Steering Committee: Drinking Water Options Workshop

Morrow and Umatilla County Drinking Water Investigation

August 29, 2024

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Workshop Objectives

- Update on project and related efforts
- Understand drinking water options and issues
- Identify project "focus areas" for subsequent detailed characterization, alternatives analysis, and data gap sampling

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Agenda

1. Introductions
2. Overview of Project Conceptual Model
3. Overview of Drinking Water Options
4. Applicability of Options
5. Preliminary Focus Area
6. Open Discussion

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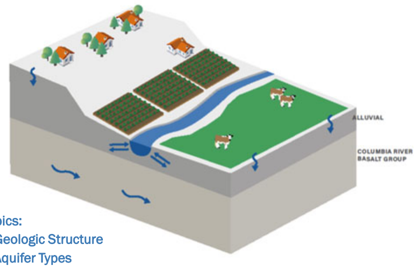
Overview of Project Conceptual Site Model (CSM)

Purpose & Components of a Conceptual Site Model



Topics:
- Geologic Structure
- Aquifer Types
- Groundwater Movement
- Recharge

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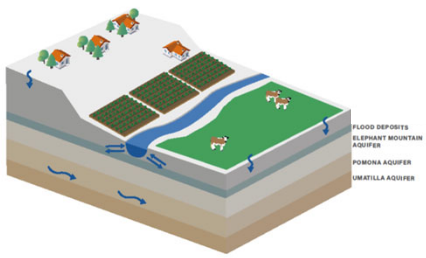
Hydrogeologic Setting - Components

1. Alluvial Aquifer
2. Basalt Aquifer



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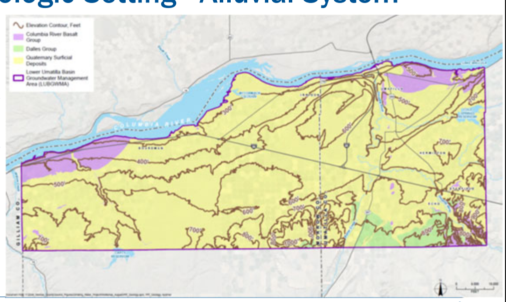
Hydrogeologic Setting - Alluvial System

- Structure Largely Controlled by "Topography" of Underlying Basalts



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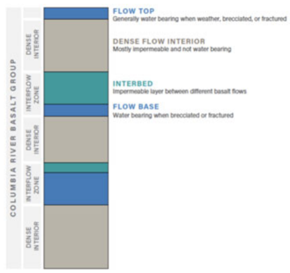
Hydrogeologic Setting - Basalt System

- Saddle Mountain Basalts (Upper Horizon of Columbia River Basalt Group)
  - Elephant Mountain Aquifer
  - Pomona Aquifer
  - Umatilla Aquifer



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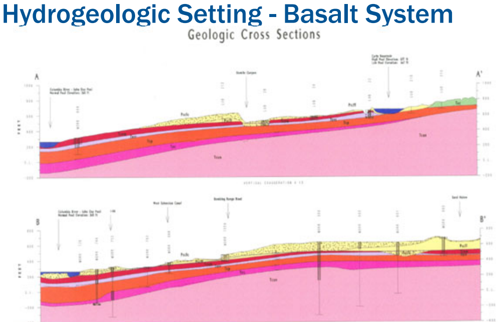
Hydrogeologic Setting - Basalt System



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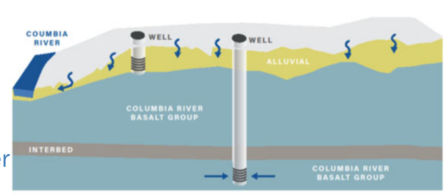
Groundwater Recharge

- Leakage from Canals, Streams, Reservoirs
- Deep Percolation of Irrigation Water
- Precipitation



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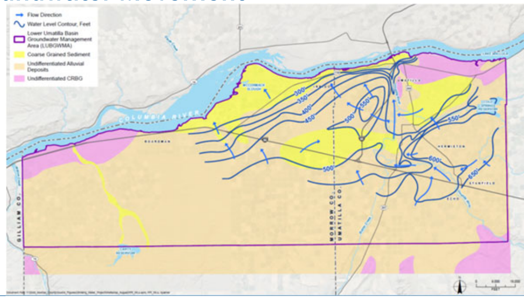
Groundwater Movement



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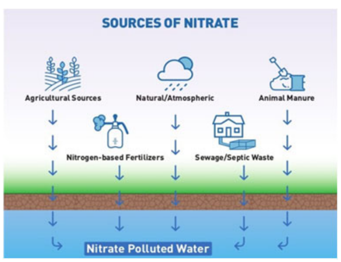
Nitrate in Groundwater

- General Sources
- General Distribution
- Datasets
- Focus Area Evaluation



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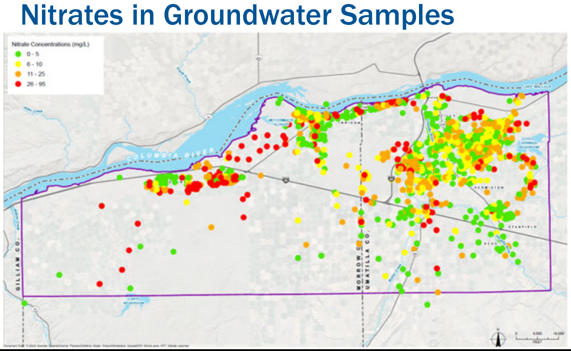
Nitrates in Groundwater Samples



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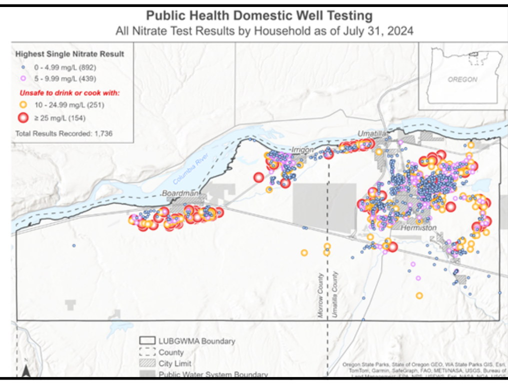

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Purpose for Focus Area Approach

- Address Extensive Project Area with Diverse Conditions
- Expedite Drinking Water Solution(s) - "low hanging fruit"
- Focus Use of Available Funding (current and pending)
- Establish Pilot Approaches for Implementation

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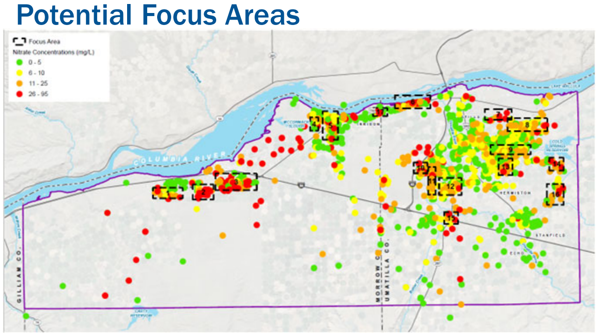
Potential Focus Areas



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Overview of Drinking Water Options

- Public Water System connection
- New well or well improvements
- Treatment Alternatives

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Public Water System Connection

- Overview of PWS in the Area
- Survey Results and Data Gathering
- Key Considerations and Concepts
- Regulatory and Costs

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Types of PWS

- Community: **Cities**, towns, subdivisions, and mobile home parks.
- Non-Transient Non-Community: **Schools**, hospitals, and work places.
- Transient Non-Community: **Restaurants** or **campgrounds**.
- Oregon Very Small (Non-Public): A water system that provides water to small residential communities that have between 4 and 14 service connections, or serves from 10 to 24 persons a day at least 60 days a year, or is licensed by the Health Division or delegate county health department but is not a Transient Water System.
- Wholesale System: A water system that produces finished water and delivers all of that finished water to one or more public water systems.

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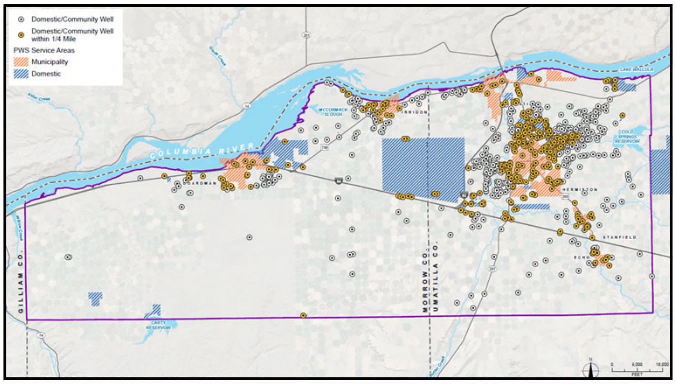

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Information Gathering for PWS

- Approach
  - OHA Summary
  - Online Research
  - Survey and Interview
  - Masterplan and Document Review
  - Team Collaboration and Nitrate Mapping

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Survey Results

- Municipal Systems
  - Sentiments toward system expansion
    - Willingness, Complexity
  - Concerns or limitations
    - Capacity, Policy, Financial Sustainability, Incentives
  - Information Sharing
    - Masterplans, Capital Improvements

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Municipal Systems

City	Population	Water Source(s)	# Wells	Willing to Expand (Y/N)	Able to Expand (Y/N)[1]
Hermiston	19,354	Groundwater, Surface Water	4	Y	Y
Umatilla	7,363	Groundwater	4	Y	Y
Boardman	3,828	Groundwater	3	Y	Y
Stanfield	2,144	Groundwater	3	Y	Y
Irrigon	2,011	Groundwater	---	---	---
Echo	632	Groundwater	4	Y	Y

1 Based on opinion of expansion and does not consider any potential political and/or legal hurdles.

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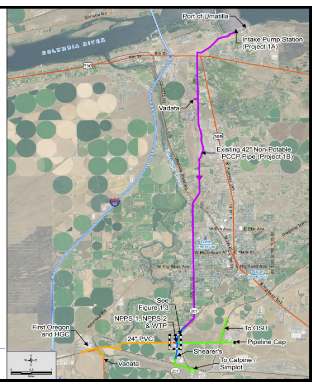
Existing Regional Water System

- Largely Industrial Purpose
- Serves Portion of Drinking Water for Hermiston
- Source of Raw Water and Finished Water
- Provides Another Option for PWS Expansion



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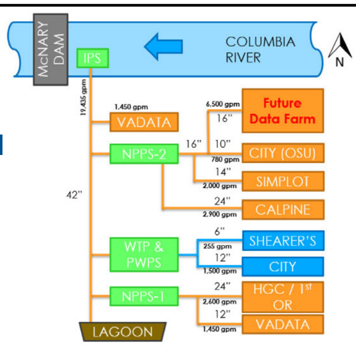
Existing Regional Water System



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Small Public Water Systems

- 54 Small Public Water Systems
  - 11 in Morrow County, 43 in Umatilla County
- Prioritized outreach
  - 29 small PWS are within ¼ mile of a domestic well cluster
  - 25 small PWS are over ¼ mile away from domestic well cluster

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Small PWS Survey Results

- Overall low interest from small PWS to expand
- Concerns
  - Funding required for expansion
  - Lack of system Capacity
  - Distance from cities

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Further Data Gathering and Research

- Municipal Systems
  - Feasibility of expanding water supply
  - Water system impacts, hydraulics, water quality
  - Options for new well locations
  - Viability of water district formation
  - Expanded use of regional system
- Small PWS
  - Feasibility of expanding water supply
  - Treatment technology

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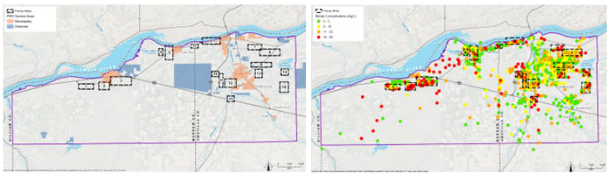
Concepts for PWS Expansion

- Municipal Water System Expansion
  - Focus Areas and "low-hanging fruit"



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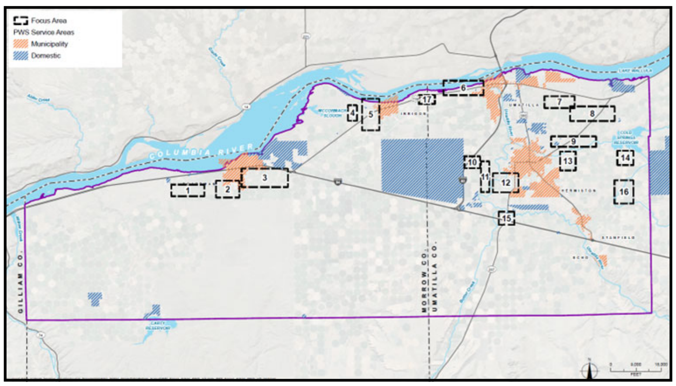

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Key Considerations

- Key Non-Infrastructure Considerations
  - Willingness, policy, incentives, financials, district formation, UGB issues, regulatory and permitting
- Key Infrastructure Considerations
  - Capacity, supply, treatment, hydraulics, distance, water quality, density, storage, ROW

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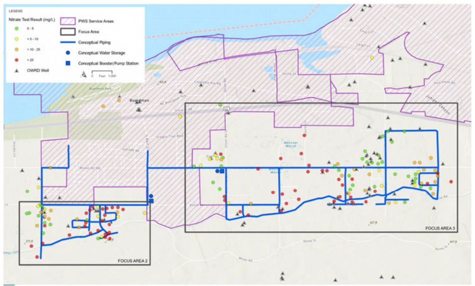
Alternatives and Scenarios – Near Boardman



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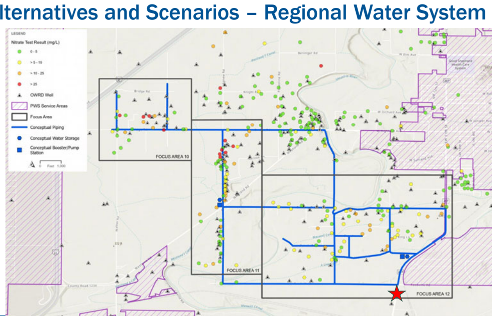
Alternatives and Scenarios – Regional Water System



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Cost Considerations

- City of Boardman Example – Rough Order of Magnitude
  - 75,000 LF Water Main - $23,000,000
  - 2 Water Storage Tanks - $6,000,000
  - 2 Booster Pump Stations - $3,000,000
- Other Cost Considerations
  - Potential City Infrastructure Investment: Water Supply, Water Treatment, Pump Stations, Water Storage, Water Mains

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Regulatory and Permitting

- **Federal:** NEPA (if Federally funded), Section 7 Endangered Species (USFWS), Wetlands and Waters (USFWS), Section 106 Historic and Cultural Resources (SHPO)
- **State:** OHA Design Approval, OHA Well Drilling Plan, OHA Disinfection Profile, Lead and Copper Rule, NPDES/WPCF WTP Discharge, NPDES 1200C Stormwater, Hazardous Materials (DEQ)
- **County:** Conditional Use Permit, Rights-of-way, Water District Formation, Annexation, Zoning
- **Local:** UGB and Annexation, Policy Modification, Rights-of-way, Water Rates and SDC Modification, Public Funding, Building Permit

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New Well or Well Improvements

- Securing a New Well
- Key Limitations
- Potential Well Improvements
- Depths to Alluvial and Basalt units
- Cost Implications

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Securing a New Well

- Desktop Review
  - Assessing the Need and Other Options
  - Production Needs Drive Depth/Construction/Cost
  - Predicted Water Quality Improvement?
- Permitting and Water-Right Considerations
  - LUBGWMA – Specific Considerations
- Driller Procurement
  - Timeline and Work Footprint
  - Oversight, Testing and Documentation

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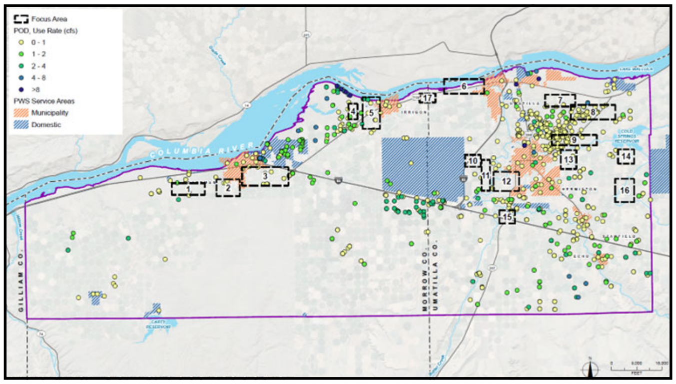

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Key Limitations

- Permitting: Proposed Use & Quantity Determine Needs
- Groundwater Availability & Water Rights
- Costs:
  - Simple: Shallow Domestic Wells: ~$20k – $100k
  - Complex: Large Diameter, Higher Capacity, Deep Production Wells: $100k - $1M
- Driller availability and lead-times

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Water Right Considerations

- Critical Groundwater Areas (Stage Gulch, Ordnance)
- New groundwater rules:
  - Basalt aquifer water levels declining
  - Alluvial aquifer likely to be treated the same as surface water moving forward
- Columbia River requires mitigation from April 15 through September 30; subject to conditions during October.
  - Exempt domestic use (but possibly not irrigation)
- Potential to use Aquifer Storage and Recovery or Aquifer Recharge to address water availability concerns?

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Exempt Uses

- Single or Group Domestic Use up 15,000 gpd
- Industrial or commercial use up to 5,000 gpd
- Irrigation of up to ½ acre of lawn or non-commercial garden.
- Per OWRD:
  - Limitations on quantities of water apply to totals for distribution system (can't just add more wells to a single system)
  - ½ acre of irrigation limitation is total for whole system

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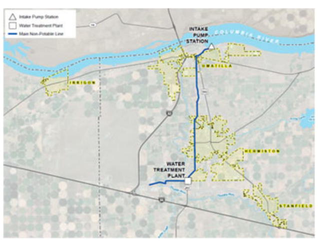
Regional Water System

- Columbia River raw water intake at Port of Umatilla
- WTP Southwest of Hermiston on Feedville Road
- Use of both raw water and potable water through the regional system is subject to a variety of contractual agreements



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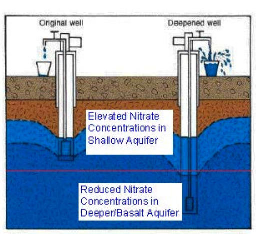
Potential Well Improvements

- Alteration: Deepening
- Alteration: Zone Isolation

  With Annular Seals, Liners, Packers, etc.



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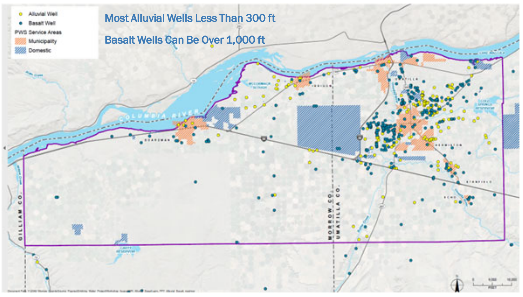
Well Depths in Alluvial and Basalt Units



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Treatment Alternatives

- Treatment Alternatives
  - Process Overview
  - Key Considerations
- Summary
  - Scalability
  - Capital Costs
  - Operations Costs
  - Additional Considerations
- Next Steps

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Treatment: Defining Local Needs

- Regional Scale
  - Adjacent to existing system
  - Greenfield
- Local Scale: 100+ users (adjacent)
- Micro Scale: 1-~99 POU users (not adjacent enough…)

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Nitrate Removal

- Reverse Osmosis
- Ion Exchange
- Biological Reduction

Process Overview

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Nitrate Removal

- Reverse Osmosis
- Ion Exchange
- Biological Reduction

Process Overview– Reverse Osmosis

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Reverse Osmosis: Process Uses

Marlo. *1000-GPM RO System.*

Regional/Local Scale

100+ Users

Olympia Water Systems. *5-Stage Undersink Reverse Osmosis Water Filtration System with 80 GPD RO Membrane.*

Micro Scale

1~99 users

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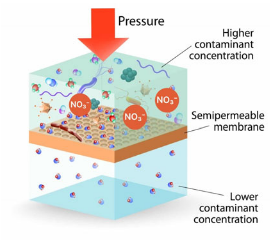
Reverse Osmosis – Process Overview



(Figure Adapted Advanced Water Solutions)

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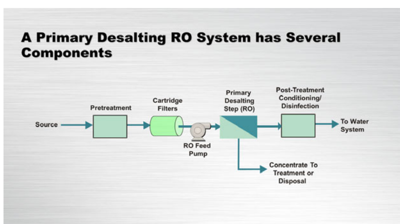
Reverse Osmosis – Process Overview



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Reverse Osmosis – Key Considerations

+ Proven technology
+ Readily commercially available
+ Compact footprint
- Requires significant improvements to existing infrastructure
- High energy; lower efficiency

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Reverse Osmosis - Key Considerations

- Generates concentrated waste stream
  - Brine line
  - Further Treatment
- Recovery dependent on well water quality/dissolved minerals

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Reverse Osmosis – Key Considerations

- Chemically intensive process
  - Antiscalant use critical to prevent scaling on membranes and in brine waste stream
  - Chemical clean in place (CIPs) activities can be frequent
  - Biological fouling control can be difficult
- Requires a high level of operational certification

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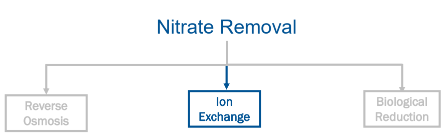

Process Overview – Ion Exchange

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Ion Exchange (IX): Process Uses

Regional/Local Scale

100+ Users

Micro Scale

1~99 users

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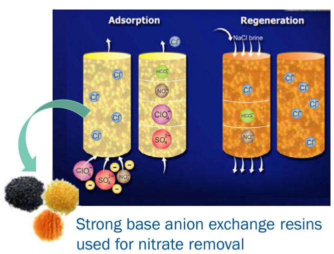
Ion Exchange (IX): Process Overview



Strong base anion exchange resins used for nitrate removal

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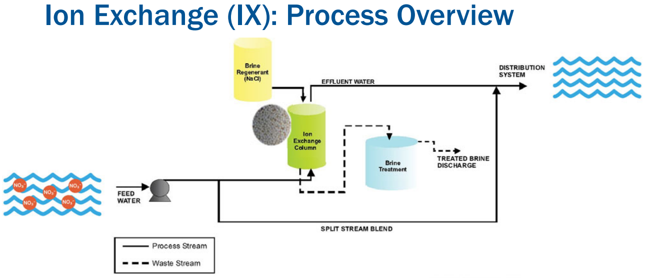
Ion Exchange (IX): Process Overview



CONVENTIONAL ION EXCHANGE PROCESS TRAIN

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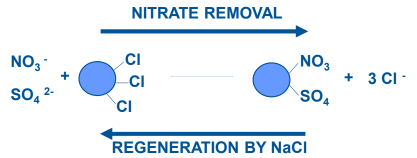
Ion Exchange: Downstream Impacts



Removal of 10 mg/L Nitrate @ 1 mgd

→ 9.8 tons chloride per year in treated water

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Ion Exchange - Key Considerations

+ Proven technology
+ Readily commercially available
+ Compact footprint
+ Easily integrates with existing well infrastructure
+ Moderate energy; high efficiency

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Ion Exchange - Key Considerations

- Generates a contaminant-laden brine
- Finished water quality can impact distribution system stability / LCR Compliance
- Radionuclide accumulation
- Scaling of spent regenerant piping a common problem

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Ion Exchange - Key Considerations

- Residual brine is highly corrosive

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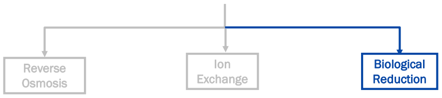
Nitrate Removal



Process Overview – Biological Reduction

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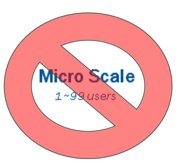
Biological Reduction: Process Uses

Cold Spring, MN. *1000-GPM Biodenitrification System.*

Regional/Local Scale

100+ Users



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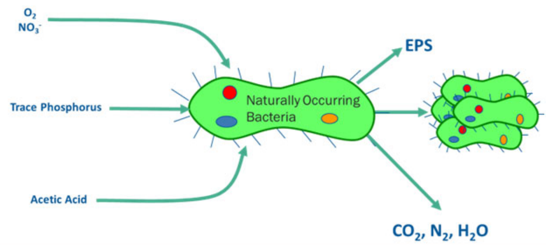
Biological Reduction: Process Overview



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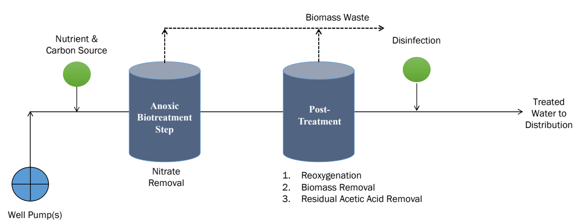
Biological Reduction: Process Overview



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Biological Reduction: Key Considerations

- Limited full-scale application in the US
- Readily Commercially available
- Relies on natural processes
- Produces N2 and biomass; no concentrated waste stream
- Low energy; high efficiency

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Slide 64

JG0 consider smaller case studies
Jude Grounds, 2024-08-22T18:04:21.933

Slide 65

JG0 consider smaller case studies
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Biological Reduction: Key Considerations

- Post-treatment is critical and often overlooked
- Biomass control is also critical
- Initial biological acclimation phase required; reacclimation after shut-downs is brief
- Not always plug-and-play; operations support during start-up and acclimation is key

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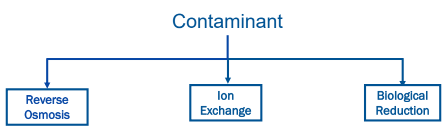

Process Overview: Summary

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Summary – Scale Applicability

	Regional	Local	Micro
RO	+	+	+
IX	+	+	+
Bio	+	+	n/a

- **RO and IX** are historically used to treat nitrate-contaminated groundwater
  - Plenty of installations at the **regional and local scale**
  - Can be installed under the sink for **micro scale** use
- **Biological reduction** utilizes naturally occurring bacteria and tools already in community, best for **regional and local scale** use

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Summary – Maximum Nitrate Concentration (mg/L) Applicability

	Regional	Local	Micro
RO	100+	100+	<25
IX	100+	100+	?
Bio	100+	100+	n/a

- **RO, IX** and **Biological Reduction** have proven efficacy at the **regional and local scale**
- **RO** and **IX** are limited in nitrate concentrations at the **micro scale**

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Summary – Relative Capital Costs

	Regional	Local	Micro
RO	$$$	$$	$
IX	$	$	$
Bio	$$	$$	n/a

- **RO** systems generally have highest capital cost, requiring membranes, high-pressure pumps and chemical cleaning/residuals handling systems.
- **IX** has the lowest capital costs, requiring treatment reactors and chemical regeneration systems, and can typically be integrated into existing well systems w/out significant impacts.
- **Biological Reduction** has more capital costs, requiring treatment reactors, post treatment facilities and chemical addition systems.

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Summary – Relative O&M Costs*

	Regional	Local	Micro
RO	$$$	$$	$$
IX	$$	$$	$$
Bio	$$	$$	n/a

- **RO** process is the most energy-intensive/high-pressure, producing a high volume of waste stream/residual and requiring several chemicals.
- **IX** process is more energy intensive, producing a smaller volume waste stream than RO, but brine/chemical residuals are difficult to dispose.
- **Biological Reduction** is the least energy intensive, producing little waste stream/residuals and requiring few chemicals.

*Not considering the impacts of PFAS

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Other Considerations: Per- and Polyfluoroalkyl Substances (PFAS)

Unique Properties

- Stain repellant
- Flame resistant
- Non-stick
- Water resistant
- Good for coatings

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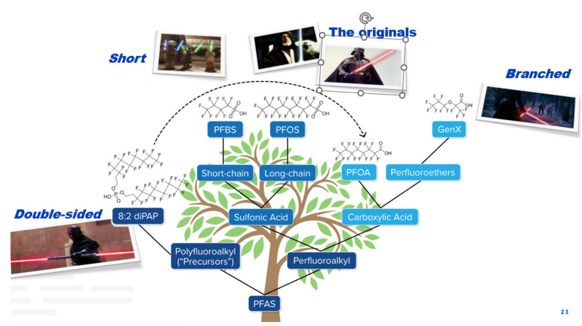

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PFAS Are Everywhere

- PFAS have been detected even atop Mount Everest and at both poles.

Young et al. 2007. *ES&T*. 41, 3455-3461.

Miner et al. 2021. *Sci. Tot. Env.* 759, 144421.

Garnett, J., et al. 2022. *ES&T*. 56, 11246–11255.

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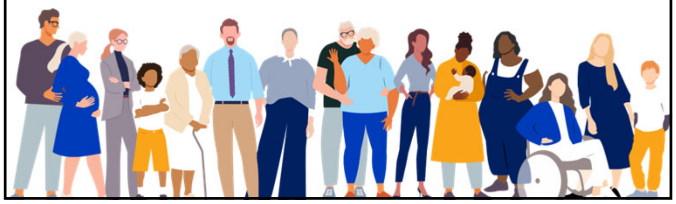
Other Considerations - PFAS

- People can be exposed to PFAS in a variety of ways
- Life-time exposure to PFAS may be harmful to human health
  - » Decreased birth weight
  - » Increased risk of cancer (e.g., kidney, liver).



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The Maximum Contaminant Levels (MCLs)

Automatic zero for likely carcinogens

Equal to Practical Quantitation Limit (PQL)

Compound	Final MCL Goal	Final MCL
PFOA	Zero	4.0 ng/L
PFOS	Zero	4.0 ng/L
PFHxS	10 ng/L	10 ng/L
PFNA	10 ng/L	10 ng/L
HFPO-DA (aka GenX)	10 ng/L	10 ng/L
Mixtures containing two or more of PFHxS, PFNA, HFPO-DA, and PFBS	1 (unitless) Hazard Index	1 (unitless) Hazard Index

$$HI = \frac{[PFHxS]}{10\ ng/L} + \frac{[GenX]}{10\ ng/L} + \frac{[PFNA]}{10\ ng/L} + \frac{[PFBS]}{2{,}000\ ng/L}$$

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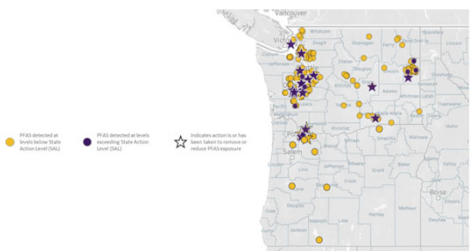
PFAS Testing: Oregon & Washington



PFAS in Drinking Water Data. (2024, May 30). Doh.wa.gov; Washington State Department of Health.

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PFAS: National Burden and NPDWR Compliance Costs

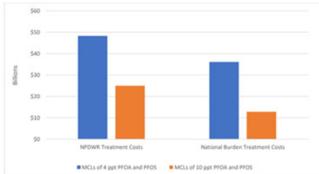

Figure 7-1 Summary of Present Value of Life-Cycle Costs for National Burdens and NPDWR Compliance Costs for Each Scenario based on a 3% discount rate

PFAS National Cost Model Report. (2023). *American Water Works Association.*

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Summary – Relative O&M Impacts of PFAS

	Regional	Local	Micro
RO	$$$$$	$$$$	$$?
IX	$$$$$	$$$$$	$$$$
Bio	$$	$$	n/a

- **RO** process can concentrate PFAS in waste stream, so concentrated levels in the waste stream could prove difficult to dispose.
- **IX** resin will remove PFAS during nitrate removal process, requiring media to be removed/incinerated instead of locally regenerated.
- **Biological Reduction** will not concentrate or accumulate PFAS during treatment; post-treatment could be designed to avoid PFAS impacts.

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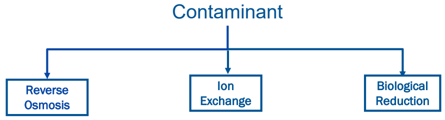

Treatment Alternatives: Next Steps

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Treatment Alternatives: Next Steps Summary

- Determine treatment effectiveness for nitrate concentrations on community scale.
- Understand impacts of PFAS on treatment options.
- Refine Opinions of Capital and O&M Costs with Key Study Areas.
- Develop a decision flowchart; optimize overall approach via modeling.

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Summary of Drinking Water Options

1a. Connection to existing PWS
1b. Connection to existing PWS + treatment
2. Connection to Regional Water System
3. Existing well with improvements/treatment*
4a. New well (deeper/not impacted)*
4b. New well with treatment*
5. Point-of-use treatment
6. Aquifer storage and recovery/Aquifer recharge

**Sub-options for #2, 3, 4: with or without extensive distribution system requiring local improvement or special district.*

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Summary of Applicability… Questions to ask

1. Do we know samples' well source?
2. What is the proximity to a PWS?
3. How many impacted well users to serve?
4. Is deeper aquifer impacted?
5. Is there available water right(s)?
6. Well-owner positions on annexation/LID?
7. Other…

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Preliminary Focus Area

- Purpose of Focus Area
- Considerations for priorities
- Recommendation
- Discussion

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Purpose of Focus Area Approach

- Address an extensive project area with diverse conditions
- Expedite drinking water solution(s) - "low hanging fruit"
- Focus use of available funding (current and pending)
- Establish pilot approaches for implementation

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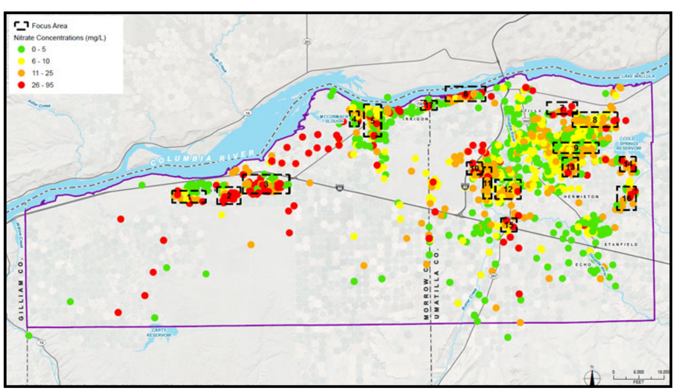

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Considerations for Priorities

- Level of characterization – nitrate data
- Representation for each county
- Representation of drinking water options
- Socioeconomic factors
- Support and consensus on option(s) by residents
- Funding opportunities

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Options by Focus Area

FA	County	PWS Extension	Regional	Remote-Small	Remote-Very Small
1	Morrow	?	−	+	+
2	Morrow	+	−	+	−
3	Morrow	+	−	+	−
4	Morrow	?	−	−	+
5	Morrow	+	−	+	−
6	Umatilla	+	−	+	−
7	Umatilla	−	−	−	+
8	Umatilla	−	−	+	−
9	Umatilla	?	?	+	−
10	Umatilla	?	?	+	−
11	Umatilla	?	?	+	−
12	Umatilla	+	+	+	−
13	Umatilla	?	?	+	−
14	Umatilla	−	−	−	+
15	Umatilla	?	?	−	+
16	Umatilla	−	−	+	−
17	Morrow	?	−	−	+

+ Likely applicable
? May be applicable
− Unlikely applicable

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Proposed Priority Focus Areas

FA	County	PWS Extension	Regional	Remote-Small	Remote-Very Small
1	***Morrow***	?	−	+	+
2	***Morrow***	+	−	+	−
3	Morrow	+	−	+	−
4	***Morrow***	?	−	−	+
5	Morrow	+	−	+	−
6	***Umatilla***	+	−	+	−
7	Umatilla	−	−	−	+
8	Umatilla	−	−	+	−
9	Umatilla	?	?	+	−
10	Umatilla	?	?	+	−
11	***Umatilla***	?	?	+	−
12	***Umatilla***	+	+	+	−
13	Umatilla	?	?	+	−
14	Umatilla	−	−	−	+
15	***Umatilla***	?	?	−	+
16	Umatilla	−	−	+	−
17	Morrow	?	−	−	+

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Priority Focus Areas Recommendation

- FA-2/3: Boardman extension approach (addressed as part of SEP funding process?)
- FA-6: Umatilla extension approach
- FA-12: Hermiston extension or Regional approach
- FA-1, FA-11 (or FA-8): remote new small system
- FA-4, FA-15: remote new very small system

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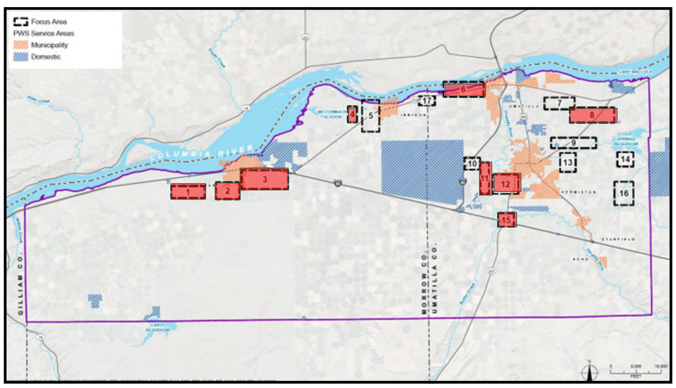

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RIO

Alternatives and Scenarios

- Water System Expansion Examples
  - Focus Area 2, 3, 5, 6, 9, 13
- Regional Water System
  - Focus Area 10, 11, 12
- Alternatives to Expanding PWS
  - Independent water systems
- Alternatives for Small PWS Systems
  - Continue exploring expansion, treatment, well improvements

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RI0 Note that the scenarios for the outlying areas overlaps with the next DW options using new wells or well improvements

Ronan Igloria, 2024-08-16T15:06:11.192

- Questions from steering committee
- Public comment opportunity

Discussion

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Thank you!

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