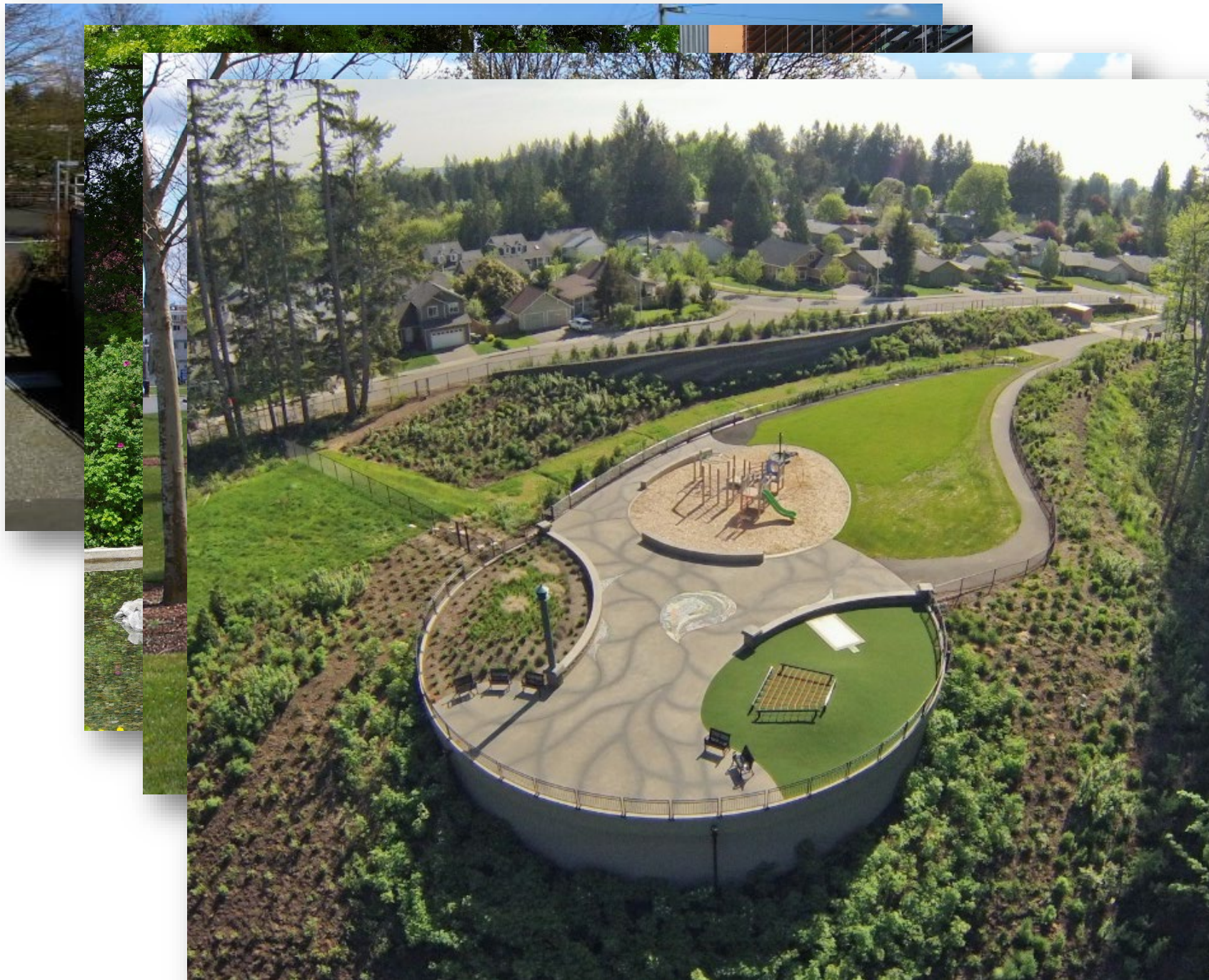




# Reclaimed Water Program Framework













# Residual Chemicals

Keep Drugs Out of the Water Supply  
(Parade)

Drugs, household chemicals are a risk 'we haven't fully  
begun to understand' (The Olympian)

## Drugs found in salmon, from tainted wastewater

Samples collected in Tacoma and Bremerton show 81 drugs and personal-care products

Scientists don't know if high levels because of residents' drug use or wastewater-treatment processes

Findings don't indicate threat to human health

BY LYNDIA V. MAPES  
Seattle Times

Puget Sound salmon are drugs — Prozac, Advil, Tylenol, Lipitor, even birth control.

Those drugs and dozens of others are showing up in the tissue of juvenile chinook, researchers have found, thanks to tainted wastewater discharge.

The estuary water near the outfalls of sewage-treatment plants and effluent sampled at the

wastewater-treatment plants' processes, said Jim Meador, an environmental toxicologist at the National Oceanic and Atmospheric Administration's Northwest Fisheries Science Center in Seattle and lead author on a paper published last week in the journal Environmental Pollution.

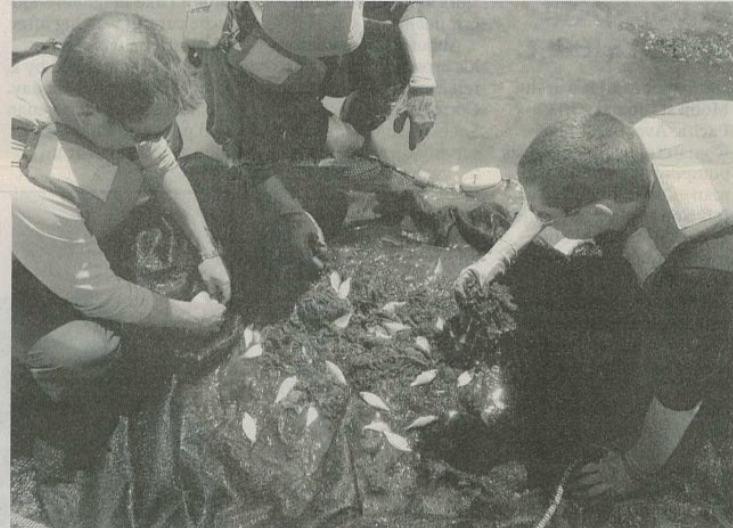
"The concentrations in effluent were higher than we expected," Meador said. The study sampled effluent for 150 compounds. "We know these

Flonase, Aleve, Tylenol, Paxil, Valium, Zoloft, Tagamet, OxyContin, Darvon, nicotine, caffeine, fungicides, antiseptics, anticoagulants and antibiotics.

Why are the levels so high? It could be because people here use more of the drugs detected, or it could be related to

Blair Waterway in Tacoma's Commencement Bay.

The chemicals turned up in the water and the tissue of migratory juvenile chinook salmon and resident staghorn sculpin. If anything, the study probably underreports the amount of drugs in the water closer to outfall pipes or in



ANDREW YEH National Oceanic and Atmospheric Administration

From left, Michael Caputo, Richard Ramsden and Stuart Munsch collect fish in a beach seine in Commencement Bay in Tacoma.

deeper water, researchers found.

Even fish tested in the intended control waters in the Nisqually Estuary, which receives no direct municipal treatment-plant discharge, tested positive for an alphabet soup of chemicals in supposedly pristine waters.

"That was supposed to be our clean reference area," Meador said. He was surprised that levels in many cases were higher than in many of the 50

largest wastewater-treatment plants around the nation. Those plants were sampled in another study by the EPA.

The findings are of concern because most of the chemicals detected are not monitored or regulated in wastewater and there is little or no established science on the environmental toxicity for the vast majority of the compounds detected.

Meador said he doubted there would be effects

from the chemicals on human health, because people don't eat sculpin or juvenile chinook, and levels are probably too low in the water to be active in humans. But one of the reasons the wastewater pollutants studied as a class are called "chemicals of emerging concern" is because so little is known about them.

However, "you have to wonder what it is doing to the fish," Meador said. His other recent work has

shown that juvenile chinook migrating through contaminated estuaries in Puget Sound die at twice the rate of fish elsewhere.

The drugs detected in the study could be part of the reason, as they have the potential to affect fish growth, behavior, reproduction, immune function and antibiotic resistance.

The drugs selected for testing were chosen on the basis of their widespread use by people, the likelihood of their continued use and the potential for higher levels of contamination as the human population in the Puget Sound region grows.

The results represent only a snapshot, and levels could be higher or lower depending on people's use of drugs and volumes of treatment-plant discharge. For instance, levels of deet (an insect repellent) and antihistamines are probably even higher in summer.

Some regional differences were detected.

Substantially higher concentrations of deet, caffeine, ibuprofen and female reproductive hormone were found in Bremerton effluent, compared with the Tacoma site, which researchers concluded could be because of differences in usage.

The Puget Sound area contains 106 publicly owned wastewater-treatment plants that discharge to local waters.

The amount of drugs and chemicals from all plants into Puget Sound could be as much as 97,000 pounds every year, the study found.

SEE DRUGS, 5A







# Thurston County Critical Areas Ordinance

## 24.10.190 - Reclaimed water

- A. Irrigation with Class A reclaimed water at agronomic rates is permitted in all CARAs, subject to TCC 24.10.030 [General Standards].
- B. Infiltration of reclaimed water (application to the land's surface above agronomic rates) Critical area regulations will be proposed when more information is available to Thurston County from the Regional Groundwater Recharge Scientific Study, and using other studies and information for reclaimed water following the requirements of the Growth Management Act (Chapter 36.70A RCW).

(Ord. No. 14773, § 3(Att. B), 7-24-2012)

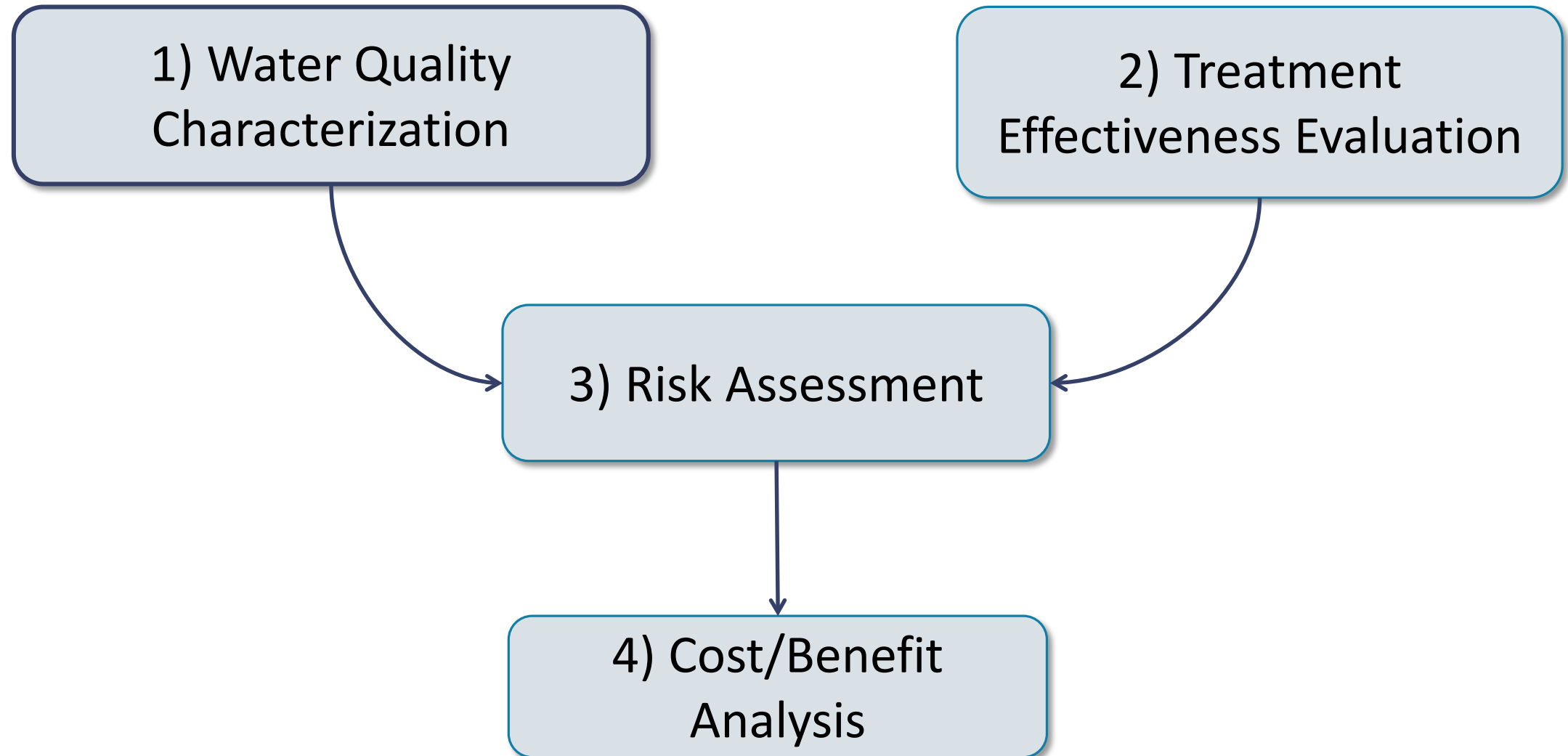


# Primary Study Question

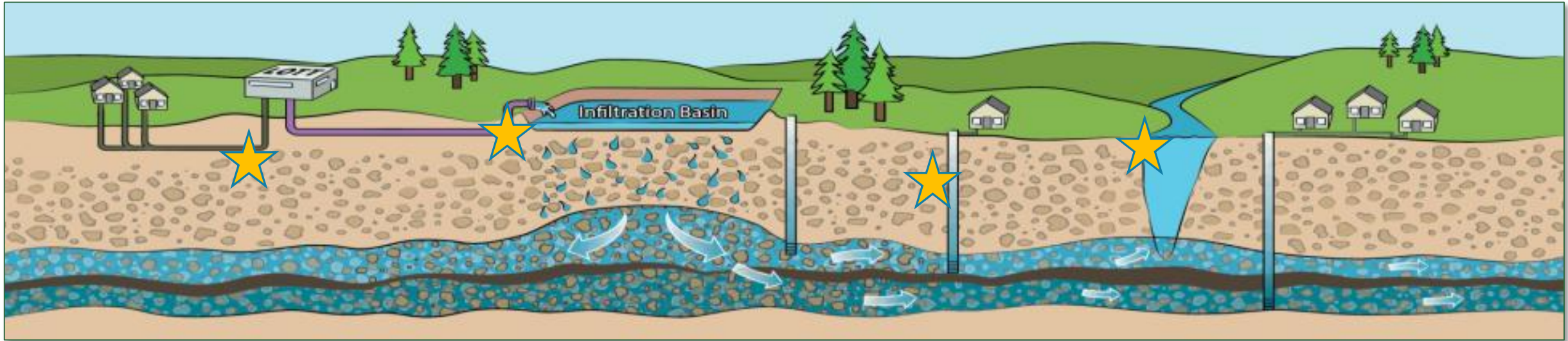
What are the risks  
from infiltrating reclaimed water into groundwater  
because of chemicals that may remain in the water  
from products people use every day,  
and what can be done to reduce those risks?



# Study Framework



# Task 1: Water Quality Characterization



- Wastewater
- Reclaimed Water
- Groundwater
- Surface Water



# Water Quality Sampling List

## Regulated Parameters

- Pathogens
- Nutrients
- Drinking Water Parameters

## Unregulated Parameters (127 Residual Chemicals)

- Medicines
- Personal Care Products
- Foods
- Hormones
- Household Chemicals

In total, 409 parameters measured

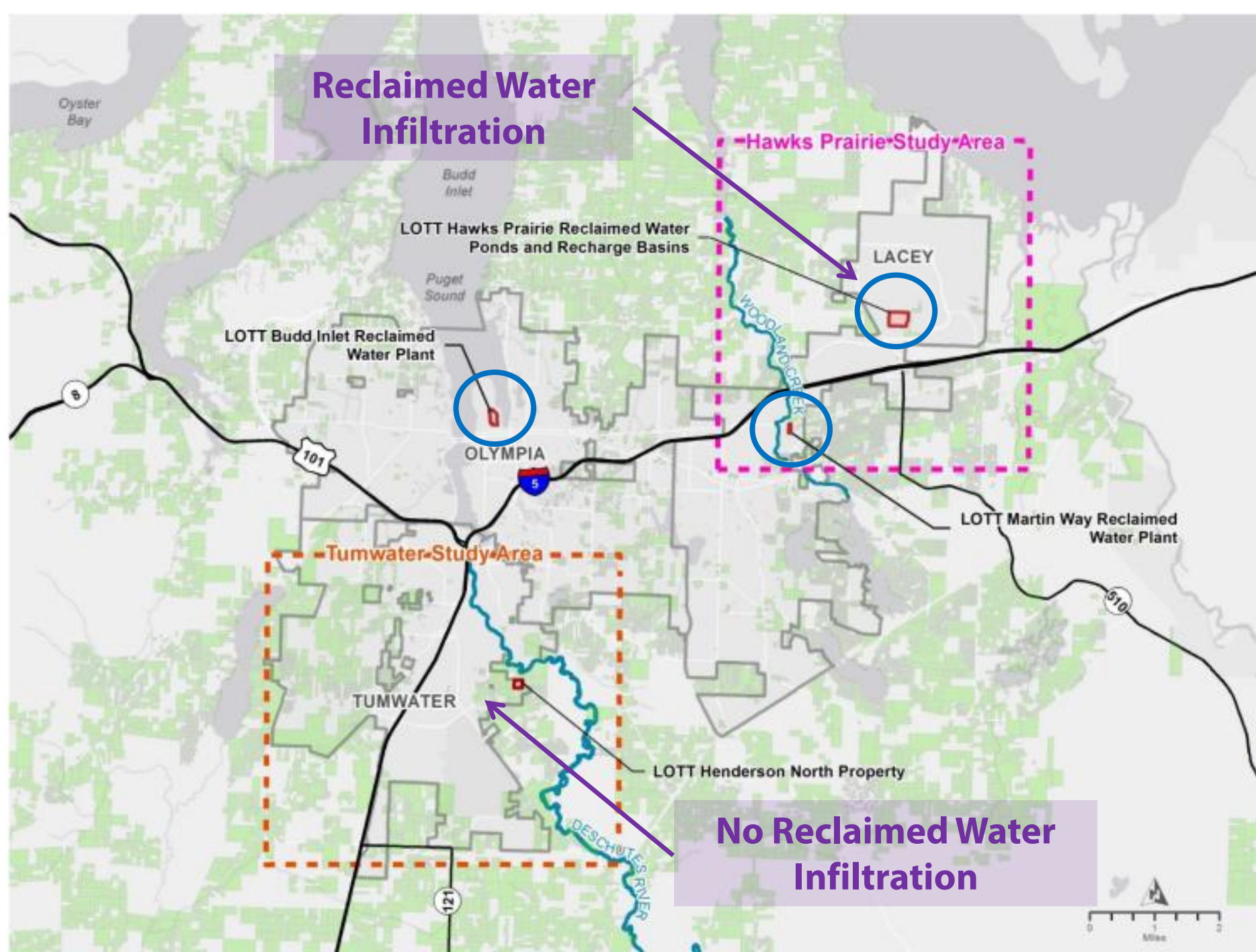
# Residual Chemicals Consistently Detected in Reclaimed Water

Chemical	Type
1,4-Dioxane	Solvent
Acesulfame-K	Sweetener
Atenolol	Beta Blocker
Carbamazepine	Anti-seizure
Cotinine	Nicotine Degradate
Fluoxetine	Anti-depressant
Iohexol	X-ray Contrast

Chemical	Type
Iopromide	X-ray Contrast
Lopressor	Beta Blocker
Metformin	Anti-diabetic
Primidone	Anti-convulsant
Sucralose	Sweetener
TCEP	Flame Retardant
TCP	Flame Retardant



## Reclaimed Water Infiltration



No Reclaimed Water Infiltration

## Detections of Residual Chemicals in the Environment

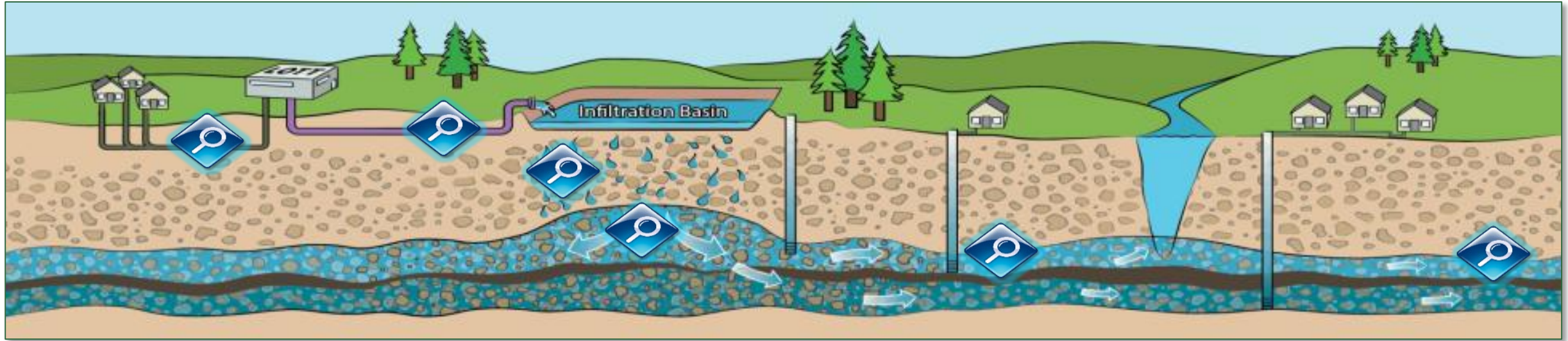
- Groundwater: 22
- Surface Water: 15

# Task 1 Summary: Water Quality Characterization

- Chemicals found in reclaimed water come from products we use everyday
- Some chemicals are effectively removed by LOTT's treatment processes, while others are fairly recalcitrant
- LOTT's reclaimed water quality is similar to that of other facilities
- Some of the residual chemicals detected in reclaimed water are also observed in the environment, including in areas where no reclaimed water use is present



## Task 2: Treatment Effectiveness Evaluation



- Tracer Testing
- Water Quality Sampling
- Modeling

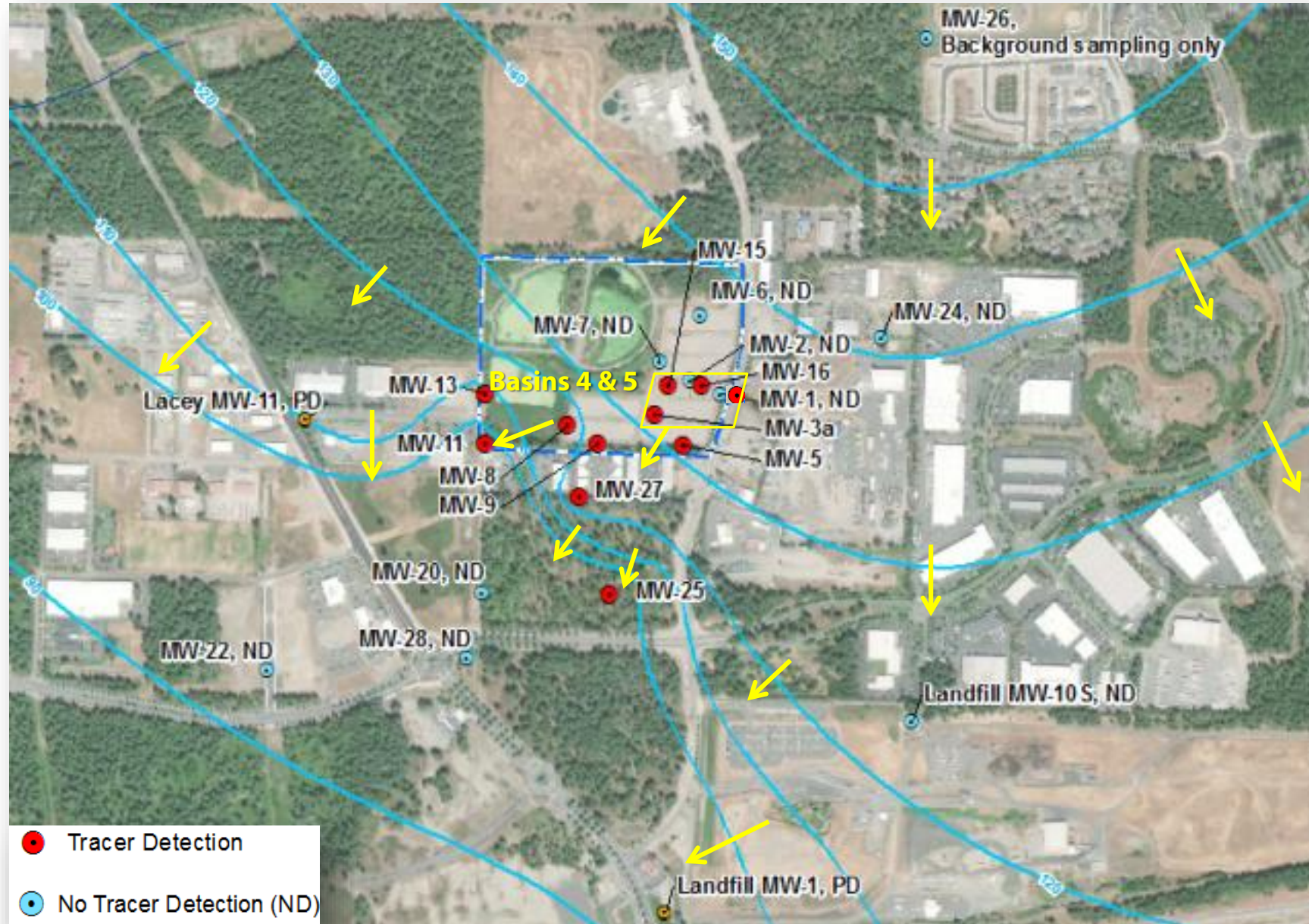
# Monitoring Well Network



- Shallow Well
- Deep Well



# Tracer Detections – Shallow (Qva) Aquifer





# Tracer Detections – Sea Level (Qc) Aquifer





## Task 2: Summary of Tracer Testing

Reclaimed water flow path:

- Confirmed reclaimed water flow paths to the west, southwest, and south
- Some preferential flow paths exist
- Lateral flow dominates
- Existence of flow paths from infiltration basins to Sea Level (Qc) Aquifer

# Water Quality Monitoring Network





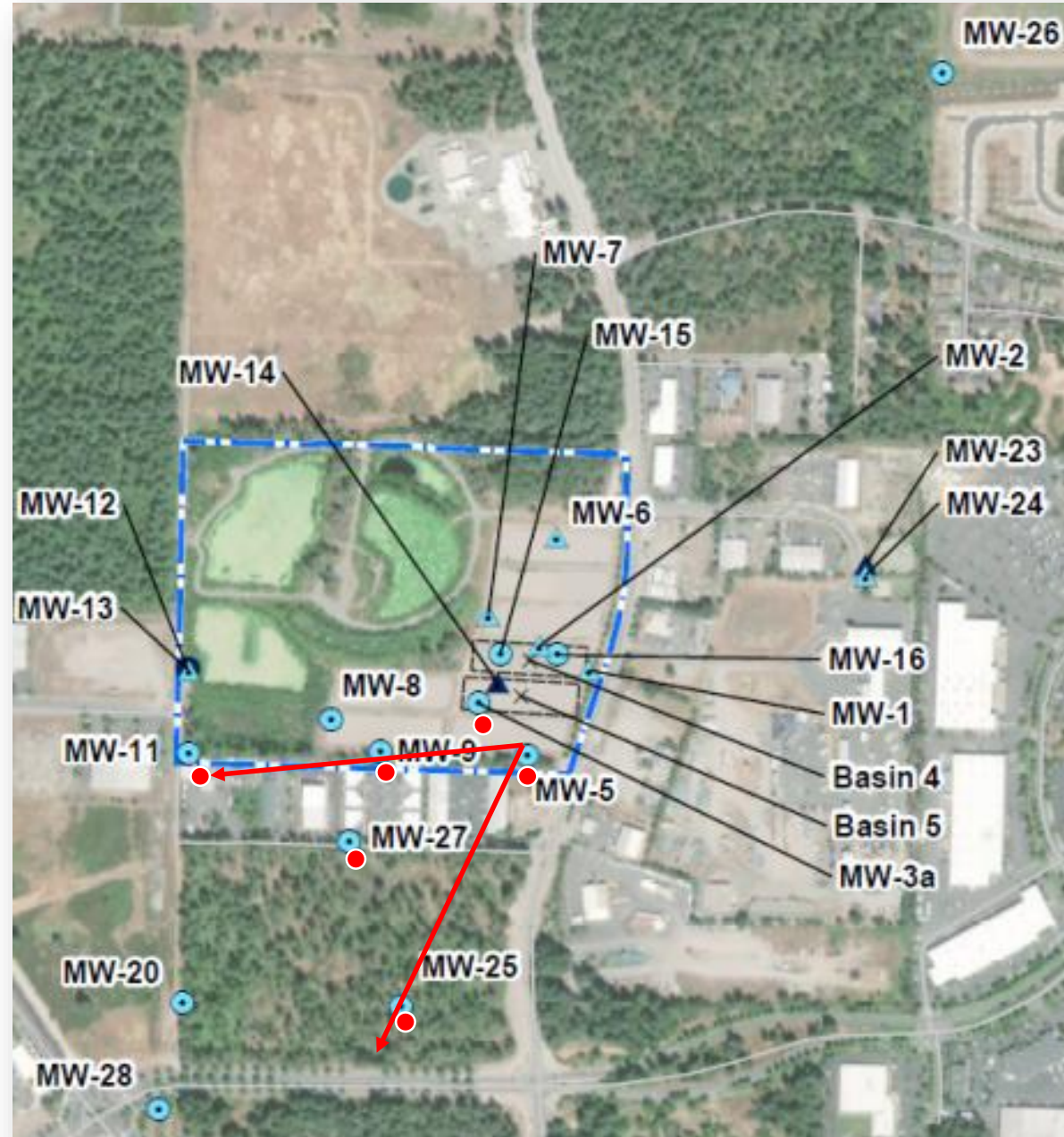
# Residual Chemicals Along Groundwater Flow Paths

## To the South:

- MW-5
- MW-27
- MW-25

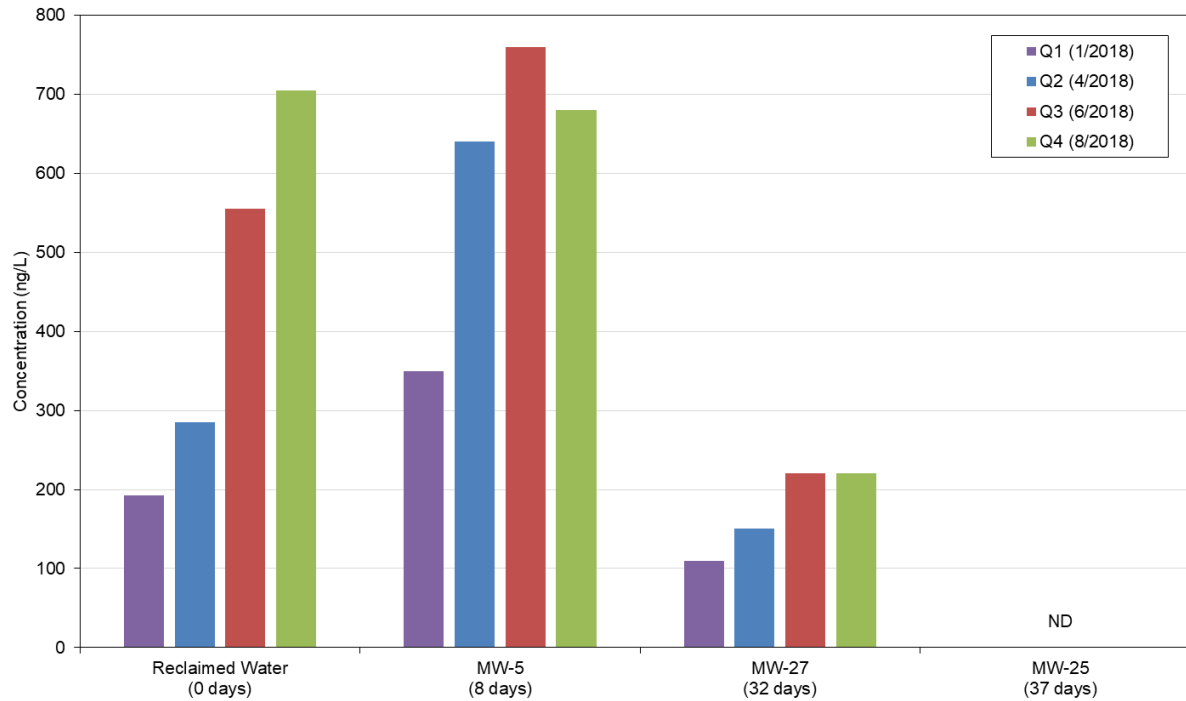
## To the West:

- MW-3a
- MW-9
- MW-11

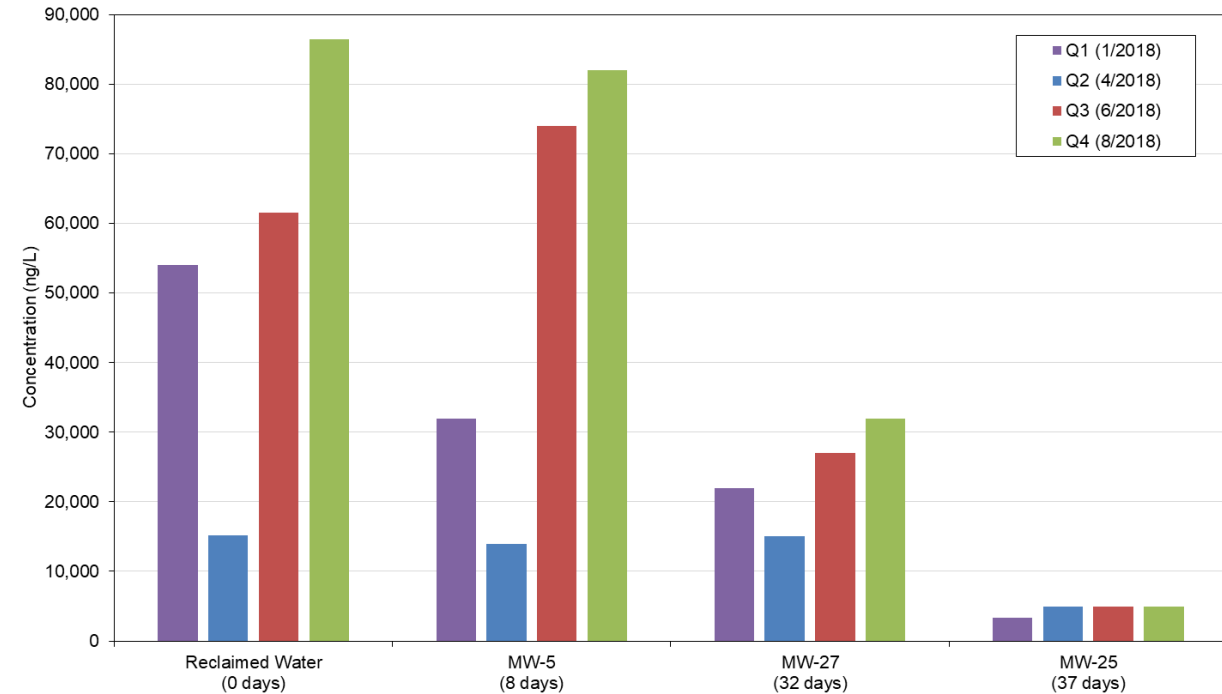


# Residual Chemicals Along South Groundwater Flow Path

Quarterly Carbamazepine Concentrations Along South Groundwater Flow Path



Quarterly Sucralose Concentrations Along South Groundwater Flow Path



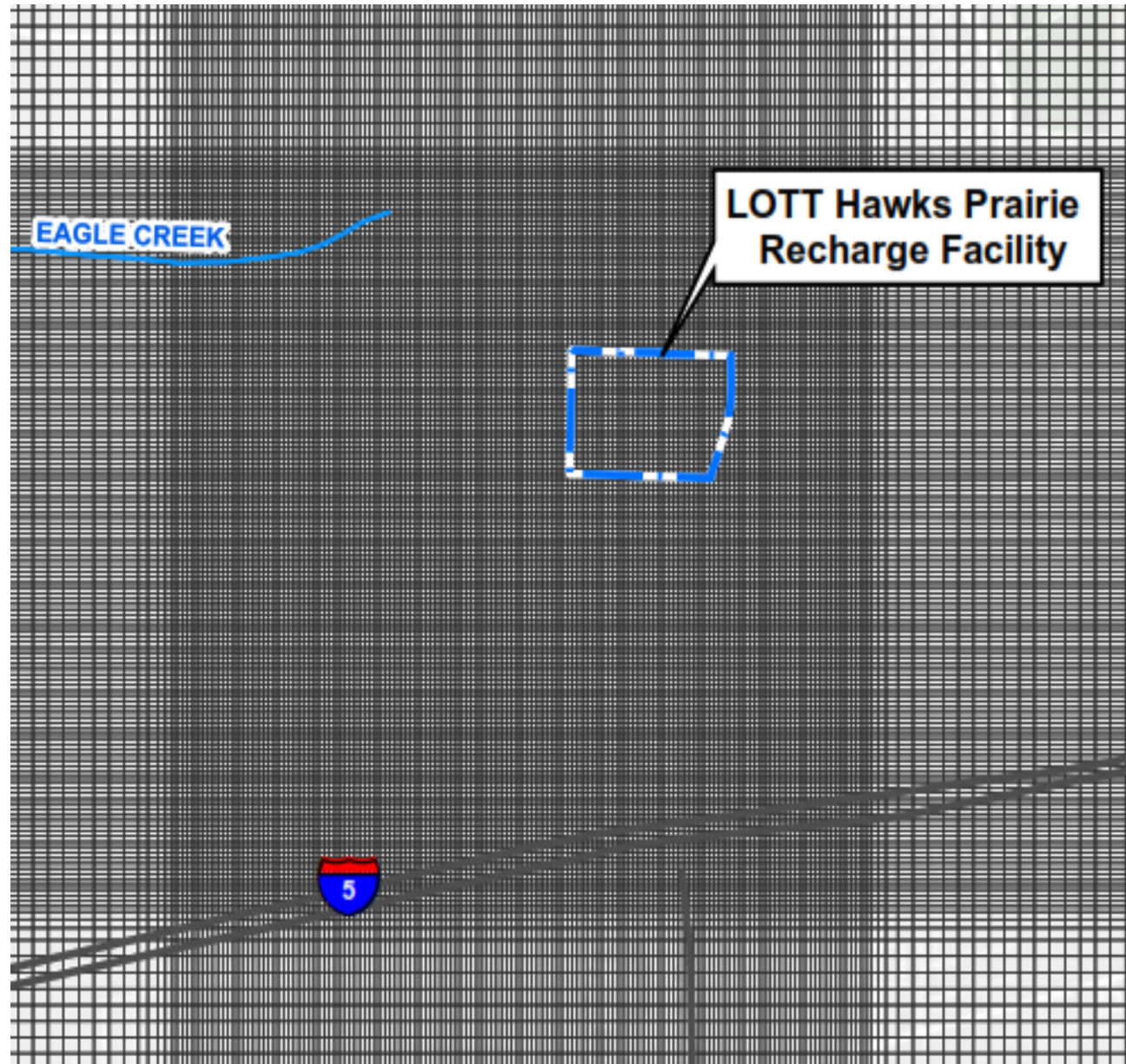
- Concentrations decrease with distance and time
- Some chemicals observed consistently in reclaimed water are not detected after ~30-40 days of travel time
- Some chemicals attenuate more rapidly than others



# Water Quality Monitoring Summary

- 24 residual chemicals detected consistently in sampling events in reclaimed water
- Residual chemical attenuation observed in downgradient flow paths
- Dispersion likely a strong factor, with more occurring to the south than to the west
- Residual chemicals observed in Sea Level Aquifer

## Task 2: Modeling





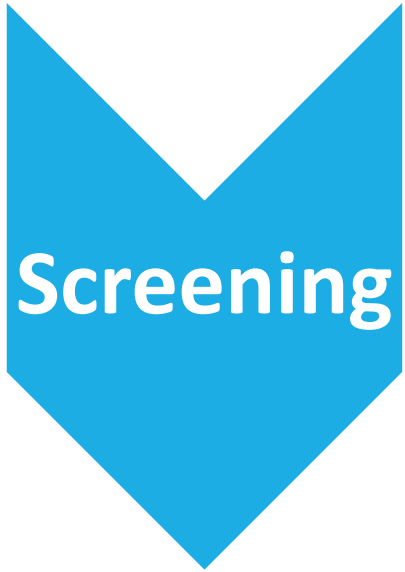
## Task 3: Risk Assessment







# Risk Assessment



- **Inputs: data from Tasks 1 and 2**
- Focus on chemicals detected at least once in reclaimed water
- Identify chemicals to consider further
  - Comparison of maximum observed concentrations against established toxicity thresholds
  - Chemicals that are persistent or bioaccumulative

# Risk Assessment



**Screening**

- **Inputs: data from Tasks 1 and 2**
- Focus on chemicals detected at least once in reclaimed water
- Identify chemicals to consider further
  - Comparison of maximum observed concentrations against established toxicity thresholds
  - Chemicals that are persistent or bioaccumulative

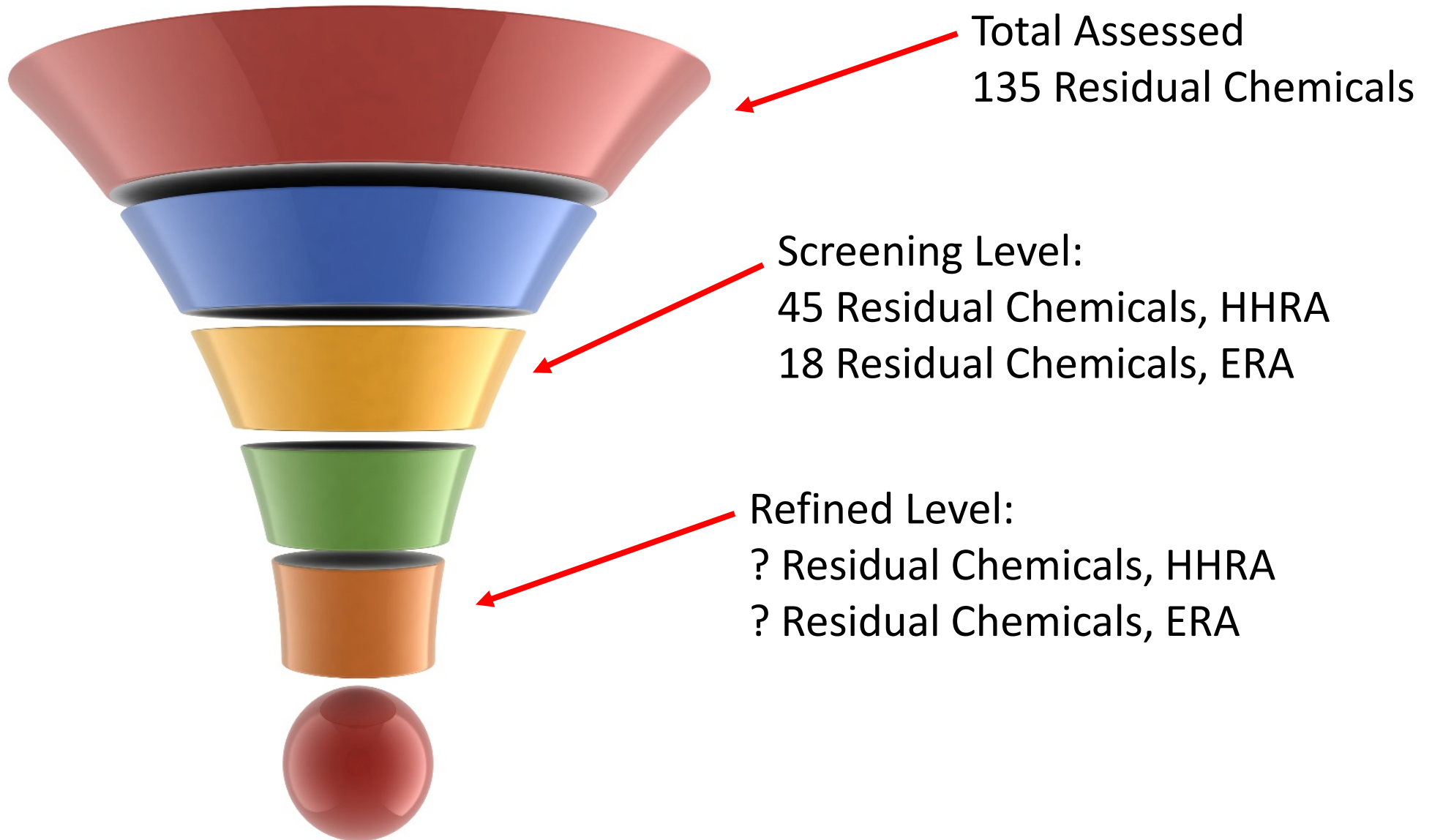


**Refined**

- **Inputs: groundwater modeling data**
- Focus on subset of chemicals from Tier 1 screening
- Consider “actual” exposures in drinking water wells and streams



# Risk Assessment







## Task 4: Cost Benefit Analysis





## Schedule

Activity	2019	2020
Task 2: Groundwater Modeling		
Task 3: Risk Assessment (Human Health and Ecological)		
Task 4: Cost / Benefit Analysis		
Reporting Out and Community Outreach		

# Questions?



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**Visit LOTT's website:**

[lottcleanwater.org](http://lottcleanwater.org)



# Chemicals for Further Evaluation - HHRA

Pharmaceuticals	Hormones	PFAS	Other
Albuterol Carbamazepine Chloramphenicol Primidone	Estradiol Estrone Ethinyl estradiol-17 $\alpha$ Norethisterone	Perfluoro-n-hexanoic acid Perfluoropentanoic acid	1,4-Dioxane, industrial chem 4-Nonylphenol, surfactant N-Nitroso dimethylamine (NDMA), industrial chem Quinoline, pesticide Tris(1,3-dichloroisopropyl) phosphate (TDCPP), a flame retardant

# Chemicals for Further Evaluation- HHRA

Pharmaceuticals, % of DWEL	Other, % of DWEL
Acesulfame-K, a sugar substitute, 11% Atenolol, a beta blocker, 23% Cotinine, a nicotine degradate, 16% Diazepam, an anti-anxiety agent, 11% Diclofenac, an anti-inflammatory medication, 31% Dilantin, anti-seizure medication, 11% Fluoxetine, an antidepressant, 22% Gemfibrozil, an antilipidemic, 14% Lopressor, a beta blocker, 30% Sulfamethoxazole, a sulfa antibiotic, 13% Theophylline, an anti-asthmatic, 24%	Sucralose, a sugar substitute, 31% TCEP, a flame retardant, 48% Thiabendazole, a fungicide, 46%



## Results – Toxicity Benchmark Comparison - ERA

Chemical Retained for Refined ERA	Chemical Type
4-Nonylphenol	Surfactant
17-alpha ethinyl estradiol	Estrogenic hormone
17-beta estradiol	Estrogenic hormone
Fipronil	Insecticide
Sucralose	Sugar substitute
Tris(chloropropyl)phosphate (TCP)	Flame retardant
Tris(1,3-dichloro-2-propyl)phosphate (TDCPP)	Flame retardant
Theobromine	Alkaloid in chocolate and coffee

## Results – Bioaccumulative Chemicals- ERA

Chemical Retained for Refined ERA	Chemical Type
Diclofenac	Anti-inflammatory
Gemfibrozil	Lipid regulator
Meclofenamic acid	Anti-inflammatory
Triclosan	Antibacterial agent
Per- and polyfluoroalkyl compounds (PFAS) (6 chemicals)	Perfluoro surfactants