

Oregon Public Water Systems Groundwater Resource Guide

For Drinking Water Source Protection

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State of Oregon
**Department of
Environmental
Quality**

Oregon Department of Environmental Quality
Environmental Solutions Division
Watershed Management



Oregon Health Authority
Center for Health Protection
Drinking Water Services

A Call to Action -

A Recommitment to Assessing and Protecting Sources of Drinking Water

“Our vision...Federal, state, and local actions reflect the high value of safe drinking water: the high value of drinking water is widely recognized at all levels of government and among the general public...”

(Appendix 1, Source Water Collaborative, 2014)

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NOTE: This document is “Version 1.0” and dated October 2017. It will be made available on DEQ’s Drinking Water Protection website in October 2017. DEQ anticipates there will be frequent revisions and updates on this document. Please feel free to make suggestions for improvements so that we can make the document more valuable to the public water systems in Oregon.

Groundwater Resource Guide

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PROJECT JUSTIFICATION

Why is there a need for a “Groundwater Resource Guide”?

Oregon faces many challenges with water quantity, water quality, and ecosystem needs. Oregon’s people rely upon water to drink, to irrigate and grow food, to supply livestock, to build products, to move goods, to recreate, to produce energy. Clean water is essential to Oregon’s environmental health—for the trees, native plants, wetlands, aquatic life, and human health. Oregon’s economy is also highly dependent upon a healthy environment and clean, reliable sources of water.

As Oregon’s population grows, the importance of high quality drinking water sources to meet the demands of that population will increase. Ensuring high quality sources of water is essential for providing clean drinking water to agricultural growers/ranchers, rural homeowners, businesses, and urban communities of all sizes.

Today, and historically, **the public is concerned about the safety of its drinking water**. This project—developing a “Resource Guide” for public water systems—was initiated after several multi-agency meetings during 2013-14 regarding how to address community concerns about drinking water quality. Oregon DEQ developed these Resource Guides to assist local government and community citizens to a) understand the various authorities associated with water quality in their source area, and b) learn about the various tools and resources available to reduce the risk of contamination of their drinking water.

While the risk of intentional contamination is small, drinking water sources can become contaminated by a variety of land uses and everyday activities. Most water resource work to date has focused on identifying pollutant impacts, then reducing the levels of pollutants and restoring impaired or polluted waters. While we will continue to do this as resources allow, it is also important to prevent problems from occurring. Pollution prevention does not depend on data showing there is an existing problem, but an understanding of factors that pose a risk of pollution. If there is already a pollution problem, it is too late to prevent it.

Pollution prevention is fundamentally different from pollutant removal or treatment. Many studies have shown that **it is more cost-effective to prevent pollution in the environment than to remove it through treatment or implement restoration**. Reducing or eliminating off-site releases of pollutants through protection and prevention activities can effectively lower treatment and maintenance costs for public water providers, and improve long-term viability of groundwater drinking water sources (Freeman et al 2008). Reducing pollutant loading to source water can reduce the need for equipment replacement or upgrades, as well as reduce risks associated with many contaminants (including ones known to be toxic, persistent, and/or bio-accumulative) where regulatory standards and/or monitoring requirements may be lacking. Long-term assurances of a safe and adequate drinking water supply also helps to protect property values and preserve the local and regional economic growth potential for the area.

This Resource Guide provides the basic information necessary for Oregon’s public water system officials and community partners to implement local place-based planning to prevent pollutant impacts that could affect their drinking water quality. **Pollution prevention can help protect public health, enhance public confidence in their drinking water, and reduce the need for expensive treatment in both surface water and groundwater.**

EXECUTIVE SUMMARY

Groundwater is an essential Oregon resource. According to the Oregon Health Authority records for public water systems, more than 70 percent of Oregon residents rely solely or in part on groundwater for their drinking water, and over 90 percent of the state's public water systems get their drinking water from groundwater. Besides public drinking water sources, important beneficial uses for groundwater within Oregon statutes and rules also include agricultural uses – irrigation/livestock, rural businesses, and private domestic water wells in rural areas.

The **Oregon Groundwater Quality Protection Act** (Oregon Revised Statute 468B.150-190) was passed by the Oregon Legislative Assembly in 1989. These statutes establish a policy that all state agencies' rules and programs affecting groundwater are to be consistent with the goal of preventing contamination of groundwater. Through this act, the Legislative Assembly declared that Oregon's groundwater resource should be characterized, conserved, restored, and that the high quality of this resource be maintained for present and future beneficial uses, including drinking water. The Department of Environmental Quality (DEQ) has primary responsibility for coordination of groundwater quality protection in Oregon under the Act. DEQ implements groundwater quality protection through a variety of programs and responsibilities that are designed to prevent groundwater contamination from point and non-point sources of pollution, to clean up pollution sources, and to monitor and assess groundwater quality.

Oregon DEQ coordinates groundwater quality protection with other state agencies which have overlapping responsibilities for regulation, involvement, or oversight. For example, DEQ implements some groundwater programs through interagency partnerships with the Oregon Water Resources Department and the Oregon Department of Agriculture. DEQ also works collaboratively with interested parties to share information about groundwater conditions, identify funding sources, and find common-ground solutions for restoration. Partners include other state, local and private organizations, businesses and individuals. As surface water resources are used to capacity across the state, Oregon communities and businesses are becoming more dependent on groundwater resources and they expect those resources to remain clean, available and usable.

Groundwater is vulnerable to contamination from activities taking place on land as well as from discharges of wastes and pollutants at or below ground surface. All water beneath the land surface is groundwater, and it sometimes occurs at very shallow depths. Once groundwater becomes contaminated, it is very difficult, and often costly, to clean up. Because groundwater moves slowly, contamination may persist for tens, hundreds or even thousands of years. Likewise, groundwater currently being contaminated may not impact beneficial uses until sometime far into the future (when clean drinking water sources may be difficult to find). This contamination may impair groundwater for use as drinking water and may affect the quality of surface waters where it comes to the surface. Groundwater contamination from nitrates, bacteria, pesticides, volatile organic

compounds, and other constituents can present potential human health risks in drinking water, both in public water systems and private domestic wells in rural areas.

When groundwater sources of drinking water become contaminated, communities must build expensive water treatment plants in order to provide safe drinking water, and this increases utility costs. In some cases, temporary emergency supplies of drinking water must be secured, and the costs to citizens and Oregon businesses can be significant. Avoiding the need for expensive treatment technology or alternative water supplies by protecting the quality of raw water is cost-effective.

In Oregon, there are over 3000 individual public water systems that use groundwater as their source of drinking water. Section 1453 of the federal 1996 *Safe Drinking Water Act* Amendments (PL 104-182) required states to develop “Source Water Assessments” for all public water systems within their state. Source Water Assessments identify watershed or aquifer conditions and potential sources of pollutants, and also identify priority areas for future protection. DEQ and the Oregon Health Authority (OHA) completed Oregon’s assessment reports in 2005. More advanced data and GIS capabilities are currently available, so the **state agencies are now completing “Updated Source Water Assessments” for public water systems in Oregon**. USWAs provide more detailed technical information on their groundwater source area. This Groundwater Resource Guide is a “toolbox” for using the Updated Source Water Assessment information on the groundwater source areas to support local drinking water source protection.

The State of Oregon adopted an “**Integrated Water Resources Strategy (IWRS)**” in 2012 to serve as a blueprint for addressing statewide water resource challenges. The Water Resources Department led the effort in consultation with Oregon DEQ, Oregon Department of Fish and Wildlife, and the Oregon Department of Agriculture. Within Goals 1 and 2 of the IWRS, the strategy seeks to improve information about local water resources and help communities undertake place-based integrated planning to improve resiliency and any public health challenges associated with water quantity and water quality. Meeting Oregon’s water resource needs under the strategy includes “ensuring the safety of Oregon’s drinking water”, and “reducing the use of and exposure to toxics and other pollutants” (IWRS 2012, Recommended Actions 1C, 9A, 12A, and 12B).

The primary purpose of the Resource Guide is to assist public water systems to prevent or reduce contamination from activities within their groundwater source area. **The approach for developing and implementing prevention plans will follow the IWRS model and recommendations**. DEQ collaborated with a number of state, federal, and university partners to develop various tools that can be used to reduce pollutant impacts. Public water system officials/staff can rarely develop and implement strategic plans for pollutant reduction without assistance from partner organizations. To increase the opportunities for finding assistance, this document provides detailed information on potential partner organizations, resources available, and funding sources. To increase the likelihood that voluntary pollution reduction strategies will be successfully implemented, in-depth information is provided on various water quality protection tools and how to develop effective place-based plans through collaborative partnerships.

The first step in preventing pollution is to identify potential problems. In order to successfully prevent pollution, we must identify what might potentially cause pollution. The Resource Guide provides technical data and tools to identify potential sources of pollutants by land use, activities, or the presence of polluting materials or wastes. Additional methods of identifying potential problems can include literature or data indicating impacts in other areas of the country or state from similar land uses. Another basis for prioritizing pollution prevention outreach may be identifying significant percentages of land uses or activities in close proximity to a sensitive beneficial use.

As a first step in preventing pollution, DEQ source water protection collects and disseminates information, provides financial and technical assistance where possible, and implements other activities and water quality programs to prevent pollution. All public water systems are required to perform monitoring tests that meet the Safe Drinking Water Act requirements, but these tests are 3 or more years apart, and not all pollutants can be tested for. This is an important reason to work collaboratively on pollution prevention in the drinking water source areas.

Community place-based planning for drinking water protection allows citizens to take an active role and work together in protecting public health and reducing the costs of providing clean drinking water.

1.0 DRINKING WATER REGULATORY OVERVIEW

It is important to understand the regulatory context of water quality as it relates to drinking water source protection. We all depend on clean water. This section will highlight the federal regulations related directly to public drinking water. Many agencies administer different aspects of water quality regulations that are intended to protect public health and water resources in Oregon. An Interagency Agreement between the OHA and DEQ provides a framework to ensure the responsibilities and tasks for DEQ associated with the drinking water *protection* aspects of public water systems are clearly articulated.

Safe Drinking Water Act

The Oregon Health Authority (OHA) is the state agency responsible for the implementation of the federal Safe Drinking Water Act in Oregon. ORS 338.277 authorizes OHA to administer the federal Safe Drinking Water Act in Oregon as the Primacy Agency in agreement with the federal government. ORS 448.131 further authorizes the adoption of standards necessary to protect public health through insuring safe drinking water within a water system. Oregon Administrative Rules OAR 333-061 include requirements for systems to meet the Safe Drinking Water Act maximum contaminant levels (MCL), submit to periodic inspections, and meet enforcement requirements as administered by OHA.

As the primacy agency, OHA also approves drinking water treatment plans and sets construction standards, operator certification standards, and enforces rules to ensure safe drinking water. In order to assist systems in complying with standards, OHA also provides technical assistance and oversight of grants and loans for public water system operation and improvements.

The Safe Drinking Water Act's "Groundwater Rule" requires all public water systems that use groundwater sources to protect from fecal-related bacterial and viral pathogens. The rule requires public water systems to take corrective action when contamination is confirmed through testing. Corrective actions may include reconstruction or abandonment of wells contributing to viral contamination. For more information on the Groundwater Rule, see:

<http://public.health.oregon.gov/HealthyEnvironments/DrinkingWater/Rules/GWR/Pages/index.aspx>

The OHA website has extensive information on all drinking water regulatory requirements:

<http://healthoregon.org/dwp>

The federal Safe Drinking Water Act currently regulates the 91 most commonly occurring pollutants in drinking water in the United States (USEPA, 2016). *There are many pollutants not regulated in treated drinking water—including pharmaceuticals, personal care products, and some pesticides used in Oregon.* For example, Community public water systems (places where people live) and Non-transient Non-community public water systems (places where people work or attend school) test for regulated synthetic organic contaminants every three years in treated drinking water, but there are many compounds used in Oregon that are not regulated under the current requirements. The testing requirements for Transient Non-community public water systems (places that don't serve

the same people every day) are limited to bacteria and nitrate, pollutants that can have an acute illness risks.

Through extensive sampling and analysis by the U.S. Geological Survey, U.S. EPA, and others, we know that many pollutants found in drinking water sources cannot be fully removed through standard drinking water treatment technologies (Glassmeyer et al 2017; Stackelberg et al 2007). The inability to remove pollutants from source water *places even more emphasis in reducing or preventing pollutants in source waters.*

Clean Water Act

The Safe Drinking Water Act does not provide authorities to prevent pollution in source waters. *Protecting water quality in source waters for public water systems requires implementation of federal Clean Water Act authorities and state law.* DEQ is responsible for implementation of the federal Clean Water Act and state water quality law in Oregon. Because of this authority, DEQ is responsible for addressing pollutants from point and nonpoint sources of pollution that affect the water quality throughout the state.

The federal Clean Water Act authorities apply to all surface waters in the United States. Oregon state statutes (ORS 468B.005(10)) expand upon the federal Clean Water Act to afford protection for all waters of the state, including groundwater. Oregon statutes authorize DEQ to implement and enforce the federal Clean Water Act within Oregon. Pertinent Oregon statutes that provide the basis for prevention of contamination include:

ORS 468B.005 Definitions for water pollution control laws.

...(5) "Pollution" or "water pollution" means such alteration of the physical, chemical or biological properties of any waters of the state, including change in temperature, taste, color, turbidity, silt or odor of the waters, or such discharge of any liquid, gaseous, solid, radioactive or other substance into any waters of the state, which will or tends to, either by itself or in connection with any other substance, create a public nuisance or which will or tends to render such waters harmful, detrimental or injurious to public health, safety or welfare, or to domestic, commercial, industrial, agricultural, recreational or other legitimate beneficial uses or to livestock, wildlife, fish or other aquatic life or the habitat thereof.

...(10) "Water" or "the waters of the state" include lakes, bays, ponds, impounding reservoirs, springs, wells, rivers, streams, creeks, estuaries, marshes, inlets, canals, the Pacific Ocean within the territorial limits of the State of Oregon and all other bodies of surface or underground waters, natural or artificial, inland or coastal, fresh or salt, public or private (except those private waters which do not combine or effect a junction with natural surface or underground waters), which are wholly or partially within or bordering the state or within its jurisdiction.

ORS 468B.015 Policy.

Whereas pollution of the waters of the state constitutes a menace to public health and welfare, creates public nuisances, is harmful to wildlife, fish and aquatic life and impairs domestic, agricultural, industrial, recreational and other legitimate beneficial uses of water... it is hereby declared to be the public policy of the state:

...(2) *To protect, maintain and improve the quality of the waters of the state for public water supplies, for the propagation of wildlife, fish and aquatic life and for domestic, agricultural, industrial, municipal, recreational and other legitimate beneficial uses;*

...(5) *To cooperate with other agencies of the state, agencies of other states and the federal government in carrying out these objectives.*

Under Oregon statute, groundwater (or underground waters) is clearly considered part of “waters of the state” that are protected for beneficial uses that include public water supplies.

In addition to ORS citations above, the Oregon Groundwater Quality Protection Act of 1989 (ORS 468B.150-190) sets a broad goal for the state of Oregon – to prevent contamination of Oregon’s groundwater resource, to conserve and restore this resource, and to maintain the high quality of this resource for present and future uses. The act established a policy that all state agencies’ rules and programs are to be consistent with the goal of protecting drinking water resources and public health.

DEQ has primary responsibility for implementing groundwater quality protection in Oregon. DEQ has a suite of programs and responsibilities to help prevent groundwater contamination from point and non-point sources of pollution, to clean up pollution sources, and to monitor and assess groundwater quality (ODEQ 2017). As part of its strategic plan, DEQ places high emphasis on protecting human health. Within the water quality program, this is achieved through work on watershed health, basin assessments, discharge permitting, nonpoint source controls, water quality standards and protecting beneficial uses. There is a high level of coordination to integrate the drinking water source area information and priorities into other agency programs, including toxics reduction, pesticide stewardship partnership implementation, emergency/spill response, hazardous waste cleanup, water quality permitting, and other programs that impact groundwater resources. Many DEQ programs prioritize public drinking water source areas in their statewide strategic planning for implementation. For example, the DEQ underground storage tank cleanup program prioritized and addressed 99 leaking tanks in the source areas adjacent to public water system wells based on the 2005 Source Water Assessment data.

Groundwater Under the Direct Influence of Surface Water

The Safe Drinking Water Act (SDWA) regulates drinking water sources that include groundwater, surface water, and springs. However, there is a category of groundwater wells with unique characteristics. SDWA defines “Groundwater Under the Direct Influence of Surface Water” (GWUDI) as: “any water beneath the surface of the ground with significant occurrence of insects or other macro organisms, algae, or large-diameter pathogens such as *Giardia lamblia* or *Cryptosporidium*, or significant and relatively rapid shifts in water characteristics such as turbidity, temperature, conductivity, or pH which closely correlate to climatological or surface water conditions” (40 CFR 141 definition).

GWUDI basically means the groundwater source is located close enough to nearby surface water, such as a river or lake, to receive unfiltered surface water recharge. Since a portion of the groundwater source’s recharge is from surface water, the groundwater source is considered at risk

of contamination from pathogens such as *Giardia lamblia*, *Cryptosporidium*, and viruses, which are not normally found in true groundwater. This means that GWUDI systems have additional regulatory requirements beyond the groundwater wells that do not have surface water contributions.

Oregon Administrative Rule (OAR) 333-061-0032 (8) requires that all public water systems using groundwater as a source of drinking water must evaluate their source(s) for the potential to be under the influence of surface water. To learn about the criteria for determining if a groundwater source (wells, springs, and infiltration galleries) is susceptible to direct surface water influence and the regulatory requirements, please refer to the following OHA webpage: <http://public.health.oregon.gov/HealthyEnvironments/DrinkingWater/SourceWater/Pages/gwudi.aspx>

2.0 GROUNDWATER CHARACTERIZATION AND RISKS

This section provides an introduction to the groundwater resources in Oregon, an overview of what makes groundwater susceptible to contamination, and highlights of important and/or unique groundwater issues in Oregon.

Groundwater is an essential Oregon resource. By law, all surface and groundwater in Oregon belongs to the public. To protect this valuable resource, the Oregon legislature passed laws to prevent groundwater contamination, conserve and restore groundwater, and maintain the high quality of Oregon's groundwater resource for present and future uses. DEQ implements Oregon's groundwater protection program to monitor, assess, protect, and restore the quality of Oregon's groundwater resources. Because the sources of groundwater contamination and consumers of groundwater cross all boundaries, DEQ also engages with other state agencies, federal agencies, private and public organizations and individuals to improve and protect groundwater quality. The Oregon Water Resources Department (WRD) has significant groundwater authorities related to issuing and regulating water rights, oversight of the demands on the state's water resources, providing water resource data, and facilitating water supply solutions (especially necessary in drought conditions).

Groundwater in Oregon has many valuable uses and functions:

- Groundwater makes up about 95 percent of available freshwater resources.
- Groundwater uses account for approximately 30 percent of all water used in Oregon.
- Groundwater is the primary source of drinking water and its use is increasing.
- Over 70 percent of all Oregon residents rely solely or in part on groundwater for drinking water.
- Over 90 percent of public water systems get their drinking water from groundwater.
- An estimated 350,000 private drinking water wells exist in Oregon today.
- Oregon's businesses require clean groundwater for industries such as food processing, breweries, dairies, manufacturing, and computer chip production.

- Groundwater provides irrigation water for Oregon agriculture and water for livestock.
- Groundwater supplies base flow for most of the state’s rivers, lakes, streams and wetlands. In many streams, the inflow of cool groundwater may be essential to reduce stream temperatures to the range required by sensitive fish species.

Groundwater Susceptibility

An understanding of the fundamentals of groundwater hydrology is essential for effective protection of groundwater used for public water supply. All water below the land surface, filling even the smallest voids in rocks, is referred to as groundwater. Groundwater occurs in several zones, and may be confined or semi-confined by geologic layers underground. The groundwater immediately below ground surface is considered the water table (or shallow) aquifer and this groundwater is generally more susceptible to contamination from the surface. Recharge to the water table aquifer occurs as water percolates from the surface through the soils and rocks until it reaches the saturated zone of water. This water table aquifer is technically an “unconfined aquifer” as there are no rock layers that prevent the downward movement of water percolating from the surface. Where groundwater is overlain by an impermeable layer or “confining bed”, the water is said to be a “confined aquifer”. In general, the confined aquifers are less susceptible to contamination from the surface. It is important to recognize that no confining layer is completely impermeable, so even confined aquifers can become contaminated.

Drinking water wells in Oregon tap into both unconfined and confined aquifers. As part of OHA and DEQ’s drinking water protection work, the “drinking water source area” for each public water system well was calculated/modeled and mapped. The source areas are the 10- to 15-year water supply for each well. **Figure 1** provides a statewide view of the drinking water source areas for Oregon’s approximately 2150 public water systems. Figure 1 includes the source areas for 3400 wells that are part of those 2150 groundwater public water systems in Oregon. Many public water systems have more than one well to serve their water supply needs. The wells labeled as “Groundwater Under the Direct Influence (GWUDI)” are those that receive a direct contribution from a surface water body, such as a nearby river. Consequently, these public water systems have both groundwater and surface water (watershed) source areas.

Individual maps can be accessed for each Oregon public water system on DEQ’s Drinking Water Protection website (ODEQ 2017): <http://staging.apps.oregon.gov/DEQ/Data-and-Reports/Pages/GIS.aspx>

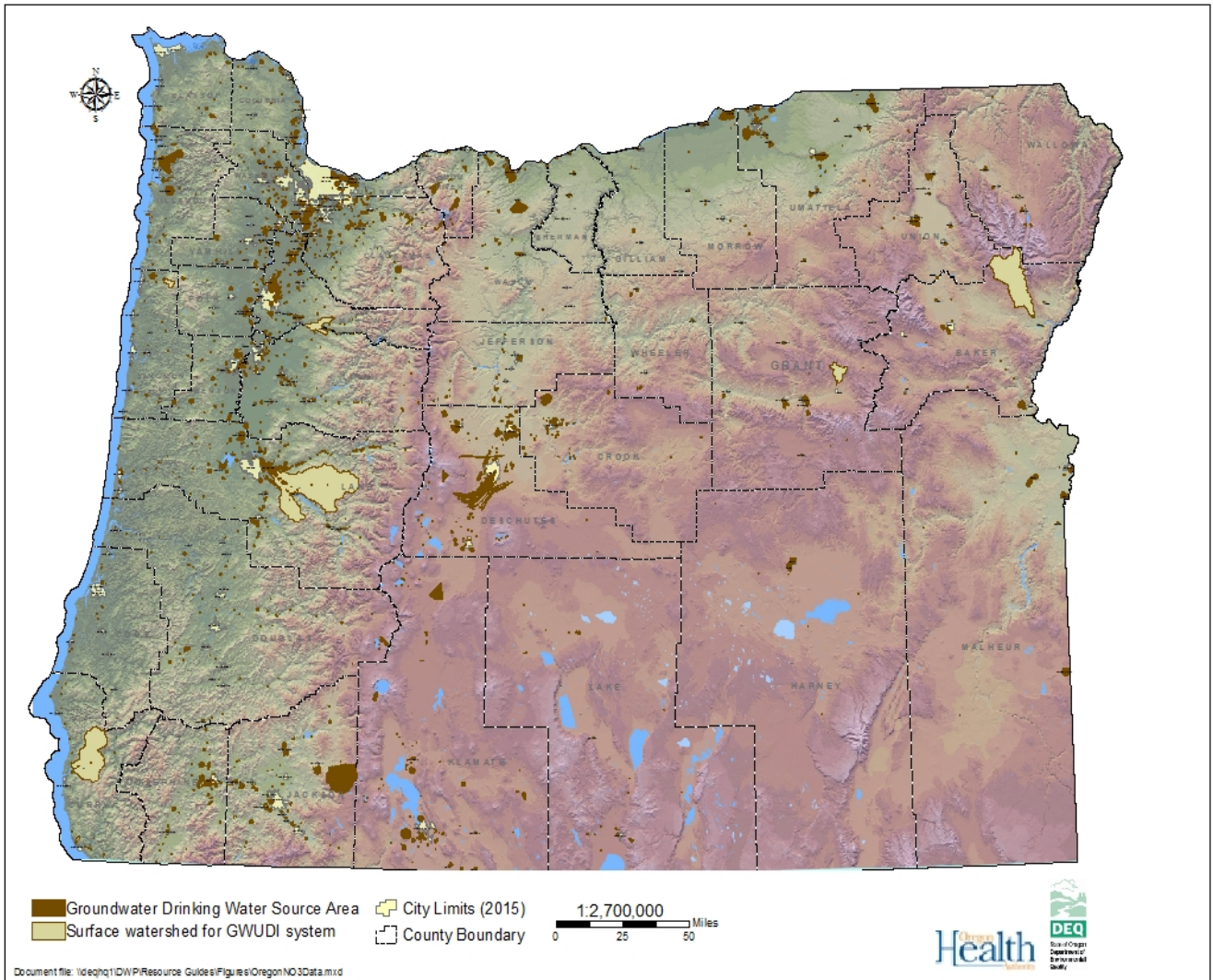


Figure 1. Drinking Water Source Areas for Public Water Systems Using Groundwater

As part of the U.S. Geological Survey National Water-Quality Assessment (NAWQA) Program, a study was published in 2013 on factors that affect the vulnerability of water from public-supply wells to contamination (Eberts et al 2013). In general, the vulnerability of the water from public-supply wells to contamination is a function of contaminant input within the area that contributes water to a well, the mobility and persistence of a contaminant once released to the groundwater, and the ease of groundwater and contaminant movement from the point of recharge to the open interval of a well. Preferential flow pathways—pathways that provide little resistance to flow—can influence how all other factors affect public-supply-well vulnerability to contamination. This kind of information can enable resource managers to prioritize actions for sustaining a high-quality groundwater source of drinking water.

In the USGS NAWQA study, each of the drinking water source areas were also assessed for characteristics that determine the well's susceptibility. The susceptibility of a drinking water well to contamination depends on both the well characteristics and the land uses and activities in the vicinity of the well(s). Well characteristics that are contributing factors for susceptibility include the depth to the aquifer, the well's construction, and the presence/absence of other nearby wells. Natural conditions that may contribute to higher contamination risks include the presence/absence of confining layers, amount of local precipitation and irrigation, and other related factors (USNRC 1993).

Anthropogenic activities and pollution sources can be a risk to a drinking water well that serves as a private or public water system source. Groundwater is susceptible to contamination from many different land uses and activities. Common potential sources of pollution within drinking water source areas include gravel quarries and other mining sites, animal management areas (including permitted confined animal feeding operations), onsite wastewater systems (domestic or industrial), fuel and hazardous material storage/use locations, irrigated agricultural areas, and solid waste handling sites (landfills or transfer stations). As described in more detail below, the Source Water Assessment reports identified a broad range of these "potential contaminant sources" for each drinking water source area.

Oregon Public Water Systems

Public water systems in Oregon are regulated by the Oregon Health Authority -- Drinking Water Services. In Oregon, public water systems with 4 or more connections or serving more than 10 people for at least 60 days of the year are regulated. There are approximately 3420 actively listed public water systems in Oregon as of December 2015. Of the total, 3081 of these use groundwater wells or springs, and 334 of these use surface water intakes on rivers, reservoirs, or wells that have been determined to be under the direct influence of surface water.

Source Water Assessments

The individual drinking water source areas for public water systems in Oregon were mapped as required in the 1996 amendments to the federal Safe Drinking Water Act (USEPA, 1996). These amendments required states to develop "source water assessments" for all public water supply systems. The work was funded through the Safe Drinking Water Act. Between 1999 and 2005, OHA and DEQ teamed up to complete the assessments for 2,656 public water systems (the total number of federal-regulated systems in Oregon). Oregon's source water assessment procedures, including the development of the list of potential risks, were established by a statewide citizen's advisory committee (Feb 1998-June 1999) and approved by US EPA in July 1999.

The assessment reports for each public water system provide community officials with detailed information on the watershed or recharge area that supplies their well, spring, or surface water intake and identify potential risks within the source area. The potential risks to be identified in these reports were defined by EPA and included both point sources and nonpoint sources. A description of each type of land use/activity defined as a potential risk is

provided in the assessment for each system, along with individual maps with locational data. The potential risks identified in the assessments were based upon a review of nine agency databases (DEQ, US EPA, State Fire Marshall, etc.) and other data sources (some field assessments where necessary).

One of the most important aspects of the source water assessment process was determining the “susceptibility” of each system to contamination. Susceptibility in the assessment was defined as the potential for contamination in the source area to reach the public water system well(s). Whether or not a particular drinking water source becomes contaminated depends on three major factors: 1) the occurrence of a land use/activity that releases contamination, 2) the location of the release, and 3) the hydrologic and/or soil characteristics in the source area that allow the transport of the contaminants to the well. (It should be noted here that if the well is constructed properly, the risk of well contamination can significantly reduced.) The assessments contained basic maps of susceptible areas within the source area for public water wells.

The 2000-2005 assessment reports are still available for the public from DEQ and OHA. Reports for groundwater sources are available by contacting OHA (541-726-2587). Maps and downloadable statewide GIS shapefiles (ODEQ 2017) of drinking water source area data are available on DEQ's drinking water source protection website at: <http://www.oregon.gov/deq/wq/programs/Pages/DWP.aspx>

Drinking water source areas, land use/activities, etc. are shown on DEQ's Interactive Map Viewer (IMV): <http://www.oregon.gov/deq/wq/programs/Pages/DWP-Maps.aspx>

The IMV is a location-based system showing DEQ and OHA data and information. The groundwater source areas are also mapped on the Oregon State University- Institute for Natural Resources website, and are also available from the Oregon Geospatial Data Clearinghouse. The information provided within the original assessment reports served as a basis for communities to develop strategies to reduce the risks of pollution in their drinking water sources.

Updated Source Water Assessments

The level of information in databases and GIS mapping has significantly improved since Oregon’s original assessments were completed between 2000 and 2005. DEQ and OHA are now able to generate “Updated Source Water Assessments (USWA)”. DEQ is working to issue updated assessments for all surface water systems and OHA is updating the groundwater assessments, with assistance from DEQ for GIS resources and mapping. For the groundwater systems, approximately 1,000 wells have been added for new or existing public water systems since 2005, so maps and data need to be updated for each of them.

One of the most important and valuable assets a public water system can have is accurate source area mapping and visual resources to share with the community residents and officials. Since the first source water assessments were completed, DEQ has expanded its GIS

capabilities and, more importantly, the range of available data for analyzing potential pollutant sources. Our understanding of potential pollutant sources has been improved by development or acquisition of new datasets (such as the hazardous material storage locations, linking water quality assessment results to pollution sources, better roadway and river networks, outfall locations for permitted pollution sources, underground injection control wells, land use based on photo imagery, permitted sources' front door locations, historic landslide data, harmful algae blooms, confined animal feeding operations, mining activities, and many more). Currently the program has more than 40 GIS datasets to assist public water systems to identify new or previously unknown potential pollutant sources.

In the updated assessment reports, DEQ and OHA provide information to the public water systems on the locations of the potential sources of contamination. The location of each well has been fixed with a precise GPS latitude and longitude location. The figures include a new regional map view of source area, aerial photo base map with the source area delineated, and maps with anthropogenic land uses, potential sources of pollutants, and historic landslides. Tables are provided that include a summary of the types of potential pollutant risks in their drinking water source area. The susceptibility of a public drinking water system source depends on both the natural conditions in the recharge area, as well as the land uses/activities in that area.

The updated assessment reports also include a variety of resources so that effective pollution prevention plans can be developed to prevent or reduce any groundwater contamination. Appendices provide information for moving forward to develop and implement source water protection, lists of websites and resources available to public water systems and community members seeking technical assistance for work on watershed protection, and descriptions and contact information for grants and loans to fund both drinking water infrastructure and source protection projects. Many of those same materials have been expanded with more information and detail in this Resource Guide.

More information on the groundwater USWA reports can be found on the OHA website: <http://public.health.oregon.gov/HealthyEnvironments/DrinkingWater/SourceWater/Pages/swp.aspx>

Surface water USWA reports completed to date can be found on the DEQ website: <http://www.oregon.gov/deq/wq/programs/Pages/DWPAssessments.aspx>

Using Oregon Data to Identify Priorities

Groundwater contamination is a serious issue in some areas of Oregon. Many state and federal agencies have studied the quantity and quality of groundwater in specific areas, but there are still significant gaps and data needs to fully characterize Oregon's groundwater resource. This section will summarize some of the best sources of data that help DEQ to determine the priorities for groundwater contaminant reduction work in the drinking water source areas.

Figure 1 (above) provides a statewide view of the drinking water source areas for Oregon's approximately 2150 public water systems using groundwater. In terms of total land area, the drinking water source areas for groundwater public wells are not a significant portion of the state. However, these relatively small areas are critical for Oregon's communities. Groundwater is susceptible to contamination from many different land uses and activities within those source areas. Groundwater may be susceptible to organic, inorganic, and pathogen pollutants from both historical and existing land uses.

For purposes of providing statewide guidance to public water systems, drinking water protection priorities could be determined by either:

- A) calculating the predominant land uses within the public drinking water source areas that have a potential to impact water quality, or*
- B) compiling monitoring data to determine the most significant contaminant or chemical in groundwater at or near public water systems.*

As previously discussed, the source water assessment reports identified the geographical areas of groundwater source areas supplying the public water system wells (for the next 10-15 years). Each assessment provided an inventory of the potential contaminant risks identified at the time of assessment completion. A review of all statewide source water assessment 2005 data within drinking water source areas found over 15,750 potential contaminant risks (in a total of 134 categories). For the public water systems served by groundwater, the following were identified as the top 5 categories for potential contaminant sources based on the source water assessment results:

- High Density Housing (more than 1 home per half acre)
Improper use, storage, and disposal of household chemicals including cleaners, vehicle maintenance products, pool chemicals, pesticides and fertilizers may impact the drinking water supply. Stormwater run-off or infiltration may carry contaminants to drinking water supply.
- Transportation Corridors – Highways (plus high use roads)
High vehicle usage increases the risks for leaks or spills of fuels and other hazardous materials that may impact drinking water. Over-application or improper handling of pesticides or fertilizers in the right-of-way may impact the drinking water supply.
- Above Ground Tanks
Spills, leaks, or improper handling of stored materials may impact the drinking water supply.
- Crops – Irrigated
Over-application or improper handling of pesticides or fertilizers may impact drinking water. Excessive irrigation may cause transport of contaminants or sediments to groundwater/surface water through runoff. NOTE: Drip-irrigated crops such as vineyards and some vegetables, as well as computer-based advanced management systems, are considered to be a lower risk.
- Underground Storage Tanks
Spills, leaks, or improper handling of stored materials may impact the drinking water supply.

The assessment inventory results were an important summary of *potential* risks to Oregon public water systems. DEQ used this list as a first step in prioritizing drinking water protection planning and implementation after delivery of the original source water assessments. **Figure 2** is a graphic showing the approximate percentage of the land uses within drinking water source areas for public water systems using groundwater.

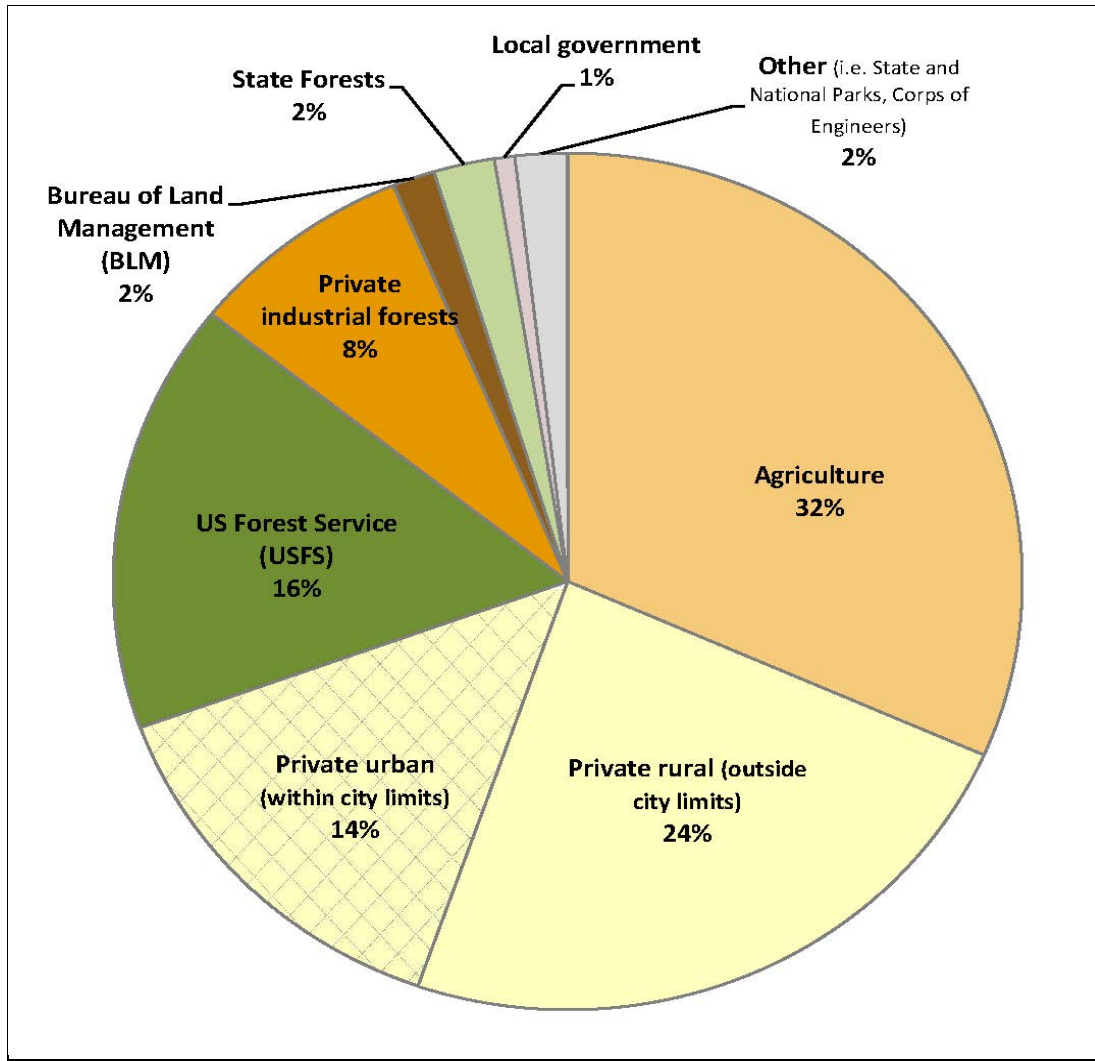


Figure 2. Approximate Percentage of Land Uses within Drinking Water Source Areas for Groundwater

The data on land uses can only be considered approximate due to limitations within the GIS layers. Not all counties have data that is accurate for all types of land uses under statewide planning.

Public water systems in Oregon are subject to Safe Drinking Water Act (SDWA) regulations. OHA implements the SDWA regulations that require public water systems to test their finished or treated drinking water before delivery to customers. Regulatory data can be evaluated to determine drinking water priorities using the detections found in groundwater systems. OHA does not routinely collect samples of source water prior to treatment. There are some data on well water quality prior to treatment, but it is limited. The Safe Drinking Water Information System (SDWIS) data for treated groundwater is still useful for prioritizing the contaminants since the public water systems must address these in the raw source water. Using Oregon SDWIS data from 1981 to 2012, the *highest number of contaminant detections in drinking water after treatment include nitrates, arsenic, pesticides, fuel constituents, phthalates, and volatile organic compounds such as tetrachloroethylene*. Detections of contaminants in regulatory monitoring are a clear indication that there is an existing pathway of contamination from the ground surface to the intake of a well, even when the individual contaminant levels do not exceed a regulatory threshold.

DEQ's Laboratory collects data as part of the statewide monitoring and assessment program for groundwater. Between 1980 and 2000, DEQ conducted 45 groundwater assessments that covered 6.4% of the state's total land area. Based on that ambient statewide groundwater monitoring, the *most commonly detected contaminant in Oregon is nitrate, followed by pesticides, volatile organic compounds, and bacteria*. Data collected show that 24% of 1156 wells sampled statewide exceed the drinking water standard for arsenic. Sixteen percent of 2187 wells sampled exceed the drinking water standard for nitrate. Thirty-three percent of Willamette Valley rural wells contain at least one pesticide (some of these are "legacy" or historic uses, not currently used). Most pesticide detections were below their associated MCLs or screening levels, however, additive or synergistic toxicity has not been performed, thus not incorporated into the MCLs or screening levels. The DEQ Laboratory ambient groundwater quality studies found 35 of 45 study areas show some impairment or reason for concern. More information on ambient monitoring programs can be found here:

<http://www.oregon.gov/deq/wq/programs/Pages/GWP.aspx>

The DEQ Laboratory staff also collects over 500 private domestic well water samples each year from the groundwater management areas (GWMAs) in Oregon. Over 90 wells, including many private domestic wells, are sampled on a routine basis. DEQ staff monitor wells in the Northern Malheur County, Lower Umatilla Basin and Southern Willamette Valley GWMAs several times each year to gather nitrate and other water quality information. This data provides a characterization of the aquifers supplying the domestic wells in GWMAs. *Area-wide contamination in these areas is associated with nitrates and pesticides* from nonpoint sources such as agricultural practices and rural residential septic systems (more about the GWMAs in next section).

In its 2013-2015 budget, DEQ received funding from the legislature to conduct new statewide groundwater monitoring. The Statewide Groundwater Monitoring Program began collecting water quality data in 2015 to further assess ambient groundwater conditions, identify emerging groundwater quality problems, and inform groundwater users of potential risks from contamination. To implement this work, two regional groundwater studies are conducted annually with the goal of monitoring Oregon's vulnerable aquifers over a 10-year period. Regional study areas are selected based on previously identified groundwater vulnerabilities, nitrate data collected

during real estate transactions as required by statute (ORS 448.271), time elapsed since water quality data were collected, analysis of potential contamination sources, and community interest to help with recruitment of volunteer participants. All studies include analysis of nitrate, arsenic, bacteria, pesticides, and common ions in 60 to 100 wells. Additional analyses are added based on local risk factors and program capacity.

The Statewide Groundwater Monitoring studies focus on characterizing groundwater in various regions within the state where groundwater contamination has been identified in previous studies, or where the area is considered vulnerable to contamination. DEQ identified two initial areas for sampling: the Rogue Basin in southern Oregon in spring 2015 and the Clatsop Plains area on the north coast in fall 2015. Each area in the statewide monitoring study receives a second sampling event that occurs approximately six months after the first event to help identify seasonal variation in groundwater quality.

The Mid-Rogue groundwater study area spanned Jackson and Josephine counties, including the communities of Grants Pass, Shady Cove, Central Point, Medford and Ashland. DEQ staff sampled 107 private domestic wells for nitrate, arsenic, bacteria, pesticides, metals, and common ions over two sampling events in February and October 2015. These domestic wells serve as sources of drinking water, along with other household uses such as for farm animals, outdoor garden and lawn irrigation, etc.

Key findings from the Mid-Rogue Statewide Groundwater Monitoring data include:

- 21% had **nitrate** levels above what is considered natural [3 milligrams per liter (mg/L) or higher] in the area. Where well logs were available, the data shows that elevated nitrate concentrations were found only in wells with shallow water bearing zones. Four wells had nitrate concentrations above the Safe Drinking Water Act Maximum Contaminant Level (SDWA MCL) of 10 mg/L, set by the US EPA for public water systems.
- 22% had **arsenic** detections; 6 wells had arsenic levels above the SDWA MCL of 10 micrograms per liter ($\mu\text{g/L}$); most arsenic sources are natural in Oregon.
- **Coliform bacteria** was detected in 43% of wells tested.
- 21% of the wells tested had **pesticides or pesticide breakdown products**. All pesticide detections were below their associated screening levels, however, additive or synergistic toxicity has not been performed, thus not incorporated into the MCLs or screening levels. Pesticide detections and concentrations were slightly higher in the winter than the fall. Many of these are legacy pesticides, no longer used.
- 53% of the study wells had detections of **manganese**, 15 were above the SDWA MCL, with two of the wells above the Lifetime Health Advisory level of 300 $\mu\text{g/L}$; manganese is predominantly from natural sources.

The results of each of the Statewide Groundwater Monitoring studies will be used to focus outreach and education activities that encourage private well owners to routinely test wells for nitrate, bacteria and arsenic and encourage well protection and maintenance best practices to protect the aquifer. The data will also serve to provide regional information on Oregon aquifers and ambient

groundwater conditions, and can assist public water systems by identifying regional issues that may impact public water supplies.

In a collaborative project with the Oregon Health Authority initiated in 2008, DEQ implemented a Drinking Water Source Monitoring project that conducted water quality testing for chemicals in the *source water for public water wells*. During the period of 2008 through 2014, Oregon DEQ tested the source waters prior to treatment at 48 groundwater wells. This provided a characterization of the aquifers supplying public water wells, as well as information on the influence from the drinking water source areas. The samples were analyzed at the DEQ Laboratory for over 250 Oregon-specific herbicides, insecticides, pharmaceuticals, VOCs (including cleaners), fire retardants, PAHs, personal care products, and plasticizers. The results showed very low levels of detections---- water quality impacts from various land uses and activities in typical groundwater aquifers. *Of all groundwater sources, 85% had wastewater constituents and 39% of the samples had pesticide detections.* With the exception of one detection (arsenic), the levels of all parameters detected were very low and met health standards where available on an individual basis.

As part of the Drinking Water Source Monitoring project's susceptibility analysis, DEQ also evaluated land uses/activities for source areas of each of the intakes and wells. Project staff conducted further evaluation of potential sources of contaminants on a site-by-site basis for each contaminant detected. These sources are likely from multiple land uses and activities in the watershed or source area for the wells. Since the levels were very low in this initial sampling project, OHA and DEQ will use the data analysis to determine potential associations with sources and to provide technical assistance to public water systems to reduce concentrations of source water contaminants.

Key findings of the data analysis from the Source Monitoring project:

Potential Sources of Contaminants Identified in the Drinking Water Source Monitoring Project

- **Microbes (E. coli)** are waste byproducts and are potentially from upgradient wastewater discharge, high-density onsite septic systems discharging to groundwater, heavy recreational uses, filtered surface water, and underground injection control wells.
- **Phthalates** are contaminants from plastics, perfumes, car care products, cosmetics and flooring. Phthalates in groundwater can come from wastewater discharges and onsite septic systems since the compounds are found in so many household products---for example, the breakdown of plastics or flooring materials. Phthalates can also come from submersible pumps, wiring, and electrical tape used in well equipment materials.
- **Pesticides** can enter groundwater from agricultural fields, forests, urban lawns, gardens, and roadside spraying. Results from this drinking water source monitoring suggest the primary sources are irrigated crops, orchards, and high-density housing. Household lawn applications of pesticides can contribute urban use pesticides to local groundwater resources (and can occur at higher concentrations in those areas).
- **Pharmaceuticals** are commonly detected in groundwater that is surrounded by high-density housing using onsite wastewater disposal. It is well documented that drugs are primarily found in human urine and can also come from improper disposal of unused drugs in toilets. Some antibiotics can come from livestock wastes.

- **Steroids and hormones** are very likely linked to human waste byproducts in wastewater released through onsite septic systems into groundwater. The most common marker of these byproducts is coprostanol, found in human feces. Some hormones can also come from livestock wastes.
- **Metals** are very common in Oregon’s groundwater resources from natural geologic formations, but are also found in stormwater runoff/infiltration from urban areas and agricultural fertilizer applications. Arsenic is commonly found in Oregon groundwater, especially in areas of volcanic rocks.

Many of the low-level detections from the Drinking Water Source Monitoring are chemicals in drinking water sources that are not currently regulated. Many volatile organic compounds are regulated, so this is an example of chemicals not tested in this project. Sampling and analyzing for low levels of a broad range of chemicals in waters of the state is important for several reasons:

- the detections become important priorities for prevention because we lack health standards for many of them,
- the detections are priorities for prevention because many of the pollutants cannot be removed through standard treatment technologies (Glassmeyer et al 2017)
- additive or synergistic toxicity has not been included in developing MCLs or screening levels for chemicals that are present in finished drinking water,
- the data is used to prioritize future water quality monitoring,
- the detections provide DEQ and others the ability to prioritize pollutant reduction efforts on activities and land uses that potentially impact groundwater.

Based on the sets of data presented in this section, DEQ will provide general groundwater quality protection recommendations for all potential contaminants, but will *focus the more detailed recommendations and prevention tools in this Groundwater Resource Guide on nitrates and pesticides.*

In Oregon, most groundwater systems do not have any treatment, and those that do have some type of treatment utilize chlorine as treatment. Chlorine is not considered an effective treatment for pesticides or nitrates. This places even more emphasis in reducing or preventing pollutants in source waters.

Nitrate Data and Susceptibility

Nitrogen is considered a macro-nutrient and one of the most important nutrients necessary to support plant growth and the food system we depend on. Nearly 80% of all nitrogen is contained in the earth’s atmosphere and therefore it surrounds us wherever we go. Despite the abundance of nitrogen in the air, only a comparatively small portion of nitrogen—fixed nitrogen—is biologically available to plants, and thereby to human beings. Nitrogen is made available to agricultural crops through the form of ammonium nitrogen (NH_4^+) or nitrate nitrogen (NO_3^-). Ammonium is positively charged and binds well to negatively charged soils and organic matter. Nitrate binds poorly to most soils and therefore is more susceptible to leach below the root zone and on into aquifers.

Alternatively, nitrate can be mobilized as runoff during peak rain events and consequently pollute our lakes and rivers.

It is important to note that in addition to the unintended off-site movement of nitrogen through fertilizer application, septic system effluent and animal wastes are also significant sources of excess nitrogen in the natural environment. Considerable advancements in agricultural conservation practices such as precision agriculture have demonstrated the potential to reduce off-target movement of fertilizers and pesticides.

Nitrate levels of up to three parts per million in well water may be naturally occurring or possibly indicate some low level of contamination, but are considered to be safe for consumption. EPA has set a maximum contaminant level of 10 ppm for nitrate (NO₃-N) for drinking water. Nitrate levels above 10 ppm may present a serious health concern for infants and pregnant or nursing women. Adults receive more nitrate exposure from food than from water. Infants, however, receive the greatest exposure from drinking water because most of their food is in liquid form. This is especially true for bottle-fed infants whose formula is reconstituted with drinking water with high nitrate concentrations. Nitrate can interfere with the ability of the blood to carry oxygen to vital tissues of the body in infants of six months old or younger. The resulting illness is called methemoglobinemia, or "blue baby syndrome". Little is known about the long-term effects of drinking water with elevated nitrate levels. Some research has suggested that nitrate may play a role in spontaneous miscarriages, thyroid disorders, birth defects, and in the development of some cancers in adults (Ward et al 2005). Recent human epidemiologic studies have shown that nitrate ingestion may also be linked to gastric or bladder cancer (USDHHS 2010).

For more information on nitrate in drinking water, see the DEQ Nitrate Fact Sheet:

<http://www.deq.state.or.us/wq/pubs/factsheets/groundwater/nitratedw.pdf>

While every community should ensure they reduce nitrate contamination of drinking water, small and rural communities may need to pay heightened attention due to the higher prevalence of agricultural activities and associated fertilizer applications, septic systems, and animal wastes. Nitrate that leaches into groundwater can sometimes discharge into streams and rivers, thereby causing elevated nitrate levels in surface waters. There are several sectors of development that contribute to the transport of nitrate to groundwater. These sectors include agriculture (e.g. fertilizer application, fertilizer manufacturing, composting operations, animal waste from livestock, nitrogen fixing crops), residential (e.g. septic systems, lawn and garden fertilizer, stormwater), and also some industrial sources. By applying nitrogen fertilizers, burning fossil fuels, and replacing natural vegetation with nitrogen-fixing crops, humans have doubled the rate of nitrogen deposition onto and into the land over the past 50 years (Vitousek et al 1997).

The Domestic Well Water Testing and the Real Estate Transaction (RET) program requires sellers of a property in Oregon with a domestic private well to have the water tested for arsenic, nitrate and total coliform bacteria. Laboratory results must be sent to the buyer of the property and OHA. The nitrate data has a statewide distribution, so the data serves as an important characterization of the groundwater quality in rural areas. For more information on the program and the data generated by

the program, see OHA's website:

<http://public.health.oregon.gov/HealthyEnvironments/DrinkingWater/SourceWater/DomesticWellsafety/Pages/Testing-Regulations.aspx>

Water samples collected from both private and public wells in Oregon over the past twenty years show that nitrate levels in some wells may approach or even exceed the level considered safe for drinking water. US Geological Survey studies indicate that about 20 percent of the wells in agricultural areas of the U.S. exceed the Safe Drinking Water MCL set by the US EPA of 10 mg/L. The state of Oregon has not set aside resources to determine the extent of groundwater nitrate levels throughout the state. Based on limited monitoring, Oregon has designated three Groundwater Management Areas (GWMA) because of elevated nitrate concentrations in groundwater. These include the Lower Umatilla Basin GWMA, the Northern Malheur County GWMA, and the Southern Willamette Valley GWMA. Each one has developed a voluntary action plan to reduce nitrate concentrations in groundwater (see Section 7.0).

Figure 3 illustrates a compilation of Oregon nitrate data showing potential areas of groundwater quality concern for nitrates. This figure includes data from public water systems (SDWIS), the Real Estate Transaction (RET) data, and DEQ Laboratory's LASAR database. For public water systems, DEQ consulted a variety of sources of information and technical data to find tools that identify areas that may be susceptible to nitrate infiltration into groundwater. Determining the relative susceptibility to nitrates within a drinking water source area will allow a public water system to focus technical assistance and resources on the highest priority sections of the drinking water source area.

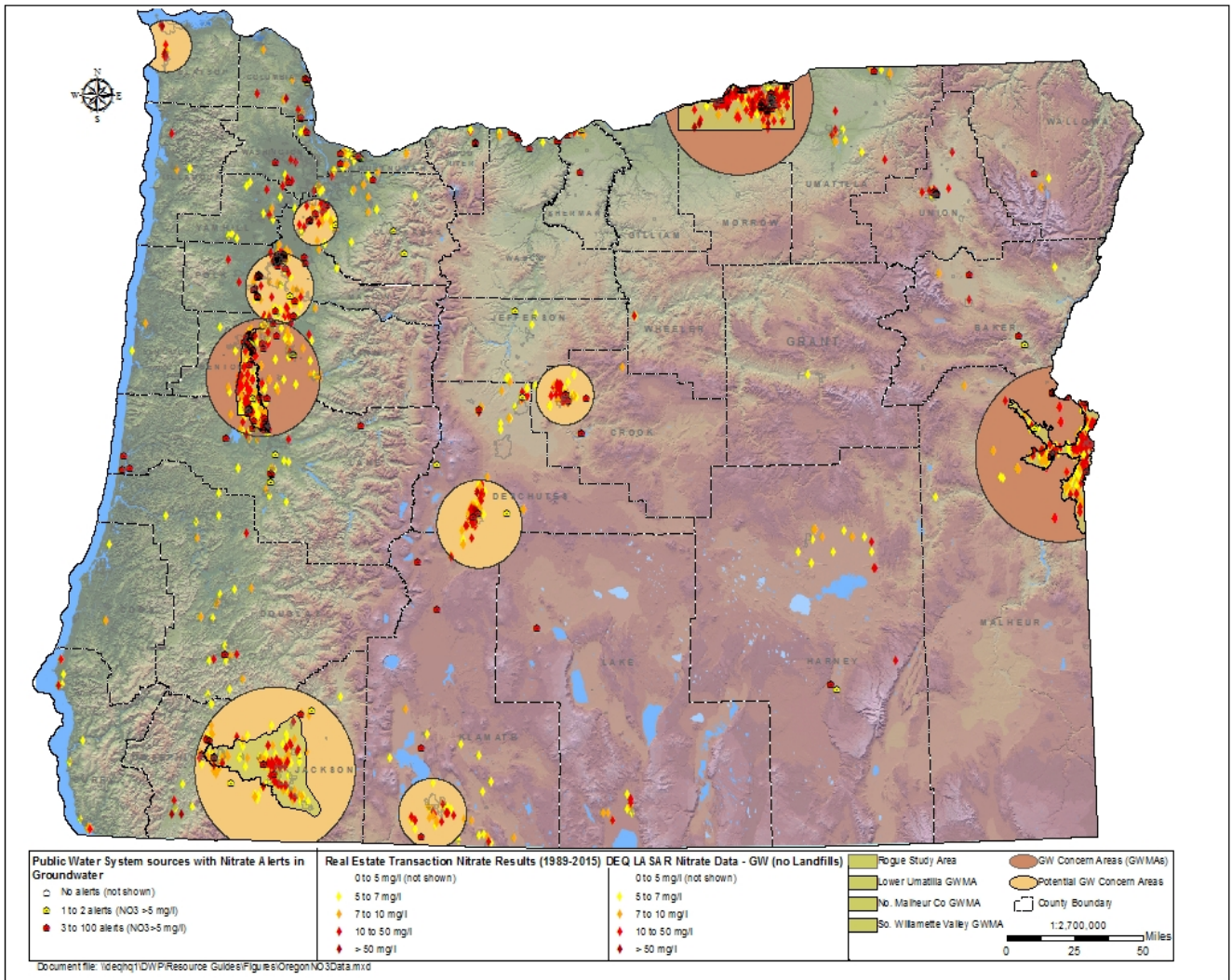


Figure 3. Compilation of Oregon Data for Nitrates in Groundwater

Two sources of data were selected to be highlighted in this guide for predicting relative susceptibilities to nitrate---- US Geological Survey (USGS) and the USDA National Soil Information System (USDA-NASIS). **Figures 4 and 5** illustrate the statewide data for each of these tools that can be used for predicting nitrate susceptibilities to groundwater.

The USGS Groundwater Resources Program provides scientific information to identify, assess, and quantify groundwater resources. Information on groundwater levels, aquifers, water use, and water quality are used to develop tools for local and regional groundwater assessments. The Groundwater Vulnerability Assessment for Shallow (GWAVA-S) aquifers was developed by USGS using shallow groundwater nitrate data. Additional model input components include nitrogen (N) sources, transport, and attenuation. The average depth of sampling results used to assess the correctness of these results is 9.8 meters (32.1ft). The mapped values are a prediction of nitrate levels and the results from this model were compared to field sampling results for accuracy. **Figure 4** illustrates the

predicted values in Oregon. The values are not a measurement of actual conditions, but a predicted value based on existing data and conditions. For a full discussion of methods and limitations, see References, Section 8 (Nolan et al 2006).

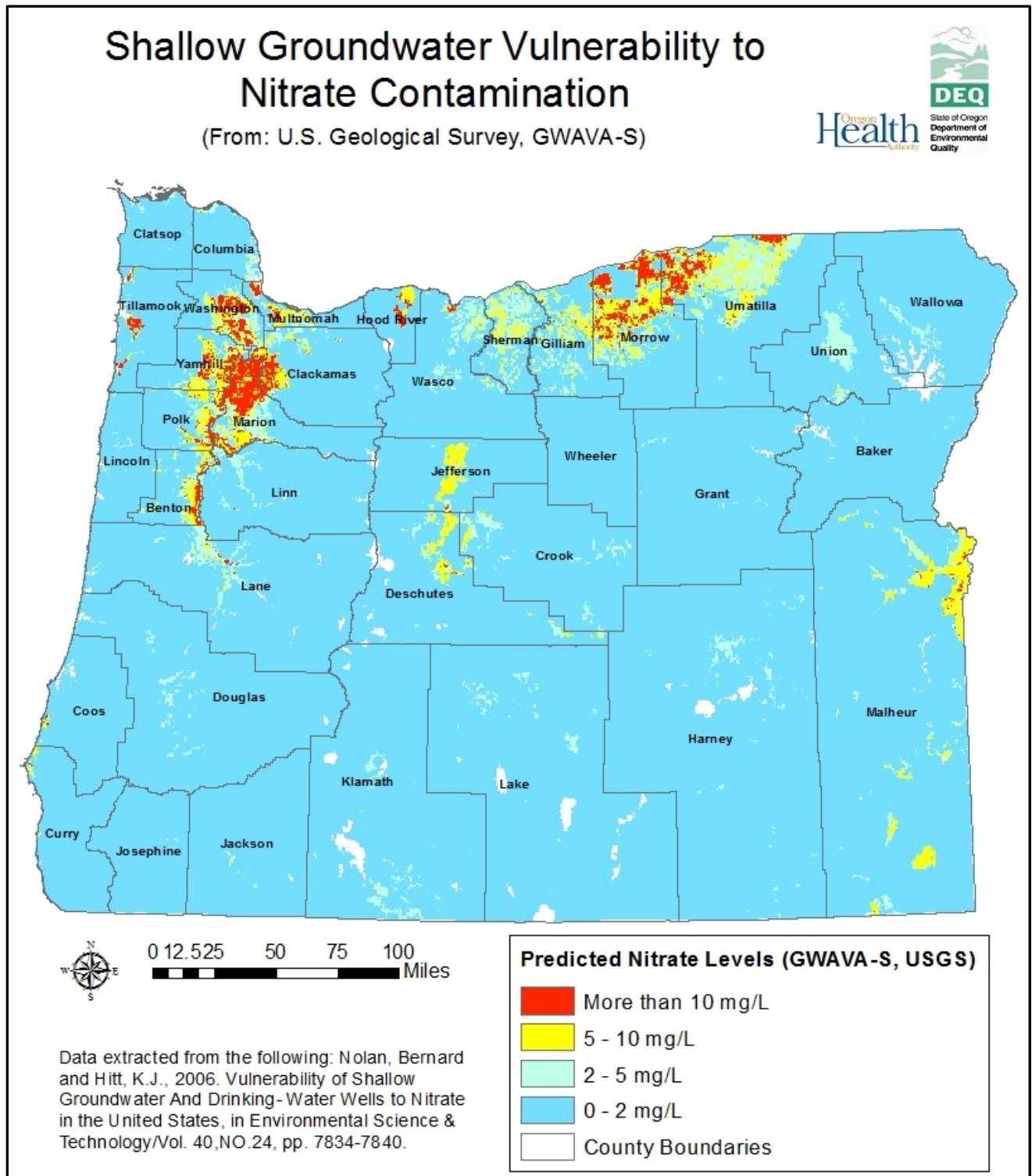


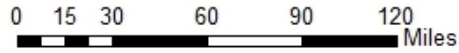
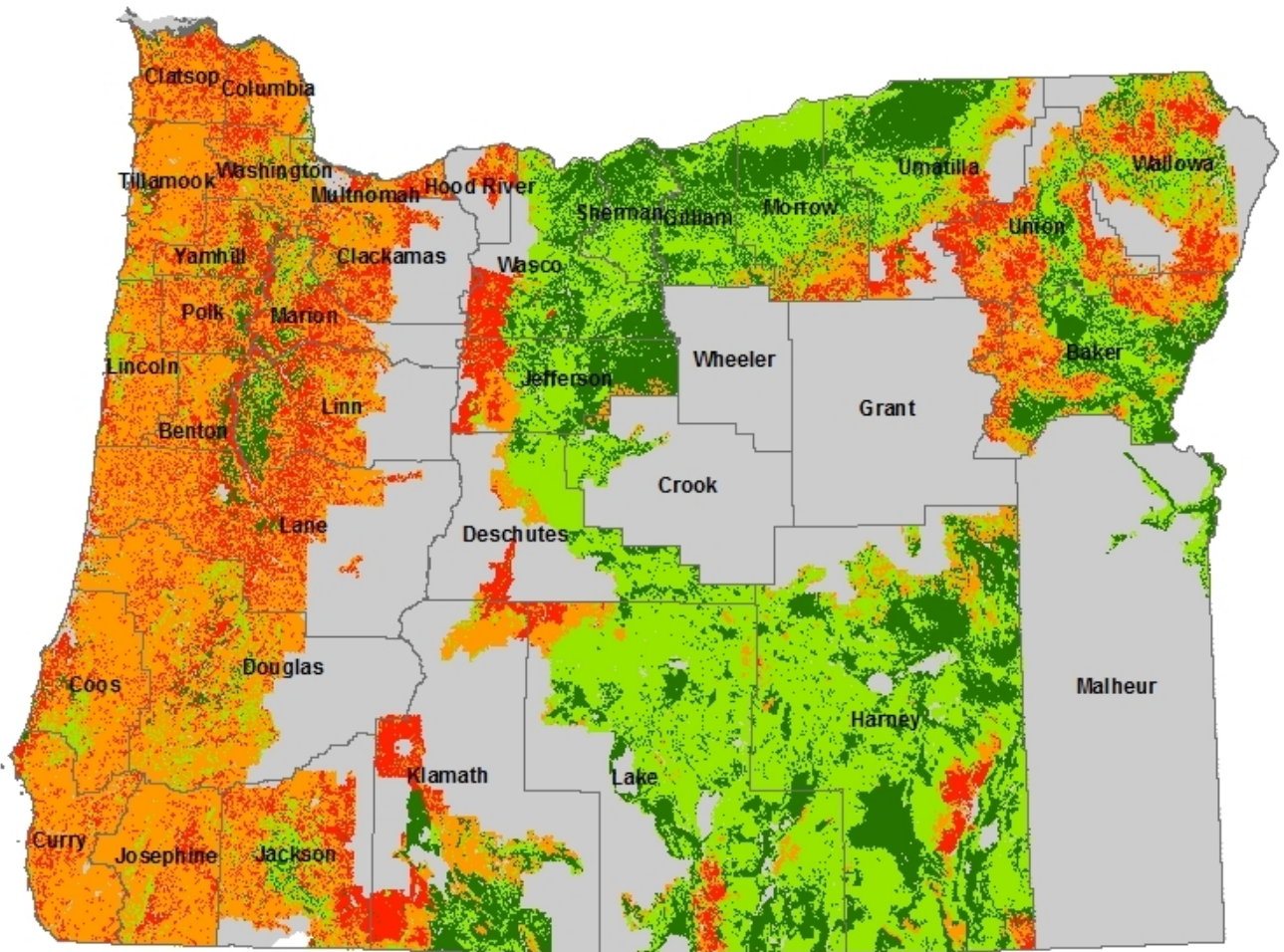
Figure 4. Statewide Predicted Groundwater Vulnerability to Nitrate Contamination

The USDA Natural Resources Conservation Service (NRCS) provides soil data and information produced by the National Cooperative Soil Survey. NRCS's "Web Soil Survey" provides access to the largest natural resource information system in the world. NRCS has soil maps and data available online for more than 95 percent of the nation's counties and anticipates having 100 percent in the near future. The site is updated and maintained online as the single authoritative source of soil survey information. Soil surveys can be used for local (ex: family farm) or regional (ex: drinking water source area) planning. Onsite investigation is needed in some cases, such as soil quality assessments and certain conservation and engineering applications.

The Web Soil Survey data was used to produce the map shown in **Figure 5**. The data used to produce this map is an evaluation of the potential for soils to allow nitrate-nitrogen to be transmitted below the root zone by percolating water under non-irrigated conditions. The nitrogen leaching potential ratings are based upon inherent soil and climate properties and do not account for management practices such as nitrogen fertilizer application rates and timing, or crop selection/rotation.

Nitrate Leaching Potential - Nonirrigated

(From: USDA-NRCS, gSSURGO Database)



10 Meter Resolution

Reference: Soil Survey Staff. Gridded Soil Survey Geographic (gSSURGO) Database for Oregon. United States Department of Agriculture, Natural Resources Conservation Service. Available online at <https://gdg.sc.egov.usda.gov/>. June 24, 2016 (FY 2016 official release).

Nitrate Leaching Potential Rating

- Not rated or not available
- Low
- Moderate
- Moderately high
- High
- County Boundaries

Figure 5. Statewide Nitrate Leaching Potential – Non-irrigated

The map shown in Figure 5 is an overview of statewide soil nitrate leaching potential. For site-specific work, such as for a drinking water source area, an “Area of Interest” (AOI) can be set, and then printed or downloaded for a localized map from the USDA Web Soil Survey website. The instructions to produce a site-specific area of interest for nitrogen leaching potential is provided in Section 5.0.

Nitrate pollutants can come from a number of potential sources. The development and implementation of strategic actions to reduce nitrate pollution will likely require research and mapping of the site-specific susceptibility within each drinking water source area.

When using these site-specific soil maps, it is important to keep in mind that interpretations and planning of conservation practices based upon these maps should be done through the involvement of a partner organization that specializes in natural resource conservation. The organizations that can most likely assist with creating and using site-specific nitrate susceptibility maps include the local Soil and Water Conservation Districts, Watershed Councils, NRCS district, the OSU Extension Service, or others. For a list of local county-level resources, see Partner Organizations in Section 3.0.

Pesticide Data and Susceptibility

Pesticide contamination of groundwater is a subject of national importance because groundwater is used for drinking water by about 50 percent of the U.S. population. This especially concerns people living in the agricultural areas where pesticides are most often used, as about 95 percent of that population relies upon groundwater for drinking water. Before the mid-1970s, it was thought that soil acted as a protective filter that stopped pesticides from reaching groundwater. Studies have now shown that this is not the case. Pesticides can reach aquifers below ground from applications to crops, seepage of contaminated surface water, accidental spills and leaks, improper disposal, and even through injection of waste material into wells. The National Water-Quality Assessment (NAWQA) Program of the US Geological Survey provides the most comprehensive national-scale analysis to date of pesticide occurrence and concentrations in streams and ground water:

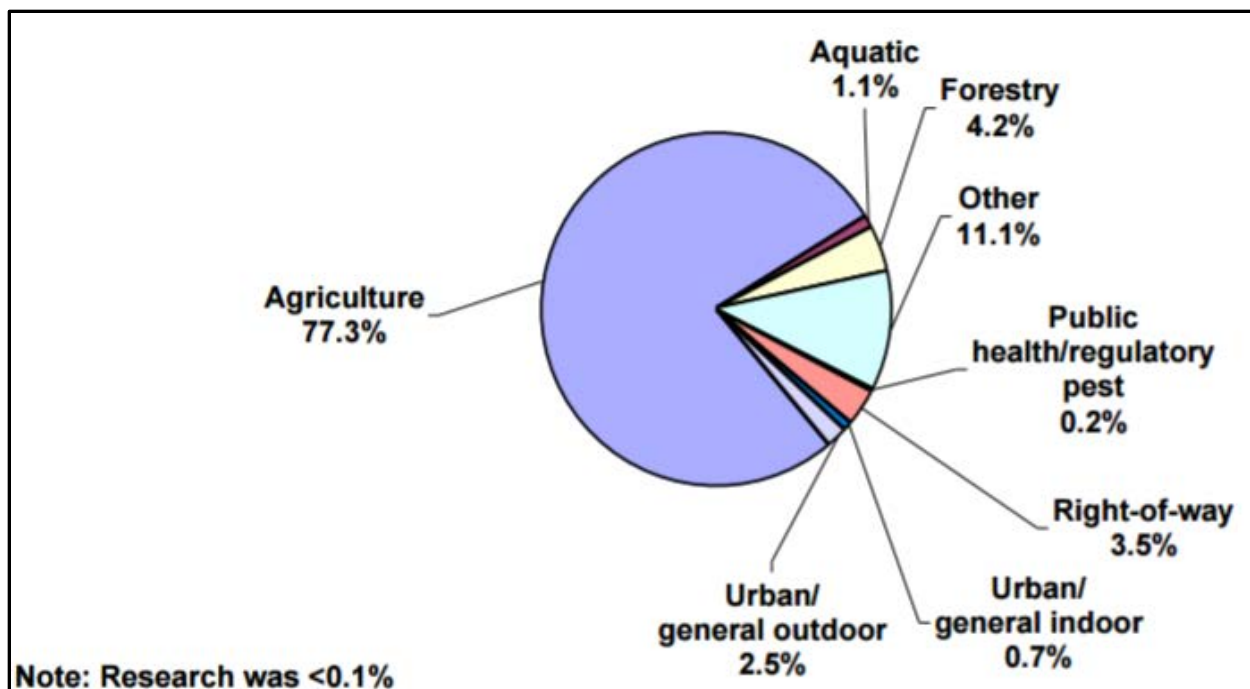
<https://pubs.usgs.gov/fs/2006/3028/>

In Oregon and Washington, while pesticide detections do occur, most detections are either localized or at levels far below any regulatory or screening levels. In USGS testing at the national scale, fewer than two percent of the wells focused on agricultural areas had concentrations that exceeded MCLs. Although this suggests that the problem is small at the national scale, our current ability to assess the significance of pesticides in ground water is limited by several factors. USGS points out that, first, MCLs or other water-quality criteria have not been established for many pesticides and for most transformation products, and existing criteria may be revised as more is learned about the toxicity of these compounds. Second, MCLs and other criteria are currently based on individual pesticides and do not account for possible cumulative effects if several different pesticides are present in the same well. Finally, many pesticides and most transformation products have not been widely sampled for in ground water and very little sampling has been done in urban and suburban areas, where pesticide use is often high.

Only a limited number of pesticides have a Safe Drinking Water Act “maximum contaminant level (MCL)” for drinking water set by the U.S. EPA. Additive or synergistic toxicity has not been included in the development of these drinking water standards. There are currently a number of studies examining whether (or how) low levels of chemical mixtures in the environment may be combining to contribute to environmental carcinogenesis; that is, the cumulative effects of individual chemicals may act on cancer pathways to synergistically produce carcinogenic effects at low exposure levels (Goodson et al 2015; Alavanja et al 2005). This is the basis for why environmental health professionals tend to be cautious about the presence of pesticides in drinking water.

The use of pesticides is prevalent in agricultural activities but also exists in municipalities, rural and urban properties, transportation right-of-ways, parks, forestlands, powerline corridors, golf courses, and others. Pesticides can sometimes be transported by water and air from the area of application to off-site locations, where they may impact beneficial uses such as drinking water.

The Oregon Department of Agriculture (ODA) has an extensive program that works to prevent off-site movement of pesticides applied to agricultural operations (see Section 6.0 below). Oregon is the national agricultural leader in the production of hazelnuts, blackberries, Christmas trees, peppermint, orchard grass seed, and other seeds. Oregon exports \$2.6 billion in raw agriculture products internationally (USDA Economic Research Service- 2013 data). Oregon’s success as a leading agricultural producer is partly due to the use of modern chemicals (pesticides) to control the insects, weeds, and other organisms that attack food crops. Of the multiple land uses/activities that use pesticides in Oregon, agriculture ranks at the top of all of those for pesticide use. **Figure 6** provides the most recent pesticide use reporting data for Oregon by land use/activity. While these data are almost ten years old, we would expect that the breakdown would be similar today if the data were collected and made available.



Source: Pesticide Use Reporting System: 2008 Annual Report. Oregon Department of Agriculture. June 2009. (<http://www.oregon.gov/ODA/programs/Pesticides/Pages/AboutPesticides.aspx>, December 2016)

Figure 6. Percentage of Pesticide Active Ingredient by Land Use/Activity in Oregon

The effects of past and present land-use practices and pesticide applications may take decades to become apparent in groundwater. When weighing pollutant reduction strategies for protection of groundwater quality, it is important to consider the time lag between application of pesticides (and any other chemicals) to the land and arrival of the chemicals at a well. This time lag generally decreases with increasing aquifer permeability and with decreasing depth to water. In response to reductions in chemical applications to the land, the quality of shallow groundwater will improve before the quality of deep groundwater, which could take decades.

Natural land conditions and land-management practices can affect pesticide distribution, particularly in groundwater. Pesticide concentrations in surface water also vary by season, with lengthy periods of low concentrations punctuated by seasonal pulses of much higher concentrations. Groundwater is most vulnerable to contamination in areas with highly permeable soil and aquifer materials. The entire hydrologic system and its complexities need to be considered in evaluating the potential for pesticide contamination of groundwater. In addition, seasonal patterns in pesticide concentrations are important to consider in managing the quality of drinking water withdrawn from groundwater in agricultural and urban settings.

Understanding the correlations of pesticide occurrence with the amounts and characteristics of pesticides used can help land managers to anticipate and prioritize the pesticides most likely to affect water quality in different land-use settings. **Table 1** lists some of the pesticide transport

factors and groundwater vulnerability factors that make portions of the drinking water source area susceptible to pesticide impacts.

| Pesticide Transport Factors | | | | | Groundwater Vulnerability Factors | |
|---|--|---------------------------|---------------------------------------|--|-----------------------------------|--|
| Pesticide Parameters | Soil Parameters | Crop Parameters | Climatological Parameters | Management Parameters | Hydrogeologic Framework | Groundwater Flow System |
| Organic carbon-normalized sorption coefficient (K_{oc}) | Dispersion coefficient | Root density distribution | Rainfall or irrigation rates | Pesticide application rate and timing | Unsaturated Zone | Recharge Rate |
| Distribution coefficient (K_d) | Saturated water content | Maximum rooting depth | Pan evaporation rates | Pesticide application method and formulation | Confining Unit | Location within flow system (proximity to recharge area) |
| Aqueous solubility | Field-capacity water content (θ_{fc}) | Pesticide uptake rates | Daily maximum and minimum temperature | Crop production-system variables | Aquifer Properties | |
| Henry's constant | Wilting-point water content | | Snow melt | Soil-management variables | | |
| Saturated vapor density | Hydraulic properties | | Hours of sunlight | | | |
| Gas phase diffusion coefficient | Bulk density (ρ_b) | | | | | |
| Biological half-life | Organic carbon content (f_{oc}) | | | | | |
| Hydrolysis half-life | pH | | | | | |
| Oxidation half-life | Cation exchange capacity | | | | | |
| Foliar decay rate | Heat flow parameters | | | | | |

Source: Adapted from the US National Research Council - Committee on Techniques for Assessing Ground Water Vulnerability. (USNRC 1993).

Table 1. Factors Influencing Pesticide Transport and Groundwater Vulnerability

Section 5.0 will provide several tools that may be useful for reducing off-site migration of pesticides, with the goal of reducing any potential impact to drinking water supply wells.

More information on the drinking water standards/benchmarks, and how Oregon regulates pesticides can be found in Section 6.0 under Pesticide Regulations.

3.0 PARTNERS, RESOURCES, AND FUNDS

Communities of sufficient size, resources, and other means may be able to develop drinking water source protection plans for their groundwater resources without the use of the tools provided in this Resource Guide. Many communities that fit this description have already taken steps to develop and utilize screening tools, resources, and strategies for reducing potential risks to their drinking water. For smaller communities, partner organizations may be able to assist with drinking water protection efforts that cannot be performed with existing staff and resources.

The tools provided in this Resource Guide are intended to be used by public water system staff/managers (where possible), and community leaders with assistance received from their regional or county partner organization. A partner organization for community-led drinking water protection efforts can be the local Soil and Water Conservation District (SWCD), Watershed Council, the University Extension Service staff (OSU), the US Department of Agriculture -Natural Resources Conservation Service district, and/or possibly a contracted natural resources consultant. *Early involvement of a partner organization is critical in order to ensure that screening tools are accessible, used properly, and are effective.* Developing a strategic protection plan may require grant writing and additional funding when significant collaboration work is necessary.

This section provides brief descriptions and contact information for resources available to public water systems---including county contacts, more information on agency programs, grants, and loans to fund drinking water infrastructure and source protection projects.

TECHNICAL ASSISTANCE - PARTNER ORGANIZATIONS BY COUNTY

| Baker County | | | |
|---|---|--|--|
| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
| 3990 Midway Lane Baker City, OR 97814-1453 (541) 523-4430 | 3990 Midway Lane Baker City, OR 97814-1453 (541) 523-7121 | 2600 East Street Baker City, OR 97814 (541) 523-6418 | 2960 Broadway St Baker City, OR 97814 (541) 523-7288 |

| Benton County | | | |
|---|--|---|---|
| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
| 456 SW Monroe Avenue, Suite 110 Corvallis, OR 97333-4400 (541) 753-7208 | 3415 NE Granger Avenue Corvallis, OR 97330-9620 (541) 757-4825 | 4077 SW Research Way Corvallis, OR 97333 541-766-6750 | 101 SW Western Blvd #105 Corvallis, OR 97339 (541) 758-7597 |

Clackamas County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|--|--|--|---|
| 221 Molalla Avenue Street, Suite 102 OR City, OR 97045 (503) 210-6000 | 221 Molalla Avenue Street, Suite 120 OR City, OR 97045 (503) 655-3144 | 200 Warner Milne Rd OR City, OR 97045 503-655-8631 | PO Box 927 OR City, OR 97045 (503) 427-0439 |

Clatsop County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|--|---|--|--|
| 750 Commercial Street Room 207 Astoria, OR 97103 (503) 325-4571 | 750 Commercial Street, Room 207 Astoria, OR 97103 (503) 325-4571 | 2001 Marine Drive, Room 210 Astoria, OR 97103 (503) 325-8573 | 42 7th Street, Suite 102 C Astoria, OR 97103 503-468-0408 |

Columbia County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|--|--|---|---|
| 35285 Millard Road St. Helens, OR 97051 (503) 397-4555 | 35285 Millard Road St. Helens, OR 97051 (503) 397-4555 | 505 N. Columbia River Hwy St. Helens, OR 97051 503-397-3462 | 57420-2 Old Portland Rd Warren, OR 97053 503-397-7904 |

Coos County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|--|--|---|---|
| 382 North Central Coquille, OR 97423-1296 (541) 396-6879 | 382 North Central Coquille, OR 97423-1296 (541) 396-2841 | 631 Alder St. Myrtle Point, OR 97458 541-572-5263 | 223 N. Alder, Suite D Coquille, OR 97423 (541) 572-2541 |

Crook County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|--|--|--|--|
| 498 S.E. Lynn Blvd Prineville, OR 97754 (541) 447-3548 | 498 S.E. Lynn Blvd Prineville, OR 97754 (541) 447-3548 | 498 S.E. Lynn Blvd Prineville, OR 97754 (541) 447-6228 | 498 S.E. Lynn Blvd Prineville, OR 97754 541-447-8567 |

Curry County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|--|-------------|--|--|
| P.O. Box 666 Gold Beach, OR 97444 (541) 247-2755 | See SWCD | 29390 Ellensburg Ave Gold Beach, Or 97444 541-247-6672 | P.O. Box 666 Gold Beach, OR 97444 (541) 247-2755 |

Deschutes County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|---|--|---|---|
| 625 SE Salmon Avenue, Suite 4 Redmond, OR 97756-9580 (541) 923-2204 | 625 SE Salmon Avenue, Suite 4 Redmond, OR 97756-9580 (541) 923-4358 | 3893 SW Airport Way Redmond, OR 97756-8697 541-548-6088 | 700 NW Hill St #1 Bend, OR 97701 (541) 382-6102 |

Douglas County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|---|--|--|--|
| 2741 West Harvard Ave Roseburg, OR 97471 (541) 957-5061 | 2593 NW Kline Street Roseburg, OR 97471 (541) 673-6071 | 1134 SE Douglas Ave. Roseburg, OR 97470 541-672-4461 | P.O. Box 101 Roseburg, OR 97470 (541) 672-7065 |

Gilliam County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|---|--|--|--|
| 333 S. Main Street Condon, OR 97823-0106 (541) 384-2281 | 333 Main, Dunn Brothers Building Condon, OR 97823-0106 (541) 384-2671 | 135 S. Main Street, Suite 219 Condon, OR 97823-0707 541-384-2271 | 333 S. Main St. Condon OR 97823 (541) 384-2281 x 111 |

Grant County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|--|--|--|--|
| 721 S Canyon Blvd John Day, OR 97845-1084 (541) 575-0135 | 721 S Canyon Blvd John Day, OR 97845-1084 (541) 575-0135 | 530 E. Main Street Ste. 10 John Day, OR 97845 (541) 575-2248 | P.O. Box 522 Mt. Vernon, OR 97865 541-792-0435 |

Harney County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|---|---|---|---|
| 530 Hwy 20 South Hines OR 97738-0848 (541) 573-5010 | 530 Hwy 20 South Hines OR 97738-0848 (541) 573-6446 | 450 N. Buena Vista #10 Burns, OR 97720 (541) 573-2506 | 450 N Buena Vista Ave # 4 Burns, OR 97720 (541) 573-8199 |

Hood River County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|---|--|---|--|
| 3007 Experiment Station Drive Hood River, OR 97031 (541) 386-4588 | 6780 Hwy 35 Mt Hood, OR 97041 541-352-1037 | 2990 Experiment Station Drive Hood River, OR 97031 541-386-3343 | 3007 Experiment Station Rd Hood River OR 97031 (541) 386-4588 |

Jefferson County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|---|---|--|---|
| 625 SE Salmon Avenue, Suite 6 Redmond, OR 97756-8696 (541) 923-4358 ext 101 | 4223 Holiday Street Warm Springs, OR 97761 (541) 553-2009 | 850 NW Dogwood Lane Madras OR, 97741-8988 (541) 475-7107 | 625 SE Salmon Ave #6 Redmond OR 97756 (541) 923-4358 x139 |

Josephine County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|---|--|---|---|
| 1440 Parkdale Drive Grants Pass OR 97527 (541) 474-6840 | 1590 SE N Street, Suite C Grants Pass, OR 97526 (541) 450-9724 | 215 Ringuette St Grants Pass, OR 97527 541-476-6613 | P.O Box 1214 Medford, OR 97501 541-414-9064 |

Lake County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|--|--|---|---|
| 17612 Hwy. 395 Lakeview, OR 97630 (541) 947-5855 | 17612 Hwy. 395 Lakeview, OR 97630 (541) 947-2367 | 103 South E Street Lakeview OR 97630 541-947-6054 | 17482 Tunnel Hill Rd Lakeview OR 97630 (541) 219-0830 |

Lane County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|---|---|--|--|
| 780 Bailey Hill Road, Suite 5 Eugene, OR 97402 (541) 465-6443 | 780 Bailey Hill Road, Suite 5 Eugene, OR 97402 (541) 465-6443 | 996 Jefferson Street Eugene, OR 97402 541-344-5859 | 751 S. Danebo Ave. Eugene, OR 97402 541-338-7055 |

Lincoln County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|---|---|--|--|
| 23 North Coast Highway Newport, OR 97365 (541) 265-2631 | 23 North Coast Highway Newport, OR 97365 (541) 265-2631 | 1211 SE Bay Blvd Newport OR 97365 541-574-6534 | 23 N Coast Hwy Newport OR 97365 (541) 265-9195 |

Linn County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|--|---|---|--|
| 33630 McFarland Road Tangent, OR 97389-9708 (541) 926-2483 | 31978 N. Lake Creek Drive Tangent, OR 97389-9708 (541) 967-5925 | 33630 McFarland Rd Tangent, OR 97389 541-967-3871 | PO Box 844 Brownsville OR 97327 (541) 466-3493 |

Malheur County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|---|---|---|--|
| 2925 SW 6th Avenue, Suite 2 Ontario, OR 97914-2446 (541) 889-2588 | 2925 SW 6th Avenue, Suite 2 Ontario, OR 97914-2446 (541) 889-9689 | 710 SW 5th Ave Ontario, OR 97914 541-881-1417 | 710 SW 5th Ave Ontario OR 97914 (541) 881-1417 x 105 |

Marion County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|---|---|--|--|
| 650 Hawthorne Avenue SE, Ste 130 Salem, OR 97301 (503) 391-9927 | 650 Hawthorne Ave. SE, Suite 130 Salem, OR 97301 (503) 399-5741 | 1320 Capitol St NE, Suite 110 Salem, OR 97301 503-588-5301 | 4780 Brush College Rd NW Salem OR 97304 (503) 371-6552 |

Morrow County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|---|---|---|--|
| 430 Heppner/Lexington Hwy Heppner, OR 97836-0127 (541) 676-5452 | 430 Heppner/Lexington Hwy Heppner, OR 97836-0127 (541) 676-5021 | 54173 Hwy 74 Heppner, OR 97836 541.676.9642 | 920 SW Frazer Ave # 210 Pendleton, OR 97801 (541) 276-2190 |

Polk County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|--|--|--|---|
| 580 Main, Suite A Dallas, OR 97338-1911 (855) 651-8930 | 580 Main, Suite A Dallas, OR 97338-1911 (855) 651-8930 | 289 E Ellendale, Suite 301 Dallas, OR 97338 503-623-8395 | 580 Main St #A Dallas OR 97338 (503) 623-9680 |

Sherman County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|---|---|---|--|
| P.O. Box 405 Moro, OR 97039-0405 (541) 565-3551 | P.O. Box 405 Moro, OR 97039-0405 (541) 565-3551 | 66365 Lonerock Road Moro 97039 541-565-3230 | PO Box 405, 302 Scott Street Moro, OR 97039 541-565-3216 X 109 |

Tillamook County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|---|--|--|--|
| 4000 Blimp Blvd. Suite 200 Tillamook, OR 97141 (503) 842-2848 Ext 4 | 4000 Blimp Blvd. Suite 200 Tillamook, OR 97141 (503) 842-2848, Ext 3 | 2204 4th Street Tillamook, OR 97141 503-842-3433 | 4000 Blimp Blvd #440 Tillamook OR 97141 (503) 322-0002 |

Umatilla County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|---|--|---|--|
| 1 SW Nye Ave Pendleton, OR 97801 (541) 278-8049 ext 134 | 1 SW Nye Ave. Suite 130 Pendleton, OR 97801 (541) 278-8049 | PO Box 100 Pendleton, OR 97801 541-278-5403 | 920 SW Frazier Ave., Suite 210 Pendleton OR 97801 (541) 276-2190 |

Union County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|---|---|---|---|
| 10507 N. McAlister Road, Room 7 La Grande, OR 97850-8705 (541) 963-1313 | 1901 Adams Avenue, Suite 6 La Grande, OR 97850 (541) 963-4178 | 10507 N McAlister Rd, Room 9 La Grande, OR 97850 (541) 963-1010 | 1114 J Ave La Grande, OR 97850 (541) 663-0570 |

Wallowa County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|---|---|---|---|
| 401 NE First St., Suite E Enterprise, OR 97828 (541) 426-4521 | 401 NE First St., Suite E Enterprise, OR 97828 (541) 426-4521 | 668 NW 1st Enterprise OR 97828 541-426-3143 | 1114 J Ave La Grande, OR 97850 (541) 663-0570 |

Wasco County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|---|---|--|---|
| 2325 River Road, #3 The Dalles, OR 97058 (541) 298-8559 | 2325 River Road, #3 The Dalles, OR 97058 (541) 298-8559 | 400 E Scenic Dr. The Dalles, OR 97058 (541) 296-5494 | 2325 River Road, Suite 3 The Dalles, OR 97058 (541) 296 - 6178 x102 |

Washington County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|---|---|---|--|
| 1080 SW Baseline, Suite B-2 Hillsboro, OR 97123-3823 (503) 681-0953 | 1080 SW Baseline, Suite B-2 Hillsboro, OR 97123-3823 (503) 648-3174 | 1815 NW 169th Place, Bdlg 1, Ste 1000 Beaverton, OR 97006 503-821-1150 | P.O. Box 338 Hillsboro, OR 97123- 0338 (503) 846-4810 |

Wheeler County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|--|----------|--|---|
| 40535 Highway 19 Fossil, OR 97830 (541) 468-2990 | See SWCD | 401 4th St Fossil OR 97830-0407 541-763-4115 | 40535 HWY 19 Fossil OR 97830 (541) 468-2990 |

Yamhill County

| SWCD | NRCS | OSU Extension | Watershed Council, 1+ |
|--|--|---|--|
| 2200 SW 2nd Street McMinnville, OR 97128-9185 (503) 472-1474 | 2200 SW 2nd Street McMinnville, OR 97128- 9185 (503) 472-1474 | 2050 NE Lafayette Avenue McMinnville, OR 97128 503-434-7517 | NE Ford Street, Suite 9 McMinnville, OR 97128 503 474-1047 |

Note: The watershed council that is listed is only one of the watershed councils within your service area. The contact information listed is the council that is located closest to the other partner organizations within the county. Upon contacting the partner organization listed, you may be redirected to the more appropriate partner organization.

RESOURCES AND FUNDS

PLEASE NOTE: The Internet URL Addresses listed in this section were included as a convenience for the users of this document. All URL Addresses were functional at the time this publication was last updated (July 2017), but many URLs are changing for state agencies, so these will be updated as necessary. For accessing active links, this list will be placed on DEQ's Water Quality and Drinking Water Protection web pages under "Funds and Resources". The location for drinking water protection is: <http://www.oregon.gov/deq/wq/programs/Pages/DWP.aspx>

Oregon Health Authority (OHA)

Drinking Water Services - Phone: 971-673-0405; **Website:**

<http://www.oregon.gov/OHA/PH/HealthyEnvironments/DrinkingWater/pages/index.aspx>

The Oregon Health Authority (OHA) is the primacy agency for the implementation of the federal Safe Drinking Water Act (SWDA) in Oregon. ORS 338.277 authorizes the OHA to administer the federal Safe Drinking Water Act in Oregon as the Primacy Agency in agreement with the federal government. ORS 448.131 further authorizes the adoption of standards necessary to protect public health through insuring safe drinking water within a water system. Standards in OAR 333-061 outlines requirements for systems to meet MCLs, submit to periodic inspections, and meet enforcement requirements as administered by OHA. As the primacy agency, OHA also approves drinking water treatment plans and sets construction standards, operator certification standards, and enforces rules to ensure safe drinking water. The OHA website above has extensive information on drinking water treatment requirements.

In order to assist systems in complying with standards, OHA also provides technical assistance and oversight of grants and loans from the Safe Drinking Water Act for public water system operation and improvements. *For those Safe Drinking Water Act loans and grant funds, the **Oregon Health Authority partners with Oregon Infrastructure Finance Authority to provide the financial services** (see below).*

Business Oregon - Infrastructure Finance Authority (IFA)

Phone: (503) 986-0123; **Website:** <http://www.oinfrastructure.org/>

IFA is a division of Business Oregon that provides funding for municipally owned infrastructure projects. IFA manages federal infrastructure funds for agencies such as Oregon Health Authority and Housing and Urban Development. IFA is not a regulatory agency but collaborates and supports our state and federal partners with financing programs and technical assistance. Available funding programs that are most applicable for groundwater source protection include: the Safe Drinking Water Revolving Loan Fund (SDWRLF), Drinking Water Source Protection Fund (DWSP), and Special Public Works Fund (SPWF).

Safe Drinking Water Revolving Loan Fund (SDWRLF)

This loan program funds drinking water system improvements needed to maintain compliance with the Federal Safe Drinking Water Act. The Safe Drinking Water Fund is funded by annual grants from

the U.S. Environmental Protection Agency (EPA) and matched with funds from the state Water/Wastewater Financing Program. The program is managed by the Oregon Health Authority (OHA), Drinking Water Services. The loans are managed by the Oregon Infrastructure Finance Authority (IFA).

The Safe Drinking Water Revolving Loan Fund (SDWRLF) is designed for water source, treatment, distribution, storage and related infrastructure projects. Funding is available for all sizes of water systems, although 15 percent of the funds are reserved for systems serving a population of fewer than 10,000. Eligible applicants can be owners of water systems that provide service to at least 25 year-round residents or systems that have 15 or more connections (or a nonprofit with 25 or more regular users). Owners can be a nonprofit, private party or municipality, but systems cannot be federally owned or operated.

To be eligible for funding, a project must solve an existing or potential health hazard or noncompliance issue under federal/state water quality standards. The following are the main types of eligible activities:

- Engineering, design, upgrade, construction or installation of system improvements and equipment for water intake, filtration, treatment, storage, transmission
- Acquisitions of property or easements
- Planning, surveys, legal/technical support and environmental review
- Investments to enhance the physical security of drinking water systems, as well as water sources

SDWRLF loan amount: The program provides up to \$6 million per project (more with additional approval) with the possibility of subsidized interest rate and principal forgiveness for a Disadvantaged Community. The standard loan term is 20 years or the useful life of project assets, whichever is less, and may be extended up to 30 years under SDWRLF for a Disadvantaged Community. Interest rates are 60-80 percent of state/local bond index rate.

To apply, the municipality should first submit a Letter of Interest to Oregon Health Authority where it will be rated and ranked. Call Oregon OHA Drinking Water Services at 971-673-0422 or go to the OHA website: www.healthoregon.org/srf

Projects placed on the Project Priority List will be invited to apply through IFA for funding. Contact your IFA Regional Coordinator for assistance and more information. Call IFA at 503-986-0123 or <http://www.orinfrastructure.org/> .

Drinking Water Source Protection Fund (DWSP)

From the Safe Drinking Water Act, loans and grants are also available for drinking water protection projects: low interest *loans up to a maximum of \$100,000 per project*, and *grant funds up to \$30,000 per water system*. Eligible systems include any public and privately-owned Community and Nonprofit Non-Community water systems with a completed Source Water Assessment are able to demonstrate a direct link between the proposed project and maintaining or improving drinking water quality. Eligible activities include those that lead to risk reduction within the delineated source water area or would contribute to a reduction in contaminant concentration within the drinking water source. Projects can take either a local or regional approach. Local projects are

defined as activities that concentrate on a public water system's source area(s). Regional projects are defined as activities that involve multiple communities and/or water systems attempting to address a common source water issue or group of issues.

The categories for eligible projects for DW Source Protection funding include the following:

Refined Delineation OHA and DEQ have completed delineations for most drinking water source areas (DWSA) for the community and non-community public water systems. DWSAs include aquifer recharge areas for groundwater sources and watershed areas for surface sources. DW Source Protection funding can be used to complete, update, or refine DWSA delineations using new or additional site-specific information as part of a more comprehensive protection strategy.

Updated Assessment

Inventory – Projects that improve upon existing potential contaminant source inventories available from the DEQ database, Geographic Information System, and Assessment Reports prepared by OHA/DEQ. A project could involve expanding or updating the inventory of land uses or existing and potential point and non-point contaminant sources.

Evaluation – Projects establishing a water quality monitoring project to evaluate existing and potential threats to water quality. This could include evaluating and prioritizing potential threats (or protection activities) based upon new or more detailed information.

Source Protection Planning

Projects designed to identify appropriate protection measures, including development of a comprehensive DW Source Protection plan, educational projects, projects to identify and ensure implementation of Best Management Practices (BMPs), development of local DW Source Protection ordinances, development of restoration or conservation plans for the source area for future easement or land acquisition.

Implementation

Funds can be used to implement many types of protection strategies in drinking water source areas. This can include implementation of any *eligible activities that will reduce risks within the source water area or would contribute to a reduction of contaminant concentration within the drinking water source(s)*.

Examples of the types of projects that can be funded include:

- Implementing drug-take-back projects in source areas
- Projects for reducing pesticide application rates and loadings in source area
- Implementing pesticide and household hazardous waste collection events
- Closure of high-risk abandoned or unused (private or irrigation) wells close to supply well
- Projects for reforestation or replanting in sensitive or riparian areas
- Installation of fencing to protect sensitive riparian source areas
- Installation of signs at boundaries of zones or protection areas
- Projects for assessing risks from onsite systems near supply wells, inspections, pump-outs, or decommissioning onsite systems.
- Secondary containment for high-risk ABOVE ground tanks

- Focused workshop events for household/business instruction for changing to alternative nonhazardous product usage (“green chemical” products)
- Seismic spill prevention or inspection project in proximate areas for high-risk sources
- Permanent abandonment (i.e. filling in) of inadequately constructed private wells within the source area
- Installation of fencing around the immediate intake or well area to provide protection
- Structures to divert contaminated stormwater runoff affecting the source area
- Set up ecosystem services (or similar) project in watershed to fund preservation areas
- Implementation of pollution prevention or waste reduction projects
- Restoration and/or conservation projects within the drinking water source area
- Implementation of water reuse and other conservation measures related to source protection
- Implementation of best management practice projects
- Implementation of conservation easements to protect sensitive source areas
- Implementation of a drinking water source protection ordinance
- Establishing management plans for easements or lands purchased within source areas
- Development of educational flyers/brochures for purposes of public education
- Purchase of lands within the drinking water source area (funded only via low interest loans)

Any *Public and Privately-owned Community and Nonprofit Non-Community water systems* with a completed *Source Water Assessment* are eligible for funds. A “community water system” is defined as a public water system that has 15 or more service connections used by year-round residents, or which regularly serves 25 or more year-round residents. This includes water systems that are owned privately, by non-profit or public entities such as a city, district, or port. A “nonprofit non-community water system” is a public water system that is not a community water system and that regularly serves at least 25 people (more than 6 months per year) and is legally recognized under Oregon law as a nonprofit entity.

For the source water protection funds, contact OHA regarding the letter of interest submittal schedule. Call Oregon OHA Drinking Water Services at 971-673-0422 or go to the OHA website: www.healthoregon.org/srf or contact IFA at 503-986-0123; www.orinfrastructure.org

Water/Wastewater Funding Program (WWFP)

This loan program funds the design and construction of public infrastructure needed to ensure compliance with the Safe Drinking Water Act or the Clean Water Act. The public entities that are eligible to apply for the program are cities, counties, county service districts, tribal councils, ports, and special districts as defined in ORS 198.010. Municipalities must either have a documented compliance issue or the potential of a compliance issue in the near future.

Allowable funded project activities may include:

- Construction costs, including Right of Way and Easements, for improvement or expansion of drinking water, wastewater or stormwater systems
- Design and construction engineering
- Planning/technical assistance for small communities

WWFP Loans

The maximum loan term is 25 years or the useful life of the infrastructure financed, whichever is less. The maximum loan amount is \$10 million per project (more with additional approval) through a combination of direct and/or bond funded loans. Loans are generally repaid with utility revenues or voter approved bond issues. A limited tax general obligation pledge also may be required. "Credit worthy" borrowers may be funded through the sale of state revenue bonds.

WWFP Grants

Grant awards up to \$750,000 may be awarded based on a financial review. An applicant is not eligible for grant funds if the applicant's annual median household income is equal or greater than 100 percent of the state average median household income for the same year.

Funding for Technical Assistance

The Infrastructure Finance Authority offers technical assistance financing for municipalities with populations of less than 15,000. The funds may be used to finance preliminary planning, engineering studies and economic investigations. Technical assistance projects must be in preparation for a construction project that is eligible and meets the established criteria.

Grants up to \$20,000 may be awarded per project.

Loans up to \$60,000 may be awarded per project.

To apply, call IFA at 503-986-0123, then contact your IFA Regional Coordinator for assistance and more information. <http://www.orinfrastructure.org/>

Special Public Works Fund (SPWF)

The Special Public Works Fund (SPWF) provides funds for publicly owned facilities that support economic and community development in Oregon. Funds are available to public entities for planning, design, purchasing, improving and constructing publicly owned facilities, replacing publicly owned essential community facilities, emergency projects as a result of a disaster, and for planning. Public agencies that are eligible to apply for funding are cities, counties, county service districts (ORS 451), tribal councils, ports, districts as defined in ORS 198.010, and airport districts (ORS 838).

SPWF Loans

Loans for development (construction) projects range from less than \$100,000 to \$10 million (more with additional approval). The Infrastructure Finance Authority offers very attractive interest rates that reflect tax-exempt market rates for highly qualified borrowers. Initial loan terms can be up to 25 years or the useful life of the project, whichever is less.

SPWF Grants

Grants are available for construction projects that create or retain traded-sector jobs. They are limited to \$500,000 or 85 percent of the project cost, whichever is less, and are based on up to \$5,000 per eligible job created or retained. Limited grants are available to plan industrial site development for publicly owned sites and for feasibility studies.

To apply, call IFA at 503-986-0123, then contact your IFA Regional Coordinator for assistance and more information. <http://www.orinfrastructure.org/>

Community Development Block Grant (CDBG)

Grants and technical assistance are available to develop livable urban communities for persons of low and moderate incomes by expanding economic opportunities and providing housing and suitable living environments. Non-metropolitan cities and counties in rural Oregon can apply for and receive grants. *[Oregon tribes, urban cities (Albany, Ashland, Bend, Corvallis, Eugene, Gresham, Hillsboro, Medford, Portland, Salem and Springfield) and counties (Clackamas, Multnomah, Washington) receive funds directly from HUD.]* Funding amounts are based on the applicant's need, the availability of funds, and other restrictions defined in the program's guidelines. The maximum available grant for drinking water system projects is \$3,000,000.

All projects must meet one of three national objectives:

- The proposed activities must benefit low- and moderate-income individuals.
- The activities must aid in the prevention or elimination of slums or blight.
- There must be an urgent need that poses a serious and immediate threat to the health or welfare of the community.

To apply, call IFA at 503-986-0123, then contact your IFA Regional Coordinator for assistance and more information. <http://www.orinfrastructure.org/>

Port Revolving Loan Fund (PRLF)

The Port Revolving Loan Fund (PRLF) is a loan program to assist Oregon ports in the planning and construction of facilities and infrastructure. Ports must be incorporated under ORS Chapter 777 or 778. The Fund may be used for port development projects (facilities or infrastructure) or to assist port-related private business development projects. The variety of eligible projects is very broad and may include water-oriented facilities, industrial parks, airports and commercial or industrial developments. Eligible project costs can include engineering, acquisition, improvement, rehabilitation, construction, operation, and maintenance or pre-project planning. Projects must be located within port district boundaries. The maximum loan amount is \$3 million at any one time. The loan term can be as long as 25 years or the useful life of the project, whichever is less. Interest rates are set by the IFA at market rates, but not less than Treasury Notes of a similar term minus one percent.

Note: Flexible manufacturing space projects will not accrue interest until the building is at least 25 percent occupied or until three years after the date of the loan contract, whichever is earlier.

To apply, call IFA at 503-986-0123, then contact your IFA Regional Coordinator for assistance and more information. <http://www.orinfrastructure.org/>

Other IFA Funding Programs

IFA administers a number of other funding programs for communities that support the design and construction of public infrastructure and economic and community development. These funding programs include the Water/Wastewater Funding Program, the Special Public Works Fund (SPWF) Community Development Block Grant (CDBG), and the Port Revolving Loan Fund (PRLF). More information and allowable funded project activities are available on IFA's website.

Oregon Department of Environmental Quality (DEQ)

Clean Water State Revolving Fund: 503-229-6412

Website: <http://www.oregon.gov/deq/wq/cwsrf/Pages/default.aspx>

Clean Water State Revolving Fund (CWSRF)

Low-cost loans for planning, design, and construction projects to attain and maintain water quality standards, and necessary to protect beneficial uses such as drinking water sources, irrigation, and recreation. Eligible borrowers are public entities, such as cities and counties, Indian tribal governments, sanitary districts, soil and water conservation districts, irrigation districts, various special districts and some intergovernmental entities. Applications are accepted year round with scheduled review and ranking in the first week of January, May and September. Contact DEQ for a list of CWSRF project officers: <http://www.oregon.gov/deq/wq/cwsrf/Pages/CWSRF-Contacts.aspx>

Financial incentives make CWSRF loans worth exploring. Principle forgiveness is available for communities meeting affordability criteria, or for meeting green project criteria. Implement a non-planning nonpoint source project *and* a traditional point source wastewater treatment project through the same application to reduce your interest rate on the combined two projects to as low as 1%. This combined application is called a sponsorship option.

CWSRF Pollution Reduction Funding

The Clean Water State Revolving Fund loan program provides low-cost loans to public entities for the planning, design or construction of both point source and nonpoint source projects that *prevent or mitigate water pollution*. CWSRF offers a Local Community Loan, which allows the borrower to make loans to private entities like home owners and farmers. The Local Community Loans fund the repair and replacement of failing decentralized systems. This loan type can also fund nonpoint source agricultural best management practices and a variety of nonpoint source watershed improvement projects.

More information on DEQ's Clean Water State Revolving Fund program can be found here:

<http://www.oregon.gov/deq/wq/cwsrf/Pages/default.aspx>

For specific information on the Sponsorship Option, Planning Loans, Nonpoint Source Loans, or Local Community Loans, see the links on the above webpage. The application requirements for CWSRF loans may take some lead-time to develop and may require out-of-pocket expense to prepare. Prospective CWSRF applicants should discuss any questions about the required content of these items with a regional DEQ CWSRF Project Officer at the earliest opportunity:

<http://www.oregon.gov/deq/wq/cwsrf/Pages/CWSRF-Contacts.aspx>

Supplemental Environmental Projects (SEPs)

Supplemental Environmental Projects are administered by DEQ's Office of Compliance and Enforcement. When DEQ assesses civil penalties for environmental law violations, violators can offset up to 80% of their monetary penalty by agreeing to pay for a Supplemental Environmental Project that improves Oregon's environment. SEPs can be for pollution prevention or reduction,

public health protection, environmental restoration and protection as long as it is a project that the respondent is not already required to do by law or where the project would be financially self-serving for the respondent. The work can be completed by a third-party like a local government, watershed council, non-profit or private entity. Community organizations with proposed projects are also free to contact respondents on their own initiative. The enforcement case does not necessarily have to be in the same area (watershed/county, etc.) as the environmental project or even address the same media (i.e. air/water/land). Interested parties can sign up for DEQ's public notifications via email at: <http://www.oregon.gov/deq/Get-Involved/Pages/Public-Notices.aspx>

When signing up, select types of information (select "enforcement actions") and which counties or subbasins are of interest.

Oregon Water Resources Department (WRD)

Website: <http://www.oregon.gov/OWRD/pages/index.aspx>

The Water Resources Department is the state agency charged with administration of the laws governing surface and ground water resources. The Department's core functions are to protect existing water rights, facilitate voluntary streamflow restoration, increase the understanding of the demands on the state's water resources, provide accurate and accessible water resource data, and facilitate water supply solutions. WRD carries out the water management policies and rules set by the Water Resources Commission and oversees enforcement of Oregon's water laws. By law, all surface and ground water in Oregon belongs to the public.

WRD developed *Oregon's 2012 Integrated Water Resources Strategy* to help individuals and communities address instream and out-of-stream needs now and into the future, including water quantity, water quality and ecosystem needs. Funding to support groundwater-related planning, feasibility studies, and implementation of water projects includes: Feasibility Study Grants, Water Project Grants and Loans (formerly Water Supply Development Grants and Loans), and Place-based Planning Grants. For more information on the criteria for these grants, visit: http://www.oregon.gov/owrd/Pages/law/integrated_water_supply_strategy.aspx

Municipal water management and conservation planning provides a process through which cities and other municipal water suppliers estimate long-range water supply needs and identify alternatives, including water conservation programs, to meet those needs. The Department requires many municipal water suppliers to prepare plans as conditions of their water use permits or permit extensions.

Water Rights and Well Construction/Abandonment

Watermasters respond to complaints from water users and determine in times of water shortage, which generally occur every year, who has the right to use water. Watermasters can also provide information on the potential risks and proper abandonment of unused wells. "Watermaster" offices across the state offer excellent local information:

http://www.oregon.gov/owrd/pages/offices.aspx#region_watermaster_map

Oregon Department of Forestry (ODF)

Website: <http://www.oregon.gov/ODF/Pages/index.aspx>

The Oregon Department of Forestry manages and regulates activities on non-federal forestland in Oregon. There are three main divisions under ODF-- Fire Protection, Private Forests, and State Forests. The Private Forests Division administers the Forest Practices Act and various forestry incentive programs and employs the use of about 50 Stewardship Foresters who work closely with landowners and operators. The State Forests Division is responsible for forest management to provide economic, environmental, and social benefits to Oregonians.

Financial incentive programs are aimed at encouraging and assisting landowners in managing their resources and meeting their objectives. Typical forestry projects can be aimed at protecting the landowner's resources/investment from fire or insect and disease infestation, to increasing its monetary and environmental value in the future.

Information about all ODF and federal forestry-related grants and incentive programs can be found at: <http://www.oregon.gov/ODF/AboutODF/Pages/GrantsIncentives.aspx>

Department of Agriculture - Natural Resources Program

Phone: 503-986-4700;

Website: <http://www.oregon.gov/ODA/programs/NaturalResources/Pages/Default.aspx>

The Oregon Department of Agriculture (ODA) is responsible for developing plans to prevent and control water pollution from agricultural activities and soil erosion on rural lands. Through the actions below, ODA's Natural Resources Program aims to conserve, protect, and develop natural resources on public and private lands to ensure that agriculture will continue to be productive and economically viable in Oregon:

- Address water quality and natural resource conservation on agricultural lands
- Ensure proper and legal sale, use, and distribution of pesticide products
- Assist local soil and water conservation districts as they help landowners properly manage Oregon's natural resources

More information on the Agricultural Plan Areas and Regulations can be found at:

<http://www.oregon.gov/ODA/programs/NaturalResources/AgWQ/Pages/AgWQResources.aspx>

Information on local management plans and your area's ODA Water Quality Specialist can be found at:

<http://www.oregon.gov/ODA/programs/NaturalResources/AgWQ/Pages/AgWQPlans.aspx>

More information on the regulation and use of pesticides can be found at:

<http://www.oregon.gov/ODA/programs/Pesticides/Pages/default.aspx>

Department of Agriculture Pesticide Analytical & Response Center (PARC)

Website: <http://www.oregon.gov/ODA/programs/Pesticides/Pages/PARC.aspx>

The Pesticide Analytical and Response Center (PARC) was created by executive order in 1978. The program was reauthorized under the Oregon Department of Agriculture (ODA) as ORS 634.550, in 1991.

PARC is mandated to perform the following activities with regard to pesticide-related incidents in Oregon that have suspected health or environmental effects: collect incident information, mobilize expertise for investigations, identify trends and patterns of problems, make policy or other recommendations for action, report results of investigations, and prepare activity reports for each legislative session.

PARC does not have regulatory authority. Their primary function is to coordinate investigations to collect and analyze information about reported incidents.

To report a pesticide incident that has impacted people, animals, or the environment, contact: Theodore Bunch Jr., PARC Coordination Team Leader at 503-986-6470 or toll-free at 844-688-7272, PARC@oda.state.or.us or Christina Higby, Citizen Advocate Liaison at 503-986-5105, chigby@oda.state.or.us

Department of Agriculture - Soil and Water Conservation Districts

Website: <http://www.oregon.gov/oda/programs/naturalresources/swcd/pages/swcd.aspx>

SWCD Program and Water Quality Program Manager: John Byers, 503-986-4718

The Soil and Water Conservation District (SWCD) Program provides services to the 45 Soil and Water Conservation Districts throughout Oregon (list current as of 6/16). SWCDs are local government entities that have authorities to address soil, erosion, and water quality issues.

Source Water Collaborative – U.S. Environmental Protection Agency

Technical assistance and lists of resources and contacts are available from this national network that has worked to promote drinking water protection for several years. The Source Water Collaborative is a network of federal, state, and local organizations led by US EPA. Some of the key Source Water Collaborative members include the US EPA, US Department of Agriculture, AWWA, American Planning Association, ASDWA, ACWA, National Rural Water Association, Groundwater Protection Council, National Association of Counties, and The Trust for Public Land. See **Appendix 1** for a summary of their priorities. Resources can be found here: <http://sourcewatercollaborative.org/>

U.S. Environmental Protection Agency

Catalog of Federal Funding Sources for Watershed Protection

Website: <https://ofmpub.epa.gov/apex/wfc/f?p=165:1:::::>

This is an online, free searchable database of financial assistance sources (grants, loans, cost-sharing) available to fund a variety of watershed protection projects.

U.S. Environmental Protection Agency - Environmental Finance Centers

Website: <https://www.epa.gov/envirofinance/tools>

Free technical assistance is available through EPA’s Environmental Finance Centers. There is currently no Environmental Finance Center for US EPA Region 10, but the resources are still available through the US EPA website. The program mission is to provide help to those facing the “how to pay” challenges of environmental protection. EFC is committed to helping the regulated community build and improve the technical, managerial, and financial capabilities needed to comply with federal and state environmental protection laws.

U.S. Department of Agriculture, Farm Service Agency Conservation Programs

Website: <https://www.fsa.usda.gov/programs-and-services/conservation-programs/index>

USDA Farm Service Agency oversees a number of voluntary conservation-related programs. These programs work to address a large number of farming and ranching related conservation issues including: drinking water protection, reducing soil erosion, wildlife habitat preservation, preservation and restoration of forests and wetlands, and aiding farmers whose farms are damaged by natural disasters.

Source Water Protection Program (SWPP)

The SWPP is designed to protect surface and ground water used as drinking water by rural residents. Through a partnership with the National Rural Water Association, local teams are formed to develop plans to reduce pollutant impacts in rural areas.

<https://www.fsa.usda.gov/programs-and-services/conservation-programs/source-water-protection/index>

Conservation Reserve Program (CRP)

In exchange for a yearly rental payment, farmers enrolled in the program agree to remove sensitive land from agricultural production and plant species that will improve environmental health and quality. Contracts for land enrolled in CRP are 10-15 years in length. The long-term goal of the program is to re-establish valuable land cover to help improve water quality, prevent soil erosion, and reduce loss of wildlife habitat. <https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/index>

Conservation Reserve Enhancement Program (CREP)

The CREP, an offshoot of CRP, targets high-priority conservation issues identified by local, state, or tribal governments or non-governmental organizations. In exchange for removing environmentally sensitive land from production and introducing conservation practices, farmers, ranchers, and agricultural land owners are paid an annual rental rate. Participation is voluntary, and the contract period is typically 10–15 years, along with other federal and state incentives as applicable per each CREP agreement.

<https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-enhancement/index>

Emergency Conservation Program (ECP)

The ECP provides funding and technical assistance for farmers and ranchers to restore farmland damaged by natural disasters and for emergency water conservation measures in severe droughts. helps farmers and ranchers to repair damage to farmlands caused by natural disasters and to help. The ECP also provides funding and assistance to help ranchers and farmers install water conservation measures during severe drought.

<https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-enhancement/index>

U.S. Department of Agriculture, Natural Resources Conservation Service

NRCS provides farmers, ranchers and forest managers with free technical assistance, or advice, for their land. Common technical assistance includes: resource assessment, practice design and resource monitoring. The conservation planner will help you determine if financial assistance is right for you. Technical assistance is also available online through Conservation Client Gateway. For more information about NRCS, visit their home page:

<https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/about/>

Several key funding opportunities for best management practices and conservation on private, non-industrial forestland and agricultural lands may provide assistance in groundwater source areas include:

Environmental Quality Incentives Program (EQIP)

<https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/>

Conservation Stewardship Program (CSP)

<https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/csp/>

Agricultural Land Easements (ALE)

<https://www.nrcs.usda.gov/wps/portal/nrcs/detail/or/home/?cid=stelprdb1249312>

Emergency Watershed Protection (EWP)

<https://www.nrcs.usda.gov/wps/portal/nrcs/main/or/programs/financial/ewp/>

Anyone applying for EQIP or any of the other NRCS grants for the first time should schedule a meeting with NRCS to discuss their options before moving forward.

U.S. Department of Agriculture, Rural Development

Water and Waste Disposal Direct Loans and Grants

Eligible Projects: Pre-construction and construction associated with building, repairing, or improving drinking water, solid waste facilities and wastewater facilities

Eligible Applicants:

- Cities or towns with fewer than 10,000 population
- Counties, special purpose districts, non-profit corporations or tribes unable to get funds from other sources at reasonable rates and terms

Funding Available: Loans (40-year term), grants in some cases, interest rates vary (currently 2.125 – 3.5%)

How To Apply: Applications accepted year-round on a fund-available basis.

<https://www.rd.usda.gov/programs-services/water-waste-disposal-loan-grant-program>

U.S. Environmental Protection Agency

Community Action for a Renewed Environment (CARE) Grants

Eligible Projects: Prevention of human exposure to harmful pollution; improve water quality. Form community-based collaborative partnerships; identifying and developing an understanding of the many local sources of risk from toxic pollutants and environmental concerns; and setting priorities for the reduction of the identified risks and concerns of the community

Eligible Applicants: Local, public non-profit institution/organizations, federally-recognized Indian tribal government, Native American organizations, private non-profit institution/organization, quasi-public nonprofit institution/organization both interstate and intrastate, local government, colleges, and universities

Funding Available: \$75,000 to \$100,000 with an average project funding of about \$90,000

How To Apply: <https://www.epa.gov/communityhealth/community-action-renewed-environment-care-resources>

U.S. Department of Commerce

Community Development Block Grant Planning Program

Phone: (206) 220-5101; Website:

https://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs

Eligible Projects: Comprehensive plans, Infrastructure plans, Feasibility studies, Community action plans, Low-income housing assessments

Eligible Applicants: Projects must principally benefit low- to moderate-income people in non-entitlement cities (under 50,000 people) and counties (under 200,000 people).

Funding Available: Grants

- Up to \$24,000 for a single jurisdiction
- Up to \$35,000 for single jurisdiction projects that address urgent public health and safety needs
- Up to \$40,000 for multiple jurisdictions/joint application

How To Apply: <https://www.hudexchange.info/grantees/>

Rural Community Assistance Corporation (RCAC)

Website: <http://www.rcac.org/>

National contact: Josh Griff, 720-951-2163, jgriff@rcac.org

Oregon contacts: Chris Marko, Rural Development Specialist 503- 228-1780; cmarko@rcac.org
RosAnna Noval, Rural Development Specialist 503-308-0207; rnoval@rcac.org

At the national level, RCAC has a variety of loans for water and/or wastewater planning, environmental work, and other work to assist in developing an application for infrastructure improvements

Eligible Applicants: Non-profit organizations, public agencies, tribes, and low-income rural communities with a 50,000 population or less, or 10,000 or less if guaranteed by USDA Rural Development financing.

Funding Available:

- Maximum \$50,000 for feasibility loan
- Maximum \$350,000 for pre-development loan
- 1 year term with 5.5% interest rate

How To Apply: Applications accepted anytime. www.rcac.org

Water Research Foundation - Source Water Protection Cost-Benefit Tool

Website: <http://www.swptool.org/index.cfm>

This is a free, online suite of tools designed to assist in evaluating the triple bottom-line costs and benefits of different source water protection options. Cost/benefit calculations help evaluate, prioritize, justify, and ultimately implement source water protection initiatives.

LAND TRUSTS

Most land trusts are community based and deeply connected to local needs, so they are well-equipped to identify land that offers critical natural habitat as well as land offering recreational, agricultural and other conservation value. There are several categories of land trusts:

- Conservation land trusts: A land trust is a nonprofit organization that, as all or part of its mission, actively works to conserve land by undertaking or assisting in land or conservation easement acquisition, or by its stewardship of such land or easements.
- Alternative type of land trust: The legal title of the property in question is held by another person (a trustee) while the original owner retains all of the rights and privileges of property ownership.
- Community land trusts (CLTs): A community land trust is a private, non-profit corporation, created to acquire and hold land for the benefit of a community, and provide secure affordable access to land and housing for community residents. CLTs offer a balanced approach to ownership: the nonprofit trust owns the land and leases it for a nominal fee to individuals who own the buildings on the land. In particular, Community land trusts attempt to meet the needs of residents least served by the prevailing land market.

Resources to assist in locating a land trust: <http://findalandtrust.org/states/oregon41>

Coalition of Oregon Land Trusts

Phone: 503-719-4732 **Website:** <http://oregonlandtrusts.org/>

The Coalition of Oregon Land Trusts (COLT) is a newly formed nonprofit representing and serving Oregon's land trusts. Its mission is to serve and strengthen the land trust community in Oregon. Oregon's land trust community is working at local, regional, and statewide scales with landowners, communities, public agencies and other partners to maintain the state's natural heritage and the economies it supports. COLT will accomplish its mission by strengthening public policies and programs that are supportive of land conservation, helping to build capacity within and across land trusts, and communicating to key audiences about the role of land trusts in conserving Oregon's natural heritage and healthy human communities that depend on it. There are currently 18 land trusts that are members of COLT.

Land Trust Alliance

Phone: (971) 202-1483 **Website:** <http://www.landtrustalliance.org/>

The Land Trust Alliance is a national conservation organization that works preserve land through conservation and easements, so land and natural resources get protected. The Alliance is based in Washington, D.C., and has several regional offices.

Individual land trusts which may be of assistance include:

The Trust for Public Land <https://www.tpl.org>

The Nature Conservancy <https://www.nature.org>

FOUNDATIONS

The National Groundwater Association

Eligible Projects: USA Groundwater Fund was established by the National Ground Water Research and Educational Foundation (NGWREF) to help fund water supply projects as well as education and training projects within the United States of America.

- Education and training program projects for groundwater development, wellhead protection, well pumping systems, and/or maintenance of wells and pumping systems
- Groundwater supply projects that serve the general public in a community setting.

Eligible Applicants: Applicant should have a history of not less than three years of demonstrated success in projects for groundwater water supply. Applicant should provide with its application documentation of its successful completion of these projects, preferably from a third party, not affiliated with the grant seeking organization that can attest to the completed work.

Funding Available: Small grants, total of \$10,000 available per year nationwide

Contact: <http://www.ngwa.org/Foundation/Pages/USA-Groundwater-Fund.aspx>

4.0 PLACE-BASED PLANNING FOR SOURCE WATER

Drinking water protection involves identifying and working to reduce the highest risks that could potentially affect the public water system, rather than prohibiting specific uses in a watershed or groundwater recharge area. The prime benefit or incentive to local communities to voluntarily develop and implement drinking water protection strategies is reduction of risk to ensure a more secure source of high-quality water. This is important in light of the pace at which new chemicals are developed and the known gaps in water quality health standards. In addition, lands within most groundwater recharge areas across the state are not owned by public water systems, so voluntary commitment within the community to collaborate on aquifer protection efforts is an essential aspect of long-term protection.

Developing pollutant reduction strategies to protect a public water system is a cost-effective use of resources, since it is expensive to treat contaminated drinking water or to construct a replacement water supply well should a supply become unusable due to contamination. DEQ estimates the cost of developing drinking water protection strategies for a community of less than 500 in population to range from \$100 (with staff or donated time) to \$6,000 (with preparation by a consultant). This level of investment in groundwater protection stands in stark contrast with the typical costs to investigate and install treatment for contamination. Based on an actual event in 1992, a small groundwater-supplied public water system in Marion County spent at least \$500,000 on contamination response. This example is consistent with a US EPA study that determined *the cost of contamination cleanup to be 5 to 200 times more expensive than basic pollution prevention efforts*.

There are several reasons why “place-based planning” is essential to the success of overcoming commonly encountered challenges for drinking water protection planning. The drinking water source area for most communities lies partially, if not entirely, outside of municipal jurisdictions. The jurisdiction of the source area may also be complicated by several different and overlapping governing agencies. The land uses and potential contaminant sources may correspond to a diverse mix of landowners, businesses and residents. When developing protection strategies, DEQ and OHA highly recommend that the water system and community involve potentially affected stakeholders early in the process to foster their awareness and trust in the resulting strategies. When groundwater protection efforts occur at the community level and involve key stakeholders, there is a greater likelihood of success. These efforts may comprise a focused strategy to address a specific issue, or broader “action plans” that address short-term and longer-term drinking water protection challenges. Regardless of the approach, all of this work is a valuable investment in protecting the quality of life and economic vitality of the local community.

In 2012 Oregon adopted an “Integrated Water Resources Strategy (IWRS)” that provides recommendations for how to follow a place-based and integrated approach to water resources planning. This approach helps communities achieve the level of coordination and collaboration to successfully address local water quality and water quantity challenges, such as developing and implementing strategies to protect their drinking water sources. The IWRS Place-Based Planning guidelines describe elements to consider for building a collaborative process, characterizing water-

related issues, quantifying existing and future water needs, developing a suite of solutions, and adopting and implementing the plan. More information about the process can be found in this Water Resources Department document:

http://www.oregon.gov/owrd/LAW/docs/IWRS/2015_February_Draft_Place_Based_Guidelines.pdf

Essentials of place-based planning include:

- Voluntary process, driven by local partners
- Involves and integrates diverse and representative perspectives
- Potentially addresses a broad array of common groundwater challenges that include:
 - Water quality impairments and water supply limitations
 - Identifying data gaps and initiating projects to address these (e.g. groundwater monitoring studies to assess aquifer characteristics, recharge, utilization, etc.)
 - Identifying water resource needs and partner to develop solutions
 - Lack of jurisdiction over lands in recharge area
 - Assessing cumulative effects of regional demands on aquifers, including existing uses, new development
 - Increasing the visibility and awareness of groundwater as a priority water resource issue
 - Connecting the health of groundwater to overall watershed health with decision makers and funders
 - Surface impacts on groundwater, e.g. development and negative effects on recharge; vulnerability of groundwater to contamination.
- Collaborative partners help implement place-based planning efforts:
 - SWCDs
 - USDA - NRCS
 - Oregon State University Extension Service
 - Watershed Councils
 - County and City jurisdictions
 - Other public groundwater systems in area
 - WRD (Watermaster and Planning staff)
 - Other relevant agencies e.g.: DEQ, ODFW, ODF, ODA
 - Representative stakeholders:
 - Irrigation districts
 - Residential homeowners
 - Commercial, industrial landowners
 - Agricultural and forestry landowners

Planning Process for Protection

Many public water systems do not have the staff or resources necessary to develop comprehensive drinking water protection plans, or maintain communication and coordination with landowners in their source area. For communities with limited resources, it is critical to streamline the process for developing and implementing strategies for groundwater protection to ensure that protection efforts focus on the highest groundwater resource priorities. **Figure 7** provides a visual map or

process for moving through the various steps for developing a pollutant reduction or drinking water protection plan.

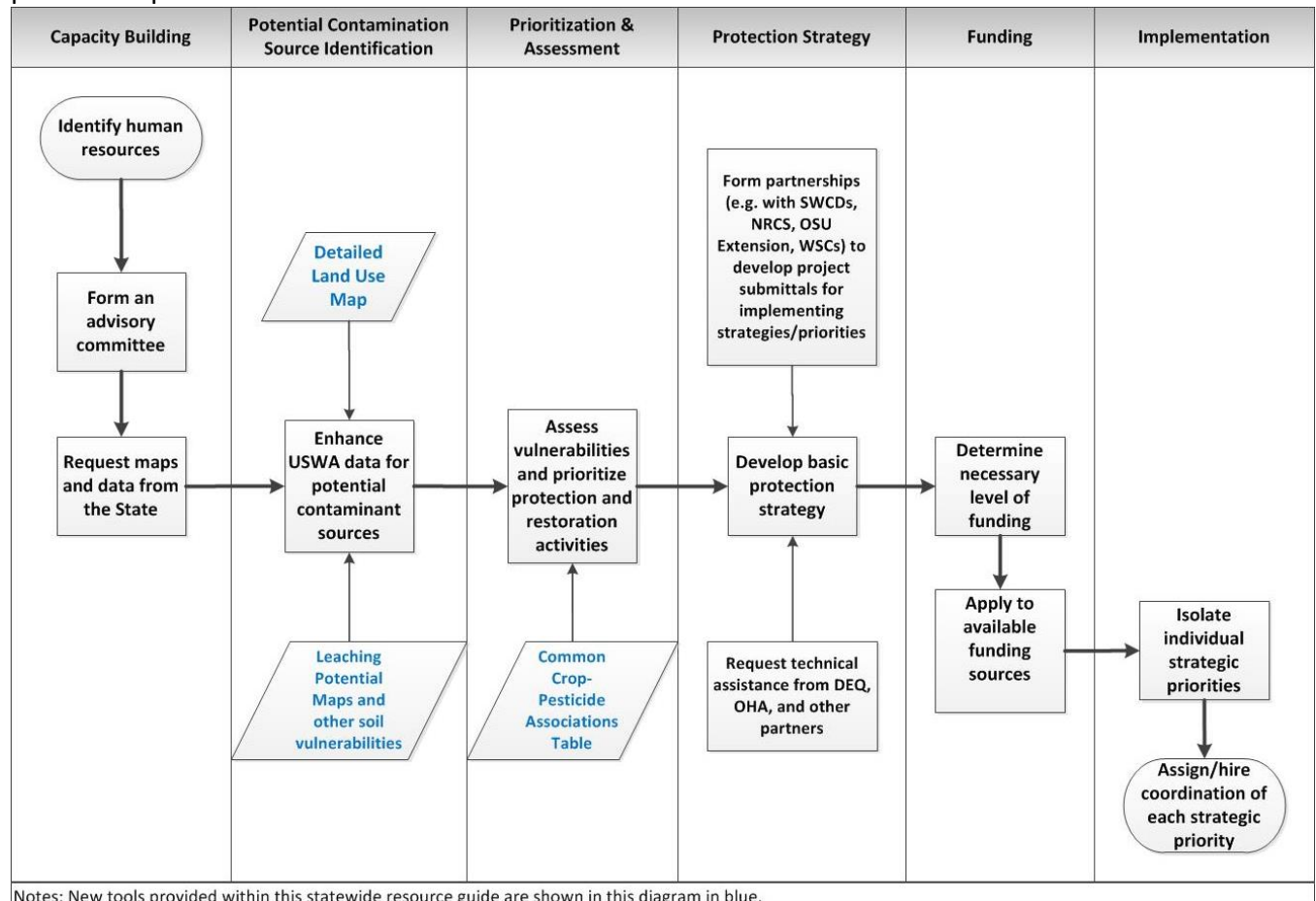


Figure 7. Process Diagram for Drinking Water Source Protection

The level of available resources, information and data will likely define the scope of the drinking water protection efforts. Initially, even a focused effort to address a few higher priority pollutants of concern is a concrete step towards pollutant reduction. Over time, as resources allow, water systems can build on their initial efforts to pursue a broader approach that engages more local and/or regional partners and diverse community perspectives. With place-based planning, the goal of collaborators could be to develop an aquifer protection plan (e.g. the City of Florence, Oregon’s plan: <http://www.ci.florence.or.us/planning/drinking-water-protection>) or a comprehensive watershed management plan that integrates surface and groundwater protection measures for drinking water and other important water uses in the region.

The process diagram in Figure 7 summarizes a streamlined approach for drinking water protection planning. Protection planning may also include the following important steps:

1. Identify human resources to work on protection/restoration planning;
2. Solicit available technical experts, citizens, and landowners to form advisory committee (DEQ/OHA can provide technical assistance and/or participate);

Review Updated Source Water Assessment and identify potential stakeholders and partners within drinking water source area. This includes the water system and any other entities that have jurisdiction and/or regulatory authority, such as cities, counties, state, federal agencies, Tribes, or special districts. This is particularly important for locations where priority sources occur.

3. REQUEST STATE AGENCY ASSISTANCE to provide GIS and database information/maps, along with technical support, especially for broader place-based planning efforts. (see Section 3.0 for list of for contacts);
4. Develop enhanced potential contaminant source (PCS) inventory to identify and map any additional PCSs not already included in the USWA
5. PRIORITIZE protection and restoration activities using all available information/maps; general criteria for prioritization include:
 - a. Proximity to wells/springs
 - b. Location within identified sensitive and/or susceptible areas in DWSA
 - c. Land uses/activities that pose significant threat to groundwater (e.g. use of toxic chemicals, application of pesticides, older septic systems, etc.)
6. Use available resources to develop basic protection strategies for high priority PCSs with input from stakeholders; if feasible pursue larger efforts such as a Place-based Planning approach (see details below), or a Drinking Water Protection Plan (which can be a component of Place-based Planning);
7. Establish a timeline for implementing strategies and identify individuals and/or organizations that will take the lead and/or assist (utilize technical assistance from DEQ and OHA);
8. Determine level of funding necessary to accomplish short-term and longer-term protection planning and identify potential funding sources;
9. Isolate individual strategic priorities and assign (or hire) a coordinator to implement each priority as resources and time permit.
10. If resources are limited for accomplishing proposed protection efforts, apply for grants or loans with assistance from partners who can implement the work.

Data Available to Support Groundwater Protection Efforts

Sources of data on watershed conditions and natural risks that could aid in developing plans and strategies for groundwater protection include, but are not limited to, the following (see also agencies and organizations listed in Section 3.0):

- DEQ Drinking Water Source Area data layers
- Drinking water source area conditions and risks from Source Water Assessment Report
- National Land Cover Database (NLCD) for land use
- Aerial photography (current and past) from Google Earth
- Digital elevation models (DEMs) from Oregon Geospatial Enterprise Office
- Waterbody locations and flow paths from USGS (National Hydrology Dataset);USDA-NASS Cropland Data Layer (USDA 2015) for land use
- Groundwater levels, aquifers, water use, and water quality data from USGS
- DOGAMI's geology data on local area
- Disturbance data from USFS

- Aquifer characteristics, e.g. permeability, infiltration capacity, confined vs. unconfined, etc. from USGS, WRD Watermasters, others
- Soil contaminant leaching research data from Oregon State University

Additional data on land uses, management, or potential risks due to human activities:

- Agricultural Water Quality Management Plan for your area (ODA)
- Source Water Assessments and Updated Assessments completed by DEQ and OHA contain information on potential contaminant sources, well construction, and susceptibility
- Site Assessment database at DEQ
- Land ownership category data from ODF and other agencies
- Most recent data on locations of hazardous material from DEQ and the State Fire Marshall
- More details on locations of county roads, forest roads (County, ODF)
- Forest practice notifications for harvest and application of pesticides (ODF)
- Update on locations of quarries and gas wells from DOGAMI

Appendix 2 is a compilation of information on the most common potential impacts to the groundwater drinking water sources in Oregon. Appendix 2 “Pollutant Reduction Strategies for Land Uses/Activities” lists the categories of land uses and activities that are identified in the Updated Source Water Assessments, then summarizes the potential impacts or risks from those activities. *Impacts generally will only occur when chemicals are improperly handled or best management practices are not followed. The purpose of developing strategies to “protect” a drinking water source area is to reduce the risks of spills, pollutant release, or off-site movement of chemicals.* The Appendix 2 table provides key pollutant reduction ideas and resources for implementing drinking water source protection strategies.

Local and statewide technical, financial, and labor resources may be available to assist in implementation of source water protection. For example, community members, volunteer labor, and the expertise of state agencies can be important sources of technical assistance and on-the-ground implementation of protection strategies. There are grants available from state and federal government agencies as well as foundations and non-profits (see Section 3.0). Local experts in water quality, conservation practices, restoration, forestry, fisheries, etc. may be willing to contribute their knowledge and time. Service organizations, schools (including colleges/universities), OSU County Extension offices, Soil and Water Conservation Districts, and Watershed Councils can be a source of knowledge, labor, and sometimes funds. Local landowners and residents are often valuable resources with important insights and understanding of area ecosystems and land management.

Working with landowners within delineated drinking water source areas for public water system wells must be a top priority in conservation and protection. If all or part of the area is owned by entities other than the public water supplier, then engagement and cooperation (or at least permission) of the landowner is necessary. This could take the form of permission to evaluate and remedy degraded sites on the landowner’s property, a cost-share agreement where the landowner does the work and the water system assists with the necessary expenses and resources, or simply encouraging the landowner to implement conservation practices on their own. Some landowners

will be reluctant to allow access to their property for liability and other reasons. Therefore, developing a carefully negotiated agreement can address those concerns. An agreement may take the form of a “Memorandum of Agreement” (MOA) often used between municipal entities and private or public landowners. The discussion and agreements with landowners in the drinking water source area regarding management practices (including agreements with monetary compensation attached) are an important tool.

There are many technical resources available to producers that outline pesticide use practices to increase yields and reduce costs. However, few resources are available to compare different pesticide management practices in terms of their impact on sustaining the quality of groundwater for agricultural production and agricultural communities. Ensuring high quality groundwater is essential for important agricultural purposes such as livestock watering and irrigation of crops, as well as for providing drinking water to rural and urban homeowners in communities of all sizes. The shared vision of protecting agricultural water quality necessitates availability of screening tools for identifying pesticide use practices and their associated potentials for contaminating groundwater. For these reasons this guide includes several crop-related tools that are intended to provide preliminary information regarding the effects of agricultural pesticide use within the vicinity of the drinking water source areas. This information may in turn encourage and bring about a greater level of discussion regarding community-led drinking water protection planning as it relates to the agricultural sector and other land uses that involve pesticide application.

In preparation of this resource guide, DEQ collaborated with a number of state partners to develop information that may help public water systems prevent or reduce contamination from sources within their recharge area.

5.0 POLLUTANT REDUCTION TOOLS

This section provides summaries and examples of tools that public water systems may find useful for implementing pollutant reduction within drinking water source areas for groundwater wells. For the purposes of this guide, a “tool” is defined broadly as an organized collection of data and/or information that may be used in informing technical assistance and implementation of drinking water protection planning. A partial list of what can be considered a “tool” are maps, tables, diagrams, checklists, charts, online resources, and other formats. The land cover related tools provided and referenced within this guide range in complexity from simple tables to high-resolution geospatial information system (GIS) maps. Several of the tools display statewide data that may not be directly transferrable for use at the local level due to the lack of resolution. In such cases where a local, site-specific, or tailored map/tool is needed, please make these requests directly to DEQ Drinking Water Protection (Sheree Stewart at 503-229-5413, and for GIS-specific needs: Steve Aalbers at 503-229-6798).

Communities of sufficient size, resources, and other means may be able to develop drinking water source protection plans for their groundwater resources without the use of the tools provided in this section. Many communities that fit this description have already taken steps to develop and utilize screening tools, resources, and strategies for reducing potential risks to their drinking water. Other communities may lack the information or data to engage landowners or managers within the drinking water source area. These discussions may be aided through the use of the tools provided in this section.

The tools provided in this section are intended to be used by public water system staff, managers, and community leaders with assistance received from their regional or county *partner organization*. A partner organization for community-led drinking water protection efforts are most often the local Soil and Water Conservation District (SWCD), watershed council, the university extension office (OSU), the USDA NRCS district, and/or possibly a contracted natural resources consultant. Early involvement of a partner organization is critical in order to ensure that screening tools are accessible, used properly, and are effective. Partner organizations may also be able to assist with follow-up efforts that may require grant writing and additional funding when in-depth investigation of natural resources may be deemed necessary. It is important that public water systems and community leaders involve their regional partner organization at the outset when using screening tools provided in this section. The consolidated list of potential partner organizations for Oregon counties can be found in Section 3.0.

The authors of this resource guide would like to stress that ***none of the tools provided in this section are regulatory***. Instead, the use of the tools are highly encouraged. A community’s decision to put the screening tools into use represents a community effort towards the broader, long-term goal of drinking water source protection planning. The tools provided in this section do not attempt to model a watershed, an aquifer, or the transport or fate of contaminants. Rather, they are viewed more as screening tools that provide preliminary information for informing community-led discussions aimed at drinking water source protection. Screening tools provide a cost-effective way

to focus and prioritize limited resources where community planning efforts are expected to yield the greatest benefit to drinking water source protection. None of the tools in this section should be considered “definitive” analysis or a “risk analysis” for groundwater vulnerability, nitrate leaching, or pesticide leaching.

Land Cover Maps

The Updated Source Water Assessments (sent to each public water system) include maps showing current land uses within the drinking water source areas. More detailed mapping is sometimes available, depending on data sources being updated on a regular basis. Public water systems can also request tax-lot data from local city or county agencies. At present, when a public water system requests a more detailed land use map from DEQ for their drinking water source area(s), the community will receive the most updated imagery available from the *USDA National Agricultural Statistics and the National Land-Cover Database* (USDA 2015).

Since the drinking water source areas (for 10-15 years of flow) for groundwater systems are generally very small, it is important to develop a detailed land use cover map in order to prioritize pollutant reduction strategies. For the groundwater public water systems in the Willamette Valley and Eastern Oregon, it is not unusual for the entire drinking water source area to be in productive agricultural lands. For those, it is much more useful to provide details of what the agricultural lands are currently producing.

Table 2 provides a list of example land covers that can be identified through imagery. The methodology for the USDA National Agricultural Statistics (NASS) imagery is to identify one of over 240 unique agricultural land covers, referred as “Cropland Data Layers (CDL)”. The metadata for generating the source CDL imagery is referenced in Section 8.0 (USDA, 2015). After identifying the CDL covers, the tool then identifies each of the non-agricultural land covers as provided by National Land-Cover Database (NLCD). The NLCD is a result of work by a federal agency consortium. The two sources of data are combined within this recommended Land Cover Map tool.

| National Land Cover Database Classifications (NLCD 2011) | Continental US Land Cover Classifications (CDL 2015) |
|--|---|
| Water/ Barren | CDL Land Use Examples |
| Open Water Perennial Ice/Snow Barren Land (Rock/Sand/Clay) | Alfalfa Barley |
| Developed | Cherries |
| Developed, Open Space - Impervious surfaces are 20% | Grapes |
| Developed, Low Intensity - Impervious surfaces are 20% to 49% | Grassland/Pasture |
| Developed, Medium Intensity - Impervious surfaces are 50% to 79% | Oats |
| Developed High Intensity - Impervious surfaces are 80% to 100% | Onions |
| Forest | Pears |
| Deciduous Forest | Potatoes |
| Evergreen Forest | Sod/Grass Seed |
| Mixed Forest | Sweet corn |
| Shrubland | Winter wheat |
| Shrub/Scrub | |
| Herbaceous | |
| Grassland/Herbaceous | |
| Wetlands | |
| Woody Wetlands | |
| Emergent Herbaceous Wetlands | |
| The classification system used by NLCD2011 is modified from the Anderson Land Cover Classification System* | The complete CDL Land Use listing can be retrieved at: https://www.nass.usda.gov/Research_and_Science/Cropland/sarsfac/s2.php#Section1_9.0 |

Table 2 Example Land Characteristics and Cover Identified through Imagery

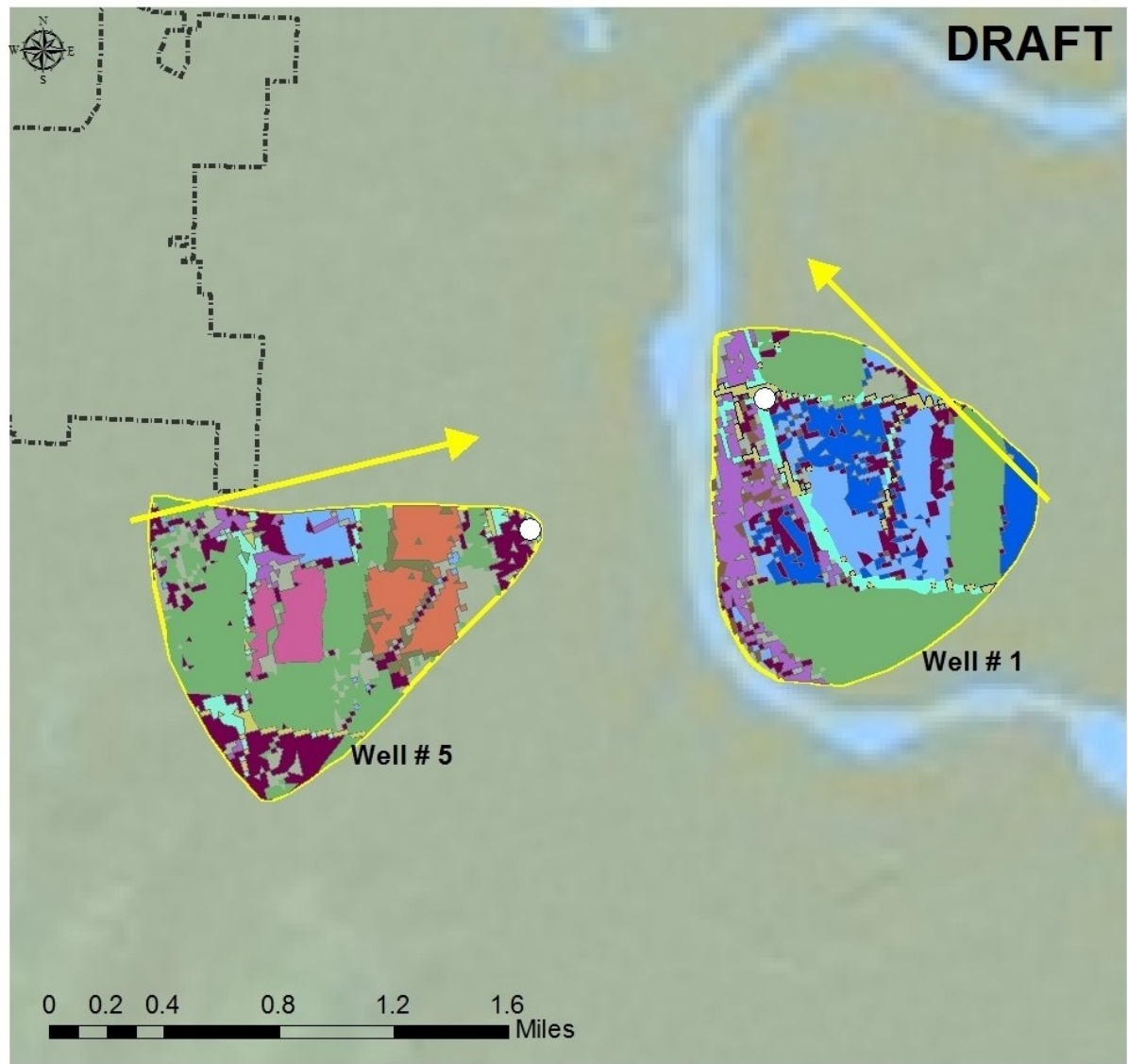
The land cover map is a starting point, or initial assessment of potential management practices or activities within the drinking water source area. An example of a map that displays the capabilities of the tool is provided in **Figure 8** below.

Land Cover Map for Drinking Water Source Areas



Oregon Health
Department of Environmental Quality

DRAFT



Percent of Land Cover for Well #5 Source Area

| | | |
|--------------------------------------|-----------------------------|------------|
| Public Well | Sod/Grass Seed, 37% | [PA = 94] |
| 10 year time of travel recharge zone | Grass/Pasture, 15% | [NLCD2011] |
| City boundary selection | Mint, 12% | [PA = 36] |
| | Winter Wheat, 7% | [PA = 98] |
| | Other Tree Crops, 4% | [PA = 67] |
| | Developed/Open Space, 4% | [NLCD2011] |
| | Herbs, 3% | [PA = 80] |
| | Developed/Low Intensity, 2% | [NLCD2011] |
| | Woody Wetlands, 2% | [NLCD2011] |

Percent of Land Cover for Well #1 Source Area

| | | |
|--------------------------------------|-----------------------------|------------|
| Public Well | Sod/Grass Seed, 34% | [PA = 94] |
| 10 year time of travel recharge zone | Shrubland, 21% | [NLCD2011] |
| City boundary selection | Other Tree Crops, 15% | [PA = 67] |
| | Blueberries, 14% | [PA = 65] |
| | Grass/Pasture, 10% | [NLCD2011] |
| | Woody Wetlands, 10% | [NLCD2011] |
| | Developed/Open Space, 5% | [NLCD2011] |
| | Developed/Low Intensity, 4% | [NLCD2011] |

Notes:
 1. YELLOWARROWS INDICATE GENERAL DIRECTION OF GROUNDWATER FLOW
 2. CONSULT WITH LANDOWNERS / PRODUCERS FOR THE MOST RECENT AND ACCURATE LAND COVER/CROP INFORMATION

Figure 8. Land Cover Map - Example

Figure 8 is an example of a land cover map for a small community with 2 wells serving as their public drinking water sources. The yellow arrow provides the general direction of groundwater flow from upgradient toward the public water supply well (white circle). The land cover imagery is only displayed for the area enclosed by the drinking water source area. The drinking water source area limits are calculated for 10-15 years of time-of-travel, depending on the data available for each particular well. More information on how the drinking water source areas were delineated can be found on the OHA website here:

<http://public.health.oregon.gov/HealthyEnvironments/DrinkingWater/SourceWater/Pages/delfact.aspx>

For this example, using the USDA NASS imagery, the percentage of each land cover classification within the groundwater source areas is listed in the map legend. The accuracy of the cover identified, if available, is also listed in the legend in the following format: [PA = 80], where “PA” represents a producer accuracy in this example of “80%”. When the a land cover is determined to be non-agricultural, it adopts the National Land Cover Database (NLCD) identification categories (Homer et al 2015), for example, “Developed/Low Intensity,” “Woody Wetlands,” and others in order to account for all land covers (see Table 2). Only land covers that comprise at least two percent of the total groundwater source area are listed in the legend of Figure 8. *The land covers shown on the map should always be confirmed through field verification, or through verification with the landowner/producer.*

Urban Homeowners and Pesticides

At present, the use of pesticides in urban settings by homeowners are considerably more heterogenous and unpredictable than agricultural pesticide applications. In high density housing areas, if a good portion of the homeowners are applying pesticides liberally, this could cause a regional problem in groundwater. For this reasons we have chosen to provide a resource that consolidates the a wide range of best use practices for homeowners when attempting to manage pests.

Urban homeowners tend to apply relatively high rates of general use pesticides on a per area basis for the maintenance of lawns, home gardens, and ornamentals plants. Most homeowners apply pesticides with minimal or no training, and they usually apply pesticides without a pesticide applicator license (as general use pesticides do not require an applicator license). For these reasons there is a reasonable likelihood to expect that residential pesticide applications tend to result in off-target transport of pesticides. This means that residential pesticides that are applied near homes may end up traveling below the root zone of the targeted vegetation. These pesticides would be expected to travel on to contaminate the underlying aquifer or a nearby aquifer. Residential pesticide use is also likely to be washed off-site during storm events or through excessive watering, and thereby have the result of contaminating municipal stormwater (surface water pollution). In recognition of this challenge several larger municipalities in the Pacific Northwest created an online tool called Grow Smart, Grow Safe. The tool is both a website (desktop) tool as well as a smartphone/mobile application (<http://www.growsmartgrowsafe.org/>). The tool provides homeowners with non-chemical options as well as



comparative hazard ratings for different products depending on their intended use and application. This is a free resource to the public that is intended to assist homeowners in making informed decisions and thereby lead to a reduction of negative environmental impacts that are commonly associated with pesticide use. Grow Smart Grow Safe organizes its information and ratings by whether the intended user is managing for insects, weeds, plant diseases, and animal pests.

Nitrate Leaching Potential Rating

There is a reasonable likelihood that pesticides and nitrates may occur together in monitoring data or public water system tests. Laboratory results that reveal nitrate detections in groundwater may also be interpreted as a “conservative tracer” for pesticide contamination. This is because nitrates tend to move through a soil, geological layers, and leach into groundwater more readily than do pesticides. When nitrate is detected in groundwater, additional followup testing is sometimes warranted to confirm whether pesticides are also present, and if so, whether the level of pesticide contamination represents a public health concern. As the number and types of pesticides available for use are constantly changing over time, developing a list of pesticide use practices within a drinking water source area and keeping this list updated is valuable for ensuring the safety of public drinking water. In an effort to proactively anticipate those soils that may lead to nitrate leaching, this section provides a tool to interpret nitrate leaching potential in advance of actual detections.

Figure 9 illustrates an example of a nitrate leaching potential rating map for a community’s drinking water source areas using the USDA-NRCS Gridded SSURGO Database through the Web Soil Survey portal (USDA 2016). This tool is designed to evaluate the potential for nitrate-nitrogen to be transmitted through the soil profile below the root zone by percolating water under non-irrigated conditions. An irrigated nitrate leaching potential map is also available. The ratings are based on inherent soil and climate properties, and *do not account for management practices* such as nitrogen fertilizer application rates and timing, or crop rotation.

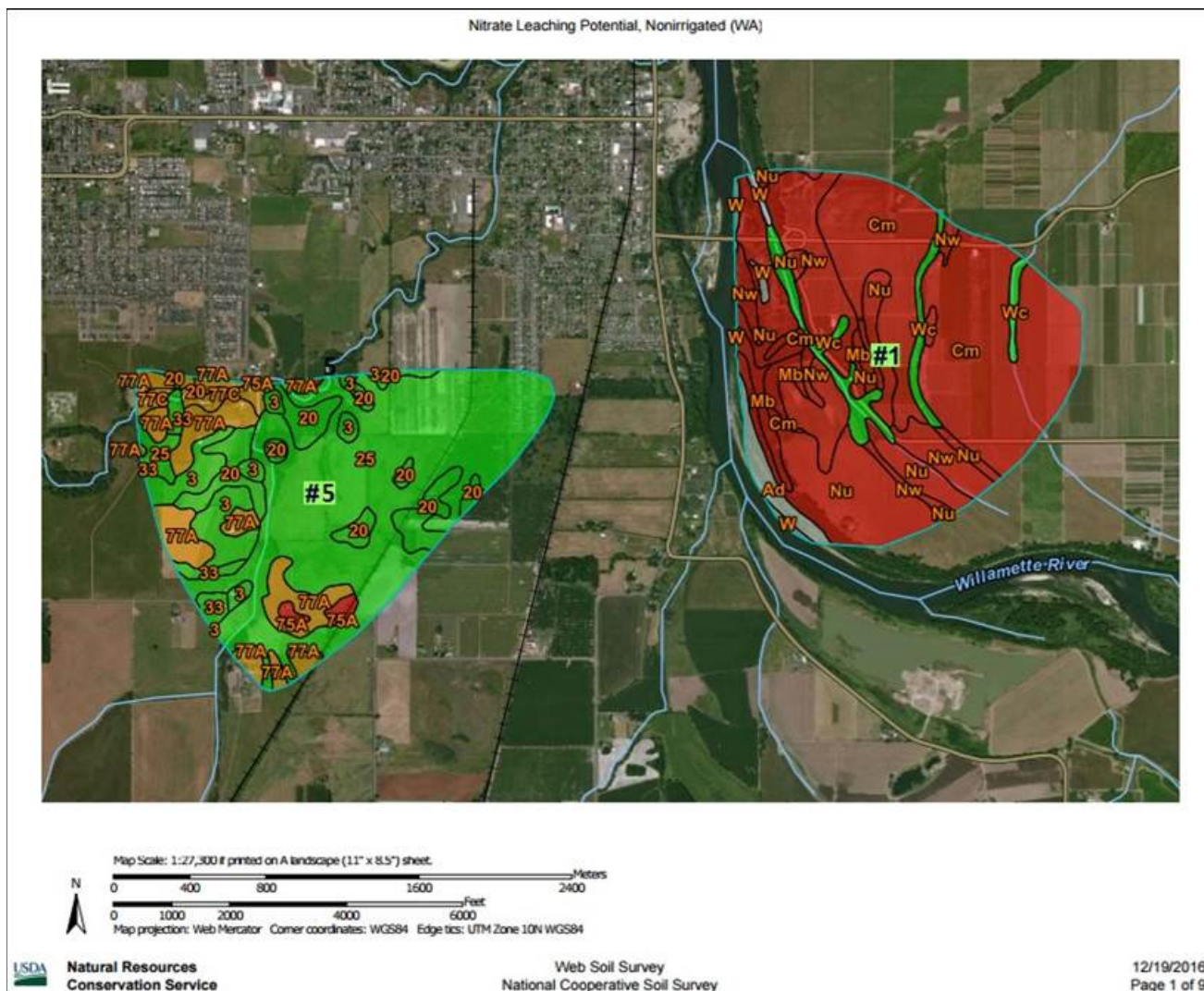


Figure 9. Nitrate Leaching Potential Map - Example

The NRCS Web Soil Survey provides a large number of soil map data layers and information, including the Nitrogen Leaching Potential rating. It is important to note that high nitrate potential leaching ratings do not confirm that groundwater vulnerability in fact exists. Rather, a high rating for soils within groundwater delineation zone means that more information and investigation is needed. In most cases there are multiple nitrate leaching potential ratings that exist within a given groundwater delineation zone (low to high). In all cases, the involvement of a partner organization with technical knowledge when using the tools in this section is strongly encouraged. It may be that landowners within the drinking water source area may have already implemented a number of conservation practices that have reduced the potential for groundwater contamination.

Additional information important to public water system staff and landowners about each soil type can be obtained on the Web Soil Survey site. Note that this example is for *non-irrigated agriculture*. The *irrigated* leaching potential ratings for nitrates in Oregon generally are moderately-high to high

for most soil types. This is primarily because of the way water serves as the vehicle for transporting nitrates and pesticides, as well as other contaminants.

Another tool for rating or predicting potential nitrate leaching is a system originally developed for a project in Washington, however it is equally available and relevant for use in Oregon through selecting an area of interest (AOI) in Oregon. **Table 3** provides the information on the soil type and the percentage of each soil type to correlate with the Figure 9 mapped units.

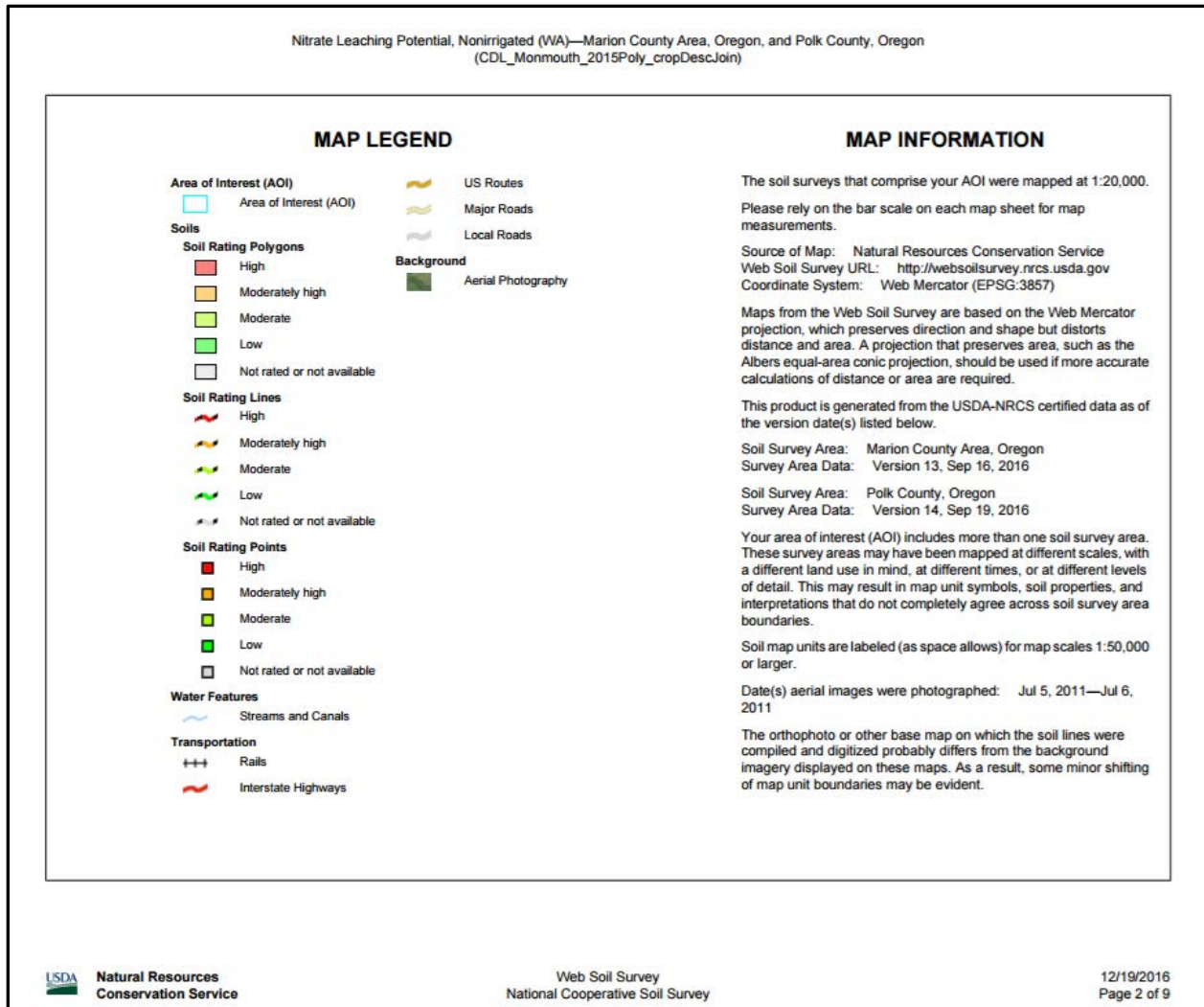


Table 3. Example Nitrate Leaching Potential Data Summary (Page 1 of 5)

Nitrate Leaching Potential, Nonirrigated (WA)

| Nitrate Leaching Potential, Nonirrigated (WA)— Summary by Map Unit — #1, Marion County Area, Oregon (OR643) | | | | | | |
|---|-------------------------|-----------|--------------------------|--|----------------|----------------|
| Map unit symbol | Map unit name | Rating | Component name (percent) | Rating reasons (numeric values) | Acres in AOI | Percent of AOI |
| Ad | Alluvial land | Not rated | Alluvial land (100%) | | 17.6 | 1.4% |
| Cr11 | Cloquato silt loam | High | Cloquato (85%) | Water quantity available for leaching (1.00) | 294.1 | 23.4% |
| | | | | Water travel time (0.90) | | |
| Mb | McBee silty clay loam | High | McBee (85%) | Water quantity available for leaching (1.00) | 18.5 | 1.5% |
| | | | | Water travel time (0.82) | | |
| Nu | Newberg fine sandy loam | High | Newberg (85%) | Water quantity available for leaching (1.00) | 169.6 | 13.5% |
| | | | | Water travel time (1.00) | | |
| | | | | Water holding capacity (0.40) | | |
| Nw | Newberg silt loam | High | Newberg (100%) | Water quantity available for leaching (1.00) | 127.2 | 10.1% |
| | | | | Water travel time (1.00) | | |
| | | | | Water holding capacity (0.20) | | |
| W | Water | Not rated | Water (100%) | | 9.2 | 0.7% |
| Wc | Wapato silty clay loam | Low | Wapato (90%) | Water quantity available for leaching (1.00) | 42.8 | 3.4% |
| | | | | Denitrification due to saturation (0.50) | | |
| | | | | Water travel time (0.22) | | |
| Subtotals for #1 | | | | | 678.9 | 54.1% |
| Totals for Area of Interest | | | | | 1,255.8 | 100.0% |

Table 3. Example Nitrate Leaching Potential Data Summary (Page 2 of 5)

| Nitrate Leaching Potential, Nonirrigated (WA)— Summary by Map Unit — #2, Polk County, Oregon (OR053) | | | | | | |
|--|--|--------|--|--|--------------|--|
| Map unit symbol | Map unit name | Rating | Component name (percent) | Rating reasons (numeric values) | Acres in AOI | Percent of AOI |
| 3 | Amity silt loam | Low | Amity (85%) | Water quantity available for leaching (1.00) | 52.5 | 4.2% |
| | | | | Denitrification due to saturation (0.50) | | |
| | | | | Water travel time (0.35) | | |
| | | | Concord (4%) | Water quantity available for leaching (1.00) | | |
| | | | | Denitrification due to saturation (0.50) | | |
| | | | Dayton (3%) | Water quantity available for leaching (1.00) | | |
| | | | | Water holding capacity (0.78) | | |
| | | | | Denitrification due to saturation (0.50) | | |
| | | | 20 | Concord silt loam | | |
| Denitrification due to saturation (0.50) | | | | | | |
| Dayton (5%) | Water quantity available for leaching (1.00) | | | | | |
| | Water holding capacity (0.78) | | | | | |
| | Denitrification due to saturation (0.50) | | | | | |
| 25 | Dayton silt loam | Low | | | Dayton (95%) | Water quantity available for leaching (1.00) |
| | | | Water holding capacity (0.78) | | | |
| | | | Denitrification due to saturation (0.50) | | | |

Table 3. Example Nitrate Leaching Potential Data Summary (Page 3 of 5)

| Nitrate Leaching Potential, Nonirrigated (WA)— Summary by Map Unit — #2, Polk County, Oregon (OR053) | | | | | | |
|--|--|-----------------|--------------------------|---|----------------|----------------|
| Map unit symbol | Map unit name | Rating | Component name (percent) | Rating reasons (numeric values) | Acres in AOI | Percent of AOI |
| | | | Concord (2%) | Water quantity available for leaching (1.00) Denitrification due to saturation (0.50) | | |
| 33 | Holcomb silt loam | Low | Holcomb (90%) | Water quantity available for leaching (1.00) Water holding capacity (0.79) Denitrification due to saturation (0.50) | 15.7 | 1.3% |
| | | | Concord (2%) | Water quantity available for leaching (1.00) Denitrification due to saturation (0.50) | | |
| | | | Dayton (2%) | Water quantity available for leaching (1.00) Water holding capacity (0.78) Denitrification due to saturation (0.50) | | |
| | | | Willamette (85%) | Water quantity available for leaching (1.00) Water travel time (0.82) | | |
| 77A | Woodburn silt loam, 0 to 3 percent slopes | Moderately high | Woodburn (85%) | Water quantity available for leaching (1.00) | 86.8 | 6.9% |
| 77C | Woodburn silt loam, 3 to 12 percent slopes | Moderately high | Woodburn (85%) | Water quantity available for leaching (1.00) | 14.3 | 1.1% |
| Subtotals for #2 | | | | | 576.8 | 45.9% |
| Totals for Area of Interest | | | | | 1,255.8 | 100.0% |

Table 3. Example Nitrate Leaching Potential Data Summary (Page 4 of 5)

| Nitrate Leaching Potential, Nonirrigated (WA)— Summary by Rating Value | | |
|--|----------------|----------------|
| Rating | Acres in AOI | Percent of AOI |
| High | 617.4 | 49.2% |
| Low | 510.4 | 40.6% |
| Moderately high | 101.1 | 8.1% |
| Null or Not Rated | 26.8 | 2.1% |
| Totals for Area of Interest | 1,255.8 | 100.0% |

Table 3. Example Nitrate Leaching Potential Data Summary (Page 5 of 5)

Using the USDA-NRCS Web Soil Survey (online) map tool to generate a nitrate leaching potential rating map for your community's drinking water source area does not require use of ArcGIS software, nor does it require GIS expertise. By following these steps, anyone with basic computer skills and access to the internet should be able to produce a Web Soil Survey map for their local area of interest. The step-by-step process to produce the map can be carried out through the use of an internet browser. If you have more than one source area, the shapefile will be bundled with multiple areas, and the shapefiles will be attached in an email as a single .zip file.

Steps for creating a soil Nitrate Leaching Potential Map:

1. Request the GIS shapefile of your community's drinking water source area(s) from DEQ (GIS Coordinator 503-229-6798). The shapefile will be provided to you by email.
2. Save the .zip file that was attached to the email on your computer.
3. Navigate to the Web Soil Survey website:
<http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx>
4. In the "Area of Interest" box on the left margin of the screen, select the double chevron that is downward pointing.
5. Click on "Create AOI from Zipped Shapefile."
6. The box will expand and a button will appear, "browse." Click the browse button.
7. A window will appear prompting you to locate the .zip shapefile that you saved from the email. Select the zipped shapefile, then click the Open button.
8. Click the smaller box below the Browse button that reads "Set AOI."
9. ****note**** If a blue-colored information box opens, read it, but then click the Close button.
10. After a few seconds, you should see the delineation zones with an outline and hash marks.
11. ****Note:** at this point you may use this Area of Interest with any other additional Web Soil Survey map data. The following steps will take you to the nitrate leaching rating map layer. ******
12. In the menu tabs that run across the top of the page, click the "Soil Data Explorer" tab.
13. In the left-hand margin of the page, select the "Land Management" drop down button (double chevron bubble).
14. Select the "Nitrate Leaching Potential, Nonirrigated (WA)" (or Irrigated) from the list (or the irrigated version if desired). Note, "WA" does not mean this tool is limited to Washington, it simply was originally developed for Washington.
15. ****Note:** If the soil ratings without mapped colors is desired, skip to step 18 at this point******
16. Also in the same area of the left margin, below the "View Options, and below the "Advanced Options," you will find two buttons. Of the two, click the "View Rating" button.
17. After a few seconds, the color ratings the nitrate leaching potential map will appear.
18. At the very top right corner above the map is a "Printable Version" button. Click this button.
19. A small window will pop-up. Click the "View" button at the bottom, right-hand side of the window.
20. ****Note:** If you have not added Web Soil Viewer as a trusted site for your browser, the printable map may be blocked and you may get a notice. Check with your IT staff/department for help in such cases******
21. After a few seconds, you will see a full nitrate leaching potential map with ratings and a summary data that you can print or save.

For more background on the topic of understanding soil sensitivity to the effects of leaching in Oregon, please see the *Determination of Soil Sensitivity Ratings for the Oregon Water Quality Decision Aid* (OWQDA) (Huddleston et al 1998). While this tool is in the process of being updated, this publication is still useful in understanding the sensitivity of soils to the effects of leaching in Oregon.

Assessing site-specific groundwater vulnerability is a relatively in-depth analysis that in most cases involves obtaining grants and funding in order to do the work. In such cases where nitrate leaching potential ratings for a particular soil are high, and mitigating management practices are few or insufficiently understood, it is recommended to apply for a grant or funding in order to assess groundwater vulnerability (See Funds and Resources in Section 3.0).

Common Crop-Pesticide Associations

Gaining a better understanding of land use activities within a drinking water source area for public supply wells is an important step towards developing strategies for drinking water source protection. As discussed in Section 4.0 above, within the place-based planning approach for drinking water source protection, it is important to use every available data source to identify vulnerabilities and risks to be addressed in risk reduction. After identifying the land uses and activities in the drinking water source area, the next step is to prioritize the reduction work based on the particular chemicals or pesticides that may impact the drinking water system. In this section, tools are provided that enable the public water system staff to identify priority areas regarding potential risks from pesticides.

The association of pesticides with specific land uses can vary over time based upon several factors. Today's producers must continually adapt to many factors when considering what to grow year to year. Some of these factors include: changing commodity prices, climate change, available labor, cost of crop inputs (pesticides and fertilizers), and encroaching urbanization in some areas (see: [//www.oregon.gov/ODA/shared/Documents/Publications/Administration/BoardReport.pdf](http://www.oregon.gov/ODA/shared/Documents/Publications/Administration/BoardReport.pdf)) However, county level statistics suggest that crop selections and their yield tend to be relatively stable over the past two decades. The stability in land use decisions is further supported by the consistency of USDA satellite imagery data (as shown in Figure 8). Proven pest management strategies tend to be carried forward from the previous year into the next. Where a crop-rotation plan is practiced, these operations typically rotate back through set grouping of crops as well as a corresponding set of pest management strategies. The possible variability in crops and pesticides can be addressed through precise mapping and working closely with the local agricultural partners.

Several resources or tools are described here that may be useful in identifying pesticides that are most commonly associated with specific land uses or crops.

Washington State University Cooperative Extension Service operates an extensive resource with information on crops and pesticides. The "Pesticide Information Center Online" (PICOL) can be found at: <http://picol.cahe.wsu.edu/labels/backup/ViewOptions.php?SrchType=C>.

The PICOL database of registered pesticides provides thousands of potential pesticide use associations. It is good resource for drinking water source planning efforts, but the sheer volume of pesticide registrations contained in PICOL means that it may not be the best tool for initiating the drinking water source protection efforts. After initial characterization, the PICOL database may be a secondary research tool for identifying more details of the crop-associated pest management strategies.

Table 4 provides a starting point or a preliminary identification of which pesticides are most commonly associated with specific land uses. Table 4 provides common crop application patterns for the pesticides that are typically applied to more common Oregon crops. The patterns or associations between land uses and pesticides in Table 4 are a result of multiple producer/landowner survey data, pesticide registration information, and published regional strategies for managing pests ([Pacific Northwest Pest Management Handbooks](http://oregonstate.edu/dept/coarc/plant-disease-management-handbook) <http://oregonstate.edu/dept/coarc/plant-disease-management-handbook>). While most of the land uses are specific crops, nursery operations, Christmas trees, and other non-crop land uses are included in these tools as they are available. Please note that this table is simplistic and may not be representative of crop pesticides in your drinking water source area. The table is included for educational purposes only. Local partners will be able to assist in identifying the actual crops and pesticides.

Table 4. Common Crop-Pesticide Associations in Oregon

DATA SOURCES: The majority of the data in this table are survey data provided by the USDA-NASS Agricultural Chemical Use Program, with the additional data sources listed at the bottom of the table. The NASS program is USDA’s official source of statistics about on-farm pesticide use and pest management practices. NASS collects information directly from growers, who participate voluntarily and on a confidential basis. The NASS data are empirical and report actual pesticide use. Estimates were subject to sampling variability; sampling variability was measured by the coefficient of variation (cv), expressed as a percent of the estimate.

| Crop | Type of Pesticide | Predominant | Estimate of % Acres Treated | Additional commonly-used chemicals | Data Source | Year |
|---------|-------------------|--------------|-----------------------------|---|-------------|-------------|
| Alfalfa | Herbicide | Metribuzin | -- | Diuron | 2 | 1992 - 2013 |
| Apples | Fungicide | Triflumizole | 55 | Penthiopyrad, Myclobutanil, Mancozeb, Streptomycin sulfate, Trifloxystrobin | 1 | 2015 |
| Apples | Herbicide | Glyphosate | 49 | -- | 1 | 2015 |

| | | | | | | |
|------------------------------------|-------------|-------------------------|----|--|---|------|
| Apples | Insecticide | Chlorantraniliprole | 58 | Carbaryl, Methoxyfenozide, Spinetoram | 1 | 2015 |
| Blackberries | Fungicide | Cyprodinil; Fludioxonil | 52 | Azoxystrobin, Pyraclostrobin, Captan | 1 | 2015 |
| Blackberries | Herbicide | Carfentrazone-ethyl | 54 | Simazine, Paraquat, Diuron | 1 | 2015 |
| Blackberries | Insecticide | Zeta-Cypermethrin | 64 | Bifenthrin | 1 | 2015 |
| Blueberries | Fungicide | Cyprodinil | 54 | Fludioxonil, Azoxystrobin, Captan, Fenhexamid, Boscalid, Pyraclostrobin, Fenbuconazole | 1 | 2015 |
| Blueberries | Herbicide | Simazine | 35 | Diuron, Flumioxazin | 1 | 2015 |
| Blueberries | Insecticide | Zeta-Cypermethrin | 61 | Malathion, Thiamethoxam, Bifenthrin | 1 | 2015 |
| Cherries, Sweet | Fungicide | Quinoxifen | 54 | Triflumizole, Pyraclostrobin, Boscalid, Trifloxystrobin | 1 | 2015 |
| Cherries, Sweet | Herbicide | Glyphosate | 25 | -- | 1 | 2015 |
| Cherries, Sweet | Insecticide | Imidacloprid | 44 | Fenpropathrin, Malathion, Lambda-Cyhalothrin | 1 | 2015 |
| Christmas Trees¹ | Fungicide | Chlorothalonil | -- | -- | 1 | 2009 |
| Christmas Trees¹ | Herbicide | Glyphosate Iso. Salt | -- | -- | 1 | 2009 |
| Christmas Trees¹ | Insecticide | Chlorpyrifos | -- | -- | 1 | 2009 |
| Corn, Sweet | Herbicide | Atrazine | 95 | Dimethenamid-P | 1 | 2014 |
| Grapes, Wine² | Fungicide | Quinoxifen | 70 | Cyclufenamid, Boscalid, Pyraclostrobin, Fluopyram, Ebuconazole, Triflumizole | 1 | 2015 |
| Grapes, Wine² | Herbicide | Glyphosate Iso-Salt | 67 | Paraquat, Glyphosate Amm. Salt, Carfentrazone-Ethyl | 1 | 2015 |
| Grapes, Wine² | Insecticide | Bifenthrin | 26 | Abamectin | 1 | 2015 |
| Hazelnuts | Fungicide | Chlorothalonil | -- | -- | 7 | 2006 |
| Hazelnuts | Herbicide | Paraquat | -- | 2,4-D | 7 | 2006 |

| | | | | | | |
|--------------------------------------|-------------|---------------------------|----|--|---|-------------------|
| Hazelnuts | Insecticide | Esfenvalerate | 80 | Chlorpyrifos, Permethrin, Pyriproxyfen | 7 | 2006 |
| Hops | Fungicide | Quinoxifen | -- | Pyraclostrobin, Boscalid | 5 | 2013 |
| Hops | Herbicide | Carfentrazone ethyl | -- | Paraquat, Clethodim, 2,4-D | 5 | 2014 |
| Hops | Insecticide | Imidacloprid | -- | Bifenthrin, abamectin (mite), spiridoclofen (mite), hexythiazox (mite) | 5 | 2010, 2013 |
| Mint | Herbicide | Bromoxynil | -- | Bentazon | 3 | 2011 |
| Mint | Insecticide | Chlorpyrifos, Acephate | -- | Chlorantraniliprole | 4 | 2015 |
| Nursery Stock¹ | Fungicide | Chlorothalonil | -- | -- | 1 | 2009 |
| Nursery Stock¹ | Herbicide | Glyphosate Iso. Salt | -- | -- | 1 | 2009 |
| Nursery Stock¹ | Insecticide | Petroleum Distillate | -- | -- | 1 | 2009 |
| Onions | Fungicide | Mancozeb | 48 | Pyraclostrobin, Mefenoxam, Chlorothalonil | 1 | 2014 |
| Onions | Herbicide | Pendimethalin | 88 | Bromoxynil Octanoate, Oxyfluorfen, Clethodim, Dimethenamid-P, Glyphosate | 1 | 2014 |
| Onions | Insecticide | Methomyl | 90 | Spirotetramat, Azadirachtin, Chlorpyrifos | 1 | 2014 |
| Pasture and Hay | Herbicide | 2,4-D | -- | MCPA, Diuron | 2 | 1992 - 2013 |
| Pears | Fungicide | Mancozeb | 84 | Penthiopyrad, Triflumiz ole, Pyraclostrobin, Boscalid | 1 | 2015 |
| Pears | Herbicide | Glyphosate | 42 | 2,4-D | 1 | 2015 |
| Pears | Insecticide | Spirotetramat | 82 | Pyridaben, Pyriproxyfen, Abamectin, Chlorantraniliprole, Etoxazole, Lambda- Cyhalothrin | 1 | 2015 |

| | | | | | | |
|------------------------------|-------------|-----------------------------|----|--|---|------|
| Potatoes ² | Fungicide | Chlorothalonil | 78 | Mancozeb, Mefenoxam, Fluazinam, Azoxystrobin, Boscalid, Fludioxonil, Cymoxanil, Famoxadone, Difenoconazole | 1 | 2014 |
| Potatoes ² | Herbicide | Rimsulfuron | 37 | -- | 1 | 2014 |
| Potatoes ² | Insecticide | Novaluron | 29 | Flonicamid | 1 | 2014 |
| Raspberries | Fungicide | Cyprodinil | 58 | Fludioxonil, Boscalid, Pyraclostrobin, Azoxystrobin | 1 | 2015 |
| Raspberries | Herbicide | Simazine | 42 | Paraquat | 1 | 2015 |
| Raspberries | Insecticide | Zeta- Cypermethrin | 58 | Bifenthrin | 1 | 2015 |
| Ryegrass seed | Insecticide | Chlorpyrifos | -- | -- | 6 | 2002 |
| Strawberries | Fungicide | Boscalid, Pyraclostrobin | 67 | -- | 1 | 2014 |
| Strawberries | Herbicide | Flumioxazin | 54 | -- | 1 | 2014 |
| Winter Wheat | Herbicide | 2,4-D | 49 | Imazamox, Metsulfuron-Methyl, Thifensulfuron, Tribenuron-Methyl | 1 | 2015 |

Notes

- 1 -Cut Christmas tree and nursery survey data from the USDA chemical use program include data from multiple program states, of which Oregon was one of the participating program states.
2 -USDA surveys of Washington wine grape and potato producers were used since Oregon data of this type was not available at the time this table was compiled.

Table 4. Common Crop-Pesticide Associations in Oregon

References/ Data Sources

- 1 -[USDA-NASS] U.S. Department of Agriculture–National Agricultural Statistics Service. 2016. Agricultural Chemical Use Program. Washington, D.C.: USDA National Agricultural Statistics Service, Accessed Online October, 18, 2016:
https://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Chemical_Use/index.php
- 2 -Pesticide use estimates are based upon USGS NAWQA project data. Nancy T. Baker, U.S. Geological Survey, 2016, written communication.
- 3 -Sbatella G and Twelker S, "Weed Control Programs in Mint Based Upon Spring Applied Herbicides to Minimize Rotational Restrictions," Central Oregon Agricultural Research Center, Oregon State University. Accessed online February 2017:
http://oregonstate.edu/dept/coarc/sites/default/files/weed_control_programs_in_mint_based_on_spring_applied_herbicides.pdf
- 4 -Butler M, Walenta D, Sullivan C, Anderson N, Berry R, "Electronic Mint Pest Alert Newsletter to Promote Optimal Application of Coragen (R) to Control Mint Root Borer, Cutworms, Armyworms and Loopers." Central Oregon Agricultural Research Center, Oregon State University. Accessed online February 2017:
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- 5 -O'Neal S, "Pest Management Strategic Plan for U.S. Hops," Washington State University Irrigated Agriculture Research and Extension Center. Accessed online February 2017:
<https://ipmdata.ipmcenters.org/documents/pmsps/US-hops-PMSP2015.pdf>
- 6 -USDA Integrated Pest Management Center, [Report], "Crop Profile for Ryegrass Seed in Oregon." Accessed online February 2017:
<https://ipmdata.ipmcenters.org/documents/cropprofiles/ORryegrass.pdf>
- 7 -DeFrancesco J, Oregon State University, Workshop Summary, "Pest Management Strategic Plan for Hazelnuts in Oregon and Washington." Accessed online February 2017:
http://www.ipmcenters.org/pmsp/pdf/ORWA_Hazelnut.pdf

The data in Table 4 provides a preliminary list for discussing pest management practices that are used within the drinking water source area. As indicated in the notes, there are limitations associated with the data. For example, the USDA surveys of Washington wine grape and potato producers were used since Oregon data of this type was not available at the time this table was compiled. The data on the percentage of total acreage treated are for the first (predominant) pesticide listed by the survey, and the data is not always available. It does not include common "organic-approved pesticides" that may be used in both organic and conventional agricultural systems. The PICOL Pesticide Database was accessed and cross-referenced for Oregon-registered products. Site-specific pesticide use practices should be confirmed through discussions with producers and landowners. These discussions benefit from guidance and assistance provided by the agricultural service partner organizations (see Section 3.0).

The US Geological Survey has done extensive research on pesticides in surface water and groundwater across the country. USGS data on pesticides in US waters can be found here:
<https://pubs.usgs.gov/fs/2006/3028/>

As part of the USGS research, their National Water-Quality Assessment (NAWQA) Program not only does research in pesticide occurrence, but also how that data relates to land use and pesticide use. The NAWQA program is currently working to publish reports on new statistical models that can be used to estimate the concentrations or occurrence of some pesticides in streams and ground water where they have not yet been measured. The national NAWQA data are sufficiently extensive to support these statistical models. The spatial extrapolation allows NAWQA's data on detections, sources and factors that affect pesticide occurrence —such as pesticide use and land use, climate, and soil characteristics—to be used as a more comprehensive national assessment that includes unmonitored areas.

USGS has developed pesticide-use maps that show the geographic distribution of estimated use on agricultural land in the conterminous United States for numerous pesticides. Maps were created by allocating county-level use estimates to agricultural land within each county. Graphs at the county level are available that show annual use by major crop for the mapped pesticides (Thelin et al 2013). These pesticide use estimates are suitable for evaluating national and regional patterns and trends of annual pesticide use (Baker et al 2015). USGS notes that the reliability of estimates generally decrease with scale and these maps are not intended for detailed evaluations, such as within or between specific individual counties. Details for how the pesticide-use maps are made, including data sources and methodologies, are available here:

<https://water.usgs.gov/nawqa/pnsp/usage/maps/>

For purposes of providing additional tools to be used within drinking water source areas, DEQ used the data from USGS and Oregon-specific data for pesticides in statewide water quality monitoring to create a “Categorical Crop to Pesticide Table”. The table is attached as **Appendix 3**. It provides a broad association between common Oregon crops and pesticide use, potentially useful as another starting point in working to develop drinking water protection strategies.

Additional information on pesticides and for crop-pesticide association is the National Pesticide Information Center (NPIC). The NPIC is a cooperative agreement between Oregon State University and the U.S. EPA (#X8-83560101). This site is an important reference for pesticide related information, providing science-based information about pesticides and pesticide-related topics, including information on health/environmental impacts, pest identification, pesticide label and MSDS databases, manufacturers, statistics, and records of exposures, etc. The NPIC site can be accessed at the following location: <http://npic.orst.edu/>

It is important to state again that pesticide use practices may have variability with respect to geography, time/season, and landowner decisions. The site-specific data for chemical and pesticide usage should be verified at the field level. The specific land uses, cropping patterns, and associated pesticides chosen by landowners/producers can change from one year to the next. Agricultural producers may need to adapt new strategies to manage pests. The particular pest pressures will vary from year to year, and chemical companies formulate new pesticides for review and potential registered usage in Oregon. Agricultural service partners (Section 3.0) may be able to assist with the outreach necessary to work with the landowners and operators so that there is an understanding of their practices and product usage.

Conservation Practices

Drawing upon the extensive research available nationwide from USDA, universities, and other organizations, it is well known that some conservation practices are universally beneficial to reducing the potential for pesticides or nitrates to leach to groundwater. To provide background information on potential technical approaches, here are summaries of some of the leading conservation practices:

- Irrigation practices - restricting irrigation based on plant needs and soil water content can reduce the potential for pesticides to be moved off-target to contaminate groundwater (as well as surface water). A selection of free-for-use desktop and mobile irrigation scheduler applications for multiple irrigation methods are available at the WSU Extension website: <http://irrigation.wsu.edu/Content/Select-Calculators.php>.
- Timing of pesticide applications – observing weather patterns and avoiding the application of pesticides preceding rain events considerably reduces the potential for off-target pesticide movement.
- Quantity of pesticide application—precision agriculture techniques are allowing producers to better utilize pesticides and their efficacy as a win-win for producers’ profits and a way to reduce the potential for groundwater contamination.
- Nutrient management – calculating the necessary nutrients using soil characteristics can maximize yields and protect water quality.
- Integrated Pest Management --developing non-chemical solutions (e.g. crop rotations, trap crops, beneficial insects, etc.)
- Conservation tillage — integrating crop residual through tillage and reduced tillage practices can provide increased returns in crop yield, enhanced soil health (increased nutrients and organic matter, better water infiltration and storage), and reduced erosion and water pollution (USDA 2016).

The above points are a few of the key strategies that can lead to increased profits while at the same time reduce costs and risks of off-site movement of agricultural crop products. A sampling of current innovations in IPM can be accessed through the OSU Integrated Plant Protection Center website at: <http://www.ipmnet.org/index.htm>

Additional strategies for IPM can be found from local partner organizations in your county (Section 7.0). *These same resources should also be consulted for technical assistance when attempting to use or implement the tools provided in this section of the guide.*

Nutrient Management

Municipal stormwater contributes a considerable amount of nitrogen from fertilizers used on urban private and commercial properties. On a per area basis, a relatively high amount of nitrogen and other macronutrients are applied to lawns, gardens, and ornamental plants throughout cities. The high rate of application, when combined with large amounts of impervious surfaces in urban settings, presents a considerable challenge to manage nitrogen and other nutrients for city planners. Urban zoning laws and building codes are increasingly taking into account over time the influence of impervious surface effect and the corresponding need to construct bioswales, buffers,

and constructed wetlands to mitigate these effects. In most cases these requirements are only placed upon new and larger-sized development projects and they do not apply to existing or previously completed projects. In 2014, DEQ issued “Oregon’s Nutrient Management Program” guidance that discusses sources and source control for nutrients in Oregon:

<http://www.oregon.gov/deq/FilterDocs/NutrientManageRep.pdf>

Many tools for urban nutrient management can be found on this US EPA website:

<https://www.epa.gov/nutrientpollution/what-you-can-do>

In agricultural areas, the Oregon Department of Agriculture (ODA) addresses excessive nutrient runoff through implementation of its 38 Agricultural Water Quality Management Area plans and rules. Numerous financial incentives are available to encourage agricultural landowners to reduce nutrient runoff and off-site movement, including programs through the state Soil and Water Conservation Districts, Oregon Watershed Enhancement Board, DEQ’s Section 319 nonpoint grants, and federal grant programs. The Oregon Department of Forestry also addresses nutrients in its fertilizer application management program.

Cover crops and no till operations have the benefit of reducing or even eliminating the need for fertilizer application, they reduce the leaching of nutrients, and they are protective of our shared drinking water resources. ODA assists farmers and ranchers in Oregon to prevent and control nutrient pollution from agricultural activities on rural lands. More information on agricultural water quality plans and programs can be found here:

<http://www.oregon.gov/ODA/programs/NaturalResources/AgWQ/Pages/AgWQPlans.aspx>

Nutrient management within the agricultural sector is extremely important for maximizing yields and protecting water quality. Calculating the necessary nutrients for cultivating crops begins with obtaining soil samples from each field that have distinct soil characteristics and crop cultivation histories. Soil samples are best obtained in the fall so that the remaining fertility after harvest can be factored into the upcoming season’s planned fertilization schedule. The OSU Extension cover crop calculator for regions both east and west of the Cascades Mountain can be found here:

<http://smallfarms.oregonstate.edu/calculator>. The leftover nutrients after harvest can be carried over to the next seasons and the leaching of these nutrients during heavy winter rainfall events can be minimized through the use of winter cover crops.

Obtaining soil test data can allow producers to fine-tune fertilizer application with each consecutive crop cycle. An additional benefit of obtaining soil sample results is that they may influence a producer’s decision for which cover crop to use. When excessive nitrogen remains in the soil, a grass cover crop will effectively take up nitrogen and conserve it for spring planting as a “green manure.” Legume cover crops fix additional nitrogen from the atmosphere. Legumes are best used when soils are deficient for this nitrogen. Legume cover crops are capable of fixing up to 150 pounds per acre—enough nitrogen for some of the most heavy nitrogen feeding crops (Hoorman et al 2009). The organic matter produced during the winter months provide a “soil building” benefit to the soil, effectively increasing tilth for present and future production. The use of cover crops have also been found to “jump start” the increase yields obtained from no-till or conservation tillage

practices (Hoorman et al 2009). Where conversion to no-till operations have taken many as nine years to observe increased yields, combining cover crops with no-till practices have reduced or even eliminated this lag time to see increase yields.

Potential Goals and Outcomes for Using Tools

The tools in this section are provided to assist public water system officials in understanding some of the primary tools and best management practices to reduce off-site migration of pollutants such as nitrates or pesticides. The tools may be useful in the following practical ways:

- for prioritizing technical assistance and outreach efforts
- to inform the creation and composition of an inclusive community-led drinking water protection planning committee
- as a technical basis for submitting grant requests
- as a basis for needing comprehensive modeling of local contaminant sources (e.g. follow-on grants, studies, and/or modeling efforts)
- as justification for new/renewed water quality monitoring/sampling activities

Additional beneficial outcomes are expected to result from using the tools provided in this section. The use of these tools are best done through collaborative place-based planning approaches. *In practice, keep in mind that most of the coordination and collaboration of the agricultural community will be done through your local partners from NRCS and SWCDs.*

6.0 LAND USES AND REGULATORY AUTHORITIES

DEQ, along with the State Departments of Forestry, Agriculture, State Lands, Geology and Mineral Industries, Fish and Wildlife, Parks and Recreation, Land Conservation and Development, and Marine Board have regulatory authority or advisory roles associated with land use activities that potentially impact water quality. Two of the primary mechanisms for DEQ to regulate pollution is through the adoption of water quality standards and Total Maximum Daily Loads (TMDLs) and the related implementation plans. TMDLs and their implementation plans are designed to control source pollution to bring water bodies into attainment with the water quality standards adopted by the state for water bodies in Oregon. Water bodies meeting water quality standards should be readily useable as drinking water sources with standard treatment technology.

In DEQ's rules, a "source" is defined as any process, practice, activity or resulting condition that causes or may cause pollution or the introduction of pollutants to a waterbody (OAR 340-42-0025). Sources of pollutants can be point sources or nonpoint sources. Under ORS 468B.110 (1), DEQ has the specific authority to take the actions necessary to attain and maintain water quality standards and to implement load allocations established under a TMDL. Management strategies to achieve wasteload and load allocations in a TMDL are implemented through water quality permits for those

sources subject to permit requirements in ORS 468B.050 and through source-specific Water Quality Management Plans (WQMP) for other sources.

Nonpoint source pollution is pollution from a diffuse area as opposed to point sources from a discrete pipe, ditch, etc. At DEQ, nonpoint sources are addressed through the following programs: Water Quality Standards, Water Quality Assessment, Groundwater, TMDLs, §319 Nonpoint Source Planning and Grants, Drinking Water Protection, Clean Water State Revolving Fund, Pesticide Stewardship Partnerships, and Water Quality Monitoring. DEQ also coordinates with federal and state agencies that are responsible for nonpoint source issues and identifies them as Designated Management Agencies (DMAs). WQMPs identify the source-specific implementation requirements and the persons, including DMAs, responsible for developing and revising those plans.

There are two areas where DEQ's authority is limited under OAR 340-42-0080 for nonpoint source controls in forested and agriculture land uses. Nonpoint source discharges of pollutants from forest operations on state or private lands are subject to best management practices and other control measures established by the Oregon Department of Forestry (ODF) under the ORS 527.610 to 527.992. DEQ may not impose or enforce effluent limits on nonpoint source discharges from forest operations subject to the State's Forest Practice Act, unless such limits are required by the CWA or other federal law.

The Oregon Department of Agriculture (ODA) regulates agricultural activities through Agricultural Water Quality Management Area rules. In areas subject to the Agricultural Water Quality Management Act under ORS 568.900, the Oregon Department of Agriculture (ODA) develops and implements agricultural water quality management area plans and rules to prevent and control water pollution from agricultural activities and soil erosion on agricultural and rural lands.

Regulatory responsibilities vary by land use and ownership type. It is important that public water systems and community citizens understand which agencies have authority for regulation of anthropogenic activities, the structure of those regulations, and the individual agency responsibilities. *The landowner is ultimately responsible for management activities and potential off-site impacts, so in addition to regulatory agencies, community engagement with landowners in a drinking water source area can be a critical component to implement strategies for improving water quality.*

Aggregate & Mineral Mining / Extraction Wells

Development, use, and reclamation of rock pits or quarries are regulated by the Department of Geology and Mining Industry (DOGAMI). DOGAMI acts as DEQ's agent for water quality permitting (under a *Memorandum of Understanding*) and adds permit conditions to the Operating Permit for each facility to ensure compliance with state regulations. Many quarries contain process water and stormwater runoff on-site which minimizes the risks of groundwater or surface water pollution. Landowners are required to obtain the following permits if they discharge process water or otherwise discharge water from their site:

- DEQ WPCF 1000 General Permit--- for disposing of process water by evaporation or seepage in ponds or by irrigation (issued through DOGAMI);

- DEQ NPDES 1200-A General Permit--- for stormwater from the mining operation and haul roads that drains to surface waters (issued through DOGAMI);
- Individual DEQ NPDES or WPCF Permit--- for discharging process wastewater to surface water or groundwater (issued by DEQ).

Rock pits or quarries located on forestland and used for forest management are exempt from needing a DOGAMI mine operating permit but under the Forest Practices Act (OAR 629-625-0500), they “shall be conducted using practices which maintain stable slopes and protect water quality”. On forestlands, the regulating agency for rock pits or quarries is the Department of Forestry.

DOGAMI is also the permitting agency for extraction wells, such as gas, oil, and geothermal wells. DOGAMI coordinates with DEQ to address NPDES or WPCF permitting to protect groundwater quality. More information on the permits for surface mining, wells, or chemical process mining in Oregon can be found here:

<http://www.oregongeology.org/mlrr/default.htm>

Agricultural Lands

Oregon regulates agricultural activities through programs administered by the Oregon Department of Agriculture (ODA). The Confined Animal Feeding Operation (CAFO) Program regulates animal facilities such as dairies and large chicken and hog operations. CAFOs are point sources of pollution under Oregon and federal law, and many must have a permit to operate. The permits provide for zero effluent discharge limits. For more information, please go to:

<http://www.oregon.gov/ODA/programs/NaturalResources/Pages/CAFO.aspx>

The Agricultural Water Quality Management (AgWQM) Program regulates animal production activities not regulated by the CAFO Program and all other agricultural activities that may impact water quality. The Agricultural Water Quality Management Act, formerly referred to as Senate Bill 1010, gives ODA the authority to establish management plans and adopt rules to prevent and control water pollution from agricultural lands. These areas include those where an agricultural water quality management plan is required by state or federal law, such as DEQ TMDLs and Oregon Groundwater Management Areas (ORS 568.909). ODA’s AgWQM area plans and rules are the official TMDL implementation plans for agricultural nonpoint sectors.

There are 38 management areas throughout the state with area plans and the rules that regulate agricultural activities to prevent and control water pollution. All 38 management areas have riparian rules requiring that agricultural activities allow the establishment and growth of stream-side vegetation to provide specific functions such as: moderation of solar heating (shade), filtration of overland flow, and stream bank stability. Further information can be found here:

<http://www.oregon.gov/ODA/programs/NaturalResources/AgWQ/Pages/AgWQPlans.aspx>

ODA’s Pesticide Program regulates the sale and use of pesticides in Oregon. Program staff conduct routine compliance monitoring, investigate complaints of alleged pesticide misuse, and administer enforcement actions when appropriate. Enforcement actions, including civil penalties, play a vital role in deterring unlawful use of pesticides. Additional responsibilities include communicating the laws and regulations to licensed pesticide applicators and the public. This is done through

continuing education training resources, informational brochures, the ODA website, and one-on-one communication. For more information about ODA's regulatory authorities, see: <http://www.oregon.gov/ODA/agriculture/Pages/Laws.aspx>

Commercial and Industrial Lands

Groundwater can be susceptible to contamination from many different commercial or industrial land uses. DEQ is responsible for waste reduction and management from commercial and industrial activities, air quality monitoring, spill preparedness and response, environmental assessment and cleanup, and underground storage tank compliance and cleanup. Oregon's Toxics Use Reduction and Hazardous Waste Reduction Act of 1989 was one of the first laws in the nation to mandate pollution prevention planning. The Act outlines a comprehensive approach to reduce or eliminate toxic chemical use and hazardous waste generation. In June 2005, the Oregon Legislature passed a law (Oregon Revised Statute 465.003 to 465.037) that streamlined and made other significant changes to the Toxics Use and Hazardous Waste Reduction Program.

Large toxics users, large quantity generators and small quantity generators must prepare a Reduction Plan or an Environmental Management System. As part of the planning, a facility must evaluate options to reduce its toxics and hazardous wastes. Materials that must be in the plan include any toxic substance reported to the U.S. Environmental Protection Agency under the Toxics Release Inventory program.

Since the Act's adoption, businesses throughout Oregon have reduced their toxic chemicals and hazardous wastes. DEQ publishes pollution prevention stories to explain how businesses are reducing their toxics and hazardous waste. In the program's 21 years, businesses have voluntarily reported: reducing more than 31.5 million pounds of hazardous waste with savings estimated at \$5.25 million, and reducing more than 56.25 million pounds of toxic chemicals with savings at over \$15 million.

For more information on toxics reduction, see: <http://www.oregon.gov/deq/Hazards-and-Cleanup/ToxicReduction/Pages/default.aspx>

When there are spills or releases that contaminate groundwater, DEQ's Site Assessment program investigates hazardous substance sites that may require further action to protect health and the environment, ranks sites based on threat to human health and the environment, overseeing limited removal and remedial actions, and maintains DEQ's Environmental Cleanup Site Information database. When extensive investigation and appropriate cleanup of hazardous substance site is necessary to protect public health and the environment, the Site Response program works to investigate and clean up contaminated hazardous waste sites throughout Oregon.

Federal Lands

Federal lands in drinking water source areas are primarily forestlands managed for multiple uses including watersheds and water quality, biodiversity and endangered species, recreation, and forest products. The US Forest Service and the Bureau of Land Management manage these lands in

National Forests and Districts, respectively. Each National Forest and BLM District has a unique management plan, but all have common features. In the past, the federal agencies have entered into agreements with municipalities and water districts to ensure protection of drinking water sources on federal lands.

In August 2016, BLM approved new Resource Management Plans (RMPs) for western Oregon. The approval marked the end of a four-year effort by the BLM to use new science, policies, and technology to protect natural resources and support local communities. DEQ's drinking water protection staff evaluated the proposals to provide input to BLM so that those federal lands will continue to provide high quality water for ecosystems and domestic use.

These RMPs provide direction for the management of approximately 2.5 million acres of BLM-administered lands, and maintain strong protections for the northern spotted owl, listed fish species, and water resources while offering predictable and sustainable outcomes for local communities from tourism, recreation, and timber harvest. For more information on the BLM plan and implementation, see:

<https://www.blm.gov/programs/planning-and-nepa/near-you/oregon-washington/rmps-westernoregon>

Forest Lands

Forestry activities on state-owned and private lands are regulated by the Oregon Department of Forestry (ODF). The rules, referred to as the "Forest Practices Act", are implemented by ODF and address the overall maintenance of the following resources: (a) air quality; (b) water resources, including but not limited to sources of domestic drinking water; (c) soil productivity; and (d) fish and wildlife (ORS 527.710(2)). The forest practice rules include water protection provisions governing activities in or adjacent to water bodies, wetlands, and riparian areas (OAR 629-635-0000 to 629-660-0060). The overall goal of the water protection rules is to provide resource protection during operations adjacent to and within streams, lakes, wetlands and riparian management areas so that, while continuing to grow and harvest trees, the protection goals for fish, wildlife, and water quality are met.

Forest practice rules related to water quality (as prescribed in ORS 527.765) must ensure that, to the maximum extent practicable, non-point source discharges of pollutants resulting from forest operations do not impair the achievement and maintenance of the water quality standards (OAR 629-035-0100(7)(a)-(c)). Forestry rules specify harvest protections for riparian areas and some steep slopes, chemical use (including pesticides), reforestation requirements, and road construction and maintenance.

Rules for private forests can be found here: <http://www.oregon.gov/ODF/Pages/lawsrules.aspx>

An illustrated guide to the rules from the Oregon Forest Resources Institute can be found here:

http://oregonforests.org/sites/default/files/publications/pdf/OR_For_Protect_Laws_2011.pdf

State-owned forestlands are referred to as "Board of Forestry lands". Management plans (rules) for state-owned forests can be found here:

<http://www.oregon.gov/ODF/Working/Pages/StateForests.aspx>

The overall goal of managing state-owned forestlands is stated as follows: “Oregon Revised Statutes direct that Board of Forestry Lands shall be managed by the State Forester to ‘secure the greatest permanent value of such lands to the state’.” The goals for state forestlands include maintaining healthy watershed conditions to support the beneficial uses of the waters of the state both in water quality and water quantity. Public water systems with state forestlands within their source area may consider contacting the District or State Forester to ensure that management of the forest to maintain the quality and quantity of public water supplies for community water systems is adequately considered when determining the greatest permanent value of these lands to the state. An economic analysis of the value of the land to provide long-term community drinking water may be helpful for demonstrating this.

Onsite Septic Systems

Approximately 30 percent of Oregon households rely on onsite septic systems to treat their sewage. Properly functioning septic systems treat sewage to minimize groundwater and surface water pollution. A malfunctioning system can be a health hazard and will harm natural resources. Under state law, DEQ is responsible for ensuring that septic systems are sited, installed, and operated so that Oregon’s land, water, and public health are protected. Improperly functioning septic systems can pollute streams and groundwater and be a public health hazard. Owners of onsite systems must operate and maintain their systems in compliance with all permit conditions and applicable requirements in this rule division and must not create a public health hazard or pollute public waters (*OAR 340-71-0130 General Standards, Prohibitions, and Requirements*).

Many counties implement the onsite system regulations within their county on behalf of DEQ, and some counties have additional requirements beyond those in state rules. For more information on regulatory oversight and counties that administer state and local rules, please go to the DEQ Onsite web pages: <http://www.oregon.gov/deq/Residential/Pages/Onsite.aspx>

A new program was initiated in 2016 between DEQ and a regional nonprofit lender “Craft3” to make repairs more affordable for Oregonians in need. The new partnership provides funds to help Oregonians get their septic systems fixed.

The Clean Water Loans will allow homeowners to pay for all costs associated with the project, including:

- Septic system design
- Relevant permits
- Installation of the new septic system
- Ongoing maintenance
- Essential safety measures, such as those to prevent children from falling into septic tanks

Special rates and deferred payment options may be available for homeowners with lower incomes. Homeowners, small businesses and onsite service providers can learn more about the Clean Water Loan program and apply for loans at www.Craft3.org/CleanWater. In addition, several public water

systems have implemented cost-share programs for local homeowners conducting septic system inspections and repairs in areas that could impact drinking water quality if the septic system fails or is not functioning properly.

There are excellent resources available to assist homeowners with septic systems. The “Septic Smart” program discussed in Section 5.0 includes resources for septic system owners for the repair and maintenance of septic systems as this helps protect the quality of groundwater.

Pesticide Regulations

Pesticide use is governed by the Federal Insecticide, Fungicide, and Rodenticide Act and corresponding state law (ORS634.005-.992). Nearly 1,400 pesticides are currently registered and approved by the US EPA for agricultural and non-agricultural use (USHHS 2010). Agencies responsible for implementation in Oregon are the US EPA and ODA, DEQ, and ODF (for non-federal forestlands).

ODA’s Pesticide Program regulates the sale and use of pesticides. Program staff conduct routine compliance monitoring, investigate complaints of alleged pesticide misuse, and administer enforcement actions when appropriate. Enforcement actions, including civil penalties, play a vital role in deterring unlawful use of pesticides. Additional responsibilities include communicating the laws and regulations to licensed pesticide applicators and the public. This is done through continuing education training resources, informational brochures, the ODA website, and one-on-one communication.

Here is a summary and website link for pertinent pesticide programs and resources:

Additional information about pesticide regulation can be found at:

<http://www.oregon.gov/ODA/programs/Pesticides/Pages/default.aspx>

Water Quality Pesticides Management Team – Collaboratively addresses challenges associated with detecting active pesticide ingredients in surface and groundwater sources for the protection of public health and environmental sustainability.

http://www.oregon.gov/ODA/PEST/Pages/water_quality.aspx

Pesticide Water Quality Program – Implements the Pesticide Water Quality Management Plan to protect waters from pesticide contamination. Prioritizes pesticides of concern, establishes water quality guidelines, performs watershed vulnerability assessments, designs and conducts monitoring, recommends management options, and develops communication strategies.

Pesticide Management Plan (2011): <http://www.oregon.gov/ODA/PEST/docs/pdf/wqpmtpmp.pdf>

Pesticide Analytical and Response Center (PARC) – Coordinate investigations to collect and analyze information about reported pesticide incidents that have health or environmental impacts.

Cooperating member agencies: ODEQ, ODF, ODFW, ODOT, OHA, OHSU, Poison Control, OSHA, State Fire Marshall, OSU <http://www.oregon.gov/ODA/PEST/Pages/parc.aspx>

Pesticide Exposure, Safety and Tracking Program - Tracks and investigates health effects reported by people exposed to pesticides.

<http://www.oregon.gov/oha/ph/HealthyEnvironments/HealthyNeighborhoods/Pesticides/Pages/index.aspx>

Human Health Benchmarks for Pesticides (HHBPs) in drinking water - US EPA recently revised this list for 363 compounds that have no drinking water health advisory or SDWA MCL. Public water systems can use this information to respond to detections of pesticides in drinking water. It will be useful to help determine the need for remedial action and assist in crafting appropriate messages for the public about risk. To view the table and supporting information online, go to:

<http://www.epa.gov/pesticides/hhbp>.

As of 2016, the HHBP list includes 11 new benchmarks and 10 updates of existing numbers, with cancer effects added to 40 pesticides. Exposure to various pesticides has been linked to brain/central nervous system, breast, colon, lung, ovarian, pancreatic, kidney, testicular, and stomach cancers, as well as Hodgkins and non-Hodgkins lymphomas, multiple myeloma, and soft tissue sarcoma (Clapp 2007). Approximately 40 chemicals classified by the International Agency for Research on Cancer (IARC) as known, probable, or possible human carcinogens, are used in EPA-registered pesticides now on the market (IARC 2009).

The HHBPs or benchmarks indicate levels in water, below which no adverse health effects are anticipated. The benchmarks include values for short term and lifetime exposure and cover both cancer and non-cancer risks. The benchmarks are based on studies and data that EPA receives through the pesticide registration process.

Health advisories and MCLs for other pesticides can be found at:

<http://www.epa.gov/drink/standards/hascience.cfm>.

Pesticide Data Program - Database provides national data on pesticide residues in food and water.

<http://www.ams.usda.gov/AMSv1.0/science>

Pesticide Container and Containment - ODA agreement with USEPA to ensure proper management and disposal of pesticides. Minimizes risk of environmental release in the event of leaks or spills through inspection of pesticide containers and containment structures, inspection of refilling establishments, and label review to verify instruction on proper rinsing and disposal of pesticide residues. <http://www.oregon.gov/ODA/PEST/Pages/disposal.aspx>

For a summary of Oregon pesticide regulations with regard to drinking water sources, please see:

<http://www.oregon.gov/deq/FilterDocs/pesticideuseVicdws.pdf>

Since 1999, Oregon has been using a voluntary, collaborative approach called Pesticide Stewardship Partnerships (PSPs) to identify problems and improve water quality associated with pesticide use at the local level. The PSP approach uses local expertise in combination with the water quality sampling and toxicology expertise of state agency partners to encourage and support voluntary changes that cause measurable environmental improvements. The key actions include: identifying

local, pesticide-related water quality issues through targeted monitoring, sharing results early and often with local stakeholders, explaining data in relation to effects and water quality criteria, engaging the agricultural community for identifying and implementing solutions, and using ongoing effectiveness monitoring to measure success and provide feedback to support water quality management.

PSPs use both water quality and crop quality as measures of success. Pest management and water quality management must both be effective for long-term stewardship of natural resources. As DEQ and ODA implement the PSP projects, there has been a focus on agricultural and some urban areas to date, but DEQ is also working with ODF and urban stakeholders with the goal of increasing the PSPs reach into urban and forested landscapes.

Currently there are nine partnerships in eight watershed areas. The eight include Hood River; Mill Creek and Fifteenmile Creek (in Wasco County); the Walla Walla River; Clackamas River; Pudding River; Yamhill River (Yamhill Pesticide Stewardship Partnership for rural and urban areas, and South Yamhill River Pesticide Stewardship Partnership, for a forested area of the watershed); Amazon Creek watershed project in Eugene; and the Middle Rogue. Periodically, work has also been done in “pilot” areas to assess the need for continued monitoring and technical assistance. These partnerships receive guidance from an inter-agency Water Quality Pesticide Management Team. This team developed a statewide plan to protect water quality from pesticide impacts. It also designates priority pesticides that could affect water quality, and helps evaluate monitoring data. In 2013, the Legislature allocated stable funding to ODA and DEQ to expand the program to additional watersheds.

In addition, DEQ and ODA work with many of the same partners to conduct pesticide waste collection events in watersheds where Pesticide Stewardship Projects are active, as well as other areas of the state. The purpose of these events is to reduce the risks of accidental releases of unwanted pesticides into surface or groundwater and provide a cost-effective disposal option for pesticide users.

DEQ’s drinking water protection program provides information on public drinking water source areas and public water system partners to help prioritize areas for Pesticide Stewardship Partnership implementation. Several waste pesticide collection events benefiting drinking water source areas occurred in 2014, including a project in Milton-Freewater that collected more than 15,000 pounds. The collection area for the Milton-Freewater pesticide waste collection event included the drinking water source area for Milton-Freewater’s public supply wells, serving over 7,000 people.

For more information on the PSP program, see:

<http://www.oregon.gov/deq/wq/programs/Pages/Pesticide.aspx>

Private Domestic Wells

Any source of household water that is a hole drilled, bored, or dug into the ground to reach water is called a “well”. All types of wells can provide drinking water or can be used for non-potable uses

such as irrigating and washing. A well is considered private domestic if it serves no more than three households. The federal Safe Drinking Water Act does not regulate private wells. Individual well owners are entirely responsible for the testing and safety of the water drawn from their wells.

In Oregon, there is a resource to assist private well owners with managing their well and promote safety. The *Oregon Domestic Well Safety Program (DWSP)* provides technical information and limited resources to assess and manage risks associated with private wells. Oregon DWSP partners with local health departments and water information providers to further promote private domestic well safety. See the Oregon DWSP website for information:

<http://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/DRINKINGWATER/SOURCEWATER/DOMESTICWELLSAFETY/Pages/index.aspx>

The Oregon Water Resources Department (WRD) regulates well construction and abandonment for groundwater wells. For information on private well regulations and technical assistance with construction or modifications, see WRD's "Water Well Owner's Handbook".

WRD is a strong partner in Oregon for protecting the groundwater resource, public health and safety by adopting policies and/or procedures to insure proper well construction and abandonment. Proper well abandonment procedures are outlined in OAR 690-Division 220. Contamination from improperly abandoned or used wells can threaten other wells over a large geographical area. As development overtakes lands on which wells are located, it is important to protect the groundwater resource through proper abandonment of unused water wells. Improperly abandoned wells can serve as a conduit for contamination or can cause loss of artesian pressure. Domestic uses and even municipal uses can be threatened by even one improperly abandoned well.

For developments on which the future use of existing wells is not anticipated, proper abandonment of wells (permanent or temporary) is very important to protect the groundwater resource. Any well that is not going to be used must be abandoned to standards established by the State of Oregon. Also if there is a suspicion that there are contaminants in any well, DEQ should be contacted before any action is taken.

In addition to protecting the groundwater resource, proper abandonment protects the land owner and developer from civil liability and civil penalties. Proper abandonment before any damage occurs to the well and/or the aquifer is worth the cost in comparison to the cost of abandonment after the fact. The advantages to proper well abandonment are to:

- protect the groundwater resource,
- lower cost than "after the fact repairs", and
- avoid liability and potential civil penalties

Local jurisdictions may wish to consider the following criteria for determining their policies.

1) Unused water wells must be permanently abandoned if the well:

- will no longer meet well construction standards,
- poses a threat to health and safety (hand dug and shallow wells are of particular concern), or

- will no longer meet local set-back requirements.

2) Unused water wells with the following risk factors are of concern because of the increased risk of contamination:

- proximity to roads, large parking lots, sewer lines, certain industrial uses, feed lots, quarries, nursery and greenhouse operations, liquid fuel transmission lines and flood plains;
- wells that may provide the opportunity for cross connections of aquifers;
- any unsecured large-diameter well (also a public safety concern); and/or
- the connection to another system not protected by a back-flow device.

For more information on maintenance and closure of private wells, see the following site:

https://www.oregon.gov/owrd/pubs/docs/Well_Water_Handbook.pdf

The Domestic Well Water Testing and the Real Estate Transaction Database requires sellers of a property with a private domestic well to have the water tested for arsenic, nitrate and total coliform bacteria. Results must be sent to the buyer and OHA. For more information on the program and the data generated by the program, see OHA's website:

<http://public.health.oregon.gov/HealthyEnvironments/DrinkingWater/SourceWater/DomesticWellsafety/Pages/Testing-Regulations.aspx>

Public Drinking Water Wells

For Oregon public water system wells, there are state rules that include prohibitions for certain land uses, activities, and chemical storage in the vicinity of the well. Certain sanitary hazards are prohibited within 100 feet under Oregon Health Authority (OHA) rules:

333-061-0050 Construction Standards

(1) General:

(a) These standards shall apply to the construction of new public water systems and to major additions or modifications to existing public water systems and are intended to assure that the system facilities, when constructed, will be free of public health hazards and will be capable of producing water which consistently complies with the maximum contaminant levels...

(2) Groundwater:

(a) Wells:

(A) For the purpose of this rule, wells are defined as holes or other excavations that are drilled, dug or otherwise constructed for the purpose of capturing groundwater or groundwater in hydraulic connection with surface water as a source of public drinking water...

(E) The following sanitary hazards are not allowed within 100 feet of a well which serves a public water system unless waived by the Authority: any existing or proposed pit privy, subsurface sewage disposal drain field; cesspool; solid waste disposal site; pressure sewer line; buried fuel storage tank; animal yard, feedlot or animal waste storage; untreated storm water or gray water disposal; chemical

(including solvents, pesticides and fertilizers) storage, usage or application; fuel transfer or storage...

A link to the full text of the rules on the OHA website:

<http://public.health.oregon.gov/HealthyEnvironments/DrinkingWater/Rules/Documents/61-0050.pdf>

Under Oregon Water Resources Department's rules related to water supply well construction, ORS 537, OAR 690-210, and OAR 690-215, there are also restrictions for setbacks:

- 25' from residential underground or above ground petroleum storage tank
- 50' from commercial underground or above ground petroleum storage tank
- 50' setback for septic tanks
- 100' for sewage disposal or line
- 50' from Confined Animal Feeding Operations
- 50' from a closed sewage or storm drainage system
- 50' from any animal waste holding area such as a pond or lagoon
- 100' from sewage sludge disposal area
- 500' from hazardous waste storage, disposal, or treatment facility

Residential Lands

Residential land uses in urban and rural areas are regulated by cities, counties, the Oregon Department of Land Conservation and Development, and, in some cases, regional governments like Metro. The primary potential groundwater impacts from rural residential lands include private domestic wells, animal management, and onsite septic systems. Those issues are summarized separately above. Urban residential lands can also be sources of chemicals from garden and lawn care. Good resources are available to assist with outreach and reduction from those chemicals from DEQ and US EPA.

Water Quality Permits

Construction stormwater, city stormwater in larger municipalities, and sewage treatment are regulated by DEQ through National Pollutant Discharge Elimination System (NPDES) permits. In urban areas, city governments are primarily responsible for regulations. In rural areas, counties are primarily responsible. Rural residential activities related to livestock and farming activities are regulated by ODA. Rules and ordinances vary among cities and counties, so restrictions on residential land activities will be different depending on the location of a given drinking water source area.

DEQ regulates sewage treatment systems and industrial dischargers through the water quality permit program. NPDES-permitted facilities are those which discharge pollutants from any point source, such as a pipe, to state waters. If a facility discharges to the ground, it is a WPCF (Water Pollution Control Facility). Several of DEQ's general permits are administered by other agencies through Memoranda of Agreement or Understanding (MOA or MOU); these include the GEN800 for CAFOs (ODA), GEN1000 for gravel mining (Oregon Department of Geology and Mineral Industries;

DOGAMI), NPDES 1200A for off-site discharge of storm and process water from gravel mining (DOGAMI), 1200C and 1200CN for stormwater runoff from construction activities administered by various local government agencies. Other permits are administered directly by DEQ.

National Pollutant Discharge Elimination System (NPDES) permits from DEQ are required for stormwater and process discharges to surface waters from construction and industrial activities and larger municipalities if stormwater from rain or snow melt leaves a site through a "point source" and reaches surface waters either directly or through storm drainage. As a result, stormwater discharges from large and medium sized municipal storm sewer systems are required to have NPDES permits. Similarly, NPDES stormwater permits are required for most industrial properties and for construction affecting one acre or more of land, including projects that are less than one acre that are part of a larger common plan of development that ultimately disturbs one acre or more.

DEQ regulates Underground Injection Control (UIC) well discharges. DEQ issues permits for UIC systems under the Safe Drinking Water Act to protect groundwater quality. Injection systems are any discharges below the ground or subsurface including geothermal systems, large capacity septic systems, and aquifer storage and recovery systems. DEQ maintains a database of Class V wells. For more information, see: <http://www.oregon.gov/deq/wq/wqpermits/Pages/UIC.aspx>

Runoff from rural communities and rural residential areas remains largely unregulated, except to the extent that it may be covered by an implementation plan developed by a local government or special district as a designated management agency identified under a TMDL. DEQ has clear legal authority to require local governments to address pollution that arises from proprietary-controlled activities. Small rural "farmsteads" are subject to regulation by ODA. Local governments operating as designated management agencies may develop TMDL implementation plans both for properties over which they have proprietary control (e.g. a street system or park) and for areas where they maintain regulatory authority (police power or land use planning) over private property.

7.0 RELATED WATER QUALITY ISSUES/PROJECTS

Climate Change Impacts

The effects of climate change will likely be many-faceted, and will affect groundwater as well as surface water systems. Precipitation, temperature, coastal inundation, and ecosystem changes could all contribute to changes in drinking water supplies (Dalton et al 2013; Dello et al 2010).

The Oregon State Legislature established the *Oregon Climate Change Research Institute* (OCCRI) within the Department of Higher Education in 2007. OCCRI is a network of over 150 researchers at Oregon State University, the University of Oregon, Portland State University, Southern Oregon University, and affiliated federal and state labs. OCCRI is tasked with serving as a clearinghouse for climate change information, developing strategies to prepare for and to mitigate the effects of climate change on natural and human systems, and providing technical assistance to local governments to assist them in developing climate change policies, practices, and programs.

OCCRI also develops periodic assessments of climate change science as it relates to Oregon, and the likely effects of climate change on the state (<http://occri.net/>). It is widely acknowledged that there will be changes in hydrologic patterns in some Oregon basins (Abatzoglou et al 2014). *These changes could affect supplies of water for all uses, and will contribute to increased water quality problems. Reduced availability of water will affect junior irrigators, change water supply planning in many basins, and affect the quality and availability of water for some public drinking water systems.* Proposals for surface water storage may increase. Water quality problems will likely increase the cost of domestic, commercial and industrial water supply and waste disposal. Public water systems may have to invest additional capital to assure adequate availability of source water (USEPA 2015).

Oregon produced a statewide Climate Change Adaptation Framework in late 2010:

http://www.oregon.gov/energy/GBLWRM/docs/Framework_Final_DLCD.pdf

The Framework was developed in part to assess Oregon's capacity to adequately address conditions and issues resulting from climate variability and change. The Framework outlines eleven climate risks, state agency responsibilities related to the risks, gaps in state capacity to address the risks, and actions needed to fill those gaps. The long-term significance of Oregon's Framework is that it outlines the climate-related risks that need to be addressed (in varying degrees) by governments, communities, and individuals across Oregon. The Framework clearly establishes what 'global climate change' means for Oregon.

The Climate Change Adaptation Framework discusses the potential economic impacts for climate change, acknowledging that irrigated agriculture is a primary economic driver in Oregon, so the state economy could suffer with changes in water availability and accessibility. Reduced access to surface water or groundwater could have the potential to significantly affect agricultural productivity until crops suited to new hydrologic conditions are developed. Reduced water availability can increase the cost to produce agricultural and manufactured goods. As surface water quantity is reduced, Oregon will depend more heavily on groundwater resources where available. In the context of long-term drought conditions for Oregon, it makes sense to promote water conservation through public water systems. Reducing the water demands from source areas can be an important component of protecting the drinking water resource, and this will help ensure that the resource is available for future growth and expansion of residential and business needs. For more information on Oregon's comprehensive water resource planning, see the Water Resources Department's Integrated Water Resources Plan at:

http://www.oregon.gov/owrd/Pages/law/integrated_water_supply_strategy.aspx

Groundwater Management Areas

DEQ designates groundwater management areas (GWMAs) when groundwater in an area has elevated contaminant concentrations resulting from nonpoint sources such as farming, onsite septic systems, timber harvesting, or other dispersed human activities. Oregon currently has three groundwater management areas: Northern Malheur County, Lower Umatilla Basin, and Southern Willamette Valley. In each area, DEQ monitors groundwater quality, provides technical assistance

and engages communities to adopt best management practices to reduce groundwater contamination. Public water systems in these areas are encouraged to be part of the implementation activities.

After years of local stakeholder coordination, committee and landowner work, the recent data in the northern Malheur County area indicated that nitrate concentrations in most wells being monitored are decreasing. In the Lower Umatilla Basin area, DEQ recently engaged more than 700 adults and children in educational outreach. In the Southern Willamette Valley, DEQ collaborates with the Oregon Department of Agriculture to study fertilizer application and irrigation methods that best limit nitrate infiltration into the groundwater.

For more information about the GWMA program and project updates, see:

<http://www.oregon.gov/deq/wq/programs/Pages/GWP.aspx>

Total Maximum Daily Loads

DEQ prepares Total Maximum Daily Load (TMDL) and Water Quality Management Plan (WQMP) documents for waterbodies in Oregon designated as water quality limited and on DEQ's 303(d) list of impaired waters. A TMDL uses scientific data collection and analysis to determine the amount and source of each pollutant entering streams. A TMDL is the maximum amount of pollutant that can be present in a waterbody while meeting water quality standards. These maximum allowable pollutant loads are assigned to contributing sources, typically to point sources (wasteload allocations) and land use authorities (load allocations). The WQMP provides the framework for management strategies to attain and maintain water quality standards. The framework is designed to work in conjunction with detailed plans and analyses provided in sector-specific or source-specific implementation plans. The plan designates organizations to prepare and carry out source-specific TMDL implementation plans including the U.S. Forest Service and Bureau of Land Management, the Oregon Departments of Agriculture and Forestry, counties, cities, and others. The implementation plans identify management measures that will be used to achieve and maintain water quality standards.

When TMDLs are developed, it is necessary to identify, assess and implement control measures that limit the known and potential sources of pollutants entering the surface water that did not meet water quality standards. *Any pollutants entering the surface water from groundwater discharge is considered a nonpoint source.* These are evaluated as part of the allocation process when the TMDL is developed. Groundwater is generally a transport mechanism for pollutants entering surface waters and should be considered as part of the load allocations for pollutants. For more information on the TMDL program and status:

<http://www.oregon.gov/deq/wq/tmdls/Pages/default.aspx>

Statewide Toxics Monitoring and Assessment

In a program referred to as "Statewide Toxics Monitoring", the DEQ laboratory staff collect samples on a rotating basin schedule during spring, summer and fall around the state. The DEQ laboratory analyzes seven major categories of toxics, including consumer product constituents, current-use pesticides, legacy pesticides, flame retardants, combustion products, metals, and industrial

intermediates. Access, site appropriateness, species availability and hydrology all determine the types of samples collected. In 2012-13 sampling, DEQ tested for more than 500 unique chemicals using 21 different analytical methods and 128 unique chemicals were detected in that round of sampling. The most commonly detected groups were priority metals and sterols present at 100% of sites, followed by current-use pesticides, at just over 50% of sites sampled. In 2015, DEQ began its second round of monitoring for toxics around the state. The DEQ laboratory is currently collecting water and sediment samples from locations in the Klamath, North Coast, Rogue, and Umpqua basins.

For an update of the status of Statewide Toxics Monitoring, see:

<http://www.oregon.gov/deq/Hazards-and-Cleanup/ToxicReduction/Pages/Reducing-Toxics.aspx>

Sole Source Aquifer Protection Program

The Environmental Protection Agency (EPA) defines a sole or principal source aquifer as one which supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer. The Sole Source Aquifer (SSA) Protection Program is authorized by Section 1424(e) of the Safe Drinking Water Act of 1974 (Public Law 93-523, 42 U.S.C. 300 et. seq). EPA guidelines also stipulate that these areas can have no alternative drinking water source(s) which could physically, legally, and economically supply all those who depend upon the aquifer for drinking water. For convenience, all designated sole or principal source aquifers are usually referred to simply as "sole source aquifers." When an aquifer is the sole or principal drinking water source for the area, which, if contaminated, would create a significant hazard to public health, no commitment for federal financial assistance may be entered into for any project that may contaminate such aquifer.

In Oregon, there is currently only one aquifer designated ---the North Florence Dunal Aquifer. For more information on the program, see:

<http://yosemite.epa.gov/r10/water.nsf/Sole+Source+Aquifers/Overview/>

Collaborative Projects in Agriculture

DEQ and the Oregon Department of Agriculture (ODA) fund groundwater projects through various grant and loan programs. For example, in 2013, DEQ awarded Clean Water Act "Section 319" grants to promote community involvement in groundwater protection in the Rogue Basin, northern Malheur County and southern Willamette Valley. ODA's Fertilizer Grants Program funds studies of the interaction of fertilizers, agricultural amendments or agricultural minerals with groundwater. In 2014, ODA granted \$20,000 towards research on fertilizer management practices in the Southern Willamette Valley Groundwater Management Area and \$50,000 for an independent review of the monitoring program for the Lower Umatilla Basin Groundwater Management Area.

Corrosivity and Lead Exposure

An issue regarding drinking water contamination that has received increased attention in recent years is the potential for it to become contaminated with heavy metals as it travels through the distribution system and the piping at the point of use. The City of Flint, Michigan and its drinking water lead contamination crisis—that occupied national headlines for many months—exemplifies the importance of managing for corrosion prevention in drinking water supplies. A recent USGS data

analysis found that all 50 states and the District of Columbia have at least some groundwater sites that are considered to be potentially corrosive to metal piping, lead solder, and other components.

Using data from USGS, a new map was developed to show the corrosivity and Langeliuer Saturation Index (LSI) for 206 Oregon private wells, public wells, and springs (Belitz et al 2016). The LSI measures the potential for untreated source water to naturally deposit a corrosion-inhibiting mineral layer (scale) within distribution and residential piping. This map is provided as **Appendix 4**.

Lead has been found to cause damage to the kidneys, brain, nervous system, and other health consequences. According to the Center for Disease Control, there is not a safe level of lead exposure that has been found to exist for infants and children. Pregnant mothers are also considered a vulnerable population to the effects of lead poisoning. The EPA's Lead and Copper Rule (LCR) consists of the following four components: a) corrosion control treatment (USEPA 2016), b) replacement of lead service lines, c) treatment of source water, and d) educating ratepayers and the public. An action level for 0.015 mg/L for lead and 1.3 mg/L for copper are set by the LCR. If 10% or more of the customer samples exceed the action level, then the PWS must take additional actions to control corrosion.

The Oregon Health Authority's drinking water program provides the following *important tips for public water systems as lessons learned from the Flint, Michigan drinking water lead contamination crisis*:

1. Revisit your water system materials evaluation to include lead pigtail removal and ensure completion.
2. Review sample site selections and confirm that no lead pigtails remain.
3. Revisit sampling instructions for residents to ensure instructions meet US EPA guidelines—such as no “pre-stagnation flushing,” etc.
4. Sample result invalidation by the state is limited only to lab error, bottle damage/tampering, or site did not meet sample site selection criteria.
5. Revisit your corrosion control treatment, especially when adding a new source or treatment.
6. Ensure consumer notification is timely following routine tap sampling.
7. Ensure required follow-up actions are taken on schedule after any lead action level exceedance, including timely and complete public education.
8. Be transparent to the public in all you do.

See OHA's website for more information:

<https://public.health.oregon.gov/HealthyEnvironments/DrinkingWater/Pages/lead-crisis.aspx>

EPA provides technical guidance for corrosion control in their recent publication found at the following location:

<https://www.epa.gov/sites/production/files/2016-03/documents/occtmarch2016.pdf>

The recent USGS groundwater sampling and analysis shows that some areas in Oregon have an overall potential for being corrosive to PWS distribution and customer piping without treatment. It is important that public water systems work with OHA to assess and reduce this risk of

contamination posed by potentially corrosive water sources. More detailed analysis of potential corrosivity of untreated groundwater sources is provided at the following USGS website: https://water.usgs.gov/nawqa/pubs/gw_corrosivity/

Other Example Groundwater Projects

Rogue Basin: DEQ staff and volunteers conducted the Rogue Basin Groundwater Investigation in 2012, which provided a snapshot of groundwater conditions in 52 selected wells in the Rogue Basin. The study found elevated nitrate concentrations (>3mg/L) in 35% of wells, arsenic was detected in 17% of wells, and low levels of fluoride were found in most wells. A final report was written in 2013 and can be found here:

<http://www.oregon.gov/deq/WQ/Documents/Groundwater/2013RogueGWReport.pdf>

Fifteenmile Creek: DEQ and the Oregon Water Resources Department (WRD) conducted a joint sampling effort in the Fifteenmile Creek area south of The Dalles in 2013. Samples were collected from surface water locations and twenty groundwater wells. One well had nitrate concentrations above the federal drinking water standard of 10 mg/L. Another well had nitrate concentrations just below the federal standard. WRD is using the data reported by DEQ to evaluate the connection between surface water and groundwater in the area.

La Pine Area: DEQ sampled monitoring wells in the City of La Pine and surrounding area, now known as the South Deschutes / North Klamath Counties Groundwater Protection Area in 2014. Previous monitoring found that this area had nitrate levels that were elevated above background levels, but most samples were below the federal drinking water standard. The elevated nitrate levels are due to a shallow underlying aquifer and individual septic systems on small rural developed lots. In addition to testing for nitrate, samples were collected for pesticides, pharmaceuticals and personal care products, to determine if these compounds are contaminants of concern. These results will be used to work with the local entities to develop a pollutant reduction plan for the area.

Southern Willamette Valley: A joint inter-agency project began in 2013 in the Southern Willamette Valley Groundwater Management Area (SWV GWMA). EPA and the Benton Soil and Water Conservation Districts (SWCDs) were awarded two grants to collaborate on a project measuring nitrate losses from fields in areas with improved fertilizer management. Soil water samples from existing and newly placed lysimeters in the GWMA are being collected once a month for 2 years, and analyzed by the DEQ laboratory to determine levels of nitrate and phosphorus leaching below the crop rooting zones in fields using precision agriculture and other innovative fertilizer management practices. Ultimately, all these data will be used to validate a groundwater protection module of the Oregon-approved USDA-NRCS Nutrient Tracking Tool (NTT) for nutrient trading. In addition, these lysimeter data will allow the SWV GWMA Committee to obtain real-time data that can be used in management of the GWMA, and to compare current and innovative best management practices and new agricultural technologies for their effectiveness in reducing nutrient release below the rooting zone.

City of Irrigon: Irrigon developed new public water system groundwater wells in 2007 to replace wells lost due to nitrate contamination. Water quality tests on the new wells immediately showed the presence of nitrate and further monitoring indicated an increasing

nitrate concentration. The City requested help from the Governor's Office and state agencies tasked with preventing groundwater contamination. DEQ and OHA collaborated on a new Source Water Assessment (SWA) document for the city in 2011. This served as a basis for understanding the risks of nitrate and other contaminants affecting the new wells. The City was awarded a Drinking Water Source Protection Fund grant in 2012 to develop strategies and implement protection within the groundwater source area. DEQ worked with City officials and a local task force with other partners (including the County, SWCD, and OSU Extension Service) to implement strategies for nitrate reduction. The County is taking the lead on potential initiatives to reduce the number of large animals on rural lands adjacent to the new supply wells. The City has developed and installed signs informing the public of the protection area. DEQ has provided customized educational materials about onsite systems and private wells to the City for distribution, and continues to provide technical assistance to the City as it implements nitrate reduction activities.

Corvallis Schools: DEQ conducted a groundwater study in the surrounding area as a follow-up to a 2012 USDA study which detected pesticides in groundwater wells supplying two Corvallis-area schools. Thirty domestic wells and three irrigation wells were sampled in October 2013 for nitrate, pesticides, and common ions. Nitrate was detected at 26 of the 30 domestic wells and was over 7 mg/L at 9 of those wells. Pesticides were detected at 26 domestic wells and 2 of the 3 irrigation wells, and were often detected as mixtures. All the detected pesticides were well below the federal drinking water standards, where standards exist. DEQ shared the results with the homeowners by letter and public meeting in early 2014. The Southern Willamette Valley Groundwater Committee incorporated this data into their project.

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APPENDICES

- APPENDIX 1. Source Water Collaborative -- Call to Action**
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APPENDIX 1. Source Water Collaborative -- Call to Action

A CALL TO ACTION – A RECOMMITMENT TO ASSESSING AND PROTECTING SOURCES OF DRINKING WATER

WHY A CALL TO ACTION NOW?

As a nation we face a host of water quality and quantity challenges that are both pressing and ongoing. Persistent threats and challenges, and disastrous chemical spills highlight the importance of safe drinking water to public health and local economies. The public and private costs of inaction can be extensive. Together, we must consider lessons learned over the past decade and apply newly available resources to prioritize threats and protect drinking water sources, both surface and ground water. A realistic assessment of recent events demonstrates that additional action by federal, state, and local partners can and must be taken to effectively protect drinking water sources.

Our Vision for the Future: The Nation's Source Waters are Protected

Our vision includes the following elements:

- **Federal, State, and Local Actions Reflect the High Value of Safe Drinking Water:** The high value of drinking water is widely recognized at all levels of government and among the general public, by regular and systematic actions to help ensure sufficient quantities of high quality water into the future.
- **Source Water Protection is Embedded Into Our Processes:** Source water protection is “hard-wired” into everyday practice at federal, state, and local levels.
- **All Stakeholders Work to Help Protect Drinking Water Sources:** Stakeholders across multiple fields and sectors are invested in source water protection. We can achieve mutual benefits through government agencies, non-governmental organizations, water utilities, communities, emergency response personnel, and businesses/ corporations working collaboratively.

To accomplish this vision, we recommend the following key actions:

- 1** Update/improve source water assessments and protection plans to prioritize risks and actions, by leveraging new data and tools.
- 2** Take priority actions to protect sources of drinking water, working with key partners.
- 3** Coordinate, plan, and communicate in advance with key “upstream” partners as well as within water utilities to help ensure that, in an event, rapid emergency notification is provided to facilitate activation of mitigation measures.



KEY ACTIONS FOR SOURCE WATER PROTECTION LEADERS AND STAKEHOLDERS

DRINKING WATER UTILITIES

Source water protection is part of an effective multiple-barrier approach to ensure the safety and quality of drinking water.

- » Leverage new contaminant information resources to update source water assessments, source water protection plans, and emergency response plans.
- » Work with local/state partners on priority actions that prevent and/or mitigate the potential for source water contamination.
- » Build relationships with emergency responders and staff at sites storing priority contaminants.
- » Develop communication plans to obtain early, actionable information from local and state agencies and potential contaminant sources.
- » Identify funding strategies for priority measures that protect source water.
- » Develop and exercise response and recovery plans for potential contamination events.

LOCAL GOVERNMENTS

Local entities are well situated to address specific local source water concerns through land use planning and collaboration with key stakeholders.

- » Address potential impacts on drinking water quality and public health through land use planning (from plan development and implementation through capital investment), zoning, development regulations, and code enforcement.
- » Disseminate educational information to community members on water quality issues.
- » Coordinate with states and water utilities in developing source water assessments and implementing protective measures.

STATE DRINKING WATER AND OTHER PROGRAMS

Collaboration between state water programs and other influential agencies (agriculture, parks, fish & game, forestry, conservation, and others) provides multiple opportunities to protect drinking water sources.

- » Where source water assessments are no longer current or sufficient for supporting source water protection efforts, encourage and engage in targeted updating of source water assessments in collaboration with drinking water systems, and other state, federal, and local officials.
- » Leverage the Clean Water Act and other programs and authorities to protect water supplies.
- » Communicate key information from source water assessments to stakeholders to guide priority actions and advance protection.
- » Factor source water protection needs into land acquisition and management strategies.
- » Partner with communities and other watershed and ground water stakeholders to implement priority actions.
- » Facilitate community and state-level all-hazards planning.

A CALL TO ACTION TO DEFEND DRINKING WATER

Source water protection ultimately takes place at the local level and, those on the front lines of drinking water protection – drinking water utilities and local governments, supported by state, federal, and community-sponsored programs – have unique opportunities to defend drinking water. Federal agencies can provide tools and data, and leverage programs and authorities to protect drinking water sources. Other source water partners, including Source Water Collaborative (SWC) members and their constituents, also play vital roles. All SWC members and other stakeholders can seize opportunities to establish, participate in or support state and local collaboratives to protect drinking water sources. Defending drinking water is truly a shared responsibility among all concerned stakeholders -- as responses to recent contamination episodes have made abundantly clear.

FEDERAL GOVERNMENT

Land management, environmental, agriculture, scientific, and public health agencies have a role in protecting drinking water sources.

- » Encourage and support collaborative approaches to source water protection between programs at the federal, state, and local levels, including USDA conservation and forestry programs, EPA programs, and all federal programs that support the quality of water resources.
- » Assist state agencies and local communities to improve source water assessments and protection plans by providing information on the nature and quantity of potential contaminant sources, as well as modeling and analytical tools to characterize contaminant transport in surface and ground waters.
- » Continue to expand electronic data sharing among federal offices and agencies to bring the most current and complete datasets possible to bear on source water assessments and protection plans.
- » Identify opportunities to incentivize collaboration between the chemical emergency response community and state and local source water assessment and protection activities.
- » Encourage upstream entities to take on shared responsibility for protecting source water, including enhancing rapid notification of contaminant spills to downstream drinking water utilities.
- » Promote use of Clean Water and Safe Drinking Water State Revolving Fund (SRF) programs to support preparedness and source water protection priorities.

OTHER SOURCE WATER PARTNERS

- » Engage in public participation processes under state and federal programs and local land use planning processes to protect sources of drinking water. In particular, take advantage of opportunities to engage in various Clean Water Act actions and projects to protect sources of drinking water [e.g., water quality standards, Total Maximum Daily Loads, point source discharge National Pollutant Discharge Elimination System (NPDES) permits, nonpoint source project development].
- » Promote grassroots place-based initiatives to advance source water protection.
- » Share data and information to help target source water protection and citizen scientist monitoring.
- » Continue to plan and install soil health best management practices to obtain the multiple benefits of soil health, including improved water quality and drinking water protection.
- » Inform and influence land use decisions that adequately consider potential impacts to drinking water sources.
- » Encourage land conservation practitioners to prioritize working with landowners, drinking water suppliers, and other interested parties to protect undeveloped land that is critically important for protecting drinking water source areas, such as headwater streams, riparian areas, wetlands and intact forests.
- » Communicate the importance of source water protection to local, state, and federal decision-makers.
- » Understand local communities' emergency response procedures for chemical spill events.
- » Adapt positive examples in contingency planning from local source water collaborations.

FOR A COMPLETE COPY OF THE CALL TO ACTION TO DEFEND DRINKING WATER INCLUDING SUPPORTING RESOURCES PLEASE VISIT THE SOURCE WATER COLLABORATIVE WEBSITE AT SOURCEWATERCOLLABORATIVE.ORG

APPENDIX 2.
Pollutant Reduction Strategies for
Common Land Uses / Activities
Within the Drinking Water Source Areas



| <i>Potential Pollutant Type</i> | <i>Potential Impact</i> | <i>Pollutant Reduction and Outreach Ideas</i> |
|---|--|--|
| <p>Chemicals stored or used in close proximity to well or spring</p> | <p>Chemicals, fuels, and equipment maintenance materials may impact groundwater source</p> | <ul style="list-style-type: none"> <input type="checkbox"/> Verify that no fuels, pesticides, fertilizers or other chemicals are used within 100 feet of the well or spring or stored near the wellhead or spring, and that all backup fuel supplies have secondary containment; update inventory as new sources are identified or become known (example: fire-fighting sites using PFAS compounds). <input type="checkbox"/> Consider increased setbacks based on aquifer sensitivity and degree of hazard. See info on Integrated Pest Management (http://npic.orst.edu/pest/ipm.html) for alternative methods. Alternate methods for vegetation management within the well or spring setback may include mechanical removal, mowing, or non-chemical pre-emergent or post-emergent herbicide. <input type="checkbox"/> Correct any outstanding well/spring box construction or casing seal deficiencies. <input type="checkbox"/> Create a spill response plan. <input type="checkbox"/> Acquire spill response equipment and any regulatory required training. <input type="checkbox"/> Ensure all fuels and chemicals have secondary containment. <p>Fact Sheets/Resources *Managing Small Quantity Chemical Use: http://www.oregon.gov/deq/FilterDocs/SQGHHandbook.pdf http://www.oregon.gov/deq/FilterDocs/EPASWPPPracticesBulletinChemUseSmallQ.pdf *Integrated Pest Management: http://npic.orst.edu/pest/ipm.html</p> |

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| <p>Cropland --</p> <p>Irrigated (includes orchards, vineyards, nurseries, greenhouses)</p> <p>Non-irrigated (includes Christmas trees, grains, grass seed, pasture)</p> | <p>Over-application or improper handling of pesticides/fertilizers may impact drinking water.</p> <p>Excessive irrigation may transport contaminants or sediments to groundwater/surface water through runoff or infiltration.</p> <p>Drip-irrigated and non-irrigated crops are considered to be lower risk</p> | <p><input type="checkbox"/> Work with the local SWCD, Oregon State University County Extension Agent, or Natural Resources Conservation Service to actively encourage management measures that protect water quality and develop farm plans when beneficial. Management measures may include: crop production practices, pesticide/fertilizer/petroleum product handling and storage, vehicle/equipment maintenance and repair, livestock waste storage and treatment, hazardous waste management, wastewater disposal/fill, and wells.</p> <p>Agency Websites: Soil and Water Conservation Districts: http://oacd.org/conservation-districts/directory OSU Extension: http://extension.oregonstate.edu/find-us Natural Resources Conservation Service, Oregon: http://www.nrcs.usda.gov/wps/portal/nrcs/site/or/home/ Oregon Department of Agriculture: http://www.oregon.gov/ODA/Pages/default.aspx</p> <p><input type="checkbox"/> Also send relevant fact sheets and information below.</p> <p>Fact Sheets/Resources</p> <p>*Managing Agricultural Fertilizer Application (US EPA source): http://www.oregon.gov/deq/FilterDocs/EPASWPPacticesBulletin_AgFertilizer.pdf</p> <p>*Managing Large-Scale Application of Pesticides: http://www.oregon.gov/deq/FilterDocs/EPASWPPacticesBulletin_PesticidesLargeScale.pdf</p> <p>*Irrigation System Maintenance, GW Quality, and Improved Production: https://catalog.extension.oregonstate.edu/em8862</p> <p>*Guidance for Evaluating Residual Pesticides on Lands Formerly Used for Agricultural Production http://www.oregon.gov/deq/FilterDocs/GuidanceEvalResidualPesticides.pdf</p> <p><input type="checkbox"/> If this land covers a large percentage of your Drinking Water Source Area, notify your local Soil and Water Conservation District (SWCD) of your source area location.</p> <p><input type="checkbox"/> Identify and document any pesticides used to maintain site and areas applied.</p> <p><i>Additional recommendations:</i></p> <p><input type="checkbox"/> Set up or participate in a local material exchange program. http://www.oregon.gov/DEQ/mm/Pages/Material-Recovery-and-Recycling.aspx</p> <p><input type="checkbox"/> Participate in Pesticide Stewardship or Integrated Pest Management Programs (or other efforts, such as pesticide collection events for unused and legacy pesticides) to reduce use of products that threaten water quality: http://www.oregon.gov/DEQ/wq/programs/Pages/Pesticide.aspx</p> <p><input type="checkbox"/> See DEQ factsheet “Pesticide use in the vicinity of drinking water sources” for additional regulations and recommendations: https://www.oregon.gov/deq/FilterDocs/pesticideuseVicdws.pdf</p> |
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| <p>Agricultural activities other than cropland or animal management; includes farm machinery repair areas and equipment maintenance areas</p> | <p>Improper soil management or improper storage or management of cleaning solvents, fuels, petroleum products, pesticides, fertilizers, and irrigation water may impact drinking water</p> | <p><input type="checkbox"/> Work with the local SWCD, Oregon State University County Extension Agent, or Natural Resources Conservation Service to actively encourage management measures that protect water quality and develop farm plans when beneficial. Management measures may include: crop production practices, pesticide/fertilizer/petroleum product handling and storage, vehicle/equipment maintenance and repair, livestock waste storage and treatment, hazardous waste management, wastewater disposal/fill, and wells.</p> <p>Agency Websites: Soil and Water Conservation Districts: http://oacd.org/conservation-districts/directory OSU Extension: http://extension.oregonstate.edu/find-us Natural Resources Conservation Service, Oregon: http://www.nrcs.usda.gov/wps/portal/nrcs/site/or/home/ Oregon Department of Agriculture: http://www.oregon.gov/ODA/Pages/default.aspx</p> <p><i>Additional recommendations:</i></p> <p><input type="checkbox"/> If this land covers a large percentage of your drinking water source area, notify your local Soil and Water Conservation District (SWCD) of your source area location.</p> <p><input type="checkbox"/> Identify and document any pesticides used to maintain site and areas applied.</p> <p><input type="checkbox"/> Set up or participate in a local material exchange program. http://www.oregon.gov/DEQ/mm/Pages/Material-Recovery-and-Recycling.aspx</p> <p><input type="checkbox"/> Other than crops, see DEQ factsheets *"Pesticide use in the vicinity of drinking water sources" for additional regulations and recommendations: https://www.oregon.gov/deq/FilterDocs/pesticideuseVicdws.pdf</p> <p>*Automotive Repair and Maintenance Tips for Drinking Water Protection: http://www.oregon.gov/deq/FilterDocs/dwpautomaint.pdf</p> <p>*Managing Vehicle Washing to Prevent Contamination of Drinking Water: http://www.oregon.gov/deq/FilterDocs/EPASWPPPracticesBulletinVehicleWashing.pdf</p> |
| <p>Grazing animals (as a guideline, only those areas with >5 large animals or equivalent per acre over an extended time)</p> <p>Includes small rural farms,</p> | <p>Improper storage and management of animal wastes and wastewater in areas of concentrated animals may impact groundwater</p> | <p><input type="checkbox"/> Encourage farm operator to work with their local Soil and Water Conservation District (SWCD), Oregon State University County Extension Agent, or Natural Resources Conservation Service (NRCS) to actively encourage management measures that protect water quality. Measures can address livestock waste storage and treatment, wastewater disposal, etc.</p> <p>Agency Websites: Oregon Department of Agriculture: http://www.oregon.gov/ODA/Pages/default.aspx Soil and Water Conservation Districts: http://oacd.org/conservation-districts/directory</p> |

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| <p>boarding stables, auction lots, fairgrounds</p> | <p>and drinking water</p> | <p>OSU Extension: http://extension.oregonstate.edu/find-us Natural Resources Conservation Service, Oregon: http://www.nrcs.usda.gov/wps/portal/nrcs/site/or/home/</p> <ul style="list-style-type: none"> <input type="checkbox"/> Share relevant fact sheets below. <input type="checkbox"/> If this land covers a large percentage of your drinking water source area, notify your local SWCD of your source area location. <input type="checkbox"/> Identify and document any pesticides used to maintain site and areas applied. <p>Fact Sheets/Resources *For grazing animals, provide Oregon NRCS Fact Sheets from this link: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/or/newsroom/?cid=nracs142p2_046062 *Managing Pastures in Eastern Oregon (or Western Oregon) *Managing Stock Water in Pastures and Streamside Areas *Managing Weeds in Pasture and Managing Pastures. (Tips for Eastern Oregon Landowners) *Managing Pastures in Western Oregon (Tips for Western Oregon Landowners) *Providing Stock Water in Fields near Streams *Managing Weeds in Pasture Also, Manure Management in Small Farm Livestock Operations http://animalag.wsu.edu/water%20quality/Tab4em8649.pdf</p> |
| <p>Confined animal feeding operations (CAFOs)</p> | <p>Improper storage and management of animal wastes and wastewater in areas of concentrated animals may impact drinking water</p> | <ul style="list-style-type: none"> <input type="checkbox"/> Verify that the owner or manager has the contact information for the public water system in the Emergency Response section of their Animal Waste/Nutrient Management Plan to ensure timely notification of spills or releases that may impact drinking water supply. <input type="checkbox"/> Contact ODA’s Livestock Water Quality specialist for your area to ensure that all CAFOs that are required to have a permit have one. Ensure the ODA specialist is aware of the public water system well location and that the permit and associated Animal Waste Management Plan are protective of the drinking water supply. Request that existing technical assistance resources and compliance inspections be prioritized for the drinking water source area. <input type="checkbox"/> Note that all permitted CAFOs are regularly inspected on a 10-month rotation and groundwater protection is part of the permit conditions. <input type="checkbox"/> Get notification from ODA on permit modifications or renewals; review/comment as appropriate. <p>Fact Sheets/Resources *Oregon Department of Agriculture CAFO program: http://www.oregon.gov/oda/programs/NaturalResources/Pages/CAFO.aspx US EPA Animal Feeding Operations: https://www.epa.gov/npdes/animal-feeding-operations-afos</p> |

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| <p>Septic systems - residential, farm, commercial on-site systems</p> | <p>If not properly sited, designed, installed, and maintained, septic systems can impact drinking water; use of drain cleaners and dumping household hazardous wastes or pharmaceuticals can result in groundwater contamination; for higher-density septic, cumulative effects of multiple systems in an area may impact drinking water supply</p> | <p>In addition to general residential lands (below), rural lands, commercial/industrial factsheets, share relevant information from list below:</p> <p>Fact Sheets/Resources *DEQ Septic Smart Program web-site: http://www.oregon.gov/DEQ/Residential/Pages/Septic-Smart.aspx *"Septic Smart for Homeowners - brochure": http://www.oregon.gov/deq/FilterDocs/septicowner.pdf *"Managing Septic Systems to Prevent Contamination of Drinking Water": http://www.oregon.gov/deq/FilterDocs/EPASWPPPracticesBulletinSepticSystems.pdf Additional measures may include: <input type="checkbox"/> Make "Septic Smart for Homebuyers" available at local permitting counter or to local realtors: https://www.oregon.gov/deq/FilterDocs/septicbuyer.pdf <input type="checkbox"/> Develop ongoing education program on septic system operation, maintenance and upgrades <input type="checkbox"/> Consider grants to partially fund inspection/repair program <input type="checkbox"/> Implement required inspection program on property transfer <input type="checkbox"/> Refer local homeowners and small businesses to Oregon Onsite loan program that can help with septic system costs: http://www.oregon.gov/deq/Residential/Pages/Onsite-Loans.aspx</p> |
| <p>Wells – private domestic, municipal, commercial, industrial, irrigation, or unused wells</p> | <p>Improperly installed or maintained wells and abandoned (unused) wells may provide a direct conduit for contamination to groundwater and drinking water source</p> | <p><input type="checkbox"/> Notify well owners of closure requirements for unused wells and construction requirements for active wells. <input type="checkbox"/> Ensure local cross-connection program protects public water supply. <input type="checkbox"/> Offer educational programs to residential well owners on proper maintenance and drinking water protection. <input type="checkbox"/> Provide financial incentives for permanent well abandonment according to the Water Resources Department’s (WRD) “Water Well Owner’s Handbook” (Provided well construction is adequate, temporary abandonment will be protective of groundwater--- contact WRD Staff for assistance, and provide a well log.) <input type="checkbox"/> Verify proper well abandonment. <input type="checkbox"/> Adopt local ordinance or internal procedures to ensure compliance with WRD well abandonment requirements prior to development. <input type="checkbox"/> Share applicable information from list below:</p> <p>Fact Sheets/Resources *Domestic Well Safety Program –Oregon Health Authority</p> |

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| | | <p>http://public.health.oregon.gov/HealthyEnvironments/DrinkingWater/SourceWater/DomesticWellSafety/Pages/index.aspx</p> <p>*Groundwater Basics: http://www.oregon.gov/deg/FilterDocs/GroundwaterBasics.pdf</p> <p>*Water Well Owner’s Handbook & other related guidance documents (WRD): http://www.oregon.gov/owrd/pages/pubs/index.aspx</p> <p>*Groundwater Friendly Gardening Tips: http://wellwater.engr.oregonstate.edu/groundwater-friendly-gardening</p> |
| <p>Stormwater run-off -- focusing on high density housing (> 1 House/0.5 acre)</p> | <p>Improper use, storage, and disposal of household chemicals may impact the drinking water supply; stormwater run-off or infiltration may carry contaminants to drinking water supply</p> | <ul style="list-style-type: none"> <input type="checkbox"/> Identify underground injection wells and dry wells for stormwater disposal. Verify permit status. <input type="checkbox"/> Education program on stormwater issues. <input type="checkbox"/> Ongoing public education program on pesticide and fertilizer use, household hazardous waste, pet waste, and household pharmaceutical waste disposal <input type="checkbox"/> Host or facilitate ongoing household hazardous waste, collections <input type="checkbox"/> Work with your municipality to increase emphasis on pre-treatment for stormwater runoff and best management practices for stormwater. <input type="checkbox"/> Develop best management practices and maintenance plan for drywells and injection wells. <p>http://www.oregon.gov/deg/wq/wqpermits/Pages/UIC-Guidance.aspx http://www.oregon.gov/deg/FilterDocs/EPASWPPacticesBulletinStormWater.pdf</p> <ul style="list-style-type: none"> <input type="checkbox"/> Review Portland’s Stormwater Management Manual and the Oregon’s Water Quality Model Code and Guidebook (or other stormwater management document), and develop program to address stormwater issues. <input type="checkbox"/> Consider municipal code to address stormwater - see DLCD Water Quality Model Code and Guidebook <input type="checkbox"/> Send applicable information from list below: <p>Fact Sheets/Resources</p> <p>*Managing Stormwater to Prevent Contamination of Drinking Water: http://www.oregon.gov/deg/FilterDocs/EPASWPPacticesBulletinStormWater.pdf</p> <p>*Water Quality Model Code and Guidebook: http://www.oregon.gov/LCD/waterqualitygb.shtml</p> <p>*Portland’s Stormwater Management Manual: http://www.portlandonline.com/bes/index.cfm?c=dfbbh</p> <p>*Best Management Practices (BMPs) for washing vehicles: http://www.oregon.gov/deg/FilterDocs/EPASWPPacticesBulletinVehicleWashing.pdf</p> <p>*Managing Pet and Wildlife Waste to Prevent Contamination of Drinking Water: http://www.oregon.gov/deg/FilterDocs/EPASWPPacticesBulletinPetWaste.pdf</p> |

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| | | <p>*Disposal of Chlorinated Water from Swimming Pools and Hot Tubs: https://www.oregon.gov/deq/FilterDocs/bmpchlorwaterdisp.pdf</p> <p>*Household Hazardous Waste Program: http://www.oregon.gov/DEQ/Hazards-and-Cleanup/hw/Pages/hhw.aspx</p> <p>*Underground Injection Control (UIC) Program: http://www.oregon.gov/DEQ/wq/wqpermits/Pages/UIC.aspx</p> <p>*Healthy Lawn, Healthy Environment: https://www.epa.gov/sites/production/files/2014-04/documents/healthy_lawn_healthy_environment.pdf</p> |
| <p>Forest lands or forest management areas</p> | <p>Forest management activities including cutting and yarding of trees; improper management of pesticide and fertilizer applications; and road building/usage/maintenance activities may impact drinking water</p> | <p><input type="checkbox"/> Notify forest landowner(s) or manager(s) of their location in your drinking water source area and send EPA fact sheets:</p> <p>*Managing Nonpoint Source Pollution from Forestry http://www.epa.gov/polluted-runoff-nonpoint-source-pollution/nonpoint-source-forestry and</p> <p>*Nonpoint Source Pollution from Forestry: National Management Measures to Control Nonpoint Source Pollution from Forestry http://www.epa.gov/polluted-runoff-nonpoint-source-pollution/forestry-additional-resources</p> <p><input type="checkbox"/> Use pesticide information and fact sheets in “Cropland” section above</p> <p><input type="checkbox"/> If there is private industrial forest land scheduled for harvest or chemical application within 2-year Time-of-Travel zone (or within short-term recharge area for a spring), work with landowner to set up direct communication, share maps, and provide notification on any chemical application.</p> <p><input type="checkbox"/> For details on pesticide use in Oregon forestry, please see: http://www.oregon.gov/ODF/AnalyticsReports/ForestryFacts_Herbicides_And_Forestry_01092017.pdf</p> <p><input type="checkbox"/> Work with Oregon Department of Forestry (ODF) Stewardship or District Forester to request that there is voluntarily no mixing, handling, or storage of bulk pesticides or fertilizers in the 2-year Time-of-Travel zone or Zone 1 for springs. ODF may be able to help facilitate communication with the land owners or managers to discuss site-specific concerns about protecting the groundwater or springs: http://www.oregon.gov/ODF/Working/Pages/FindAForester.aspx</p> <p><input type="checkbox"/> For assistance with drinking water source protection issues on federal forest lands, contact US Forest Service Region 6: https://hrm.gdcii.com/directory/R6.htm</p> <p>Additional recommendations:</p> <p><input type="checkbox"/> Set up an agreement or MOU with landowner(s) or manager(s) that addresses handling and application of pesticides and fertilizers and best management practices for equipment fueling and spills.</p> <p><input type="checkbox"/> See DEQ factsheet on “Pesticide use in the vicinity of drinking water sources” for additional regulations and recommendations:</p> |

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| | | https://www.oregon.gov/deq/FilterDocs/pesticideuseVicdws.pdf |
| <p>Commercial or industrial sites –</p> <p>includes businesses that</p> <p>1) do not require permits or</p> <p>2) regulated facilities like dry cleaners, cleanup sites, hazardous waste/materials sites, underground storage tanks, wastewater and solid waste disposal</p> | <p>Spills, leaks, or improper handling of solvents, petroleum products, wastewater, or other chemicals and materials associated with commercial or industrial activities may impact the drinking water supply</p> | <ul style="list-style-type: none"> <input type="checkbox"/> Review "Drinking Water Protection Strategies for Commercial and Industrial Lane Uses" and consider other general or business sector specific strategies for pollution risk reduction. http://www.oregon.gov/deq/FilterDocs/DWPStrategiesComInd.pdf <input type="checkbox"/> Notify the owner or manager of their location within your drinking water source area and send the following general fact sheets: <ul style="list-style-type: none"> *Basic Tips for Keeping Drinking Water Clean and Safe http://www.oregon.gov/deq/FilterDocs/BasicTips12WQ005.pdf *Groundwater Basics http://www.oregon.gov/deq/FilterDocs/GroundwaterBasics.pdf *Business and Industry tips for reducing water quality impacts (DEQ) http://www.oregon.gov/deq/FilterDocs/dwpbusindtips.pdf *Pollution Prevention for Industry and the Environment: http://www.oregon.gov/deq/Hazards-and-Cleanup/ToxicReduction/Pages/Pollution-Prevention.aspx <input type="checkbox"/> Contact owner/operator to verify that any chemical or petroleum product storage (if present) cannot impact groundwater. For example, chemicals could be stored and used inside, or have secondary containment. Encourage business to receive technical assistance from DEQ's non-regulatory Toxics Use/Waste Reduction Technical Assistance Program: http://www.oregon.gov/DEQ/Hazards-and-Cleanup/hw/Pages/Technical-Assistance.aspx <input type="checkbox"/> Implement relevant best management practices (BMPs) for stormwater and industrial wastewater: https://www.epa.gov/npdes/national-menu-best-management-practices-bmps-stormwater#edu https://www.epa.gov/npdes/industrial-wastewater <input type="checkbox"/> Work with Drinking Water Protection staff and permitting program staff to ensure permitted facilities are in compliance. |
| <p>Golf courses, parks, lawn care</p> <p>(any highly-maintained areas)</p> | <p>Over-application or improper handling of pesticides/fertilizers may impact drinking water. Excessive irrigation may cause transport of contaminants</p> | <ul style="list-style-type: none"> <input type="checkbox"/> Determine degree and type of chemicals used for lawns and landscaping maintenance. <input type="checkbox"/> work with landowners or operators to minimize or eliminate pesticide and fertilizer application. <input type="checkbox"/> Provide training/workshops to park staff on water quality protection. <input type="checkbox"/> Use products that are environmentally friendly. <input type="checkbox"/> Minimize irrigation, or use water efficient irrigation. <input type="checkbox"/> Ensure pesticides are handled and stored safely. <input type="checkbox"/> Ensure that a spill response plan is in place, a spill kit is available and employees are trained annually in spill response. <input type="checkbox"/> For golf courses, distribute Integrated Pest Management (IPM) information. |

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| | through runoff and infiltration | <p>Fact Sheets/Resources</p> <p>*Healthy Lawn, Healthy Environment: https://www.epa.gov/sites/production/files/2014-04/documents/healthy_lawn_healthy_environment.pdf</p> <p>*EPA Source Water Protection Practice Bulletins:</p> <ul style="list-style-type: none"> - Managing Small-Scale Application of Pesticides: http://www.oregon.gov/deq/FilterDocs/EPASWPPPracticesBulletinPesticidesSmallScale.pdf - Managing Turfgrass and Garden Fertilizer Applications: http://www.oregon.gov/deq/FilterDocs/EPASWPPPracticesBulletinTurfgrassGarden.pdf - Managing Small Quantity Chemical Use: http://www.oregon.gov/deq/FilterDocs/EPASWPPPracticesBulletinChemUseSmallQ.pdf <p>*Groundwater Basics: http://www.oregon.gov/deq/FilterDocs/GroundwaterBasics.pdf</p> <p>*Integrated Pest Management Info for Golf Courses: http://www.greengolfusa.com/tiki-index.php</p> <p>*Integrated Pest Management website (OSU): http://npic.orst.edu/pest/ipm.html</p> |
| Underground storage tanks (USTs) | Existing or historic contamination from spills, leaks, or improper handling of stored materials may impact the drinking water supply; spills or improper handling during tank filling or product distribution may also impact the drinking water supply | <p><input type="checkbox"/> Notify owner or manager of their location within your drinking water source area. Share technical information about protecting drinking water resources and basic groundwater principles: http://www.oregon.gov/deq/wq/programs/Pages/DWPAssessments.aspx</p> <p>http://www.oregon.gov/deq/FilterDocs/GroundwaterBasics.pdf</p> <p>*DEQ's Underground Storage Tank Program: http://www.oregon.gov/DEQ/tanks/Pages/default.aspx</p> <p><input type="checkbox"/> For Active Registered Tanks: Verify permit status at http://www.oregon.gov/DEQ/tanks/Pages/Tank-Lists.aspx</p> <p>Contact DEQ Tanks program with questions. Ensure pre-treatment for stormwater runoff and best management practices for stormwater are in place.</p> <p><input type="checkbox"/> For Leaking USTs, verify status at http://www.oregon.gov/deq/tanks/Pages/Leaking-Undergr-Tanks.aspx</p> <p>Contact DEQ Tanks program at: Underground Storage Tanks Helpline, 1-800-742-7878, 503-229-6652, tanks.info@deg.state.or.us or Drinking Water Protection staff (Julie Harvey, DEQ, 503-229-5664) for assistance in verifying that cleanup is protective of drinking water.</p> <p><input type="checkbox"/> For non-regulated tanks (<1,100 gals or large heating oil tanks) also send:</p> <p>*Frequently Asked Questions About Heating Oil Tanks http://www.oregon.gov/deq/tanks/Pages/hot.aspx</p> |

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| <p>Transportation corridors, right-of-ways, roads, railroads, transmission lines</p> | <p>Vehicle use increases risk for fuel and other chemical leaks, spills and emissions affecting drinking water. Over-application or improper handling of pesticides or fertilizers may impact drinking water supply. Construction and maintenance of roadways and corridors may contribute to increased erosion and turbidity in drinking water.</p> | <p><input type="checkbox"/> Notify the owner (City, County, ODOT, railroad, transmission line, etc) and local first responders of your Drinking Water Source Area location. 'OR Emergency Response Program Local Emergency Managers List: https://www.oregon.gov/OMD/OEM/docs/plan_train/locals_list.pdf</p> <p>Recognize stormwater discharge issues from transportation sources: https://www.epa.gov/npdes/stormwater-discharges-transportation-sources</p> <p><input type="checkbox"/> In areas where pesticides are used for weed suppression, share technical information on groundwater and pesticides: *Groundwater Basics http://www.oregon.gov/deq/FilterDocs/GroundwaterBasics.pdf Managing Small-Scale Application of Pesticides: http://www.oregon.gov/deq/FilterDocs/EPASWPPacticesBulletinPesticidesSmallScale.pdf</p> <p><input type="checkbox"/> See DEQ factsheet “Pesticide use in the vicinity of drinking water sources” for additional regulations and recommendations: https://www.oregon.gov/deq/FilterDocs/pesticideuseVicdws.pdf</p> <p><input type="checkbox"/> Request elimination or minimization of herbicide application on right-of-ways that may contaminate groundwater.</p> <p><input type="checkbox"/> Identify if stormwater injection wells are present. If they are present, verify the permit status by contacting the Oregon DEQ’s Water Quality staff at (503) 229-5945.</p> <p>Additional recommendations:</p> <p><input type="checkbox"/> Encourage proper use or elimination of any dry wells or sumps in your wellhead protection area.</p> <p><input type="checkbox"/> Ask transportation officials to examine spill/runoff detention capacity to avoid contaminants entering the groundwater after an accident. Transportation and handling of fuels and chemicals in bulk Website: http://groundwater.orst.edu/protect/transport.html</p> <p><input type="checkbox"/> Ask for notification of water system in case of spills</p> <p><input type="checkbox"/> Reroute transport of hazardous materials</p> <p><input type="checkbox"/> Water system assumes responsibility of non-chemical weed control.</p> |
| <p>Residential lands – private urban or private rural homes</p> | <p>Spills, leaks, or improper handling of chemicals, fuels, wastewater, and other materials may impact drinking</p> | <p>Provide information to residents within your drinking water source area. See Example letter - http://www.oregon.gov/deq/FilterDocs/dwpExampleLettertoResidents.docx. Outreach can be done through local media or via utility bills. Send (or refer to) relevant fact sheets and web resources from list below.</p> <p>Fact Sheets/Resources *DEQ DWP website for Residential/Rural Land Uses (under Management Strategies by Land Use):</p> |

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| | <p>water; infiltration containing pesticides or fertilizers may impact drinking water</p> | <p>http://www.oregon.gov/DEQ/wq/programs/Pages/DWP-Source.aspx</p> <p>*Groundwater Basics: http://www.oregon.gov/deq/FilterDocs/GroundwaterBasics.pdf</p> <p>*Healthy Lawn, Healthy Environment: https://www.epa.gov/sites/production/files/2014-04/documents/healthy_lawn_healthy_environment.pdf</p> <p>*What is Household Hazardous Waste?: http://www.oregon.gov/deq/FilterDocs/WhatisHHW.pdf</p> <p>*Household Hazardous Waste Program: http://www.oregon.gov/DEQ/Hazards-and-Cleanup/hw/Pages/hhw.aspx</p> <p>*Household Pharmaceutical Waste Disposal: http://www.oregon.gov/deq/FilterDocs/HouseholdPharmaceuticalWasteDisposal.pdf</p> <p>*Groundwater Friendly Gardening Tips: http://wellwater.engr.oregonstate.edu/groundwater-friendly-gardening</p> <p>Stormwater runoff from residential lands: http://www.oregon.gov/deq/FilterDocs/EPASWPPPracticesBulletinStormWater.pdf</p> <p>Additional measures may include:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Establish ongoing educational program on household hazardous waste and proper disposal of pharmaceuticals, lawn and landscaping, septic system maintenance. |
| <p>Sewer lines – within close proximity to well or spring</p> | <p>If not properly designed, installed, and maintained, sewer lines can impact drinking water, especially adjacent to a waterbody or within the 2-year time-of-travel zone for drinking water wells</p> | <ul style="list-style-type: none"> <input type="checkbox"/> Contact jurisdiction for sewer/wastewater management and determine locations, status of sewer lines and sewer plan <input type="checkbox"/> Identify broken or cracked lines, areas with inflow and infiltration. <input type="checkbox"/> Work with jurisdiction to request maintenance, replacement, or double sleeve of sewer lines within 2-year TOT or within Zone 1 for springs; identify upgrade or replacement of lines as a high priority within City Sewer Master Plan. |
| <p>Random dump sites</p> | <p>Illegal trash and debris containing chemicals and hazardous materials may generate</p> | <ul style="list-style-type: none"> <input type="checkbox"/> Notify the owner or operator of their location within your drinking water source area and send "Combating Illegal Dumping". <input type="checkbox"/> Implement appropriate community-based cleanup strategies including an education campaign – install sign, newspaper releases and ads, utility inserts, cleanup event, collection event, install lights, use vehicle barriers, or public-private partnerships. <input type="checkbox"/> If contamination is suspected, contact DEQ Drinking Water Protection or Site Assessment Program staff for assistance. |

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| | runoff and cause contamination to groundwater | <p>Fact Sheets/Resources</p> <p>Combating Illegal Dumping: http://www.oregon.gov/DEQ/mm/Pages/Illegal-Dumping-Clean-Up.aspx</p> <p>DEQ Site Assessment Program: http://www.oregon.gov/DEQ/Hazards-and-Cleanup/env-cleanup/Pages/Site-Assessment.aspx</p> |
| Irrigation canal, ponds | Runoff or infiltration containing pesticides or fertilizers may impact drinking water | <p><input type="checkbox"/> Determine from owner(s) or operator(s) whether fertilizer or pesticides may be present. If so, encourage practices to minimize groundwater infiltration. Send DEQ Factsheet: "Pesticide use in the vicinity of drinking water sources": https://www.oregon.gov/deq/FilterDocs/pesticideuseVicdws.pdf</p> <p><input type="checkbox"/> Work with Drinking Water Protection staff or water quality permitting program staff to verify permit status (if any) and ensure pesticide application is protective of drinking water.</p> <p><input type="checkbox"/> Work with land owner or manager to ensure that the pesticide/fertilizer/petroleum mixing and storage areas is located outside the 2 year Time-of-Travel zone or Zone 1 for springs.</p> <p><input type="checkbox"/> If irrigation canals are in close proximity to shallow wells, share guidance on integrated pest management approaches to control vegetation: http://pdxscholar.library.pdx.edu/cgi/viewcontent.cgi?article=1010&context=centerforlakes_pub</p> |
| Known contamination sites, spill sites, or downgradient plumes | Existing contamination from spills, leaks, or improper handling of used or stored materials may impact the drinking water supply | <p><input type="checkbox"/> Verify cleanup site status by checking Environmental Cleanup Site Information (ECSI) database at: http://www.oregon.gov/deq/Hazards-and-Cleanup/env-cleanup/Pages/ecsi.aspx</p> <p><input type="checkbox"/> Contact DEQ Cleanup program or Drinking Water Protection staff (Julie Harvey, DEQ, 503-229-5664) for assistance in verifying that cleanup is protective of drinking water.</p> <p><input type="checkbox"/> Ensure DEQ cleanup program staff are aware of the drinking water source area location, and are working towards "No Further Action" status. For more information, go to: http://www.oregon.gov/DEQ/Hazards-and-Cleanup/env-cleanup/Pages/default.aspx</p> |
| Mining activities | Spills, leaks, or improper handling of chemicals and wastes generated in mining operations or from heavy equipment may impact | <p><input type="checkbox"/> Contact the site manager and verify that chemicals, petroleum products, and other materials are handled properly and share: *Business and Industry Tips for Drinking Water Protection http://www.oregon.gov/deq/FilterDocs/dwpbusindtips.pdf</p> <p><input type="checkbox"/> Contact Oregon Dept. of Geology and Mineral Resources for more information on best management practices: http://www.oregongeology.org/mlrr/surfacemining-faq.htm</p> <p><input type="checkbox"/> Contact DEQ Drinking Water Protection staff if you need assistance</p> <p><input type="checkbox"/> Verify Permit status with regional DEQ office. Gravel mines may have a general WPCF permit 1000 for gravel mining activities and a General 1200-A permit for stormwater discharge.</p> |

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| | the drinking water supply | <input type="checkbox"/> Get notification from DEQ on permit modifications. Additional recommendations: <input type="checkbox"/> Review Recommended Best Management Practices for Storm Water Discharges and implement best management practices (See Section 2.1) http://www.oregon.gov/deq/FilterPermitsDocs/BMPManual.pdf |
| Landfills, composting facility, historic waste dumps, waste transfer, waste recycling stations | Water percolating through or coming into contact with waste material may transport contaminants to groundwater supply | <input type="checkbox"/> Notify the landowner or manager of their location within your drinking water source area <input type="checkbox"/> Work with DEQ Drinking Water Protection staff or permitting program staff to review permits and ensure permitted facilities are in compliance. http://www.oregon.gov/DEQ/mm/swpermits/Pages/default.aspx <input type="checkbox"/> For historic landfills, check with the DEQ Site Assessment program to verify status of site: http://www.oregon.gov/DEQ/Hazards-and-Cleanup/env-cleanup/Pages/Site-Assessment.aspx <input type="checkbox"/> Ensure DEQ cleanup program staff are aware of the drinking water source area location, and are working towards “No Further Action” status. For more information, go to: http://www.oregon.gov/DEQ/Hazards-and-Cleanup/env-cleanup/Pages/default.aspx |
| Aboveground storage tanks | Spills, leaks, or improper handling of stored materials may impact the drinking water supply | <input type="checkbox"/> Conduct a survey of existing aboveground storage tanks to determine status. <input type="checkbox"/> Ensure aboveground storage tanks (ASTs) are 1) placed on a concrete pad or 2) have a drip pan or 3) have secondary containment. <input type="checkbox"/> Local government can potentially adopt ordinance, covenant, or rules to ensure ASTs have secondary containment. <input type="checkbox"/> Notify the AST owner of their location within your drinking water source area and send: *Proper Care and Maintenance for Unregulated Tank Systems: http://www.oregon.gov/deq/FilterDocs/ProperCareMaintenance.pdf *Managing Aboveground Storage Tanks to Prevent Contamination of Drinking Water: http://www.oregon.gov/deq/FilterDocs/EPASWPPPracticesBulletin_ASTs.pdf Heating Oil Tank Program: http://www.oregon.gov/DEQ/tanks/Pages/hot.aspx Additional recommendations: <input type="checkbox"/> Develop a plan for ongoing (yearly) education to aboveground storage tank owners. <input type="checkbox"/> Implement the following best management practices: check regularly for leaks and loose fittings, and check the integrity of gaskets; test pipes for leaks; cleanup the area around the tank; know how to clean up spills and drips. |

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| <p>Underground injection control (UICs), dry wells, stormwater sumps</p> | <p>Shallow injection wells may transport untreated water directly into groundwater and impact drinking water</p> | <ul style="list-style-type: none"> <input type="checkbox"/> Notify the landowner or manager of their location within your drinking water source area. <input type="checkbox"/> Work with Drinking Water Protection staff or permitting program staff to ensure permitted facilities are in compliance. <input type="checkbox"/> Share applicable information on UICs: <p>*Oregon DEQ Underground Injection Control Program: http://www.oregon.gov/DEQ/wq/wqpermits/Pages/UIC.aspx</p> |
| <p>Schools, universities</p> | <p>Over-application or improper handling of cleaning products, lab chemicals, pesticides or fertilizers used on the school grounds may impact drinking water; parking lots, roadways, or vehicle maintenance may also contribute contaminants to runoff and infiltration</p> | <ul style="list-style-type: none"> <input type="checkbox"/> Notify the school of their location within your drinking water source area and send the following fact sheets and/or links as appropriate: <p>*DEQ’s Household Hazardous Waste Program: http://www.oregon.gov/DEQ/Hazards-and-Cleanup/hw/Pages/hhw.aspx</p> <p>*Healthy Lawn, Healthy Environment: https://www.epa.gov/sites/production/files/2014-04/documents/healthy_lawn_healthy_environment.pdf</p> <p>*Managing Septic Systems: http://www.oregon.gov/deq/FilterDocs/EPASWPPacticesBulletin_SepticSystems.pdf</p> <p>*Septic Systems OSU Extension website: http://wellwater.oregonstate.edu/septic-systems-0</p> <p>*Automotive Repair and Maintenance Tips for Drinking Water Protection: http://www.oregon.gov/deq/Filterdocs/automaint.pdf</p> <p>*Managing Vehicle Washing to Prevent Contamination of Drinking Water: http://www.oregon.gov/deq/FilterDocs/EPASWPPacticesBulletin_VehicleWashing.pdf</p> <ul style="list-style-type: none"> <input type="checkbox"/> Contact the school and verify that there are no septic system, aboveground storage tanks, underground injection wells, or vehicle maintenance and washing. If there are, contact Drinking Water Protection staff for assistance. <input type="checkbox"/> Contact the school and verify they are complying with Oregon school Integrated Pest Management (IPM) law. Contact ODA with questions or assistance http://www.ipmnet.org/tim/IPM_in_Schools/IPM_in_Schools-Main_Page.html <p>Learn more about schools and drinking water: https://www.epa.gov/schools-air-water-quality/schools-water-quality</p> |

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| <p>Utility stations, substations, maintenance, and transformer storage</p> | <p>Spills, leaks, or improper handling of chemicals and other materials including PCBs during transportation, use, storage and disposal may impact the drinking water supply</p> | <ul style="list-style-type: none"> <input type="checkbox"/> Notify the landowner or property manager of their location within your drinking water source area <input type="checkbox"/> Work with DEQ Drinking Water Protection staff or permitting program staff to ensure permitted facilities are in compliance. <input type="checkbox"/> In areas where pesticides are used for weed suppression, share technical information on groundwater and pesticides: <ul style="list-style-type: none"> *Groundwater Basics http://www.oregon.gov/deq/FilterDocs/GroundwaterBasics.pdf Managing Small-Scale Application of Pesticides: http://www.oregon.gov/deq/FilterDocs/EPASWPPacticesBulletinPesticidesSmallScale.pdf <input type="checkbox"/> See DEQ factsheet “Pesticide use in the vicinity of drinking water sources” for additional regulations and recommendations: https://www.oregon.gov/deq/FilterDocs/pesticideuseVicdws.pdf |
| <p>Large capacity onsite septic systems (serves > 20 people)</p> | <p>If not properly sited, designed, installed, and maintained, septic systems can impact groundwater and drinking water</p> | <ul style="list-style-type: none"> <input type="checkbox"/> In addition to general Residential/Municipal Fact Sheets, send: <ul style="list-style-type: none"> *Managing Septic Systems to Prevent Contamination of Drinking Water http://www.oregon.gov/deq/FilterDocs/EPASWPPacticesBulletinSepticSystems.pdf <input type="checkbox"/> Verify UIC registration and on-site permit with DEQ. <input type="checkbox"/> Get notification from DEQ on permit modifications <input type="checkbox"/> Upgrade septic systems and establish an ongoing septic system maintenance program. <p>DEQ On-site permitting: http://www.oregon.gov/DEQ/Residential/Pages/Onsite.aspx</p> <ul style="list-style-type: none"> <input type="checkbox"/> If applicable, ongoing education program for residents or businesses on household hazardous waste and proper disposal of pharmaceuticals. <p>Household Hazardous Waste Program: http://www.oregon.gov/DEQ/Hazards-and-Cleanup/hw/Pages/hhw.aspx</p> <p>Household Pharmaceutical Waste Disposal: http://www.oregon.gov/deq/Hazards-and-Cleanup/hw/Pages/Pharmaceuticals.aspx</p> |

APPENDIX 3. Categorical Crop to Pesticide Table

DRAFT

Crop Application Table

Based upon USGS Pesticide Synthesis Project using EPest Low method, for years 1992-2013. The below table is based upon the estimated kilograms of pesticide applied in Oregon by crop/crop category.

- This table is comprised of selected pesticides ingredients as per their designation as an Oregon Pesticide of Concern (POC), Pesticide of Interest (POI), or as per water quality monitoring results.
- The research/scientific basis for how color coding ratings for crop and pesticide application rates are explained below the table in the references and notes section.

KEY for crop and pesticide associations

- Orange - highly associated [> 25% of kg estimated]
- Yellow - moderately associated [10-25% of kg estimated]
- Green - less often associated [2 - 10% of kg estimated]
- Blue - weakly associated [1 - 2 % of kg estimated]
- Not listed - dataset did not support association

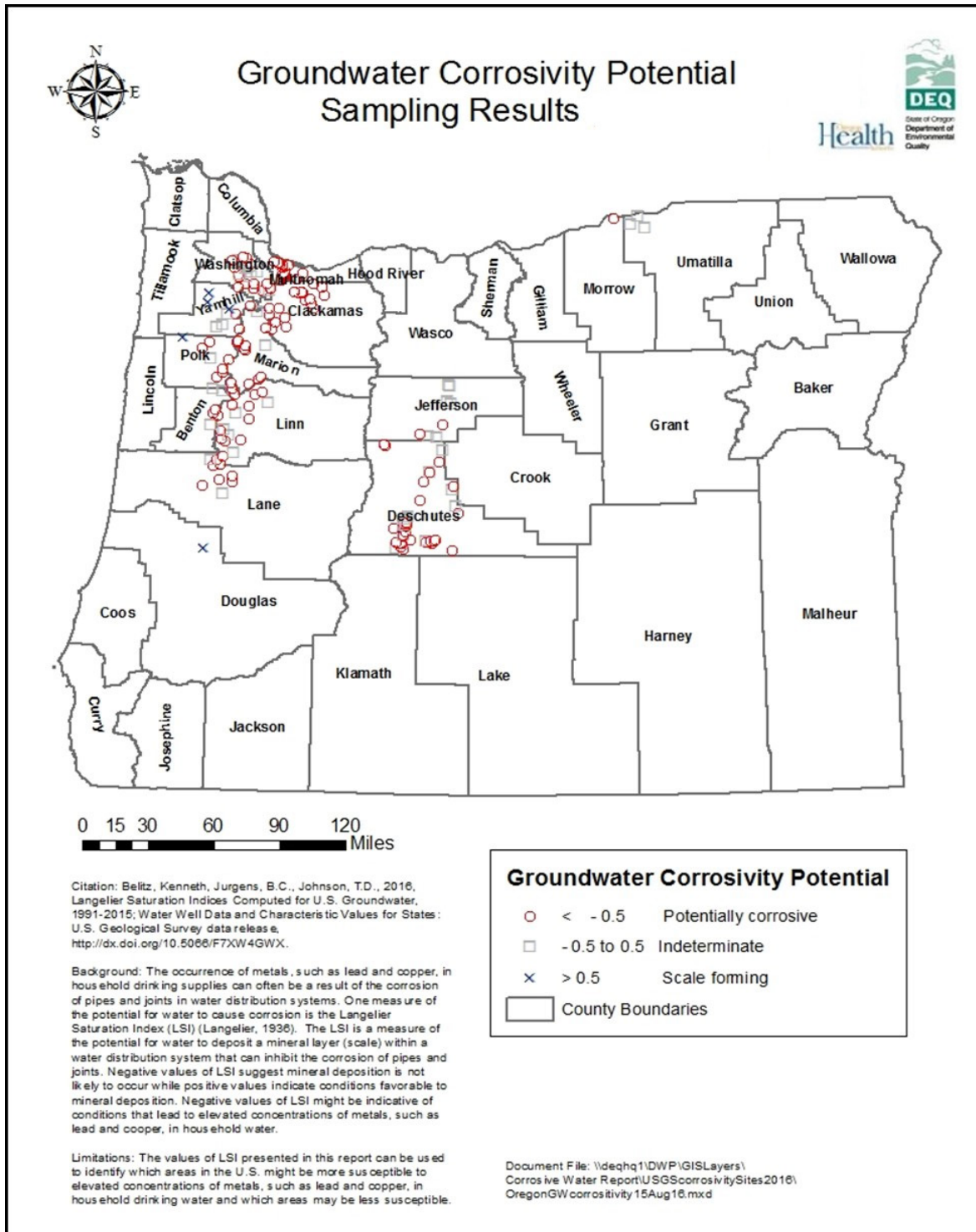
| | | | | | |
|----------------------|-------------|------------------|--------------|--------------------------|------------------|
| Alfalfa | Metribuzin | Diuron | Chlorpyrifos | 2,4-D | Malathion |
| Pasture and Hay | 2,4-D | MCPA | Diuron | Atrazine | |
| Wheat | 2,4-D | MCPA | Diuron | Metribuzin | Propiconazole |
| Corn | Atrazine | Metolachlor | Chlorpyrifos | 2,4-D | Ethoprop (Mocap) |
| Orchards and grapes | 2,4-D | Chlorpyrifos | Simazine | Azinphosmethyl (Guthion) | Malathion |
| Vegetables and fruit | Metolachlor | Ethoprop (Mocap) | Chlorpyrifos | Atrazine | DCPA (Dacthal) |
| Other crops | 2,4-D | MCPA | Atrazine | Chlorpyrifos | Carbaryl |
| | | | | | Diuron |
| | | | | | Carbaryl |
| | | | | | Metribuzin |
| | | | | | Carbaryl |
| | | | | | Diuron |
| | | | | | Malathion |
| | | | | | Simazine |
| | | | | | Diuron |
| | | | | | MCPA |

REFERENCES & NOTES:

- <- Orchard & grape crop group in Oregon principally include: hazelnuts, pears, wine grapes, cherries, apples, and other crops
 - <- Vegetable & Fruit crops group in Oregon principally include: Potatoes, onions, blueberries, other berries, snap beans, strawberries, garlic, green peas, cranberries, and others
 - <- Other crops group in Oregon principally include: Field and grass seeds, hops, and others
- Pesticides selected on the basis of water quality monitoring results include: DCPA, diazinon, and MCPA. Source: DEQ December 2009 report for LASAR data: "Analysis of DEQ and DHS Pesticide Data in Oregon"
- Pesticide use estimates are based upon USGS NAWQA project data. Source data: Nancy T. Baker, U.S. Geological Survey, 2016, written communication
- Limitations: EPest values from this study are suitable for making national, regional, and watershed assessments of annual pesticide use. Although estimates are provided by county to facilitate estimation of watershed pesticide for a variety of watersheds, there is a greater degree of uncertainty in individual county-level estimates when compared to Crop Reporting District or state-level estimates because (1) EPest crop-use rates were developed on the basis of pesticide use on harvested acres in multi-county areas (Crop Reporting Districts) and then allocated to county harvested cropland; (2) pesticide-by-crop use rates were not available for all Crop Reporting Districts in the conterminous United States, and extrapolation methods were used to estimate pesticide use for some counties; and (3) it is possible that surveyed pesticide-by-crop use rates do not reflect all agricultural use on all crops grown. The methods developed in this study also are applicable to other agricultural pesticides and years.

- Note 1: One POI, Sulfometuron, was not included in the table above due to the lack of sufficient available data.
- Note 2: Bromacil was also considered as part of the analysis on the basis of water quality monitoring results, however the data did not support an association with a crop/crop category.
- Note 3: Grass seed is included under "other crops" category

APPENDIX 4. Corrosivity Potential –Oregon Monitoring Data Map



APPENDIX 5. Drinking Water Protection Websites

Oregon Health Authority

Regulations for drinking water, health effects information, data, etc.:

<http://public.health.oregon.gov/HealthyEnvironments/DrinkingWater/Pages/index.aspx>

Oregon DEQ's Drinking Water Protection

<http://www.oregon.gov/deq/wq/programs/Pages/DWP.aspx>

Technical resources, best management practices, fact sheets, etc.:

<http://www.oregon.gov/deq/wq/programs/Pages/DWP-Pubs.aspx>

Department of Geology and Mineral Industries

Information on landslides, mapping, 3D terrain, and LiDAR:

<http://www.oregongeology.org/sub/projects/olc/default.htm>

Oregon Geospatial Enterprise Office

For Oregon Geographic Information Systems (GIS) data layers:

<http://www.oregon.gov/DAS/CIO/GEO/pages/index.aspx>

Google Earth

For maps, satellite imagery, etc.:

<https://earth.google.com/>

US Geological Survey

Information on toxics, monitoring data, and human health benchmarks, etc.:

<http://toxics.usgs.gov/regional/emc/index.html>

http://health.usgs.gov/dw_contaminants/

Scientific information to identify, assess, and quantify the availability of groundwater resources.

Information on groundwater levels, aquifers, water use, and water quality.

<http://water.usgs.gov/ogw/gwrp/>

Multidisciplinary studies of regional groundwater availability across the United States to provide resource managers and policy makers with essential information needed for management of a limited resource in areas experiencing chronic water-supply issues and concerns.

<http://water.usgs.gov/ogw/gwrp/activities/regional.html>