POTABLE WATER REUSE AND RECLAIMED WATER ISSUES IN WASHINGTON STATE

Washington State Department of HEALTH

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Background

- Potable water sources in Washington – surface water, groundwater, desalinated seawater. Competing demands – fish, irrigation, power generation, along with climate changes and population put stress on existing sources, especially in eastern side of the state.

- **Reclaimed** (recycled or reused) **water** (treated municipal wastewater) has been successfully used across USA including Washington State and the world for **non-potable supplies**.

- Reclaimed water can and has been used for **potable reuse** in USA and the world. Potable reuse is divided into indirect and direct. Direct Potable Reuse:
  - Windhoek, Namibia 1968!
  - Big Spring and Wichita Falls, Texas 2013.

ODW Rule Involvement & Reuse

- **Drinking Water Regulations – WAC 246-290**
  - Health is sole implementer
- **Reclaimed Water Rule – WAC 173-219**
  - Section 060(4) Health responsibilities as the lead or nonlead agency will:
    - (a) Develop permit requirements as necessary to ensure adequate public health protection … use of reclaimed water.
  - Section 390 – Specific water use-based standards. There are 24 listed uses.
    - **Subsections 20-24 deal with potable reuse**.
- **Onsite Non-potable Water Systems - WAC 246-275** (Being written!)

Potable Reuse

- Potable reuse of reclaimed water represents a substantial difference in water quality requirements from all non-potable reuse applications. This cannot be stressed enough.
- Significant public health and water quality issues / risks are involved with using municipal wastewater as a source. Microbiological pathogens – viruses, bacteria and protozoa are considered the primary concern because of human health concerns resulting from short-term exposure to microbes. Municipal wastewater contains very high numbers of microbial organisms.
- Chemical contaminants that can cause human harm are also found in sewage. These contaminants may cause harm from both short and long-term exposure.
- Disinfection Byproducts (DBPs) including N-Nitrosodimethyline (NDMA) can be formed during treatment of wastewater. Personal care products and chemicals of emerging concern (CEC) are potential water quality concerns as is antibiotic resistance issues associated with discharging wastewater into the natural environment.

Potable Reuse

Indirect Potable Reuse **(IPR)**

IPR involves using reclaimed water to:

1. Recharge groundwater aquifers via
   a. surface spreading (water filters thru soil / vadose zone) or,
   b. through direct injection into the aquifer
2. Augment a river or reservoir that serves as a drinking water source.

Direct potable reuse (**DPR**)

DPR adds reclaimed water directly into a raw water supply

- Immediately upstream of a drinking water treatment facility (DWTF) or,
- Directly into a potable water distribution system

The key difference between IPR and DPR is the presence or absence of a "**substantial environmental buffer.**"

Environmental Buffer

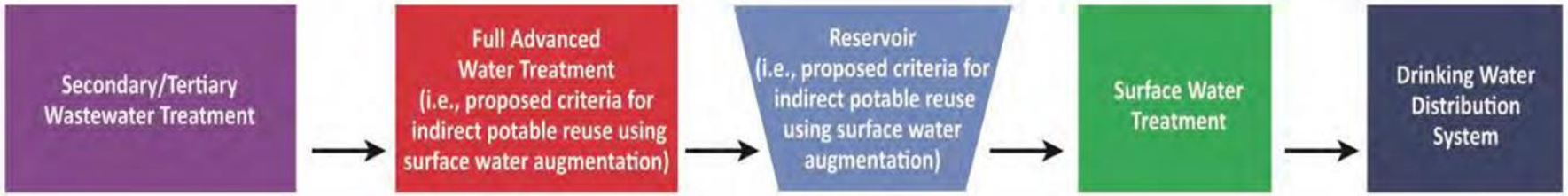
An **environmental buffer** is generally the overlaying soil of an aquifer, an aquifer and/or a surface water body.

Four Key Benefits:

1. Storage of advanced treated water for subsequent use
2. Attenuation of some contaminants that evade treatment
3. Allows response time for treatment upsets
4. Equalization of water quality through storage

a) Indirect potable reuse using *groundwater replenishment via surface spreading.*

b) Indirect potable reuse using *groundwater replenishment via subsurface injection.*



c) Indirect potable reuse using *surface water augmentation*. The reservoir, which acts an an environmental buffer, provides dilution and the time to respond to water quality issues should a problem occur with full advanced treatment.

Schematics of indirect potable reuse in California using groundwater replenishment (a, b) and surface water augmentation (c).

Advanced Water Treatment

- **Reverse Osmosis (RO)** –> target organic chemicals that pose health threat
- **Advanced Oxidation Process (AOP)** -> (UV + H_2O_2) degrade chemicals that pass through RO (NDMA and 1,4-dioxane)
- AOP provides multi barrier treatment
- TOC (total organic carbon) limit of 0.5 mg/L used to address unregulated chemicals
- Continuous performance monitoring – indicates when integrity of the treatment process has been compromised (Conductivity, UV absorbance, TOC, …)

What is Class A water (219-173)

1. Treatment Methods:
   a. Biological oxidation, followed by coagulation, filtration and disinfection, demonstrating at least 4-log virus removal or inactivation
   b. Biological oxidation, followed by membrane filtration …
2. Performance Standards (raw domestic sewage)
   a. Coagulation/Filtration – Month Ave 2 NTU / Sample max 5 NTU. (no decimals) **Membrane Filtration** Month Ave 0.2 NTU, max 0.5 NTU.
   b. No Giardia – no Cryptosporidium treatment required
   c. Coliform – 7 day mean 2.2 MPN/100 mL / Sample max 23 MPN/mL
   d. Total Nitrogen – Monthly Ave 10 mg/L / Weekly Ave 15 mg/L
   e. Dissolved Oxygen, TSS, BOD_5 , $CBOD_5$

Treatment Goals for Potable Reuse

- California research led to 2014 IPR via ground water injection treatment requirements of 12-log virus (99.9999999999% reduction), 10-log crypto, and 10-log giardia for microbial risks (known as 12/10/10 Rule)
- By comparison WAC 173-219-340 calls for 4-log virus treatment for Class A water (99.99%)
- CA microbial treatment requirements apply equally to DPR settings using municipal wastewater as a drinking water supply
  - (The key difference between IPR and DPR is the presence/ absence of a substantive environmental buffer - the same level of treatment is needed)

Treatment Needs for Different Approaches

- IPR water discharged to an aquifer that includes **surface spreading** undergoes secondary / tertiary treatment (**Class A water** as defined WAC 173-219-320, 330, 340). Washington has approximately 8 recharge groundwater aquifers through surface spreading projects.
- IPR water discharged directly into an aquifer (that serves as a drinking water supply) or into a surface water body (that serves as a drinking water supply) should undergo secondary/tertiary treatment (Class A) **and** advanced water treatment (**AWT**). *(The soil treatment component associated with surface application has been bypassed).*
- Washington does not have any permitted groundwater direct injection or surface water augmentation IPR projects….Yet!
  - One is underway. Cascadia WWTP – Pierce County (DOH comments rejected by ECY)

WAC 173-219 – 'rough spots' with Potable Water Uses

The State should facilitate the maximum use of our precious water resources. However, the potable reuse portions (IPR and DPR) of the rule do not reflect evolving best practices and present some conflicts or tension with drinking water public health protections and regulations.

- **Section 010** - *Indirect Potable Reuse* and *Direct Potable Reuse* are not defined nor used in the administrative code. *Environmental buffer* is not defined.
- **Section 390 (23)** - Recovery of reclaimed water from an aquifer – this appears to be a concept driven by ASR (aquifer storage and recovery) miscommunication. (**This is DPR!**) Use of any well for drinking water requires explicit DOH approval. Existing ASR projects for municipal supply use treated approved drinking water sources to recharge the aquifer during excess water times of the year (Walla Walla).

Fact Sheet

Aquifer Storage and Recovery Projects and Drinking Water Wells

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"Only water from DOH-approved potable water sources may be injected into any drinking water source involved in an ASR or MAR project. This applies to any proposed or existing water source. No existing drinking water source may be augmented by an ASR or MAR project without explicit DOH authorization."

WAC 173-219 – 'rough spots' with Potable Water Uses

- **Section 390 (20, 22, 23, 24)** – Reference WAC 246-290-310 as the appropriate drinking water quality standards (performance). Unfortunately, the microbial contaminants of most concern are **not** covered in section 310 – they are covered in Part 6 of the drinking water regulations that deals with surface water treatment requirements. These requirements apply to IPR and DPR sources.

- **Potable Reuse Applications** – indirect or direct potable reuse applications require additional treatment beyond Class A Water. **These uses should require Class A+ water (Advanced Water Treatment)**. (Subsections 20, 22, 23, 24). (CA & NV)

WAC 173-219 – 'rough spots' with Potable Water Uses

- **Section 390 (24)** - Direct Potable Reuse requires the state board of health to issue a waiver (unspecified) for WAC 246-290 drinking water regulations. It is difficult to envision Health asking for a waiver of any section of the drinking water regulations in combination with a request to use one of the most challenging and risky water sources imaginable. In this setting, ODW would likely want to emphasize that all regulations are in effect plus additional requirements. There is nothing in the drinking water regulations to waive.

Additional things to Consider

- Unplanned or “de facto” potable reuse can and does happen when a WWTP discharges into a river source upstream of a surface water treatment plant. The impact of de facto reuse varies widely across the USA.
- Here in Washington State most surface water supplies come from protected sources (Bremerton, Pt. Townsend, Everett, Seattle, Tacoma, Walla Walla, Friday Harbor, etc.) with no WWTP discharges.
- But we do have some surface water systems that may have upriver WWTP discharges (Tri-cities and Anacortes).
- Tribal IPR projects involving reclaimed water treated to Class A standards only, and injected into deep wells for aquifer recharge may have been approved by EPA Region 10.

Questions?

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Potable Reuse from Municipal Wastewater Treatment Goals

Quantitative Microbial Risk Assessment (QMRA) and log reduction values (LRVs)

1. Determine the acceptable level of risk associated with drinking water. A level of risk of 1 infection per year per 10,000 people (10^{-4}) has been used in the United States since adoption of the SDWA. This is the same risk used for all water sources.
2. Determine the type of and concentrations (amounts) of viral, bacterial and protozoa pathogens in municipal wastewater. Knowing the different types of pathogens (for instance norovirus versus adenovirus) is important because different organisms require different treatment processes. (Water Research April 2022)

Potable Reuse from Municipal Wastewater Treatment Goals

Quantitative Microbial Risk Assessment (QMRA) and log reduction values (LRVs) - Continued

3. Determine what the infectious dose is for the different viruses, bacteria and protozoa. Some organisms may require hundreds or thousands of organisms to cause an infection, while others may only need a few organisms. The different modes of exposure must also be evaluated – direct ingestion by drinking or inhalation – along with exposure volumes.
4. The difference between the concentration of pathogens in the raw wastewater and the concentration in the final water that equates to only 1 infection per year per 10,000 people determines the level of treatment required. This reduction in concentration is referred to as log reduction value (LRV). A base 10 log reduction equates to a 90% decrease. So 1-log equals 90%, 2-log represents 99%, 3-log represents 99.9%.

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