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DEQ Department of Environmental Quality

Statewide Groundwater Quality Monitoring Program:

Mid-Willamette Basin - 2017

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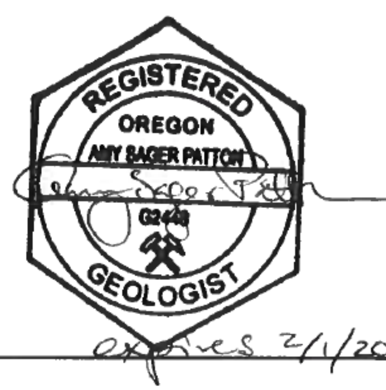

Acknowledgements

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Executive summary

Oregon's overarching goal for groundwater quality is to prevent contamination of Oregon's groundwater resource while striving to conserve and restore this resource and to maintain the high quality of Oregon's groundwater resource for present and future uses (ORS 468B.155). Oregon DEQ's statewide groundwater quality monitoring program contributes to this goal by assessing the quality of groundwater across the state and identifying areas with-widespread nonpoint source contamination. The goals of the statewide groundwater monitoring program are to evaluate existing groundwater conditions, identify emerging groundwater quality problems and inform groundwater users of potential risks from contamination.

The Mid-Willamette Valley study area was selected based on considerations of known water quality issues in the Southern Willamette Valley Groundwater Management Area, particularly around Mission Bottom and Lake Labish area, the presence of shallow aquifers, and considerable agricultural activity in the valley.

In February and October/November of 2017, DEQ collected and analyzed groundwater samples from 100 wells between Albany and Beaverton. Most of the sampled wells were domestic drinking water wells. Twenty of the wells sampled in February 2017 were re-sampled in the fall of 2017. Results from the 2017 study are summarized below:

- Nitrate was detected in 66% of wells sampled, although no samples tested above the drinking water standard of 10 mg/L.
- Arsenic was detected in 57% of wells sampled, seven of the 100 wells tested had levels above the drinking water standard of 10 µg/L.
- Lead was detected in 65% of wells sampled. Two had levels above the MCL of 15 µg/L.
- Manganese was detected in 21% of wells over the health-based screening level of 300 µg/L.
- Coliform bacteria were present in 34% of wells tested.
- Pesticides and volatile organic compounds (VOCs) were detected at low levels in 29 wells. Some wells had multiple pesticide detections. The pesticide 2,6-dichlorobenzamide, a breakdown product of dichlobenil, was detected in 16 wells. Atrazine and its breakdown products were detected in six wells. All detections of pesticides and VOCs were below any existing health-based screening levels.
- Three wells showed low detections of one pharmaceutical analyte, diphenhydramine (Benadryl), an antihistamine, suggesting contamination by wastewater, possibly from septic tanks.
- Well users who participated in the study received laboratory reports in 2018 and educational resources about groundwater contaminants, well and septic tank maintenance. Participants were also referred to the Oregon Health Authority Domestic Well Safety program and county environmental and public health representatives to learn about water treatment options and well stewardship. In addition, DEQ laboratory staff conducted presentations and reported findings at public meetings in the community and shared results with interested parties.

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1. Background

Groundwater is a vital resource in Oregon. Over 600,000 Oregonians rely on private wells for their drinking water (Maupin et al., 2014). Public water systems, the agricultural community and industry all rely on groundwater to meet their operational needs. Oregon's rivers and streams depend on groundwater for the maintenance of summer flows and cooling temperatures for fish populations and for recreation. Groundwater is a critical water reserve that can be used when surface water resources are inadequate to meet demands. It is important that Oregon's groundwater remain protected from contamination.

Oregon's overarching goal for groundwater quality is "to prevent contamination of Oregon's groundwater resource while striving to conserve and restore this resource and to maintain the high quality of Oregon's groundwater resource for present and future uses" (ORS 468B.155). Oregon DEQ's statewide groundwater quality monitoring program is in place to identify and characterize groundwater quality, identify areas that are vulnerable to contamination, identify long term trends in quality, determine ambient groundwater quality and evaluate any emerging concerns. Recent groundwater quality studies are the Mid-Rogue Basin (2011 and 2015), North Coast (2015-2016), the Walla Walla Basin (2016), Harney County (2018), the Klamath Basin (2019-2022), and Southern Deschutes County (2023-2024) in addition to this study. DEQ also conducts ongoing, long-term groundwater monitoring in the three Groundwater Management Areas (Lower Umatilla Basin, Northern Malheur County, and the Southern Willamette Valley).

1.1 Statewide groundwater quality monitoring

The Oregon Department of Environmental Quality has conducted groundwater quality monitoring in various parts of the state since the agency's inception. Groundwater quality studies since 2015 have included sampling and analysis of groundwater in two seasons for 60 to 100 wells.

Informed by previous investigations and guided by the goals of the statewide groundwater quality monitoring program, the objectives of the 2017 Mid-Willamette Valley groundwater study were:

1. To collect high-quality data on nitrate, arsenic, coliform bacteria, pesticides, pharmaceutical and personal care products, and volatile organic in groundwater throughout the study area
2. To identify areas of groundwater contamination related to these parameters
3. To inform well water users of the results of this study and provide information regarding potential risks to human health
4. To identify areas needing additional investigation and help focus efforts to prevent further contamination
5. To help establish long-term trending data and describe changes over time.

The following work products are outside the scope of this study and report:

- Hydrogeologic characterization of the study area and contamination
- Investigation of the sources of contamination
- Health risk assessments.

Groundwater reports that DEQ's Laboratory and Environmental Assessment Division published from 2015 through 2021 summarized and provided context for the analytical data but had limited hydrogeological data interpretation. For this report, DEQ's groundwater protection program staff co-authored the report and provided additional data interpretation.

1.2 Study area description

The Mid-Willamette Valley study area was selected based on considerations of water quality issues in the Southern Willamette Valley Groundwater Management Area, the presence of shallow and vulnerable aquifers (Sweet et al., 1980), and considerable agricultural activity in the valley, making it a priority for Oregon's statewide groundwater quality monitoring program. Other factors considered while selecting this area for study included current available data from Real Estate Transactions, results from previous DEQ groundwater studies, results from ongoing DEQ monitoring efforts for toxic contaminants, detections of contaminants in municipal Public Water Systems (PWS) that rely on groundwater in this area, and demographic characteristics (such as income, race, age and languages spoken) to ensure the study appropriately represents communities that may be more vulnerable to groundwater impacts or environmental health risks. The Mid-Willamette Valley study boundary was selected to capture a wide geographic area with a diversity of residential, urban and rural wells and opportunities to sample shallow and deep wells in areas with varying adjacent land uses.

In February and October/November of 2017, the Oregon DEQ collected and analyzed water samples from 100 wells in a vulnerable groundwater area of the Mid-Willamette Basin, north of Albany. Most of the sampled wells were domestic wells serving one household each, four were irrigation wells. Sixty wells were sampled in February, and sixty in October/November of 2017. Twenty of the same wells sampled in February were re-sampled in October/November.

1.2.1 Study area boundary

The Willamette River Basin includes the drainage basins of numerous rivers and streams that contribute to the Willamette River as it flows northward to meet the Columbia River. The basin covers a 12,000 square mile area in northwestern Oregon bordered by the Coast and Cascade Mountain ranges and extends from the border of Douglas and Lane Counties to Columbia County.

The Mid-Willamette Basin defined by this study (Figure 1) extends from north of Albany to south of Beaverton (more specifically from Monmouth, Jefferson and Stayton in the south to Newberg, Sherwood and Oregon City in the north). The width of the study area is approximately centered around Keizer, with a diameter of 50 miles, and includes Sheridan in the west and Molalla in the east.

A shallow aquifer defined in a 1980 study (Sweet, 1980) is present in the center of the study area and shown in light blue in Figure 1. Well locations are identified with corresponding DEQ identification numbers.

Wells used in the study were selected from a pool of well-owners who volunteered to participate in this project. DEQ used the EPA EJSCREEN (an environmental justice screening and mapping tool that utilizes standard and nationally consistent census data to highlight places that may have higher environmental burdens and vulnerable populations) to identify areas with higher percentages of low-income households, residents of color, linguistically isolated populations, and populations aged over 65 or under 5 years of age. DEQ included these areas in solicitations (translated into Spanish and Russian) for project participant volunteers, in an effort to include demographically sensitive populations. See the Sampling and Analysis Plan for this project to learn more about this study area and project design (DEQ17-LAB-0002-SAP).

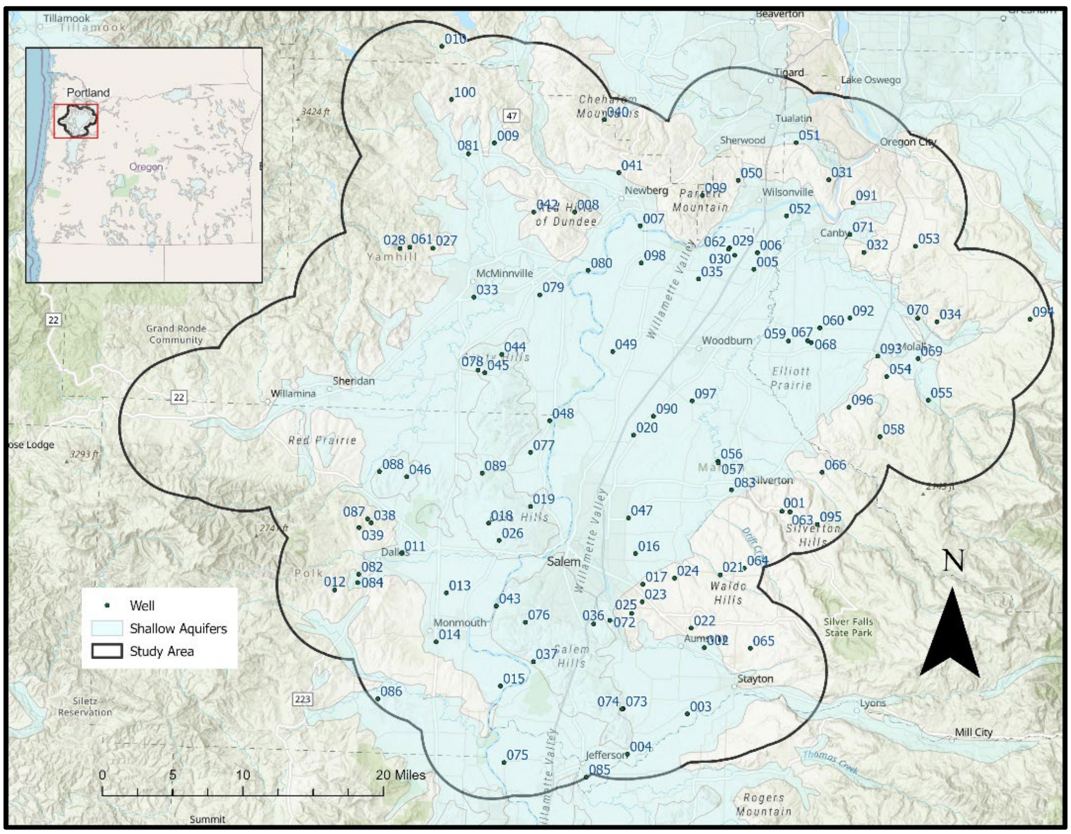

Figure 1. Location of wells within Mid-Willamette study area

1.2.2 Geology

The Willamette Valley is a broad structural depression between the volcanic Cascade Range and the accreted marine volcanic and sedimentary rock terrane of the Coast Range (Baldwin, 1976).

Volcanic activity in the Western Cascades on the east side of the valley began during the Eocene epoch (approximately 56 – 39 million years before present) before transitioning during the late Miocene through the Pliocene eastward into the High Cascades where it continues to present day. The mostly flat valley floors are interrupted by low basalt and bedrock hills in various areas. Within the study area, the geology can be generally grouped into marine bedrock, Columbia River Basalts, Cascades volcanics/volcaniclastics, and more recent basin-fill deposits (Gannett, 1998; McClaughry, 2010).

In many areas the shallowest deposits are fine deposits known as the Willamette Silts and are often present beneath topsoil. These silty units vary in thickness and can, in some cases, significantly limit mobilization of groundwater. However, Willamette Silts are missing in some areas especially adjacent to the edges of the valley or areas of erosion and deposition nearest our major river systems. The Willamette Silts produce fertile soils and are generally believed to be related to post-glacial flooding (Oregon Department of Geology and Mineral Industries, 2026). Beneath the silts are clastic deposits with a mixture of sand, silt, and clay that often constitute a productive aquifer. These are known as the Middle Sedimentary unit and the Lower Sedimentary Unit (Condon, 2005). In the northern part of the valley, this is known as the Troutdale formation and is Pliocene-aged (5.33 to 2.58 million years before present). In some areas, the Troutdale formation rests on the Sandy River Mudstone and in other areas it lies directly on the Columbia River Basalt group which may be present for several hundred feet of depth.

Various volcanic units are commonly present in bedrock in the southern Willamette Valley and are likely older than the Columbia River Basalt Group. Tuffaceous sandstones are often present as productive aquifers and are overlain by Willamette Silts (Baldwin, 1976). For more information on Oregon geology, visit the Oregon Department of Geology and Mineral Industries Geologic Provinces web page.

1.2.3 Hydrogeology

Conlon et al. (2005) defined six regional hydrogeologic units in the study area which are (from youngest to oldest): the Upper Sedimentary Unit, the Willamette Silt Unit, the Middle Sedimentary Unit, the Lower Sedimentary Unit, the Columbia River Basalt Unit, and the Basement Confining Unit.

The Upper and Middle Sedimentary Units are unconsolidated, locally-derived Pliocene and braided stream and alluvial fan deposits, predominantly sand and gravel with interbeds of silt and clay. The Upper Sedimentary Unit is generally less than 40 ft thick, while the Middle Sedimentary Unit is generally less than 60 ft thick over most of the study area but can be thicker in the alluvial fans associated with the larger rivers (Conlon, 2005). Although stratigraphically distinct, these units are often contiguous and high yielding; thus, they are collectively designated as the "Willamette Aquifer" of Woodward et al. (1998).

The (Pleistocene) Willamette Silt Unit consists primarily of silt and clay eroded from the Columbia River Basin and deposited in the Willamette Basin by the Missoula Floods likely between approximately 15,000 – 13,500 years before present (O'Connor, 2001), although minor amounts of other fine-grained deposits that are contiguous with the Missoula Flood deposits are also included in the unit. Within the study area, the Willamette Silt Unit is mostly 60 to 120 ft thick in the central part of the basin and thinner in the southern part of the study area. Where present, this unit behaves as a confining unit for the underlying Middle Sedimentary Unit aquifer (Conlon, 2005).

Within the study area, the Lower Sedimentary Unit consists mostly of fine-grained sediments deposited by Cascade and Coast Range streams, although in places the unit contains considerable proportions of sand and gravel sometimes present as discrete beds. On a regional scale, the Lower Sedimentary Unit is low yielding and can be characterized as a confining unit; however, locally, productive sand and gravel beds within the unit can allow moderate to high well yields. Around Saint Paul, Oregon, near the center of the study area, the Lower Sedimentary Unit is greater than 1,600 ft thick and is greater than 200 ft thick across most of the lowlands of the study area; however, the unit thins substantially with higher elevation and west of the Willamette River, and it is absent from the surrounding hills (Conlon, 2005).

In the Willamette Basin, the Columbia River Basalt Unit consists of a series of flood-basalt lava flows of the Grande Ronde and Wanapum Basalts (Beeson, 1989; Conlon, 2005). The Columbia River Basalt Unit is present across much of the study area, where it is generally 200 to 1,000 ft thick (Conlon, 2005). In the lowland, it is generally overlain by the Lower Sedimentary Unit – and, where present, the Upper and Middle Sedimentary Units – but is exposed along the Chehalem and Parrett Mountains, the Dundee, Eola, Salem, and Waldo Hills, and some of the upland areas along the south and eastern margin of the study area (Conlon, 2005). The Columbia River Basalt Unit is characterized by thin, often permeable, interflow zones separated by thick, low permeability flow interiors (Conlon, 2005). Well yields in the Columbia River Basalt Unit are moderate to high, with most high-capacity wells being open to multiple interflow zones (Conlon, 2005). Saline groundwater is common in deeper parts of the Columbia River Basalt Unit and is probably derived from connate water entrapped in the underlying marine sediments of basement confining unit (Woodward et al, 1998).

The Basement Confining Unit underlies the other units in the study area and is exposed along some of the hills and the upland areas at the study area margins. The Basement Confining Unit includes Eocene oceanic Siletz River Volcanics, Eocene to Oligocene marine sedimentary rocks, and Oligocene to upper Miocene volcanic and volcaniclastic rocks of the Western Cascades (Gannett, 1998; Conlon, 2005). The Basement Confining Unit includes a variety of geologic formations and rock types with widely varying properties, but it is characterized by low permeability, low porosity, and low well yield. Useable yields of water are typically derived from saturated fractures, as the primary porosity of the rocks has typically been reduced by secondary mineralization (Conlon, 2005). Saline groundwater is common in the marine sedimentary rocks of the Basement Confining Unit and is thought to have originated as seawater that was trapped in the pore spaces of buried sediments (Woodward, 1998).

1.2.4 Land use

Outside of the cities in the Mid-Willamette Basin study area, land uses are predominantly agricultural, rural residential, and forest. Vineyards and some rangelands are plentiful in the northwestern part of the study area, and a variety of grass seed, grain, and row crops are grown in the valley. Forest lands are present in the uplands at the periphery of the study area.

Groundwater use includes municipal, community, domestic, commercial-industrial, agricultural, livestock, and fish and wildlife. Sources of anthropogenic contamination may include fertilizers and pesticides applied on domestic or agricultural lands. Land application of wastewater for fertilization may be another source of contamination including nitrate, bacteria and consumer use products. Septic tanks are a possible source of contamination in urban to rural transition areas that are not connected to a sewer. There are multiple businesses in the study area that have the potential to contribute to groundwater contamination such as CAFOs, nurseries and kennels as well as industrial sites and businesses in the cities that may use or store hazardous materials. Wells tested for this study, however, are generally located in rural areas, outside of industrial or heavy commercial areas.

1.2.5 Climate

The Willamette Valley climate is generally described as mediterranean, with warm, dry summers and mild, wet winters. Average temperatures (in degrees Fahrenheit) range from 50s to 80s in the summer and 30s to 50s in the winter. Monthly precipitation ranges from 0 to 7 inches, mostly falling between November and March, with an annual average measured at 40.67 at McNary Field in Salem. To supplement low precipitation in the summer, most farms apply irrigation water from ground and surface water sources. The length of the irrigation season is about 120 days, from mid-May to mid-September on average (Gonthier, 1983).

1.3 Previous groundwater quality studies

The following sections summarize groundwater data for various parts of the study area from various sources to provide context for the findings of the 2017 study.

1.3.1 USGS, WRD and DEQ groundwater quality studies

Dallas/Monmouth (west of Salem): A review of groundwater quality from 1956 through the 1970s states that water from shallow depths in the consolidated rocks is generally of good quality, but with increasing depth becomes too mineralized. Groundwater samples from a 1976 USGS study indicated that the unconsolidated aquifers generally yield good quality, but in some locations may contain high concentrations of iron (up to 19,000 µg/L) or manganese (up to 800 μg/L), requiring treatment. Six out of 51 wells (12%) had concentrations of arsenic from 5-10 μg/L. Nitrate concentrations were generally low, with only two wells reported to have concentrations near the EPA drinking water standard (otherwise known as maximum contamination level or MCL). Thirteen of the 51 samples (25%) had boron levels above 1 mg/L, which is toxic for irrigation of sensitive plants. Recharge to the younger alluvium was estimated at 8-15 inches annually. Lower recharge rates of 2-5 inches/year were estimated for the consolidated formations and older alluvium, which have lower permeability. (Gonthier, 1983).

Mission Bottom, Grand Island, South Newberg, West Salem, East Independence and West Stayton: DEQ conducted groundwater testing in September 1980 through January 1981 from a number of wells in residential and agricultural areas with hydrogeologic conditions similar to those in Mission Bottom near Salem to evaluate potential metal contamination of groundwater related to applications of domestic sewage sludge on agricultural lands from Salem's Willow Lake facility. No heavy metal contamination was encountered, however, the study found that about 40% of the wells sampled in the Mission Bottom area had nitrate-nitrogen concentrations exceeding the drinking water standard versus about 8% of the wells tested in the other areas sampled for this study (DEQ, 1982).

Mission Bottom, Lake Labish, Jefferson (regions around Salem): In the mid-1980s, the U.S. Environmental Protection Agency, DEQ, ODA, OSU, OHA, OWRD and the USGS conducted an assessment of agricultural chemicals in groundwater in selected areas of Oregon considered to have high vulnerability to contamination. The study found that close to 100 different pesticides were in use in the Willamette Valley at the time, more than 50 of which had use rates of over 1000 pounds per year. The analyte list for the study included 32 pesticides plus lists of VOCs, metals, nutrients, and general chemistry parameters. The highest nitrates in groundwater were found in the Mission Bottom area. Of the 93 wells sampled, 29 (31%) were over the drinking water standard in this area. Pesticides detected in the Willamette Valley study included 19 detections of the banned pesticide ethylene dibromide (EDB), three detections each of carbofuran and fonofos, two detections of bromacil, and one detection each of dinoseb and lindane (also known as gamma BHC) (Fortuna, 1988).

Canby (SE of Woodburn, NW of Molalla): DEQ conducted a small-scale groundwater study in the Canby area in February and August of 1993 to evaluate potential contaminants related to agriculture and septic systems. Nitrate was detected in 16 of the 21 wells sampled (76%); three wells (14%) in a cluster north of Canby had concentrations exceeding the drinking water standard of 10 mg/L. The pesticide, dacthal, was detected in one well in February but not detected in the August resampling of that well (Cole, 2004).

Woodburn (mid-way between Salem and Sherwood): DEQ conducted a small-scale groundwater study in the Woodburn area in March and August of 1993 to evaluate potential contaminants related to agriculture and septic systems. Nitrate was detected in 7 of the 19 wells sampled (37%); no wells had concentrations of nitrate above the drinking water standard. Arsenic was detected in 12 of the 19 wells sampled (63%) and exceeded the drinking water standard in seven wells (37%). Barium was detected in three wells at low concentrations and copper was detected in one well at a concentration below the EPA Action Level (Cole, 2004).

1.3.2 Real Estate Transaction domestic well testing

Since 1989, Oregon statute (ORS 448.271) requires that groundwater wells that are used for domestic purposes be sampled for nitrate and bacteria when a house is sold or transferred. Requirements for arsenic testing were added in 2009. Additional requirements for lead testing, and notification to tenants of well water quality within Groundwater Quality Management Areas, were added in 2025 (ORS 90.321), effective 1/1/2027. The Oregon Health Authority houses this data.

Real Estate Transaction data (from OHA DWTA-RET database 1989-2020) in groundwater in the mid-Willamette Valley study area shows pockets of high nitrate in the Jefferson-Stayton, Hayesville, and Canby areas (Figure 2). The OHA RET data for arsenic in groundwater shows levels of arsenic at and above the drinking water standard of 10 µg/L along the Interstate 5 corridor between Salem and Wilsonville (Figure 3).

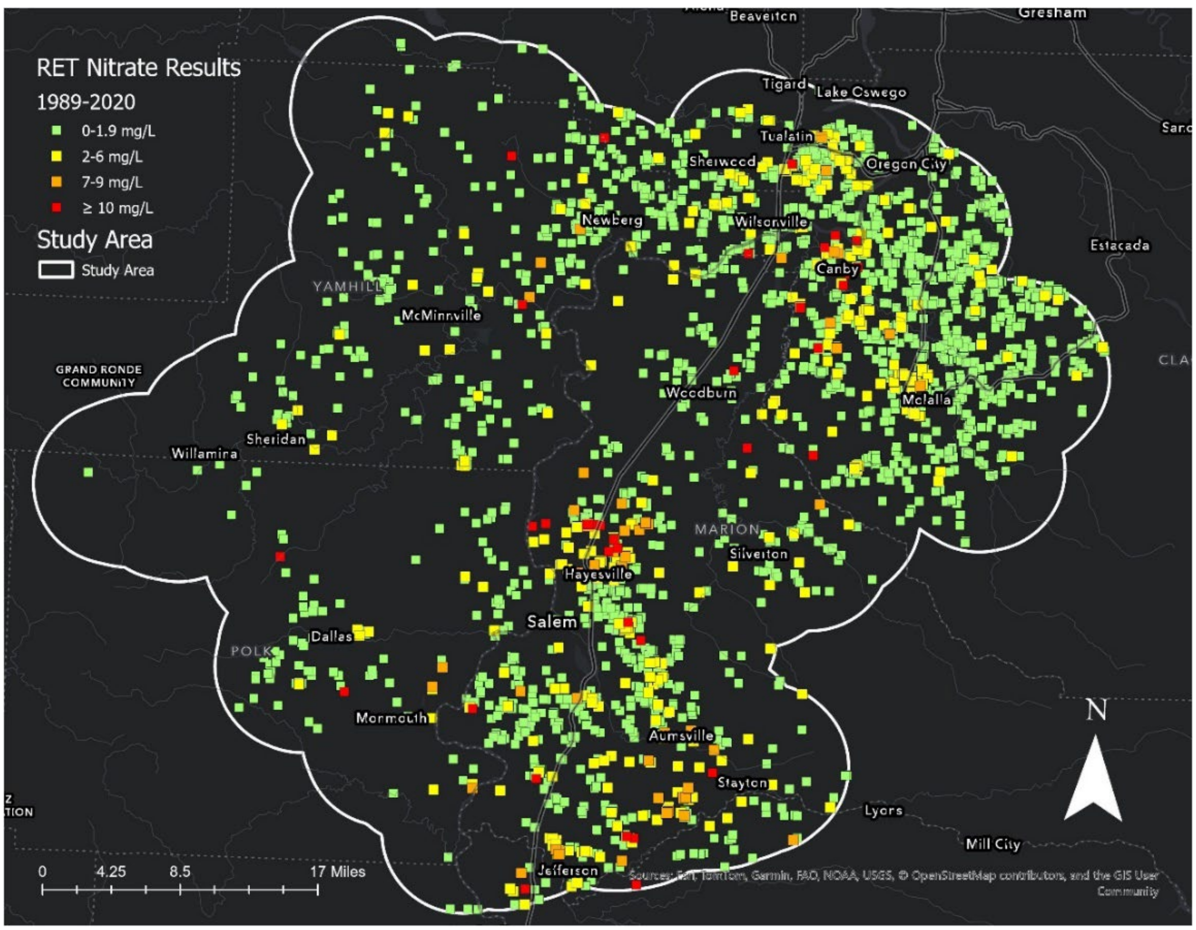

Figure 2. Nitrate in groundwater–Oregon Health Authority Real Estate Transaction data.

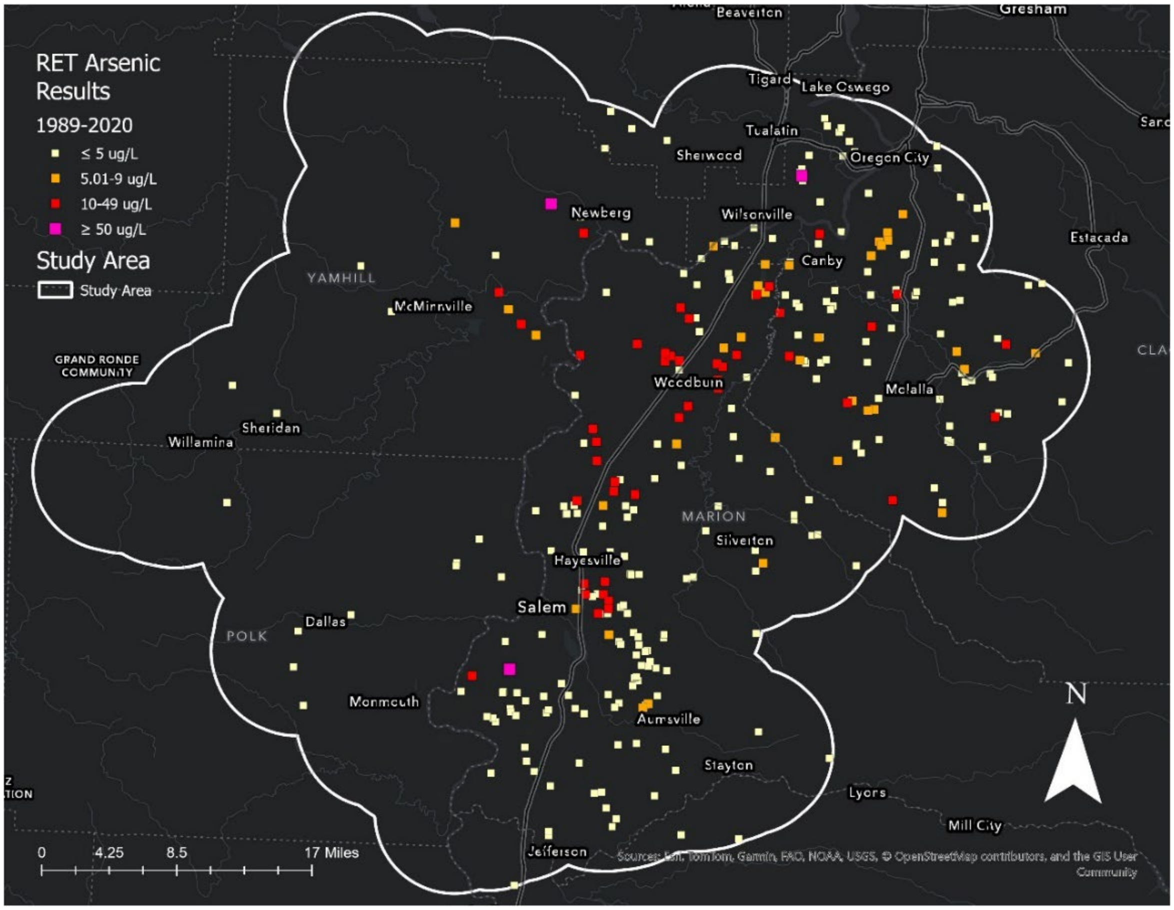

Figure 3. Arsenic in groundwater–Oregon Health Authority Real Estate Transaction data.

1.3.3 Public drinking water systems

There are 357 public water systems (PWS) using groundwater wells with drinking water source areas that intersect the study area. These systems serve approximately 475,300 people. Eight (2%) of the systems, servicing more than 50% of the population in the area (approximately 281,600 people), are primarily supplied by surface water. A drinking water source area is defined as the area of land which contributes water to the drinking water supply and where potential contamination from human activities or natural sources may pose a threat to the water quality.

Of the 357 PWS, 117 are active "community" PWS which use either groundwater, or a combination of groundwater and surface water sources to serve approximately 432,700 people on a regular basis, in addition to visitors at recreation sites. There are 69 active "non-transient", "non-community" (for workplaces or schools) PWS which serve 17,809 people regularly. The remaining 116 PWS are "transient non-community" systems and state-regulated systems (such as for a gas station or campground) with an estimated service population of 18,800. There are an additional 55 PWS in the study area that are currently inactive. See Appendix A for a list of the PWS, their classifications, primary source and activity status, and populations served. A brief summary of recent PWS data is presented below.

Bacteria: Total coliform bacteria alerts and E. coli bacteria alerts for PWS are generated by the Oregon Health Authority when their presence is detected in sample results. Water systems sample for total coliform bacteria and confirmed detections trigger additional sampling for fecal coliforms or E. coli. Within the study area, 41 (11%) PWS had one or more alerts for detections of E. coli bacteria in the past ten years (Appendix A). When E. coli is detected, additional site-specific review is typically needed to evaluate the source of E. coli, which may not be related to impacts to groundwater quality. If confirmed E. coli detections are considered to be contributing to groundwater contamination, PWS repairs are required by OHA. There are several PWS with E. coli detections clustered in the North Salem/Kaiser area as well as E. coli alerts at pairs of systems of Monmouth and Independence, and Woodburn and Hubbard, indicating further assessment may be needed to evaluate potential impacts to groundwater quality in those areas.

Nitrate, Arsenic, Manganese: An alert for elevated nitrate concentrations is generated by the Oregon Health Authority when nitrate sample results for PWS exceed 5 mg/L, which is half the EPA maximum contaminant level (MCL), also known as drinking water standard. Within the study area, 21 (6 %) of the PWS had one or more alerts for elevated nitrate results in the past ten years.

Within the study area, 19 (5%) of the PWS had one or more alerts for arsenic concentrations exceeding 10 µg/L in the past ten years. Four of the PWS had one or more alerts for manganese exceeding 300 µg/L in the past ten years.

Other contaminants: Water quality samples from PWS within the study area also detected other contaminants including volatile organic chemicals: trichloroethylene, tetrachloroethylene, CIS-1,2-dichloroethylene, 1,2-dichlorlethane, dichloromethane, trans-1,2-dichloroethylene, xylenes, toluene, ethylbenzene, 1,2-dichloropropane, and synthetic organic chemicals: picloram, di(2-ethylhexyl) phthalate, hexachlorobenzene, pentachlorophenol, dalapon, and 2,4-D. In addition, radionuclides, and the disinfection byproducts total haloacetic acids (HAA5) and total trihalomethanes (TTHM) were detected in water sampling.

Community and Non-Transient, Non-Community public water systems in Oregon are testing for six PFAS compounds in their water supplies. Results are due to OHA by April 2027. Many tests have been completed and data is available on OHA's online PWS database or under individual PWS data at OHA's Drinking Water Data Online site. More details about PFAS testing requirements for PWS are provided on OHA's website.

2. Well selection, sampling and analysis

The study design for this Mid-Willamette groundwater quality investigation is similar in structure to previous DEQ studies since 2015, with the intention of monitoring ambient groundwater quality, identifying water quality and health concerns and presenting results to well users. The availability and diversity of wells change with each study area identified, as does the list of relevant contaminants based on historical data, current use conditions and interests of local partners. Analytical methodologies available at the DEQ Laboratory also shift over time. This section details the considerations that went into sample site selection, analyte selection, sampling methods and context for data interpretation. DEQ quality assurance documents referenced in this report can be made available upon request.

2.1 Sample site (well) selection

DEQ's statewide groundwater monitoring program relies primarily on well owners who volunteer to have their wells tested in exchange for a complete report of the analytical results from their well. A limitation of using active, private wells versus monitoring wells installed specifically for this purpose is that private wells are not always available in the desired locations or constructed to desired depths. However, partnerships with dozens of well users within a geographic area can allow access to a range of well depths and locations within the aquifer area of interest. This approach meets the objectives of the DEQ Statewide Groundwater Quality Monitoring Quality Assurance Project Plan (DEQ93-LAB-0024-QAPP).

DEQ recruited well owner volunteers for this study using flyers, emails, a press release, and other announcements with the help of local partners, including the North Santiam Watershed Council. Communications offering free well water testing to participants in this study were provided in English, Spanish and Russian to reach a diversity of well users. Flyers were posted at libraries and post offices in target communities, which included the demographically vulnerable communities identified by the EJ Screening Tool. The DEQ Groundwater Monitoring hotline voicemail offered translation services for all interested callers. Outreach materials were broadcast on local Spanish and English language radio stations in addition to local print and digital newspapers and social media sites.

DEQ continued to recruit volunteers until adequate options were available to select 100 study wells of various depths and geographic locations sufficient to represent conditions in the study area (Figure 1). Well selection was limited to the availability of well users who volunteered, the accessibility of their well and the location of an access point prior to water treatment. DEQ included wells without a working pump if the associated well head could accommodate a submersible pump. Of the volunteered wells received in the Mid-Willamette study area, those selected were primarily domestic drinking water wells. Four irrigation wells were also included.

The Oregon Department of Water Resources has required filing records of drilled wells in the state since 1955. These records, called well logs in this report, are available on the OWRD website at [Well Report Query](). Well logs contain valuable information such as depth of well, depth of first water, well construction materials, screened interval, materials encountered while drilling (to evaluate aquifer type), seal depth and material, use of well, age of the well, and estimated yield. Many of these well characteristics are helpful in the evaluation of which aquifer a water sample might represent. An example well log is included in Appendix B.

Not all wells selected for this study had a documented well log. This is intentional since many of the older wells in the state do not have recorded well logs and yet can be good sources of shallow groundwater quality samples. Many of the newer wells may only access deeper aquifers which do not provide information about shallow contamination. In addition, older wells are more often in use at older residences, which are sometimes associated with lower income households or rental properties. The inclusion of older wells is one way to assess groundwater quality conditions in vulnerable communities. For some wells for which well logs could not be located, approximate well construction dates and depths were provided by well owners and noted as estimated in the list of project wells in Appendix C. Of the 100 wells sampled in this study, 72 were able to be reasonably associated with a well log.

Sample collection dates attempted to capture seasonal and land activity differences between the spring and fall in Oregon. Twenty wells were sampled in both the spring (February) and fall (October/November) of 2017. These wells were selected based on spatial distribution, availability and cooperation of the well owners. Detections of contaminants in the February sampling event influenced the wells that were selected for resampling in the fall. Some wells could only be sampled once due to permission restrictions or because an irrigation well was not in operation during colder months of the year. Section 3.2 provides DEQ's evaluation of correlations between water quality sampling results and the season in which samples were collected.

Personal data collected from participants during this study is not included in this report. All volunteer well owners received an individualized copy of groundwater quality laboratory report in 2018 associated with their well along with resources for data interpretation and well maintenance. Appendix D provides an example of the letter and laboratory report that participants received.

2.2 Analyte selection

Sample analyses included common ions and common field parameters, nitrate/nitrite as N (referred to as nitrate in this report), total coliform bacteria, E. coli bacteria, arsenic and other metals. Current use and legacy pesticides were included due to high agricultural land use in the Willamette Valley. Pharmaceuticals and personal care products were included in this study based on the suburban rural demographic with potential for septic tanks densities to impact groundwater quality. Volatile organic compounds were also included in this study based on historical data of detections in this area. In total, 238 chemicals or water quality parameters were analyzed for each well water sample tested. A complete analyte list can be found in Appendix E. The corresponding laboratory methods and reporting limits are in the Sampling and Analysis Plan (DEQ17-LAB-0002-SAP).

2.3 Sampling methods

DEQ water quality monitoring staff collected and processed samples in the field according to standard procedures found in the Water Quality Monitoring Mode of Operations Manual: Field Collection Methods (DEQ03-LAB-0036-SOP_V3) and the project Sampling and Analysis Plan (DEQ17-LAB-0002-SAP). In general, where possible, samples were collected from an outdoor spigot closest to the well head, and always before any water filtration or treatment. Some samples were collected from a pressure tank or large storage reservoir when access to water directly from the well was not available. In those cases, the pressure or storage tank volume was purged prior to collecting the sample to ensure a representative sample from the aquifer. Wells with active pumps were purged for at least five minutes and until field readings of conductivity, temperature and dissolved oxygen stabilized. Bacteria samples were collected last, after the sample point was disinfected with isopropyl alcohol.

Determination of a direct connection between the spigot used for sample collection and the well was evaluated based on best available information. It was either visually clear that the spigot was plumbed to the wellhead, or the well user or well owner confirmed verbally or with written instructions that the spigot was connected to the wellhead.

For collection of samples for lead analysis, the goal was to measure the quality of the water coming from the aquifer rather than from static water in piping. Therefore, pipes were flushed for 5-10 minutes before the lead sample was collected. For homeowners to evaluate for potential worst case lead contamination of drinking water from plumbing, samples should be collected differently, using the first draw method described in the EPA document, Module 5: Conducting Sampling and Interpreting Results - 2-Step Sampling Protocol

2.4 Context for data interpretation

Many of the chemicals analyzed in this study are not found naturally in groundwater (e.g., pesticides, personal care products, volatile organic compounds) or have very low natural background concentrations (e.g. nitrate). Detection of these chemicals indicates an influence from human activities such as leaching from agricultural or residential use of fertilizers and pesticides, improperly designed or maintained septic systems, poor well construction, or improper storage/disposal of solvents or leaking underground storage tanks. These contaminants, along with minerals and elements generally considered to be naturally occurring, such as arsenic and manganese, may be harmful to human health when present in drinking water above certain levels.

The quality and safety of drinking water from private, domestic wells is generally not regulated. However, as mentioned in section 1.3.2, domestic well testing is required at the time of real estate transactions.

For this study, the water quality results have been compared to various health-based screening levels. For public water systems, EPA sets a maximum contaminant level goal (MCLG) as the concentration of a contaminant below which there is no known or expected health risk. The EPA then sets the maximum contaminant level (MCL) as close to the MCLG as feasible considering treatment technologies and cost. MCLs, otherwise known as drinking water standards, are enforceable water quality criteria for public water systems. Secondary MCLs (SMCLs) are non-enforceable guidelines indicating concentrations at which aesthetic effects might be noticeable (scaling, odor, taste) which are not health related. EPA also develops Action Levels for responses to concentrations of copper or lead in drinking water (U.S. EPA, 2018). DEQ's analytical reports sent to well owners included information on the MCLs for relevant contaminants. See Appendix D for an example of a laboratory report.

Many of the chemicals measured in this study do not have a maximum contaminant level. In these cases, there are several other sources of health risk information, such as the EPA Human Health Benchmarks for Pesticides, and EPA Regional Screening (U.S. EPA, 2018; U.S. EPA, 2017). In addition, Health-Based Screening Levels (HBSLs) are developed by the United States Geological Survey. The USGS non-regulatory screening values are based on available toxicological research and can be used to determine whether the concentration of a contaminant in drinking water may pose a risk to human health (Toccalino, 2014 and USGS, 2024). For this project, results are compared to maximum contaminant level goal and maximum contaminant levels when available. If no maximum contaminant level is available, the result is compared to the lowest value of the current Human Health Benchmarks for Pesticides, Regional Screening Levels, or USGS Health-Based Screening Levels. Tables 1a and 1b list the relevant screening level for each detected analyte.

Health screening levels related to soil health, crops, or livestock are not widely available. DEQ referred participants in this study to their local Oregon State University (OSU) Extension Service Agent to discuss the impacts that particular contaminants may have on their soil, crops, livestock management, or food gardens.

A note about quantitative data summaries of analytes: due to quality assurance measures related to sampling, sample preparation and analysis, some samples or analytes were downgraded to a lower data quality level and rejected from the data used in Tables 1a and 1b. Only samples and analytes that maintained an A or B data quality level were included in the quantitative analysis described in this report. All other data in this study were associated with non-detect results.

3. Water quality results and discussion

The results of the Mid-Willamette Valley Groundwater Quality Study are presented below. The complete raw data from this study may be obtained through the Ambient Water Quality Monitoring System (AWQMS) data portal or by contacting DEQ at Groundwater.Monitoring@deq.oregon.gov.

Factors that influence the likelihood of groundwater contamination include: 1) proximity of a well to the source of contamination, 2) the concentration of chemical naturally present in soils or native rock, 3) chemicals that are applied, spilled, or discharged to the ground or below the ground surface, 4) depth of groundwater accessed by a well (shallow groundwater is affected by surface spills or discharges more quickly and more severely than deep groundwater), 5) local geology (aquifers present below a clay or other confining layer are less vulnerable to contamination), and 6) time (groundwater generally moves slowly, so it can take months or years for surface contamination to reach well water).

3.1 Water quality results

Tables 1a and 1b identify the maximum concentrations for all detected parameters out of 238 separate parameters analyzed for the study. The health-based screening levels for each parameter are also listed in the tables as well as how many samples exceeded the screening level for each parameter. The following sub-sections of the report highlight results that may present a potential human health risk for people drinking the water and/or may indicate contamination of groundwater due to human activities.

Table 1a. Summary of 23 of the 50 detected analytes, maximum concentrations, and number of wells with detections exceeding health-based screening levels.

Characteristic Name	Units	Screening Level*	# Wells w/ Detections	Max Conc	# Wells with detections above screening levels
General Chemistry and Common Ions (Ca, SO4)					
Alkalinity, total	mg/L	not available	99	326	NA
Calcium	mg/L	not available	100	394	NA
Chloride	mg/L	250[3]	100	1010	4
Conductivity	umho/cm	not available	100	3446	NA
Dissolved Oxygen	mg/L	not available	100	10.8	NA
Hardness, Ca, Mg	mg/L	not available	100	1030	NA
pH	SU	<6.5, >8.5[3]	100	9.5	15-low pH, 8-high pH
Sodium	mg/L	not available	100	332	NA
Sulfate	mg/L	250[3]	92	393	1
Total solids	mg/L	not available	100	2330	NA
Nutrients					
Nitrate + Nitrite	mg/L	10[1]	66	9.33	0
Total Phosphorus, mixed forms	mg/L	not available	98	1.83	NA
Bacteria					
Escherichia coli	MPN/100mL	0[1]	3	248	3
Total Coliform	MPN/100mL	0[1]	34	2420	34
Metals					
Aluminum	µg/L	70[2]	15	1620	8
Arsenic	µg/L	10/0[1]	57	41.5	7> MCL, 57>MCLG
Iron	µg/L	4000[2]	66	27600	6
Lead	µg/L	15/0[1]	65	44.9	2 >MCL, 65>MCLG
Magnesium	mg/L	not available	98	30.8	NA
Manganese	µg/L	300[2]	77	3600	21
Potassium	mg/L	not available	95	15.1	NA
Uranium	µg/L	30[1]	10	0.41	0
Vanadium	µg/L	86[4]	29	43	0

***If an EPA MCL is not available, the lowest concentration of other available screening levels is referenced.**

NA = Not applicable

[1]EPA MCL/MCLG (drinking water standards/goals)

[2]USGS Non-Cancer HBSL-Health Based Screening Levels for evaluating water quality

[3]EPA SMCL for aesthetic purposes

[4]EPA Regional Screening Levels

Table 1b. Summary of 27 of the 50 detected analytes, maximum concentrations, and number of wells with detections exceeding health-based screening levels.

Characteristic Name	Units	Screening Level*	# Wells w/ Detections	Max Conc	# Wells with detections above screening levels
Pesticides					
2,6-Dichlorobenzamide	ng/l	270,000[5]	16	628	0
Acifluorfen	µg/L	80[2]	5	0.7	0
Bromacil	ng/l	100,000[2]	2	2360	0
EPTC (Eptam)	ng/l	300,000[5]	1	44.3	0
Hexazinone	ng/l	300,000[2]	1	63.4	0
Metribuzin	ng/l	8,000[2]	1	5.17	0
Triazine Pesticides					
Atrazine	ng/l	3,000[1]	2	8.48	0
Deisopropylatrazine	ng/l	10,000[2]	2	12.6	0
Desethylatrazine (2-Chloro-4-isopropylamino-6-amino-s-triazine)	ng/l	not available	5	47.7	NA
Simazine	ng/l	4,000[1]	2	14	0
Legacy Pesticides					
p,p'-DDE (4,4'-DDE)	ng/l	46[4]	1	0.243	0
o,p'-DDT (2,4'-DDT)	ng/l	not available	1	0.0809	NA
p,p'-DDT (4,4'-DDT)	ng/l	230[4]	1	0.0739	0
Aldrin	ng/l	2-200[2]	1	0.0874	0
Dieldrin	ng/l	2-200[2]	3	0.175	0
Lindane	ng/l	200[1]	1	0.206	0
Methoxychlor	ng/l	40,000[1]	1	0.41	0
VOCs and SVOCs					
cis-1,2-Dichloroethylene	µg/L	70[1]	1	0.81	0
m-Dichlorobenzene (1,3-Dichlorobenzene)	µg/L	500[2]	1	5.37	0
p-Dichlorobenzene (1,4-Dichlorobenzene)	µg/L	75[1]	1	9.42	0
Chlorobenzene	µg/L	100[1]	1	3.83	0
Styrene	µg/L	100[1]	1	1.11	0
Toluene	µg/L	1,000[1]	1	1.7	0
Trichloroethylene	µg/L	5[1]	1	0.81	0
TDCP-Tris(1,3-dichloro-2-propyl)phosphate	ng/l	360,000[4]	2	270	0
TCEP-Tris(2-chloroethyl)phosphate	ng/l	3,800[4]	2	67.6	0
Consumer Product Constituents					
Diphenhydramine (Ethanamine, 2-(diphenylmethoxy)-N,N-dimethyl-)	ng/l	not available	3	18.7	NA

*If an EPA MCL is not available, the lowest concentration of other available screening levels is referenced.

NA = Not applicable

[1]EPA MCL/MCLG (drinking water standards/goals)

[2]USGS Non-Cancer HBSL-Health Based Screening Levels for evaluating water quality

[3]EPA SMCL for aesthetic purposes

[4]EPA Regional Screening Levels

[5]EPA HHBP-Human Health Benchmarks for Pesticides

3.1.1 Nitrate

Nitrate in this study was measured as nitrate/nitrite. While nitrite is rarely found naturally in groundwater at significant levels due to geochemical conditions, these results represent a conservative measurement of nitrate. Nitrate is a natural and necessary nutrient found in soil and surface water. Human activities, however, can influence the concentrations of nitrate found in soil and water. Nitrate-enriched water can leach into aquifers from areas of fertilizer use, improper composting, manure storage or application, or from improperly designed or maintained septic systems (Powers, 1989). Background concentrations of nitrate in groundwater have been conservatively estimated by the United States Geological Survey as 1.1 mg/L (Nolan, 2003). Other reports (Mueller, 1996 and Madison, 1985) have estimated background levels of 2 or 3 mg/L. For the purposes of this report, any concentrations at or above 3 mg/L will be considered as levels sufficiently above background to indicate an impact from human activities on groundwater quality.

Figure 4 illustrates the spatial distribution of sampled wells with nitrate detections. There were 66 nitrate detections in this study. Only eight of the 100 wells tested had detections of nitrate above 3 mg/L and none of the detections exceeded the EPA drinking water standard of 10 mg/L. One well had nitrate concentrations close to the drinking water standard. The range of concentrations was from non-detect to 9.33 mg/L. Most detections were in the southern part of the study area. Pockets of elevated nitrate in the Jefferson-Stayton, Hayesville, and Canby areas apparent in the RET data in Figure 2 were not observed in the 2017 study data. Three of the wells with elevated nitrate that were sampled twice had higher concentrations on the February 2017 sampling date than on the October/November 2017 sampling dates and two had higher concentrations in the fall than in February.

Health concerns associated with elevated nitrate in drinking water include potential problems for infants, pregnant women and nursing mothers. More information for well users about nitrate in drinking water can be found on the Oregon Health Authority's Well User Resource Toolkit web page.

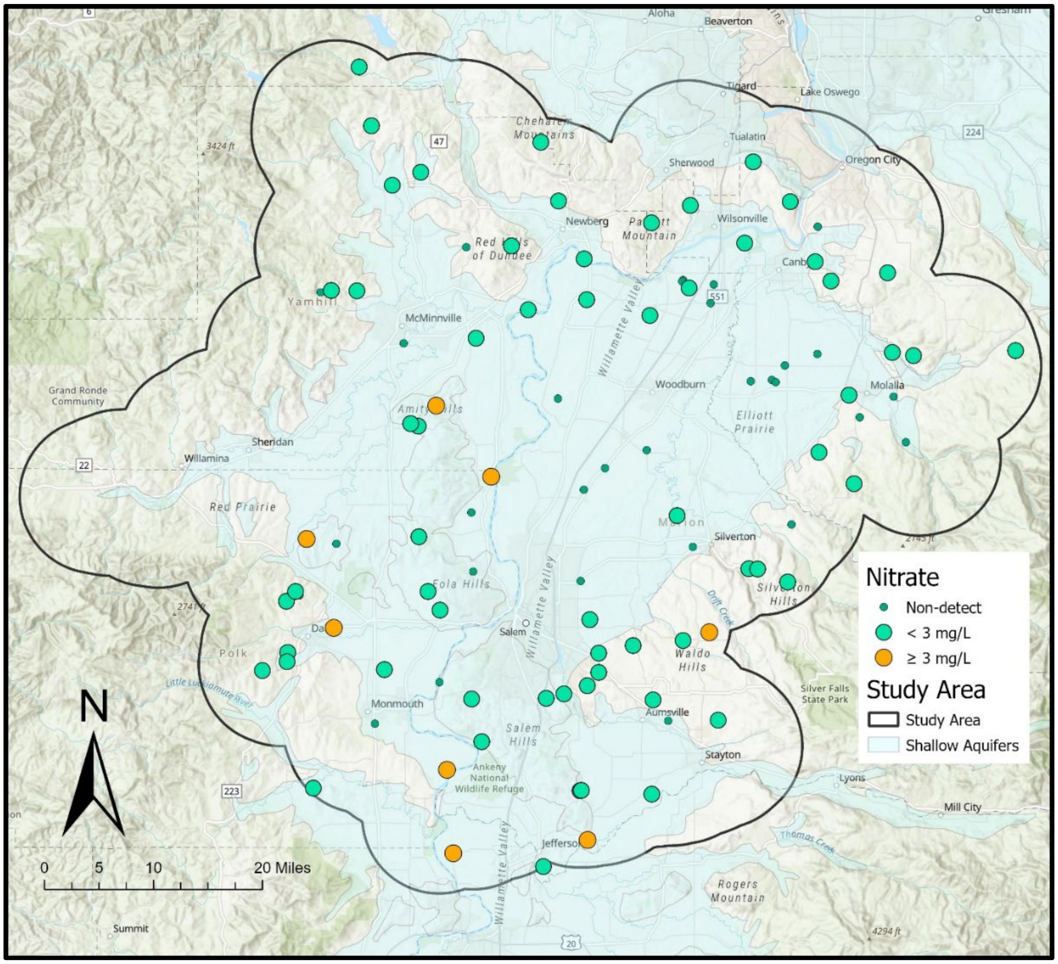

Figure 4. Nitrate concentrations in sampled wells.

3.1.2 Arsenic

Arsenic is a naturally occurring element found in the earth's crust. It is found in groundwater in many areas of Oregon, often due to dissolution of arsenic-containing minerals associated with volcanic rock or soils. Other potential sources include use as a wood preservative, historic uses as an insecticide for orchards, and for embalming fluids prior to 1945, indicating that historic cemeteries and orchards may be potential sources of arsenic in addition to the natural sources. Arsenic geochemistry is complex, and several factors may influence its mobility through soils and into shallow groundwater and wells (Welch, 2000). Arsenic in drinking water presents a health risk and EPA has established an MCL of 10 µg/L for total arsenic. The MCLG is zero.

Figure 5 illustrates the distribution of arsenic in groundwater in the study area. Fifty-seven of the 100 wells tested had concentrations of total arsenic above the detection level of 0.25 µg/L (Table 1a). Seven wells showed arsenic levels exceeding the MCL of 10 µg/L. The range of concentrations was from non-detect to 41.5 µg/L. The map of RET wells tested for arsenic (Figure 3) shows most of the RET-tested wells located east of the I-5 corridor with elevated arsenic concentrations ($\geq$10 ug/L) are mainly located around Salem, north along the I-5 corridor to Oregon City and along the eastern edge of the Amity Hills between Salem and Newberg. While this Mid-Willamette study also identified wells with arsenic concentrations (≥10 ug/L in these areas, the overall distributions of the two data sets differ. This is likely because the RET database is a much larger and longer-term pool of data than the 100 wells of this study. In addition, RET-associated sampling is opportunistic (as property is sold) while DEQ's sample design for the Mid-Willamette study attempted to achieve a representative geographic distribution.

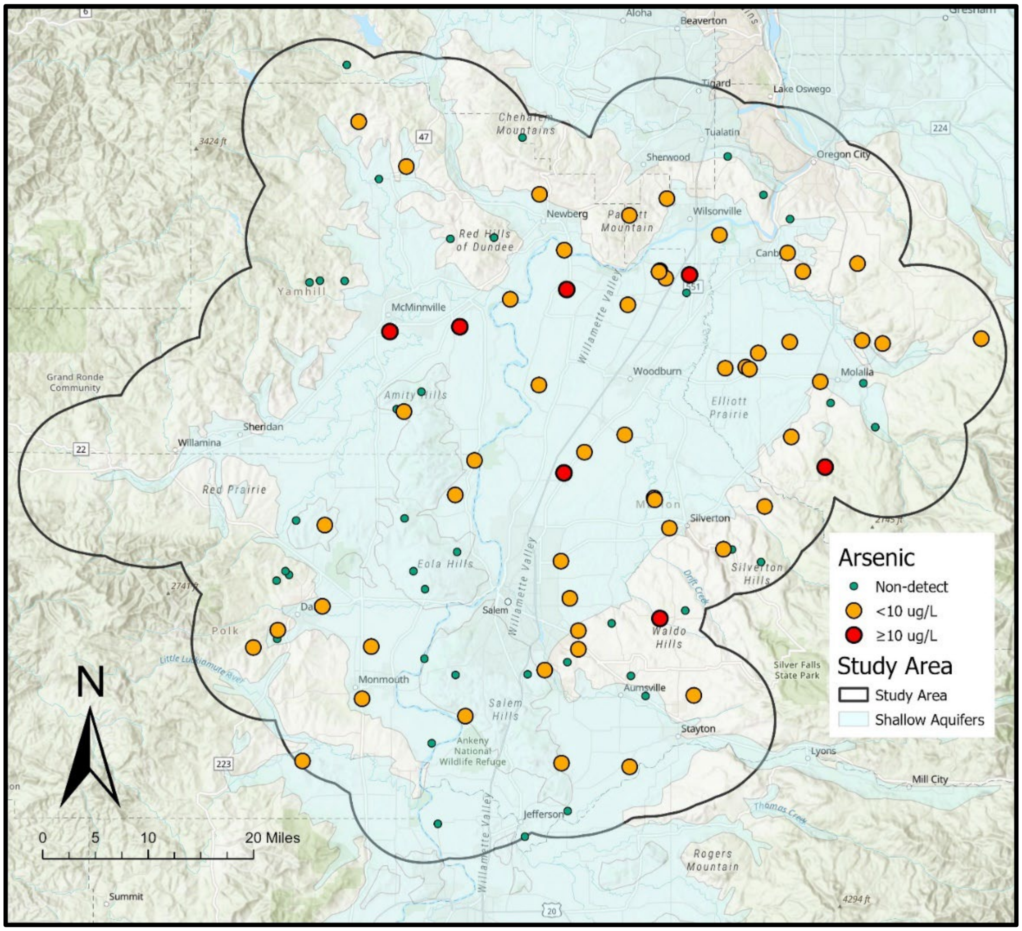

Figure 5. Arsenic concentrations in sampled wells

Figure 6 shows that 9 out of 13 wells (69%) with detections of arsenic >5 µg/L and documented well construction drew water from a shallow (<110 ft.) sand or sand and gravel aquifer. Two wells with arsenic >5 µg/L drew water from deep (>170 ft.) sand and gravel aquifers. Two of the four wells with the highest concentrations of arsenic (18 and >40 µg/L) drew water from deep (>220 ft.) basalt aquifers. Five wells had intermediate concentrations of arsenic, but no available data about aquifer type.

More information for well users about arsenic in drinking water can be found on Oregon State University's Well Water Program website https://wellwater.oregonstate.edu/well-water/arsenic or from the Oregon Health Authority's Testing Recommendations web page.

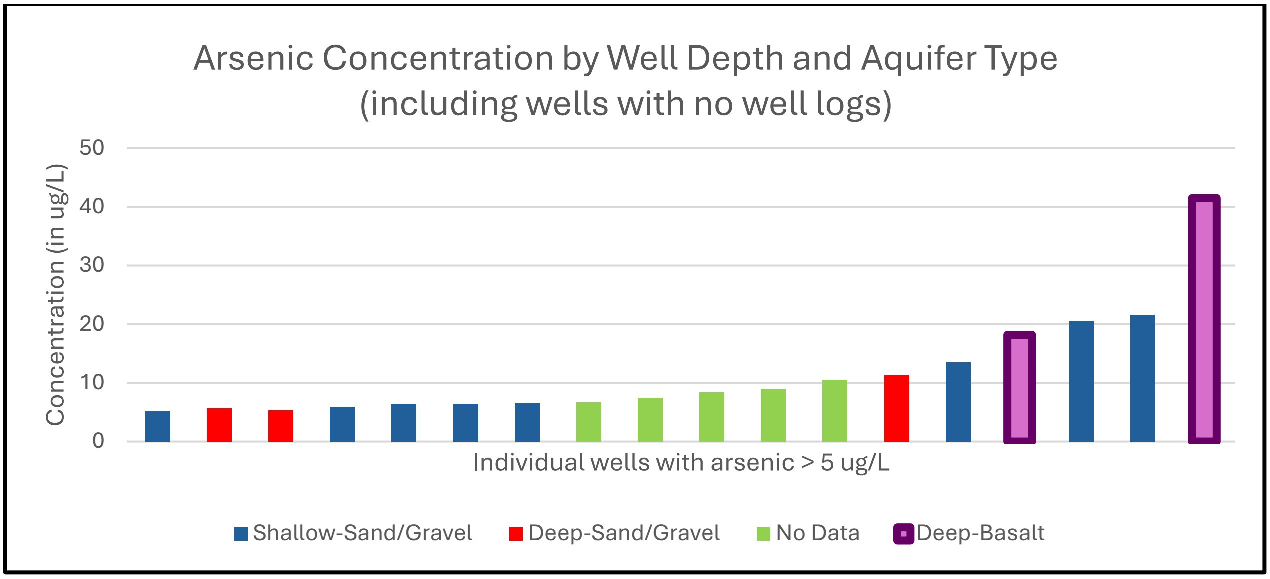

Figure 6. Arsenic concentrations versus well depth and aquifer type

3.1.3 Lead

DEQ includes lead in the statewide groundwater monitoring program as a public health screen. Although there are naturally occurring sources of lead, most lead detections in drinking water are from localized contamination, not an area-wide concern. Lead in drinking water is often the result of leaching from pipes, plumbing, solder used in well construction, and pump machinery, typically from older wells and plumbing in the household. Acidity, temperature and the concentration of other minerals in well water can influence the lead leaching rate. To avoid detecting lead from stagnant water inside plumbing, DEQ followed sampling methods described in Section 2.3 to ensure that pipes were flushed adequately before sampling. Lead in drinking water presents a health risk and EPA has established an MCL for lead of 15 µg/L. The MCLG is zero. The United States Center for Disease Control and Prevention (CDC) states that lead can be harmful to human health even at low exposure levels since lead can accumulate in the body over time (USCDC, 2025). For adults, high lead can result in high blood pressure or kidney problems.

Sixty-five of the 100 wells tested (65%) had detections of total lead. Two wells had detections over the lead MCL of 15 µg/L (24.1 and 44.9 µg /L).

More information for well users about lead in drinking water can be found on the Oregon Health Authority's [Well User Resource Toolkit web page]

3.1.4 Aluminum, manganese and iron

Aluminum, manganese and iron were also detected in well water sampled for this study. Metals in groundwater typically are the result of the interaction of water with soils and rock of the aquifer (USGS.gov, 2026). Concentrations can be influenced by pH and oxidation as well as the general chemistry of natural groundwater. USGS established a Non-Cancer Health-Based

Screening Level for aluminum at 70 µg/L and for manganese at 300 µg/L. There is no HBSL for iron. Secondary MCLs (SMCLs) are established for some constituents by EPA, primarily as an advisory regarding aesthetic impacts (discoloration or scaling) rather than due to health concerns. The SMCL for these metals are: aluminum (50-200 µg/L), manganese (50 µg/L) and iron (300 µg/L).

Of the 100 wells tested, 15 had detections of total aluminum and 66 had detections of total iron. Eight wells had detections of aluminum over the USGS Non-Cancer Health-Based Screening Level of 70 µg/L and 35 wells had iron exceedances over the non-health related SMCL of 300 µg/L.

Of the 100 wells tested, 77 had detections of total manganese. Twenty-one wells had detections of manganese over the USGS HBSL of 300 µg/L, eight of these detections exceeded the HBSL by 2-10 times. The range of concentrations was from non-detect to 3600 µg/L. Five wells had concentrations over 1000 µg/L. Elevated total manganese in water samples can be influenced by sediment in the samples (ODEQ Laboratory, 2026). Figure 7 shows that eight out of 16 wells (50%) with detections of total manganese >300 µg/L and documented well construction drew water from a shallow (<110 ft.) sand, gravel, or sand and gravel aquifers. The two wells with the highest concentrations of manganese (>2500 µg/L) drew water from deep (>120 ft.) basalt aquifers.

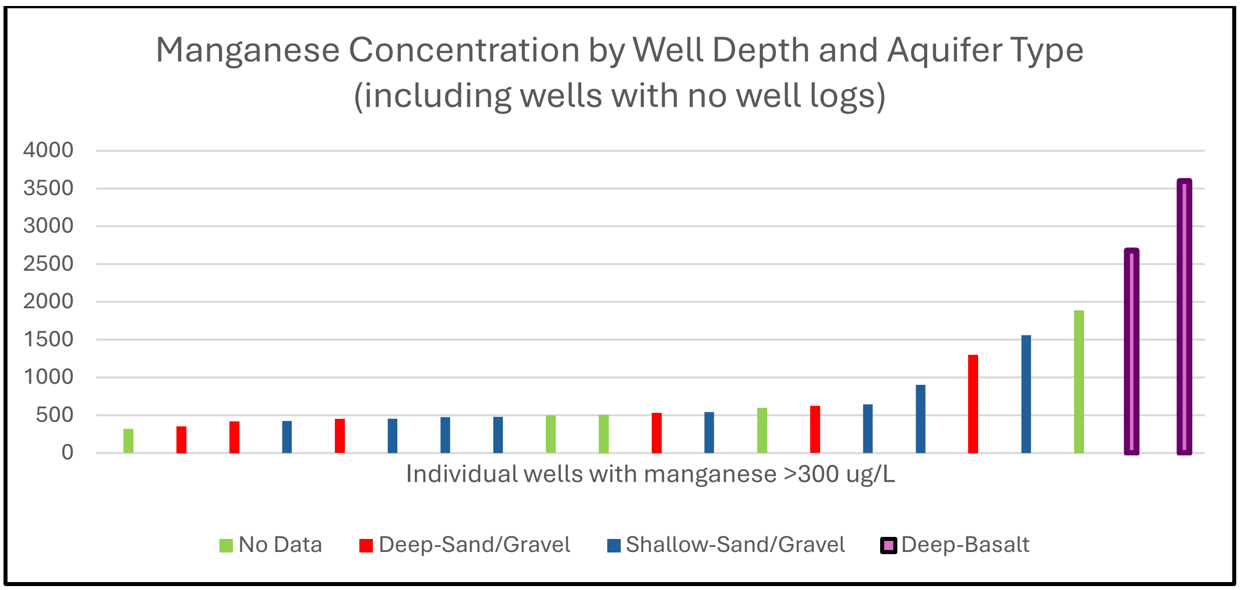

Figure 7. Manganese concentration by well depth and aquifer type

Figure 8 shows the distribution of detected manganese concentrations in groundwater. The highest concentrations seemed to be concentrated in the central part of the study area in the alluvial valley of the Willamette River between Eola Hills and Silverton to the south and Newberg and Wilsonville to the north. Manganese concentrations above the SMCL of 50 ug/L but below 300 ug/L were detected in the Dallas-Monmouth area in the southwest part of the study area and in various locations in the northern part of the study area.

More information for well users about manganese in drinking water is available from the Oregon Health Authority [Oregon Health Authority : Well User Resource Toolkit : Domestic Well Safety : State of Oregon](#).

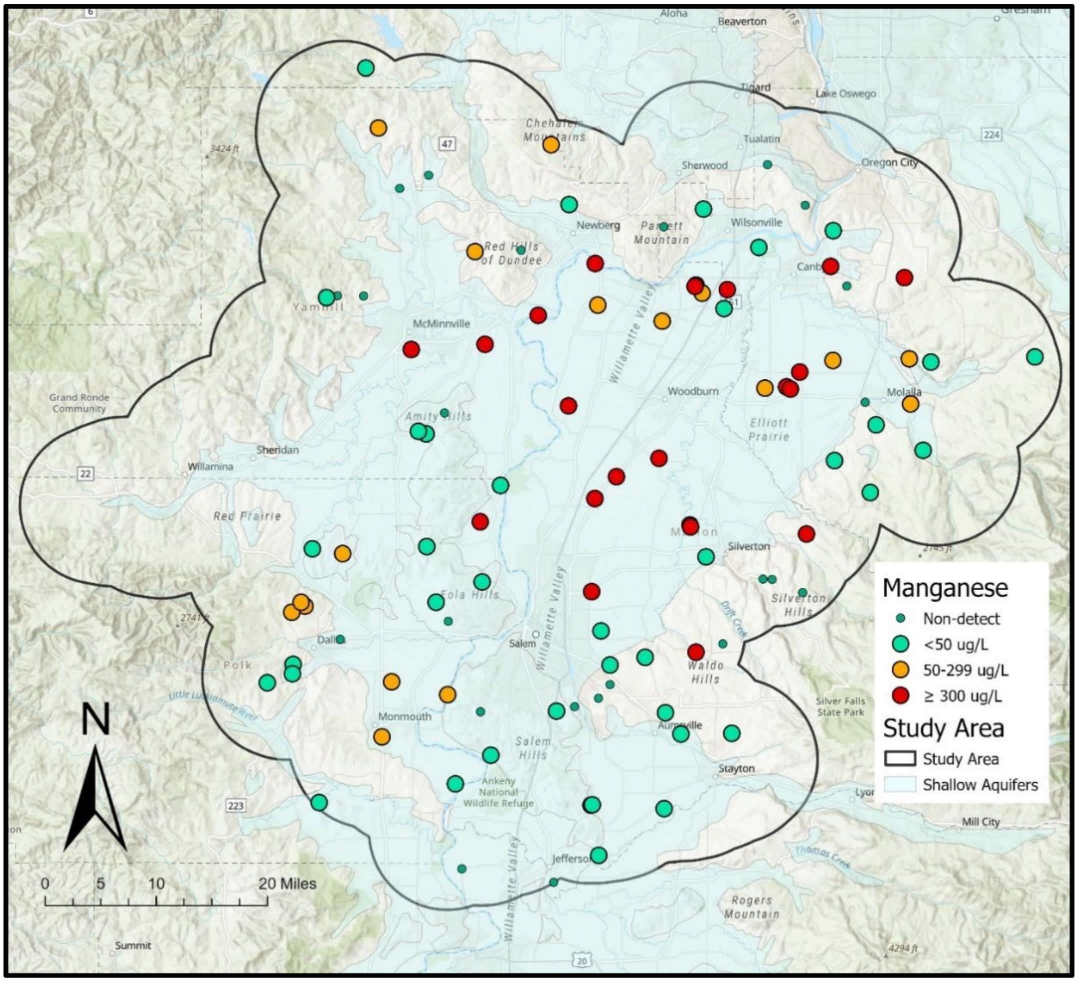

Figure 8. Manganese concentrations in sampled wells

3.1.5 Coliform bacteria and Escherichia coli

Coliform bacteria are a group of closely related bacteria that are typically not harmful to humans. However, coliform bacteria are a useful indicator to determine if similar, disease-causing microorganisms (e.g. bacteria, viruses) may be present in water bodies. E. coli is a specific class of coliform bacteria more commonly associated with illness. The presence of coliform bacteria may indicate a problem with the integrity of a well's construction, allowing contamination from surface or soil sources into the well. Bacterial contamination may also indicate potential contamination in shallow groundwater from improperly designed or maintained septic systems, or from leaching of materials through soils where manure is stored or has been spread. The MCLG for coliform bacteria is zero.

Total coliform bacteria were detected in 34% of the 100 wells tested. E. coli was detected in 3 of those wells.

More information for well users about testing for bacteria and understanding test results is available from the Oregon Health Authority's Well User Resource Toolkit web page

3.1.6 Pesticides

Pesticides are a broad class of chemicals that include insecticides, herbicides and fungicides. This study tested for current use and legacy pesticides. Legacy pesticides are those no longer in use since many have been banned from use for environmental reasons. The legacy pesticides that were detected in the area were chlorinated insecticides: aldrin, DDT, dieldrin, lindane and methoxychlor.

The study also measured several chemicals that are the breakdown products of the original pesticides. Physical processes, such as photo-degradation from sunlight, or biological processes, such as metabolism from bacteria, can break parent pesticides down into different chemicals. In some cases, breakdown products may be more toxic than the parent compound. In addition, some breakdown products may have different chemical structures making them more soluble and mobile in the groundwater or more persistent and resistant to further degradation. In general, less is known about the potential health impacts of the breakdown products than the parent pesticides. Due to chemical properties or time passed since application, often the breakdown products are detected, and not the parent (Mitra, 2024).

Table 1b lists the current use and legacy pesticides that were detected in area wells. Of the 136 pesticides analyzed, 93 were current use pesticides and 43 were legacy pesticides. Seventeen different pesticide-related chemicals were detected in this study, representing 13 different parent pesticides. Twenty-nine study wells (29% of wells tested) had at least one pesticide detection.

Figure 9 shows that pesticides were detected throughout the study area. The wells with the greatest number of detections seemed to be clustered in the southeast section of the study area, north of Stayton, northeast of Salem Hills. Concentrations of detected pesticides for which drinking water standards exist were below those standards.

The pesticide detections likely indicate contamination from agricultural-related activities, landscaping practices, or weed control. The pesticide detected most frequently (16 wells) was 2,6-dichlorobenzamide, or BAM, a breakdown product of dichlobenil, an herbicide used on roadsides and other places for weed and grass control. Dichlobenil was not detected in any well. Six of the 16 wells with 2,6-dichlorobenzamide that were sampled in both February and October/November of 2017 had higher concentrations in February, two wells had lower concentrations in February. Three of the wells with BAM detections also had detections for atrazine or its breakdown products.

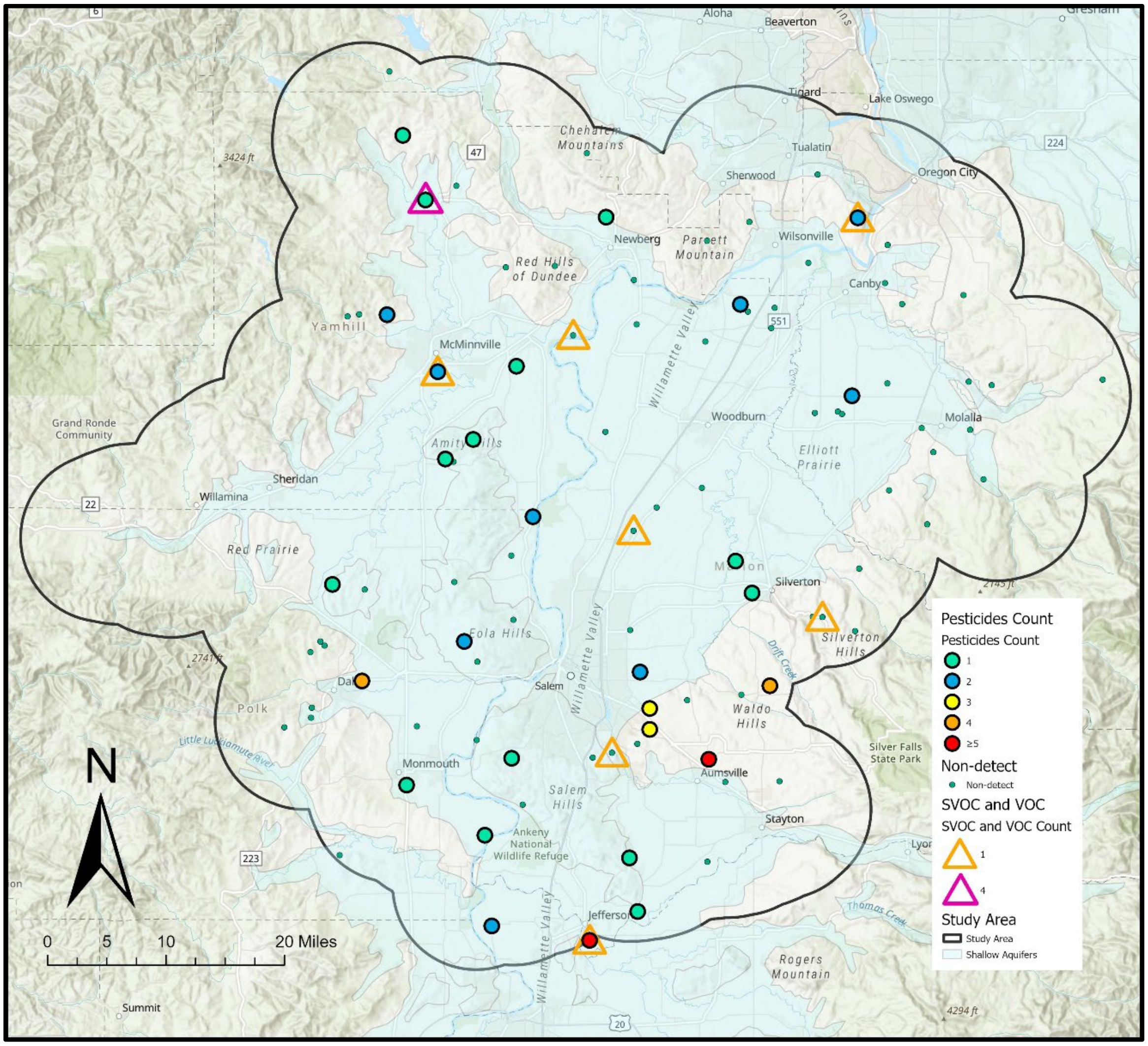

Figure 9. Number of pesticides, volatile and semi-volatile organic compounds detected

Atrazine and its breakdown products were detected in six wells, primarily in the southeastern portion of the study area, between Corvallis and Silverton. Atrazine is widely used for weed control before or after planting in agricultural areas and also on lawns and golf courses. Atrazine was detected in two wells along with the breakdown products (desethylatrazine , deisopropylatrazine), and simazine. In addition, atrazine breakdown products were found in four other wells without the parent product. Two of the wells with atrazine breakdown products had detections on both sampling dates. In one well, the pesticide concentration in the fall sample of desethylatrazine was more than four times higher than in the February sample. Atrazine uses were canceled in 2021 for roadsides and Conservation Reserve Program land. Atrazine and simazine uses were cancelled for forestry in 2021 (EPA, 2021).

As mentioned in section 1.3.1, bromacil was detected in two wells in the 1980s and in three wells in this study. Lindane was detected in one well in the 1980s and one well in this study. Fonofos (also known as Dynofate), a legacy pesticide used on commercial turf, home lawns and gardens, was detected in three wells in the 1980s. Fonofos was not included in the pesticide list for this study. Three other pesticides detected in the area in the 1980s (EDB, carbofuran) (Fortuna, 1988), and 1990s dacthal) (Cole, 2004) were not detected during this study.

3.1.7 Volatile and semi-volatile organic compounds

Volatile Organic Compounds are a class of chemical compounds that share two main properties: (1) they evaporate easily from water into the air and (2) they contain carbon. They are associated with products such as plastics, adhesives, cleaning fluids, paints, gasoline and other fuels, fumigants, refrigerants, and dry-cleaning fluids. Biological sources of VOCs are from the degradation of organic matter in feed and manure. VOCs may be released into the environment and may reach groundwater through many sources and pathways, including leaking storage tanks, landfills, infiltration of urban stormwater and wastewater, septic systems, and injection through wells. Some VOCs are known or suspected human carcinogens and their concentrations in drinking water from public water systems are regulated by the EPA (Zogorski, 2006). A fact sheet about VOCs for well owners is available on the wellcarehotline.org website.

Out of the 65 VOCs analyzed in this study, seven were detected in eight different wells (8% of the wells sampled). One well sampled in the fall, contained four different chlorinated VOCs. Detections were at concentrations well below drinking water standards (Figure 9).

Three separate VOCs (styrene, toluene, and trichloroethylene) were detected in three separate wells. Styrene and toluene are commonly associated with gasoline hydrocarbons. Trichloroethylene is a solvent, commonly used for cleaning and degreasing in both industrial and consumer products (Zogorski, 2006).

Two SVOCs, tris(1,3-dichloro-2-propyl)phosphate (TDCP) and tris(2-chloroethyl)phosphate (TCEP), were detected in four wells. TDCP and TCEP belong to the family of organophosphate flame retardants, which may be used in flexible PUR foams found in baby mattresses, car safety seats, residential upholstered furniture, and paints and coatings. These chemicals have been detected in sewage effluent, river water, seawater, drinking water, sediment, and fish throughout the world. In laboratory animal studies, TDCP and TCEP have been associated with cancer of the liver, kidney, brain and testis (NRDC, 2010).

In this study, TDCP and TCEP were not detected at concentrations above the EPA regional screening levels.

3.1.8 Consumer product constituents

Consumer product constituents include fragrances, pharmaceuticals, insect repellants and other products found in everyday household chemicals, cleaning products, beauty products, clothing, and medications. One of the goals for the statewide groundwater monitoring program is to investigate emerging groundwater quality problems. Consumer product constituents detected in groundwater are considered indicators of nearby septic or ground discharging wastewater treatment systems that have not been primarily designed to function as treatment for pharmaceuticals and personal care products (Phillips, 2015).

Examples of commonly detected consumer products in other studies include the insect repellant DEET, the stimulant caffeine, and the antibiotic sulfamethoxazole (Groundwater Foundation, 2022). These constituents likely make their way into the water through wastewater discharges and septic systems. Although detected levels in this study are significantly lower than a human pharmaceutical dose, detections of these chemicals in groundwater may lead to aquatic life impacts through surface and groundwater interactions (Hejna, M, 2022). No water quality criteria or benchmarks currently exist for most of these compounds

Only one of the 11 consumer product constituents analyzed was detected during this study. Ethanamine, 2-(diphenylmethoxy)-N,N-dimethyl, commonly known as Benadryl or Diphenhydramine, is an antihistamine, used to treat cold or allergy symptoms. This compound was detected in three wells in three distinct areas of the study site, slightly above reporting limits at 13-18 ng/L. There is not a drinking water standard for this compound.

3.2 Effects of season or depth of groundwater on water quality

3.2.1 Seasonal characteristics

To evaluate the potential for seasonal variations in nitrate concentrations in groundwater due to agricultural activities, irrigation or precipitation levels, nitrate concentrations were compared for samples collected at the same (20) wells in both the spring (February) versus in the fall (October/November) of 2017. As mentioned in section 3.1.1, some wells had higher nitrate concentrations in February than in October/November and others had the reverse relationship. The small sample size of wells sampled in both February and October/November (20 wells) did not allow for statistical evaluation.

3.2.2 Depth of water in contributing aquifer

A thorough evaluation of factors affecting nitrate concentrations in groundwater was beyond the scope of this project. Shallow groundwater often has higher nitrate concentrations because (1) nitrate contamination originates at land surface, (2) shallow groundwater generally represents recent recharge, (3) deep groundwater is often older and was recharged before modern land uses, and (4) denitrification can remove nitrate as groundwater moves deeper into reducing environments. Groundwater nitrate concentrations are often best explained by the combination of land use in the recharge area, groundwater age, well depth, redox conditions, and aquifer geology (Burow, 2010, MacLeod, 1995, Frans, L., 2000).

For the purposes of this project, an evaluation was conducted of the potential relationship between nitrate concentrations and the estimated depth of the groundwater sampled at each well for 82 wells.

DEQ does not collect groundwater level data from domestic wells since the tools and process for this measurement could introduce contaminants into the wells. Therefore, the likely depth of groundwater collected from each well was estimated using data from 72 available well logs and well owner information for 10 wells. Well logs provide information on first water encountered while drilling, static water level (the level of the water in the well after drilling), and depth of well screen interval or other well openings. For this project, a combination of first water level information and the shallowest depth of well screening were used to estimate the depth of groundwater sampled at the site. Factors such as confining clay layers and different aquifer materials at the well screen depth were also considered in the evaluation. Note that since well log notations are recorded by well drillers on the date the well is drilled, actual water levels could have changed over time.

A total of 44 deep water wells and 38 shallow water wells were included in this evaluation. Forty-one of the wells with well logs were determined to draw water from 100 or more feet below ground surface. These were considered deep water wells. Thirty-one of the wells with well logs indicating the wells drew water from depths of less than 100 feet below ground were considered shallow water wells. Well owner estimates of the depth of their well were used to assign depths for 10 additional wells. In these cases, seven of the wells with estimated depths of less than 100 feet were assigned as shallow water wells and three of the wells with estimated depths of 160, 380 and 440 feet were assigned as deep water wells.

The Peto & Peto modification of the Gehan-Wilcoxon test was conducted to compare nitrate concentrations between samples collected from deep water wells versus from shallow water wells. The test was run in R using the Cendiff function in the NADA package. This test is used in environmental statistics to analyze data with non-detects (censored data) and determine if there is a difference in the distribution of data across multiple groups.

For the 82 wells included in this study, the evaluation of nitrate concentrations versus water depth in the contributing aquifer indicated a statistically significant difference between nitrate in well water supplied by a shallow aquifer versus nitrate in well water supplied by a deep aquifer (n = 38 [shallow], 44 [deep], $\chi^2 = 5.1$, $p = .02$).

4. Summary

The 2017 Mid-Willamette groundwater quality study met the following study objectives:

1. **To collect high-quality data on nitrate, arsenic, coliform bacteria, metals, pesticides, pharmaceutical and personal care products, and volatile organic compounds in groundwater throughout the study area.** Groundwater samples were collected from 100 wells within the study area and analyzed for 238 chemical parameters. The data collection and analysis were quality-controlled, allowing the data to be useable for future data comparisons.

2. **To identify areas of groundwater contamination related to these parameters.**

   Nitrate: The results of this 2017 study did not indicate widespread nitrate contamination of groundwater in this area, with no detections over the MCL of 10 mg/L and only eight detections above 3 mg/L. In contrast, a 1982 DEQ study reported that 28 (40%) of wells sampled had nitrate over 10 mg/L in the Mission Bottom area (north of Salem near the center of the 2017 study area). The RET Nitrate map (Figure 2) indicates elevated ($\geq$10 mg/L) nitrate concentrations north of Salem around Hayesville, in the Jefferson to Stayton, and Canby areas. The 2017 study did not confirm these 1982 and RET associated findings in overlapping portions of the 2017 study area, which may be a result of sampling different wells or hydrologic changes, This 2017 study was not designed to evaluate water quality changes over time; however, lower measured nitrate concentrations in groundwater could also result from improvements in land use practices in the study area. This 2017 study found that higher concentrations of nitrate were found in shallow groundwater at a statistically significant greater incidence than in samples from deeper groundwater.

   Arsenic: 57% of sampled wells had detections of arsenic in groundwater above the MCLG of 0 µg/L. Only 7% of the sampled wells had concentrations above the MCL of 10 µg/L. A 1993 DEQ study (Cole, 2004), reported that seven wells (37% of wells tested) in the Woodburn area had arsenic concentrations above the MCL. The RET arsenic map (Figure 3) likewise shows elevated arsenic in the Woodburn area and along the I-5 corridor to Salem. The 2017 study confirms elevated arsenic is present in various parts of the study area.

   Manganese: 21% of sampled wells in the central to northern parts of the project area had detections of manganese over the USGS HBSL of 300 µg/L.

   Pesticides: 29% of sampled wells had detections of at least one of the 17 pesticide chemicals derived from 12 pesticide products. Wells with one or two pesticide detections were spread throughout the project area. Five wells with 2 to $\geq$5 pesticide detections were located in the southeast section of the study area, north of Stayton, northeast of Salem Hills**.** Some pesticides that were detected in the area in the 1980s and 1990s (Ethylene dibromide (EDB), carbofuran, and dacthal) were not detected during this study. Bromacil was detected in two wells in the 1980s and in three wells in this study. Lindane was detected in one well in the 1980s and one well in this study. While current use and legacy pesticides were detected in 29 wells in this study, all results were below any health-based benchmark.

   Consumer Product Constituents: Only one of the 11 consumer product constituents analyzed was detected during this study (diphenhydramine, known as Benadryl) in three wells in three distinct areas of the study site. No health-based screening level has been established for this constituent.

3. **To inform well water users of the results of this study and provide information regarding potential risks to human health.** All well owners who participated in this study received a report of test results for their wells and information related to health-based screening levels in 2018. DEQ provided educational packets of information about contaminants, potential health concerns, and actions that can be taken to reduce risk. Contacts for toxicologists at the Oregon Health Authority were provided as well as local county public environmental health representatives to assist with questions related to health

concerns or well inspections or treatment options. In addition, DEQ laboratory staff presented summary data at the Oregon Association of Clean Water Agencies, Oregon State University Pesticide recertification program, and Oregon Department of Agriculture and reported findings at public meetings in the community such as the North Santiam Watershed Council and shared results in packaged data sets with any interested parties who inquired.

4. **To identify areas needing additional investigation in order to describe the extent of contamination and help focus efforts to prevent further contamination.** The study identified widespread arsenic and elevated concentrations of manganese in groundwater across the project area, and evidence that pesticides are entering the groundwater, particularly shallow aquifers. Where this study has confirmed elevated nitrate, arsenic and manganese concentrations, also evident in RET maps, this study might be useful for targeting outreach in those areas. Further investigation of reported high nitrate in the Mission Bottom area and elevated arsenic in the Woodburn area would help determine if conditions have changed in those areas since the groundwater studies from the 1980s and 1990s.

5. **To help establish long-term trending data and describe changes over time.** Conducting future testing of groundwater from selected wells from this and previous studies, if possible (with permission from well owners), would allow comparison of data and trend analyses over time.

5. Recommendations

Based on the results of this study and the evaluation of current and past data from the area, DEQ recommends the following future actions that DEQ, in collaboration with others, could take, as resources allow.

Additional Evaluation of Hot Spots and Determination of Trends: DEQ recommends additional sampling to investigate potential areas of elevated nitrate, arsenic and manganese in areas indicated by this study and/or RET test data. As possible, select wells from this and previous studies should be re-sampled on a regular basis to evaluate groundwater quality trends.

RET test data is a useful screening tool to highlight areas of potential concern for domestic drinking water wells. Samples are required to be collected and analyzed prior to every sale of a home supplied by a domestic well. Education and outreach to realty organizations in the area (and banks which provide mortgage loans) may increase the number of wells tested and provide the state with valuable and updated information about well water quality in the region.

Another means of conducting wide-ranging community nitrate screening is by using colorimetric (pH dip-stick like) tests run by volunteers. These low-cost, quick screening tests for nitrate can be conducted by community organizations, providing an on-the-spot result for well users. These tests have been provided at county fairs, Soil & Water Conservation District offices, and earth day celebrations by organizations with minor training from OSU or DEQ staff.

Public Education and Training: DEQ recommends public education about the presence of nitrate, arsenic and manganese in the area. This could be provided through OSU extension, OHA's Domestic Well Safety program, DEQ's ongoing work with OHA's Drinking Water Source Protection program, the county health departments, and through local drinking water testing laboratories, well drillers and water well maintenance providers to ensure that well owners are aware of potential contaminants in groundwater and potential health considerations of drinking and cooking with elevated concentrations of these chemicals in their water supply, where to find assistance, and what steps they can take to test their wells and treat their well water if needed.

The study results indicated some groundwater contamination from domestic wastewater (possibly through septic system discharges). Septic system maintenance providers and the county health departments could be a point of distribution for information about how septic system users can ensure proper functioning and maintenance of their systems and where they can go for assistance in the event of system failure.

The study results also indicated groundwater contamination that may be from land applications of fertilizers and pesticides. Improved education about proper use of pesticides and alternatives for weed removal along roadways or on farmland, private lawns or golf courses could reduce the concentrations of pesticides reaching groundwater supplies in the area. Educational outreach to well users encouraging evaluation of practices in and around their wells may prevent additional introduction of these chemicals.

Resources:

The **U.S. Environmental Protection Agency** website has links and information for private well owners.

The **Oregon State University** Well Water Program website is dedicated to protection of the groundwater that provides our drinking water through education. Their site has many resources and a wealth of information about Willamette Valley groundwater quality.

The Oregon Health Authority runs the Oregon Domestic Well Safety Program which has resources to assist private well owners, including the Well User Resource Toolkit. OHA partners with other state agencies to assess health risks associated with private wells and promote domestic well safety. The program currently includes a special focus on domestic wells in the Lower Umatilla Basin Groundwater Quality Management Area.

The **Oregon Department of Agriculture** works with landowners to implement the Agricultural Water Quality Rules to prevent and control water pollution from agricultural activities. ODA created 38 watershed-based regions with focused Area Plans and required Area Rules for each. There are Area Plans for the Middle Willamette, the Molalla-Pudding-French Prairie-N.Santiam, Yamhill, and the Tualatin areas with recommended practices for farmers and ranchers. Landowners must prevent movement of excess sediment, animal waste, fertilizers, or excess chemicals into groundwater or surface water and protect streamside vegetation. The Benton, Polk, Yamhill, and Tualatin Soil and Water Conservation Districts and Watershed

Councils are available to provide technical and financial assistance with these efforts. Site specific information about these programs are available on ODA's Agricultural Water Quality website.

The **Oregon Water Resources Department** and Oregon Health Authority jointly publish The Water Well Owners Handbook, also available in Spanish (Pozos de Agua: Manual para el Propietario**)**. This guide to water wells in Oregon is a useful resource for well owners and available online or at your local watermaster's office.

The **Oregon Water Resources Department** operates a Well Abandonment, Repair and Replacement Fund (WAARF) which provides grants to qualifying low to moderate income homeowners and tribal members to address dry wells due to declining water levels in counties with drought declarations and for wells damaged by wildfire.

A **Department of Environmental Quality** proposal for an Oregon Environmental Restoration Fund project to finance the repair and replacement of failing septic systems for low to moderate income households was accepted in 2026. Final approvals and administrative details were not available at the time of this report's publication. Prioritization for funding under this program will be in the LUB GWMA and South Coast areas of Oregon. However, funding may be available for septic needs in other areas of the state as well. Look for updates on DEQ's Water Quality Grants website.

The **Department of Environmental Quality's** Groundwater Protection Program website has links to previous groundwater studies around the state and information about grants, loans and technical assistance for communities or individuals. DEQ's Drinking Water Protection Program has developed many tools to assist public water systems to prevent contamination of their groundwater supplies. Many of the tools are also applicable to domestic well users.

- Basic Tips for Keeping Drinking Water Clean and Safe
- Groundwater Basics for Drinking Water Protection

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Appendix A – Public Water Systems

Note: This summary is of public water systems within the study area and does not include public water systems that purchase drinking water from these water systems.

Public Water System ID	Public Water System Name	Primary Source	System Type	Population	MCL Alerts
4101184	62ND COURT MUTUAL WATER CO	GW	C	50	
4101352	ALPINE CREST IMPROVEMENT DIST	GW	C	91	
4100041	AMITY, CITY OF	SW	C	1810	
4100770	ARROWHEAD MOBILE HOME PARK	GW	C	220	Nitrate
4101153	ASHDOWN WOOD WATER COMPANY	GW	C	75	
4100065	AUMSVILLE, CITY OF	GW	C	4125	
4193784	AURORA ACRES RV RESORT	GW	C	450	
4100067	AURORA, CITY OF	GW	C	1133	Arsenic
4100078	BARLOW, CITY OF	GW	C	140	
4101221	BELLE PASSI ESTATES	GW	C	30	
4100151	BETHEL PARK	GW	C	125	
4100762	BREWSTER COMMUNITY HOMEOWNERS	GW	C	70	E.coli
4101174	BUELL-RED PRAIRIE WD	SW	C	800	
4100163	CANBY REGENCY	GW	C	265	E.coli, Nitrate
4100157	CANBY UTILITY	SW	C	18754	
4100733	CAROLINA WATER SYSTEM	GW	C	300	
4101326	CENTURY FARM COURT	GW	C	38	
4100066	CENTURY MEADOWS INC	GW	C	480	E.coli
4100772	CHAPARRAL MOBILE RANCH	GW	C	110	
4101200	CHATEAU MOBILE HOME PARK	GW	C	136	
4100562	CHEHALEM MTN SUN RIDGE WATER CO	GW	C	70	
4101009	CROWN MOBILE HOME PARK	GW	C	42	E.coli
4100248	DALLAS, CITY OF	SW	C	16854	
4100252	DAYTON, CITY OF	GW	C	2535	
4100068	DEER CREEK ESTATES	GW	C	350	
4100812	DELPHIAN SCHOOL	GW	C	350	
4100158	DIETZ AIR PARK WATER SYSTEM	GW	C	85	
4100259	DONALD, CITY OF	GW	C	1107	
4100262	DUNDEE, CITY OF	GW	C	2960	
4100962	DUNN COURT DUPLEXES	GW	C	88	Arsenic, Manganese
4101397	DUPLEX VILLAGE WATER SYSTEM	GW	C	165	
4100599	EXCALIBUR VILLAGE	GW	C	180	
4100023	FIR VIEW WATER COMPANY	GW	C	150	
4101150	FOREST HAVEN SUBDIVISION	GW	C	165	
4101207	FOREST PARK MOBILE VILLAGE	GW	C	75	
4101434	FOX HOLLOW ESTATES WATER CORP	GW	C	26	E.coli
4100319	GERVAIS WATER DEPARTMENT	GW	C	2500	
4100459	GLENMORRIE COOPERATIVE ASSN	GW	C	300	
4100338	GRAND RONDE COMMUNITY WTR ASSN	GW	C	2500	
4100774	GREEN OAKS PARK LLC	GW	C	165	Arsenic
4100006	GRIM ESTATES	GW	C	40	
4101464	HIDDEN MEADOWS WATER ASSN INC	GW	C	110	
4105398	HILAND WC - FRYER HILL	GW	C	32	
4100741	HILAND WC - HELTON	GW	C	75	Nitrate
4100743	HILAND WC - HERITAGE WATER COMPANY	GW	C	55	

4105398	HILAND WC - FRYER HILL	GW	C	32	
4100741	HILAND WC - HELTON	GW	C	75	Nitrate
4100743	HILAND WC - HERITAGE WATER COMPANY	GW	C	55	
4100755	HILAND WC - ILLAHE GOLF CLUB ESTATES	GW	C	561	
4100748	HILAND WC - LOMBARD	GW	C	300	E.coli
4101392	HILAND WC - PENTICTON/COLLEGE PARK	GW	C	710	E.coli
4100947	HILAND WC - SHADOW WOOD	GW	C	175	
4106213	HILAND WC - STABLES	GW	C	20	
4105940	HILAND WC - WILDERNESS	GW	C	20	E.coli
4101538	HILAND WC - WYLAND	GW	C	25	
4100391	HOODVIEW MOBILE ESTATES	GW	C	100	Arsenic
4193698	HOPE VALLEY RESORT	GW	C	200	
4100251	HOPEWELL WATER COMPANY	GW	C	100	
4100389	HUBBARD, CITY OF	GW	C	3478	E.coli
4100399	INDEPENDENCE WATER SYSTEM	GW	C	10300	E.coli
4100409	JEFFERSON MOBILE ACRES	GW	C	65	
4100744	KEIZER, CITY OF	GW	C	38585	Manganese
4100745	LABISH VILLAGE WTR COMMISSION	GW	C	452	Nitrate
4100746	LAKESHORE TERRACE	GW	C	60	
4101097	LAKEWOOD HOMEOWNERS	GW	C	289	
4100159	LARK MEADOWS ASSOCIATION	GW	C	80	
4100315	LAURELWOOD WATER USERS	GW	C	200	E.coli
4101399	LAZY ACRES MOBILE HOME PARK	GW	C	59	E.coli, Arsenic
4100776	LGC MEADOWLARK MANOR LLC	GW	C	195	
4100765	MCLAIN VILLAGE WATER DEPT	GW	C	100	
4100498	MCNARY OAKS MOBILE VILLA	GW	C	160	
4100537	MONMOUTH, CITY OF	GU	C	11146	E.coli, Nitrate
4100945	MOSSY BRAE WATER DISTRICT	GW	C	100	
4100544	MOUNT ANGEL, CITY OF	GW	C	3650	
4190170	MT ANGEL ABBEY	GW	C	150	
4100547	MULINO WATER DISTRICT	GW	C	700	
4100557	NEWBERG, CITY OF	GW	C	25138	E.coli
4101416	OAKDALE TRAILER PARK	GW	C	26	E.coli
4100392	OLDS MOBILE PARK	GW	C	60	E.coli
4100960	OR YOUTH AUTHORITY - MACLAREN	GW	C	750	Arsenic
4105308	OXBERG WATER SYSTEM #1	GW	C	90	
4100824	PALO MOBILE HOME PARK	GW	C	40	
4101498	PARRETT MOUNTAIN VIEW ESTATES	GW	C	140	
4101149	PERRYDALE DOMESTIC WTR ASSN	GW	C	2655	Arsenic
4100161	PETES MOUNTAIN WATER CO	GW	C	250	
4100784	PIONEER PARK CO-OP INC	GW	C	54	E.coli
4101398	RALPH TAYLOR TRAILER COURT	GW	C	45	
4100704	RICKREALL WATER ASSOCIATION	GW	C	1650	Nitrate
4100458	RIVERBEND-RIVERBANK COMMUNITY	GW	C	225	
4100461	RIVERGROVE WATER DISTRICT	GW	C	4200	
4194601	RIVERSIDE RV PARK	GW	C	200	Arsenic
4105157	ROCK OF AGES REST HOME	GW	C	97	
4101119	ROYAL ESTATES	GW	C	160	

4100779	SALEM MOBILE ESTATES/SHADY ACRES	GW	C	150	Nitrate
4100731	SALEM PUBLIC WORKS	SW	C	199820	
4105392	SANTIAM MEADOWS COMMUNITY WS	GW	C	40	E.coli
4101025	SCOFIELD MOBILE HOME COURT	GW	C	39	E.coli, Arsenic
4100797	SCOTTS MILLS, CITY OF	GW	C	421	
4100018	SCRAVEL HILL WATER CO-OP	GW	C	300	E.coli
4100811	SHERIDAN, CITY OF	SW	C	6494	E.coli
4195241	SILVER SPUR RV PARK LLC	GW	C	275	E.coli
4100825	SILVERTON MOBILE ESTATES	GW	C	45	
4100462	SKYLANDS WATER COMPANY	GW	C	250	
4100727	ST PAUL, CITY OF	GW	C	434	Manganese
4100781	STARLITE MOBILE VILLAGE	GW	C	250	
4100844	SUBLIMITY, CITY OF	GW	C	3025	
4105317	SUNNYCREST MEADOWS WS	GW	C	29	
4100782	SUNNYVIEW MOBILE HOME PARK	GW	C	100	
4101070	SUNSET VILLAGE MHP	GW	C	120	
4100069	SUNSET WATER SYSTEM INC	GW	C	140	
4100757	SURFWOOD VILLA HOA	GW	C	200	
4101171	TOTEM VILLAGE MHP	GW	C	70	
4100730	TRAILER PARK VILLAGE	GW	C	105	
4101223	WALNUT MOBILE HOME PARK	GW	C	200	
4100071	WESTERN WAGON VILLAGE	GW	C	100	E.coli
4100954	WILSONVILLE, CITY OF	SW	C	25915	E.coli
4100381	WOLSBORN FARMS WATER DISTRICT	GW	C	90	
4100964	WOODBURN MOBILE ESTATES	GW	C	70	Arsenic
4100959	WOODBURN, CITY OF	GW	C	26013	E.coli
4101488	WORKMAN AIR PARK #3	GW	C	75	
4195372	5 ROCK RANCH	GW	NC	40	
4195424	ANTIQUE POWERLAND - NORTH	GW	NC	140	
4195425	ANTIQUE POWERLAND - SOUTH	GW	NC	140	
4190030	ARROWHEAD GOLF CLUB	GW	NC	200	
4195235	ASPINWALLS NURSERY AND PRODUCE	GW	NC	100	
4195532	ATHEY CREEK CHURCH	GW	NC	1000	
4195500	AURORA COLONY VINEYARD	GW	NC	25	
4195351	BAUMANS FARM AND GARDEN	GW	NC	75	
4195169	BEAVERCREEK UNITED CHURCH OF CHRIST	GW	NC	70	
4194835	BETHEL BAPTIST CHURCH	GW	NC	90	
4194459	BLACKMANS 4-WAY GROCERY	GW	NC	100	
4195516	BLM CEDAR GROVE REC SITE	GW	NC	30	
4195521	BLM THREE BEAR REC SITE	GW	NC	30	
4194791	BLONDZEES WATER SYSTEM	GW	NC	250	
4193941	BOBS GRAND ISLAND GROCERY AND DELI	GW	NC	50	
4195327	BROADACRES STORE/TAVERN	GW	NC	50	
4195277	BUTTEVILLE GENERAL STORE	GW	NC	30	
4190031	CAMP ADAMS	GW	NC	50	
4190034	CAMP ARRAH WANNA	GW	NC	100	
4191658	CAMP TALOALI	GW	NC	25	
4190047	CANBY GROVE CONF CTR WELL 1	GW	NC	40	
4194996	CANBY GROVE CONF CTR WELL 2	GW	NC	40	E.coli
4105661	CANBY GROVE CONF CTR WELL 3	GW	NC	40	

4105661	CANBY GROVE CONF CTR WELL 3	GW	NC	40	
4190866	CANYONVIEW CAMP	GW	NC	150	
4194623	CENTER MARKET #25	GW	NC	250	
4194879	CHEHALEM VALLEY BAPTIST CHURCH	GW	NC	100	
4195225	CIRCLE K #9641	GW	NC	100	
4195452	CLACKAMAS CO PKS - BOONES FERRY MARINA	GW	NC	50	
4190761	CLACKAMAS CO PKS-FEYRER PARK	GW	NC	100	
4190760	CLACKAMAS CO PKS-HEBB PARK	GW	NC	100	
4195074	CLARKES GENERAL STORE & EATERY	GW	NC	100	
4194250	COME N GO MARKET	GW	NC	200	Arsenic
4195405	COPPER STONE INC	GW	NC	40	
4195526	DOMAINE SERENE	GW	NC	124	E.coli
4195420	EMERALD VALLEY RV PARK	GW	NC	75	
4190304	ENCHANTED FOREST	GW	NC	520	
4190305	EVERGREEN GOLF CLUB	GW	NC	75	
4193552	FIR VALLEY POUR HOUSE	GW	NC	50	
4195410	FORDYCE FARM	GW	NC	40	
4194565	GINGERICH FARMS	GW	NC	25	
4191985	GOLDEN ENTERPRISES	GW	NC	700	
4195382	GREEN VILLA FARMS	GW	NC	50	Nitrate
4194615	HITCHIN POST BAR & GRILL	GW	NC	50	
4195422	HOLLAND YOUTH PARK	GW	NC	25	
4194545	HOPEWELL COMMUNITY CHURCH	GW	NC	80	
4106001	HUBBARD 76 STATION	GW	NC	50	
4194922	IFA NURSERY	GW	NC	50	
4195312	J MAR RACING/WOODBURN DRAGSTRIP	GW	NC	450	
4195403	KNUDSEN VINEYARDS	GW	NC	30	
4190299	LAST CHANCE SALOON	GW	NC	60	
4194086	LIVELY STATION	GW	NC	50	
4195237	MACKSBURG LUTHERAN CHURCH	GW	NC	40	Nitrate
4101325	MACLEAY CHRISTIAN RETREAT	GW	NC	150	
4194080	MACLEAY COUNTRY INN	GW	NC	100	
4190842	MARION CO PKS-SPONGS LANDING	GW	NC	50	
4194406	MARION GROCERY	GW	NC	50	
4193557	MARKUM INN	GW	NC	200	
4194658	MEADOWBROOK GROCERY	GW	NC	500	
4194314	MOLALLA RETREAT CENTER	GW	NC	25	
4195275	MONITOR INN	GW	NC	65	E.coli
4195139	MONMOUTH KINGDOM HALL	GW	NC	57	
4195523	NEIGHBORHOOD CHURCH	GW	NC	60	
4194438	NEW HARVEST CHURCH	GW	NC	200	
4194511	NEW HOPE FOURSQUARE CHURCH	GW	NC	85	
4195453	OAK PARK CONGREGATION	GW	NC	51	
4105314	ODOT HD WOODBURN PORT OF ENTRY	GW	NC	25	
4194503	OPRD CHAMPOEG OVERNIGHT ST PK	GW	NC	885	
4194504	OPRD CHAMPOEG RIVERSIDE ST PK	GW	NC	141	
4191083	OPRD MAUD WILLIAMSON STATE PK	GW	NC	55	Manganese
4191006	OPRD MOLALLA RIVER STATE PARK	GW	NC	75	

4193489	OPRD WILLAMETTE MISSION ST PK	GW	NC	200	
4190495	OREGON OUTDOOR EDUCATION CENTER	GW	NC	284	
4194148	OTE SANTIAM RIVER RA-NORTH	GW	NC	3000	
4194149	OTE SANTIAM RIVER RA-SOUTH	GW	NC	3000	
4195496	PANAMERICAN BERRY GROWERS	GW	NC	89	Nitrate
4193569	PAR 3 INVESTMENTS WS	GW	NC	125	
4194856	PORTLAND ONNURI CHURCH	GW	NC	80	
4192159	SANTIAM GOLF CLUB	GW	NC	200	
4193565	SHORTLAND GOLF COURSE	GW	NC	80	
4194551	SILVER INN	GW	NC	100	E.coli
4194674	SILVERTON RESERVOIR REC AREA	GW	NC	50	
4105433	SLEIGHBELLS	GW	NC	25	
4194534	SMYRNA UNITED CHURCH OF CHRIST	GW	NC	40	
4195512	SOKOL BLOSSER VINEYARDS	GW	NC	110	
4195530	STOLLER FAMILY ESTATE	GW	NC	85	Nitrate
4194833	SUN OUTDOORS PORTLAND SOUTH	GW	NC	190	
4191961	THE PRESERVE	GW	NC	100	
4194940	TITANIC ICE CO	GW	NC	25	
4101308	TRAPPIST ABBEY	GW	NC	29	E.coli
4195437	TRINITY LUTHERAN CHURCH	GW	NC	75	
4194941	TUALATIN VALLEY REGIONAL TRNG CTR	GW	NC	300	
4195514	TURNER LDS CHURCH	GW	NC	500	
4195032	UNITARIAN UNIVERSALIST CHURCH	GW	NC	44	
4195363	USFWS TUALATIN RIVER NATL WLR	GW	NC	275	
4195309	WEYERHAEUSER NR TURNER GREENHOUSE	GW	NC	40	
4190519	WEYERHAEUSER-AURORA	GW	NC	30	
4191970	YAMHILL CO PKS-ED GRENFELL PK	GW	NC	30	
4194605	YAN YAN CHINESE CUISINE	GW	NC	80	
4195120	ZION MENNONITE CHURCH	GW	NC	110	
4193768	ABIQUA SCHOOL	GW	NTNC	160	
4194894	ARBOR SCHOOL	GW	NTNC	215	
4194885	BAILEY NURSERY II	GW	NTNC	45	
4194993	BAILEY NURSERY III	GW	NTNC	160	
4195376	BENTS COURT WATER COMPANY	GW	NTNC	2500	
4190586	BETHANY ELEMENTARY SCHOOL	GW	NTNC	90	Nitrate
4193761	BETHEL ELEMENTARY SD 24J	GW	NTNC	130	
4194219	BOISE CASCADE-WILLAMINA VENEER	GW	NTNC	75	
4194699	BROOKS CSD	GW	NTNC	450	
4190581	BUTTE CREEK ELEMENTARY SD 67J	GW	NTNC	326	
4193970	CARUS ELEMENTARY	GW	NTNC	415	
4194593	CASCADE UNION JR/SR HIGH SD 5	GW	NTNC	1300	Nitrate
4194948	CCC SANTIAM CENTER	GW	NTNC	150	
4195179	CCC VITACULTURE CENTER	GW	NTNC	25	
4190589	CENTRAL HOWELL ELEMENTARY	GW	NTNC	165	
4190523	CHILDRENS DAY EDUCATION CENTER	GW	NTNC	48	
4195124	CHURCH OF THE RESURRECTION	GW	NTNC	130	
4194911	CHURCH ON THE HILL	GW	NTNC	375	E.coli
4193752	CLOVERDALE ELEMENTARY	GW	NTNC	140	

4105201	COLD SPRINGS WATER CO	GW	NTNC	100	E.coli
4193751	COMMUNITY ACTION HEADSTART	GW	NTNC	70	
4195098	COUNTRY CHRISTIAN SCHOOL	GW	NTNC	400	
4193753	EVERGREEN ELEMENTARY	GW	NTNC	90	Nitrate
4191972	EWING YOUNG ELEM SD 29J	GW	NTNC	245	E.coli
4195003	FORUM SALEM CAMPUS	GW	NTNC	600	Nitrate
4193763	FRUITLAND ELEMENTARY SD 24J	GW	NTNC	70	
4194361	GRAY & COMPANY	GW	NTNC	25	Arsenic
4195308	HD AVIATION	GW	NTNC	100	Arsenic
4190578	HOLY FAMILY ACADEMY	GW	NTNC	60	
4190588	HTPS WATER SYSTEM	GW	NTNC	75	
4190043	INTERFOR PACIFIC INC	GW	NTNC	100	
4195136	JEFFERSON BAPTIST CHURCH	GW	NTNC	50	E.coli, Nitrate
4194431	JLR	GW	NTNC	200	Arsenic
4193765	LAKE LABISH ELEMENTARY SD 24-J	GW	NTNC	25	
4195034	LANGDON FARMS GOLF CLUB	GW	NTNC	100	
4194312	LIVINGSTONE ADVENTIST ACADEMY-SDA	GW	NTNC	220	
4194399	MARION CO PUBLIC WORKS	GW	NTNC	200	
4193909	MOLALLA RIVER ACADEMY	GW	NTNC	200	
4190530	MOLALLA RIVER SD - CLARKES ELEM	GW	NTNC	180	
4190529	MOLALLA RIVER SD RURAL DELL ELEM	GW	NTNC	280	
4190580	MONITOR OLD-RITE SCHOOL	GW	NTNC	144	
4194336	MONROVIA NORTH	GW	NTNC	175	E.coli
4193718	NINETY-ONE ELEM SD 91	GW	NTNC	450	Arsenic
4193755	NORTH MARION SD #15	GW	NTNC	2100	Arsenic
4105714	NORTHWEST HAZELNUT COMPANY	GW	NTNC	100	Nitrate
4190076	NWREC/OSU	GW	NTNC	40	E.coli
4195024	OREGON GOLF COURSE	GW	NTNC	35	
4105963	PILOT TRAVEL CENTER #386	GW	NTNC	500	
4194279	PNW VEG CO, LLC DBA NORPAC	GW	NTNC	40	
4193593	PORTLAND TRAVEL CENTER	GW	NTNC	400	
4193759	PRATUM ELEMENTARY	GW	NTNC	90	
4194604	REWORLD MARION	GW	NTNC	38	E.coli
4194901	RIVERSIDE HIGH SCHOOL	GW	NTNC	565	
4195247	ROBINSON NURSERY AMITY WS	GW	NTNC	70	Nitrate
4195052	ROLLING HILLS CHURCH	GW	NTNC	60	
4190083	RSG FOREST PRODUCTS INC	GW	NTNC	275	
4194461	SKYLANE FARMS	GW	NTNC	32	
4195541	SOUTHLAKE CHURCH WS	GW	NTNC	150	Nitrate
4195572	ST. COUSAIR INC.	GW	NTNC	35	
4193701	STAFFORD ELEMENTARY	GW	NTNC	600	
4195378	TIMBERLINE BAPTIST CHURCH	GW	NTNC	150	
4194441	TREE TOP	GW	NTNC	45	
4193921	TRI-COUNTY INDUSTRIAL PARK #1	GW	NTNC	100	
4193764	VALLEY INQUIRY CHARTER SCHOOL	GW	NTNC	188	
4194063	WEST LINN/WILSONVILLE SD	GW	NTNC	40	
4190582	WESTERN CHRISTIAN SCHOOL	GW	NTNC	540	E.coli
4194451	WILLAMETTE EGG FARMS - CANBY	GW	NTNC	80	E.coli
4195137	WILLAMETTE VALLEY VINEYARDS	GW	NTNC	378	

4101248	YOUTH WITH A MISSION	GW	NTNC	100	
4105644	AMSTAD FARMS	GW	OVS	5	
4100728	APPLEBLOSSOM MOBILE HOME PARK	GW	OVS	23	
4190577	CASCADE OPPORTUNITY CENTER	GW	OVS	19	
4194473	DICKEY PRAIRIE STORE & MHP	GW	OVS	16	E.coli
4101359	FAIRVIEW WATER COMPANY	GW	OVS	22	
4101065	HIGHLAND VIEW MOBILE HOME PARK	GW	OVS	21	
4194762	IAA SOUTH PORTLAND	GW	OVS	15	Arsenic
4194567	MCMINNVILLE HONDA	GW	OVS	20	
4191607	MOUNTAIN HOME METHODIST CHURCH	GW	OVS	20	
4195460	NUNHEMS USA INC - BROOKS	GW	OVS	20	
4193758	PIONEER ELEMENTARY SD 13	GW	OVS	20	
4194468	PLYWOOD COMPONENTS INC	GW	OVS	18	
4100636	PRAIRIEVIEW WATER COMPANY	GW	OVS	20	
4194786	QUIKRETE	GW	OVS	23	
4195033	STAFFORD COUNTRY MONTESSORI	GW	OVS	17	
4194566	WEST CHEHALEM FRIENDS CHURCH	GW	OVS	13	
4105663	WILLAMETTE NURSERIES	GW	OVS	20	Arsenic
4101477	ASPEN ESTATES SUBDIVISION (Inactive)	GW	C	80	
4100963	CHATEAU RANCHETTES (Inactive)	GW	C	90	
4100818	DRIFTWOOD MHP (WASH CO) (Inactive)	GW	C	84	
4101384	DRIFTWOOD MOBILE HOME PARK (Inactive)	GW	C	95	
4101016	HILAND WC - COLLEGE PARK (Inactive)	GW	C	290	E.coli
4100777	OAKWOOD MOBILE VILLA (Inactive)	GW	C	69	
4100756	SLEEPY HOLLOW PHASE I WS (Inactive)	GW	C	88	Arsenic
4101120	THUNDERBIRD MOBILE CLUB (Inactive)	GW	C	150	
4194132	BIG BURGER DRIVE-IN (Inactive)	GW	NC	100	
4194559	CAFE UNCORKED (Inactive)	GW	NC	365	
4192019	CAMP ONAHLEE LLC (Inactive)	GW	NC	90	
4195064	CANBY UNITED METHODIST CHURCH (Inactive)	GW	NC	150	
4191963	CRABTREE PARK (Inactive)	GW	NC	30	
4195456	CRAWFORD ELECTRIC (Inactive)	GW	NC	25	
4191973	FLYING M RANCH (Inactive)	GW	NC	25	
4106079	HYPER-DRIVE ENTERPRISES (Inactive)	GW	NC	100	
4194210	IGGYS PUB (Inactive)	GW	NC	50	
4194729	J FERNANDEZ LLC (Inactive)	GW	NC	70	
4195103	JANNAS JAVA (Inactive)	GW	NC	50	
4195381	KEIZER RAPIDS PARK (Inactive)	GW	NC	100	
4195043	LAS AGUILAS (Inactive)	GW	NC	80	
4193910	LAWRENCE & LAWRENCE INC (Inactive)	GW	NC	30	
4190839	LEATHERS SHELL (Inactive)	GW	NC	500	
4105255	LIBERAL COUNTRY STORE (Inactive)	GW	NC	100	
4193550	LITTLE RED BARN SALOON, THE (Inactive)	GW	NC	60	
4191694	LUMBER TAVERN (Inactive)	GW	NC	25	
4194827	MONITOR MARKET & DELI (Inactive)	GW	NC	50	
4193696	MULKEY RV PARK (Inactive)	GW	NC	120	

4191983	RIVERWOOD GOLF COURSE (Inactive)	GW	NC	30	
4195429	ROGUE FARMS (Inactive)	GW	NC	25	Nitrate
4191650	SHERWOOD ELKS CLUB (Inactive)	GW	NC	100	
4194721	ST JOSEFS WINE CELLAR (Inactive)	GW	NC	25	
4105959	SUNNYVIEW FARMS BLUEBERRIES (Inactive)	GW	NC	50	
4193570	TOP O HILL RESTAURANT (Inactive)	GW	NC	65	Nitrate
4190963	WEYERHAEUSER NR TURNER NURSERY (Inactive)	GW	NC	60	
4194772	WHISKEY HILL STORE (Inactive)	GW	NC	100	
4195087	YODER STORE (Inactive)	GW	NC	100	
4194876	ABIQUA LEARNING CENTER (Inactive)	GW	NTNC	35	
4193717	FAITH CUSTOM LEARNING (Inactive)	GW	NTNC	45	
4190883	FIR GROVE ELEMENTARY (Inactive)	GW	NTNC	140	
4193754	MARION ELEMENTARY (Inactive)	GW	NTNC	140	
4194394	MID WILLAMETTE PRECUT INC (Inactive)	GW	NTNC	60	
4193766	MIDDLE GROVE ELEM SD 24J (Inactive)	GW	NTNC	150	
4193721	MOLALLA ALTERNATIVE OPTIONS SCHOOL (Inactive)	GW	NTNC	80	
4193757	N MARION ELEM/MIDDLE SD 15 (Inactive)	GW	NTNC	1400	
4194445	TAYLOR COUNTRY FARMS LTD (Inactive)	GW	NTNC	40	
4190579	WILLAMETTE VALLEY CHRISTIAN SCHOOL (Inactive)	GW	NTNC	137	
4194821	WILLOW LAKE TREATMENT PLANT (Inactive)	GW	NTNC	50	
4100314	ANANDA CENTER AT LAURELWOOD (Inactive)	GW	OVS	1	
4194367	DENALI NUT COMPANY LLC (Inactive)	GW	OVS	15	
4191260	EOLA INN (Inactive)	GW	OVS	10	
4194549	HAPPY ACRES AT THE BAYOU (Inactive)	GW	OVS	20	
4193614	MID VALLEY REHABILITATION WOOD PRD (Inactive)	GW	OVS	6	
4100740	OR YOUTH AUTHORITY - HILLCREST (Inactive)	GW	OVS	1	

System Type:

C - "Community Water System (C)" means a public water system that has 15 or more service connections used by year-round residents, or that regularly serves 25 or more year-round residents.

NTNC - "Non-Transient Non-Community Water System (NTNC)" means a public water system that is not a Community Water System and that regularly serves at least 25 of the same persons over 6 months per year.

NC - "Transient Non-Community Water System (NC)" means a public water system that serves a transient population of 25 or more persons.

NP or OVS - "State Regulated Water System (NP)" means a public water system, which serves 4 to 14 service connections or serves 10 to 24 people. Monitoring requirements for these systems are the same as those for Transient Non-Community water systems. This designation was recently changed to OVS for Oregon Very Small systems. Both designations are still used.

Appendix B – Example Well Report (Log)

are to be filed with the WATER RESOURCES DEPARTMENT, SALEM, OREGON 97310 within 30 days from the date of well completion.

RECEIVED AUG 17 1978 WATER RESOURCES DEPT.

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

YAMH 6018

State Well No. 4S/5W-10
State Permit No.

(1) OWNER:
Name Carl Crabtree
Address Rt 2 Bx 266 A
McMinnville, Ore.

(2) TYPE OF WORK (check):
New Well ☑ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☑ Driven ☐
Cable ☐ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):
Domestic ☑ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

CASING INSTALLED: Threaded ☐ Welded ☐ Glued
6" Diam. from 0 ft. to 55 ft. Gage .255
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

PERFORATIONS: Perforated? ☐ Yes ☑ No.
Type of perforator used
Size of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

(7) SCREENS: Well screen installed? ☐ Yes ☑ No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(8) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a ~~pump~~ comp test made? ☑ Yes ☐ No If yes, by whom? Driller
Yield: 12 gal./min. with 30 ft. drawdown after 1 hrs.
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m.
Temperature of water Depth artesian flow encountered ft.

(9) CONSTRUCTION:
Well seal—Material used Cement grout
Well sealed from land surface to 55 ft.
Diameter of well bore to bottom of seal 9 1/2 in.
Diameter of well bore below seal 6 in.
Number of sacks of cement used in well seal 10 sacks
How was cement grout placed? Pumped

Was a drive shoe used? ☐ Yes ☑ No Plugs Size: location ft.
Did any strata contain unusable water? ☐ Yes ☑ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☑ No Size of gravel:
Gravel placed from ft. to ft.

(10) LOCATION OF WELL:
County Yamhill Driller's well number 583
¼ ¼ Section 10 T. 4S R. 5W W.M.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.
Depth at which water was first found 56 ft.
Static level 25 ft. below land surface. Date 8-7-78
Artesian pressure lbs. per square inch. Date

(12) WELL LOG: Diameter of well below casing 6
Depth drilled 230 ft. Depth of completed well 60 ft.
Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. Report each change in position of Static Water Level and indicate principal water-bearing strata.

MATERIAL	From	To	SWL
TOP SOIL	0	2	
BROWN CLAY	2	15	
SAND STONE	15	40	
Shale	40	200	
BASALT	200	210	
Blue SHALE	210	230	

RECEIVED AUG 17 1978 WATER RESOURCES DEPT. SALEM, OREGON

Work started 8-2 1978 Completed 8-7 1978
Date well drilling machine moved off of well 8-7 1978

Drilling Machine Operator's Certification:
This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.
[Signed] Robert S. Gilbow (Drilling Machine Operator) Date 8-8, 1978
Drilling Machine Operator's License No. 337

Water Well Contractor's Certification:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Name BLUE WATER DRILLING CO (Person, firm or corporation) (Type or print)
Address RT 1 BX 75 DAYTON ORE
[Signed] Robert S. Gilbow (Water Well Contractor)
Contractor's License No. 417 Date 8-8, 1978

(USE ADDITIONAL SHEETS IF NECESSARY)

SP*45656-119

Appendix C – Study well log information

Spring or Fall Sampling	Well ID	Mid-Willamette GW Study ID	Type of well	Latitude	Longitude	WRD Well Log #	Depth of well (estimated in gray)	Depth to water in contributing aquifer in ft. (estimated)*	Deep or Shallow water?	Water-bearing Geology	Year well completed (estimated in gray)
SPRING	38384	MWV-001	Domestic	44.9830	-122.7321	MARI_3642	500	409	D	basalt, grey, seamy	1990
SPRING	38385	MWV-002	Domestic	44.8400	-122.8392	MARI_8942	260	255	D	basalt, black	1976
SPRING	38386	MWV-003	Domestic	44.7712	-122.8610	MARI_57326	100	12	S	sand & gravel	2003
BOTH	38387	MWV-004[1]	Domestic	44.7280	-122.9461	not found	20	not found	S	not found	1952
SPRING	38388	MWV-005	Domestic	45.2315	-122.7829	not found	75	not found	S	not found	2002
BOTH	38389	MWV-006	Domestic	45.2488	-122.7786	MARI236 (new); MARI226 (deepened)	230	220	D	sand, black strips in clay	1977
BOTH	38390	MWV-007	Domestic	45.2727	-122.9505	YAMH_671	93	63	S	sand, blue, brown	1991
SPRING	38391	MWV-008	Irrigation	45.2849	-123.0471	YAMH_7944, YAMH_57672(alt)	333	175	D	basalt, vesicular	1995
SPRING	38392	MWV-009	Domestic	45.3533	-123.1673	YAMH_53598	200	72	D	shale, grey, brown	2003
SPRING	38393	MWV-010	Domestic	45.4514	-123.2489	not found	not found	not found	NA	not found	not found
BOTH	38394	MWV-011	Domestic	44.9274	-123.2826	not found	95	not found	S	not found	1979-80
SPRING	38395	MWV-012	Domestic	44.8872	-123.3775	POLK_3567	100	82	S	claystone, sandstone, limestone	1988
SPRING	38396	MWV-013	Domestic	44.8882	-123.2155	POLK_2835[2]	40	22	S	sand & gravel, brown	1984
SPRING	38397	MWV-014	Domestic	44.8373	-123.2281	POLK_222[3]	not found	not found	NA	not found	not found
BOTH	38398	MWV-015	Domestic	44.7941	-123.1327	not found	40	not found	S	not found	1957 or older
SPRING	38399	MWV-016	Domestic	44.9350	-122.9432	MARI_7817, MARI_66041(alt)	73	20	S	sand & gravel	1971
BOTH	38400	MWV-017	Domestic	44.9036	-122.9312	MARI_9496	143	80	S	basalt, sandstone	1976

Spring or Fall Sampling	Well ID	Mid-Willamette GW Study ID	Type of well	Latitude	Longitude	WRD Well Log #	Depth of well (estimated in gray)	Depth to water in contributing aquifer in ft. (estimated)*	Deep or Shallow water?	Water-bearing Geology	Year well completed (estimated in gray)
BOTH	38401	MWV-018	Domestic	44.9615	-123.1578	POLK_1993	90	76	S	sandstone, grey	1964
SPRING	38402	MWV-019	Domestic	44.9801	-123.0978	POLK_1614/ POLK122(deepened)	191/231	107	D	claystone, blue	1968/1987
BOTH	38403	MWV-020	Domestic	45.0571	-122.9511	not found	87	not found	S	not found	not found
BOTH	38404	MWV-021	Domestic	44.9154	-122.8192	MARI_16329	228	180	D	basalt, grey	1990
BOTH	38405	MWV-022	Domestic	44.8597	-122.8592	MARI_8810(new) MARI_8782(deepened)	115/135	35-115	S	sandstone, grey/basalt, green	1966/1971
BOTH	38406	MWV-023	Domestic	44.8854	-122.9314	MARI_9720(new), MARI_9719(deepened)	202/216	185	D	basalt, black, fractured	1964/1965
SPRING	38407	MWV-024	Domestic	44.9108	-122.8856	MARI_9212	222	142	D	basalt, black, fractured	1989
SPRING	38408	MWV-025	Domestic	44.8731	-122.9463	MARI_10454	222	165	D	basalt, grey, fractured	1986
SPRING	38409	MWV-026	Domestic	44.9440	-123.1415	POLK2057	245	220	D	basalt, fractured	1964
BOTH	38682	MWV-027	Domestic	45.2429	-123.2520	YAMH_6068	172	30	S	basalt, grey, fractured	1972
SPRING	38683	MWV-028	Domestic	45.2414	-123.3002	YAMH_52552	280	255	D	sandstone, grey	2001
SPRING	38684	MWV-029	Domestic	45.2528	-122.8194	MARI_279(new)/ MARI_260(deepened)	90/163	85	S	sand, red, black/sand &gravel	1973/1985
SPRING	38685	MWV-030	Domestic	45.2455	-122.8115	not found	128	not found	NA	not found	not found

Spring or Fall Sampling	Well ID	Mid-Willamette GW Study ID	Type of well	Latitude	Longitude	WRD Well Log #	Depth of well (estimated in gray)	Depth to water in contributing aquifer in ft. (estimated)*	Deep or Shallow water?	Water-bearing Geology	Year well completed (estimated in gray)
BOTH	38686	MWV-031	Domestic	45.3260	-122.6774	CLAC_9142	502	147	D	basalt, black, brown	1977
SPRING	38687	MWV-032	Domestic	45.2520	-122.6230	not found	not found	not found	NA	not found	not found
BOTH	38688	MWV-033	Domestic	45.1939	-123.1901	YAMH_5886	98	68	S	sand & gravel, blue	1985
SPRING	38689	MWV-034	Domestic	45.1823	-122.5140	CLAC_1442	275	220	D	cemented gravel	1990
SPRING	38690	MWV-035	Domestic	45.2198	-122.8634	not found	160	not found	D	not found	not found
SPRING	38691	MWV-036	Domestic	44.8613	-123.0010	not found	not found	not found	NA	not found	not found
SPRING	38692	MWV-037	Domestic	44.8203	-123.0865	not found	not found	not found	NA	not found	not found
SPRING	38693	MWV-038	Domestic	44.8764	-123.1425	MARI_63564	85	70	S	claystone, grey	2011
SPRING	38694	MWV-039	Domestic	44.9578	-123.3282	POLK_2297	178	115	D	sandstone, blue, claystone, grey	1972
SPRING	38695	MWV-040	Domestic	44.9522	-123.3453	POLK2383	120	42	S	claystone, grey, fractured	1979
BOTH	38696	MWV-041	Domestic	45.3813	-123.0078	WASH_13546	200	180	D	"rock"	1977
SPRING	38697	MWV-042	Domestic	45.3268	-122.9845	YAMH_2156	75	48	S	shale, blue, broken	1976
SPRING	38698	MWV-043	Domestic	45.2836	-123.1068	YAMH_3917	160	125	D	shale, grey, unstable layers	1995
BOTH	38699	MWV-044	Domestic	45.1358	-123.1467	not found	not found	not found	NA	not found	not found
SPRING	38700	MWV-045	Irrigation	45.1164	-123.1706	YAMH_7077[4]	580	555	D	shale, blue	1977
SPRING	38701	MWV-046	Irrigation	45.0064	-123.2790	POLK_52792	260	118	D	silty claystone, grey	2008

Spring or Fall Sampling	Well ID	Mid-Willamette GW Study ID	Type of well	Latitude	Longitude	WRD Well Log #	Depth of well (estimated in gray)	Depth to water in contributing aquifer in ft. (estimated)*	Deep or Shallow water?	Water-bearing Geology	Year well completed (estimated in gray)
SPRING	38702	MWV-047	Domestic	44.9713	-122.9550	MARI_53260-no log	not found	not found	NA	not found	1957
BOTH	38703	MWV-048	Domestic	45.0689	-123.0739	POLK54001-no log	83	not found	S	not found	not found
SPRING	38704	MWV-049[5]	Domestic	45.1423	-122.9853	not found	not found	not found	NA	not found	not found
SPRING	38705	MWV-050	Domestic	45.3226	-122.8096	CLAC_07941	340	314	D	basalt, red, grey	1981
SPRING	38706	MWV-051	Domestic	45.3632	-122.7264	CLAC_03664	485	445	D	"rock"	1985
SPRING	38707	MWV-052	Domestic	45.2873	-122.7375	CLAC_17971	127	112	D	sand & gravel, compacted	1992
SPRING	38708	MWV-053	Domestic	45.2598	-122.5481	CLAC_16332	98	97	S	coarse sand, brown	1975
SPRING	38709	MWV-054	Domestic	45.1246	-122.5850	CLAC_20065	456	440	D	basalt, grey, fractured	1994
SPRING	38710	MWV-055	Domestic	45.1013	-122.5240	not found	not found	not found	NA	not found	not found
BOTH	38711	MWV-056	Domestic	45.0326	-122.8271	MARI_3262	97	35	S	sand & gravel, greyish blue, loose	1956
BOTH	38712	MWV-057	Irrigation	45.0309	-122.8266	MARI_17933[6]	280	152	D	claystone & sand, coarse sand, brown	1992
SPRING	38713	MWV-058	Domestic	45.0625	-122.5926	CLAC_15367/ CLAC_15364 [7]	350/220	210	D	basalt/ black rock	1966/1978
SPRING	38714	MWV-059	Domestic	45.1584	-122.7296	CLAC_57316	135	110	D	sand & gravel, black	2001

Spring or Fall Sampling	Well ID	Mid-Willamette GW Study ID	Type of well	Latitude	Longitude	WRD Well Log #	Depth of well (estimated in gray)	Depth to water in contributing aquifer in ft. (estimated)*	Deep or Shallow water?	Water-bearing Geology	Year well completed (estimated in gray)
BOTH	38715	MWV-060	Domestic	45.1731	-122.6845	not found	not found	not found	NA	not found	not found
FALL	38716	MWV-061	Domestic	45.2431	-123.2857	YAMH_2789	252	208	D	basalt, black, green, fractured	1993
FALL	38717	MWV-062	Domestic	45.2516	-122.8207	MARI_268	167	160	D	medium gravel	1978
FALL	38718	MWV-063	Domestic	44.9825	-122.7206	MARI_8331	177	80	S	basalt, grey-brown, fractured	1978
FALL	38719	MWV-064	Domestic	44.9231	-122.7846	MARI_6441	151	61	S	"rock"	1975
FALL	38720	MWV-065	Domestic	44.8408	-122.7726	MARI_8869	320	200	D	basalt, fractured	1975
FALL	38721	MWV-066	Domestic	45.0242	-122.6756	MARI_5794	290	120	D	basalt, grey	1973
FALL	38722	MWV-067	Domestic	45.1596	-122.7016	CLAC_63547	105	76	S	sand & gravel	2007
FALL	38723	MWV-068	Domestic	45.1575	-122.6967	CLAC_02413	150	120	D	sand, grey, black	1987
FALL	38724	MWV-069	Domestic	45.1440	-122.5401	CLAC_57286	150	130	D	sandstone, grey, soft	2001
FALL	38725	MWV-070	Domestic	45.1854	-122.5420	CLAC_59238	76	39	S	sand	2003
FALL	38726	MWV-071	Domestic	45.2700	-122.6443	CLAC_72947	205	178	D	sand & gravel	2017
FALL	38727	MWV-072	Domestic	44.8653	-122.9773	not found	not found	not found	NA	not found	not found
FALL	38728	MWV-073	Domestic	44.7746	-122.9544	MARI_60905	101	60-84	S	basalt, grey, brown, fractured	2007
FALL	38729	MWV-074	Domestic	44.7743	-122.9560	MARI_55986	180	48	S	basalt, black, fractured	2001

Spring or Fall Sampling	Well ID	Mid-Willamette GW Study ID	Type of well	Latitude	Longitude	WRD Well Log #	Depth of well (estimated in gray)	Depth to water in contributing aquifer in ft. (estimated)*	Deep or Shallow water?	Water-bearing Geology	Year well completed (estimated in gray)
FALL	38730	MWV-075	Domestic	44.7155	-123.1241	LINN_5340-no log	35	not found	S	gravel	1948
FALL	38731	MWV-076	Domestic	44.8606	-123.0997	MARI 12132/63540	55	50	S	basalt, broken	1957
FALL	38732	MWV-077	Domestic	45.0357	-123.1002	POLK_821	82	65	S	Sand/gravel	1994
FALL	38733	MWV-078	Domestic	45.1189	-123.1805	YAMH_55658	180	140	D	claystone, grey	2010
FALL	38734	MWV-079	Domestic	45.1985	-123.0939	YAMH_479	99	60	S	sand, black	1973
FALL	38735	MWV-080	Domestic	45.2253	-123.0247	YAMH_3301	130	88	S	sand & gravel, blue	1994
FALL	38736	MWV-081	Domestic	45.3413	-123.2049	YAMH_4720	155	118	D	sandstone, grey	1986
FALL	38737	MWV-082	Domestic	44.9043	-123.3436	POLK_53022	295	212	D	claystone, grey	2009
FALL	38738	MWV-083	Domestic	45.0034	-122.8064	MARI_3555	110	105	D	gravel, brown	1962
FALL	38739	MWV-084	Domestic	44.8957	-123.3446	POLK_52237	136	32	S	claystone, grey	2005
FALL	38740	MWV-085	Domestic	44.7030	-123.0047	not found	not found	not found	NA	not found	not found
FALL	38741	MWV-086	Domestic	44.7767	-123.3097	POLK_4013[8]	80	24	NA	claystone, blue	1971
FALL	38742	MWV-087	Domestic	44.9614	-123.3335	POLK_2296	131	122	D	sandstone, grey	1972
FALL	38743	MWV-088[9]	Domestic	45.0107	-123.3185	not found	not found	not found	NA	not found	not found
FALL	38744	MWV-089	Domestic	45.0129	-123.1696	POLK_1252	440	296	D	grey shale	1987
FALL	38745	MWV-090	Domestic	45.0770	-122.9231	MARI_51822	180	177	D	sand & gravel, black	1996
FALL	38746	MWV-091	Domestic	45.3027	-122.6408	CLAC_9200	155	122	D	black rx	1966
FALL	38747	MWV-092	Domestic	45.1839	-122.6411	not found	not found	not found	NA	not found	not found
FALL	38748	MWV-093	Domestic	45.1454	-122.5992	CLAC_10034	85	74	S	sand, red	1976

Spring or Fall Sampling	Well ID	Mid-Willamette GW Study ID	Type of well	Latitude	Longitude	WRD Well Log #	Depth of well (estimated in gray)	Depth to water in contributing aquifer in ft. (estimated)*	Deep or Shallow water?	Water-bearing Geology	Year well completed (estimated in gray)
FALL	38749	MWV-094	Domestic	45.1872	-122.3785	not found	not found	not found	NA	not found	not found
FALL	38750	MWV-095	Domestic	44.9705	-122.6805	MARI_55795	63	47	S	basalt, fractured, weathered	2001
FALL	38751	MWV-096	Domestic	45.0920	-122.6391	CLAC_53133	810	738	D	sandstone, grey	1998
FALL	38752	MWV-097	Domestic	45.0939	-122.8676	MARI2111	91	82	S	sand & gravel, black	1979
FALL	38753	MWV-098	Domestic	45.2347	-122.9473	MARI_1130	130	94	S	sand, brown	1969
FALL	38754	MWV-099	Domestic	45.3062	-122.8614	not found	not found	not found	NA	not found	not found
FALL	38760	MWV-100	Domestic	45.3968	-123.2326	YAMH_1383	247	179	D	basalt, grey	1981

D = Considered deep water well

S = Considered shallow water well

NA = Data not available

*First water level information and the shallowest depth of well screening were used to estimate the depth of groundwater sampled at the site.

Gray shading indicates information was obtained from well owner, not an official well record or could not confirm well log number.

1. MWV-004 may be MARI_16029, could not confirm with potentially 2 wells on property.

2. MWV-013 actually may be POLK 2838 per OWRD Water Right records. Homeowner records match POLK_2835.

3. MWV-014 newly matched to POLK_222, not included in statistical analysis.

4. MWV-045 well drilling report mismatched. May instead be YAMH_51825 or YAMH_53164. Doesn’t affect well depth statistics.

5. MWV-049 well drilling report not found, but geotechnical hole drilled on the same property can give insight into lithology, MARI_72147.

6. MWV-057 matched with MARI_17933 but OWRD has different location for that drilling report, need additional ground-truthing confirmation on well location.

7. MWV-058 unclear if matched with CLAC_15367 (350ft) or CLAC_15364 (220ft). Need additional well sounding measurements to confirm.

8. MWV-086 newly matched with POLK_4013, not included in well depth statistics.

9. MWV-088 well drilling report not found, but POLK_666 drilled and abandoned on same property may be useful for lithology.

Reach out to paige.haxton-evans@deq.oregon.gov with questions about well drilling report information used for this study.

Appendix D – Example Results Letter and Lab Report

Oregon

Kate Brown, Governor

Department of Environmental Quality
Laboratory and Environmental Assessment Division
3150 NW 229th, Suite 150
Hillsboro, OR 97124
Voice & TTY (503) 693-5700
FAX (503) 693-4999

October 2018

[redacted]

Station Description: 38387 Mid Willamette Groundwater Study Well MWV-004
Well Address: [redacted]

Dear [redacted]

Thank you for volunteering to have your well tested in October/November 2017 as part of the Statewide Groundwater Monitoring Program in the Mid-Willamette Valley. Your test results will help us develop a better understanding of the quality of Oregon's groundwater resources, including any potential health concerns in the Mid-Willamette Valley. With this letter, we have included a report of your well water analytical test results.

We would like to assist you with the following:

- Understanding how the report is presented
- Providing the Analytical Report for your records
- Understanding what your results mean for your health
- Explaining the terms and definitions used in the report

Should you or other members of the household have health concerns that you feel may be related to your domestic well, we encourage you to talk with your physician or contact the Oregon Health Authority's (OHA) Domestic Well Safety Program (DWSP) at **971-673-0977**.
For additional questions about:

- Your **report**, call DEQ at **503-693-5736**
- **Water treatment options**, call your county environmental health department:
  Greg Deblase
  gdeblase@co.marion.or.us
  503 588 5407

Your well is one of many we tested in the Mid-Willamette Valley area. A summary of the complete project will be available on our website once all the sampling and analysis is complete. We will email study participants to let them know when this is posted.

A note about lead results: Your well water was tested for lead. However, in order to measure the quality of the water coming from the groundwater aquifer, rather than the water sitting in the pipes, our sampling procedures include a 5-10 minute flushing period before we collect a sample. If you are concerned about lead contamination from your plumbing you should retest your water using the "first flush" method.

A note about radiochemistry: Radionuclides occur naturally as trace elements in rocks and soils from the radioactive decay of uranium-238 and thorium-232. Breathing air or drinking water contaminated with radionuclides can have health effects. This study did not have the capacity to sample for radiochemistry

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in groundwater, however, if you are concerned about radionuclides in your well water, please visit these webpages to learn more.

>> https://www3.epa.gov/radtown/private-wells.html
>> http://wellowner.org/water-quality/radionuclides/

Understanding your Report

The Analytical Report is organized so that the chemicals that were detected in your well water are **highlighted in bold** and at the top of the list. Many of these are basic parameters used to characterize the groundwater aquifer (under the headings *Nutrients, General Chemistry, Total Metals by Inductively Coupled Mass Spectrometry and General Field Parameters*). Bacteria (coliform, total and *E. coli*) are also listed (*Microbiology*). The last few sections contain the results for the pesticides, pharmaceuticals and volatile organic compounds (VOCs) tested. These analytes are sorted by laboratory method. If there was a detection of any of these pesticides in your water it will be listed in bold at the top of the report, all other analytes are considered non-detect, designated by "<". Additionally, if there were any detections of contaminants known to have a potential health risk (such as bacteria, nitrate, arsenic, lead, manganese, pesticides or VOCs), we provided a brief description of the chemical, compared your result to the known risk levels, and made recommendations for follow-up testing or treatment at the end of the report. These recommendations are provided with cooperation from OHA. You may also reference the packet of materials we provided when we came to test your well to learn more about well maintenance and common contaminants.

There are also some online tools you may find helpful in understanding your results:
Drinking Water Interpretation Tool: http://www.psiee.psu.edu/water/dwit.asp
Well Water Interpretation Tool: http://ohiowatersheds.osu.edu/know-your-well-water/well-water-interpretation-tool

We are available to answer questions you may have about this analytical report or to provide additional resources on groundwater quality. Please feel free to contact us at:
groundwater.monitoring@deq.state.or.us or **503-693-5736**
If we do not know the answer, we will direct you to health professionals at OHA or technical experts at your local health authority to assist you.

Thank you again for participating in this study!

Sincerely,

Paige Evans
Statewide Groundwater Monitoring
Oregon Department of Environmental Quality
Laboratory Environmental Assessment Program
groundwater.monitoring@deq.state.or.us
503-693-5736

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DEQ Laboratory and Environmental Assessment Program

Analytical Report

Station: 38387
Station Description: Mid Willamette Groundwater Study Well MWV-004
Sampled Date/Time: 10/31/2017 1:27:00PM
Laboratory ID: 1711002-09
Sample Type: Field Primary::FP

Analysis Summary

Analyte Name	Result:	Units:	DQL:
Nutrients			
Nitrate/Nitrite as N	**2.43**	mg/L	A
Phosphate, Total as P	**0.02**	mg/L	A
General Chemistry			
Alkalinity, Total as CaCO3	**44**	mg/L	A
Chloride	**2.48**	mg/L	A
Sulfate	**5.87**	mg/L	A
Total Solids	**112**	mg/L	A
Total Metals by Inductively Coupled Plasma Mass Spectrometry			
Calcium, Total recoverable	**11.8**	mg/L	A
Hardness as CaCO3, Total recoverable	**46.8**	mg/L	A
Iron, Total recoverable	**455**	µg/L	A
Lead, Total recoverable	**0.25**	µg/L	B
Magnesium, Total recoverable	**4.23**	mg/L	A
Manganese, Total recoverable	**24.5**	µg/L	A
Potassium, Total recoverable	**0.86**	mg/L	A
Sodium, Total recoverable	**4.99**	mg/L	A
General Field Parameters			
Conductivity	**128**	µmhos/cm	A
Dissolved Oxygen	**3.9**	mg/L	A
pH	**6.4**	pH Units	A
Temperature	**13.2**	°C	A
Pesticides by Liquid Chromatography/Tandem Mass Spectrometry			
Metribuzin	**5.17**	ng/L	A
Microbiology			
Coliform, Total	< 1	MPN/100 mL	A
E. Coli	< 1	MPN/100 mL	A
Total Metals by Inductively Coupled Plasma Mass Spectrometry			
Aluminum, Total recoverable	< 20.0	µg/L	A
Arsenic, Total recoverable	< 0.25	µg/L	A
Uranium, Total recoverable	< 0.10	µg/L	A
Vanadium, Total recoverable	< 4.00	µg/L	A
Low Level Analysis of Pesticides by Gas Chromatography/Mass Spectrometry			
2,6-Dichlorobenzamide	< 21.7	ng/L	A
4,4´-DDD	< 21.7	ng/L	A
4,4´-DDE	< 21.7	ng/L	A
4,4´-DDT	< 21.7	ng/L	A
Acephate	< 43.5	ng/L	B

DEQ Laboratory and Environmental Assessment Program

Analytical Report

Station: 38387
Station Description: Mid Willamette Groundwater Study Well MWV-004
Sampled Date/Time: 10/31/2017 1:27:00PM
Laboratory ID: 1711002-09
Sample Type: Field Primary::FP

Analysis Summary

Analyte Name	Result:	Units:	DQL:
Low Level Analysis of Pesticides by Gas Chromatography/Mass Spectrometry			
Aldrin	< 21.7	ng/L	A
alpha-BHC	< 21.7	ng/L	A
Azoxystrobin	< 21.7	ng/L	A
beta-BHC	< 21.7	ng/L	A
Bifenthrin	< 21.7	ng/L	A
Bromacil	< 21.7	ng/L	A
Butachlor	< 21.7	ng/L	A
Butylate	< 21.7	ng/L	A
Chlorobenzilate	< 21.7	ng/L	A
Chloroneb	< 21.7	ng/L	A
Chlorothalonil	< 21.7	ng/L	A
Chlorpropham	< 21.7	ng/L	A
Chlorpyrifos	< 21.7	ng/L	A
cis-Chlordane	< 21.7	ng/L	A
Cyanazine	< 21.7	ng/L	A
Cycloate	< 21.7	ng/L	A
Dacthal (DCPA)	< 21.7	ng/L	A
delta-BHC	< 21.7	ng/L	A
Diazinon	< 21.7	ng/L	A
Dichlobenil	< 21.7	ng/L	A
Dichlorvos	< 21.7	ng/L	A
Dieldrin	< 21.7	ng/L	A
Dimethenamid	< 21.7	ng/L	A
Dimethoate	< 21.7	ng/L	B
Diphenamid	< 21.7	ng/L	A
Endosulfan I	< 21.7	ng/L	A
Endosulfan II	< 21.7	ng/L	A
Endosulfan sulfate	< 21.7	ng/L	A
Endrin	< 21.7	ng/L	A
Endrin aldehyde	Void	ng/L	D
EPTC	< 21.7	ng/L	A
Ethoprop	< 21.7	ng/L	A
Etridiazole	< 21.7	ng/L	A
Fenamiphos	< 54.3	ng/L	A
Fenarimol	< 21.7	ng/L	A
Fenvalerate+Esfenvalerate	< 217	ng/L	A
Fluridone	< 21.7	ng/L	A

DEQ Laboratory and Environmental Assessment Program

Analytical Report

Station: 38387
Station Description: Mid Willamette Groundwater Study Well MWV-004
Sampled Date/Time: 10/31/2017 1:27:00PM
Laboratory ID: 1711002-09
Sample Type: Field Primary::FP

Analysis Summary

Analyte Name	Result:	Units:	DQL:
Low Level Analysis of Pesticides by Gas Chromatography/Mass Spectrometry			
gamma-BHC (Lindane)	< 21.7	ng/L	A
Heptachlor	< 21.7	ng/L	A
Heptachlor epoxide	< 21.7	ng/L	A
Hexazinone	< 21.7	ng/L	A
Malathion	< 21.7	ng/L	A
Methoxychlor	< 21.7	ng/L	A
Methyl paraoxon	< 21.7	ng/L	B
Mevinphos	< 21.7	ng/L	A
MGK 264	< 21.7	ng/L	A
Mirex	< 21.7	ng/L	A
Molinate	< 21.7	ng/L	A
Napropamide	< 21.7	ng/L	A
Norflurazon	< 21.7	ng/L	A
Oxyfluorfen	< 21.7	ng/L	A
Parathion-ethyl	< 21.7	ng/L	A
Parathion-methyl	< 21.7	ng/L	B
Pebulate	< 21.7	ng/L	A
Pendimethalin	< 21.7	ng/L	A
Permethrin	< 43.5	ng/L	A
Pronamide	< 21.7	ng/L	A
Propachlor	< 21.7	ng/L	A
Pyraflufen ethyl	< 21.7	ng/L	A
Pyriproxyfen	< 109	ng/L	A
Tebuthiuron	< 21.7	ng/L	A
Terbacil	< 21.7	ng/L	A
Terbufos	< 21.7	ng/L	A
Tetrachlorvinphos (Stirophos)	< 54.3	ng/L	B
trans-Chlordane	< 21.7	ng/L	A
trans-Nonachlor	< 21.7	ng/L	A
Triadimefon	< 21.7	ng/L	A
Tricyclazole	< 54.3	ng/L	A
Trifloxystrobin	< 21.7	ng/L	A
Trifluralin	< 21.7	ng/L	A
Tris (1,3-dichloro-2-propyl) phosphate (TDCP)	< 43.5	ng/L	A
Tris (2-chloroethyl) phosphate (TCEP)	< 21.7	ng/L	A
Vernolate	< 21.7	ng/L	A
Pesticides by Liquid Chromatography/Tandem Mass Spectrometry			

DEQ Laboratory and Environmental Assessment Program

Analytical Report

Station: 38387
Station Description: Mid Willamette Groundwater Study Well MWV-004
Sampled Date/Time: 10/31/2017 1:27:00PM
Laboratory ID: 1711002-09
Sample Type: Field Primary::FP

Analysis Summary

Analyte Name	Result:	Units:	DQL:
Pesticides by Liquid Chromatography/Tandem Mass Spectrometry			
Acetamiprid	< 4.35	ng/L	A
Acetochlor	< 10.9	ng/L	A
Alachlor	< 10.9	ng/L	A
Ametryn	< 4.35	ng/L	A
Aminocarb	< 4.35	ng/L	A
Atrazine	< 4.35	ng/L	A
Azinphos-methyl (Guthion)	< 21.7	ng/L	A
Baygon (Propoxur)	< 4.35	ng/L	A
Carbaryl	< 5.43	ng/L	A
Carbofuran	< 4.35	ng/L	A
DEET	< 32.6	ng/L	A
Deisopropylatrazine	< 4.35	ng/L	A
Desethylatrazine	< 4.35	ng/L	A
Diuron	< 4.35	ng/L	A
Fluometuron	< 4.35	ng/L	A
Imazapyr	< 43.5	ng/L	A
Imidacloprid	< 21.7	ng/L	A
Linuron	< 4.35	ng/L	A
Methiocarb	< 4.35	ng/L	A
Methomyl	< 4.35	ng/L	A
Metolachlor	< 10.9	ng/L	A
Metsulfuron Methyl	< 4.35	ng/L	A
Mexacarbate	< 4.35	ng/L	A
Neburon	< 5.43	ng/L	A
Oxamyl	< 4.35	ng/L	A
Prometon	< 4.35	ng/L	A
Prometryn	< 4.35	ng/L	A
Propazine	< 4.35	ng/L	A
Propiconazole	< 21.7	ng/L	A
Pyraclostrobin	< 4.35	ng/L	A
Siduron	< 4.35	ng/L	A
Simazine	< 4.35	ng/L	A
Simetryn	< 4.35	ng/L	A
Sulfometuron-methyl	< 4.35	ng/L	A
Terbutryn (Prebane)	< 4.35	ng/L	A
Terbutylazine	< 4.35	ng/L	A
Phenoxy Herbicides by Electron Capture Detector			

DEQ Laboratory and Environmental Assessment Program

Analytical Report

Station: 38387
Station Description: Mid Willamette Groundwater Study Well MWV-004
Sampled Date/Time: 10/31/2017 1:27:00PM
Laboratory ID: 1711002-09
Sample Type: Field Primary::FP

Analysis Summary

Analyte Name	Result:	Units:	DQL:
Phenoxy Herbicides by Electron Capture Detector			
2,4,5-T	< 0.3	µg/L	A
2,4,5-TP (Silvex)	< 0.1	µg/L	A
2,4-D	< 0.1	µg/L	A
2,4-DB	< 0.6	µg/L	A
3,5-Dichlorobenzoic acid	< 0.3	µg/L	A
Acifluorfen	< 0.2	µg/L	A
DCPA acid metabolites	< 0.6	µg/L	B
Dicamba	< 0.3	µg/L	A
Dichloroprop	< 0.3	µg/L	A
Dinoseb	< 0.3	µg/L	A
MCPA	< 20.4	µg/L	A
MCPP	< 61.2	µg/L	A
Pentachlorophenol	< 0.1	µg/L	A
Picloram	< 0.6	µg/L	A
Triclopyr	< 0.3	µg/L	B
Pesticides by High Resolution Mass Spectrometry			
2,4´-DDD	< 0.0636	ng/L	B
2,4´-DDE	< 0.0636	ng/L	B
2,4´-DDT	< 0.0636	ng/L	B
4,4´-DDD	< 0.0636	ng/L	B
4,4´-DDE	< 0.0636	ng/L	B
4,4´-DDT	< 0.0636	ng/L	B
Aldrin	< 0.0636	ng/L	B
alpha-BHC	< 0.0636	ng/L	B
alpha-Chlordane	< 0.0636	ng/L	B
beta-BHC	< 0.0636	ng/L	B
cis-Nonachlor	< 0.0636	ng/L	B
delta-BHC	< 0.0636	ng/L	B
Dieldrin	< 0.0636	ng/L	B
Endosulfan I	< 0.159	ng/L	B
Endosulfan II	< 0.159	ng/L	B
Endosulfan sulfate	< 0.159	ng/L	B
Endrin ketone	< 1.27	ng/L	B
Endrin+cis-Nonachlor	< 0.127	ng/L	B
gamma-BHC (Lindane)	< 0.0636	ng/L	B
gamma-Chlordane+trans-Nonachlor	< 0.127	ng/L	B
Heptachlor	< 0.0636	ng/L	B

DEQ Laboratory and Environmental Assessment Program

Analytical Report

Station: 38387
Station Description: Mid Willamette Groundwater Study Well MWV-004
Sampled Date/Time: 10/31/2017 1:27:00PM
Laboratory ID: 1711002-09
Sample Type: Field Primary::FP

Analysis Summary

Analyte Name	Result:	Units:	DQL:
Pesticides by High Resolution Mass Spectrometry			
Heptachlor epoxide	< 0.0636	ng/L	B
Hexachlorobenzene	< 0.794	ng/L	B
Methoxychlor	< 0.254	ng/L	B
Mirex	< 0.0636	ng/L	B
Oxychlordane	< 0.0636	ng/L	B
Trifluralin	< 0.530	ng/L	B
Pharmaceuticals and Personal Care Products by Liquid Chromatography/Tandem Mass Spectrometry			
Acetaminophen	< 78.3	ng/L	A
Caffeine	< 78.3	ng/L	A
Carbamazepine	< 13.0	ng/L	A
Codeine	< 26.1	ng/L	A
Cotinine	< 13.0	ng/L	A
Diphenhydramine	< 13.0	ng/L	A
Ibuprofen	< 261	ng/L	A
Sulfamethoxazole	< 13.0	ng/L	A
Triclosan	< 261	ng/L	A
Venlafaxine	< 13.0	ng/L	A
Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry			
1,1,1,2-Tetrachloroethane	< 0.750	µg/L	A
1,1,1-Trichloroethane	< 0.500	µg/L	A
1,1,2,2-Tetrachloroethane	< 0.500	µg/L	A
1,1,2-Trichloroethane	< 0.600	µg/L	A
1,1-Dichloroethane	< 0.500	µg/L	A
1,1-Dichloroethylene	< 0.600	µg/L	A
1,1-Dichloropropene	< 0.500	µg/L	A
1,2,3-Trichlorobenzene	< 0.500	µg/L	A
1,2,3-Trichloropropane (TCP)	< 0.750	µg/L	A
1,2,4-Trichlorobenzene	< 0.600	µg/L	A
1,2,4-Trimethylbenzene	< 0.600	µg/L	A
1,2-Dibromo-3-chloropropane (DBCP)	< 1.25	µg/L	A
1,2-Dibromoethane (EDB)	< 0.500	µg/L	A
1,2-Dichlorobenzene	< 0.500	µg/L	A
1,2-Dichloroethane (EDC)	< 0.500	µg/L	A
1,2-Dichloropropane	< 0.500	µg/L	A
1,2-Dimethylbenzene	< 0.750	µg/L	A
1,3,5-Trimethylbenzene	< 0.500	µg/L	A
1,3-Dichlorobenzene	< 0.500	µg/L	A

DEQ Laboratory and Environmental Assessment Program

Analytical Report

Station: 38387

Station Description: Mid Willamette Groundwater Study Well MWV-004

Sampled Date/Time: 10/31/2017 1:27:00PM

Laboratory ID: 1711002-09

Sample Type: Field Primary::FP

Analysis Summary

Analyte Name	Result:	Units:	DQL:
Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry			
1,3-Dichloropropane	< 0.500	µg/L	A
1,4-Dichlorobenzene	< 0.600	µg/L	A
1,4-Dimethylbenzene + 1,3-Dimethylbenzene	< 1.00	µg/L	A
2,2-Dichloropropane	< 0.500	µg/L	A
2-Butanone (MEK)	< 50.0	µg/L	A
2-Chlorotoluene	< 0.600	µg/L	A
4-Chlorotoluene	< 0.600	µg/L	A
4-Isopropyltoluene	< 0.500	µg/L	A
4-Methyl-2-pentanone (MIBK)	< 5.00	µg/L	A
Acetone	< 40.0	µg/L	A
Benzene	< 0.600	µg/L	A
Bromobenzene	< 0.600	µg/L	A
Bromochloromethane	< 0.600	µg/L	A
Bromodichloromethane	< 0.750	µg/L	A
Bromoform	< 0.600	µg/L	A
Bromomethane	< 1.00	µg/L	B
Carbon disulfide	< 2.00	µg/L	A
Carbon tetrachloride	< 0.500	µg/L	A
Chlorobenzene	< 0.600	µg/L	A
Chloroethane	< 0.500	µg/L	A
Chloroform	< 0.600	µg/L	A
Chloromethane	< 0.600	µg/L	A
cis-1,2-Dichloroethene	< 0.500	µg/L	A
cis-1,3-Dichloropropene	< 0.600	µg/L	A
Dibromochloromethane	< 0.750	µg/L	A
Dibromomethane	< 0.500	µg/L	A
Dichlorodifluoromethane (Freon 12)	< 0.500	µg/L	A
Dichloromethane	< 0.500	µg/L	A
Ethylbenzene	< 0.500	µg/L	A
Hexachloro-1,3-butadiene	< 0.500	µg/L	A
Isopropylbenzene (Cumene)	< 0.500	µg/L	A
Methyl tert-butyl ether (MTBE)	< 0.500	µg/L	A
Naphthalene	< 1.00	µg/L	A
n-Butylbenzene	< 0.500	µg/L	A
n-Propylbenzene	< 0.500	µg/L	A
sec-Butylbenzene	< 0.600	µg/L	A
Styrene	< 0.600	µg/L	A

DEQ Laboratory and Environmental Assessment Program

Analytical Report

Station: 38387
Station Description: Mid Willamette Groundwater Study Well MWV-004
Sampled Date/Time: 10/31/2017 1:27:00PM
Laboratory ID: 1711002-09
Sample Type: Field Primary::FP

Analysis Summary

Analyte Name	Result:	Units:	DQL:
Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry			
tert-Butylbenzene	< 0.500	µg/L	A
Tetrachloroethylene	< 0.600	µg/L	A
Toluene	< 0.500	µg/L	A
trans-1,2-Dichloroethene	< 0.600	µg/L	A
trans-1,3-Dichloropropene	< 0.500	µg/L	A
Trichloroethylene	< 0.500	µg/L	A
Trichlorofluoromethane (Freon 11)	< 0.500	µg/L	A
Vinyl chloride	< 0.600	µg/L	A
Xylenes, total	< 1.75	µg/L	A

DEQ Laboratory and Environmental Assessment Program

Analytical Report

Station: 38387

Station Description: Mid Willamette Groundwater Study Well MWV-004

Sampled Date/Time: 10/31/2017 01:27 PM

Laboratory ID: 1711002-09

Sample Type: Field Primary::FP

Information about your detection

Nitrate/Nitrite as N

Nitrate is a naturally occurring oxide of nitrogen and is an essential component of all living things. It is the primary source of nitrogen for plants and it occurs naturally in soil and water. But if the levels of nitrate get too high it can pose a potential health risk. Sources of excess nitrate in water include fertilizers, septic systems, wastewater treatment effluent, animal wastes, industrial wastes, and food processing wastes. Nitrite is a chemical related to nitrate that quickly converts to nitrate in the presence of oxygen. The DEQ laboratory measures nitrate and nitrite together and reports the amount of nitrogen (nitrate/nitrite as N). Since the concentration of nitrate is often much higher than nitrite, we compare the combined nitrate/nitrite concentration to the nitrate MCL to evaluate risk. Nitrate levels of up to 2 mg/ L (milligrams per liter) in well water may be naturally-occurring or possibly indicates some low level of contamination. The EPA has set an MCL of 10 mg/L for nitrate (nitrate as N) for drinking water. Nitrate levels above 10 mg/L may present a serious health concern for infants and pregnant or nursing women. The concentration of nitrate in your well was **2.43 mg/L**.

Less than 2 mg/L -- no or very little impact from human activities and your results likely represent natural background levels.
2 to 4 mg/L-- a small impact from human activities may be present. However, this level of nitrate is not a health concern for most people.
4 to 7 mg/L-- obvious impact from human activities
7 to 9.9 mg/L-- obvious impact from human activities. Your water is approaching public health limits for nitrate (10 mg/L).

Recommendations for non-detect (ND) up to 10 mg/L:

1. Nitrate in this range does not pose a significant health risk for healthy individuals, but increased monitoring for nitrate is recommended.

2. Annual testing for nitrate is recommended. Seasonal monitoring once every six months in the middle of the wet and dry seasons is best for detecting seasonal highs and lows

3. When considering nitrate treatment options remember to account for individual tolerance to risk. For example, dietary exposure to foods that have nitrates, such as cured meats; pregnant women, infants, and children; pre-existing medical conditions; or persons who are 65 years of age or older may be at higher risk. We recommend that you share these test results with your physician if you have health concerns.

DEQ Laboratory and Environmental Assessment Program

Analytical Report

Station: 38387

Station Description: Mid Willamette Groundwater Study Well MWV-004

Sampled Date/Time: 10/31/2017 01:27 PM

Laboratory ID: 1711002-09

Sample Type: Field Primary::FP

Information about your detection

Lead, Total Recoverable

This result may not represent the level of lead in the water in your home. DEQ's sampling procedure is different than that recommended for testing lead in the home and may result in a lower concentration. If you are concerned about lead in your household water, you should arrange for a point of use test with an accredited laboratory. A list of accredited laboratories in Oregon can be found here: http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Documents/AllLabsDWMatrix.pdf

Lead is a metal that occurs naturally in the earth's surface. Lead can also be produced from burning fossil fuels, manufacturing, and mining. Lead is used to produce many items such as batteries, certain kinds of solder, and metal parts for machinery. Because of health concerns, its use has been discontinued in many products such as paint, fuel and kitchenware. However, lead levels can still be present in drinking water. The most common source of lead in drinking water is due to leaching from lead in solder used to join drinking water pipes. Although rare, lead can also enter drinking water through erosion of natural deposits in the earth's crust. Lead is a health hazard. Infants and children are particularly susceptible to the health effects of lead. Drinking water with more than 15 micrograms per liter (µg/L) of lead over long periods of time can cause health effects such as:

• Delay in children's physical or mental development
• Decreased IQ in children
• Kidney problems
• High blood pressure
• Increased risk of cancer

The EPA has established an action level of 15 µg/L for lead in drinking water. Lead was detected in your well water at a concentration of **0.25 µg/L .**

Up to 15 µg/L: This concentration of lead is not expected to cause health effects for children or adults in your family.

DEQ Laboratory and Environmental Assessment Program

Analytical Report

Station: 38387

Station Description: Mid Willamette Groundwater Study Well MWV-004

Sampled Date/Time: 10/31/2017 01:27 PM

Laboratory ID: 1711002-09

Sample Type: Field Primary::FP

Information about your detection

Iron, Total Recoverable

EPA and the Agency for Toxic Substances and Disease Registry (ATSDR) do not have health-based guidelines for concentrations of Iron in drinking water. EPA's secondary contaminant level for iron which is set at 300 ug/L is designed to prevent water with a rusty color, metallic taste, or reddish/orange staining but is not associated with health effects.
Iron was detected in your well at a concentration of **455 µg/L**.

>300 ug/L: This concentration may affect the taste, color, or smell of your water, however it is not expected to pose a significant health risk to you or your family.

DEQ Laboratory and Environmental Assessment Program

Analytical Report

Station: 38387

Station Description: Mid Willamette Groundwater Study Well MWV-004

Sampled Date/Time: 10/31/2017 01:27 PM

Laboratory ID: 1711002-09

Sample Type: Field Primary::FP

Information about your detection

Manganese, Total Recoverable

Manganese is a natural mineral commonly found in groundwater. If the groundwater is oxygen poor, manganese (and iron) will dissolve more readily, particularly if the pH of the water is on the low side (slightly more acidic). At high concentrations it can cause water to have a brown or black color and cause staining and a bitter metallic taste. To avoid these aesthetic effects, the EPA has set a non-mandatory Secondary Drinking Water Regulation for manganese at 50 µg/L. At much higher concentrations, manganese may cause nervous system effects. To avoid these potential health effects, the EPA Lifetime Health Advisory for manganese is set at 300 µg/L. The EPA also has a 10-day exposure health advisory for children of 1000 ug/L and for bottle-fed infants under 6 months they recommend avoiding short-term exposure above 300 ug/L. These short term levels are a safe range designed to prevent effects on children's developing brains, and do not necessarily reflect a level where health effects will occur. Manganese was detected in your well at a concentration of **24.5 µg/L**.

Up to 50 ug/L: This concentration is not expected to have any aesthetic effects or pose a significant health risk to you or your family.

DEQ Laboratory and Environmental Assessment Program

Analytical Report

Station: 38387

Station Description: Mid Willamette Groundwater Study Well MWV-004

Sampled Date/Time: 10/31/2017 01:27 PM

Laboratory ID: 1711002-09

Sample Type: Field Primary::FP

Information about your detection

Metribuzin

Metribuzin is an herbicide used to control broadleaf and grassy weeds on crop and non-crop lands. It can be harmful to health. The EPA has calculated a lifetime health advisory level of 0.07 mg/L (equal to 70,000 ng/L). Concentrations of metribuzin in drinking water below this level are not expected to cause any adverse noncarcinogenic effects for a lifetime of exposure. Metribuzin was detected in your well water at a concentration of **5.17 ng/L** and is not expected to pose a significant health risk to you or your family.

DEQ Laboratory and Environmental Assessment Program

Analytical Report

Explanation of terms and phrases used in your Analytical Report

Data Quality Levels (DQL) listed on your Analytical Report:

A = Data of known Quality; meets Quality Control (QC) limits established in a DEQ approved plan.

B = Data of known but lesser quality; Data may not meet established QC but is within marginal acceptance criteria; or data value may be accurate, however controls used to measure Data Quality Objective elements failed (e.g. batch failed to meet blank QC limit); the data is generally usable for most situations or in supporting other, higher quality data.

C= Data of unacceptable quality; Generally due to QC failures but may be related to other known information about the sample. Data should not be used for quantitation purposes but may have qualitative use.

D= No data available; No sample collected or no reportable results. Samples are either voided or cancelled.

E= Data of unknown quality; Insufficient QA/QC or other information available to make determination. Data could be acceptable; however, no evidence is available to prove either way. Data is provided for Educational Use Only.

Terms

mg/L (milligrams per liter; parts per million; ppm)

Unit of concentration equivalent to one penny in $10,000; or one 8 oz. glass of water in a 65,000 gallon Olympic sized swimming pool

µg/L (micrograms per liter; parts per billion; ppb)

Unit of concentration equivalent to one second in 32 years. There are 1,000 µg/L in 1 mg/L.

ng/L (nanograms per liter; parts per trillion; ppt)

Unit of concentration equivalent to one drop of ink distributed in a 12 million-gallon reservoir. There are 1,000 ng/ L in 1 µg/L and 1,000,000 ng/L in 1 mg/L.

EPA

United States Environmental Protection Agency

MCL

Maximum Contaminant Level defined by EPA as the maximum permissible level of a contaminant in water, which is delivered to any user of a public water system. There are no regulations for water that comes from a private, domestic well. However, the MCL set for public water systems is a very reliable health based standard for domestic wells. http://water.epa.gov/drink/contaminants

SMCL

EPA has established National Secondary Drinking Water Regulations (NSDWRs) that set non-mandatory water quality standards for 15 contaminants. EPA does not enforce these "secondary maximum contaminant levels" (SMCLs). They are established as guidelines to assist public water systems in managing their drinking water for aesthetic considerations, such as taste, color, and odor. These contaminants are not considered to present a risk to human health at the SMCL.
https://www.epa.gov/dwstandardsregulations/secondary-drinking-water-standards-guidance-nuisance-chemicals

Human health benchmark for pesticides (HHBP), Regional Screening Level (RSL) and Health-based screening level (HBSL)

Non-Enforceable benchmark concentrations in water below which adverse health effects are not expected over a lifetime of exposure calculated by the EPA and the United States Geological Survey, respectively.
http://www.epa.gov/region9/superfund/prg/, http://water.usgs.gov/nawqa/HBSL

Breakdown product

A new chemical that results from the degradation of another (parent) chemical. Degradation may occur because of biological activity, exposure to light or air, or by another similar process.

Appendix E – Complete Analyte List

Mid-Willamette Basin Groundwater Study 2017 Analyte List of 238
Analyte group, *Analyte sub-group*, Analyte Name 1/4
Bacteria
Total Coliform
E.coli
Consumer Product Constituents
Acetaminophen
Caffeine
Carbamazepine
Codeine
Cotinine
N,N-Diethyl-m-toluamide (DEET)
Diphenhydramine, Ethanamine, 2-(diphenylmethoxy)-N,N-dimethyl-
Ibuprofen, Benzeneacetic acid, .alpha.-methyl-4-(2-methylpropyl)-
Sulfamethoxazole
Triclosan
Venlafaxine
Pesticides (current use and legacy)
Fungicides
Azoxystrobin
Chloroneb
Chlorothalonil
Etridiazole
Fenarimol
Hexachlorobenzene (banned in US in 1984)
Propiconazole
Pyraclostrobin
Triadimefon
Tricyclazole
Trifloxystrobin
Herbicides
2,4,5-T (banned in US since 1985)
2,4,5-TP (Silvex) (herbicide banned in US since 1985)
2,4-D
2,4-DB
2,6-Dichlorobenzamide (DBA)
Acetochlor
Acifluorfen
Alachlor
Ametryn
Aminocarb
Pesticides (current use and legacy) cont'd
Herbicides
Atrazine
Bromacil
Butachlor
Butylate
Chlorpropham
Cyanazine
Cycloate
Dacthal (DCPA) (Chlorthal-dimethyl) (banned in US in 2024)
DCPA acid metabolites (Chlorthal monoacid and diacid degradates)
Deisopropylatrazine [diaminochlorotriazine (DACT)]
Desethylatrazine (2-Chloro-4-isopropylamino-6-amino-s-triazine)
Dichlobenil
Dichlorprop
Dimethenamid
Dinoseb (banned in 1986)
Diphenamid
Diuron
EPTC (S-Ethyl dipropylthiocarbamate)
Fluometuron
Fluridone
Hexazinone
Imazapyr
Linuron
MCPA
Mecoprop-p (MCPP-P)
Metolachlor
Metribuzin
Metsulfuron-methyl
Molinate
Napropamide
Neburon
Norflurazon
Oxyfluorfen (not banned but heavily regulated)
Pebulate
Pendimethalin
Picloram
Prometon

Analyte group, *Analyte sub-group*, Analyte Name 2/4	
Pesticides (current use and legacy) cont'd	**Pesticides (current use and legacy) cont'd**
Herbicides	*Insecticides*
Prometryn	Methomyl
Pronamide	Methyl paraoxon
Propachlor (discontinued in 1998)	**Methyl parathion (banned in US in 2014)**
Propazine (banned in 2021)	Mevinphos
Pyraflufen-ethyl	**Mexacarbate (Zectran) (considered discontinued as of 2009)**
Siduron	MGK264 (N-2-Ethylhexylbicycloheptenedicarboximide)
Simazine	Oxamyl
Simetryn	**Parathion (banned in US in 1998)**
Sulfometuron methyl	Permethrin
Tebuthiuron	Propoxur (Baygon)
Terbacil	Pyriproxyfen
Terbutryn (Prebane)	Terbufos
Terbuthylazine	Tetrachlorvinphos (Stirophos)
Triclopyr	**Other Legacy Pesticides**
Trifluralin	**Aldrin (banned in US in 1987)**
Vernolate	**Chlorobenzilate (banned in US in 1999)**
Insecticides	**Dieldrin (banned in US in 1987)**
3,5-Dichlorobenzoic acid	**alpha.-Endosulfan, Endosulfan I (banned in US in 2010)**
Acephate	**beta.-Endosulfan, Endosulfan II (banned in US in 2010)**
Acetamiprid	**Endosulfan sulfate (banned in 2010)**
Azinphos-methyl (Guthion)	**Endrin (banned in US in 1986)**
Bifenthrin	**Endrin aldehyde (banned in US in 1986)**
Carbaryl	**Endrin ketone (banned in US in 1986)**
Carbofuran (banned in US in 2009)	**Endrin + cis-Nonachlor (banned in US in 1986)**
Chlorpyrifos	**Heptachlor (banned in 1988)**
Diazinon	**Heptachlor epoxide (banned in 1988)**
Dicamba	**Methoxychlor (banned in US in 2003)**
Dichlorvos	**Mirex (banned in US in 1978)**
Dimethoate	**Pentachlorophenol (banned in US in 2024)**
Ethoprop	*BHC-Technical (HCH)*
Fenamiphos	**alpha.-Hexachlorocyclohexane (alpha BHC) (banned in US in 1985)**
Fenvalerate + Esfenvalerate	**beta.-Hexachlorocyclohexane (beta BHC) (banned in the 1980s)**
Imidacloprid	**delta.-Hexachlorocyclohexane (delta-BHC) (banned in 1976)**
Malathion	**gamma-BHC (Lindane) (banned in US in 2023)**
Methiocarb	

Analyte group, *Analyte sub-group*, Analyte Name 3/4	
Other Legacy Pesticides, cont'd	**Standard Parameters, cont'd**
Chlordane	Nitrate + Nitrite as N
cis-Chlordane (alpha-chlordane) (banned in US in 1988)	Phosphate, Total as P
cis-Nonachlor (banned in US in 1988)	Sulfate
gamma-Chlordane + trans-Nonachlor (banned in 1988)	Total solids
Oxychlordane (banned in US in 1998)	**Field Parameters**
trans-Chlordane (banned in 1988)	Conductivity
trans-Nonachlor (banned in 1988)	Dissolved oxygen (DO)
Total DDT	pH
o,p'-DDD (2,4´-DDD) (banned in US in 1972)	Temperature
o,p'-DDE (2,4´-DDE) (banned in US in 1972)	**Volatile Organic Compounds**
o,p'-DDT (2,4´-DDT) (banned in US in 1972)	1,1,1,2-Tetrachloroethane
p,p'-DDD (4,4´-DDD) (banned in US in 1972)	1,1,1-Trichloroethane
p,p'-DDE (4,4´-DDE) (banned in US in 1972)	1,1,2,2-Tetrachloroethane
p,p'-DDT (4,4´-DDT) (banned in US in 1972)	1,1,2-Trichloroethane
Metals, Total Recoverable	1,1-Dichloroethane
Aluminum	1,1-Dichloroethylene
Arsenic	1,1-Dichloropropene
Calcium	1,2,3-Trichlorobenzene
Iron	1,2,3-Trichloropropane (TCP)
Lead	1,2,4-Trichlorobenzene
Magnesium	1,2,4-Trimethylbenzene
Manganese	1,2-Dibromo-3-chloropropane
Potassium	1,2-Dichloroethane (EDC)
Sodium	1,2-Dichloropropane
Uranium	1,3,5-Trimethylbenzene
Vanadium	1,3-Dichloropropane
Standard Parameters	2,2-Dichloropropane
Alkalinity, total as CaCO3	Acetone
Chloride	Benzene
Hardness as CaCO3, Total recoverable	

Analyte group, *Analyte sub-group*, Analyte Name 4/4	
Volatile Organic Compounds, cont'd	**Volatile Organic Compounds, cont'd**
Bromobenzene	Naphthalene
Carbon disulfide	n-Butylbenzene
Carbon tetrachloride	n-Propylbenzene
CFC-11 (Trichlorofluoromethane (Freon 11))	o-Chlorotoluene
CFC-12 (Dichlorodifluoromethane (Freon 12))	o-Dichlorobenzene (1,2-Dichlorobenzene)
Chlorobenzene	o-Xylene (1,2-Dimethylbenzene)
Chlorodibromomethane (Dibromochloromethane)	p-Chlorotoluene
Chloroethane	p-Cymene, 4-Isopropyltoluene
Chloroform	p-Dichlorobenzene (1,4-Dichlorobenzene)
Chloromethane	sec-Butylbenzene
cis-1,2-Dichloroethylene	Styrene
cis-1,3-Dichloropropene	tert-Butylbenzene
Cumene (Isopropylbenzene)	Tetrachloroethylene
Dibromomethane	Toluene
Dichlorobromomethane (Bromodichloromethane)	trans-1,2-Dichloroethylene
Ethylbenzene	trans-1,3-Dichloropropene
Ethylene dibromide (1,2 Dibromoethane) (EDB)	Tribromomethane (Bromoform)
Halon 1011 (Bromochloromethane)	Trichloroethylene
Hexachlorobutadiene	Vinyl chloride
m,p-Xylene (1,4-Dimethylbenzene + 1,3-Dimethylbenzene)	Xylenes
m-Dichlorobenzene (1,3-Dichlorobenzene)	**Semi-volatiles**
Methyl bromide(Bromomethane)	Tris (1,3-dichloro-2-propyl) phosphate (TDCP)
Methyl ethyl ketone (2-Butanone (MEK))	Tris (2-chloroethyl) phosphate (TCEP)
Methyl isobutyl ketone (MIBK)	
Methyl tert-butyl ether	
Methylene chloride	