Multiple Barrier Approach to Drinking Water Protection and Treatment

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Oregon Department of Environmental Quality

Drinking Water Protection in Oregon

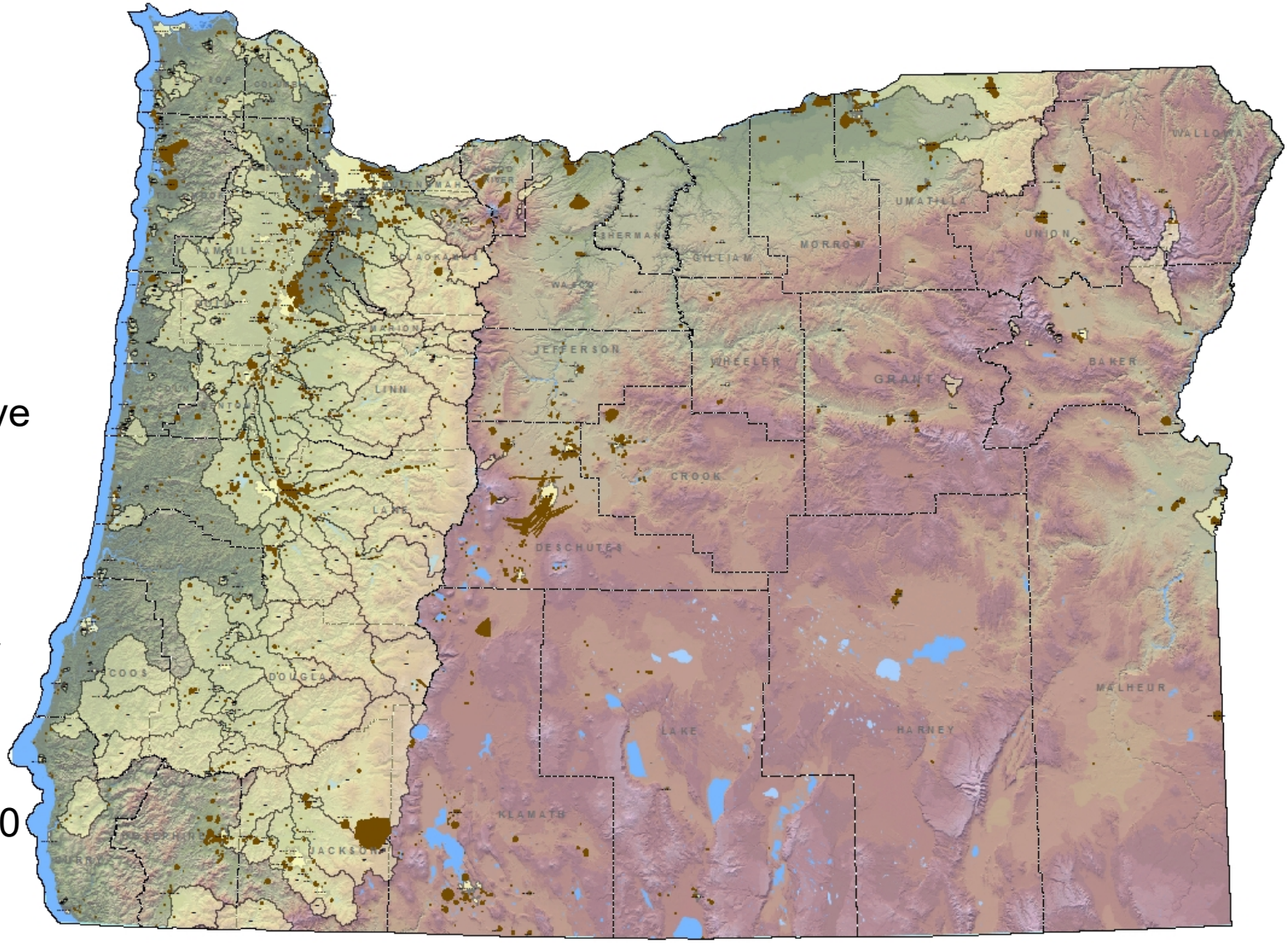
- Oregon Health Authority regulates finished drinking water
- Dept. of Environmental Quality regulates ground and surface water quality
- DWP is a joint program between OHA and DEQ focused on public health
  - OHA funds drinking water protection staff at DEQ
  - Interagency communication & coordination
  - Both produce Source Water Assessments
  - Protection planning, PWS assistance, & funding

North Coast Drinking Water Protection Workshop

Over 2,500 public water systems serve 85% of Oregonians

Public Water Systems

serve >25 people or >10 connections



Drinking Water Protection in Oregon

DEQ oversees water quality regulation under Clean Water Act

- Issues point source permits
- Creates WQ standards
  - MCLs included as default WQ standards
- Issues Total Maximum Daily Loads (TMDLs)
- Groundwater protection authority under state law
  - Can create Groundwater Management Areas (GWMAs)
- Works with federal land management agencies (USFS, BLM)

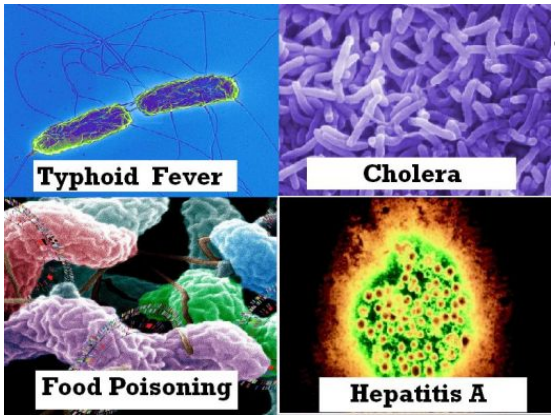
Drinking Water Protection in Oregon

Oregon Dept. of Forestry has regulatory authority on non-federal forestlands Forest Practices Act

- Practices must meet water quality standards
  - Ongoing riparian rulemaking
  - Updated road rules (wet weather hauling, drainage, etc)

- Oregon Dept. of Agriculture regulates agricultural & rural residential lands
  - Agricultural Water Quality Management Act (SB1010)
  - Area rules should be protective of water quality & meet standards
- Oregon Dept. of Geology and Mineral Resources
  - Permitting for surface mines and administers water quality permits at mine sites (WPCF 1000 and NPDES 1200A)
- DEQ coordinates & works with these agencies

Drinking Water: Source Water Quality



ICT Project

Oregon DEQ

- Generally, healthy aquatic systems provide better drinking water
- Polluted & degraded systems are riskier or dangerous
  - Algae blooms introduce toxins & bad tastes
    - Due to nutrient pollution & warm, stagnant water
  - Sediment pollution inhibits filtering of water sources
  - Pathogens (disease organisms) cause direct harm & mortality
  - Toxic metals & compounds can lead to acute & chronic health implications

North Coast:
Potential Contaminant Sources

C. Murphey/The Daily Astorian

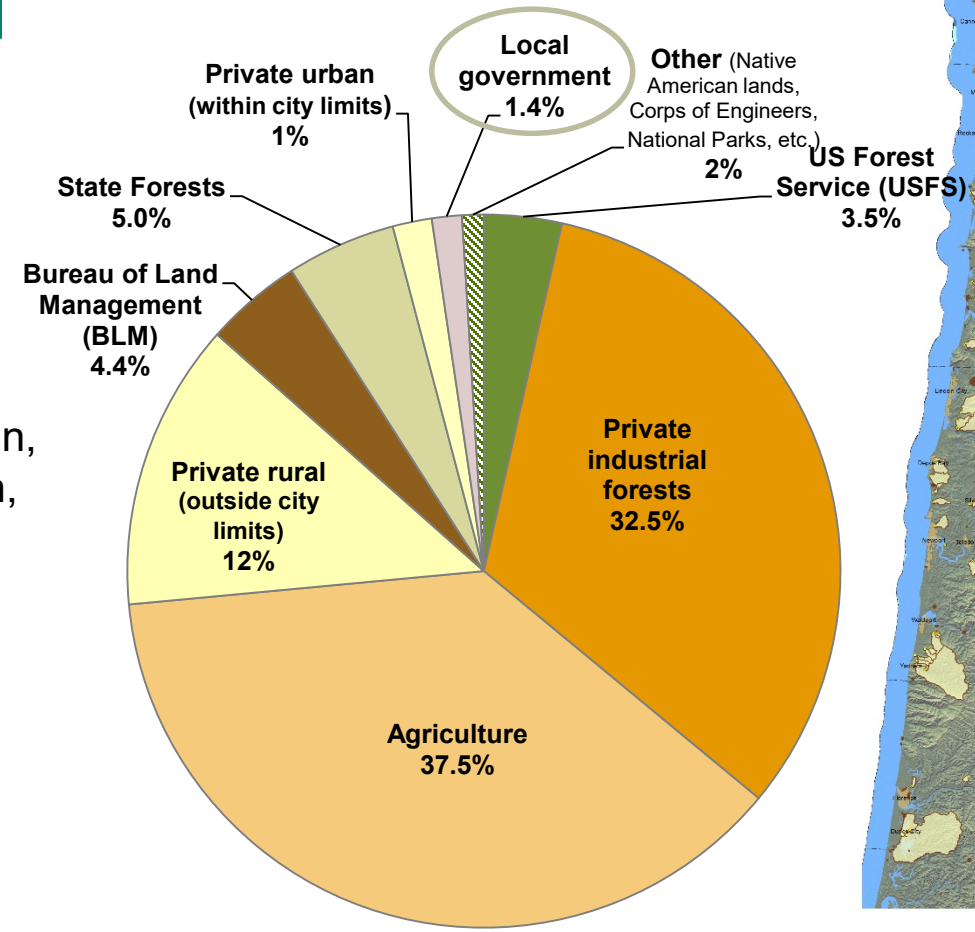
- Agriculture
- Forestry
- Mining (gravel & minerals)
- Residential Uses & Development

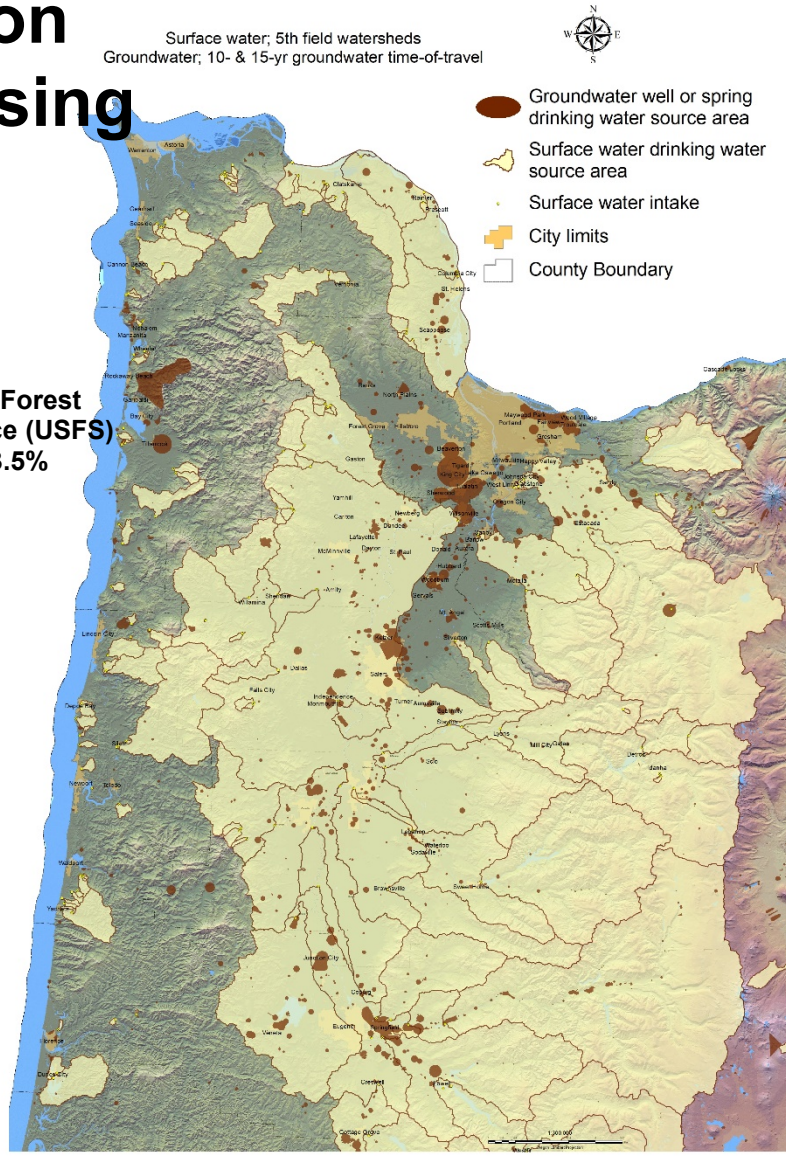
  (urban, suburban, rural land uses; incl. sewer/septic, fuel/oil, hazardous materials)
- Transportation (roads, railroads, marinas)
- Recreation (OHVs, hiking/camping, boating)

Land Uses for NW Oregon Public Water Systems using Surface Water

Counties Included:

Benton, Clatsop, Columbia, Lane, Lincoln, Linn, Marion, Polk, Tillamook, Yamhill



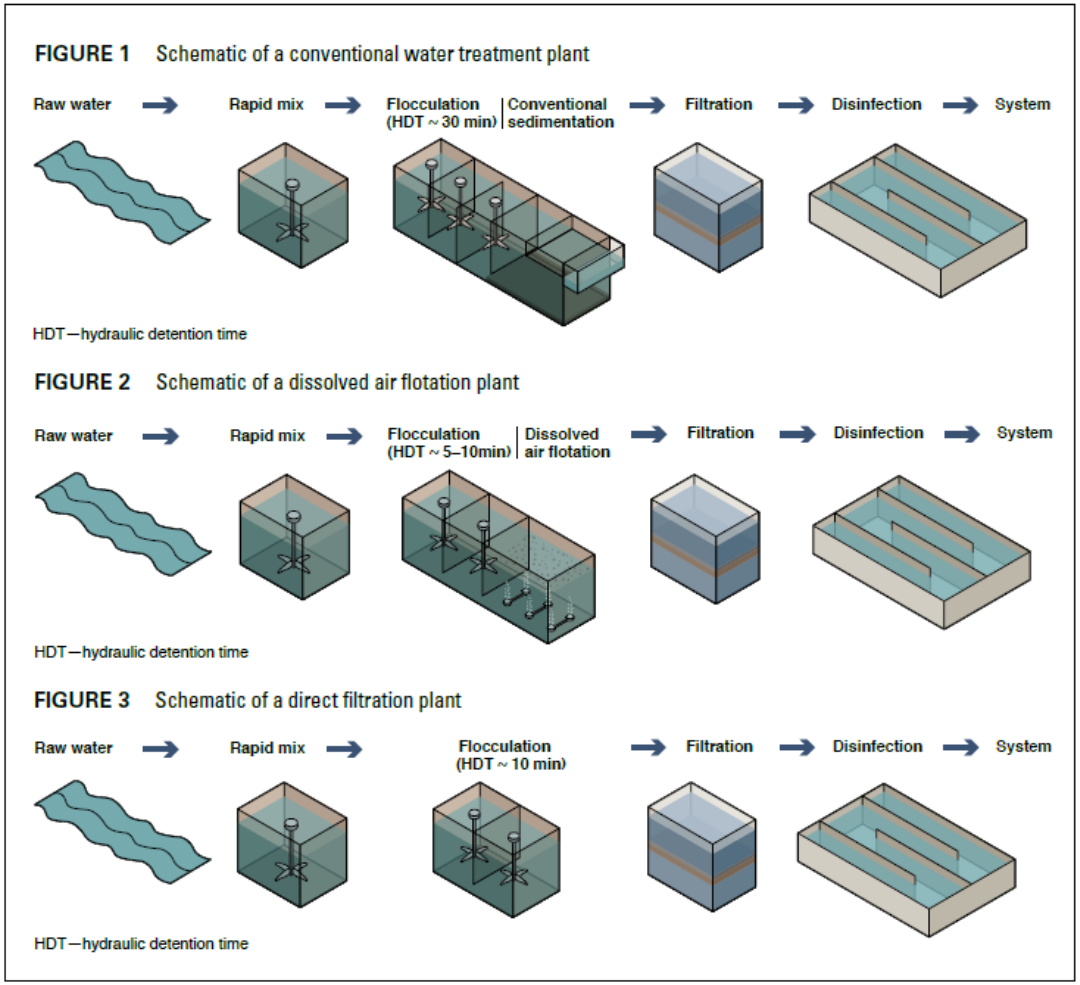


Climate Change & Management Interactions

- Climate change resulting in higher temperatures, drier summers, & lower summer/early autumn flows
  - Can interact with temperature & flow changes from management
- Wetter winters with more intense storms increase erosion & flood risks
  - Can interact with management effects to increase erosion & landslide risks

Treatment Types & Limits

- A given treatment technology has limits on raw water quality
- Regardless of source water quality, must meet SDWA MCLs
- When source water meets CWA standards, conventional treatment should be adequate to meet all Safe Drinking Water Act requirements.



Treatment Types & Limits

TABLE 1 Raw source water quality pre- and post-wildfire, post-fire water quality for an unburned reference site, and post-fire rainstorm samples

Water Quality Parameter		Pre-fire Routine Monitoring Samples[a]	Post-Fire Reference Site Samples	Post-Fire Routine Monitoring Samples[b]	Post-Fire Rainstorm Samples[c]
Turbidity—*ntu*	Mean Stdev	3.6 (±4.5)	4.4 (±5.0)	35 (±38)	321 (±291)
TOC—*mg/L*	Mean Stdev	4.8 (±2.8)	4.2 (±1.9)	4.9 (±1.9)	11.8 (±5.6)
$SUVA_{254}$ —*L/mg-m*	Mean Stdev	2.7 (±0.5)	3.3 (±0.8)	3.3 (±0.7)	4.5 (±0.87)
Total phosphorus—*mg P/L*	Mean Stdev	0.018 (±0.014)	0.013 (±0.004)	0.058 (±0.077)	0.377 (±0.407)
Total nitrogen—*mg N/L*	Mean Stdev	0.29 (±0.20)	0.27 (±0.10)	0.66 (±0.69)	1.61 (±0.90)

Stdev—standard deviation, $SUVA_{254}$—specific ultraviolet absorbance at 254 nm, TOC—total organic carbon

[a]Pre-fire water quality is shown for the water intake during routine monitoring (Hohner et al. 2016).
[b]Post-Fire samples were also collected following rainstorms.
[c]Rainstorm samples were analyzed for the dissolved fraction resulting from high particulate matter.

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Table 4. Recommended Raw Water Turbidity Range for Various Treatment Technologies.

Filtration Type	Turbidity Range (NTU)[1]	Color Range (CU)[1]	Maximum Filtration Rate (gpm/ft^2)[2]	General Design Reference
Conventional	Unlimited	< 75	6.0	Kawamura 2000b
Direct	< 15	< 40	6.0	Kawamura 2000b
Pressure Sand	< 5	< 10	3.0	T.S.S 2007[3]
Membrane	See Note 4	See Note 4	See Note 4	USEPA 2005
Slow Sand	< 10	< 10	0.1	Hendricks et. al. 1991; WADOH 2003b
Cartridge/Bag	< 5	See Note 4	See Note 4	USEPA 2003a
Diatomaceous Earth	< 10	< 5	1.0	AWWA 1999; Fulton 2000; WADOH 2003b

[1]Water quality limitations are adopted from the DOH Surface Water Treatment Rule Guidance Manual (DOH 331-085) and references cited therein.

Treatment Types & Limits

- Upgrade treatment? Or protect the source?
- Multiple Barrier Approach:
  - Protection and prevention are the first barrier to contamination
  - Treatment processes form additional barriers

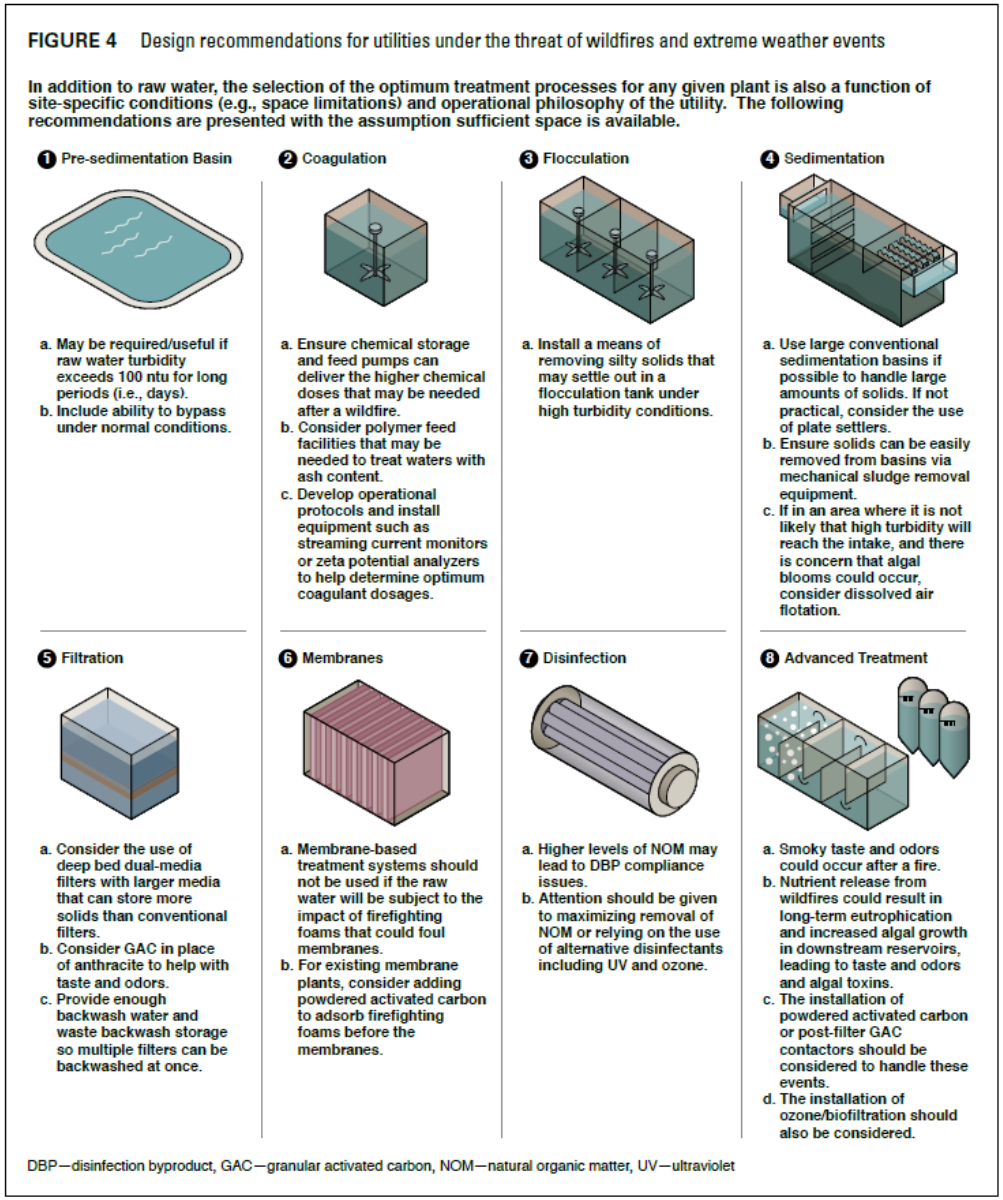


FIGURE 4 Design recommendations for utilities under the threat of wildfires and extreme weather events

In addition to raw water, the selection of the optimum treatment processes for any given plant is also a function of site-specific conditions (e.g., space limitations) and operational philosophy of the utility. The following recommendations are presented with the assumption sufficient space is available.

1 Pre-sedimentation Basin

a. May be required/useful if raw water turbidity exceeds 100 ntu for long periods (i.e., days).
b. Include ability to bypass under normal conditions.

2 Coagulation

a. Ensure chemical storage and feed pumps can deliver the higher chemical doses that may be needed after a wildfire.
b. Consider polymer feed facilities that may be needed to treat waters with ash content.
c. Develop operational protocols and install equipment such as streaming current monitors or zeta potential analyzers to help determine optimum coagulant dosages.

3 Flocculation

a. Install a means of removing silty solids that may settle out in a flocculation tank under high turbidity conditions.

4 Sedimentation

a. Use large conventional sedimentation basins if possible to handle large amounts of solids. If not practical, consider the use of plate settlers.
b. Ensure solids can be easily removed from basins via mechanical sludge removal equipment.
c. If in an area where it is not likely that high turbidity will reach the intake, and there is concern that algal blooms could occur, consider dissolved air flotation.

5 Filtration

a. Consider the use of deep bed dual-media filters with larger media that can store more solids than conventional filters.
b. Consider GAC in place of anthracite to help with taste and odors.
c. Provide enough backwash water and waste backwash storage so multiple filters can be backwashed at once.

6 Membranes

a. Membrane-based treatment systems should not be used if the raw water will be subject to the impact of firefighting foams that could foul membranes.
b. For existing membrane plants, consider adding powdered activated carbon to adsorb firefighting foams before the membranes.

7 Disinfection

a. Higher levels of NOM may lead to DBP compliance issues.
b. Attention should be given to maximizing removal of NOM or relying on the use of alternative disinfectants including UV and ozone.

8 Advanced Treatment

a. Smoky taste and odors could occur after a fire.
b. Nutrient release from wildfires could result in long-term eutrophication and increased algal growth in downstream reservoirs, leading to taste and odors and algal toxins.
c. The installation of powdered activated carbon or post-filter GAC contactors should be considered to handle these events.
d. The installation of ozone/biofiltration should also be considered.

DBP—disinfection byproduct, GAC—granular activated carbon, NOM—natural organic matter, UV—ultraviolet

Drinking Water Source Protection

- Identify potential contaminant sources & risks
- Use risk-reduction & avoidance strategies to prevent contamination of supplies
- Manage watersheds or source areas w/ practices proven to be low- or no-risk
- Use ecological processes & resiliency to reduce impact of disturbances
- Save money & resources in the long-term
- Provide clean, safe drinking water to ratepayers

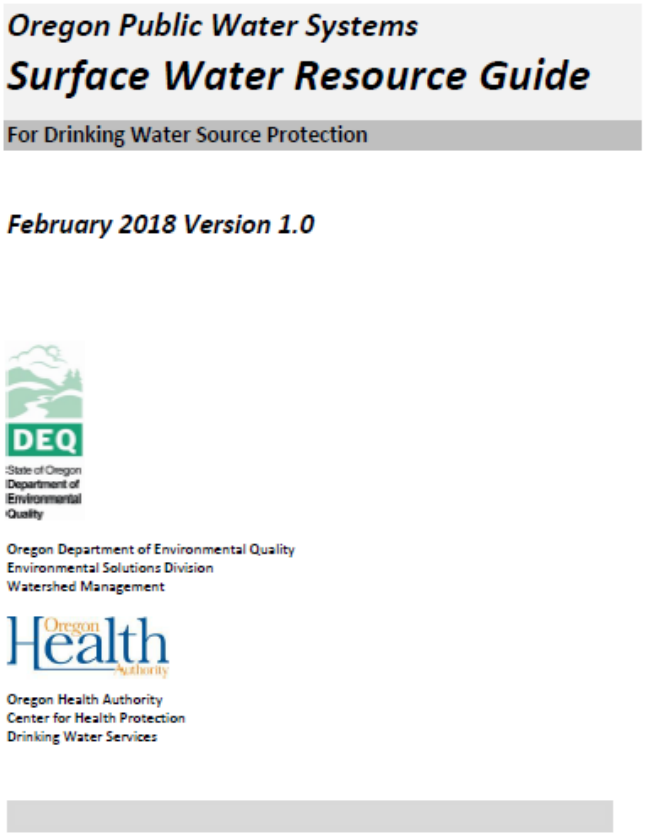
Drinking Water Source Protection can be achieved through a variety of approaches

- **Federal agencies** prioritizing municipal drinking water
- **State agencies** implementing statewide programs to reduce public health risks
- **County or city government** using maps of source areas to focus key land use decisions; protect sensitive areas
- **Local officials** implementing protection/prevention activities for high risks; obtaining grants and hiring consultants
- **Landowner/individual** actions, especially within sensitive areas

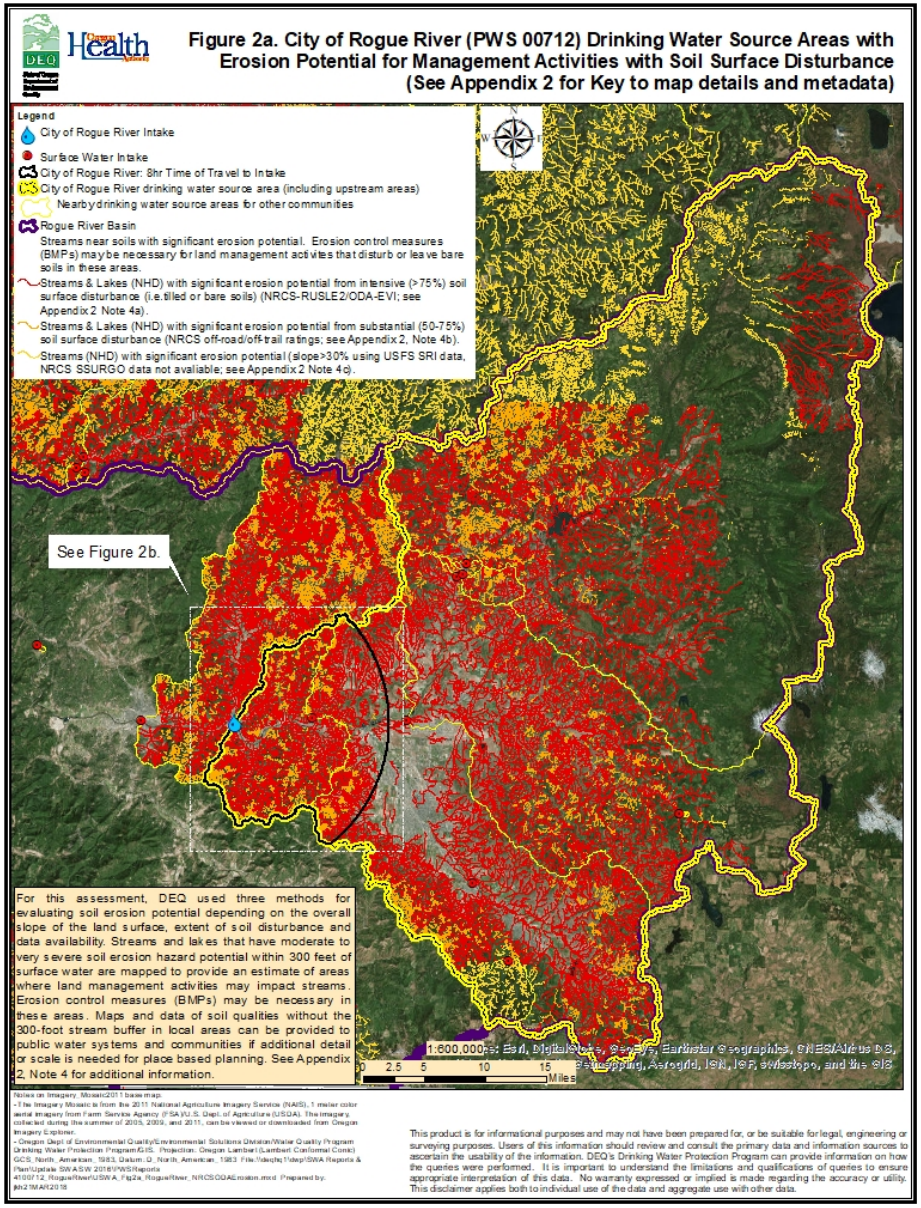
Assistance to Public Water Systems

- OHA provides funding, engineering assistance, oversight
- DEQ provides technical advice & assistance on watershed management & drinking water source protection
  - Source water protection planning & implementation
  - Site visits & data analysis
  - Facilitate working with landowners & nonpoint source regulating agencies (ODF & ODA)

Planning & Evaluation Tools



- Updated Source Water Assessments and tools
- Surface Water & Groundwater Resource Guides
- Modeling & Analysis of erosion/sediment sources
  - GRAIP_Lite (roads)
  - SWAT (surface & bank erosion & transport)
  - Shallow landslide susceptibility (in progress)



Planning & Evaluation Tools

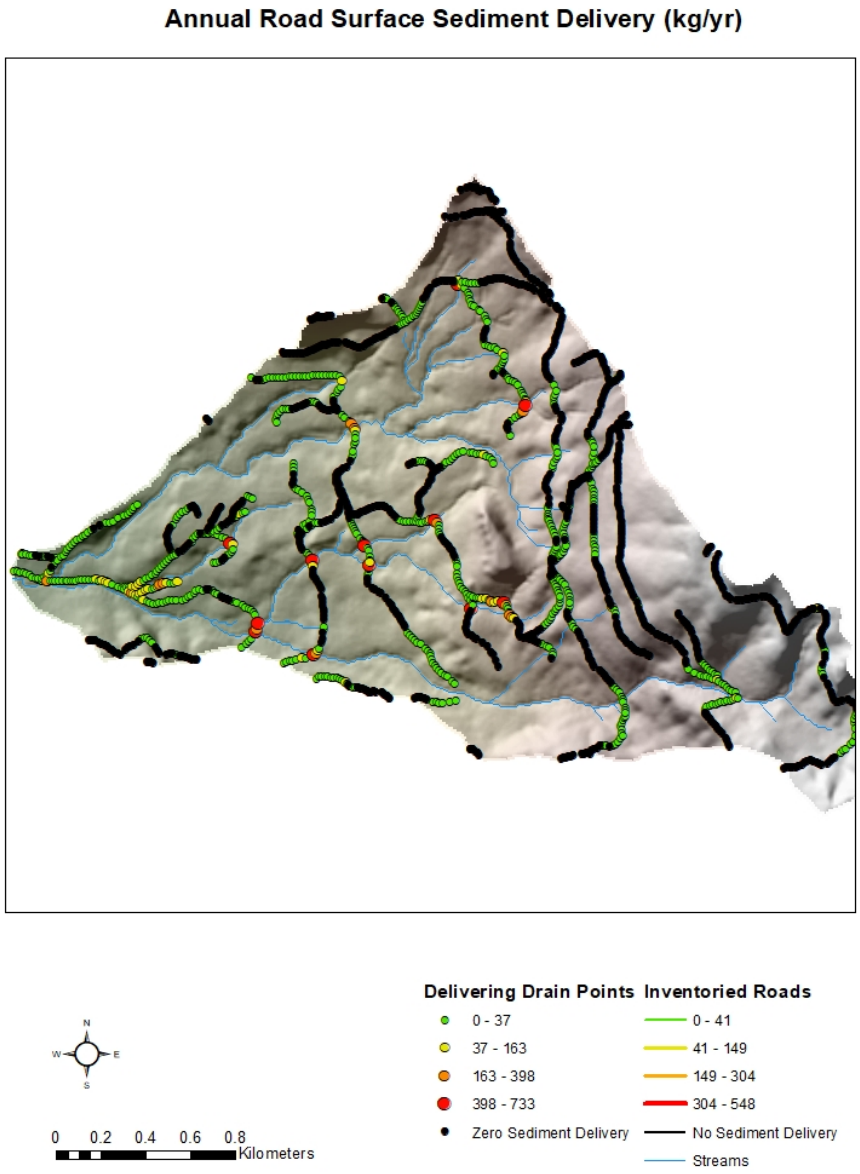
- Three methods to evaluate soil erosion susceptibility
  - NRCS Off-Road/Off-Trail Erosion Hazard Rating
  - RUSLE2 analysis of Erosion Vulnerability Index
  - USFS Soil Resource Inventory data where:

i.e. SRI factors “medium”, “high”, or “medium to high”:

"Sedimentation Yield Potential"

“Sediment”, or

"Surface Soil Erosion Potential"

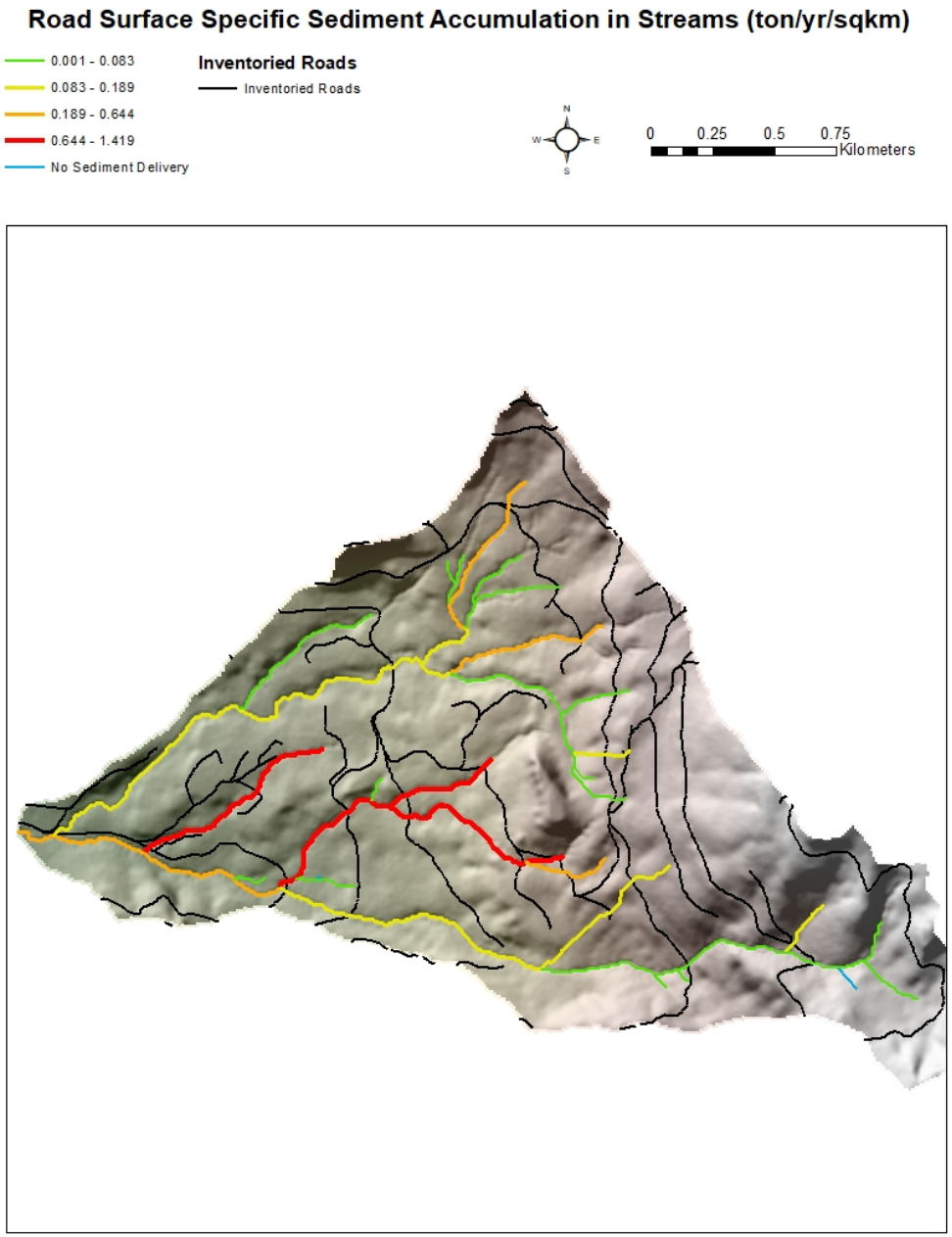


Planning & Evaluation Tools

GRAIP_Lite (USFS method)

- Uses road locations, DEMs, and field data calibrations to predict sediment delivery from roads to streams
- Can do alternatives analysis for new roads, decommissioning, maintenance

- Prioritize maintenance and road decommissioning
- See relative effects of changes



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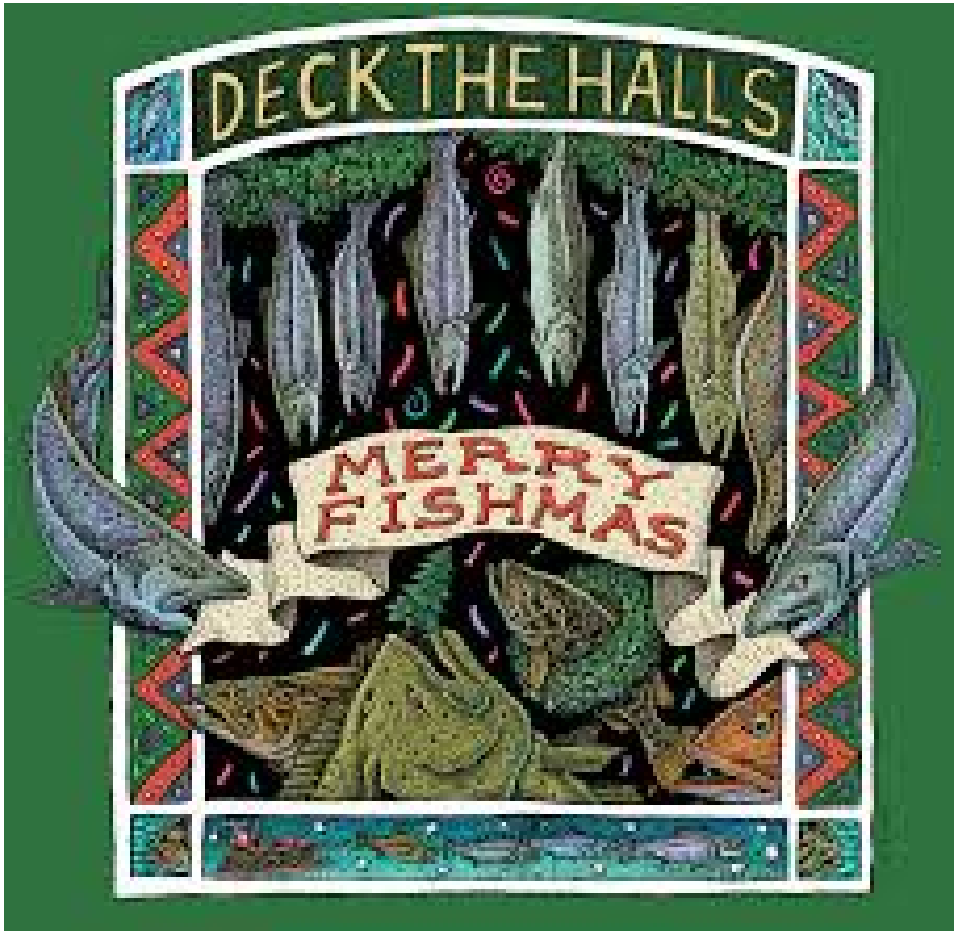
- The key is to manage your watershed to:
  - Prevent immediate impacts
  - Reduce overall risk
  - Increase resiliency & redundancy
- Resilient ecosystems are more sustainable: ecologically, socially, economically

Questions?



Ray Troll