Groundwater Basics and Source Water Protection

Insert Name
Regional Geologist – OHA DWP
Outline

- What is groundwater; how does it work?
- Well Construction
- Source Water Assessments
- Source Water Protection
- GWUDI & GWR Tie-ins
- Hands-on Exercise
An Introduction to Groundwater
The entire process can be divided into five parts:

1. **Evaporation**
2. **Precipitation**
3. **Condensation**
4. **Transpiration** (also known as Evapotranspiration)
5. **Infiltration**

**Water Cycle Processes**
Origin of Groundwater

- Groundwater originates from precipitation sinking into the ground from the surface to the water table.
- Groundwater occurs in the open spaces between silt, sand, and gravel particles or in natural fractures with the bedrock.

OHA Drinking Water Services
Origin of Groundwater

- Unsaturated Zone
- Capillary Fringe
- Saturated Zone (Groundwater)

OHA Drinking Water Services
Origin of Groundwater
Aquifers

- Once water reaches the saturated zone it is called groundwater.
- If the geologic material of this saturated zone is permeable and can yield water to a well in sufficient quantity to supply user needs, it is referred to as an aquifer.
- Aquifers can be either unconfined or confined.
Bedrock Aquifers

- Fractured Bedrock
- Layered Volcanics
Groundwater Movement: Winter

- Groundwater moves from areas of high elevation to areas of low elevation.
- How easily water travels underground is a function of the type of material that it is moving through.
- Permeability: gravel > sand > clay
Groundwater Movement: Summer

Groundwater fall during the drier summer months.
- Additionally, the greater number of pumping of wells in the summer impacts groundwater levels of wells through drawdown.

OHA Drinking Water Services
Interfering Wells

Image supplied by Mahometaquiferconsortium.org

OHA Drinking Water Services
Well Construction: Components

- Bore Hole
- Casing: holds hole open
- Casing Seal: Protects against inflow of shallow water
- Concrete Slab: protects against inflow of surface water
- Screens/Perforations: allow access of water
Well Construction

- If not constructed properly, wells can provide access to the aquifer of contaminants from the surface or near surface.

- The Oregon Water Resources Department (WRD) regulates the construction of water wells. WRD recognizes that DWP may have additional rules for public water systems.

- When a new well is proposed during plan review, the DWP evaluates well reports from the local area in order to make recommendations regarding well construction characteristics like placement of casing seals.
# Well Log Data

**OHA Data Online:** [https://yourwater.oregon.gov](https://yourwater.oregon.gov)

---

### OWRD Well Log Link

<table>
<thead>
<tr>
<th>Facility ID</th>
<th>Facility Name - Well Log</th>
<th>Activity Status</th>
<th>Availability</th>
<th>Source Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPA</td>
<td>EP FOR WELLS #2 AND #5</td>
<td>A</td>
<td>Permanent</td>
<td>GW</td>
</tr>
<tr>
<td>SRC A</td>
<td>WELL #2 - KJLM15096</td>
<td>A</td>
<td>Permanent</td>
<td>GW</td>
</tr>
<tr>
<td>SRC C</td>
<td>WELL #5 - KJLM15097</td>
<td>I</td>
<td>Emergency</td>
<td>GW</td>
</tr>
<tr>
<td>EP B</td>
<td>EP FOR WELLS #3</td>
<td>I</td>
<td>Emergency</td>
<td>GW</td>
</tr>
<tr>
<td>SRC BA</td>
<td>WELL #4 - KJLM15097</td>
<td>I</td>
<td>Emergency</td>
<td>GW</td>
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<tr>
<td>SRC C</td>
<td>WELL #7 - KJLM15098</td>
<td>I</td>
<td>Emergency</td>
<td>GW</td>
</tr>
</tbody>
</table>

### GW-GWUDI Link

- **Sources:**
  - Facility ID: Facility Name - Well Log, Activity Status, Availability, Source Type.
  - **Treatment:**
    - State ID: Facility Name, Treatment Process, Treatment Objective, Filter Type.
    - **Consumer Confidence Reports (Last 5 Years):**
      - For Year: Date Received, Date Certified.
Groundwater/GWUDI Source Detail Page

**SRC-AB: WELL #4**

**GW, Active, Permanent ---- Operating Period: Jan 1 - Dec 31**

**Disinfection:** HYPOCHLORINATION, PRE; RESID. MAINT. HYPOCHLORINATION

### Sensitivity Analysis Data

<table>
<thead>
<tr>
<th>Aquifer sensitivity:</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction adequate?:</td>
<td>No - Seal Not Constructed Property</td>
</tr>
<tr>
<td>E. coli sources within 2-year time-of-travel</td>
<td>Yes</td>
</tr>
</tbody>
</table>

| Surface water within 500 feet | No |
| Surface water type | Unknown |

| Data last updated | 02/13/2008 |

### Monthly Assessment Monitoring Data

#### Monthly Assessment Monitoring Required? Completed

**Monthly Schedule (Closed): 1 sample(s) per month to be taken beginning 01/01/2010 - 12/31/2010**

<table>
<thead>
<tr>
<th>Jan</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
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<td>1</td>
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<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>10</td>
</tr>
</tbody>
</table>

| TC+ | - | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|     | - | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| E. coli+ | - | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Outcome/Determination | Low Risk |

No historic GWUDI data were found.

**SRC-AF: WELL #9**

**GW, Active, Permanent ---- Operating Period: Jan 1 - Dec 31**

**Disinfection:** HYPOCHLORINATION, PRE; RESID. MAINT. HYPOCHLORINATION

### Sensitivity Analysis Data

<table>
<thead>
<tr>
<th>Aquifer sensitivity:</th>
<th>Moderate</th>
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<tbody>
<tr>
<td>Construction adequate?:</td>
<td>Yes</td>
</tr>
<tr>
<td>E. coli sources within 2-year time-of-travel</td>
<td>Yes</td>
</tr>
</tbody>
</table>

| Surface water within 500 feet | No |
| Surface water type | Unknown |

| Data last updated | 02/13/2008 |

### Monthly Assessment Monitoring Data

#### Monthly Assessment Monitoring Required? No

No monthly assessment monitoring schedule found.
No historic GWUDI data were found.
Source Water Assessments

1996 Amendments to the Safe Drinking Water Act
Drinking Water Protection Process for Public Water Systems (PWS)

OHA and DEQ contact PWS; GPS intake or well and request PWS assistance

DELINEATION of the source area or “Drinking Water Source Area”

INVENTORY for “Potential Sources of Contamination” per guidance

Determine SUSCEPTIBILITY to contamination

SOURCE WATER ASSESSMENT REPORT Sent to PWS

Activate community citizens, gather input, select a few strategies for protecting the source area

OPTIONAL: Consider writing a Drinking Water Protection Plan and gaining certification from DEQ

IMPLEMENT the strategies to prevent contamination
SOURCE WATER ASSESSMENT REPORT

Summary of Analysis

Water System Name
City, Oregon
County
PWS #41XXXXX

Date

Prepared By

Oregon Department of Human Services
Health Services
Drinking Water Program

And

Oregon Department of Environmental Quality
Water Quality Division
Drinking Water Protection

OHA Drinking Water Services
Value of Planning and Protection

- Protecting the current resource
  - Water quality – Multiple barrier approach
  - Sustainable supply for the future: Resource Adequacy

- Preserving public trust

- Protecting investment

- Protecting economic value: Property values

- Community Viability: Attracting new residents and businesses

- Avoiding costly treatment, M&O

- New regulations, emerging contaminants of concern

OHA Drinking Water Services
“Price Tag” of Contamination

- Lakewood Utilities in Marion County: population ~350
- **February 1991: TCA, 1,1-DCE – MCL violation**
- Initial Direct Costs covered by DEQ:
  - Water and soil analysis: $120,000
  - Contractor field work: $300,000
  - Treatment System: $150,000
  - Total Initial Direct costs = ~$1600/person
- **Other Costs**
  - Bottled Water: $300-500/household/year
  - O & M of treatment unit: $20/month/household
“Price Tag” of Contamination

- Indirect costs
  - Fear of unknown chemicals
  - Loss of trust in water system
  - Frustration in lengthy process
  - Noise/Appearance of treatment tower
  - Change in water quality
  - Negative press
  - Decrease in property values

- Some residents still use individual home treatment device in spite of successful system treatment unit

- “An ounce of prevention is worth a pound of cure”
Source Water Assessments completed for all public water systems

- Groundwater: 948 systems statewide
- Surface Water: 154 systems statewide
- Each assessment unique to individual water system
Capture Zone
Capture Zone
Procedures for Delineation: Groundwater

- Identify that part of the aquifer that supplies water to the well or spring
- Site-specific parameters
- Radius a function of time
- Project to the surface
Groundwater DWSA
Hydrogeologic Mapping
Surface Water-DWSA
Oregon’s source areas for public water systems
SWA includes... List of potential sources of contaminants

- Inventoried >100 types covering various land uses
- Identified >15,000 PCSs in source areas
- Access Database – readily accessible data
Oregon’s SWA Inventory Results

Groundwater Systems

Highest Potential Risks in 2-yr TOT

- High-Density Housing: 21%
- Transportation Corridors: 15%
- Large Capacity Septic Systems: 11%
- Sewer Lines: 11%
- Irrigated Crops: 10%
- Above Ground Tanks: 10%
- Auto Repair: 6%
- Chem/Petrol Proc/Storage: 5%
- Parking Lots/Malls: 5%
- High-Density Septic Systems: 6%
- Sewer Lines: 11%
SWA includes…

- Evaluation of sensitive areas within source area
  - Aquifer characteristics and ease with which water can move from the surface to the aquifer,
  - Chemical or coliform detections,
  - Well construction, and
  - Potential contaminant source inventory

- Recommendations for how to protect the water quality, but *no new requirements*
Source Water Assessments

Sensitive Areas (Natural Factors) + Contamination Risks = Susceptibility of the Drinking Water Source
Protecting The Source
Protecting the Source
What Steps Should We Take?

- Know where the Drinking Water Source Area is located.
  - Within city limits
  - Extends into the county
  - Rural/private land

- Identify who has jurisdiction/regulatory control?
  - City
  - County
  - Dept of Agriculture
  - US Forest Service / Oregon Forestry Dept
Protecting the Source

*Developing Protection Strategies*

- Use Source Water Assessment to identify high- and moderate- risks. Update list
  - Risk factors
  - Aquifer sensitivity
- Evaluate based on
  - Benefit achieved (risk reduction, economic factors)
  - Challenges (time, staff, cost)
  - Community buy in
  - Long-term plans
- Associate appropriate BMPs with each identified risk
- Implementation of BMPs through Local authority
  - Through land use planning process or through changes in City code
## Checklist: Please Return to DHS

Public Water System #4100909  
Barlow Water District  
Please trifold (see other side) and return to DHS upon completion of any actions

<table>
<thead>
<tr>
<th>Land Use Type</th>
<th>Recommended Actions for Drinking Water Protection</th>
<th>Date Completed</th>
</tr>
</thead>
</table>
| Drinking Water Facilities    | □ Verify that no chemicals are stored near the wellhead or spring, and that all backup fuel supplies have secondary containment.  
                                □ Alert residents and businesses within your drinking water source area to opportunities to properly dispose of common hazardous wastes |                |
| Housing - High Density       | □ Notify residents of their location within your source area and communicate the information found in the fact sheets listed on backside of the Example Letter to Customers. Help educate them about pesticide and fertilizer use, and disposal of household hazardous wastes, pharmaceuticals, and pet waste.  
                                □ Identify underground injection wells and dry wells for stormwater disposal. Verify permit status.  
                                □ Review a stormwater management document and develop a program to address stormwater. |                |
| Homes with Septic Systems    | □ Notify residents that they are located within the Drinking Water Source Area and send fact sheets on septic system maintenance.  
                                □ Ongoing education program on household hazardous waste and disposal of pharmaceuticals.  
                                □ For residents with horses, send "Managing Small-acreage Horse Farms" fact sheet.  
                                □ Work with local government to require septic inspections when property is transferred |                |
| Crops (inc. orchards, vineyards, nurseries, greenhouses, Christmas trees, grains, grass seed, pasture) | □ Notify the owner(s) or operator(s) of their location within your Drinking Water Source Area and send fact sheets on "Managing Agricultural Fertilizer Application" and "Managing Large-Scale Application of Pesticides."  
                                □ Encourage farm operator to work with their local Soil and Water Conservation District (SWCD) or Oregon State University County Extension Agent to develop a farm plan, if they have not done so already.  
                                □ If this land covers a large percentage of your Drinking Water Source Area, notify your local SWCD of your Source Area location.  
                                □ Identify and document any pesticides used to maintain site and areas applied.  
                                □ Encourage growers to participate in local pesticide collection event for unused and legacy pesticides. |                |

OHA Drinking Water Services
# Implementation Matrix: Prioritizing the Approach

<table>
<thead>
<tr>
<th>BMPs</th>
<th>BMPs for High Risk PCSs</th>
<th>BMPs for Mod Risk PCSs</th>
<th>BMPs for Low Risk PCSs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Easy to do</td>
<td>High Risk PCS BMP Easy to do</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mod difficult to do</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficult to do</td>
<td></td>
<td></td>
<td>Low Risk PCS BMP Hard to do</td>
</tr>
</tbody>
</table>
Examples of Drinking Water Protection Strategies

- public awareness – news features, sign installation
- incorporate pollution prevention concepts and BMPs for high-risk locations
- household hazardous waste education/collection
- community/watershed spill response plans
- local zoning ordinances
- easements in sensitive areas – agriculture/forestry
- septic system outreach/maintenance program
- technical training for high risk facilities’ employees
- County overlay; early notification re: changes
Linking Source Water Protection with Groundwater Rule and GWUDI
Inadequately Constructed Well Susceptible to Fecal Contamination
Monthly Assessment Monitoring

- Monthly tracking of samples
  - Schedules now available on SDWIS on-line
  - Violations to be issued for not sampling starting in 2011
The Source Has a Confirmed EC+ result. What Next?

- Assessment monitoring for that specific source can stop.
  - If your water system has multiple sources on assessment monitoring, the other sources must continue with assessment monitoring.

- Regional Hydrogeologist will review the SWA results and determine:
  - If GWUDI Coordinator should review results for possible MPA test
  - If there are well construction issues that suggest that the groundwater source should be repaired or replaced.

- If needed, the GWUDI Coordinator will contact you regarding MPA testing requirements.

- Communicate with your County/State Health Dept contact
Pumping Wells Close to Streams
Groundwater Under the Influence of Surface Water

- Water system vulnerable to microorganisms such as Giardia lamblia or Cryptosporidium.
- Protocol for determination:
  - Hydrogeologic Assessment (SWA)
  - Assessment monitoring - year-long collection of raw water coliform data (if needed): confirmed fecal coliform?
  - Microscopic Particulate Analysis (if needed)
- If source determined to be GWUDI, then must treat as a surface water source or take other corrective action.
- Contact Russ Kazmierczak for more details
  - (541) 726-2587 x26
Wells and Springs identified as susceptible to fecal contamination.
High sensitivity & fecal contaminant source (includes surface water) within 2-yr TOT Zone.

Monthly Assessment Monitoring

Confirmed EC +

Is GWUDI an issue?

Corrective actions:
1) Correct all significant deficiencies
2) Disconnect water source
3) Eliminate contamination source
4) Provide 4-log treatment or reconstruct water source
Protecting the Source

SDWA grant opportunities

- Apply with simple form to DHS
- $30,000 per PWS, per year, maximum
- Selection based on risks, reduction, etc.
- Examples of eligible projects:
  - Drug take-back projects
  - Pesticide use / application rate reduction workshops, etc
  - Household hazardous waste collection events
  - Workshops promoting alternative nonhazardous products
  - Abandonment of nearby unused private wells
  - Reforestation / replanting of sensitive riparian areas
  - Installation of signs / fencing of sensitive protection areas
  - Decommissioning septic systems & installation of sewer hookups

- If applying for infrastructure loans, having implemented protection strategies will give you more points (but, we must be aware of it!)
Protecting the Source

Technical Assistance & Information

Technical Assistance

**Groundwater**
Insert Regional Hydrogeologist
OHA Drinking Water Services
(541) 726-2587
XXX.XXXX@state.or.us

**Surface Water**
Sheree Stewart
DEQ Drinking Water Protection
(503) 229-5413
Stewart.sheree@deq.state.or.us

Information

  - Drinking Water Protection Bulletins
  - Fact sheets

- [http://www.deq.state.or.us/wq/dwp/dwp.htm](http://www.deq.state.or.us/wq/dwp/dwp.htm)
  - Management strategies for specific land uses
  - Fact sheets
  - GIS resources
Summary

- Water resources are scarce. A decline in water quality can reduce the quantity of water available locally.
- Source Water Assessment Reports help identify potential threats to drinking water quality.
- The goal of Drinking Water Protection is to reduce the risk of contamination, not necessarily eliminate it.
- DEQ/OHA can help public water systems prioritize their protection efforts and identify specific strategies.
- Drinking Water Protection in Oregon is voluntary but is necessary in order to protect existing and future drinking water sources.
Implementation Exercise

1. Open SWA Report (see Table of Contents for pg #): Review Table 4.1 Aquifer Sensitivity Analysis and Table 4.2 Well Construction Sensitivity Analysis

2. Review Table 2 Inventory Results located in Appendix. Note BMP section.

3. Complete BMP Matrix for each of the PCSs.

4. Discuss completion of the matrix.
   - Are the BMPs easy to do, moderate or hard to complete?

5. Complete Recommended Actions List

6. Complete Sign-up Sheet or Call for Additional Technical Assistance
   - Provide Guidance
   - Copies of Fact Sheets

OHA Drinking Water Program
Implementation Exercise

1. Open the Source Water Assessment Report and turn to Table 2. Inventory Result, near the end of the report, located in Appendix (see below for example).

2. Select a high relative risk PCS in the 2 year Time of Travel (TOT), see example below. Select a lower risk PCS if none in the 2 yr TOT and/or move out to the next TOT if no PCSs in the 2 yr TOT.

### Table 2. Inventory Results - List of Potential Contaminant Sources

<table>
<thead>
<tr>
<th>Reference No. (See Figure)</th>
<th>Potential Contaminant Source Type</th>
<th>Name</th>
<th>Approximate Location</th>
<th>City</th>
<th>Method for Listing</th>
<th>Proximity to Sensitive Areas</th>
<th>Relative Risk Level (1-5)</th>
<th>Potential Impacts</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Homeilectric-Rural-Septic Systems (N 1 to 2)</td>
<td>Rural homestead septic</td>
<td>Throughout Draw</td>
<td>Pendleton</td>
<td>Field Observation Interview</td>
<td>Within the 2yr TOT</td>
<td>3</td>
<td>Not properly shielded, designed, installed, and maintained, septic systems can impact drinking water. Use of drain field and dumping household hazardous wastes can result in ground water contamination.</td>
<td></td>
</tr>
</tbody>
</table>
Implementation Exercise

3. Example of the Potential Contaminate Source Map showing TOT zones, PCSs and well locations

![Map Image](image.png)
### Implementation Exercise

4. Using handout, review initial/substantial implementation Best Management Practices (BMPs) for each PCS identified in Table 2.

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>ALL_BMPs</th>
<th>Initial Implementation</th>
<th>Substantial Implementation</th>
<th>FactSheetLinks</th>
<th>Pcs_Code</th>
<th>Pot_Impact</th>
</tr>
</thead>
</table>
| Homesteads - Rural - Septic Systems (< 1/acre) | - Notify the residents of their location within your Drinking Water Source Area and send the following fact sheets:  
  *Groundwater Basics*  
  *Managing Septic Systems to Prevent Contamination of Drinking Water*  
  *What is Household Hazardous Waste?*  
  *Bec* | - Notify the residents of their location within your Drinking Water Source Area and send the following fact sheets:  
  *Groundwater Basics*  
  *Managing Septic Systems to Prevent Contamination of Drinking Water*  
  *What is Household Hazardous Waste?*  
  *Bec* | Groundwater Basics: http://www.deq.state.or.us/wq/pubs/factsheets/drinkingwater/gwbasics.pdf  
  Healthy Lawns, Healthy Families: http://www.healthylawns.org/how/print.pdf  
  Managing Septic Systems: http://www.epa.gov/safewater/ sourcesw/tepubs/fs_swpp_septi | M09 | If not properly sited, designed, installed, and maintained, septic systems can impact drinking water. Use of drain cleaners and dumping household hazardous wastes can result in groundwater contamination. |
Implementation Exercise

5. Complete Best Management Practices (BMPs) Implementation Matrix for each of the PCSs listed in Table 2 (see above for example).
Implementation Exercise

6. Discuss completion of the matrix.
   » Are there any BMPs that are “easy to do” that would have a “High” impact?
   » Are there any BMPs that are “difficult to do” that would have a “Low” impact?
   » Which BMPs would you try to implement first? Which ones last or not at all?

7. Post Class Implementation: Repeat the exercise above for the remaining PCSs listed in the Source Water Assessment and after the PCSs have been addressed and BMPs implemented (that means provided to the owner of the PCS and used by the owner of the PCS), please send a completed copy of the Checklist to OHA (see example below and included in the handouts).

Address to:
Russell Kazmierczak
Drinking Water Program
444 A Street
Springfield, OR 97477
### Implementation Exercise

**Example Checklist**

**CHECKLIST: PLEASE RETURN TO OHA**

Public Water System #:4100416 PWS MCKAY ACRES IMPROVEMENT DISTRICT

Please tifold (see other side) and return to OHA upon completion of any actions

<table>
<thead>
<tr>
<th>Land Use Type</th>
<th>Recommended Actions for Drinking Water Protection</th>
<th>Date Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural Homes and Septic Systems</td>
<td>X Notify residents that they are located within the Drinking Water Source Area and send appropriate fact sheets as suggested on page 2 of example letter to customers.</td>
<td>Initials and Date Completed</td>
</tr>
<tr>
<td></td>
<td>X Ongoing education program on household hazardous waste and disposal of pharmaceuticals.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>X For residents with horses, send &quot;Managing Small-acreage Horse Farms&quot; fact sheet.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>X Work with local government to require septic inspections when property is transferred</td>
<td></td>
</tr>
<tr>
<td>Wells - Abandoned</td>
<td>□ Notify the well owners of proper well abandonment procedures and send the Water Resources Department's &quot;A consumer's guide to Water Well Construction, Maintenance, And Abandonment.&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Provide financial incentives for permanent well abandonment according to the Water Resources Department's &quot;A consumer's guide to Water Well Construction, Maintenance, And Abandonment.&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Verify proper well abandonment. Provided well construction is adequate, temporary abandonment will be protective of groundwater. Contact OHA Staff for assistance, and</td>
<td></td>
</tr>
</tbody>
</table>

**Eastern Region Geologist**

Russ Kazmierczak  
OHA Drinking Water Program  
(541) 726-2587 x26  
Russell.A.Kazmierczak@state.or.us

OHA Drinking Water Program