# 0Rogue Drinking Water Providers Source Water Protection Plan

NRCS National Water Quality Initiative

Prepared by Greg Stabach and Amie Siedlecki,
Rogue Valley Council of Governments
In partnership with NRCS and John Speece,
Rogue River Watershed Council

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## 1.0 INTRODUCTION

*Project Area Overview*

The Rogue Drinking Water Providers (RDWP) Source Water Protection (SWP) project area (Figure 1.1) encompasses 148,273 acres and includes six United States Geological Survey (USGS) 12th- field watershed hydrologic unit codes (HUC): Lower Antelope, Whetstone, Reese, Lick, Kanutchan, and Indian Creek. Table 1.1 summarizes the size (acres) and percent of project area for each subwatershed. The project area was chosen for SWP following collaborative discussions with members of the RDWP, the Oregon Department of Environmental Quality (DEQ), and the Natural Resources Conservation Service (NRCS). The project area starts at the Rogue River above Shady Cove, and extends past the old Gold Ray Dam site to approximately 2.75 miles upstream of the Gold Hill surface water intake. Additionally, it is located almost entirely (78%) in the 783,300-acre Upper Rogue Watershed. The Upper Rogue Watershed begins at the headwaters near Crater Lake and ends at Dodge Bridge, south of the city of Shady Cove, and represents approximately 25% of the Rogue Basin.

Figure 1.1: Project Area Location

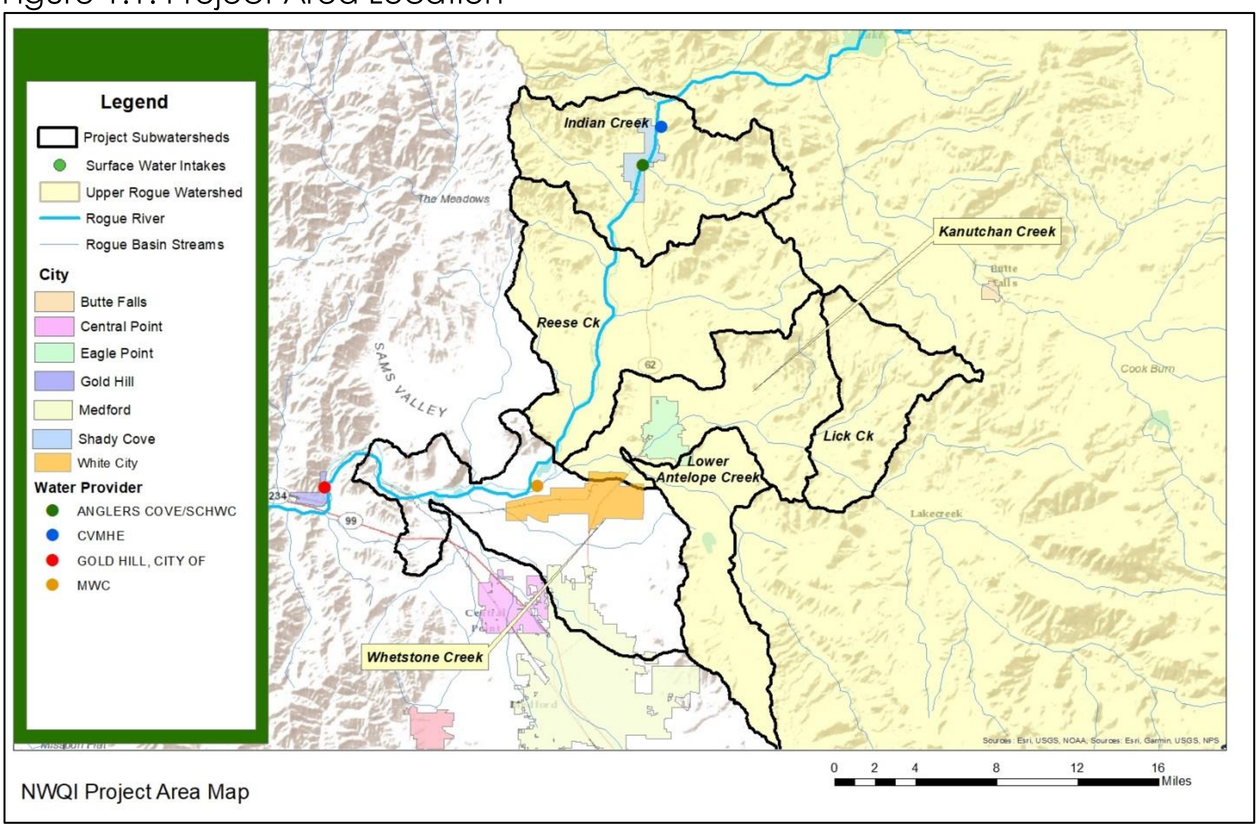


Table 1.1: Subwatershed Summary

| Subwatershed | Area (Ac) | Percent of Project Area |
|---|---|---|
| Lower Antelope Creek | 16,097 | 11 |
| Whetstone Creek | 32,763 | 22 |
| Reese Creek | 37,467 | 25 |
| Lick Creek | 14,839 | 10 |
| Kanutchan Creek | 21,960 | 15 |
| Indian Creek | 25,237 | 17 |

*Drinking Water Providers and System Information*

The Upper Rogue Watershed serves as the drinking water source for over 160,000 people in Jackson County, Oregon, with total withdrawals (from both surface and groundwater) equaling 39.04 million gallons per day (Mgal/d) (USGS, 2015). There are four larger drinking water providers (DWP) that utilize groundwater and surface water within the project area include Anglers Cove/Shady Cove Heights Water Company (SCHWC), Country View Mobile Home Estates (CVMHE), Hiland Water Company, and Medford Water Commission (MWC). Tables 1.2 and 1.3 (a.) and (b.) provide summary information for each of the DWPs, including treatment technologies needed to meet standards based on local water quality conditions, the number of surface water (SW) intakes and groundwater (GW) wells, and if there is a Source Water Protection Plan (SWP) completed. The locations of the surface water intakes are shown in Figure 1.1.

Table 1.2: Drinking Water Provider Information

| Water Provider | Owner Type | Start of Operation | # SW Intakes | # GW Wells | # People Served | # Connections | SWP Plan? |
|---|---|---|---|---|---|---|---|
| Anglers Cove/SCHWC | Private | 1999 | 1 | 1 | 83 | 42 | No |
| CVMHE | Private | 2002 | 1 | 3 | 132 | 53 | No |
| Hiland Water Company | Private | 2011 | 1 | 1 | 1,000 | 234 | No |
| MWC | Public | 1927 | 1 | 9 | 140,000 | 31,195 | No[1] |

[1]Plan is in development/drafted.

Table 1.3(a.) and (b.): Treatment Technologies Utilized

| **Water Provider** | ***Filtration*** | ***Pressure Sand*** | ***Rapid Sand*** | ***Membrane*** | ***Coagulation*** | ***Flocculation*** |
|---|---|---|---|---|---|---|
| Anglers Cove/SCHWC | Yes | Yes | No | No | Yes | No |
| CVMHE | Yes | No | Yes | No | Yes | Yes |
| Hiland Water Company | Yes | No | No | Yes | No | No |
| MWC | Yes | No | Yes | No | Yes | Yes |

| **Water Provider** | ***Rapid Mix*** | ***Sedimentation*** | ***Hypochlorination (pre or post)*** | ***Ozonation (pre or post)*** | ***pH Adjustment (pre or post)*** |
|---|---|---|---|---|---|
| Anglers Cove/SCHWC | No | No | Yes; post | No | No |
| CVMHE | Yes | Yes | Yes; pre | No | No |
| Hiland Water Company | No | No | Yes; post | No | No |
| MWC | Yes | Yes | Yes; pre and post | Yes; pre | Yes; pre, post pending |

*Drinking Water for Rural Residents (Other Supplies)*

While the majority of residents in Jackson County receive their drinking water through private or public DWPs, over 50,000 people utilize surface water (0.24 Mgal/d) and groundwater (7.91 Mgal/d) outside of DWPs (USGS, 2015) as their drinking water source. Contrary to the minimum treatment requirements of the private and public DWPs, domestic well water is only regulated, under the Domestic Well Testing Act, during a sale or exchange of real estate in Oregon (OHA, 2020). Due to water quality concerns with many domestic wells in Jackson County (more information in section 3.0), it is recommended that well owners get their well water tested for total coliform, *E. coli,* and nitrate every year, and tested for arsenic every three to five years (OHA, 2020).

*Land Ownership*

The project area comprises approximately 148,273 acres. Private lands make up most of the land ownership (83%), as seen in Figure 1.2. Private land includes urbanized areas of Shady Cove, Eagle Point, White City (unincorporated), and a portion of Medford. The cities comprise approximately 15% of the total private land, seen as the colored City polygons overlaid by the light blue Private Land Ownership polygon. In addition, the land use is largely agricultural and rangeland. Federal lands (primarily BLM) comprise approximately 11% of the land, the State of Oregon: 2% (including Oregon State Forest Lands), Jackson County: 2%, and City Land: 2% (all cities).

Figure 1.2: Land Ownership

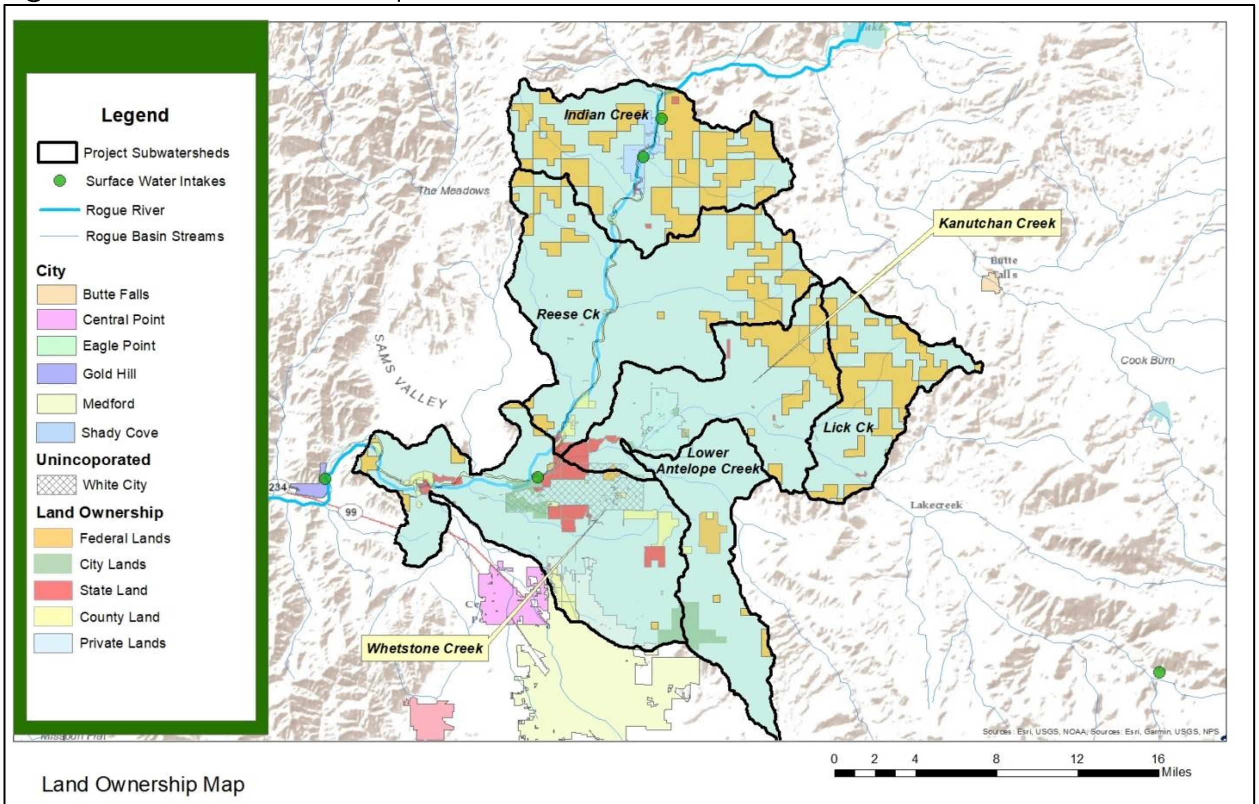



Table 1.4: Land Ownership by Subwatershed (Percent)

| | Lower Antelope Creek | Whetstone Creek | Reese Creek | Lick Creek | Kanutchan Creek | Indian Creek |
|---|---|---|---|---|---|---|
| Federal | 5.4 | 2.4 | 15.2 | 37.8 | 16.7 | 60.3 |
| Private | 89 | 84.3 | 83.1 | 62 | 79.8 | 39.1 |
| State | <0.1 | 5 | 0.5 | 0.2 | 3.1 | 0.3 |
| County | 0.6 | 4.8 | 1.1 | <0.1 | 0.1 | 0.2 |
| City | 5 | 3.4 | 0.1 | 0 | 0.4 | 0.04 |

*NRCS – NWQI*

In 2012, the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) launched the National Water Quality Initiative (NWQI), in collaboration with the Environmental Protection Agency (EPA) and state water quality agencies, to reduce nonpoint sources of nutrients, sediment, and pathogens related to agriculture in small high-priority watersheds in each state. These priority watersheds have been selected by NRCS State Conservationists, in consultation with state water quality agencies and NRCS State Technical Committees, where targeted on-farm conservation investments will deliver the greatest water quality benefits. NWQI provides a means to accelerate voluntary, private lands conservation investments to improve water quality with dedicated financial assistance through NRCS's Environmental Quality Incentives Program (EQIP), Clean Water Act Section 319, or other funds to focus state water quality monitoring and assessment efforts where they are most needed to track change. A key part of the NWQI targeting effort includes the implementation of conservation systems that avoid, trap, and control run-off in these high-priority watersheds (https://www.epa.gov/nps/nonpoint-source-national-water-quality-initiative).

As part of the NWQI process, a multi-phased area-wide plan is developed for each identified area of interest. This document represents the framework area-wide plan focusing on SWP.

# 2.0 OVERVIEW OF THE SOURCE WATER PROTECTION AREA

## 2.1 Physical Geography

The project area is located in the Upper Rogue Watershed from Shady Cove to downstream of the former Gold Ray Dam area, approximately 2.75 miles upstream of the Gold Hill water intake. The project area encompasses 148,273 acres (232 square miles). Elevations range from 1,120 to 4,320 feet.

Table 2.1(a): Physical Characteristics Summary

| Physical Characteristics | Project Area |
|---|---|
| Basin Size (square miles) | 232 |
| Basin size (acres) | 148,273 |
| Maximum Elevation (feet)[1] | 4,320 |
| Minimum Elevation (feet)[1] | 1,120 |

[1] Based on available contour data analysis

Table 2.1(b): Physical Characteristics Summary – Subwatersheds

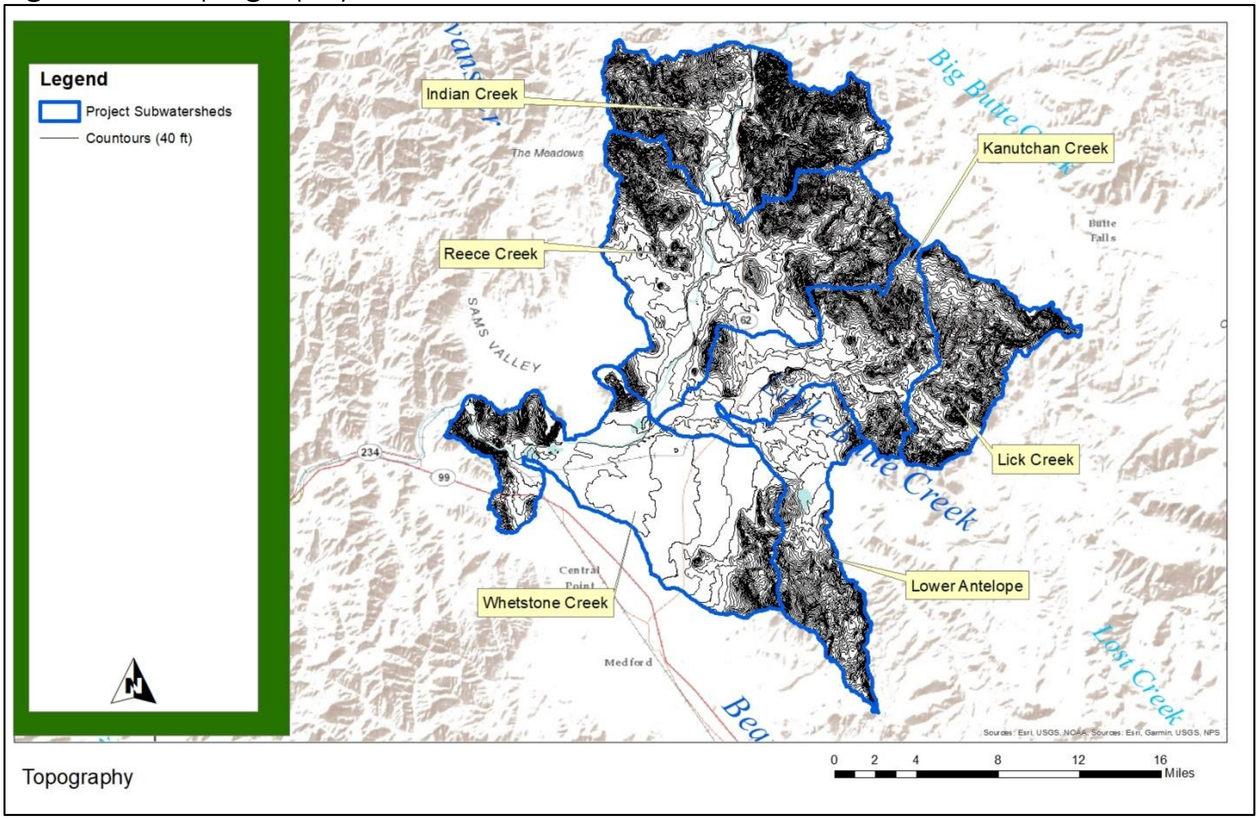
| Subwatershed | Area (Square Miles) | Area (Ac) | Maximum Elevation (feet)[1] | Minimum Elevation (feet)[1] |
|---|---|---|---|---|
| Lower Antelope Creek | 25 | 16,097 | 4,320 | 1,280 |
| Whetstone Creek | 51 | 32,763 | 3,560 | 1,120 |
| Reese Creek | 59 | 37,467 | 3,560 | 1,200 |
| Lick Creek | 23 | 14,839 | 4,160 | 1,480 |
| Kanutchan Creek | 34 | 21,960 | 3,680 | 1,200 |
| Indian Creek | 39 | 25,237 | 3,520 | 1,360 |

[1] Based on available contour data analysis

*Topography*

The topography of the project area (Figure 2.1) is characterized by mountainous terrain along the outskirts, with gentle valleys in the center. These flatter valleys are the result of the Rogue River, Little Butte Creek, and other tributaries flowing through the area. The steep slopes of the mountains provide a continuous direction for drainage, and this precipitation flows down as rainfall and snowmelt to empty into the various waterways.

Figure 2.1: Topography




## 2.2 Climate, Water, Geology, and Soils

*Climate*

Average annual precipitation in Jackson County is 26 inches, which generally occurs as low-intensity rainfall. Greater amounts of precipitation, including snow, fall in higher elevations; conversely, the valley floors are very dry. Very little precipitation occurs in the summer months, with most occurring between November and April. Representative average temperatures range between 31 degrees (January) and 89 degrees (July) Fahrenheit. Climate averages and ranges in the project area are summarized in Table 2.2.

Table 2.2: Climate Averages

| | Jackson County | Shady Cove | Eagle Point | Gold Hill | United States |
|---|---|---|---|---|---|
| Rainfall | 25.8 in. | 26.2 in. | 25.0 in. | 25.1 in. | 38.1 in. |
| Snowfall | 6.0 in. | 3.5 in. | 3.7 in. | 3.6 in. | 27.8 in. |
| Precipitation | 108.8 days | 113.5 days | 111.4 days | 96.4 days | 106.2 days |
| Sunny | 196 days | 194 days | 199 days | 197 days | 205 days |
| Avg. July High | 88.9° | 89.2° | 89.3° | 89.8° | 85.8° |
| Avg. Jan. Low | 30.6° | 31.0° | 31.2° | 31.1° | 21.7° |
| Comfort Index (higher=better) | 7.4 | 7.4 | 7.4 | 7.5 | 7 |
| UV Index | 3.2 | 3.2 | 3.2 | 3.2 | 4.3 |
| Elevation | 3173 ft. | 1394 ft. | 1306 ft. | 1093 ft. | 2443 ft. |

https://www.bestplaces.net/climate/

*Water*

With the amount of precipitation that occurs each year (26 inches average annual precipitation) and the abundance of groundwater present in alluvial deposits within Jackson County, freshwater is available for a number of beneficial uses including drinking water, irrigation, livestock, industry and the natural environment. Using information from the Upper Rogue Watershed Assessment (2006), consumptive use data for the Indian Creek and Reese Creek subwatersheds was compiled into Table 2.3 and Table 2.4 below.

Table 2.3: Indian Creek Consumptive Use Data

| Subwatershed | Storage | Irrigation | Total |
|---|---|---|---|
| Indian Creek | 16.6 cfs – 87% | 2.47 cfs – 13% | 19.07 cfs |

Table 2.4: Reese Creek Consumptive Use Data

| Subwatershed | Storage | Irrigation | Domestic | Agricultural | Total |
|---|---|---|---|---|---|
| Reese Creek | 0.06 cfs – 1% | 3.41 cfs – 79% | 0.24 cfs – 6% | 0.6 cfs – 14% | 4.31 cfs |

*Geology*

Figure 2.2 and Table 2.5 show the geological diversity in the project area. Alluvial deposits flank the Rogue River and its tributaries, with adjacent terraces, pediments, and lag gravels. Basaltic lava flows comprise much of the eastern half of the project area, while nonmarine sedimentary rocks, gabbro, and ultramafic rocks characterize much of the western half. Additionally, there are several other smaller segments of varying geologies within the project area.

Figure 2.2: Local Geology

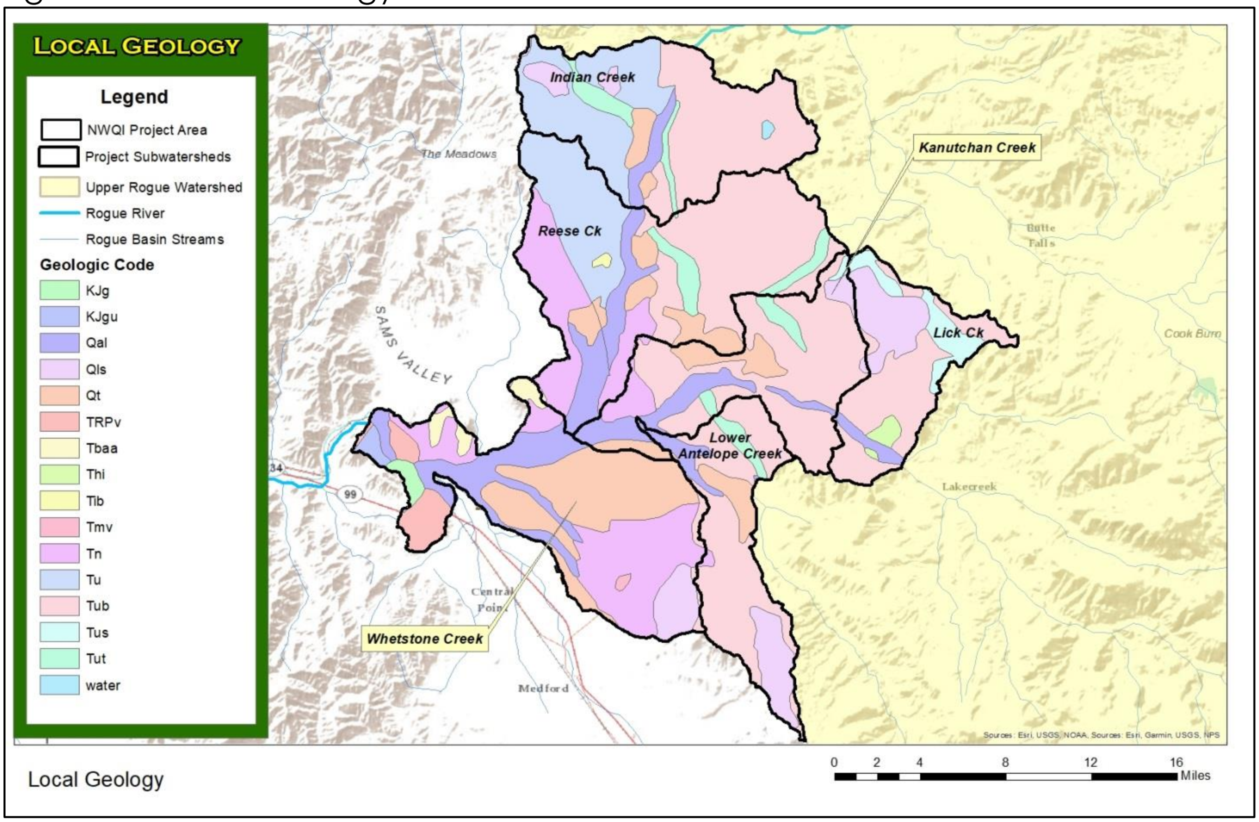


Table 2.5: Geologic Descriptions

| Geologic Code | Unit Name | Age |
|---|---|---|
| KJg | Granitic rocks | Late Jurassic and Early Cretaceous |
| KJgu | Gabbro and ultramafic rocks associated with granitic plutons | Late Jurassic and Early Cretaceous |
| Qal | Alluvial deposits | Holocene |
| Qls | Landslide and debris-flow deposits | Pleistocene to Holocene |
| Qt | Terrace, pediment, and lag gravels | Pleistocene to Holocene |
| TRPv | Volcanic rocks | Triassic and (or) Jurassic |
| Tbaa | Basaltic and andesitic rocks | Middle to Late Miocene |
| Thi | Hypabyssal intrusive rocks | Miocene |
| Tib | Basalt and andesite intrusions | Oligocene(?) to Pliocene |
| Tmv | Mafic vent complexes | Late Miocene to Pleistocene |
| Tn | Nonmarine sedimentary rocks | Eocene |
| Tu | Undifferentiated tuffaceous sedimentary rocks, tuffs, and basalt | Oligocene to Miocene |
| Tub | Basaltic lava flows | Oligocene to Miocene |
| Tus | Sedimentary and volcanoclastic rocks | Tertiary |
| Tut | Tuff | Tertiary |

https://mrdata.usgs.gov/geology/state/fips-unit.php?code=f41029

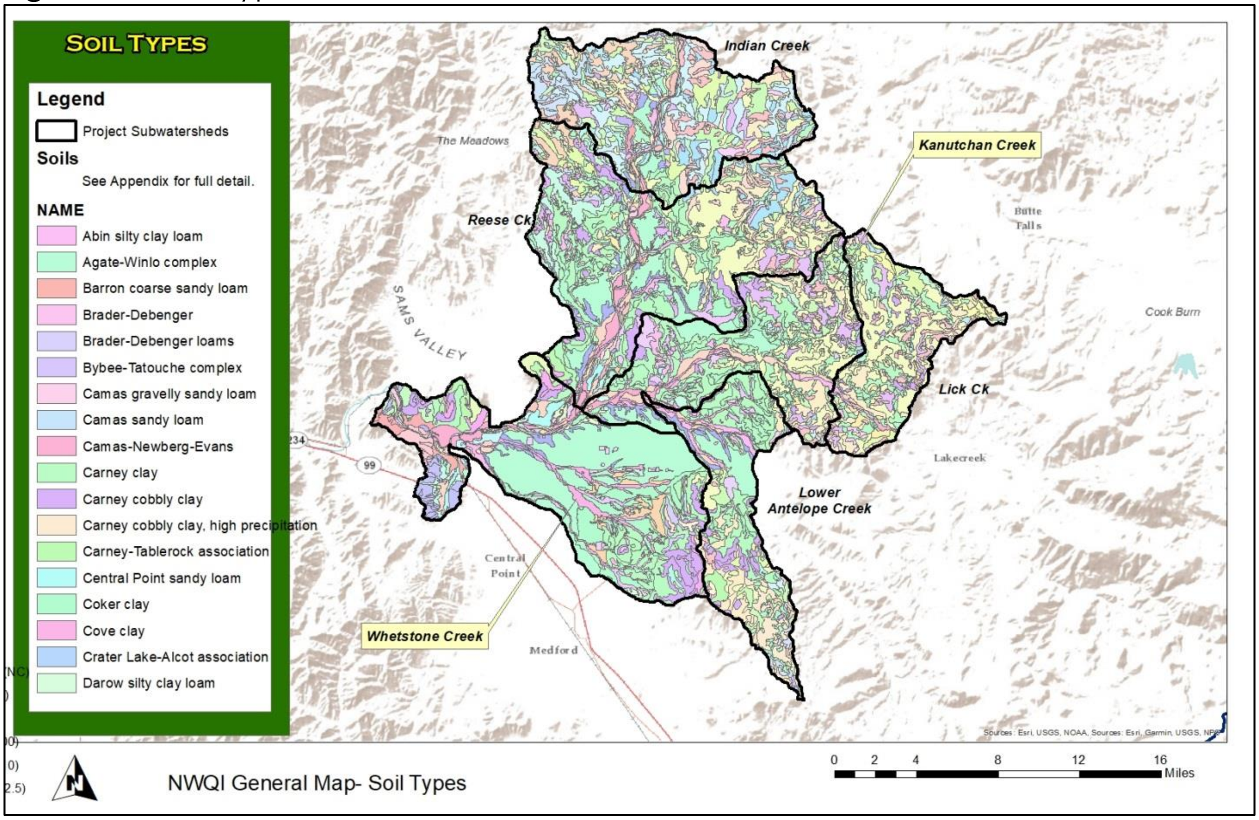
*Soil Types*

Within the project area, the dominant soil orders include: Alfisols, Inceptisols, and Ultisols. For descriptions of these soil orders, see Appendix B.

Figure 2.3 shows the soil types found in the project area. The legend on the figure shows a partial list of the soil types (only those that would fit in the legend). A full list can be found in the Appendix C. Additional information on each soil type including specific descriptions, engineering properties, water management, characteristic plant communities, crop and pasture capability and yields, and physical and chemical properties can be found in the Soil Survey of Jackson County Area, Oregon or accessed online through the NRCS' web soil survey site: https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm.

All soils data was collected by the NRCS and was summarized from the Soil Survey of Jackson County accessed online (websoilsurvey), electronically (GIS files), or referenced from hard copies.

Figure 2.3: Soil Types




*Soil Limitations*

Figure 2.4 shows severe and severe-moderate soil limitations in the project area. These limitations may be due to surface runoff, wind erosion, and/or other causes that have led to a decrease in fertile topsoil. Many of the areas adjacent to the Rogue River and other tributaries do not appear to be as heavily impacted. This may be attributed to the gentler topography (seen in Figure 2.5) within the valleys and the reduced impact of water erosion. Additional limitations (slope hazards) are also shown on Figure 2.5.

Figure 2.4: Soil Limitations

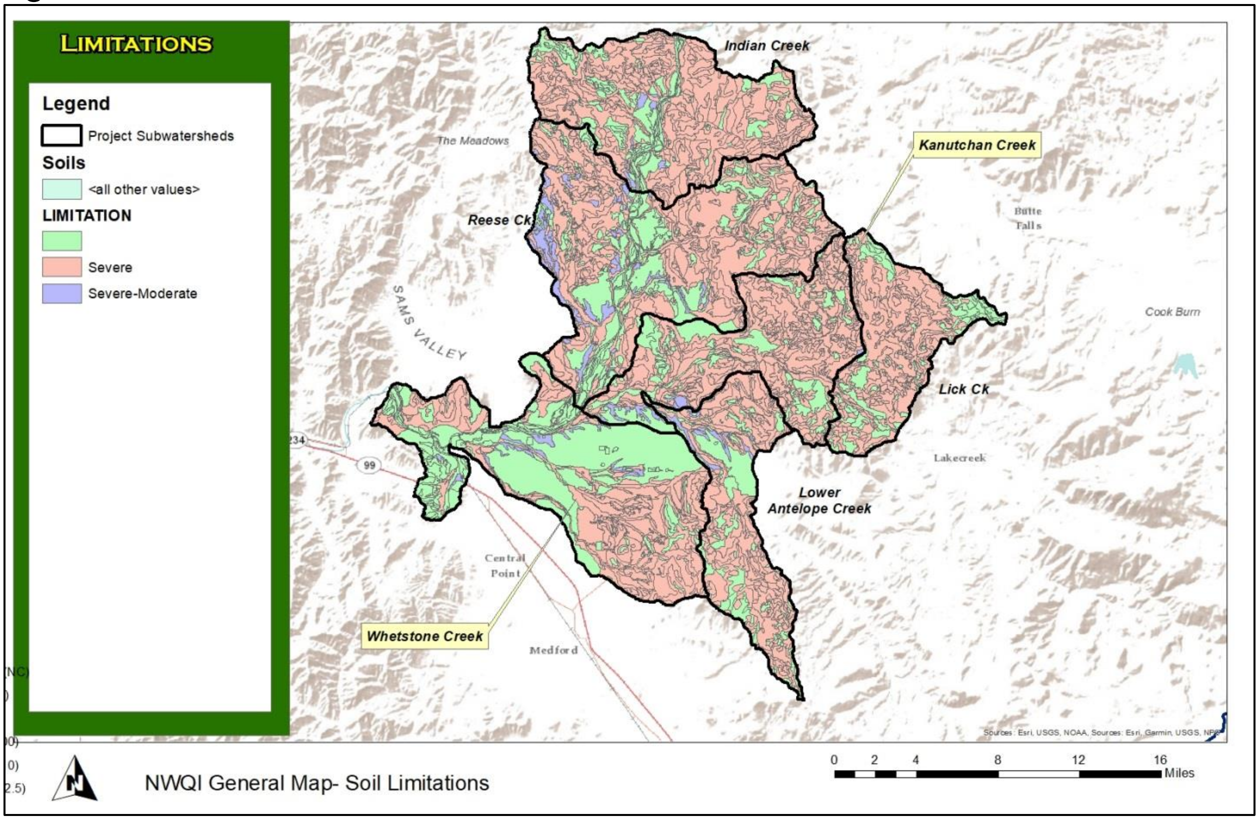
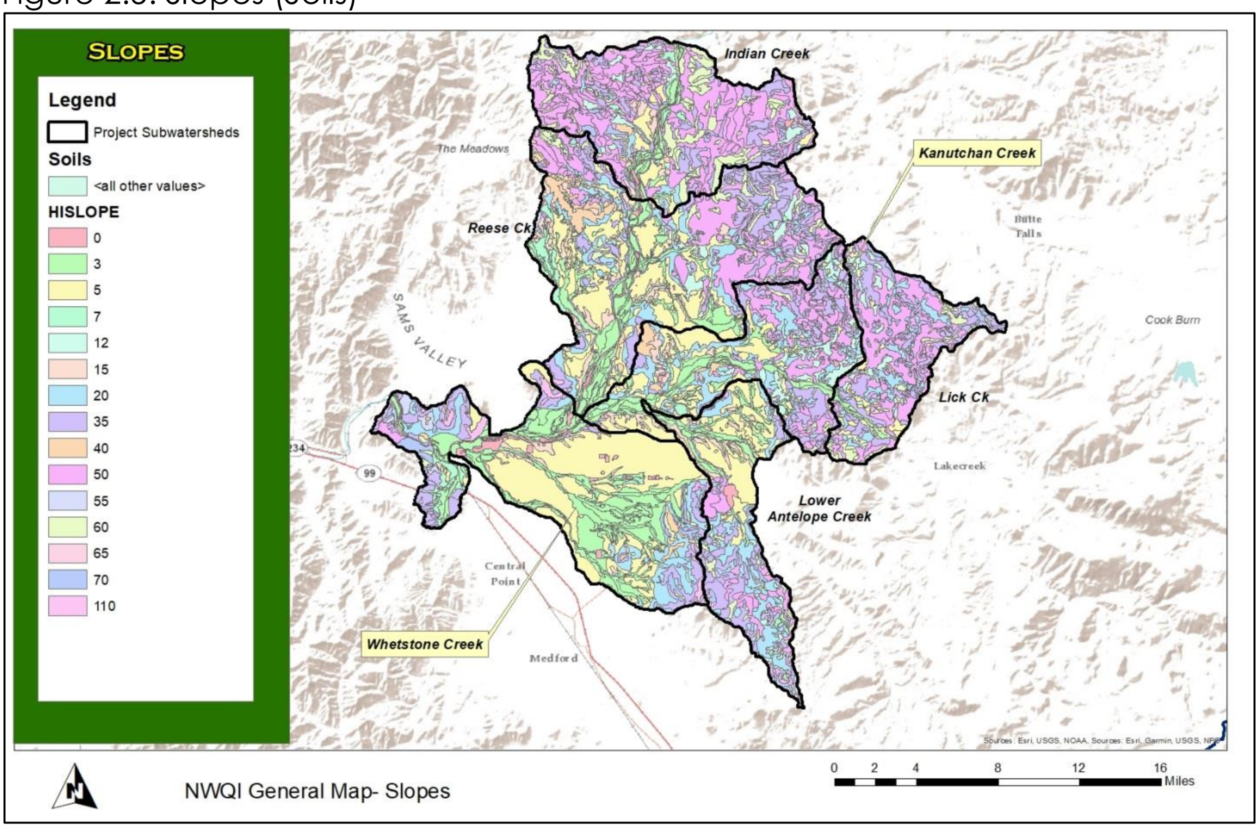



Figure 2.5: Slopes (Soils)



## 2.3 Land Use and Population

*Land Use*

Figures 2.6 through 2.9 show land use in the project area based on zoning, agricultural land use, and protected areas in the watershed, both private and public, including National Forests, BLM land, parks, trails, nature preserves, cemeteries, athletic fields, historical sites, and greenways.

A large portion of the project area (45%) is zoned for agricultural use (EFU or AG) and almost all agricultural land is private (97%).

Figure 2.6: General Zoning (County)

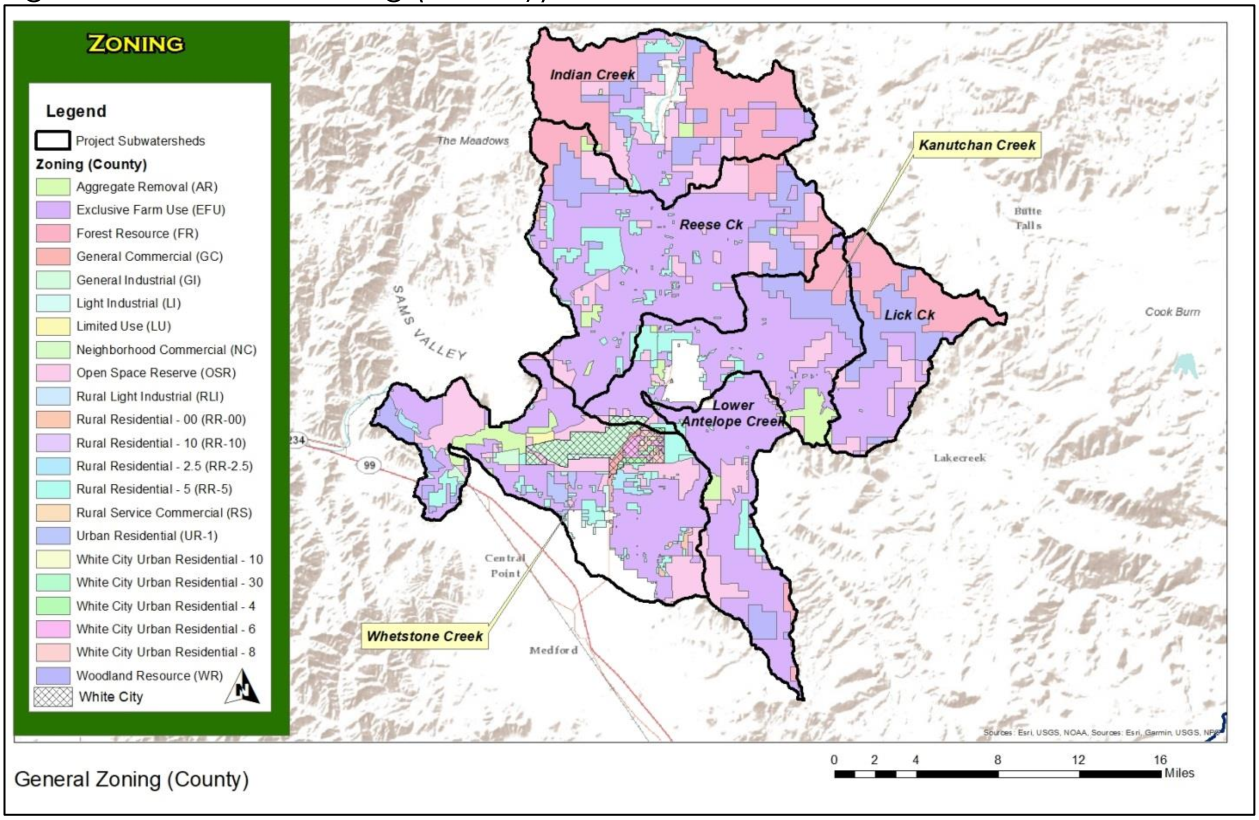


Figure 2.7: General Zoning (City)

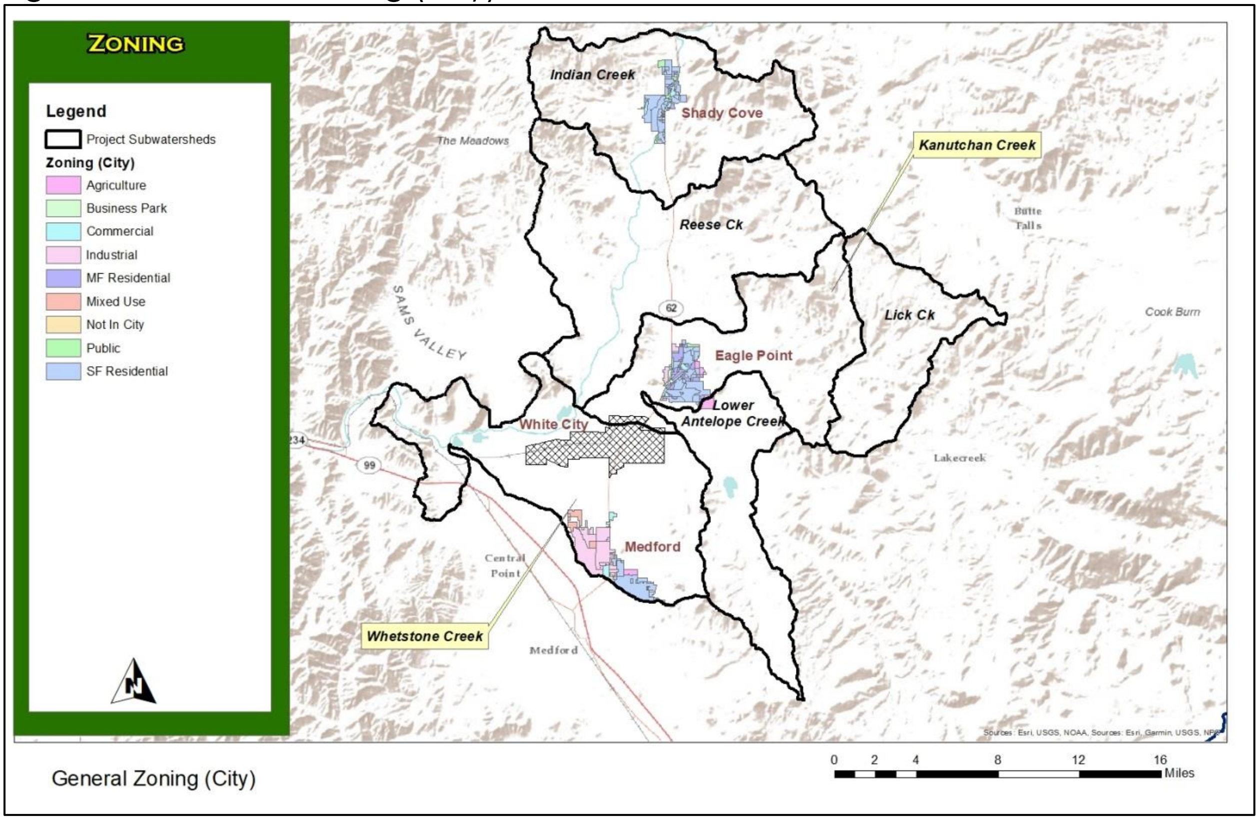



Figure 2.8: South Obenchain Fire and Agricultural Lands

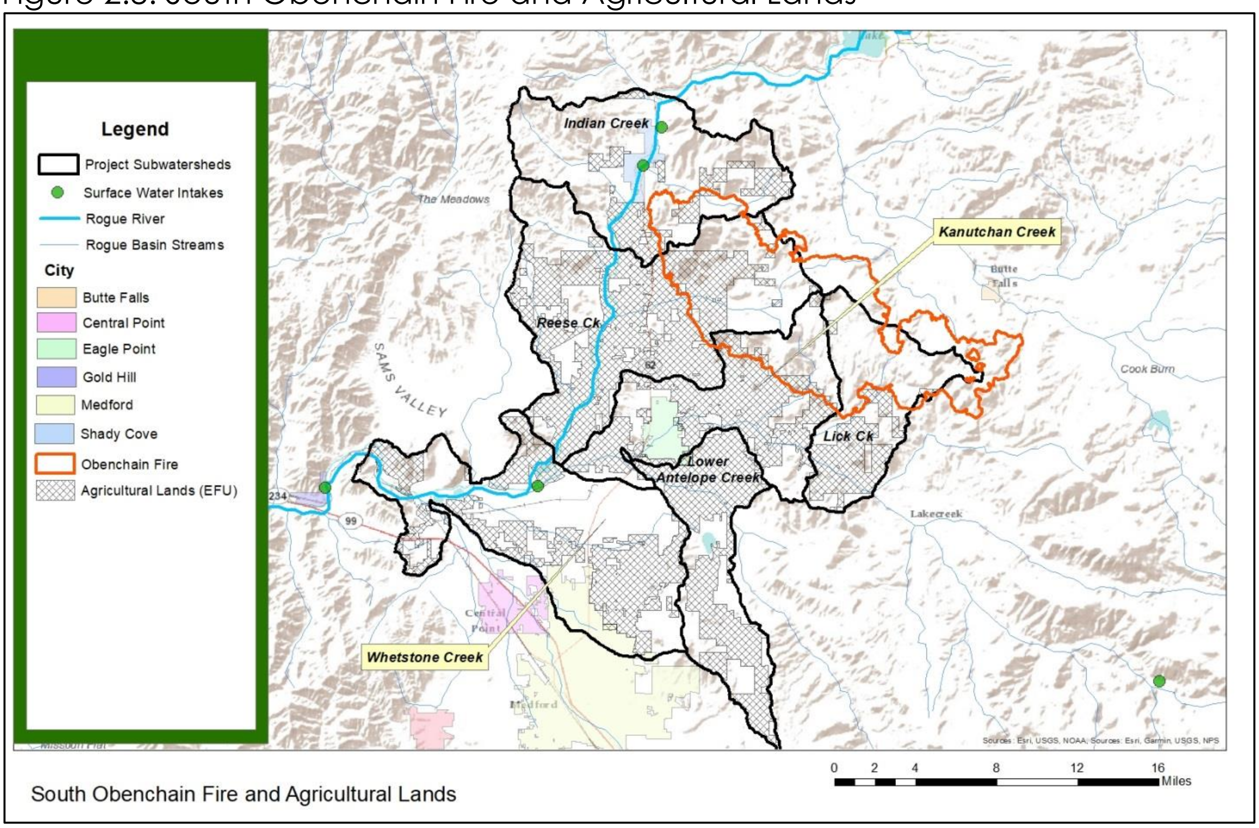
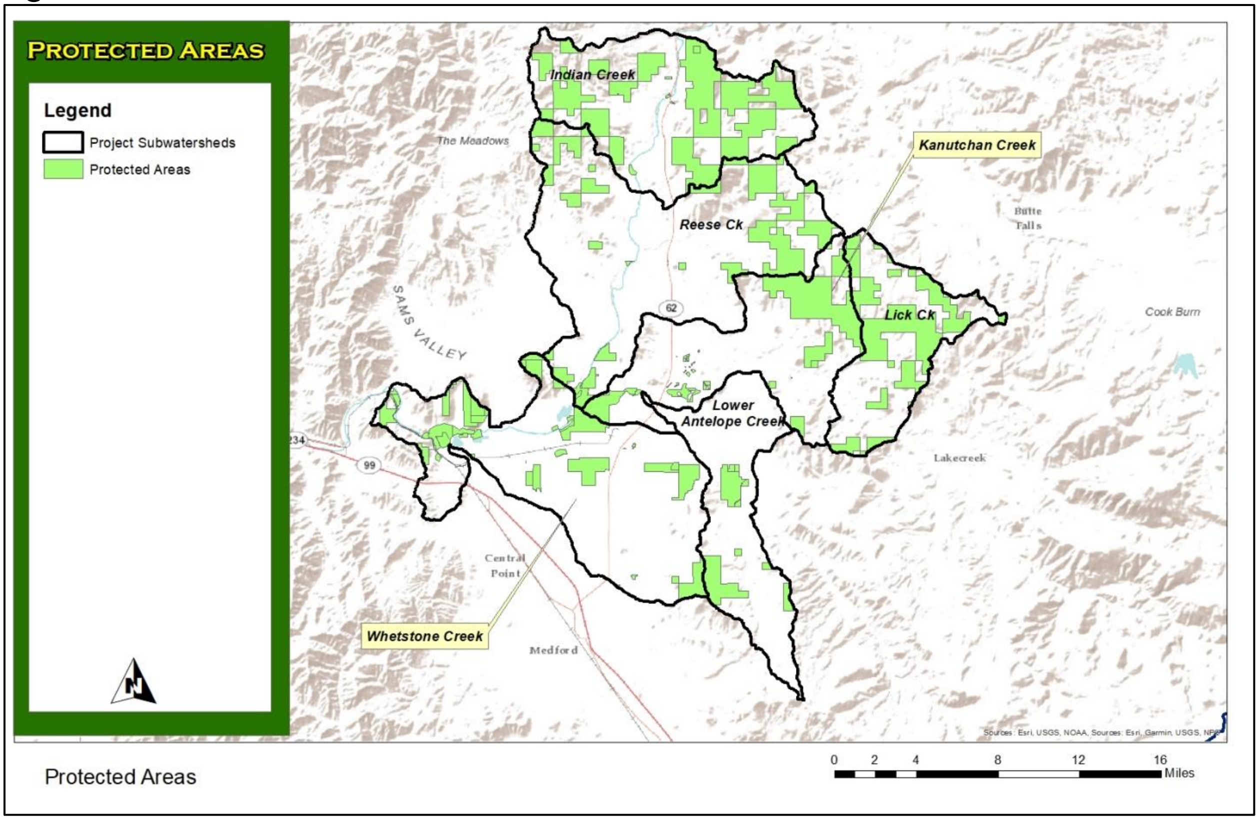


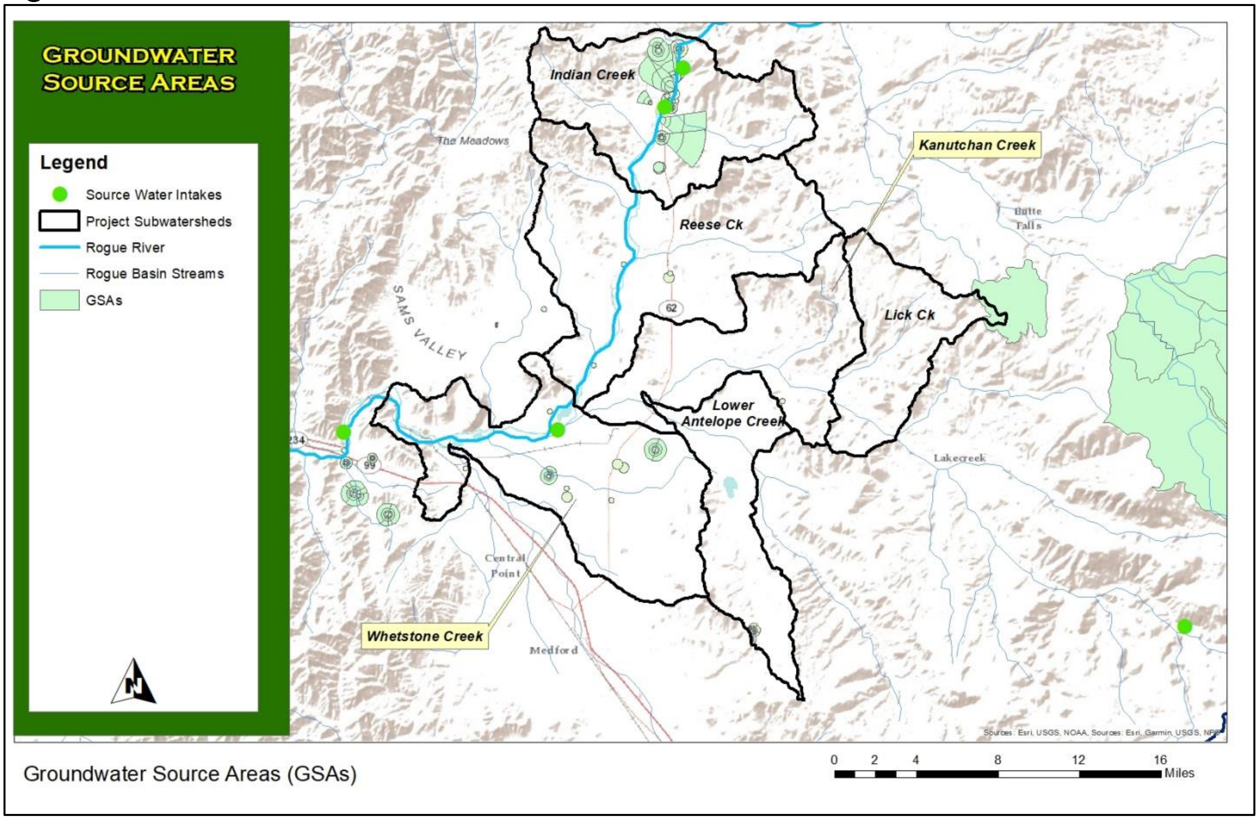
Figure 2.9: Protected Areas




*Population*

The project area includes the communities of Shady Cove (pop. 2,904*), Eagle Point (8,469*), White City (7,975*), parts of Medford (estimated 11,236 residents*), and Jackson County (*population figures from the 2010 census). These residents rely not only on the private (non-public) and public water suppliers, but on private domestic-use wells for their drinking water. Refer to Table 1.2 for information on the private and public drinking water providers. Figure 2.10 shows the location of known Groundwater Source Areas (GSAs), or Public Groundwater Source Areas delineated by OHA.

Figure 2.10: Groundwater Source Areas




## 2.4 Socioeconomic Conditions

Beginning in the 1840s, Euro-American settlers began farming and ranching in the Rogue Valley. In the 1850s, the first wave of agricultural growth within the region was the result of miners flocking to Jacksonville to find gold, followed by the second wave in the 1890s for timber. With new harvesting equipment and methods, along with the establishment of the Oregon and California Railroad in 1887, both the agricultural and timber industries grew rapidly.

During the early 1900s, the Rogue River Electrical Company, which was absorbed by the California-Oregon Power Company, harnessed the technology of hydroelectric power on the Rogue River. Mines, such as the Elk Creek Mine, produced gold, silver, and lead. To attract tourists to the areas of the Upper Rogue, poor road conditions were improved (URWA, 2006).

While the Upper Rogue Watershed is mainly rural, the project area includes several towns and a portion of Medford. Overall, populations in the small towns of Shady Cove and Trail, as well as the larger cities of Eagle Point and White City, have grown significantly over the last fifty years.

For a more current picture of the project area's environmental and demographic indicators, the EPA's Environmental Justice Screen (EJSCREEN) online tool was used to reveal variables, such as particulate matter, ozone, hazardous waste proximity, minority and low income populations, and others, summarized in Table 2.6 below.

Table 2.6: Environmental and Demographic Indicators for the Project Area

| Selected Variables | Value | State | | EPA Region | | USA | |
|---|---|---|---|---|---|---|---|
| | | Avg. | %tile | Avg. | %tile | Avg. | %tile |
| **Environmental Indicators** | | | | | | | |
| Particulate Matter (PM 2.5 in µg/m³) | 6.4 | 6.63 | 35 | 6.6 | 47 | 8.3 | 10 |
| Ozone (ppb) | 36 | 34.2 | 77 | 35.1 | 69 | 43 | 13 |
| NATA* Diesel PM (µg/m³) | 0.264 | 0.393 | 40 | 0.479 | <50th | 0.479 | <50th |
| NATA* Air Toxics Cancer Risk (risk per MM) | 34 | 31 | 59 | 31 | 50-60th | 32 | 60-70th |
| NATA* Respiratory Hazard Index | 0.55 | 0.48 | 70 | 0.46 | 60-70th | 0.44 | 70-80th |
| Traffic Proximity and Volume (daily traffic count/distance to road) | 230 | 480 | 55 | 500 | 55 | 750 | 51 |
| Lead Paint Indicator (% pre-1960s housing) | 0.098 | 0.25 | 34 | 0.23 | 42 | 0.28 | 37 |
| Superfund Proximity (site count/km distance) | 0.019 | 0.083 | 15 | 0.13 | 19 | 0.13 | 16 |
| RMP Proximity (facility count/km distance) | 0.24 | 0.78 | 47 | 0.65 | 50 | 0.74 | 43 |
| Hazardous Waste Proximity (facility count/km distance) | 0.24 | 1.4 | 37 | 1.5 | 41 | 4 | 39 |
| Wastewater Discharge Indicator (toxicity-weighted concentration/m distance) | 9.5E-05 | 0.0056 | 53 | 31 | 60 | 14 | 54 |
| **Demographic Indicators** | | | | | | | |
| Demographic Index | 29% | 29% | 59 | 29% | 59 | 36% | 48 |
| Minority Population | 20% | 23% | 51 | 27% | 44 | 39% | 37 |
| Low Income Population | 39% | 34% | 63 | 31% | 69 | 33% | 64 |
| Linguistically Isolated Population | 1% | 3% | 55 | 3% | 52 | 4% | 49 |
| Population with Less Than High School Education | 12% | 10% | 68 | 9% | 71 | 13% | 59 |
| Population under Age 5 | 6% | 6% | 61 | 6% | 55 | 6% | 56 |
| Population over Age 64 | 18% | 16% | 65 | 15% | 72 | 15% | 72 |

*The National-Scale Air Toxics Assessment (NATA) is EPA's ongoing, comprehensive evaluation of air toxics in the United States. EPA developed the NATA to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that NATA provides broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. More information on the NATA analysis can be found at: https://www.epa.gov/national-air-toxics-assessment.

## 2.5 Goals and Objectives of the Source Water Protection Plan

### Source Water Protection Plan Goals and Objectives

1. Provide an overview of the source water protection area and at-risk public water system(s).

2. Characterize the areas of influence for the SWP.

3. Identify and prioritize areas that require the implementation of SWP measures in the project area.

4. Identify best management practices (BMP) to protect source water quality in relation to pollution and chemicals, including pesticides and CAFOs.

5. Identify BMPs that will help protect source water quality from the impacts of erosion related to landslides and wildfires.

6. Increase coordination and collaboration between local, state, and federal partners to address SWP and the actions that can be taken.

7. Increase the capacity of the RDWP to respond to the actions of private landowners and provide guidance for implementing BMPs.

8. Develop an outreach strategy for partners and the greater RDWP to utilize when providing assistance to private landowners in critical areas.

9. Highlight education and outreach as an effective strategy for effecting change within critical areas.

10. Through BMP implementation, reduce the total amount of contaminants that enter waterways within the SWP project area.

**Assessment of NRCS' Ability to Help Partners Reach Source Water Protection Goals**

1. NRCS can support the goal of reducing the total amount of contaminants that enter waterways through BMP implementation.

2. NRCS can provide technical assistance and resources to increase the capacity of partners to provide education and outreach to private landowners within the SWP project area.

3. NRCS can provide support to partners and the RDWP to leverage funding from multiple local, state, and federal sources to address threats to the SWP project area.

## 3.0 IDENTIFIED THREATS TO THE SOURCE WATER PROTECTION AREA

Source water is surface and/or groundwater that serve as a source of drinking water. When source water is heavily impacted by residential, urban, industrial, and agricultural activities, as well as natural disasters (erosion, landslides, wildfires, etc.), potential contaminant sources (PCS) can enter waterways. Furthermore, infrastructure can be damaged, releasing additional pollutants. Commonly identified PCS and threats to source water include pollution/chemicals, pesticides, concentrated animal feeding operations (CAFOs), high risk land uses, erosion, landslides, and debris flows, and wildfires. A list of PCS and potential water quality impacts are shown in Appendix A.

*PCS – General*

PCS within the source water and/or delivery and treatment infrastructure can lead to both short-term and long-term supply interruptions, including system shut-downs, use of alternate supplies, diminished reservoir capacity, and/or increased maintenance costs for drinking water treatment facilities. These increased maintenance costs come in the form of more frequent backwashing (forcing clean water through filters in a direction opposite to normal flow) of filters and repeated replacement of filter media (sand, gravel, and/or charcoal), as well as an elevated use of disinfectants (chlorine or chloramine). In addition to increased costs, the use of additional disinfectant to treat drinking water can cause the water to have a slight chemical smell and/or taste, which may lead to customer dissatisfaction.

In order to combat both the increasing presence of PCS in the source water and the costs of drinking water treatment, it is important to understand the types of pollution and chemicals that currently exist in the watershed, including pesticides, natural processes (which are often exacerbated by human influence), and the mix of land use activities. Specific threats are discussed in more detail in the following sections.

*Pollution/Chemicals*

Pollutants of concern that have been identified during discussions with local drinking water providers, or identified in research completed for this report, include: ammonium, bacteria (total coliform and *E. coli*), barium, bromate, dioxin and furan, inorganic arsenic, nickel, polychlorinated biphenyls (PCB), radon, total organic carbon (TOC), turbidity, and uranium (DEQ, 2020). A summary of violations and alerts for each provider is provided in Table 3.1 below.

Table 3.1: Violation and Alert Summary by Water Provider

| Water Provider | Current MCL Violations? | Years | Alerts | Other Substances of Concern |
|---|---|---|---|---|
| Anglers Cove/SCHWC | No | 2007 | Total coliform[A] | Barium[1], radon[2], and uranium[2] |
| CVMHE | No | 2010-2015, 2018 | Sodium[3], total coliform[3], and xylenes[3] | - |
| Hiland Water Company | No | - | - | Barium[1], radon[2], and uranium[2] |
| MWC | No | 2003, 2007-2017 | Bromate[4], nickel[5], and total coliform[4] and *E. coli*[4] | High levels of turbidity[6] and total organic carbon[6] (TOC) |

[A]Violation
[1]Barium is a naturally-occurring substance in Shady Cove's source water (Hiland Water Company, 2017).
[2]Radon and uranium in the source water are a result of the erosion of natural deposits and/or mining activities (Hiland Water Company, 2017).
[3]Sodium (2010), total coliform (2011 and 2018) and xylenes (2010-2015) alerts listed in the updated source water assessments (SWA) (DEQ, 2018).
[4]Bromate (2009; at surface water intake) and total coliform and *E. coli* (2007-2017; at Big Butte Springs groundwater well) alerts listed in the updated SWA (DEQ, 2018; OHA, 2020).
[5]Nickel (2003; at Big Butte Springs groundwater well) alert listed under public water system alerts on Oregon Public Health's Drinking Water Data Online platform (OHA, 2020).
[6]Heightened levels of turbidity and organic matter can create issues for drinking water treatment, as well as aquatic life (DEQ, 2020), which will be discussed in a later section.

According to the updated SWA from DEQ for each of the drinking water providers, substances identified within each DWP area will likely continue to be present in the source water due to high soil erosion potential and erodible soils within the 8-hour time of travel (TOT) (the distance that PCS can travel within 8 hours). Appendix D. shows the 8-hour TOT in the vicinity of the project area. Issues with erosion are discussed further in later sections.
Regarding domestic well water, both groundwater quantity and quality is declining within the Rogue Basin. Decreasing groundwater recharge and an

increasing rural population has caused a significant drop in the water table. Paired with the issue of groundwater quantity are pollutants present within the groundwater system, including: bacteria, nitrate, arsenic, salts and minerals, fluoride, and boron (DEQ, 2011). These pollutants pose as a threat to human health, especially the levels of nitrate seen in the Rogue Basin. Nitrate concentrations within several wells in the Rogue Basin amount to 7 milligrams per liter (mg/L); concentrations at or above 11 mg/L begin to limit the recommended water use for those wells (OHA, 2016). Although the Rogue Basin is not yet designated as a Groundwater Management Area (GWMA), if nitrate concentrations continue to trend upwards, DEQ may declare the area as such (DEQ, 2020).

*Pesticides*

Two pesticides of concern and one local problem pesticide were identified in the Middle Rogue Pesticide Stewardship Partnership (MRPSP) 2019 Strategic Plan: Diuron, Imidacloprid, and Oxyfluorfen, respectively (MRPSP, 2019). Both Diuron and Imidacloprid are pesticides of concern throughout Oregon. It has been suggested that these pesticides' widespread surface water contamination is linked to regulatory and labelling issues at the state level, rather than local misuse and application in excess amounts. While these pesticides were found within the Bear Creek Watershed, it can be inferred that these pesticides would likely be detected within the project area. Specifically, these pesticides are likely to be found in the Whetstone Creek area, which is the most similar to the Bear Creek subwatersheds in terms of land use and ownership.

*CAFOs*

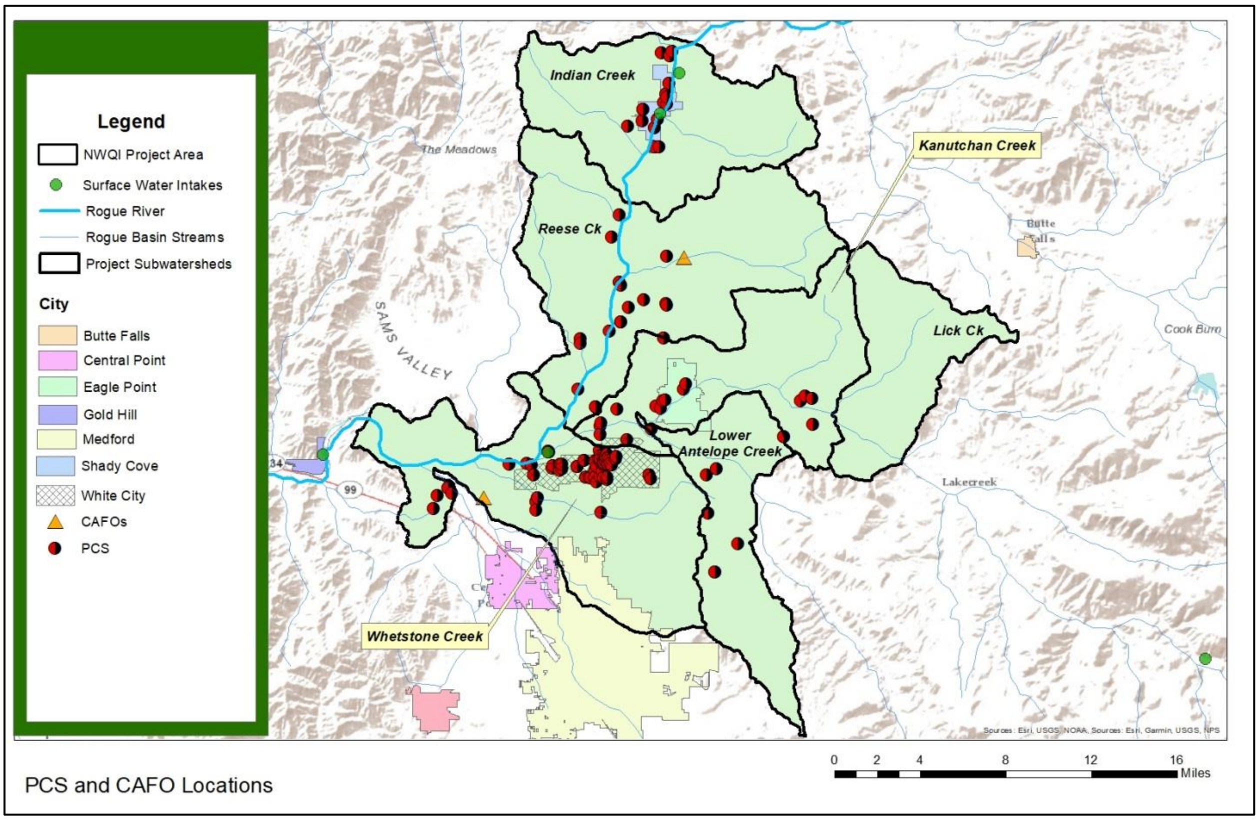
A concentrated animal feeding operation (CAFO) is an agricultural enterprise in which more than 1,000 animal units are confined on site for more than 45 days during the year (NRCS, 2020). Animals, along with their feed, manure and urine, are kept within a small land area. In addition, dead animals, tools, and other materials supporting the CAFOs may also be kept onsite. While CAFOs have the potential to negatively impact both air and water quality, NRCS provides both technical and financial assistance to landowners to help them protect natural resources. As such, two CAFOs are located in the project area, and these operations are designated by the orange triangles in Figure 3.1. The CAFOs do not overlap with any Groundwater Source Areas (GSAs), or areas where groundwater aquifers are utilized for source water, which would present a high risk for the project area and source water.

*High Risk Land Use*

Evaluation of high risk land uses was completed using the PCS rating data provided by DEQ and others. PCS locations were plotted in Figure 3.1. Individual ratings were evaluated (high, moderate, and low rankings), and the highest risk land uses were selected based on data evaluations and discussions with the Rogue Drinking Water Partnership (RDWP) members, including MWC, City of Grants Pass, DEQ, and the Rogue River Watershed Council (RRWC).

Descriptions of PCS codes, activity types, risks to surface water (SW) and groundwater (GW), and potential water quality impacts can be found in Appendix A.

Figure 3.1: PCS and CAFO Locations in the Project Area

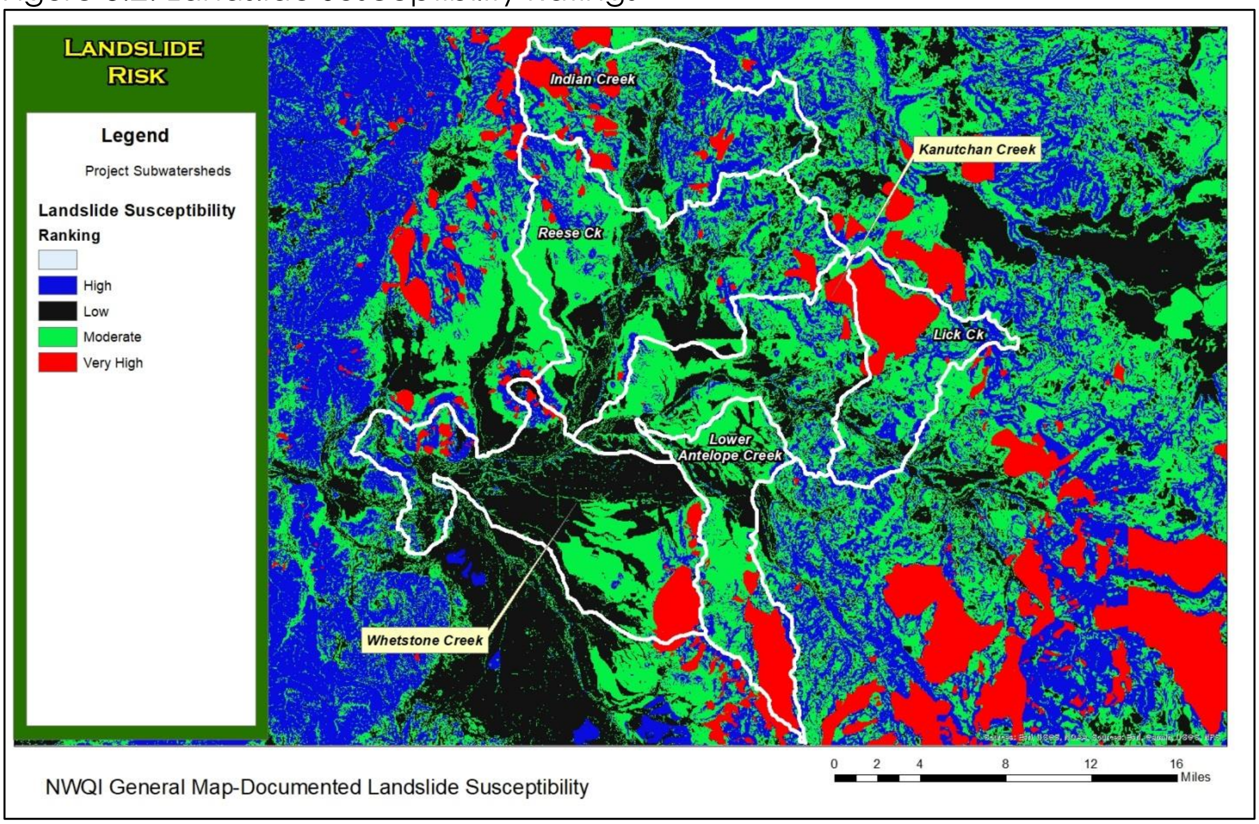



*Erosion, Landslides, and Debris Flows*

The risk of soil erosion and transport to waterbodies increases substantially with both steep slopes and in post-fire environments (DEQ, 2020). Associated with soil erosion is ash and loosened sediments from logging roads, landings on steep slopes, and burned areas, which may include chemicals bonded to these sediments. Monitoring is currently underway to determine specifically which chemicals are of a concern from the fires. Additional information relating to chemicals from fires can be found in the wildfire discussion below. Sediments, and especially those that have bonded with chemicals, pose as major water quality concerns for both drinking water and aquatic life.

Landslides also present a risk in the project area, specifically in portions of the upper area of most subwatersheds. Figure 3.2 shows landslide susceptibility (risk) in the watershed, including very high risk (red areas), high risk (blue), and moderate risk (green) from LIDAR imaging provided by DOGAMI.

Figure 3.2: Landslide Susceptibility Ratings




Four recent landslides have been documented in the project area as shown in Figure 3.3. Two of the landslides occurred in the Indian Creek Basin and two in the Whetstone Creek Basin. In addition, a debris slide occurred in June of 2018 in the upper Little Butte Creek Basin (MWC, 2021), and the impacts of that debris slide can be seen in Figure 3.4 below.

Figure 3.3: Documented Landslides

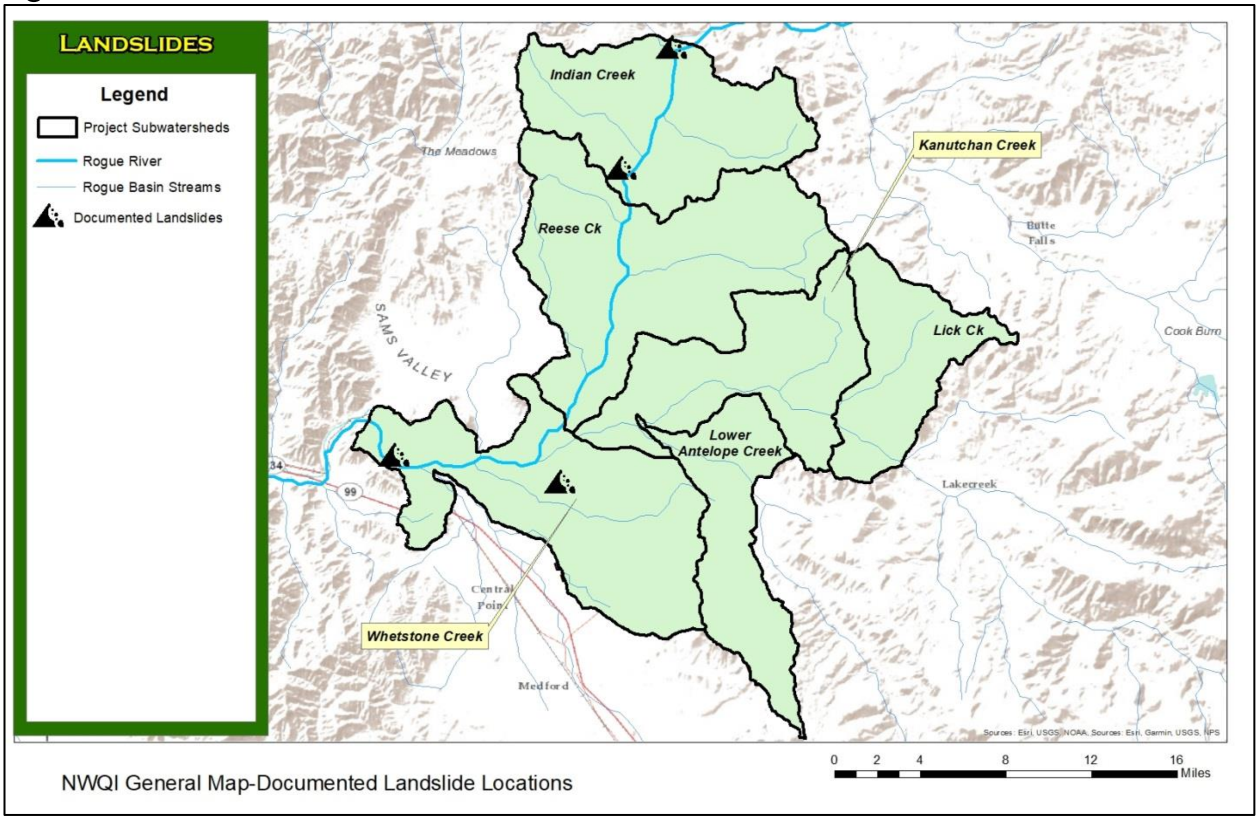



Figure 3.4: Turbidity Plume Entering the Rogue River from Little Butte Creek

Debris flows, which are slurries of rocks, water, logs, and other debris, are often influenced by landslides. Often occurring on steep slopes and drainages after storm events and snowmelt, debris flow hazards are elevated in the absence of vegetation and in the presence of soil disturbance. Debris flows can cause damage to drinking water infrastructure (intakes, treatment plants, storage ponds, and tanks), as well as lead to massive spikes in turbidity and organic matter concentrations in nearby waterbodies. Heightened levels of turbidity and organic matter can create issues for drinking water treatment, such as the creation of disinfection by-products, as well as aquatic life (i.e., smothering of salmonid eggs by sediments) (DEQ, 2020). Fires (discussed in the next section) can increase the risk and occurrences of debris flows.

*Wildfire (South Obenchain Fire)*

On September 8th, 2020 at 1:59 P.M., the South Obenchain Fire started five miles east of Eagle Point. Due to extremely dry and hot conditions, wind gusts, and an abundance of fuel (timber, brush, and logging slash), the wildfire had engulfed 32,671 acres by the end of September, which is an estimated 20% of the project area (seen as the orange area in Figure 3.5(a.) and (b.) below).

Figure 3.5(a.): South Obenchain Fire Location

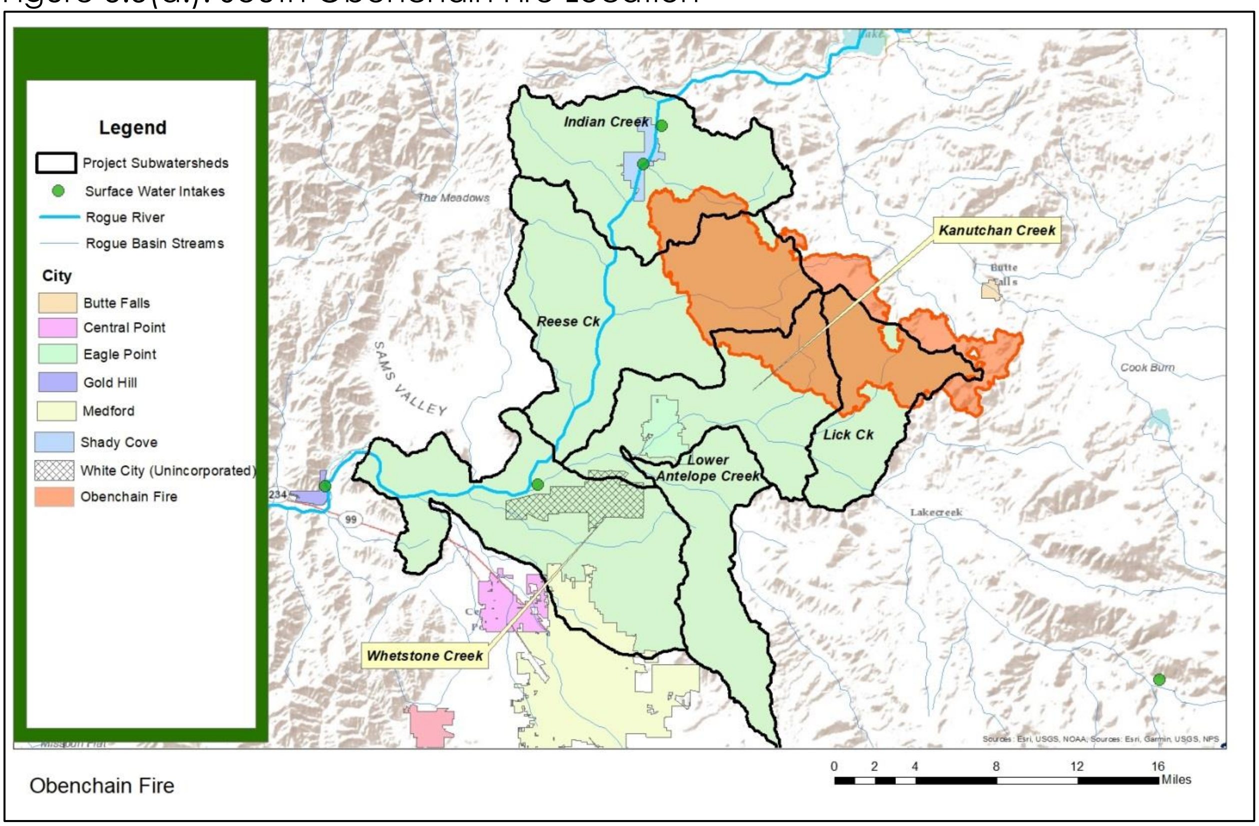
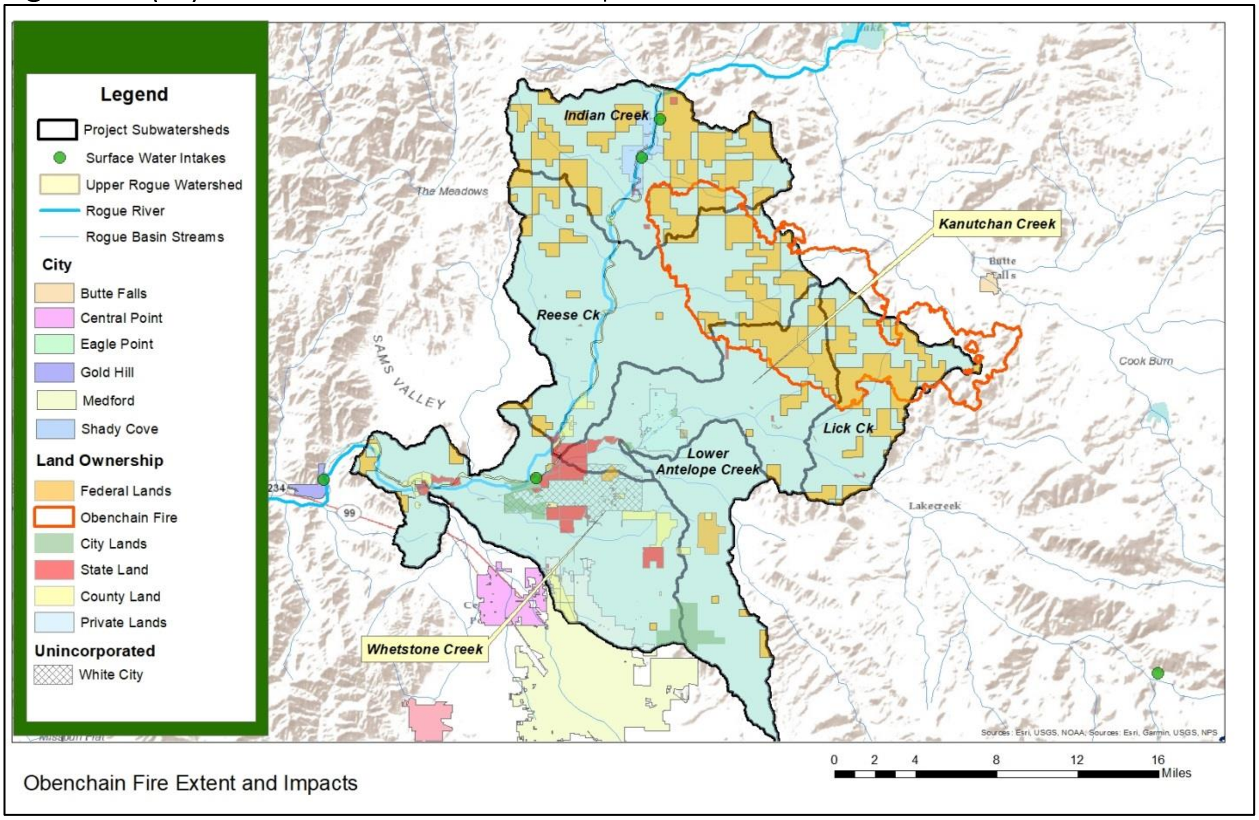


Figure 3.5(b.): South Obenchain Fire Impacts




https://inciweb.nwcg.gov/incident/7185/

Potential water quality concerns related to local wildfires (Almeda and South Obenchain Fires) are elevated levels of aluminum (Al), perfluorinated compounds (PFAS; used for fire suppression), total phosphorus (TP), total organic carbon (TOC), turbidity, and volatile and semi-volatile organic compounds (VOC and SVOC). In the absence of healthy root systems to keep soils in place, these contaminants wash into waterways adjacent to burn areas. It is likely that Al, TP, and TOC are linked to turbidity, in that these materials are bonded and are adhered to soil particles. While natural sources and levels of Al, phosphorus, and TOC exist in soils, current water samples indicate concentrations that have the potential to lead to major losses of macroinvertebrates and fish, as well as harmful algal blooms (DEQ 2020).

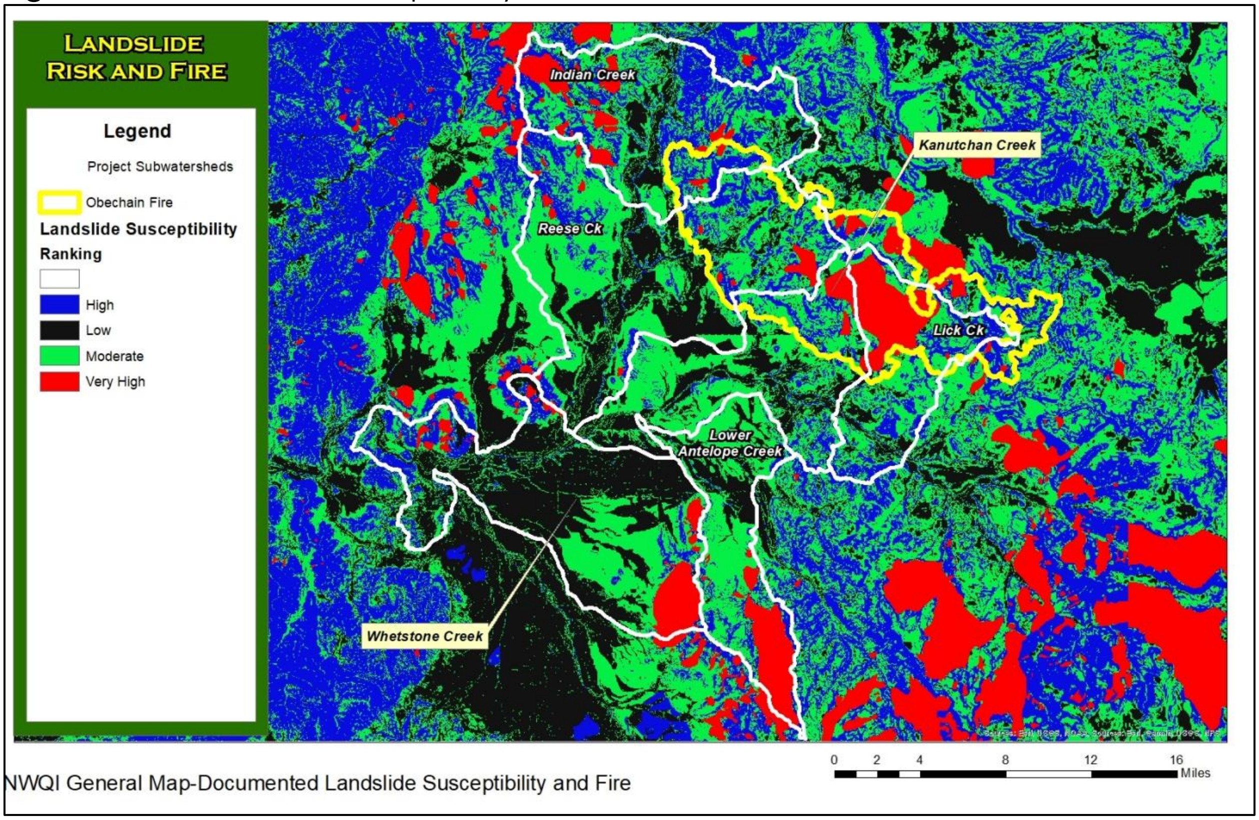
Additional constituents of concern that have been identified following other wildfires, such as the 2015 Butte and Valley Wildfires, the 2017 Tubbs Fire, and the 2018 Camp Fire in Central and Northern California, include: bacteria (*E. coli)*, ammonium and nitrates, metals (antimony, arsenic, cadmium, copper, lead, nickel, mercury, and zinc), pesticides and herbicides, polycyclic aromatic hydrocarbons (PAH; dioxins and furans), asbestos, polychlorinated biphenyls (PCB), and disinfection by-products, which are formed when disinfectants, such as chlorine, that are used during water treatment, react with dissolved organic matter (Geosyntec Consultants, 2015; EOS, 2020). Following Geosyntec's investigation of the harmful contaminants in burn debris and ash from these fires, Geosyntec Consultants concluded that metals concentrations exceeded human health screening levels, as well as the U.S. Environmental Protection Agency's (EPA) soil screening levels for groundwater protection, within both fire footprints.

It is important to note that harmful pollutants can also arise within drinking water distribution networks, rather than the source water itself, following urban fire events. For example, following the Tubbs Fire and the Camp Fire, benzene, a known carcinogen, was found in the distribution network, caused by the burning of plastic pipes and other plastics used in urban areas (EOS, 2020).

*Fire and Landslide Risk*

With the loss of thousands of acres of vegetation, erosion is a major concern within the steep, burned areas where fire damage overlaps with very high risk or high risk areas for landslides. Figure 3.6 shows the overlap of the burned area and landslide risk. Areas in red and blue are of particular concern for further analysis, as these areas represent very high and high landslide susceptible areas, respectively.

Figure 3.6: Landslide Susceptibility and the South Obenchain Fire




## 4.0 ACTIONS TO PROTECT SOURCE WATER

The Rogue Drinking Water Partnership (RDWP) is an informal coalition of municipal and private drinking water providers and other partners seeking to protect and enhance source water quality. The Rogue River provides drinking water for over 200,000 people, recreation for thousands, and habitat for fish and wildlife. In 2017, the RDWP set a trajectory to focus group actions on source water protection. As such, a grant application was submitted and awarded that funded the initial work of the partnership to inventory PCS and evaluate potential threats to water quality. That work resulted in updates to the DEQ source water assessments for the area, identifying high priority areas of concern, developing educational and outreach components, identifying BMPs to protect drinking water, and creating a document including initial elements of an emergency response and contingency plan for providers to refer to. As a result of this work, a Memorandum of Agreement committing to engagement and cooperation between partners was developed by the RDWP.

The RRWC works throughout the Middle and Upper Rogue River areas. Specifically, RRWC has developed and implemented ecological restoration projects that address degraded instream and riparian habitat conditions in the Elk Creek and Little Butte Creek watersheds. This includes treatment of noxious and invasive species, revegetation of streamside riparian buffers with native vegetation, and installation of instream complex habitat structures that encourages floodplain connectivity. Collectively, these actions improve water quality conditions that benefit aquatic species and drinking water providers.

RRWC led the baseline water quality data collection of the Water for Irrigation, Streams, and Economy (WISE) Project. Baseline data is important for identifying and defining changes in water quality that may result from watershed restoration activities. This monitoring effort focused on the WISE Project because its impact on water quality is expected to be substantial. The project monitoring team measured water quality at upstream and downstream locations in both the Bear Creek and Little Butte Creek watersheds. Each monitoring station was co-located with an Oregon Water Resources Division near-real time flow gage. This monitoring effort was designed to track longitudinal and temporal changes in water quality that may result from regional water quality improvement and salmon recovery activities.

Jackson Soil and Water Conservation District (JSWCD) has been working extensively with agricultural landowners in the Little Butte Creek watershed to improve the agricultural impacts on water quality in this area. To this end, JSWCD has worked with landowners to improve or modernize their irrigation systems to eliminate agricultural runoff, develop grazing management plans to improve upland landscape health, and restore riparian areas to combat noxious weeds, re-establish native vegetation, and install fencing to provide healthy stream buffers and restrict the amount of time livestock spend directly in creeks. JSWCD also hosts a series of technical assistance seminars designed for landowners in this watershed to provide resources and information on natural resource management that will help them individually improve water quality.

To address erosion concerns within the fire-affected areas of the South Obenchain Fire, JSWCD distributed dryland pasture and wildlife habitat/erosion control seed mixes to landowners. Laying these seed mixes, especially in previously forested areas and riparian zones, is the first step in combatting future erosion and sediment concerns, as well as protecting water quality.

The MRPSP formed in 2014 to identify potential concerns and improve water quality affected by pesticide use in the Middle Rogue area. The MRPSP brings together partner organizations, agricultural producers, DWPs, local and state agencies, and Oregon State University technical providers to encourage voluntary changes in pesticide use and management practices, while also promoting BMPs in all users of pesticides from licensed applicators to backyard gardeners. In 2019, the MRPSP developed a 5-year strategic plan to guide the partnerships resources to reduce pesticide detections in the area.

## 4.1 Proposed Actions to Protect the Source Water Protection Area

*John Speece wanted to address this section.*

## 5.0 HYDROLOGY AND WATER QUALITY CHARACTERIZATION

This section provides a summary of the hydrology and water quality conditions in the project area based on available data. Information that was not found or does not exist was identified as data gaps. This report will be updated as information becomes available.  While the primary focus of this plan is on agriculture, potential contaminant sources (PCS), and their impacts, other sources of pollution were also evaluated. Overall, this information will help decision makers identify areas needing site-specific BMPs to address a range of water quality concerns.

### 5.1 Hydrogeology of the Source Water Protection Area

The project area (shown in Figure 1.1) encompasses 148,273 acres and includes six USGS 12$^{th}$- field watershed HUC: Lower Antelope, Whetstone, Reese, Lick, Kanutchan, and Indian Creek. Specific information for several of the watersheds (Lower Antelope, Reese, and Indian Creek) is summarized in Table 5.1. Information includes drainage area, stream length, mean elevation, mean annual precipitation, and mean minimum temperature. Additional information on water usage by category and month is shown in Table 5.2.

The Little Butte Creek (LBC) watershed has the most stream length and drains the largest area, followed by Antelope Creek, Reese Creek, and Indian Creek, based on the information in Table 5.1. Overall, the mean elevations for all four watersheds vary between approximately 1,900 and 3,400 feet with LBC having the highest average elevation and areas above 3,000 feet. Mean annual precipitation is also highest in LBC (6-8 inches more) than the other basins, which is consistent with precipitation patterns at higher elevations.

Table 5.2 shows project area water usage by subwatershed. For all of the subwatersheds, storage and irrigation make up over 80% of the overall use. For most of the subwatersheds, the use is heavily split between these two uses with the exception of Reese Creek, which uses 76% for irrigation and only 5% for storage. Overall, storage ranges from 5% to 89%, irrigation from 11% to 76%, domestic from <1% to 15%, and agriculture from 1% to 13%. In addition, LBC is also used for industrial purposes. Information on Water Right Information Search (WRIS) codes and what may be included under each use category can be found under OWRD in the Resource Guide at the end of this document.

Table 5.1: Project Area Watershed Information (Information from the Oregon Water Resources Department downloaded in 2021)

| | Watershed | | | |
|---|---|---|---|---|
| | Indian | Little Butte | Reese | Antelope |
| Station Number | 71033 | 263 | 264 | 248 |
| Latitude of Outlet (°) | 42.6124 | 42.4511 | 42.5321 | 42.459 |
| Longitude of Outlet (°) | -122.815 | -122.875 | -122.834 | -122.832 |
| Latitude of Centroid (°) | 42.603 | 42.379 | 42.547 | 42.36 |
| Longitude of Centroid (°) | -122.759 | -122.555 | -122.759 | -122.708 |
| Drainage Area (square miles) | 12.16 | 378.2 | 22.2 | 75.16 |
| Stream Length (mi) | 9.855 | 406.6 | 36.26 | 96.68 |
| Perimeter (mi) | 15.45 | 113.3 | 21.7 | 47.27 |
| Lakes and Ponds (%) | 0 | 0.183 | 0 | 0 |
| Area/Perimeter (NA) | 0.787 | 3.339 | 1.023 | 1.59 |
| Maximum Relief (ft) | 1795 | 8045 | 2172 | 4445 |
| Mean Slope (°) | 14.23 | 13.14 | 10.83 | 14.18 |
| Average Aspect (°) | 178.6 | 191.5 | 213.8 | 187.8 |
| Mean Elevation(feet) | 2169 | 3398 | 1947 | 2636 |
| Area above 3000 ft (%) | 1.354 | 54.3 | 0.941 | 31 |
| Area above 4000 ft (%) | 0 | 37.7 | 0 | 11.71 |
| Area above 5000 ft (%) | 0 | 14.5 | 0 | 2.223 |
| Area above 6000 ft (%) | 0 | 1.401 | 0 | 0 |
| Mean Annual Precip (in) | 27.5 | 33.65 | 24.15 | 25.16 |
| Mean Annual Min Temp (°F) | 38.59 | 34.16 | 38.57 | 36.44 |
| Mean January Min Temp (°F) | 28.14 | 23.68 | 28.43 | 26.1 |
| Mean February Min Temp (°F) | 31.23 | 26.53 | 31.27 | 29.01 |
| Mean March Min Temp (°F) | 32.87 | 28.33 | 33.01 | 30.72 |
| Mean April Min Temp (°F) | 35.33 | 31 | 35.44 | 33.24 |
| Mean May Min Temp (°F) | 40.88 | 36.55 | 40.68 | 38.72 |
| Mean June Min Temp (°F) | 47.5 | 43 | 47.03 | 45.18 |
| Mean July Min Temp (°F) | 51.15 | 46.73 | 50.48 | 48.85 |
| Mean August Min Temp (°F) | 50.75 | 46.18 | 50.15 | 48.4 |
| Mean September Min Temp (°F) | 44.93 | 40.44 | 44.88 | 42.75 |
| Mean October Min Temp (°F) | 38.23 | 34.13 | 38.64 | 36.34 |
| Mean November Min Temp (°F) | 33.19 | 29.12 | 33.65 | 31.33 |
| Mean December Min Temp (°F) | 28.65 | 24.23 | 29.07 | 26.63 |

Table 5.2: Project Area Water Usage by Watershed (Information from the Oregon Water Resources Department downloaded in 2021) – Storage by month is in acre-feet with the overall breakdown in percentage.

| | Station ID | Month | Storag | Irrigatio | Municipa | Industria | Commerci | Domesti | Agricultu | Other | Total | Download_Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indian Creek | 71033 | JAN | 5.42 | 0 | 0 | 0 | 0 | 0.001 | 0 | 0 | 5.42 | 6/14/2021 |
| | | FEB | 6.23 | 0 | 0 | 0 | 0 | 0.001 | 0 | 0 | 6.23 | 6/14/2021 |
| | | MAR | 4.38 | 0 | 0 | 0 | 0 | 0.001 | 0 | 0 | 4.38 | 6/14/2021 |
| | | APR | 0 | 0.13 | 0 | 0 | 0 | 0.001 | 0 | 0 | 0.131 | 6/14/2021 |
| | | MAY | 0 | 0.29 | 0 | 0 | 0 | 0.001 | 0 | 0 | 0.291 | 6/14/2021 |
| | | JUN | 0 | 0.47 | 0 | 0 | 0 | 0.001 | 0 | 0 | 0.471 | 6/14/2021 |
| | | JUL | 0 | 0.67 | 0 | 0 | 0 | 0.001 | 0 | 0 | 0.671 | 6/14/2021 |
| | | AUG | 0 | 0.54 | 0 | 0 | 0 | 0.001 | 0 | 0 | 0.541 | 6/14/2021 |
| | | SEP | 0 | 0.34 | 0 | 0 | 0 | 0.001 | 0 | 0 | 0.341 | 6/14/2021 |
| | | OCT | 0 | 0.03 | 0 | 0 | 0 | 0.001 | 0 | 0 | 0.031 | 6/14/2021 |
| | | NOV | 0.57 | 0 | 0 | 0 | 0 | 0.001 | 0 | 0 | 0.571 | 6/14/2021 |
| | | DEC | 2.77 | 0 | 0 | 0 | 0 | 0.001 | 0 | 0 | 2.77 | 6/14/2021 |
| | | Totals | 19.37 | 2.47 | 0 | 0 | 0 | 0.012 | 0 | 0 | 21.848 | 6/14/2021 |
| | | % | 88.658 | 11.305 | 0 | 0 | 0 | 0.05492 | 0 | 0 | 100 | 6/14/2021 |
| Little Butte Creek | 263 | JAN | 44.5 | 0.006 | 0.018 | 0.41 | 0 | 0.041 | 0.485 | 0 | 45.4 | 6/14/2021 |
| | | FEB | 55.9 | 0.006 | 0.018 | 0.41 | 0 | 0.041 | 0.485 | 0.016 | 56.9 | 6/14/2021 |
| | | MAR | 59.5 | 0.005 | 0.018 | 0.41 | 0 | 0.041 | 0.485 | 0.016 | 60.4 | 6/14/2021 |
| | | APR | 5.68 | 13 | 0.018 | 0.41 | 0 | 0.041 | 0.485 | 0.016 | 19.7 | 6/14/2021 |
| | | MAY | 0.19 | 30 | 0.018 | 0.41 | 0 | 0.041 | 0.485 | 0.016 | 31.2 | 6/14/2021 |
| | | JUN | 0 | 48.2 | 0.077 | 0.41 | 0 | 0.041 | 0.485 | 0 | 49.3 | 6/14/2021 |
| | | JUL | 0 | 69.2 | 0.077 | 0.41 | 0 | 0.041 | 0.485 | 0 | 70.2 | 6/14/2021 |
| | | AUG | 0 | 56 | 0.077 | 0.41 | 0 | 0.041 | 0.485 | 0 | 57.1 | 6/14/2021 |
| | | SEP | 0 | 34.7 | 0.077 | 0.41 | 0 | 0.041 | 0.485 | 0 | 35.7 | 6/14/2021 |
| | | OCT | 11.4 | 0.01 | 0.018 | 0.41 | 0 | 0.041 | 0.485 | 0 | 12.4 | 6/14/2021 |
| | | NOV | 21.5 | 0.008 | 0.018 | 0.41 | 0 | 0.041 | 0.485 | 0 | 22.4 | 6/14/2021 |
| | | DEC | 37.7 | 0.006 | 0.018 | 0.41 | 0 | 0.041 | 0.485 | 0 | 38.6 | 6/14/2021 |
| | | Totals | 236.37 | 251.14 | 0.452 | 4.92 | 0 | 0.492 | 5.82 | 0.064 | 499.3 | 6/14/2021 |
| | | % | 47.34 | 50.299 | 0.09053 | 0.98538 | 0 | 0.09854 | 1.165632 | 0.0128 | 100 | 6/14/2021 |
| Reese Creek | 264 | JAN | 0.079 | 0 | 0 | 0 | 0 | 0.02 | 0.05 | 0 | 0.149 | 6/14/2021 |
| | | FEB | 0.116 | 0 | 0 | 0 | 0 | 0.02 | 0.05 | 0 | 0.186 | 6/14/2021 |
| | | MAR | 0.031 | 0 | 0 | 0 | 0 | 0.02 | 0.05 | 0 | 0.101 | 6/14/2021 |
| | | APR | 0 | 0.17 | 0 | 0 | 0 | 0.02 | 0.05 | 0 | 0.24 | 6/14/2021 |
| | | MAY | 0 | 0.4 | 0 | 0 | 0 | 0.02 | 0.05 | 0 | 0.47 | 6/14/2021 |
| | | JUN | 0 | 0.65 | 0 | 0 | 0 | 0.02 | 0.05 | 0 | 0.72 | 6/14/2021 |
| | | JUL | 0 | 0.93 | 0 | 0 | 0 | 0.02 | 0.05 | 0 | 1 | 6/14/2021 |
| | | AUG | 0 | 0.75 | 0 | 0 | 0 | 0.02 | 0.05 | 0 | 0.82 | 6/14/2021 |
| | | SEP | 0 | 0.47 | 0 | 0 | 0 | 0.02 | 0.05 | 0 | 0.54 | 6/14/2021 |
| | | OCT | 0 | 0.04 | 0 | 0 | 0 | 0.02 | 0.05 | 0 | 0.11 | 6/14/2021 |
| | | NOV | 0 | 0 | 0 | 0 | 0 | 0.02 | 0.05 | 0 | 0.07 | 6/14/2021 |
| | | DEC | 0 | 0 | 0 | 0 | 0 | 0.02 | 0.05 | 0 | 0.07 | 6/14/2021 |
| | | Totals | 0.226 | 3.41 | 0 | 0 | 0 | 0.24 | 0.6 | 0 | 4.476 | 6/14/2021 |
| | | % | 5.0492 | 76.184 | 0 | 0 | 0 | 5.36193 | 13.40483 | 0 | 100 | 6/14/2021 |
| Antelope Creek (Upper and Lower) | 248 | JAN | 4.85 | 0 | 0 | 0.05 | 0 | 0 | 0.025 | 0 | 4.93 | 6/14/2021 |
| | | FEB | 6.1 | 0 | 0 | 0.05 | 0 | 0 | 0.025 | 0.016 | 6.19 | 6/14/2021 |
| | | MAR | 5.83 | 0 | 0 | 0.05 | 0 | 0 | 0.025 | 0.016 | 5.92 | 6/14/2021 |
| | | APR | 0.019 | 0.55 | 0 | 0.05 | 0 | 0 | 0.025 | 0.016 | 0.66 | 6/14/2021 |
| | | MAY | 0 | 1.27 | 0 | 0.05 | 0 | 0 | 0.025 | 0.016 | 1.36 | 6/14/2021 |
| | | JUN | 0 | 2.04 | 0 | 0.05 | 0 | 0 | 0.025 | 0 | 2.12 | 6/14/2021 |
| | | JUL | 0 | 2.93 | 0 | 0.05 | 0 | 0 | 0.025 | 0 | 3 | 6/14/2021 |
| | | AUG | 0 | 2.37 | 0 | 0.05 | 0 | 0 | 0.025 | 0 | 2.44 | 6/14/2021 |
| | | SEP | 0 | 1.47 | 0 | 0.05 | 0 | 0 | 0.025 | 0 | 1.54 | 6/14/2021 |
| | | OCT | 0.16 | 0 | 0 | 0.05 | 0 | 0 | 0.025 | 0 | 0.235 | 6/14/2021 |
| | | NOV | 0.43 | 0 | 0 | 0.05 | 0 | 0 | 0.025 | 0 | 0.505 | 6/14/2021 |
| | | DEC | 3.01 | 0 | 0 | 0.05 | 0 | 0 | 0.025 | 0 | 3.08 | 6/14/2021 |
| | | Totals | 20.399 | 10.63 | 0 | 0.6 | 0 | 0 | 0.3 | 0.064 | 31.98 | 6/14/2021 |
| | | % | 63.787 | 33.24 | 0 | 1.87617 | 0 | 0 | 0.938086 | 0.2001 | 100 | 6/14/2021 |

*Major and Minor Aquifers Providing Domestic and Public Water Supplies*

Several aquifers in Jackson County provide groundwater within the study area. The USGS reports that, collectively, over 50% of the area's population relies on these aquifers for their drinking water. There are three alluvial aquifer units and several Tertiary and older, granitic and metamorphic rocks which produce water via fractures. Surface water from creeks, rivers, reservoirs, lakes, irrigation, and seepage from irrigation ditches in the valley locally recharge the alluvial aquifers. Additionally, precipitation in the highlands recharges the bedrock aquifers, which may recharge alluvial aquifers via fracture flow (DEQ, 2013; Orzal, 1993).

Other than shallow stream deposits, most formations have little or no primary porosity, so wells depend on secondary porosity, or fractures. Steep slopes hinder the recharge of groundwater and encourage runoff (refer to Figure 2.1 for the topography of the area). However, precipitation stored as snowfall at higher elevations will allow higher infiltration rates. The Tertiary volcanic rocks, the Tertiary sedimentary rocks, and the Paleo-Mesozoic rocks each have low permeability, capable of yielding only small quantities of groundwater. The quantities are generally adequate, however, for domestic or livestock use (DEQ, 2013; Young, 1985). Some of the aquifers accessed by fractures can produce substantial volumes of water, but perhaps not sustainably.

Alluvium provides the most productive aquifer in the area. Where total thickness is generally 30 feet or more, the units generally had a saturated thickness of more than 10-15 feet and would yield 10 to 50 gallons per minute (gpm) (per bailer test results prior to 1971). In a few areas, yields of 100 gpm or more were obtainable (DEQ, 2013; Robison, 1971).

The Tertiary Roxy Formation volcanics are located above the water table in much of the area but are capable of yielding 10 gpm where available. Water is likely to be of good quality. The older, Colestine Formation tuffs and conglomerates are capable of yielding about 20 gpm in many places. Water may be hard or saline in some areas. The Tertiary nonmarine sedimentary formations are capable of yielding 5 to 15 gpm in most areas; however, they can yield water with excessive boron and fluoride and may be too saline in some areas. Wells in the Sams Valley area and in the area near Jacksonville commonly draw from this formation (DEQ, 2013; Robison, 1971).

Of Cretaceous age, the Hornbrook Formation sandstones can yield 5 to 10 gpm in some areas and less than 1 gpm in others. The chemical quality of the water varies. Granodiorite and quartz diorite units of Jurassic or Cretaceous age yield less than 5 gpm generally, yet water is expected to be of good quality (Robison, 1971). Figure 2.2 shows the geology of the project area including individual geologic unit types. In addition, specific lithology related to wells located in (or close to) the project area can be viewed in Figures 5.7 and 5.8.

Additional information on aquifers, yields, and well depths can be found in the next section. Well data was located in historical reports, downloaded from the Oregon Water Resources Department's (OWRD) Groundwater Information system, and provided by OSU Extension based on information from OWRD.

Detailed well analysis was completed from the thousands of wells provide by OSU Extension. In addition, 10 wells were chosen at random for analysis and comparison of data (charts) from the 126 wells located in or near the project area and available online from the Oregon Water Resources Information System accessed online in 2021.

*Aquifer and Well Depths*

Aquifer volumes are presumed to be shrinking based on well depth trends observed over the last few decades (or years) that show water levels in wells to be further from the surface and wells needing to be drilled deeper to find usable water supplies. In reports from DEQ and Dittmer, the average well depth has increased, as drillers need to drill deeper to encounter adequate water yields. In the 1950s and 1960s, the typical well depth was 100 to 200 feet. In the 1990s, some wells extended to 800 or 1,000 feet deep to reach adequate water supplies. Over 13% of wells drilled from August 1991 to July 1992 yielded less than 1 gpm and 4% were dry. Despite the increasing depths and increasing number of dry wells, the number of wells increased in the early 1990s by approximately 2.7% per year (DEQ, 2013; Dittmer, 1994).

Southern Oregon University (then Southern Oregon State College) graduate student Gail Elder conducted a statistical study of 7,500 wells drilled in the Shady Cove area between 1950 and 1995. Elder found that the average depth of wells drilled increased in each decade of her study period, from an average depth of 88.5 feet in the 1950s to an average depth of 229 feet in the 1990s. This corresponded to a consistent increase in depth to first water encountered, from an average of 57 feet in the 1950s to an average of 133 feet in the 1990s. Average water yield of the wells stayed between 18 and 21 gpm. However, yields vary significantly, with many wells yielding barely 1 gpm, to others yielding 100 to 224 gpm. Elder notes that "many people I talked with buy their drinking water." They say, "Our water used to taste better than it does now" (DEQ, 2013; Elder, 1995). Shady Cove is the only municipality in the study area that does not have its own public water supply and is supplied primarily by a private water company or small community systems. The City of Rogue River utilizes groundwater for a portion of its public water supply (2019 Consumer Confidence Report). Butte Falls also utilizes groundwater (from Ginger Springs) for its water supply. Table 5.3 has well depth information from three of the local water providers.

*Current/Recent Well Data and General Trends*

Analyzing well data provided by OSU Extension shows a similar trend with well depths increasing to the greatest depths since 1990. In addition, completed wells depths (averages) increased from under 100 feet (82 feet) from 1940-1960 to 217.8 feet from 2001-2021. Average yields decreased by approximately 27% over this time period as well (Table 5.3

Table 5.3: Summary of Well Information (1940-2021)

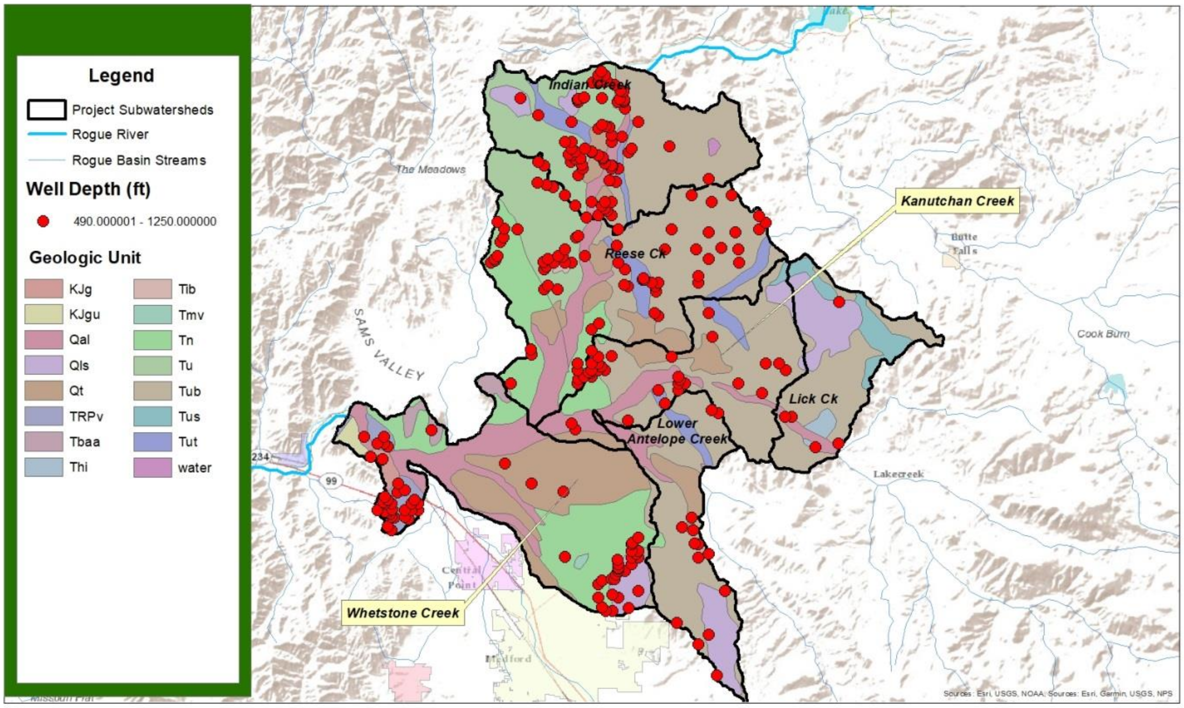
| Data Range | Number of Wells | Maximum Depth (ft) | Minimum Depth (ft) | Range (ft) | Mean (ft) | Median (ft) | Average yield (gpm) |
|---|---|---|---|---|---|---|---|
| 1940-1960 | 241 | 503 | 12 | 491 | 82 | 69 | 22 |
| *1961-1980* | 2533 | 757 | 12 | 745 | 153.1 | 123 | 20 |
| *1980-2000* | 2655 | ***1250**** | 0 | 1250 | 202 | 180 | 17 |
| *2001-2021* | 1516 | 1160 | 2 | 1158 | ***217.8*** | ***181*** | **16**** |
| *Community Systems (1975-2020)* | 27 | 900 | 100 | 800 | 331.1 | 260 | 30 |

* 97% of the wells (59/61) that are greater than 600 feet were drilled after 1990.
**Highlighted value is the lowest average yield.

Figure 5.1 shows wells over 490 feet deep by subwatershed and geologic unit type. Correlation between well depths and geologic units or aquifers is currently a data gap.

Figure 5.2 shows higher well yields (above 25 gallons per minute) by subwatershed and geologic unit. Correlation between yields and geology is currently a data gap.

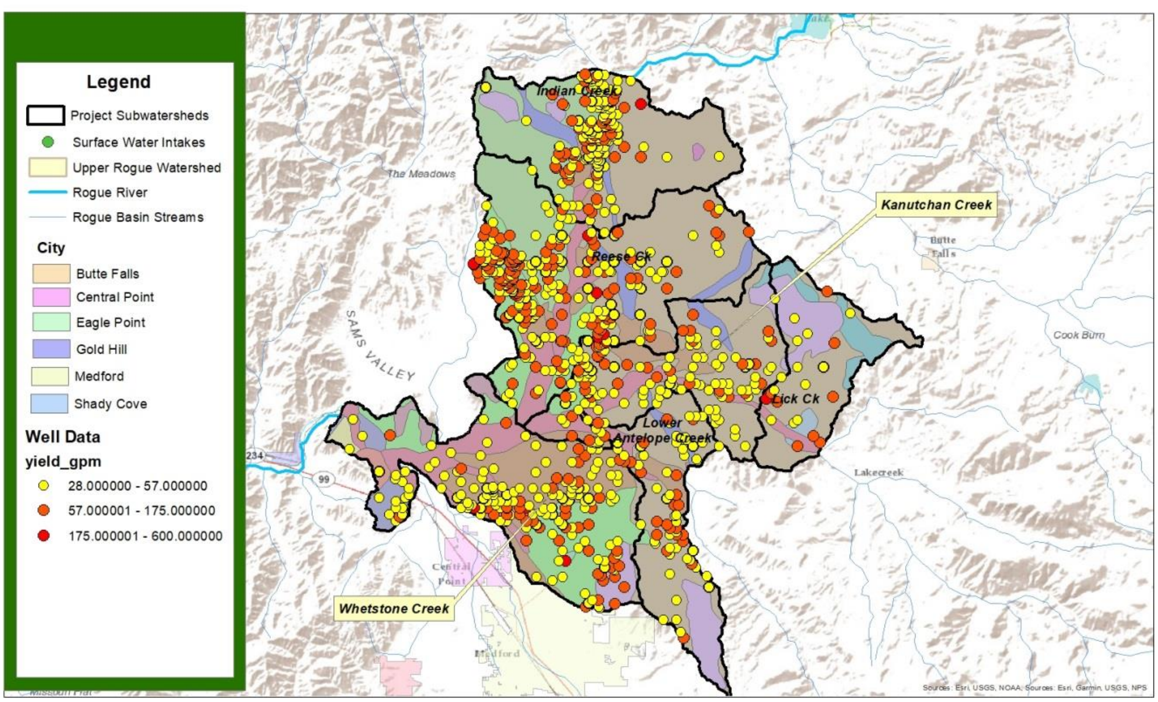
Figure 5.1: Wells Over 490 Feet Deep




NWQI Completed Well Depths greater than 490 feet

0 2 4 8 12 16 Miles

Figure 5.2: Higher Well Yields (greater than 25 gpm)




NWQI Well Yield Data (higher yields)

0 2 4 8 12 16 Miles

Current well depths provided by information extracted from the OWRD's Groundwater Information System show that wells drilled in 2017 and 2019 (yellow) were over 350 feet deep as compared to 4 wells drilled prior to 1981 (orange)at less than 165 feet. Additional data analysis (beyond the 10 wells) should look at comparing wells from representative aquifer types and dates if the information is available (Table 5.4).

Table 5.4: Well Data

| Aquifer | Well Name | Completed Date | Yields (gpm) | Use | Max Depth (feet) |
|---|---|---|---|---|---|
| Pacific Northwest basin-fill aquifers (Regional USGS) | Jack 7146 | 7/13/1953 | NA | NA | 110 |
| NA | Jack 728 | 9/27/1989 | 50 | Domestic | 123 |
| Middle-Early Tertiary Volcanic and Volcanistic Rock Aquifer | Jack 2932 | 8/27/1968 | 100 | Domestic | 134 |
| Tertiary Marine Volcanic & Sedimentary Rock | Jack 3425 | 7/3/1981 | 45 | Domestic | 160 |
| Little Butte Formation | Jack 2909 | 6/30/1977 | 70 | Industrial | 165 |
| Little Butte Formation | Jack 30014 | 3/28/1990 | 6 | Domestic | 202 |
| Pacific Northwest basin-fill aquifers (Regional USGS) | Jack 468 | 9/15/1988 | 2 | Domestic | 292 |
| Western Cascade Volcanics | Jack 30158 | 6/11/1990 | 250 | Domestic | 301 |
| Western Cascade Volcanics | Jack 62926 | 1/20/2017 | 200 | Irrigation | 360 |
| Payne Cliffs Formation | Jack 63735 | 2/21/2019 | NA | Domestic | 408 |

In the summer of 2021, the Watermaster is receiving multiple reports of wells going dry. An inventory is underway to compile reports of the wells including locations of where the dry wells are. As information becomes available it will be included in the data analysis for this project.

*Well Depth Variation over time*

Figures 5.4- 5.7 and their associated tables show how water levels and conditions have changed over time from the 10 representative wells selected from the Oregon Water Resources Department's (OWRD) Groundwater Information system. Wells were selected based on available information, aquifer, and completion date based on information in the OWRD Groundwater Information Mapping Tool (Figure 5. ). Selected details on the wells including locations, depths, yields, and aquifers (if known) is shown in Table 5.5.

Figure 5.3: OWRD Groundwater Information System Mapping Tool

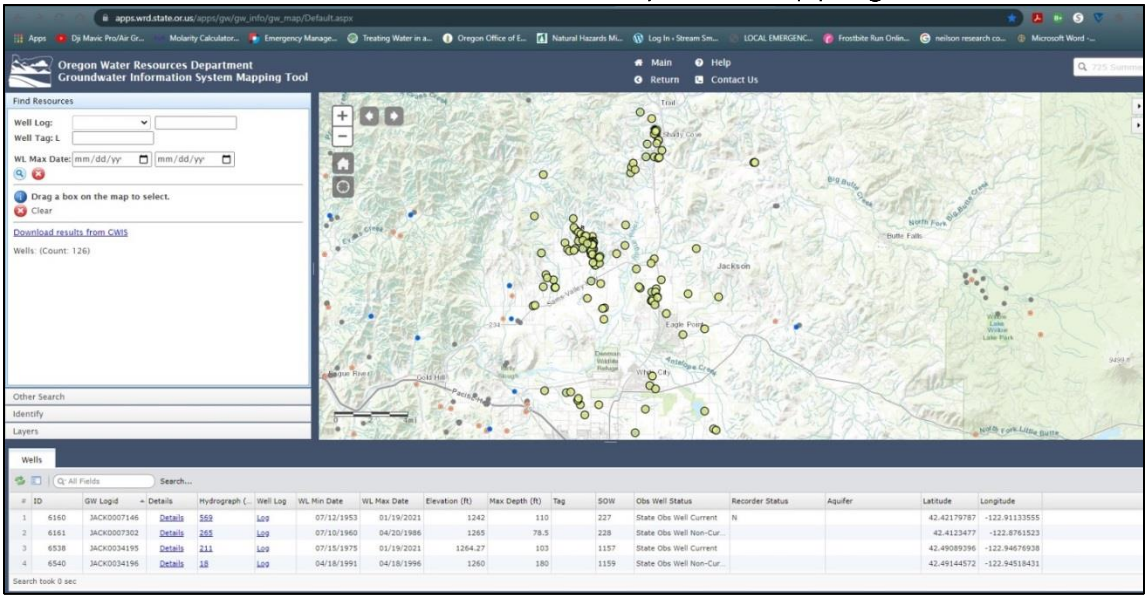



Table 5.5: Project Area Wells Selected for Analysis

| Aquifer | Well Name | Completed Date | Yields (gpm) | Use | Max Depth (feet) | Latitude | Longitude |
|---|---|---|---|---|---|---|---|
| Pacific Northwest basin-fill aquifers (Regional USGS) | Jack 7146 | 7/13/1953 | NA | NA | 110 | 42.42179787 | -122.9113356 |
| Middle-Early Tertiary Volcanic and Volcanistic Rock Aquifer | Jack 2932 | 8/27/1968 | 100 | Domestic | 134 | 42.50206338 | -122.8190296 |
| Little Butte Formation | Jack 2909 | 6/30/1977 | 70 | Industrial | 165 | 42.496323 | -122.818236 |
| Tertiary Marine Volcanic & Sedimentary Rock | Jack 3425 | 7/3/1981 | 45 | Domestic | 160 | 42.50206338 | -122.8190296 |
| Pacific Northwest basin-fill aquifers (Regional USGS) | Jack 468 | 9/15/1988 | 2 | Domestic | 292 | 42.61988282 | -122.8139703 |
| NA | Jack 728 | 9/27/1989 | 50 | Domestic | 123 | 42.60898 | -122.8257121 |
| Little Butte Formation | Jack 30014 | 3/28/1990 | 6 | Domestic | 202 | 42.390059 | -122.836819 |
| Western Cascade Volcanics | Jack 30158 | 6/11/1990 | 250 | Domestic | 301 | 42.497421 | -122.813367 |
| Western Cascade Volcanics | Jack 62926 | 1/20/2017 | 200 | Irrigation | 360 | 42.501956 | -122.814974 |
| Payne Cliffs Formation | Jack 63735 | 2/21/2019 | NA | Domestic | 408 | 42.54959255 | -122.8985184 |

The water levels measured in Figures 5.4 and 5.5 illustrate how water levels are getting further away from the surface over time (at least over the last few years as observed on the figure). The accompanying tables provide more detailed information to help interpret the chart.

Figure 5.4: Well JACK 728

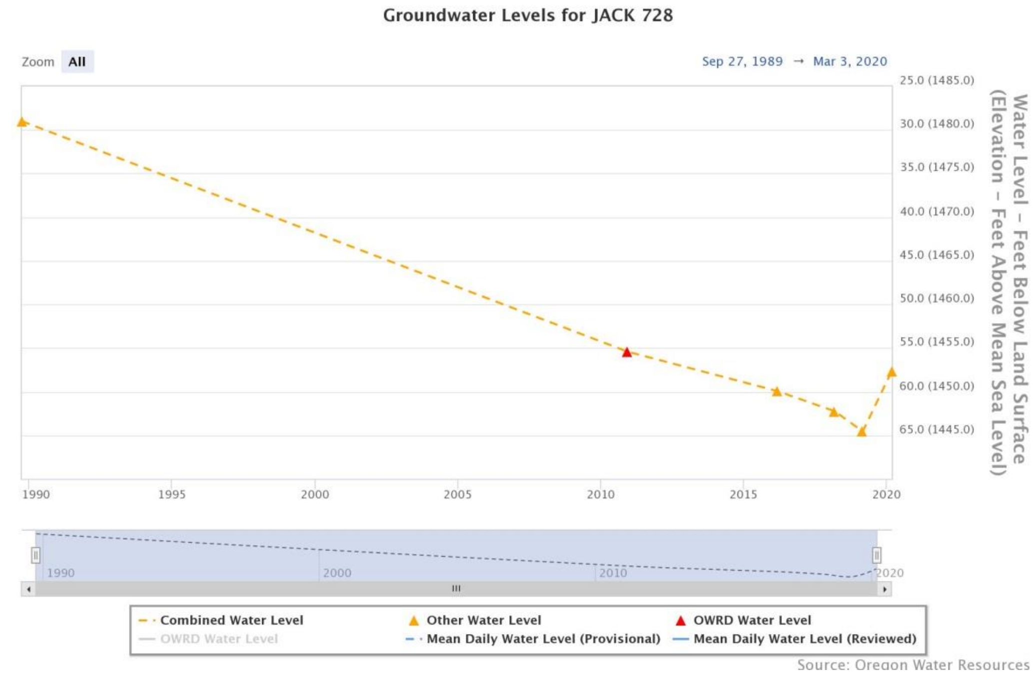
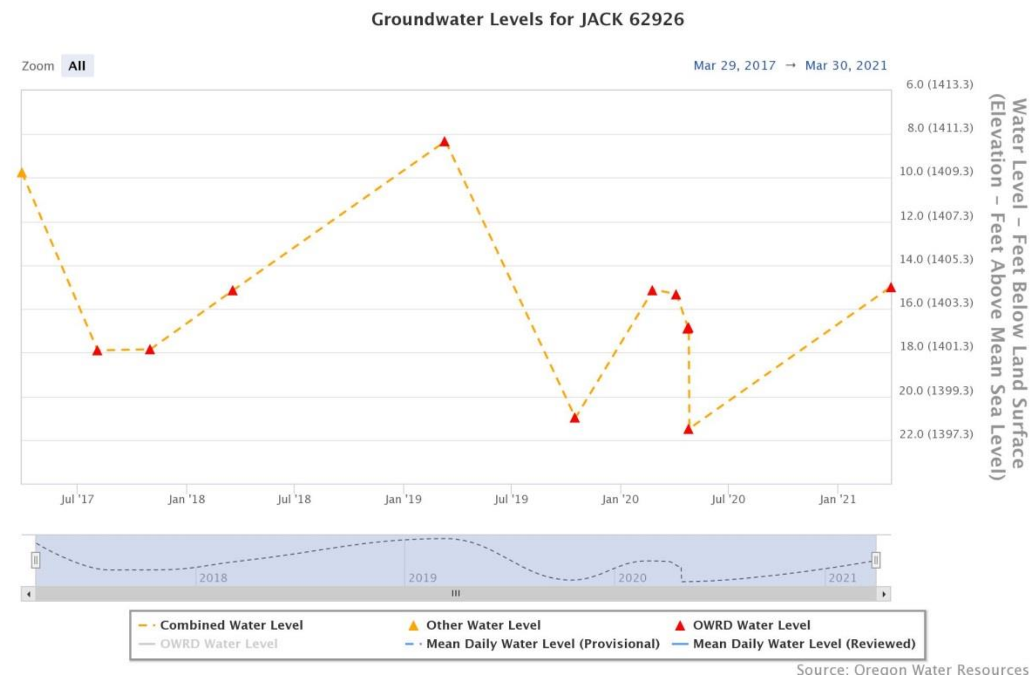



Table 5.6: Water Levels Below the Surface in Feet

| ID | Well | Date | Water Level (BLS) in feet |
|---|---|---|---|
| 1 | JACK0000728 | 3/3/2020 | 57.63 |
| 2 | JACK0000728 | 2/25/2019 | 64.56 |
| 3 | JACK0000728 | 3/5/2018 | 62.25 |
| 4 | JACK0000728 | 3/2/2016 | 59.94 |
| 5 | JACK0000728 | 12/9/2010 | 55.43 |
| 6 | JACK0000728 | 9/27/1989 | 29 |

## Figure 5.5: Well JACK 62926




## Table 5.7: Details for Well JACK 62926

Water Level | Daily Water Level | Lithology | Construction

**Measured Water Levels for JACK 62926**

| Water Level Elev. (FT AMSL) | | Well | Date | Time | Water Level (BLS) | Organization | OWRD | Method | Status | Meas. Point Ht. | Reviewed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1,404.27 | 2 | JACK0062926 | 03/30/2021 | 15:17:00 | 14.99 | OWRD | GWTR | ETAPE | STATIC | 2 | |
| 1,394.11 | 3 | JACK0062926 | 10/20/2020 | 10:44:00 | 25.15 | OWRD | GWTR | ETAPE CALIBRATED | STATIC | 2 | |
| | 4 | JACK0062926 | 07/31/2020 | 16:56:00 | | OWRD | MEDF | NOT MEASURED | PUMPING | | |
| 1,397.78 | 5 | JACK0062926 | 04/25/2020 | 08:26:00 | 21.48 | OWRD | GWTR | ETAPE CALIBRATED | STATIC | 2 | |
| 1,395.12 | 6 | JACK0062926 | 04/24/2020 | 18:01:00 | 24.14 | OWRD | GWTR | ETAPE CALIBRATED | RISING | 2 | |
| 1,395.00 | 7 | JACK0062926 | 04/24/2020 | 17:29:00 | 24.26 | OWRD | GWTR | ETAPE CALIBRATED | RISING | 2 | |
| 1,394.95 | 8 | JACK0062926 | 04/24/2020 | 17:13:00 | 24.31 | OWRD | GWTR | ETAPE CALIBRATED | RISING | 2 | |
| 1,395.98 | 9 | JACK0062926 | 04/24/2020 | 14:40:00 | 23.28 | OWRD | MEDF | ETAPE CALIBRATED | FALLING | 2 | |
| 1,397.78 | 10 | JACK0062926 | 04/24/2020 | 12:38:00 | 21.48 | OWRD | MEDF | ETAPE CALIBRATED | FALLING | 2 | |
| 1,398.83 | 11 | JACK0062926 | 04/24/2020 | 11:38:00 | 20.43 | OWRD | GWTR | ETAPE CALIBRATED | FALLING | 2 | |
| 1,399.83 | 12 | JACK0062926 | 04/24/2020 | 10:38:00 | 19.43 | OWRD | MEDF | ETAPE CALIBRATED | FALLING | 2 | |
| 1,399.94 | 13 | JACK0062926 | 04/24/2020 | 10:33:00 | 19.32 | OWRD | MEDF | ETAPE CALIBRATED | FALLING | 2 | |
| 1,402.41 | 14 | JACK0062926 | 04/24/2020 | 07:46:00 | 16.85 | OWRD | GWTR | TRANSDUCER | STATIC | 2 | |
| 1,402.43 | 15 | JACK0062926 | 04/24/2020 | 06:10:00 | 16.83 | OWRD | GWTR | ETAPE CALIBRATED | STATIC | 2 | |
| 1,402.37 | 16 | JACK0062926 | 04/23/2020 | 15:23:00 | 16.89 | OWRD | GWTR | ETAPE CALIBRATED | STATIC | 2 | |
| 1,403.94 | 17 | JACK0062926 | 04/03/2020 | 13:26:00 | 15.32 | OWRD | OST | ETAPE | STATIC | 2 | |
| 1,404.14 | 18 | JACK0062926 | 02/24/2020 | 12:32:00 | 15.12 | OWRD | OST | ETAPE | STATIC | 2 | |
| 1,398.27 | 19 | JACK0062926 | 10/16/2019 | 15:04:00 | 20.99 | OWRD | OST | ETAPE | STATIC | 2 | |
| 1,410.94 | 20 | JACK0062926 | 03/12/2019 | | 8.32 | OWRD | PCPR | ETAPE | STATIC | 2 | |
| 1,404.11 | 21 | JACK0062926 | 03/19/2018 | 11:45:00 | 15.15 | OWRD | OST | ETAPE | STATIC | 2 | |
| 1,401.41 | 22 | JACK0062926 | 10/31/2017 | 11:00:00 | 17.85 | OWRD | OST | ETAPE | STATIC | 2 | |
| 1,401.36 | 23 | JACK0062926 | 08/03/2017 | 12:17:00 | 17.9 | OWRD | OST | ETAPE | STATIC | 2 | |
| 1,409.51 | 24 | JACK0062926 | 03/29/2017 | | 9.75 | PMPI | PCPR | ETAPE | STATIC | 1.5 | |

Figure 5.6 show water levels fluctuating seasonally. Water levels are closer to the surface in the winter months (Jan-Apr/May) and get further away in the summer (Jun-Sept).

Figure 5.6: Well JACK 63735

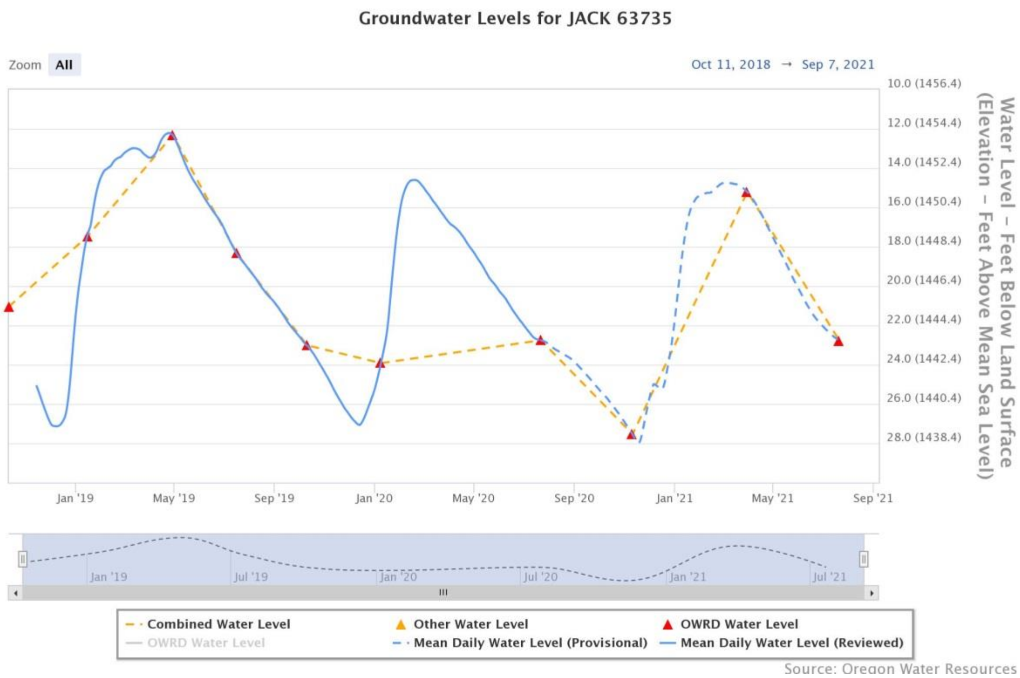



Table 5.8: Additional Details for JACK 63735

| ID | Well | Date | Water Level (BLS) in feet |
|---|---|---|---|
| 1 | JACK0063735 | 7/20/2021 | 22.77 |
| 2 | JACK0063735 | 3/30/2021 | 15.21 |
| 3 | JACK0063735 | 11/10/2020 | 27.54 |
| 4 | JACK0063735 | 7/21/2020 | 22.76 |
| 5 | JACK0063735 | 1/8/2020 | 23.92 |
| 6 | JACK0063735 | 10/10/2019 | 23.02 |
| 7 | JACK0063735 | 7/16/2019 | 18.33 |
| 8 | JACK0063735 | 4/29/2019 | 12.31 |
| 9 | JACK0063735 | 1/15/2019 | 17.47 |
| 10 | JACK0063735 | 10/11/2018 | 21.05 |

Figures 5.7 and 5.8 show fluctuations over the last 10 years and the last 68 years respectively. Over the last 5 years or so, well 7146 appears to be impacted by drought and is showing a slight downward trend. Detailed information for all values charted well 7146 including the chart value detail is available from OWRD

and is too large to include in the report. Table 5 reflects the data for the area circled from 2012 to January 2021.

Figure 5.7: Well JACK 468

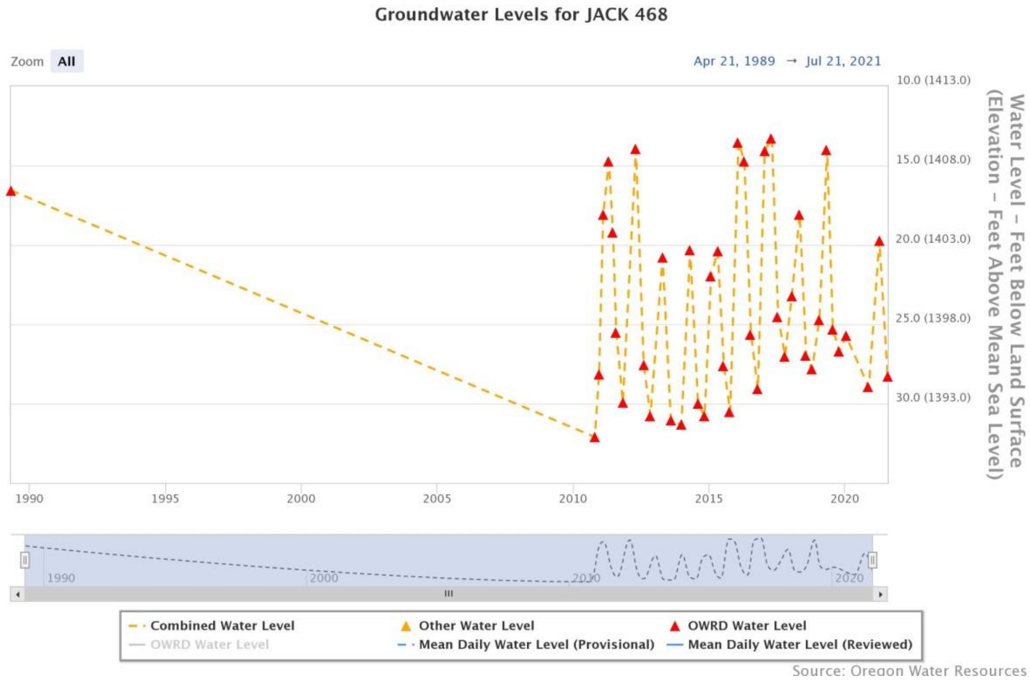



Figure 5.8: Well JACK 7146

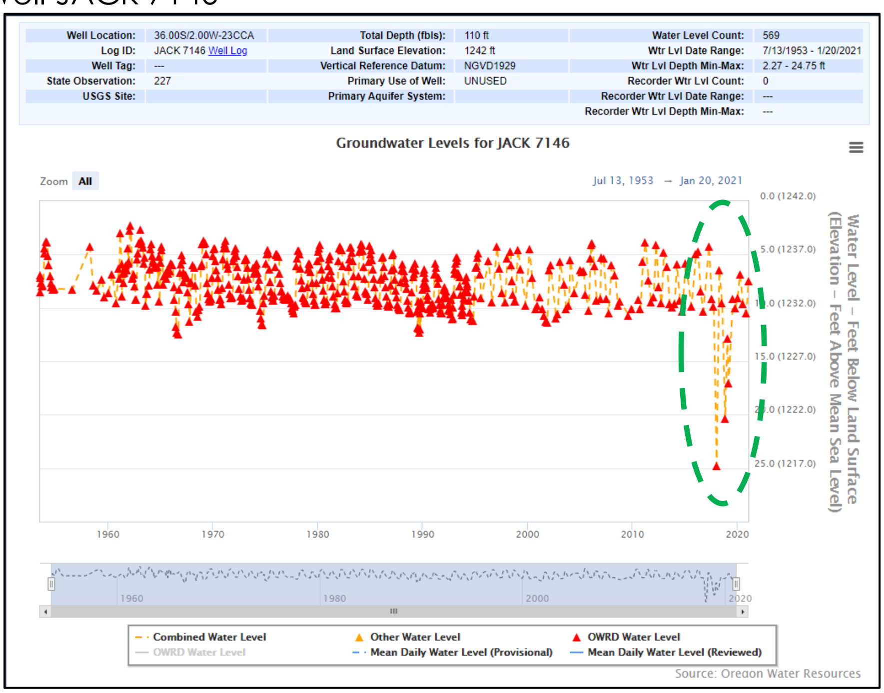
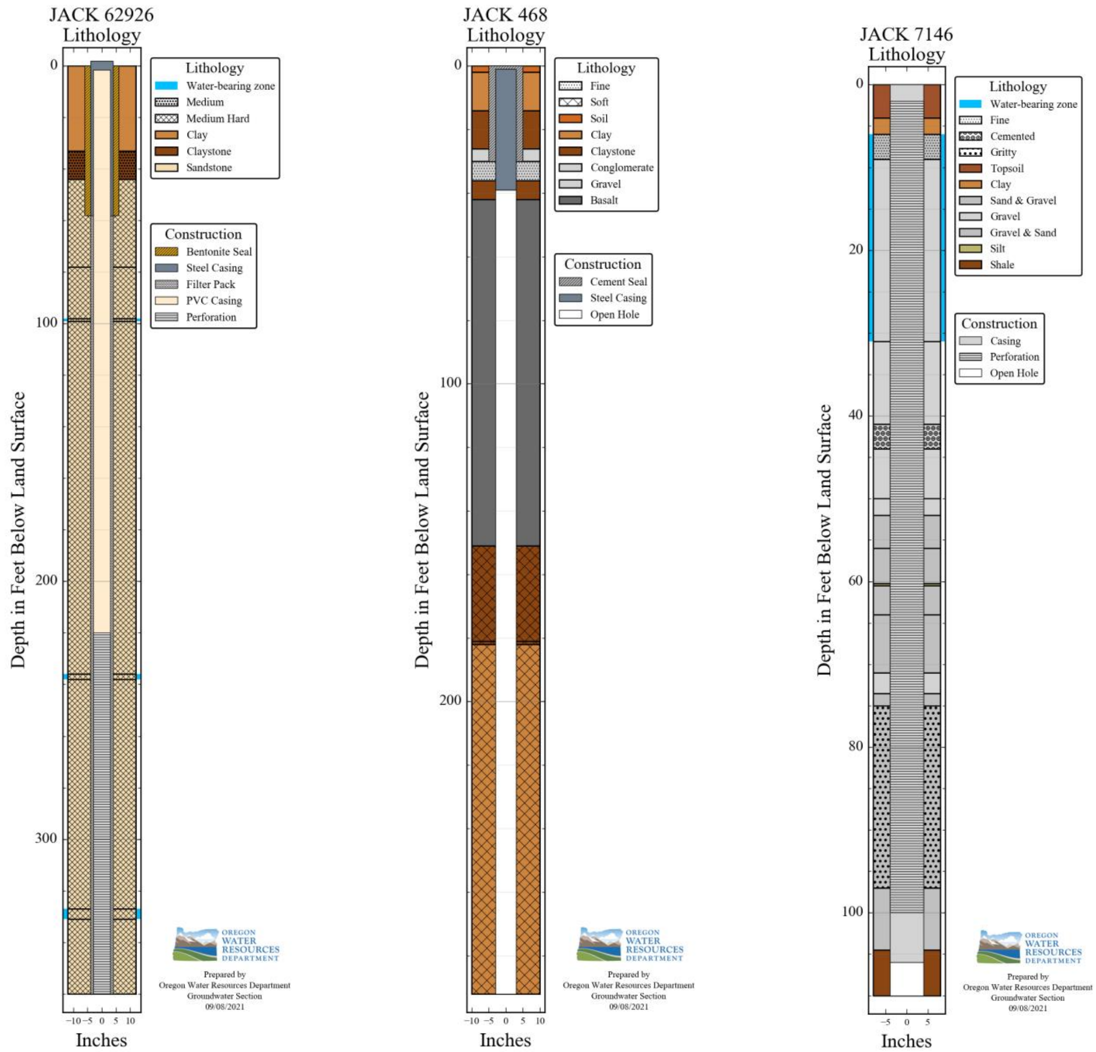


Table 5.9: Well Depths by Date Excerpt (2012-2021)

| ID | Well | Date | Water Level (BLS) in feet |
|---|---|---|---|
| 1 | JACK0007146 | 1/20/2021 | 7.52 |
| 2 | JACK0007146 | 11/11/2020 | 10.48 |
| 3 | JACK0007146 | 7/21/2020 | 9.64 |
| 4 | JACK0007146 | 4/3/2020 | 6.88 |
| 5 | JACK0007146 | 1/8/2020 | 9.08 |
| 6 | JACK0007146 | 10/28/2019 | 10 |
| 7 | JACK0007146 | 7/29/2019 | 9.18 |
| 8 | JACK0007146 | 3/6/2019 | 17.04 |
| 9 | JACK0007146 | 1/18/2019 | 12.83 |
| 10 | JACK0007146 | 11/1/2018 | 20.4 |
| 11 | JACK0007146 | 7/24/2018 | 9.57 |
| 12 | JACK0007146 | 4/12/2018 | 6.44 |
| 13 | JACK0007146 | 1/10/2018 | 24.75 |
| 14 | JACK0007146 | 10/5/2017 | 9.9 |
| 15 | JACK0007146 | 7/31/2017 | 9.15 |
| 16 | JACK0007146 | 4/18/2017 | 4.25 |
| 17 | JACK0007146 | 10/4/2016 | 10.34 |
| 18 | JACK0007146 | 7/1/2016 | 8.45 |
| 19 | JACK0007146 | 4/8/2016 | 4.7 |
| 20 | JACK0007146 | 1/27/2016 | 4.95 |
| 21 | JACK0007146 | 8/19/2015 | 9.84 |
| 22 | JACK0007146 | 1/29/2015 | 5.82 |
| 23 | JACK0007146 | 10/1/2014 | 10.38 |
| 24 | JACK0007146 | 7/16/2014 | 9.35 |
| 25 | JACK0007146 | 4/1/2014 | 5.94 |
| 26 | JACK0007146 | 1/6/2014 | 9.64 |
| 27 | JACK0007146 | 10/2/2013 | 9.98 |
| 28 | JACK0007146 | 7/23/2013 | 9.6 |
| 29 | JACK0007146 | 4/25/2013 | 6.19 |
| 30 | JACK0007146 | 1/3/2013 | 4.85 |
| 31 | JACK0007146 | 10/8/2012 | 9.59 |
| 32 | JACK0007146 | 7/12/2012 | 8.03 |
| 33 | JACK0007146 | 4/4/2012 | 4.1 |
| 34 | JACK0007146 | 1/9/2012 | 8.98 |

Figure 5.9 shows a cross section of the lithology of the wells drilled. Information is from the OWRD Groundwater Information System Mapping Tool.

Figure 5.9: General Lithology of Study Wells




*Potentiometric Levels and Flow Directions*

No information has been located to date. This section is currently identified as a data gap needing more information.

*Water Supply*

A *Jackson County Water Resources Study* was completed in November 2001 to evaluate the adequacy of available water supplies through 2050. This report found that groundwater is generally being used faster than it is being recharged in numerous locations. For example, it was estimated that the population in the Eagle Point through Ashland area in 2001 was approximately 176,000 and approximately 1/3 of that population (60,000) relied on groundwater for their water supply, suggesting a groundwater usage of about 10,000 acre-feet per year (AF/Y). This is an increase from approximately 50,000 people dependent on groundwater in 1992, and an estimated use of 8,400 AF/Y. At the time of the report, the Medford Water Commission was selling over 4.8 million gallons (14.73 AF) of water per year through vending machines (Ryan and Dittmer, November 2001).

The report concludes that rural homeowners are facing groundwater shortages and deteriorating water quality. Limitations in groundwater quantity and/or quality may influence the decisions of newcomers to Jackson County, as to whether to live in cities where the water supply is more reliable or choose to live on property served by a well. It is also likely that residents dependent on marginal well yields or wells with poor water quality will seek alternate sources (Ryan and Dittmer, November 2001).

Over the last 20 years, the region is beginning to see changes in climatic conditions that impact water supply and water quality. A detailed discussion of climate change on water supply and water quality can be found in Section 6.5.

*Surface and Groundwater Withdrawals*

Within the Rogue Basin, there are 22 public water systems using surface water, and 251 public water systems relying wholly or partially on groundwater (wells and springs). Within the project area, there are four larger public water suppliers (PWS). Information on these PWS can be viewed in Table 1.2. MWC and CVMHE utilize both surface and groundwater sources to supply their customers with drinking water. The other two PWS use surface water and have emergency back-up sources. It should be noted that MWC's groundwater sources are springs rather than wells. Groundwater withdrawal information from wells based on yields for three of the PWS is detailed in Table 5.10.

Table 5.10: PWS Well Information

| PWS | Well Log | Completed Depth (ft) | Static Water Level (ft) | Yield (GPM) | Completed Date | Received Date | Startcard |
|---|---|---|---|---|---|---|---|
| Anglers Cove/SCHWC | JACK 54751 | 240.0 | 125.0 | 5.0 | 07/26/2001 | 8/7/2001 | 138587 |
| CVMHE | JACK 293 | 200.0 | 85.0 | 30.0 | 07/13/1973 | 7/27/1973 | - |
| CVMHE | JACK 372 | 380.0 | 96.0 | 100.0 | 06/22/1986 | 7/16/1986 | - |
| Hiland Water Company | JACK 32812 | 160.0 | 35.0 | 100.0 | 10/06/1993 | 10/25/1993 | 55264 |

*Well Water Quality and Well Testing*

For the nearly 63,000 residents that live in unincorporated areas within Jackson County and rely on groundwater for drinking water, it is incredibly important that they get their wells tested to ensure that the quality of the groundwater is safe for consumption. The Oregon Health Authority's Domestic Well Testing Act and Real Estate Transaction (RET) requires that, prior to the sale of a property, the seller must test the well's water quality, for a number of parameters including (EPA Top 35) arsenic, nitrate, and total coliform bacteria, and share those results with potential buyers. For more information on this process, see the Resource Guide towards the end of this document.

Well water quality data was downloaded as part of the Ambient Water Quality Monitoring System (AWQMS) dataset, provided from a few studies referenced in the report, and nitrate and arsenic data was provided in the well data provided by OSU Extension. An in-depth discussion of groundwater and well chemistry occurs later in this document following Tables 5.7 (a.) and 5.7 (b.).

*Additional Water Quality Data/Source Water Data including surface water*

There are a number of river and stream monitoring stations that are sampled regularly in the watershed by DEQ and MWC.

*Water Rights and the Influence on Supplies*

Most basins in the project area are closed to new water rights outside of storage from Lost Creek Lake. As a result, this creates an increasing demand on groundwater supplies or alternative water supplies (e.g., trucking in water).

*Recharge and Discharge Areas/Surface Water-Groundwater Interconnections*

No information was found regarding recharge/discharge areas. This is identified as a data gap for the report.

*Runoff and Stream Flow Generation Processes*

Water budget analysis, including runoff and stream flow generating processes, is currently a data gap in the project. In discussions with the OWRD (via Zoom call, June 14th, 2021), lack of funding has prevented the OWRD from collecting and analyzing this data. In addition, detailed aquifer data does not exist. However, general runoff and stream flow patterns in the project area can be evaluated by examining data from the Raygold and Dodge Bridge stations on the Rogue River (see Figures 5.9 and 5.10). A data gap currently exists for a detailed analysis of the impact (before and after) of Lost Creek Lake Dam and Reservoir completed in 1977 on runoff and stream flow patterns. Based on the information shown in the figures, the dam has impacted both runoff and streamflow.

Runoff is shown declining based on the ONI versus Runoff Trendline (blue line) shown in Figure 5.10, and is lowest during the El Niño years. Historical runoff is also below average during neutral years, as most records in that range fall below the average (green line). In addition, for the data pre-dam completion (1971-76) all of the years with the exception of 1973 are at the higher end of the historical runoff curve.

Figure 5.11 shows the annual peak discharge levels in cfs. The largest flow was around 90,000 cfs from the 1964 flood. Lost Creek Lake Dam and reservoir started construction soon after that and was completed in 1977. Flows after 1977 (42 years) are lower with a peak of around 33,000 cfs in 2006. Prior to dam construction, peak flows were at this level or more 13 times in a 33 year period.

Figure 5.10: ENSO Runoff Analysis for Rogue River at Raygold (RYGO3)

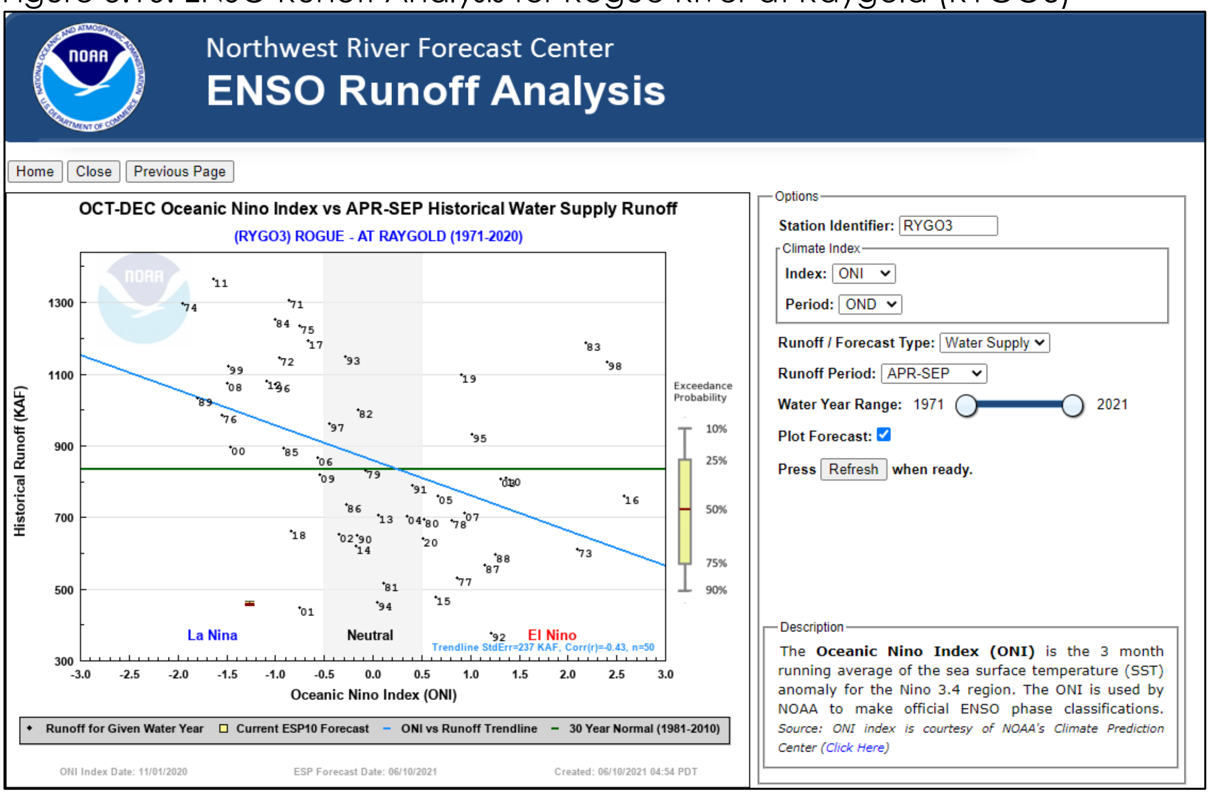
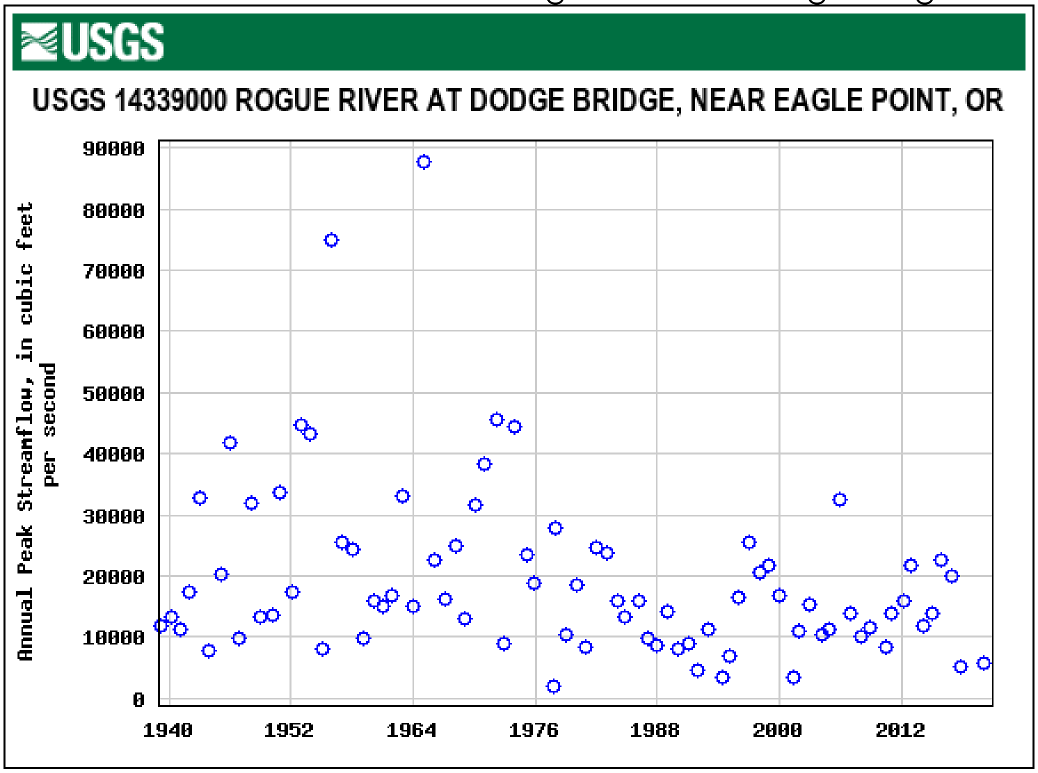


Figure 5.11: Annual Peak Stream Flow – Rogue River at Dodge Bridge




*Precipitation-Runoff Budget*

Precipitation-runoff budgets for the project area are identified as a gap for the project. General information for the State of Oregon was found, but nothing specific to the project area.

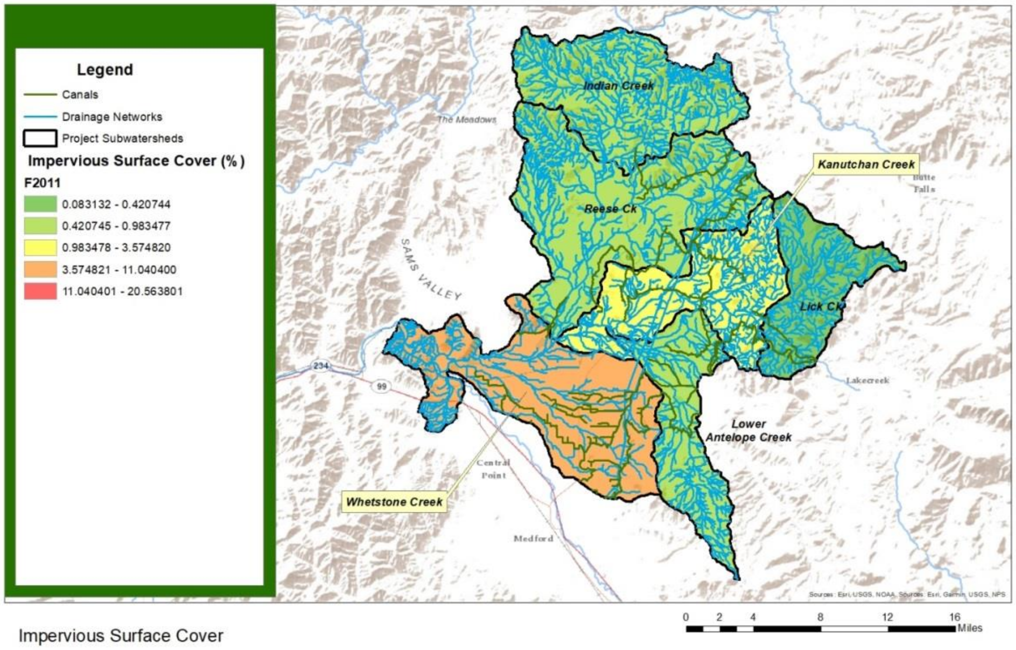
*Spatial and Temporal Distribution of Runoff*

Precipitation varies with elevation from about 20 inches in the interior valley areas to about 70 inches in the upper Cascade Range. Average annual rainfall for the basin above (Raygold) is about 43 inches. (ACOE, 1961).

Runoff varies depending on several factors, including overall precipitation, type of precipitation (rain versus snow), and amount of snowpack, land use, including urban areas and impervious surface cover, and other factors.

Impervious surface cover varies as the project area also includes the communities of Eagle Point, Shady Cove, and White City (unincorporated) in addition to parts of Medford and Jackson County. Figure 5.12 shows the impervious surface cover by percent (%) in the project area. It can be inferred that within areas of high impervious surface cover, there will be a higher rate of untreated and unfiltered runoff into nearby storm drains, creeks, and rivers.

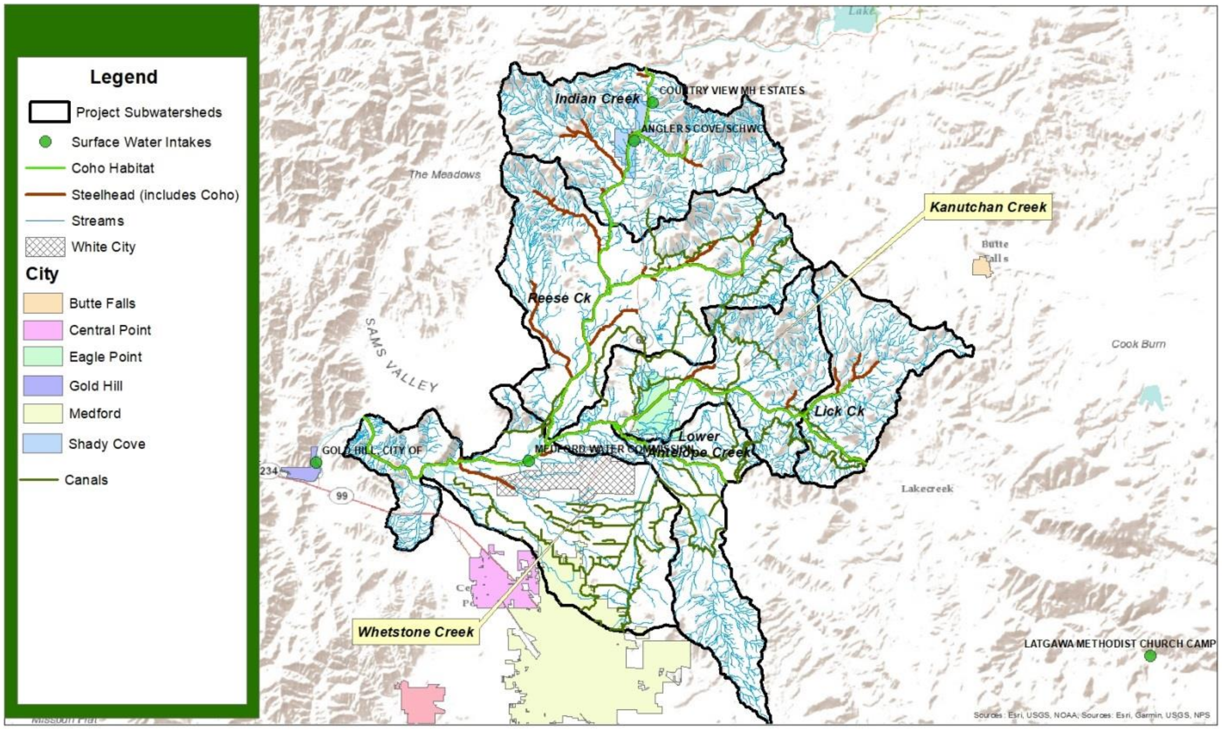
Figure 5.12: Impervious Surface Cover (%)




*Surface Water Drainage Networks*

For this project, the Rogue Basin is the major watershed that encompasses the drainage networks (Figure 5.13). Project subwatersheds including Indian, Kanutchan, Lick, and Reese Creeks provide Coho and Steelhead habitat in addition to other services (see Section 5.7).

Figure 5.13: Surface Water Drainage Networks




Surface Water Drainage Networks

## 5.2 Monitoring and Water Quality Characterization

*Source Water Quality*

To assess the quality of source water (also referred to as drinking water), this report looks at surface and groundwater data collected from a number of sources , advisory notices, well logs, applicable rules and regulations (e.g., TMDLs), and other relevant information. To characterize groundwater chemistry and summarize aquifer data, this report reviewed well log data, reviewed two groundwater studies conducted in 2011 and 2015, analyzed well data from DEQ and others (downloaded from the Ambient Water Quality Monitoring System (AWQMS) and reports), and analyzed data on arsenic and nitrates from well data provide by OSU Extension. Surface water monitoring data was also primarily downloaded and analyzed from the AWQMS.

*Advisory Notices*

One advisory notice was identified in the project area, specifically within the city of Shady Cove, for arsenic. This water advisory remains in place until treatment processes have removed the hazard. At present, the PWS has failed to submit up-to-date CCRs to OHA, although cross connection/backflow prevention information was submitted on 2/25/2021.

Figure 5.14: OHA Water Advisory Notice

**OHA Drinking Water Services**
**Water Advisory Details**

| | |
|---|---|
| **PWS ID:** | OR41 06155 |
| **PWS Name:** | MANZANITA HILLS SUBDIVISION |
| **Advisory Type:** | Do Not Drink Water |
| **Reason:** | Arsenic |
| **Area Affected:** | System-wide |
| **Affected Populations:** | All |
| **Begin Date:** | Jan 07, 2020 |
| **Date Lifted:** | *Open* |
| **Contacted By:** | BAKER, SUSAN (JACKSON COUNTY) |
| **Who Was Contacted:** | James Robinson |
| **Contact Phone:** | 541-951-1183 |
| **Details:** | Contact operator regarding the recent arsenic test results with the Acute Level of 35 ppm. I have informed the operator that a Tier 1 Public Notice is required to be posted within the next 24 hours. Public Notice posted on 1-7-20. Operator reports that a arsenic removal system has been ed and installation will occur as soon as possible. |
| **Associated Alerts:** | CHEM8789 - 01/07/2020 - ARSENIC |

*Well Logs*

Wells close to or within the project area are shown in Table 5.11 (a.) and 5.11 (b.). Specifically, wells ROG021, ROG022, BCV17, BCV18, BCV19, BCV20, BCV1, and BCV6 are relevant to the scope of this report.

Table 5.11 (a.): Groundwater Quality Investigation Results

**Table 4: Rogue Valley Groundwater Quality Investigation Results , Department of Environmental Quality 1992.**

| Station Identifier | Nitrate/nitrite as N (mg/L) | Total Arsenic (mg/L) | Fluoride (mg/L) | Dissolved Boron (mg/L) | Dissolved Manganese (mg/L) |
|---|---|---|---|---|---|
| ROG001 | <0.02 | <0.005 | 0.8 | 1.3 | <0.01 |
| ROG002 | 0.06 | <0.005 | 0.2 | 0.17 | 0.02 |
| ROG003 | <0.02 | <0.005 | 0.2 | 0.39 | 0.02 |
| ROG004 | 0.68 | <0.005 | 0.2 | 0.38 | <0.01 |
| ROG005 | <0.02 | <0.005 | 11 | 12 | <0.01 |
| ROG006 | 1.1 | <0.005 | 0.1 | 0.07 | 0.63 |
| ROG007 | <0.02 | <0.005 | 1.4 | 2.8 | <0.01 |
| ROG008 | <0.02 | <0.005 | 0.5 | 0.36 | 0.13 |
| ROG009 | 2 | <0.005 | 0.1 | 0.08 | <0.01 |
| ROG012 | 0.81 | <0.005 | | 0.43 | <0.01 |
| ROG013 | 0.04 | <0.005 | | 14 | <0.01 |
| ROG014 | 2.7 | <0.005 | | 0.15 | <0.01 |
| ROG015 | 0.51 | <0.005 | | 0.37 | 0.1 |
| ROG016 | 0.02 | <0.005 | | 1.2 | 0.16 |
| ROG017 | 4.6 | <0.005 | | 0.12 | <0.01 |
| ROG018 | 2.9 | <0.005 | | 0.16 | <0.01 |
| ROG019 | <0.02 | <0.005 | | 2.2 | 0.05 |
| ROG020 | 6.7 | <0.005 | | 0.05 | <0.01 |
| ROG021 | <0.02 | 0.006 | | 0.61 | <0.01 |
| ROG022 | <0.02 | 0.026 | | 1 | 0.02 |
| ROG023 | 0.02 | <0.005 | | 1.6 | 0.01 |
| ROG024 | <0.02 | <0.005 | | 1.1 | <0.01 |
| ROG025 | 1.3 | <0.005 | | 0.08 | 0.03 |
| ROG026 | 0.15 | <0.005 | | 0.04 | <0.01 |
| ROG027 | <0.02 | <0.005 | | 0.43 | 0.18 |
| ROG028 | 0.06 | <0.005 | | <0.03 | <0.01 |
| ROG029 | 1.9 | <0.005 | 0.1 | 0.06 | <0.01 |

Table 5.11 (b.): Groundwater Quality Investigation Results (Continued)

Water samples were also analyzed for selected pesticides (those expected to be in use in the area). Pentachlorophenol was detected in one well near a parking lot and area of intensive agricultural activity. Dacthal Acid, a pesticide, was detected in another well—surprisingly—in the deepest well (200 feet deep) of the study. The Dacthal was not detectable in a confirmation sample collected two months later, although Trichlorofluoromethane and Chloroform were detected in an increased Volatile Organic Compounds scan.

**Table 5: Bear Creek Valley Groundwater Quality Investigation Results, Department of Environmental Quality 1994**

| Station Identifier | Nitrate/nitrite as N (mg/L) | Total Arsenic (mg/L) | Fluoride (mg/L) | Dissolved Boron (mg/L) | Total Manganese (mg/L) |
|---|---|---|---|---|---|
| BCV01 | 3.1 | <0.005 | 0.1 | <0.03 | <0.01 |
| BCV02 | 3.9 | <0.005 | 0.1 | <0.03 | <0.01 |
| BCV03 | <0.02 | 0.016 | 0.2 | 0.19 | 0.23 |
| BCV04 | <0.02 | <0.005 | | 0.13 | 0.11 |
| BCV06 | 9.2 | <0.005 | 0.1 | <0.03 | 0.02 |
| BCV07 | 4.5 | <0.005 | | 0.35 | <0.01 |
| BCV08 | 4.5 | <0.005 | | 0.35 | <0.01 |
| BCV09 | 3.9 | <0.005 | 0.5 | 0.54 | <0.01 |
| BCV10 | 13 | <0.005 | 0.2 | 0.19 | <0.01 |
| BCV11 | 5 | <0.005 | 0.1 | 0.29 | <0.01 |
| BCV12 | 12 | <0.005 | | 0.37 | <0.01 |
| BCV13 | 10 | <0.005 | | 0.34 | <0.01 |
| BCV14 | 0.85 | <0.005 | 0.1 | 0.17 | <0.01 |
| BCV15 | 4.2 | <0.005 | 0.7 | 0.99 | 0.03 |
| BCV16 | 5.7 | <0.005 | 0.2 | 0.24 | <0.01 |
| BCV17 | 0.34 | <0.005 | 0.2 | 0.36 | <0.01 |
| BCV18 | 3.3 | <0.005 | 0.2 | <0.03 | <0.01 |
| BCV19 | 2.4 | <0.005 | 0.2 | <0.03 | <0.01 |
| BCV20 | <0.02 | <0.005 | 0.6 | 0.8 | 0.01 |

Table 5.12: Summary Well Information

| Location/Well | Arsenic (mg/l) | Nitrate (mg/l) | Bacteria | Comments |
|---|---|---|---|---|
| ROG021 | 0.006 | <0.02 | No data | Fluoride, Boron, and Manganese levels are in Table 5.5 and 5.6. |
| ROG022 | 0.026 | <0.02 | No data | |
| BCV17 | <0.005 | 0.034 | No data | |
| BCV18 | <0.005 | 3.3 | No data | |
| BCV19 | <0.005 | 2.4 | No data | |
| BCV20 | <0.005 | <0.02 | No data | |

*Groundwater Studies Summary*

Groundwater chemistry was assessed in two recent studies from 2011 and 2015. Overall, the studies identified arsenic, boron, and nitrate, in addition to other pollutants (e.g., pesticides), as impacting drinking water quality.

**Key Observations from the Two Studies:**

- Nitrate concentrations of 3 mg/L or lower in groundwater were the result of fertilizers and animal manure.
- Nitrate concentrations higher than 3 mg/L are often associated with septic system activity and irrigated agriculture.
- It appears that nitrate contamination in Jackson County has been declining since the USGS studies of 1971-1972.
- Elevated nitrate concentrations were generally associated with shallower wells.
- 8-18% of the nitrate detections exceeded the MCL level of 10 mg/l. Percentages vary based on the study referenced.
- In addition to arsenic detections in wells, arsenic was also found in several creeks and springs in the Upper Rogue and LBC.
- Of the samples detected for arsenic, 25% of them exceeded the MCL level of 10 ug/l.
- 26% of manganese detections were above the secondary contaminant level of 50 ug/l. 3.5% of the detections were above the 300 ug/L Lifetime Health Advisory standard from the EPA.
- 29% of the vanadium detections from the 2011 study exceeded the California State standard. The California standard was used for comparison because there is not a standard in Oregon.
- Pesticides were detected in 35% of the samples collected.

Table 5.13 lists the drinking water standards and/or health-based concentration limits for several parameters of concern.

**2011 Rogue Basin Groundwater Investigation**

**Overview**

The 2011 Rogue Basin Groundwater Investigation, completed by hydrogeologists from both Patton Environmental and DEQ, occurred within Jackson and Josephine counties, which are the 6$^{th}$ and 12$^{th}$ most populous counties in Oregon, respectively. Over 30% of residents (62,516) in Jackson County live in unincorporated areas and rely on groundwater wells for their drinking water supply. Previous studies by the USGS (1970s), DEQ (1990s), and Jackson County (1990s), have evaluated groundwater conditions, but the goals of the 2011 investigation also included:

- Updating the DEQ statewide database for nitrate concentrations,
- Investigating arsenic, boron, fluoride, and other potentially hazardous constituents, and

- Disseminating information about current groundwater conditions to local agencies and organizations.

Between March and June of 2011, nitrate testing and public education events were conducted within the Rogue Basin. Three-hundred and twenty-five samples were collected from 52 wells from Ashland to Shady Cove and Rogue River, and in Grants Pass and Cave Junction. Additionally, permissions to conduct further analyses on 118 properties were acquired.

**Monitoring and Analysis Results**

**Nitrate**

Following the investigation, it was found that 47% of the wells sampled within Jackson County had elevated nitrate concentration (>3 mg/L), with 8% of those wells testing above the drinking water standard of 10 mg/L (Table 5.6), one of which tested at 20 mg/L. The location for wells that tested above the drinking water standard was Central Point. Low nitrate concentrations were observed in Eagle Point and Shady Cove.

In many cases, nitrate concentrations of 3 mg/L or lower in groundwater are the result of fertilizers and animal manure, while concentrations higher than 3 mg/L are often associated with anthropogenic contributions, such as septic system activity and irrigated agriculture. Soils also play a large role in nitrate concentrations. For example, clay soils are better able to absorb nitrate inputs to the ground. Within these areas with high concentrations of nitrate, such as Central Point, it is possible that the dominant soil types are mostly or partially clay. Further evaluation of the soil conditions in these areas is recommended.

Overall, in viewing the results of the various groundwater studies reviewed, the nitrate contamination in Jackson County appears to have been declining since the USGS studies of 1971-1972. Currently, the area of highest nitrate contamination is Central Point, which is located outside of the project area, but is adjacent to the Whetstone Creek subwatershed.

**Arsenic**

Within Jackson County, 44% of wells had detectable levels of arsenic concentrations. In addition to arsenic detections in wells, arsenic was also found in several creek and springs in the Upper Rogue and LBC. Sources of arsenic may be from anthropogenic or natural sources. Generally, areas are impacted by both sources of the arsenic. Arsenic detections are associated with both orchard pesticide applications and rock formations which release the chemical element. Interestingly, arsenic is associated with basalt aquifers and not granitic aquifers. Additionally, arsenic concentrations are positively associated with low dissolved oxygen and high pH.

Table 5.13: Drinking Water Standards or Health-Based Concentration Limits

**Table 2: Drinking Water Standards or Health-Based Concentration Limits***

| Parameter | Drinking Water Standard or Health-Based Concentration Limit |
|---|---|
| Nitrate | 10 milligrams per liter (mg/L) = EPA MCL |
| Arsenic | 10 micrograms per liter (ug/L) = EPA MCL;<br>2 ug/L = 10-4 cancer risk Health Advisory (HA) |
| Fluoride | 4 mg/L = EPA MCL;<br>2 mg/L = Secondary drinking water regulation (dental fluorosis) |
| Boron | 3 mg/L = Ten-day exposure HA for 20 pound child drinking 1L/day;<br>6 mg/L = Lifetime exposure HA for adults drinking 2 L/day |
| Vanadium | 50 ug/L = EPA Proposed Action Level;<br>15 ug/L = California proposed notification level |
| Manganese | 0.3 mg/L + EPA suggested Health Advisory Level (staining, odor) |
| Chloride | 250 mg /L = EPA SMCL (salty taste, corrosivity) |

*See Appendix A for a Glossary of Terms relating to Drinking Water Standards

*Information from https://www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulations*

*Information on Oregon Specific Standards can be found in the link below. Standards are consistent for the most part with the values listed in the table above.*
*https://www.oregon.gov/oha/ph/HealthyEnvironments/DrinkingWater/Operations/Documents/pipeline/pipefa01.pdf*

### Fluoride

This study uncovered that most fluoride detections are associated with granitic aquifers (6/6 samples), followed by basalt aquifers (9/10 samples), and sandstone aquifers (5/7 samples).

### Boron

As with arsenic, sources of boron are both anthropogenic and natural. Human-made sources are found in pesticides and fertilizers, and natural sources are found most often in sandstone and claystone aquifers.

### Vanadium

Within Jackson County, 56% of the wells tested (29/52 wells) showed detectable levels of vanadium. Further, 29% of the wells tested above 15 ug/L of vanadium, which is the standard for the State of California; Oregon does not currently regulate for vanadium.

**2015 Statewide Groundwater Monitoring Program: Mid-Rogue Basin**

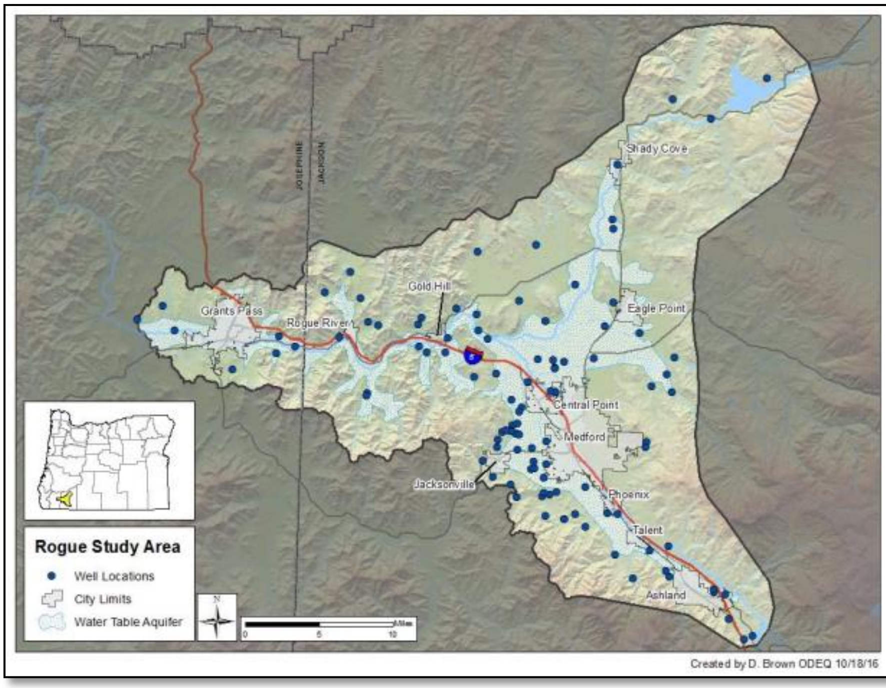
The 2015 Statewide Groundwater Monitoring Program for the Mid-Rogue Basin, based partly on the 2011 Rogue Basin Groundwater Investigation, aimed to establish the status of ambient groundwater conditions, identify emerging groundwater quality problems, and inform groundwater users of potential risks from contamination, through the collection of water quality data. Parameters analyzed under this program included nitrate, arsenic, bacteria, pesticides, and common ions, such as manganese, uranium, and vanadium. The goals of the program were:

- To collect high-quality data on nitrate, arsenic, coliform bacteria, and pesticide concentrations in groundwater throughout the study area,
- To identify areas of groundwater contamination related to these parameters,
- To inform well water users of the results of this study and provide information regarding potential risks to human health, and
- To identify areas needing additional investigation in order to describe the extent of contamination and help focus efforts to prevent further contamination.

The study area (Figure 5.15) for the program included the communities of Grants Pass, Shady Cove, Central Point, Medford, and Ashland, with 107 wells sampled. Between February 9th and March 4th, 2015, 60 wells were sampled, and between October 12th and October 28th, 2015, the other 47 were sampled. The NWQI project area is included in the Groundwater Monitoring Program Study Area (GMPSA)

Data was also mapped for arsenic and nitrates based on the data provided by OSU Extension and is provided for additional detail in the appropriate sections.

Figure 5.15: 2015 Statewide Groundwater Monitoring Program Study Area

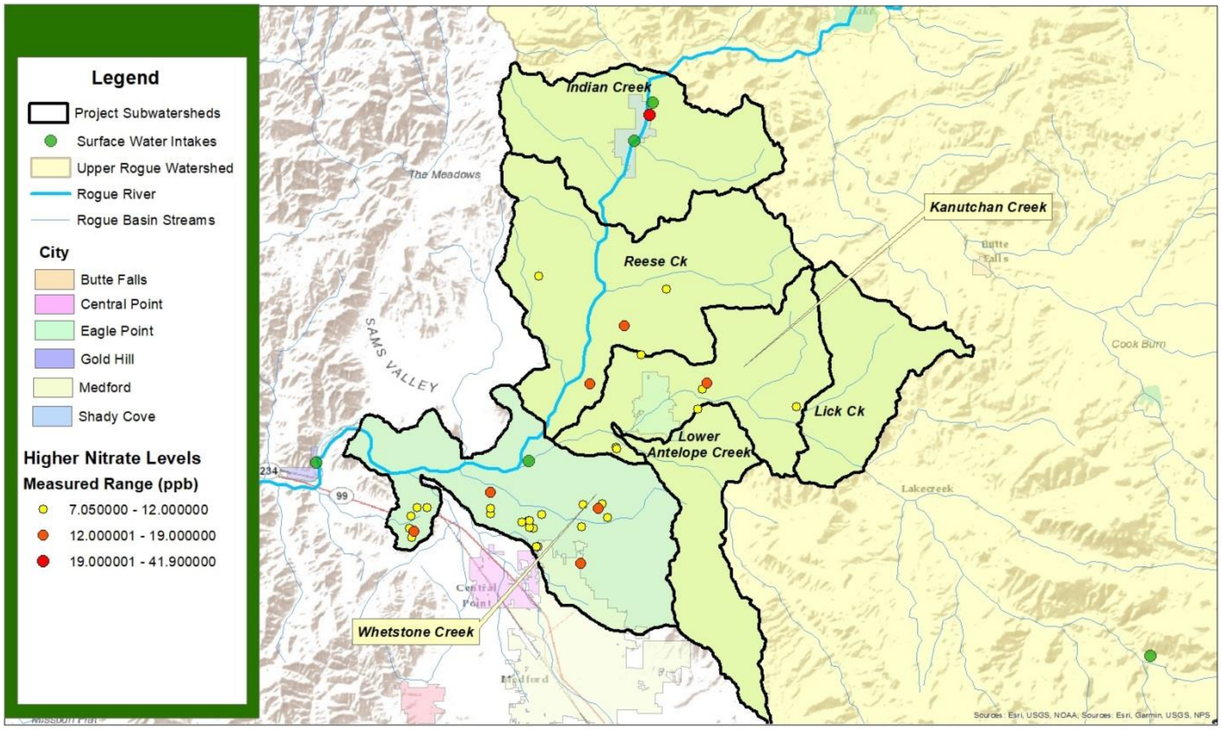



**Monitoring Results**

**Nitrate**

At the close of the program, it was found that 22/107 wells sampled had elevated concentrations of nitrate (3 mg/L or higher), and 4 of those 22 tested above the maximum contaminant level (MCL) of 10 mg/L. Elevated nitrate concentrations were associated with shallower wells, although not all shallow wells indicated a nitrate contamination issue. Interestingly, one of the wells analyzed in this study was also tested in the 2011 study, and nitrate concentrations in that 5-year period did not show much change. For example, the July 2011 sample indicated a concentration of 4.5 mg/L, the March 2015 sample showed 4.22 mg/L, and the October 2015 sampled tested at 4.53 mg/L.

Figure 5.16: Nitrate Concentrations in the Project Area Wells



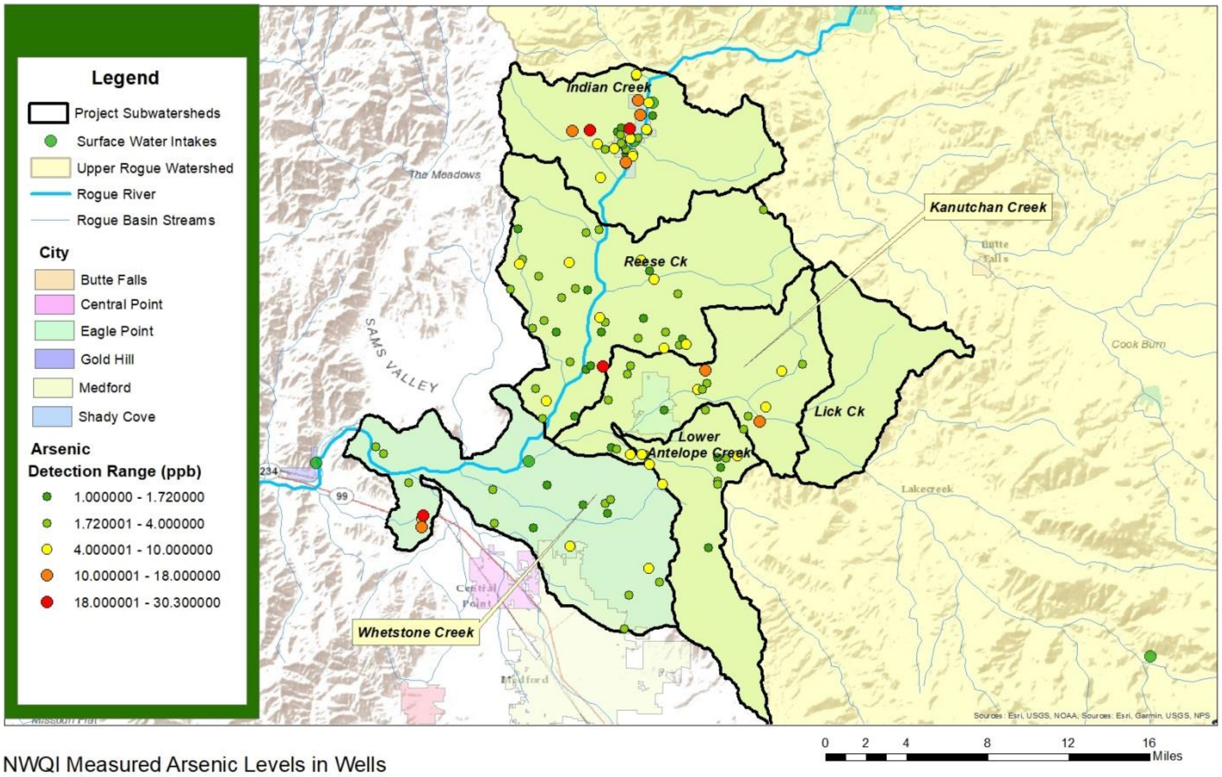

0 2 4 8 12 16 Miles

Measured Nitrate Levels in Wells (Higher Levels)

## Arsenic

Results showed that 24/107 wells had detections of arsenic (2 ug/L or higher), and 6 of those 24 had arsenic concentrations above the MCL of 10 ug/L. Most of these MCL-violating samples (5/6) were collected near the Rogue River and Lost Creek Lake.

Figure 5.17: Arsenic Concentration in Wells




## Coliform Bacteria

Coliform bacteria were found in 43% (46/107) of wells, and *E. coli* was detected in 8 of those 46. There was no correlation found between well depth and bacteria concentrations.

## Pesticide Concentrations

This study found that at least one current-use pesticide-related chemical was detected in 37/107 wells, and 6 of those 37 showed detections of at least one chemical originating from a legacy pesticide, or chemicals that were once used in the U.S. but are now banned. Results show that the most commonly detected pesticides belong to the triazine herbicide group, including atrazine and simazine. These are widely used in both agriculture and urban applications. Fortunately, no chemical detections were above any human health screening levels.

Data analyzed from the AWQMS information for the project area for pesticides commonly detected in groundwater are summarized in Table 5.14 . Only two pesticides (Atrazine and Carbaryl) were detected.

Table 5.14: Common Pesticides Found in Groundwater

Pesticides Detected in Groundwater from multiple land use types

| Pesticide | Applicatio | Analyzed | Detected | Max Value (ug/l) | Occurrence (%) |
|---|---|---|---|---|---|
| 2,4 D | Herbicide | 13 | 0 | 0 | 0 |
| 2,4 DB | Herbicide | 13 | 0 | 0 | 0 |
| Atrazine | Herbicide | 13 | 2 | 53.2 | 15 |
| Carbaryl | Insecticide | 13 | 4 | 57.5 | 31 |
| Diazinon | Insecticide | 13 | 0 | 0 | 0 |
| Diuron | Herbicide | 13 | 0 | 0 | 0 |
| Hexazinone | Herbicide | 13 | 0 | 0 | 0 |
| Imazapyr | Herbicide | 13 | 0 | 0 | 0 |
| Imidacloprid | Insecticide | 13 | 0 | 0 | 0 |
| Oxyfluorfen | Herbicide | 13 | 0 | 0 | 0 |
| Prometon | Herbicide | 13 | 0 | 0 | 0 |
| Sulfometuron methyl | Herbicide | 13 | 0 | 0 | 0 |
| Triclopyr | Herbicide | 13 | 0 | 0 | 0 |

**Manganese**

Manganese was found in 57/107 wells, with 15 of those 57 surpassing the secondary drinking water standard of 50 ug/L, and only 2 above the 300 ug/L Lifetime Health Advisory standard from the EPA.

**Uranium**

Low concentrations of uranium were detected in 71/107 wells, and none of these detections came close to the 30 ug/L MCL. The highest concentration of uranium was measured at 8.28 ug/L.

**Vanadium**

Vanadium was detected in 44/107 wells, with the highest recorded concentration level at 31.1 ug/L. While the EPA has a Regional Screening Level standard for tap water set to 86 ug/L for vanadium, there are no federal or state regulatory standards (with California as the exception).

*Current Status*

Currently, there are no known ongoing groundwater monitoring programs in the Rogue Basin, except for OHA's Domestic Well Testing Act and Real Estate Transaction (RET) program.

*Surface Water Monitoring Data*

Surface water quality monitoring has occurred or is occurring at a number of locations within the project area by numerous organizations. Streams and rivers monitored include several sites on the Rogue River, along with Kanutchan, Lower Antelope, Reese, Little Butte, and Whetstone Creeks. Kanutchan and Reese Creeks are monitored periodically. Lower Antelope Creek is monitored by JSWCD to determine the impacts of switching from flood to drip irrigation and other agricultural BMPs, and Whetstone Creek was monitored during the summer seasons of 2012, 2013, and 2014. In addition, the sites located on the Rogue River are monitored as part of the ambient monitoring program by DEQ and USGS. See Table 5.15 below for more information regarding water quality monitoring within the project area. Data requests related to each of these projects should be made to the responsible organization. For the DEQ/USGS, data can be downloaded from DEQ's AWQMS.

For the project area, monitoring data was downloaded from AWQMS for a 10-year period from January 2011 through January 2021. Data was analyzed to look at overall conditions, trends, and exceedances within the project area, and includes information pertaining to basic field parameters, as well as metals, such as aluminum, lead, copper, manganese, arsenic, and chromium.

Table 5.15: Project Area Water Quality Monitoring

| Creek/River: | Monitored By: | Parameters Analyzed: | Monitoring Years: |
|---|---|---|---|
| Kanutchan | MWC | Temperature, conductivity, turbidity, and UV 254. | Status Unknown |
| Lower Antelope | JSWCD | *E. coli*, total phosphorus | Current |
| Reese | MWC | Temperature, conductivity, turbidity, and UV 254. | Current |
| Whetstone | RVCOG/SOU | Temperature, flow, conductivity, and pH. | 2012, 2013, and 2014 |
| Little Butte | DEQ/MWC | All basic water quality parameters, metals, others. | Current, available in AWQMS |
| Rogue | DEQ/MWC | All basic water quality parameters, metals, others. | Current, available in AWQMS |

## Metals

### Aluminum

Aluminum concentrations were recorded at four USGS gauging stations using continuous monitoring technology. Basic statistics (minimum, maximum, range, average, and median all in ug/l) were calculated from the data and are shown in Figure 5.18 below. While LBC at Agate Road (White City) saw the highest maximum recorded value, and therefore the widest range, Rogue River at Highway 234 (Dodge Park) showed both the highest average and median aluminum concentration values. Median aluminum concentration values in ug/l are also depicted in Figure 5.19.

Figure 5.18: Basic Statistics for Aluminum Concentrations (ug/l)at Four Sampling Sites in the Project Area based on the 10 years of AWQMS Data (January 2011 through January 2021)

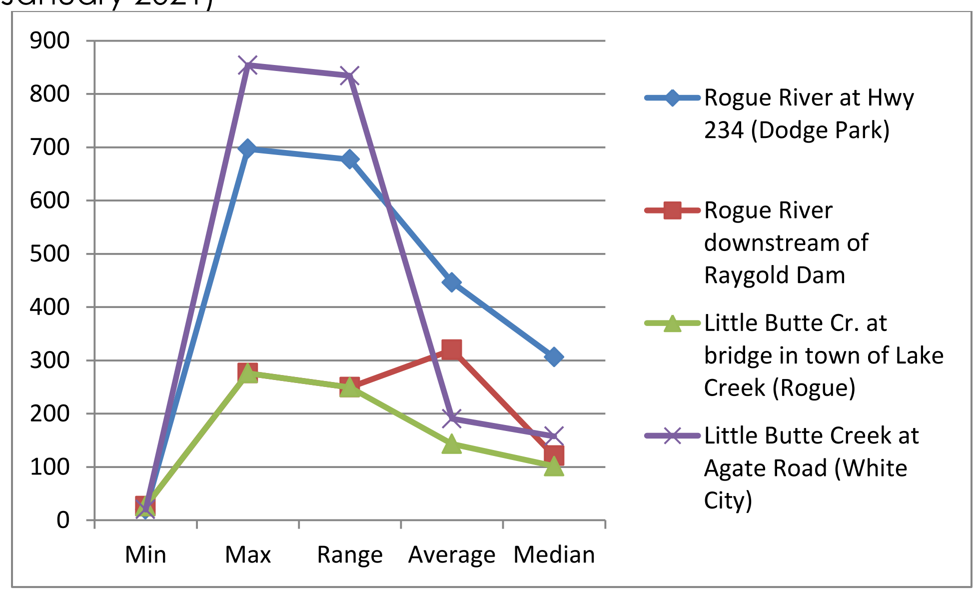
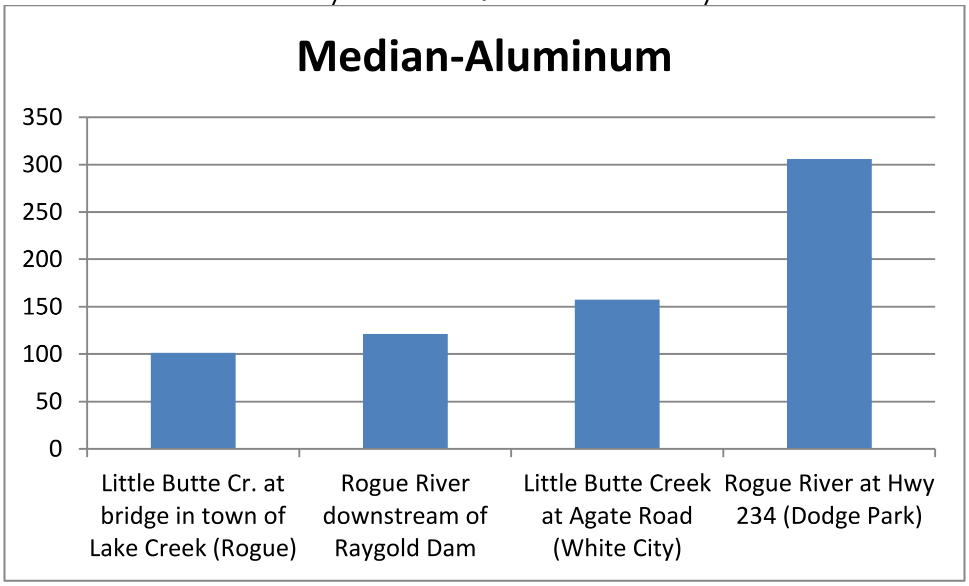


Figure 5.19: Median Aluminum Concentrations (ug/l) at Four Sampling Sites in the Project Area based on the 10-year AWQMS Data analysis.




## Lead, Copper, Manganese, Arsenic, and Chromium

Data analyzed from the AWQMS record for lead, copper, manganese, arsenic, and chromium is summarized in Table 5.12. Only values for manganese, arsenic , and chromium were detected. Values in the table represent the median value of the data recorded. Arsenic and manganese values did not approach the EPA limits shown in Table 5.16.

Table 5.16: Median Values for Lead, Copper, Manganese, Arsenic, and Chromium

| | Lead | | Copper | | Manganese | | Arsenic | | Chromium | |
|---|---|---|---|---|---|---|---|---|---|---|
| Sample Location | Dissolved (ug/l) | Total Recoverable (ug/l) | Dissolved (ug/l) | Total Recoverable (ug/l) | Dissolved (ug/l) | Total Recoverable (ug/l) | Dissolved (ug/l) | Total Recoverable (ug/l) | Dissolved (ug/l) | Total Recoverable (ug/l) |
| Little Butte Creek at Agate Road (White City) | <0.20 | <0.20 | <1.50 | <1.50 | 5.4 | 17.5 | 1.99 | 2.21 | <1.0 | <1.0 |
| Rogue River at Hwy 234 (Dodge Park) | <0.20 | <0.20 | <1.50 | <1.50 | 9.3 | 17.9 | 1.65 | 1.76 | <1.0 | <1.0 |
| Rogue River downstream of Raygold Dam | <0.20 | <0.20 | <1.50 | <1.50 | 2.515 | 7.19 | 0.31 | 0.34 | <1.0 | <1.0 |
| Little Butte Cr. at bridge in town of Lake Creek (Rogue) | <0.20 | <0.20 | <1.50 | <1.50 | 6.49 | 14.5 | 0.42 | 0.46 | <1.0 | <1.0 |
| Rogue River upstream of Raygold Dam | NA | NA | <1.50 | <1.50 | 9.78 | 16.6 | 0.49 | 0.58 | <1.0 | 3.79 |

In viewing Table 5.16, the Rogue River upstream of Raygold Dam recorded the highest concentrations of dissolved manganese, while Rogue River at Highway 234 (Dodge Park) recorded the highest concentrations of total recoverable manganese. Arsenic was found at the highest concentrations, both dissolved and total recoverable, at LBC at Agate Road (White City). Chromium was recorded at the highest total recoverable concentrations at Rogue River upstream of Raygold Dam. Lead and copper concentrations fell below the detectable rates for all five sites. The sample size analyzed was small for all parameters. Additional data is needed (data is identified as a gap) to better determine parameter levels and trends.

*Rogue Basin Total Maximum Daily Load – Regulatory Outlook*

Under the Federal Clean Water Act, Federal, State (DEQ, for Oregon), and local designated management agencies (DMA) must work to protect water quality for human health, wildlife, and fish, including salmonids. Streams that do not meet water quality standards for beneficial uses, (e.g., fishing, swimming, contact recreation) are placed on an impaired waterways list under Section 303(d). Once on the list, the waterways are subjected to a process that looks at the maximum amount of a specific substance (pollutant) that can be present in the waterbody while maintaining all categorized beneficial uses. This amount is called the Total Maximum Daily Load. Once established, the load (maximum amount) is divided up among different uses including agriculture, forestry, and urban areas. In addition, amounts are set aside for natural contributions. DMAs are identified to help meet the pollution threshold. Plans are developed and implemented over time to meet the benchmark levels of pollutants until water quality standards and beneficial uses are met.

Within the Rogue Basin, there are TMDLs implemented within several watersheds and subbasins, including: Bear Creek, Lobster Creek, the Applegate Subbasin, Lower Sucker Creek, Upper Sucker Creek, and the mainstem of the Rogue River including through the project area. The Rogue River TMDL covers the project area, and temperature and bacteria are the main concerns. Specific information on the TMDL can be accessed from the Resource Guide under DEQ at the end of this document.

**Temperature TMDL**

Due to the presence of salmonids within the Rogue Basin and their need for cold-water habitat for spawning, rearing, and migration, as well as the recent trend of temperature loading within the basin, a temperature TMDL was established in part of the Rogue Basin in 2008. To illustrate the expanse of this issue, the temperature TMDL addresses 100 temperature impairments from the 2004-2006 list of impaired waterbodies and sets basin-wide limits on pollution. Stream temperatures are influenced by agricultural practices, logging, urban/rural development, removal of canopy cover along the river, influxes of heated wastewater effluent, channel modifications, reservoirs, removal of water, and irrigation returns. With the temperature TMDL in place, DEQ expects temperature improvements, specifically a 7° Celsius decrease during the summer months, and a 2° Celsius decrease during the early fall. With these improvements, salmonid habitat and the associated biological activities can be supported within the Rogue Basin.

**Bacteria TMDL**

The bacteria TMDL was established to protect human health during contact recreation with streams, rivers, and lakes. Water quality standards related to bacteria, specifically *E. coli,* limit levels to 406 most probable numbers of organisms (MPN). *E. coli* is used as a bacterial indicator of fecal contamination. Under the bacteria TMDL, 25 reaches from the 2004-2006 list of impaired waterbodies are addressed with pollution limits. Sources of fecal contamination range from agricultural practices, such as CAFOs, livestock grazing, and irrigation and stormwater runoff, as well as urban/rural runoff and failing septic systems. DEQ is requiring a reduction in fecal pollution to meet the bacteria TMDL, ensuring that contact recreation is a continued beneficial use into the future.

## 5.3 Organic Contaminant Monitoring (USGS)

*Purpose*

Within this report, the term, "organic contaminant" describes any carbon-based compound found in surface water. Examples include: pesticides, semi-volatile organic compounds (SVOC), volatile organic compounds (VOC), polycyclic aromatic hydrocarbons (PAH), pharmaceuticals, and personal care products (PPCP). For other organic contaminant groups and potential sources, see Table 5.17 (from the 2020 McKenzie Source Water Assessment Report, Table 3.3) below. Overall, chronic exposure to these organic contaminants, especially at high levels, can lead to a range of health effects.

Unfortunately, the long-term effects of many of these organic contaminants within surface waters are unknown, which poses a challenge to DWPs and wastewater treatment plant operators. Additionally, commercial laboratories are finding it difficult to analyze and assess new and emerging contaminants. As stated within the 2020 McKenzie Source Water Assessment Report, "Although laboratory and analytical methods are constantly improving, new compounds are constantly entering the market, and finding the right assortment of analytical methods with adequate resolution to assess those compounds at meaningful levels is a challenge." And lastly, to understand the source, fate, unintended consequences, and risks of organic contaminants within surface waters requires years of data and significant funding. Overall, organic contaminants will surely become the topic of more and more studies into the future.

Table 5.17: Organic Contaminant Groups and Potential Sources

| Table 3-3: Organic Contaminant Groups and Potential Sources | | | |
|---|---|---|---|
| **Contaminant Group** | **Abbreviation** | **Example(s)** | **Use(s) or Source(s)** |
| Organic Carbon | OC | Dissolved Organic Carbon (DOC) | Natural and synthetic forms |
| Dioxins and furans | | 2,3,7,8-Tetrachlorodibenzop-dioxin | Waste or fuel incineration |
| Disinfection Byproducts | DBPs | Haloacetic Acids | Water treatment |
| Hormones and sterols | | Coprostanol | Natural and synthetic forms |
| Pesticides | | Atrazine | Forestry, Agriculture, Urban, Hwy |
| Petroleum Hydrocarbons | | Diesel | Roads, Urban areas |
| Pharmaceuticals and Personal Care Products | PPCP | Diphenhydramine | Septic Systems, Waste Water Plants |
| Plasticizers | | Phthalate Esters | Industry, Urban Areas |
| Polybrominated diphenyl ethers | PBDEs | Decabromodiphenyl ether | Flame retardant |
| Polychlorinated biphenyls | PCBs | | Transformers, electrical equipment |
| Polycyclic aromatic hydrocarbons | PAHs | Anthracene | Combustion by-products |

*Background*

Data analyzed for this report is based on an excerpt of 10 years of data (2011-2021) from the AWQMS database. Data was collected primarily by DEQ as part of their Statewide Toxics Monitoring program and Pesticide Stewardship Partnership (PSP). Additional data was collected by the City of Medford and the United States Bureau of Reclamation (USBR).

*Current Status*

Monitoring is ongoing for many of the parameters and is planned to continue for statewide programs (e.g., Statewide Toxics Monitoring and PSP) which includes additional sampling in southern Oregon.

*Monitoring Results*

Based on the data analyzed for the Toxics Monitoring report, most of the parameters listed in Table 5.13 were evaluated in the project area. Many of the samples analyzed were at the minimal reporting level or estimated detection level. Table 5.18 summarizes the information for the project area.

Table 5.18: Parameters of Concern within the Project Area

| ***Parameter*** | ***Abbreviation*** | ***Examples*** | ***Notes*** |
|---|---|---|---|
| Organic Carbon | DOC | Organic Carbon | Multiple records for dissolved and total. |
| Dioxins and Furans | | 2,3,7,8 Tetrachlorodibenzo-p-dioxin | Sampled. All results below minimal reporting levels or estimated detection limits (BRL). |
| Disinfection Byproducts | DBPs | Haloacetic Acids and Trihalomethanes | Gap. No records for MCA, DCA, TCA, MBA, or DBA (the 5 most common Haloacetic Acids). |
| Hormones and Steroids | | Coprostanal | No records of coprosanal. Coprosterol, which is a precursor of Coprostanal, was detected in 19 samples with levels ranging from 4.86 – 270 ng/l. |
| Pesticides | | Atrazine | Multiple detections (9). Values range from 4.51 to 53.2 ng/l. |
| Petroleum Hydrocarbons | | Diesel | No records. Gap. Whetstone report RVCOG/SOU? |
| Pharmaceuticals and Personal Care Products | | Diphenhydramine | Diphenamid detected, but all BDL. |
| Plasticizers | | Phlalate Esters | DEHP – Multiple |

| | | | |
|---|---|---|---|
| | | Di(2-ethylhexyl) phthalate (DEHP) | detections (6) ranging from 0.84 to 1.56 ng/l. |
| Polybromated Diphenyl Ethers | PBDEs | Decambramodiphenylether | 2 detections 1.2 and 1.43 ng/l. PBDEs BDL. |
| Polychlorinated biphenyls | PCBs | | BDL. |
| Polycyclic Aromatic Hydrocarbons | PAHs | | BDL. |

## 5.4 Cyanobacteria (Harmful Algal) Blooms

*Description*

Cyanobacteria (harmful algal) blooms, also referred to as cyanoHABs (OHA, 2021), are an overgrowth of microscopic algae or algae-like bacteria in fresh, salt, or brackish waters that can release toxins. CyanoHABs can produce foul-smelling scum, foam, froth, or paint-like slick, and can be seen in a variety of colors, such as blue-green, yellow, brown, pink, or red (Natural Resources Defense Council, NRDC, 2021). CyanoHABs significantly impact aquatic ecosystems, endangered species within those ecosystems, and drinking water supplies. CyanoHABs have become an ever-increasing public health hazard and will be present into the future due to favorable climatic conditions for the growth of cyanobacteria. CyanoHABs will likely occur earlier in the season, be more frequent, and of a larger size.

*Background*

According to the USGS, the past decade has seen the detection of various cyanotoxins, including microcystins, anatoxin-*a*, and cylindrospermopsin, in surface waters in Oregon, such as the Clackamas, North Santiam, and the Tualatin River, all of which are important drinking water sources (2021). These cyanoHABs have not only caused significant health advisories, but have led to several water contact and recreational closures. Additionally, dogs exposed to cyanotoxins have experienced severe illness and/or death. Regarding drinking water quality, cyanobacterial HABs produce a variety of materials, including geosmin, organic matter, and toxins, which threaten drinking water quality and complicate drinking water treatment processes.

Locally, there have been advisories issued in Lost Creek Lake, Fish Lake, Willow Lake, and Whetstone Pond (https://www.oregon.gov/OHA/PH/HEALTHYENVIRONMENTS/RECREATION/HARMFULALGAEBLOOMS/Pages/archive.aspx). . .

*Current Status*

In Oregon, cyanoHABs have the potential to impact revenue from recreation. Numerous popular waterbodies have had multiple advisories over the past decade due to cyanoHABs and the toxins they produce, including Detroit Lake, Odell Lake, Tenmile Lake, Timothy Lake, Upper Klamath Lake, and many others. HABs can be found in multiple types of waterbodies including reservoirs, lakes, and irrigation and stock ponds. For example, blooms of Dolichospermum (formerly *Anabaena*) are common in the large water storage reservoirs on the tributaries of the Willamette River, and in several lakes in Lincoln and Clatsop Counties (Cullaby, Carnahan, Tenmile, and Devils Lake, for example), where *Gloeotrichia*, *Aphanizomenon*, *Microcystis*, and other cyanobacteria can bloom during summer months. CyanoHABs in small agricultural (nursery) irrigation ponds have also led to releases of cyanotoxins downstream, sometimes impacting drinking water intakes. In Central Oregon, various stock ponds and reservoirs used for livestock watering have experienced cyanoHABs with resulting deaths of cattle. In one incident in 2017, 32 cattle perished near Lakeview (USGS, 2021).

CyanoHABs have occurred in many of the large water storage reservoirs in the Willamette River Basin, resulting in health advisories for water contact recreation, and in 2018, for the first time in Oregon, a drinking water advisory was established due to cyanotoxins. A cyanoHABs event in Detroit Lake during spring produced cyanotoxins that were transported downstream in the North Santiam River, affecting Salem's drinking water for about a month. Similar types of cyanobacterial blooms occur in Blue River and Cougar Reservoirs, in the McKenzie River Basin, with similar threats to drinking water for the City of Eugene (USGS, 2021).

OHA collects and reviews available information on cyanobacterial blooms, and informs the public through the issuing and lifting of recreational use health advisories when water sampling data warrants. HAB advisories are posted on their website. As of July 13th, 2021, there were no current advisories posted for the project area. It should be noted that only a fraction of all waterbodies in Oregon are visually monitored or sampled due to limited physical and monetary resources. CyanoHABs Monitoring for local waterbodies is a gap for the project area.

In or near the project area, there are multiple public water systems that are considered susceptible to cyanoHABs and subject to OHA-DWS Permanent Cyanotoxin Rules including the Medford Water Commission, City of Gold Hill, City of Rogue River, Anglers Cove, and Country View Mobile Home Estates (see Table 5.19). Susceptible water source risk criteria/factors identified in the drinking water source area include previous documented cyanoHABs detections, or a DEQ Water Quality Listing (WQL) for algae and aquatic weeds.

Table 5.19: OHA-DWS Permanent Cyanotoxin Rules

Oregon Health Authority

## Table 1. Public Water Systems susceptible to harmful algae blooms (HABs) and subject to OAR 333-061-0510 to 333-061-0580 for OHA-DWS Permanent Cyanotoxin Rules

**version: April 15, 2020 , subject to change**

Notes:

(1) Includes surface water intake and groundwater under the direct influence of surface water (GWUDI) sources. Systems that purchase water from wholesale providers (*)can be identified in OHA's Data Online for each individual PWS.

(2) System Type: C = Community; NTNC = Non-Transient Non-Community; NC=Transient Non-Community; NP= Non-Public State Regulated systems

(3) Previous HAB Detection or Advisory based on Recreational HABs from OHA, 2011, updated with data from OHA Recreational HAB Website for 2012-2018; Previous cyanotoxin detections based on 2018 or earlier PWS or watershed data.

(4) DEQ Water Quality Limited (WQL) listing indicates the waterbody is impaired and needs a Total Maximum Daily Load to calculate amount of pollutant a water body can receive and still meet Oregon water quality standards. Based on Category 4 and 5 listings in most recent OR DEQ Integrated Report and 303(d) list (2012).

(5) GU - Groundwater under the direct influence of surface water - refers to a groundwater source that is located close enough to nearby surface water (e.g., a river or lake) to receive direct surface water recharge. Since a portion of the groundwater source's recharge is from surface water, the groundwater source is considered at risk of contamination from pathogens and viruses that are not normally found in true groundwaters and the water source is subject to the surface water treatment rule.

| PWS_ID | PWS Name (1) | Drinking Water Source | County | System Type (2) | Population Served | "Susceptible" Water Source (OAR 333-061-0510 (2)) risk criteria/factors identified in the Drinking Water Source Area | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Previous Documented HAB or Cyanotoxin Detection (3) OAR 333-061-0510 (2a and 2c) | DEQ Water Quality Limited (WQL) listing (4) for algae and aquatic weeds OAR 333-061-0510 (2b and 2c) | Other Criteria OAR 333-061-0510 (2d) |
| **Susceptible Water Source per OAR 333-061-0510 (2)** | | | | | | | | |
| OR4100012 | Albany, City of (*) | Santiam River | Marion | C | 56,100 | X | X | |
| OR4101483 | Angler's Cove/SCHWC | Rogue River | Jackson | C | 83 | X | X | |
| OR4100047 | Ashland Water Department | Ashland Creek | Jackson | C | 20,700 | X | | |
| OR4101174 | Buell-Red Prairie Water District | Gooseneck Creek | Polk | C | 788 | X | | |
| OR4191786 | Camp Baker BSA | Infiltration Gallery | Lane | NC | 75 | X | X | |
| OR4100157 | Canby Utility | Common header for Molalla River, IG and Springs Gallery | Clackamas | C | 16,866 | X | | |
| OR4100187 | Clackamas River Water - Clackamas (*) | Clackamas River | Clackamas | C | 41,338 | X | X | |
| OR4100548 | Clarks Branch Water Association | South Umpqua River | Douglas | C | 140 | X | X | |
| OR4100236 | Cottage Grove, City of | Row River | Lane | C | 10,005 | X | X | |
| OR4100808 | Country View MH Estates | Rogue River | Jackson | C | 132 | X | X | |
| OR4100246 | Creswell, City of | Coast Fork Willamette River | Lane | C | 5,075 | X | X | |
| OR4193944 | Douglas Co. Parks Whistlers Bend | North Umpqua River (seasonal source, must sample when activated) | Douglas | NC | 100 | X | X | |
| OR4100260 | Drain, City of | Bear Creek (Whipple Reservoir) | Douglas | C | 1,151 | X | | |
| OR4100279 | Estacada, City of | Clackamas River | Clackamas | C | 3,155 | X | X | |
| OR4100287 | Eugene Water & Electric Board (*) | McKenzie River | Lane | C | 168,000 | X | X | |

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| PWS_ID | PWS Name [1] | Drinking Water Source | County | System Type (2) | Population Served | "Susceptible" Water Source (OAR 333-061-0510 (2)) risk criteria/factors identified in the Drinking Water Source Area | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Previous Documented HAB or Cyanotoxin Detection [3] OAR 333-061-0510 (2a and 2c) | DEQ Water Quality Limited (WQL) listing [4] for algae and aquatic weeds OAR 333-061-0510 (2b and 2c) | Other Criteria OAR 333-061-0510 (2d) |
| OR4100317 | Gates, City of | North Santiam River | Marion | C | 490 | X | X | |
| OR4100326 | Glide Water Association | North Umpqua River | Douglas | C | 1,200 | X | X | |
| OR4100333 | Gold Hill, City of | Rogue River | Jackson | C | 1,115 | X | X | |
| OR4100342 | Grants Pass, City of (*) | Rogue River | Josephine | C | 37,088 | X | X | |
| OR4101520 | Hiland WC - Shady Cove (*) | Rogue River | Jackson | C | 1,000 | X | X | |
| OR4100379 | Hillsboro & JWC Plant (*) | Tualatin River | Washington | C | 397,769 | X | | |
| OR4190730 | Jackson Co Pks Emigrant Lake | Common Header for Emigrant Lake intakes (North and South Intakes) | Jackson | NC | 800 | X | | |
| OR4100408 | Jefferson, City of | Santiam River | Marion | C | 3,165 | X | X | |
| OR4190186 | Josephine Co Pks Lake Selmac 1 | Lake Selmac | Josephine | NC | 50 | X | X | |
| OR4194645 | Josephine Co Pks Lake Selmac 2 | Lake Selmac | Josephine | NC | 50 | X | X | |
| OR4100457 | Lake Oswego Municipal Water (*) | Clackamas River | Clackamas | C | 36,093 | X | X | |
| OR4105082 | Lone Rock Court | North Umpqua River | Douglas | NP | 14 | X | X | |
| OR4100492 | Lowell, City of | Dexter Lake | Lane | C | 1,170 | X | X | |
| OR4100493 | Lyons Mehama Water District | North Santiam River | Marion | C | 1,300 | X | X | |
| OR4100513 | Medford Water Commission (*) | Rogue River | Jackson | C | 91,100 | X | X | |
| OR4100250 | Milo Academy | South Umpqua River | Douglas | C | 150 | X | X | |
| OR4100540 | Monroe, City of | Long Tom River | Benton | C | 615 | X | X | |
| OR4100550 | Myrtle Creek, City of | South Umpqua River | Douglas | C | 3,460 | X | X | |
| OR4100566 | Newport, City of | Common Header for Big Creek and Siletz River | Lincoln | C | 10,160 | X | | |
| OR4100580 | North Clackamas County Water Commission (*) | Clackamas River | Clackamas | C | 87,700 | X | X | |
| OR4194929 | On The River RV Park | Well (GU[5] South Umpqua River) | Douglas | NC | 60 | X | X | |
| OR4100613 | Pendleton, City of | Umatilla River | Umatilla | C | 17,310 | | X | |
| OR4100672 | Powers, City of | South Fork Coquille River | Coos | C | 700 | X | X | |
| OR4101012 | PP&L-Toketee Village | Toketee Lake (N.Umpqua River) | Douglas | C | 50 | X | X | |

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| PWS_ID | PWS Name [1] | Drinking Water Source | County | System Type (2) | Population Served | "Susceptible" Water Source (OAR 333-061-0510 (2)) risk criteria/factors identified in the Drinking Water Source Area | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Previous Documented HAB or Cyanotoxin Detection [3] OAR 333-061-0510 (2a and 2c) | DEQ Water Quality Limited (WQL) listing [4] for algae and aquatic weeds OAR 333-061-0510 (2b and 2c) | Other Criteria OAR 333-061-0510 (2d) |
| OR4100839 | Rainbow Water District | Chase Well #2 (GU[5] Willamette River) | Lane | C | 6,300 | X | X | |
| OR4101445 | River Bend West Water | Umpqua River | Douglas | NP | 24 | X | X | |
| OR4100717 | Roberts Creek Water District | South Umpqua River | Douglas | C | 6,500 | X | X | |
| OR4100712 | Rogue River, City of | Rogue River | Jackson | C | 2,250 | X | X | |
| OR4194300 | Roseburg Forest Products - Dillard | South Umpqua River | Douglas | NTNC | 2,000 | X | X | |
| OR4100720 | Roseburg, City of (*) | North Umpqua River | Douglas | C | 28,800 | X | X | |
| OR4100731 | Salem Public Works (*) | Common Header for North Santiam River, I.G., Geran Island wells (GU[5] North Santiam River) | Marion | C | 192,000 | X | X | |
| OR4100799 | Seaside Water Department (*) | Common Header (post reservoir) for Necanicum River/SF Necanicum River | Clatsop | C | 6,605 | X | | |
| OR4100835 | Shangri La Water District | Well (GU[5] McKenzie River) | Lane | C | 200 | X | X | |
| OR4100591 | South Fork Water Board - Oregon City (*) | Clackamas River | Clackamas | C | 65,000 | X | X | |
| OR4100837 | Springfield Utility Board (*) | Common Header for Middle Fork Willamette River and Willamette Wells (GU[5]) | Lane | C | 59,500 | X | X | |
| OR4100837 | Springfield Utility Board (*) | Thurston Well #2 (GU[5] McKenzie River) | Lane | C | 59,500 | X | X | |
| OR4100843 | Stayton Water Supply | North Santiam River | Marion | C | 7,830 | X | X | |
| OR4194508 | Susan Creek Mobile Home Park | North Umpqua River | Douglas | NP | 20 | X | X | |
| OR4100549 | Tri-City JW & SA | South Umpqua River | Douglas | C | 3,500 | X | X | |
| OR4100719 | Umpqua Basin Water Association | North Umpqua River | Douglas | C | 8,900 | X | X | |
| OR4100714 | Umpqua Ranch Co-op | North Umpqua River (seasonal source, must sample when activated) | Douglas | NC | 161 | X | X | |
| OR4194179 | USFS Horseshoe Bend CG | North Umpqua River | Douglas | NC | 80 | X | X | |
| OR4101091 | USFS Steamboat Work Center | North Umpqua River | Douglas | NC | 20 | X | X | |
| OR4101092 | USFS Tiller Ranger Station | South Umpqua River | Douglas | NTNC | 34 | X | X | |
| OR4100954 | Wilsonville, City of (*) | Willamette River | Clackamas | C | 22,729 | X | | |
| OR4100957 | Winston-Dillard Water District | South Umpqua River | Douglas | C | 8,060 | X | X | |

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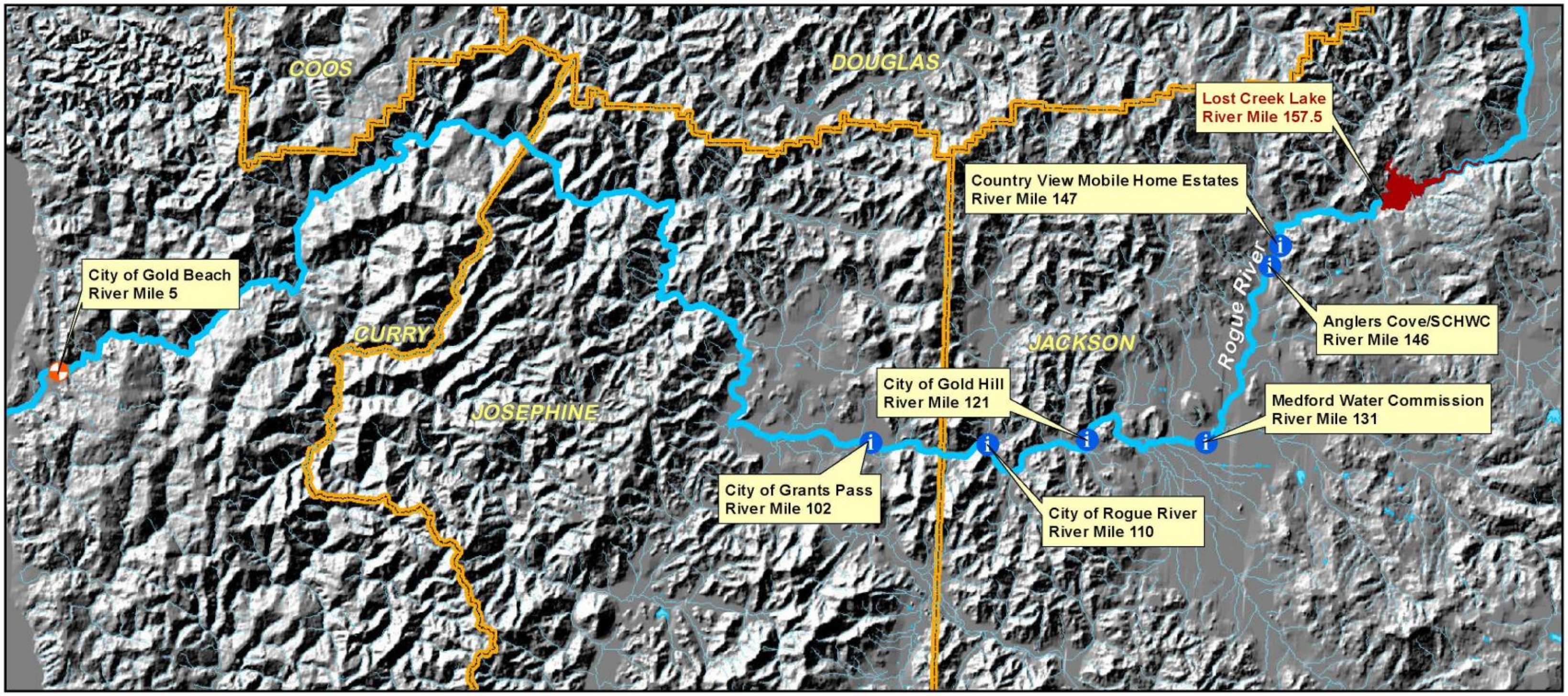
In addition, there has been a documented HAB at Lost Creek Lake (see Figure 5.20, provided by OHA). While outside of the project area, impacts may have been seen in the Rogue Basin below the dam, which includes the mainstem Rogue River which flows through the project area.

Figure 5.20: CyanoHABs at Lost Creek Lake (red outline on the right-hand side)

## Rogue River Basin - Public Water System HAB Response Network




**Public Water System Contact Information**

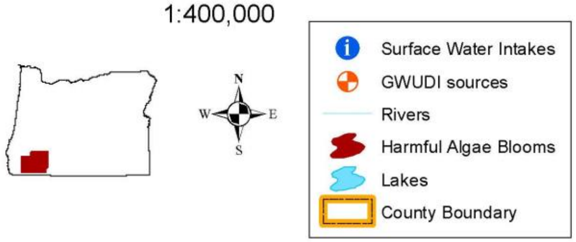
| PWS Name | PWS No. | Phone # | River Mile |
|---|---|---|---|
| Country View Estates WS | 01403 | 541-687-7581 | 147 |
| Anglers Cove/SCHWC | 01483 | 541-878-2498 | 146 |
| Medford Water Commission | 00513 | 541-774-2440 | 131 |
| City Of Gold Hill | 00333 | 541-890-3679 | 121 |
| City Of Rogue River | 00712 | 541-582-4401 | 110 |
| City Of Grants Pass | 00342 | 541-474-6353 | 102 |
| City Of Gold Beach | 01059 | 541-247-7459 | 5 |

Oregon Health Authority

Map Creator: M. Byrd
Map Revised: 11/19/12

0 3 6 12 18 24 Miles

1:400,000




**Other Relevant Contacts**

| Organization | Contact | Phone/Email |
|---|---|---|
| U.S. Army Corps of Engineers | Chad Stuart | 541-878-2255 |
| U.S. Forest Service | Al Johnson | 541-225-6431<br>ajohnson@fs.fed.us |
| DEQ TMDL Program Rogue Basin | Bill Meyers | 541-776-6277<br>meyers.bill@deq.state.or.us |

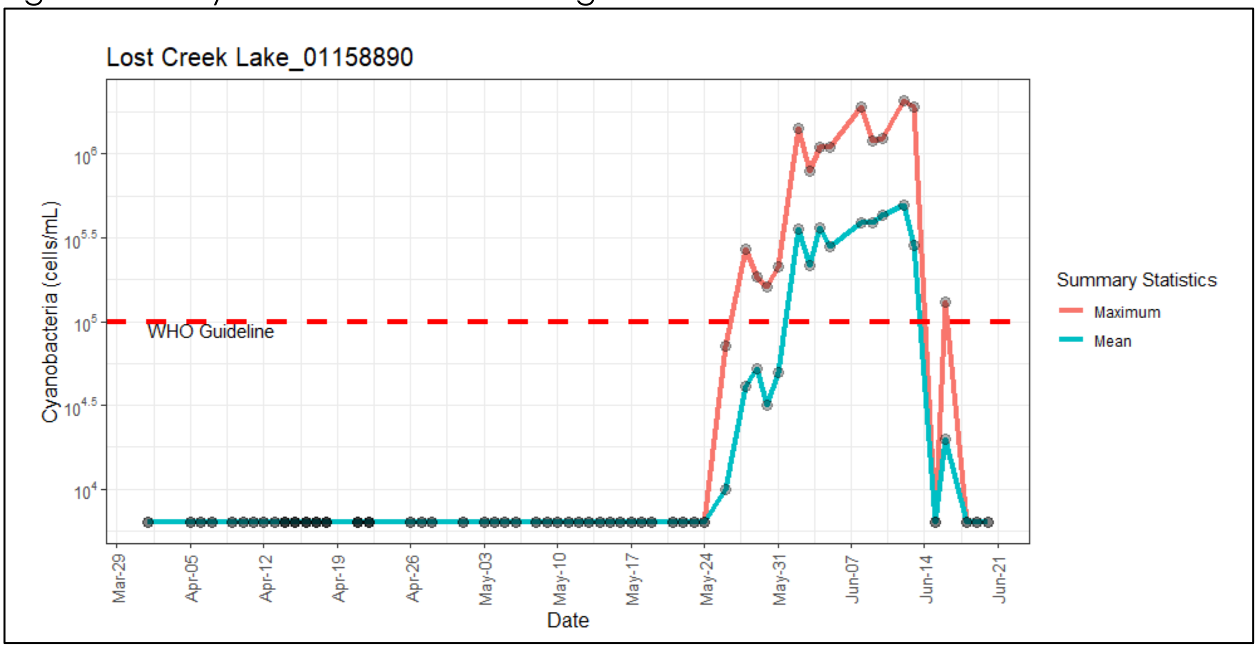
**Harmful Algae Bloom Locations**

Bloom locations are in red. In many cases, the locations are connected by tributaries downstream from the original bloom. The confluence with major drinking water sources are shown in red text and include river mileage. Generally, the river miles were estimated from U.S. Geological Survey 7.5 minute topographical maps.

*Monitoring Results*

The only current monitoring results for cyanoHABs in the project area are from OHA's required cyanotoxin sampling during the bloom season at vulnerable surface water intakes, including the four surface water systems within the project area. To date, none of the four water systems have reported detections of cyanotoxins in raw water. Lost Creek Lake, which is upstream of the project location, is currently being monitored by DEQ and the Corps. Data in Figure 5.17 below was provided by DEQ on June 23rd, 2021 and covers monitoring through June 21st, 2021.

Figure 5.21: Cyanobacteria Monitoring Data for Lost Creek Lake




## 5.5 Bacterial Source Tracking

*Purpose*

Bacterial source tracking uses a number of different testing methods to identify the underlying source of bacteria (e.g., human or animal, type of animal). Identifying the underlying source also helps tie it to a land use and/or location.

*Current Status*

No current studies have been identified in the research completed for this project. It is identified as a data gap. There is caffeine data that was collected for some surface water stations. This data could be used as a surrogate for human impacts in the project area if there was an immediate need for data for the evaluation of human impacts (cross connections, leaking septic systems) in areas of high bacteria. However, all samples (17) pulled from the AWQMS system for caffeine registered below the detection limits for samples collected in 2011 and 2015.

## 5.6 Continuous Water Quality Monitoring

*Purpose*

Data sondes maintained by OWRD and others are or have been located throughout the project area to monitor water quality conditions. Additional data sondes are being purchased and installed in 2021-2023. In addition, the USGS maintains stations in or near the project area. Information on real-time sonde data can be found on USBR's Hydromet site: https://www.usbr.gov/pn/hydromet/. In addition, there are discharge stations located on streams, canals, and rivers operated by a number of organizations including the USGS. Data sondes collect limited water quality data focused mostly on temperature, turbidity, conductivity, dissolved oxygen, and pH. Most of the sonde data focuses on streamflow.

Information from station 14359000 (Rogue River at Raygold) is included primarily for flow reference in Figure 5.22 (a.) and (b.) below.

Figure 5.22 (a.): Continuous Water Quality Monitoring Station – USGS 14359000

**USGS 14359000 ROGUE RIVER AT RAYGOLD NEAR CENTRAL POINT, OR**

**Stream Site**

**DESCRIPTION:**

Latitude 42°26'15", Longitude 122°59'10" NAD27
Jackson County, Oregon, Hydrologic Unit 17100308
Drainage area: 2,053 square miles
Datum of gage: 1,121.78 feet above NGVD29.

**AVAILABLE DATA:**

| Data Type | Begin Date | End Date | Count |
|---|---|---|---|
| **Current / Historical Observations** (availability statement) | 1977-12-09 | 2021-08-12 | |
| **Daily Data** | | | |
| Temperature, water, degrees Celsius | 1995-10-02 | 2021-08-12 | 25958 |
| Discharge, cubic feet per second | 1905-09-01 | 2021-08-11 | 42346 |
| **Daily Statistics** | | | |
| Temperature, water, degrees Celsius | 1995-10-03 | 2021-02-22 | 8518 |
| Discharge, cubic feet per second | 1905-09-01 | 2021-06-16 | 42293 |
| **Monthly Statistics** | | | |
| Temperature, water, degrees Celsius | 1995-10 | 2021-02 | |
| Discharge, cubic feet per second | 1905-09 | 2021-06 | |
| **Annual Statistics** | | | |
| Temperature, water, degrees Celsius | 1996 | 2021 | |
| Discharge, cubic feet per second | 1905 | 2021 | |
| **Peak streamflow** | 1906-01-16 | 2020-01-24 | 115 |
| **Field measurements** | 1964-12-24 | 2021-07-27 | 290 |
| **Water-Year Summary** | 2006 | 2020 | 15 |
| **Revisions** | Available (site:1) (timeseries:1) | | |

**OPERATION:**

Record for this site is maintained by the USGS Oregon Water Science Center
**Email questions about this site to Oregon Water Science Center Water-Data Inquiries**

Figure 5.22 (b.): Discharge Values – USGS 14359000

| | Discharge (cfs) |
|---|---|
| Max | 705006 |
| Min | 8060 |
| Range | 696946 |
| Mean | 107556.5965 |
| Median | 43750 |
| 75th percentile | 157006 |
| 25th percentile | 22825 |

*Background*

Water quality parameters currently include temperature, conductivity, dissolved oxygen (DO), pH and turbidity. However, developments in sensor technology over the last 10 years have resulted in a number of new sensors being available for continuous monitoring efforts. Some of the newer sensors that have been used on other areas include chlorophyll and phycocyanin, which together can measure total algae, and fluorescent dissolved organic matter (fDOM) (2020 McKenzie Source Water Assessment Report). Sensors for total algae and fDOM have been purchased recently for installation at the LBC site in Eagle Point.

*Current Status*

There are a number of stations in the Rogue Basin, including the project area, that measure flow, water levels, and/or temperature in reservoirs, streams, and canals. There are currently two stations in the project area that monitor more detailed water quality: LBGO (Little Butte Creek in Eagle Point) and LBCO (Little Butte Creek at Lake Creek).

*Monitoring Results*

Data available from USBR's Hydromet site was downloaded and basic summary statistics were calculated. Available data is shown in Figures 5.23 (a.) and (b.) and the summaries are available in Tables 5.20 (a.) and (b.).

Figure 5.23 (a.): LBGO – Available Parameter Records

Start: Year: 2021 Month: July Day: 12

End: Year: 2021 Month: August Day: 10

**Little Butte Ck at Eagle Point, OR**

| parameter | available records | description |
|---|---|---|
| ☐ HJ | | 2015-2021 |
| ☐ Q | Discharge, cfs | 2015-2021 |
| ☐ WP | Water pH Value, PH | 2015-2021 |
| ☐ GH | River Water Surface Gauge Height, feet | 2015-2021 |
| ☐ WF | Water Temperature, degF | 2015-2021 |
| ☐ DO | Water Dissolved Oxygen , ppm | 2015-2021 |
| ☐ WT | Water Turbidity, NTU | 2015-2021 |
| ☐ WC | Water Temperature, degC | 2015-2021 |
| ☐ WE | Water Specific Conductance, uMHOS/cm | 2015-2021 |

Retrieve Daily Data

Table 5.20 (a.): LBGO Summary Statistics – 2015-2021

| LBGO Summary Statistics 2015-2021 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | ***Discharge (cfs)*** | ***pH*** | ***Gauge Height (ft)*** | ***Temperature (°F)*** | ***Dissolved Oxygen*** | ***Turbidity (NTUs)*** | ***Temperature (°C)*** | ***Conductivity (umos/cm)*** |
| ***Max*** | 45.5 | 8.07 | 4.7 | 81.83 | 9.9 | 30.22 | 26.97 | 163.37 |
| ***Min*** | 7.59 | 0 | 4.2 | 0 | 0 | 0 | 0 | 0 |
| ***Range*** | 37.91 | 8.07 | 0.5 | 81.83 | 9.9 | 30.22 | 26.97 | 163.37 |
| ***Avg*** | 18.948399 | 7.450524079 | 4.404012 | 66.13227337 | 7.6325673 | 8.233523371 | 22.4483711 | 135.4247415 |
| ***Median*** | 19 | 7.4 | 4.41 | 71.055 | 7.32 | 8.01 | 22.36 | 130.45 |

Figure 5.23 (b.): LBCO – Available Parameter Records

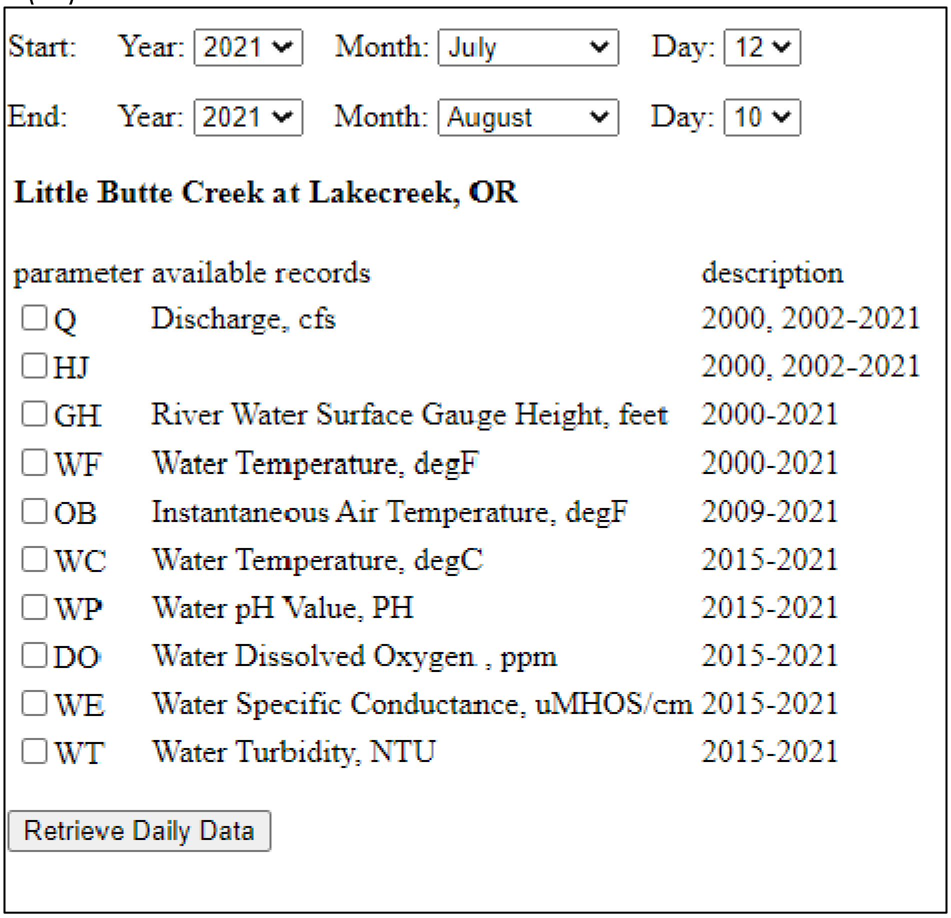



Table 5.20 (b.): LBCO Summary Statistics – 2015-2021

| | Discharge (cfs) | Gauge Height (ft) | Temperature (°F) | Instantaneous Air Temp (°F) | Temperature (°C) | pH | Dissolved Oxygen | Conductivity (umos/cm) | Turbidity (NTUs) |
|---|---|---|---|---|---|---|---|---|---|
| **Max** | 2030 | 15.79 | 75.56 | 105.38 | 24.29 | 8.6 | 14.11 | 1065.04 | 1310.71 |
| **Min** | 0 | 0.79 | 31.72 | 9.73 | 0 | 0 | 0 | 0 | 0 |
| **Range** | 2030 | 15 | 43.84 | 95.65 | 24.29 | 8.6 | 14.11 | 1065.04 | 1310.71 |
| **Avg** | 168.62797 | 1.872033557 | 50.66485 | 52.19301054 | 9.901692581 | 7.733201 | 10.77931494 | 95.52600915 | 8.21531 |
| **Median** | 64 | 1.5 | 48.82 | 49.58 | 8.73 | 7.75 | 11 | 89 | 5.51 |

*Future Projects in the Rogue River Watershed*

There are currently plans by MWC to partner with the OWRD to place recently purchased algae and fDOM sensors in LBC in Eagle Point. In addition, Hydrosphere Software is being purchased by a number of members of the RDWP and will be installed at this station and others for real-time reporting of results.

Data analysis of parameters collected after the fires in 2020 to present will help in evaluating impacts of the fire to the Rogue River and drinking water intakes downstream. When continuous data collected on the Rogue River is compared with stations collecting data in Bear Creek, differences in impacts from the Obenchain and Almeda Fires may be seen.

In addition, there is work being completed by the RDWP to develop an emergency response plan including a warning system. Established station locations with supplemental sensors may provide the basis of or a start for the monitoring warning network.

*Recommendations*

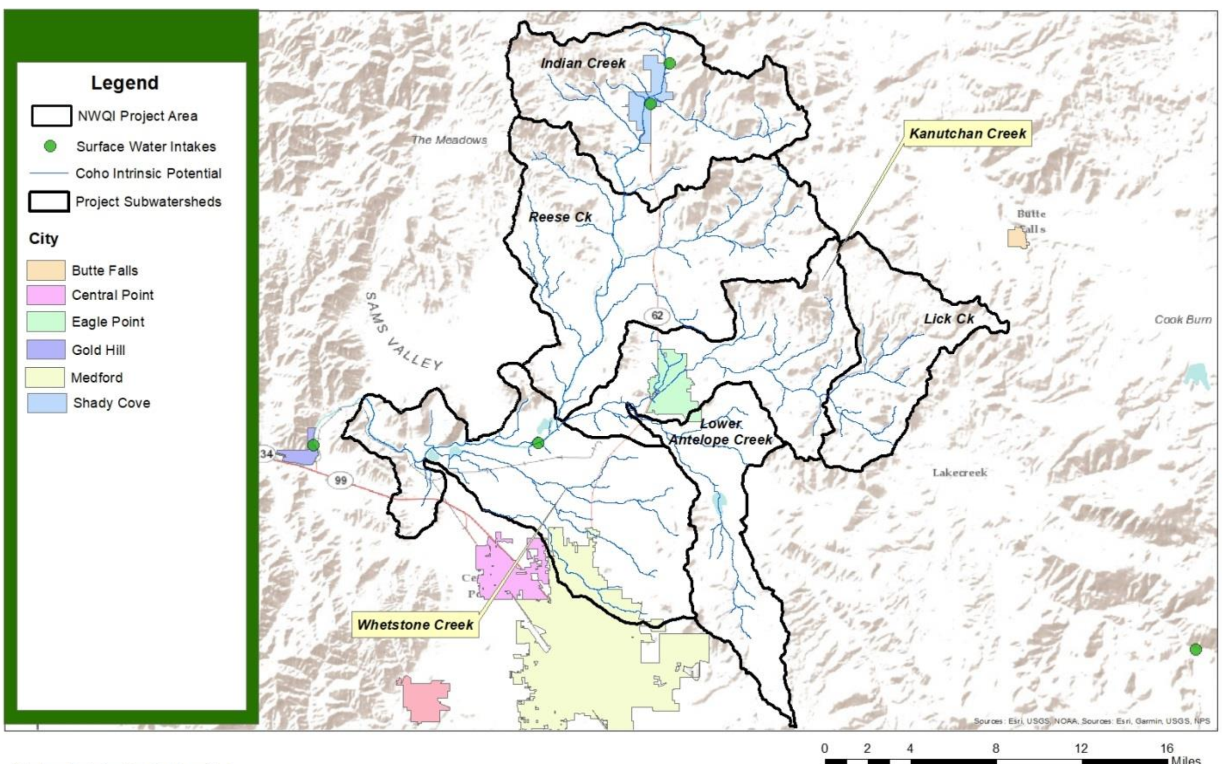
Continuous monitoring plays an important role in evaluating watershed health, identifying impacts of specific land use activities, looking at trends, and supporting current and planned projects. Maintaining the existing gauge networks is recommended in addition to supporting any planned stations or new stations in the future.

New stations established should consider increasing the geographic coverage of the station network, evaluating specific land uses (urban, agriculture, forestry, mixed), or potential problem areas.

## 5.7 Fish Populations

The project area provides important salmonid habitat, as seen in Figures 5.24, 5.25, 5.26, and 5.27. Additional habitat can be connected through restoration projects including barrier removal, riparian restoration, and in-stream projects. According to the U.S. Forest Service – Pacific Northwest Research Station, "Intrinsic potential is a measure of a stream's capacity to provide high-quality habitat for Coho and Steelhead" (2005). Areas of high intrinsic potential (HIP) are often good candidates for protection when unaffected by past management, or restoration when impacted by past management. It can be inferred that the history of the project area qualifies the majority of the subbasins for restoration rather than protection. As such, the figures below represent a promising outlook on fish populations if restoration activities can be organized and funded.

Figure 5.24: Coho Intrinsic Potential in the Project Area




Coho Intrinsic Potential

Figure 5.25: Winter and Summer Steelhead Intrinsic Potential in the Project Area

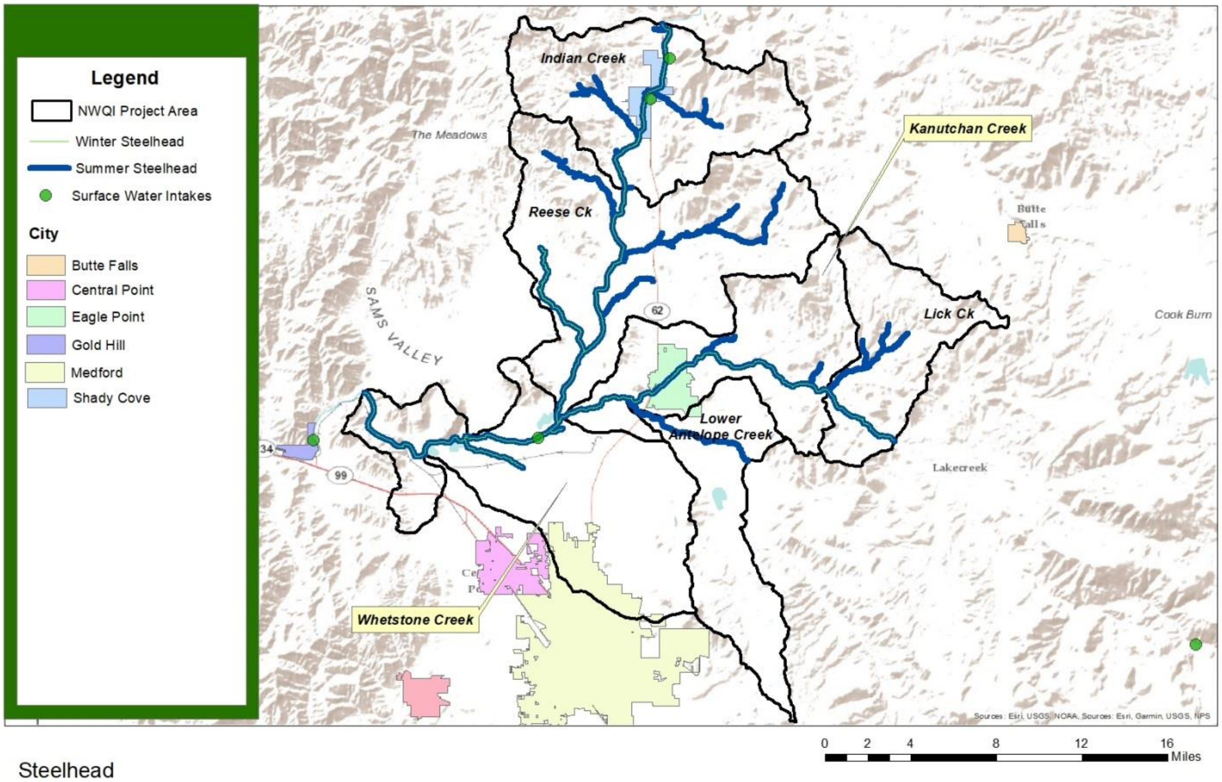



Figure 5.26: Spring Chinook Intrinsic Potential in the Project Area

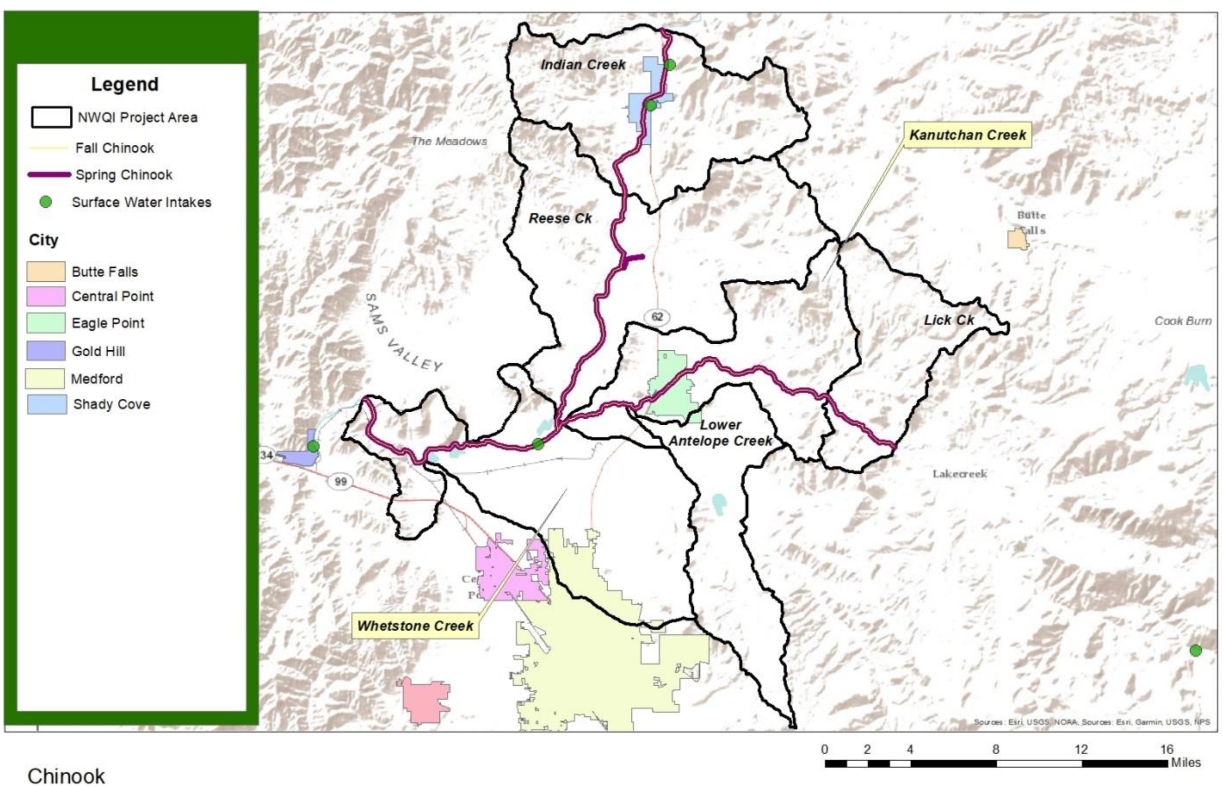
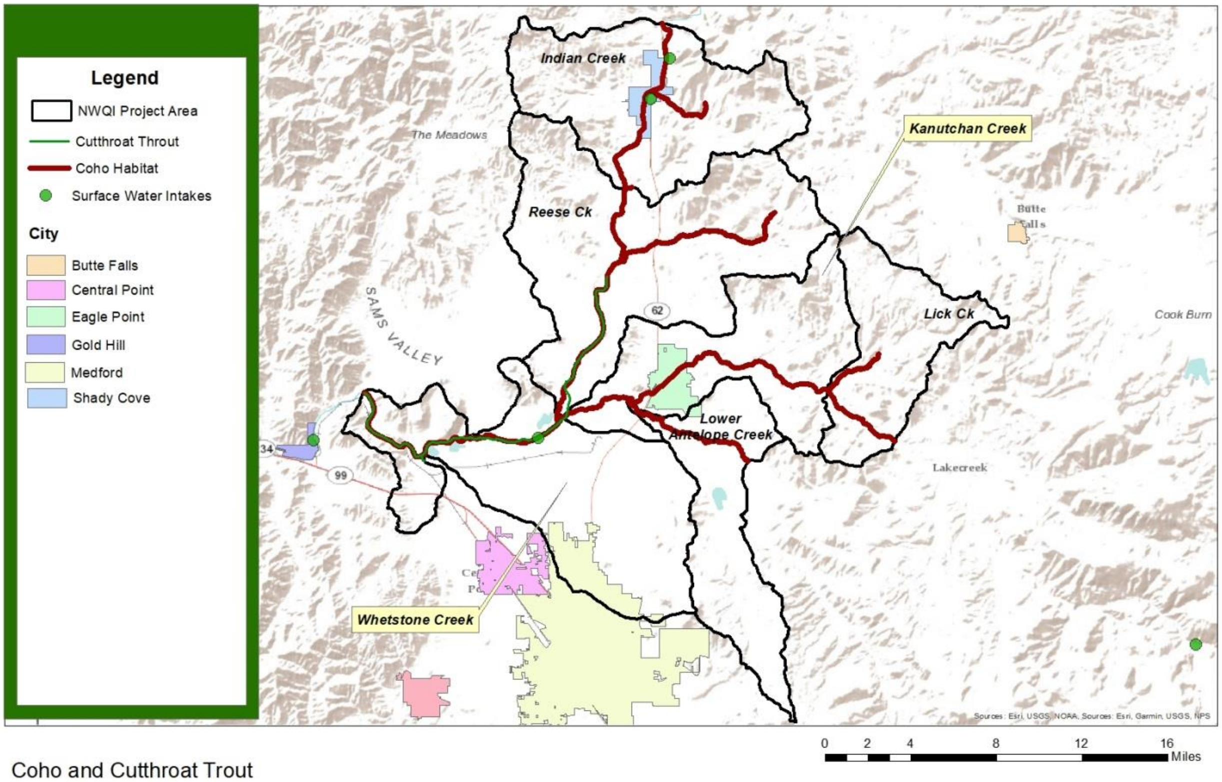


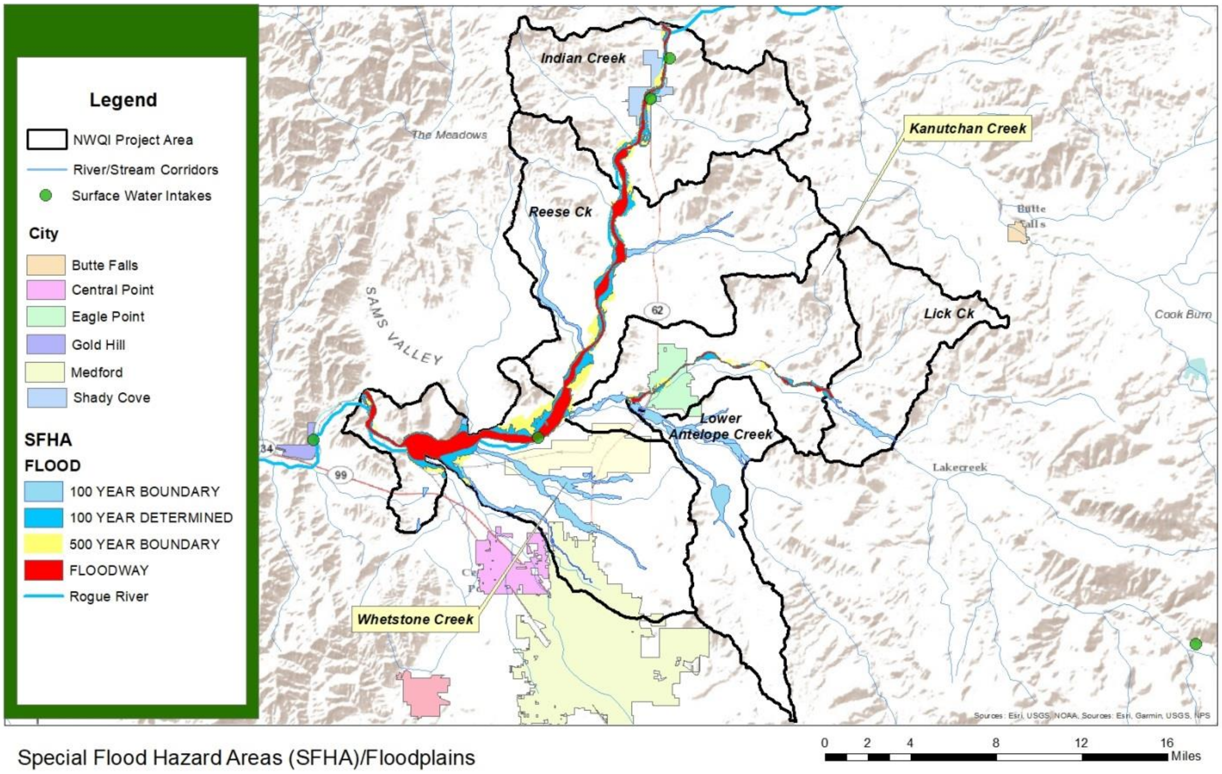
Figure 5.27: Coho Habitat Intrinsic Potential in the Project Area




## 5.8 Floodplain/Floodway Zones

The mainstem of the Rogue River in the project area is the most susceptible to the impacts of severe floods, with the widest floodway, 500-year flood zone, and 100-year flood zone. Several of the major tributaries also have large delineated floodplains that general expand with movement downstream. For example, the 100-year boundary zones for Indian and Kanutchan Creeks (upper portion of the project area) are much narrower than the 100-year boundary zones for Reese and Whetstone Creeks (lower portion of the project area).

Figure 5.28: Flood Zones in the Project Area



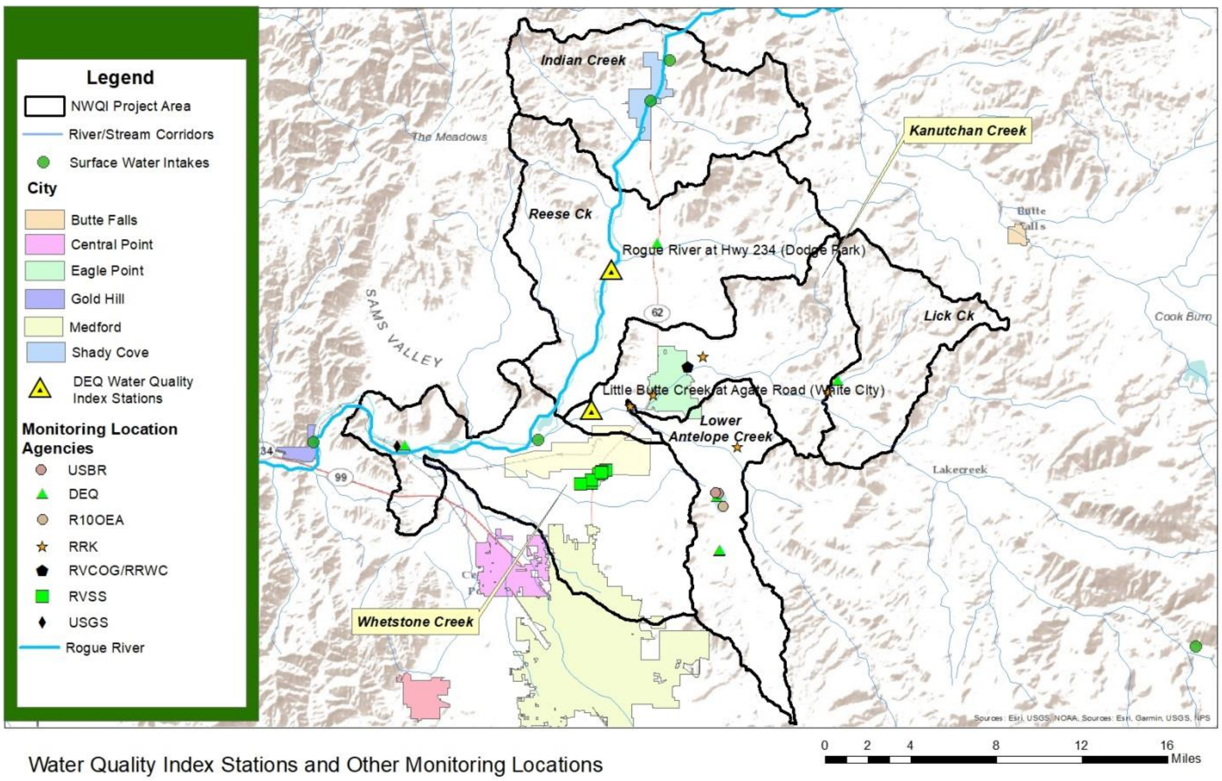

## 5.9 Oregon Water Quality Index

The Oregon Water Quality Index (OWQI) provides a statistical overview of the water quality status and trends across Oregon, and has been calculated for over 30 years. Parameters analyzed to determine the index values include: ammonia-nitrogen, bacteria (*E. coli),* biological oxygen demand (BOD), dissolved oxygen (DO), nitrate-nitrogen, pH, temperature, total phosphorus, and total solids. Index scores range from 10 (worst case) to 100 (ideal water quality). This index is used by DEQ to easily communicate water quality issues with the public, agency managers, and the Oregon Legislature.

It is important to note that OWQI ambient monitoring data is not compared to water quality standards, does not evaluate if beneficial uses (i.e., drinking water, contact recreation, fishing, and swimming) are supported, does not have regulatory standing, and does not identify pollutant sources causing water quality issues. However, it does help project the magnitude and direction of significant water quality trends.

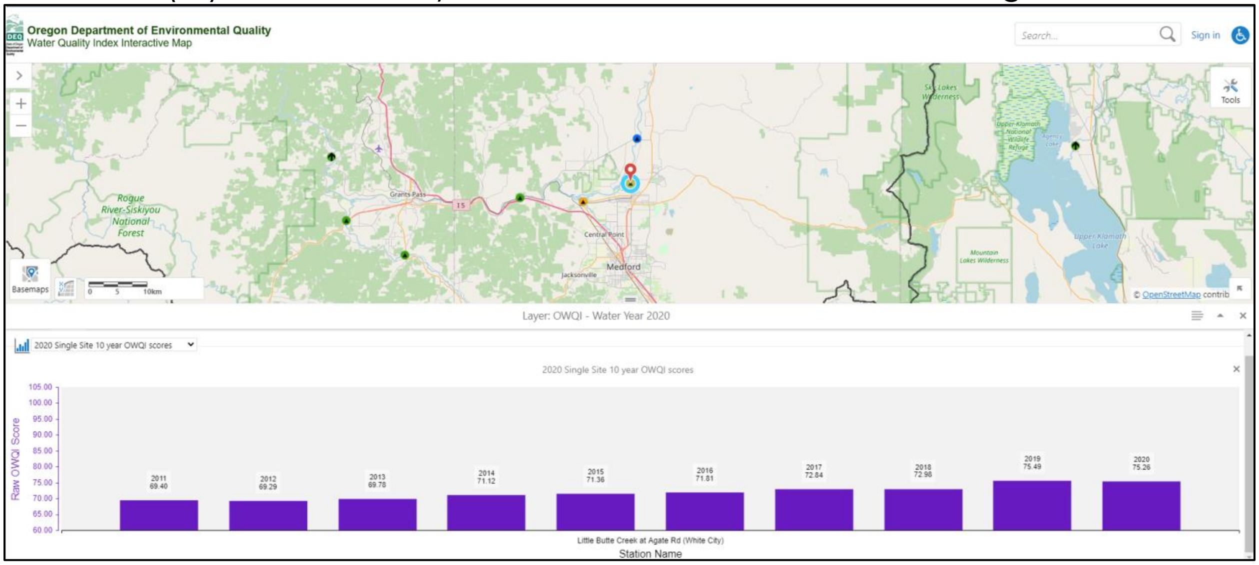
As seen in Figure 5.29 below, there are two OWQI stations located within the project area: one in the Kanutchan Creek sub-basin, and one in the Reese Creek sub-basin. These stations are visited approximately 6 times per year, or every other month. In addition to the OWQI stations, there are several other monitoring sites visited by a variety of organizations within the project area (denoted by varying shapes/colors).

Figure 5.29: Monitoring Locations in the Project Area




In viewing Table 5.21(a.), water quality trends within LBC have improved since 2011 (ranging from a score of ~69 to ~75), while Table 5.21 (b.) shows that trends in the Rogue River at Dodge Park improved from 2011 to 2015, and then began declining (ranging from a score of ~92 to ~93). This is also depicted in Table 5.22, along with the trends of several other OWQI ambient monitoring stations around the state.

## Table 5.21 (a.): Water Quality Index Data – Little Butte Creek at Agate Road




## Table 5.21 (b.): Water Quality Index Data – Rogue River at Dodge Park

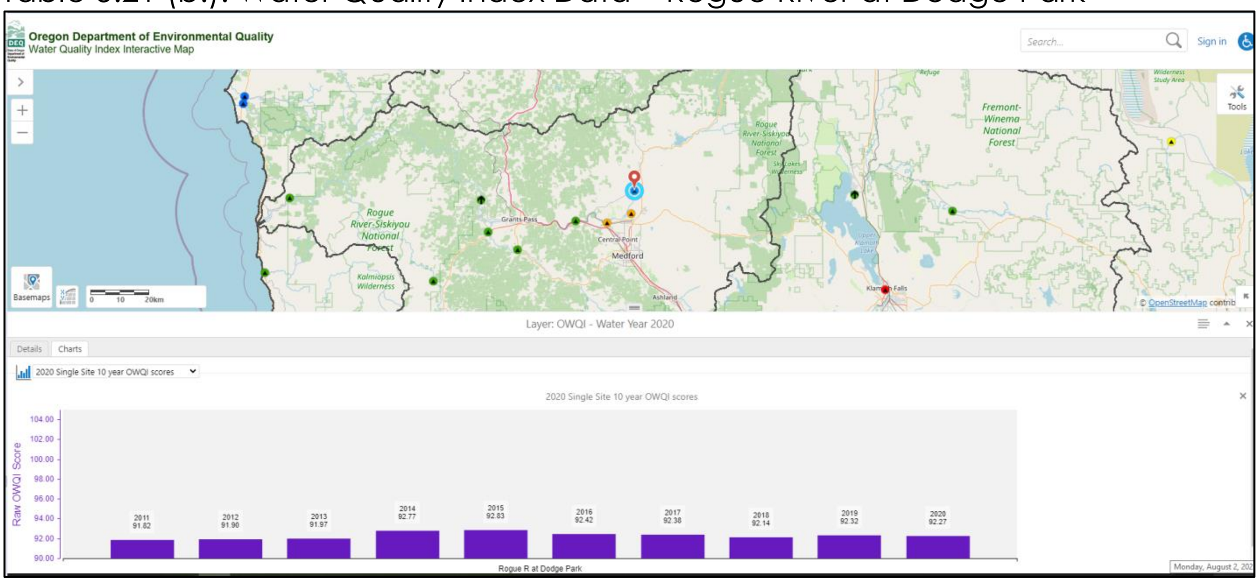


Table 5.22: OWQI Basin Summary

Oregon Department of Environmental Quality

## OWQI Basin Summary

| Station | Location Description | Land Use | Water Year Range | OWQI Score | OWQI Status | OWQI Trend and Magnitude | | OWQI Trend for Past 10 Reporting Years | Sub-Index Status and Trend | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Temp | pH | DO | BOD | TS | N | P | Bact |
| **UMPQUA BASIN** | | | | | | | | | | | | | | | | |
| 10996 | Calapooya Creek at Umpqua | Forest | 2011-20 | 80 | Fair | ↓ | -3.1 | | ↑ | ↑ | | | ↓ | | ↑ | |
| 10997 | Cow Creek at Mouth (Riddle) | Forest | 2011-20 | 86 | Good | ↑ | 2.1 | | | ↑ | ↑ | ↑ | | | ↑ | |
| 10441 | Elk Creek at Elkton | Forest | 2011-20 | 84 | Fair | NT | | | | | | | | | | ↑ |
| 10451 | N Umpqua R at Garden Valley Rd | Mixed | 2011-20 | 88 | Good | NT | | | | | ↓ | | | | ↑ | |
| 11491 | Smith River 4.4 miles ds smith river falls | Forest | 2011-20 | 89 | Good | NT | | | | | ↓ | ↑ | | | ↑ | |
| 11484 | S Umpqua R at Days Creek Cutoff Rd | Forest | 2011-20 | 83 | Fair | NT | | | | ↑ | ↑ | ↑ | ↓ | ↓ | ↑ | |
| 10443 | S Umpqua R at HWY 42 (Winston) | Mixed | 2011-20 | 74 | Poor | NT | | | | ↑ | ↓ | | | | ↑ | |
| 10442 | S Umpqua R at Melrose Rd | Mixed | 2011-20 | 70 | Poor | NT | | | | | ↓ | | | | ↑ | |
| 11522 | S Umpqua R at Stewart Park Rd (Roseburg) | Mixed | 2011-20 | 76 | Poor | NT | | | | | | ↑ | | ↓ | | ↑ |
| 10437 | Umpqua R at Elkton | Forest | 2011-20 | 86 | Good | NT | | | | ↑ | | | | ↓ | ↑ | |
| **ROGUE BASIN** | | | | | | | | | | | | | | | | |
| 10428 | Applegate R at HWY 199 | Forest | 2011-20 | 89 | Good | NT | | | ↑ | ↑ | ↑ | | | | | |
| 36805 | Applegate River at Murphy, OR | Forest | 2012-20 | 89 | Good | NT | | | ↑ | | ↑ | | ↓ | ↓ | | |
| 11051 | Bear Creek at Kirtland Rd | Mixed | 2011-20 | 67 | Poor | NT | | | | ↓ | ↓ | ↑ | ↓ | | ↑ | |
| 11482 | Illinois R ds Kerby | Forest | 2011-20 | 87 | Good | NT | | | ↑ | ↑ | | | ↓ | | ↑ | |
| 10602 | Little Butte Creek at Agate Rd (White City) | Agriculture | 2011-20 | 75 | Poor | NT | | | | | ↓ | ↑ | ↓ | | | |
| 10423 | Rogue R at Dodge Park | Mixed | 2011-20 | 92 | Excellent | NT | | | ↑ | ↑ | ↓ | | | | | |

Overall, the OWQI is helpful in illustrating the general status of water quality within various basins and among differing land uses, as well as which parameters (bacteria, pH, temperature, etc.) are improving, degrading, or remaining stable.

## 6.0 DESCRIPTION OF POTENTIAL CONTAMINANTS OF CONCERN

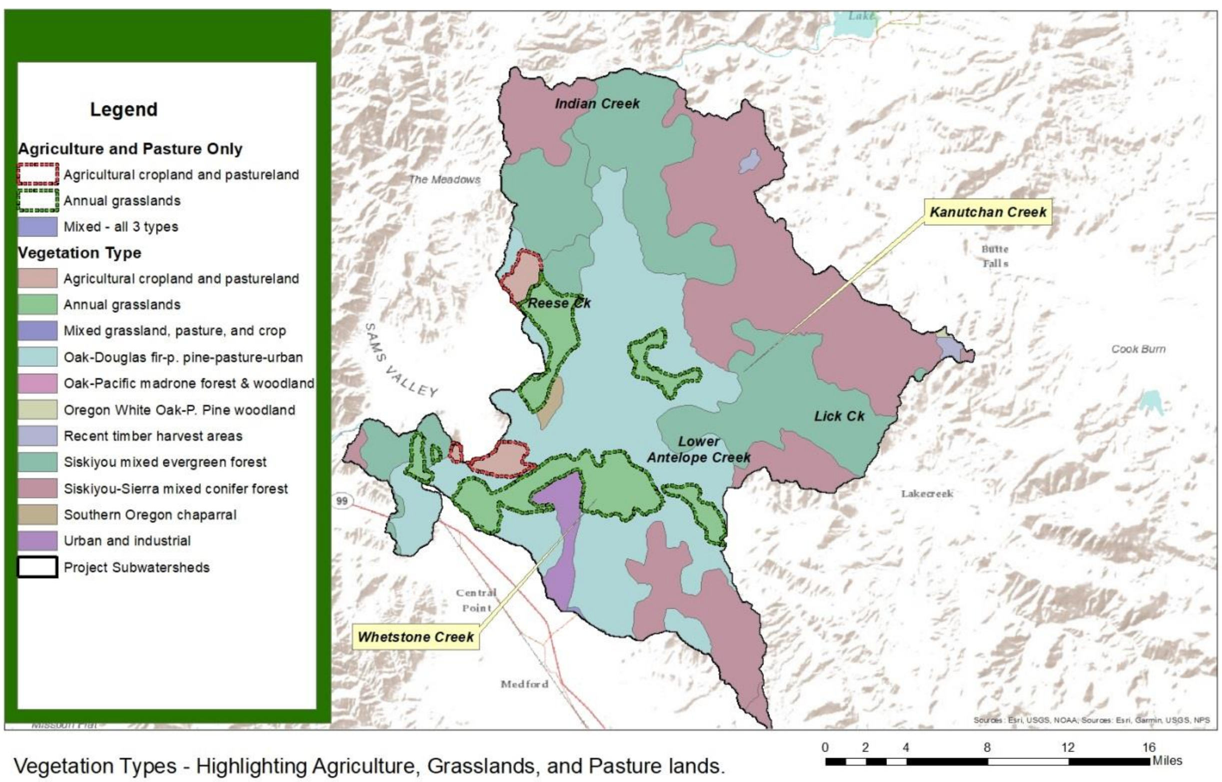
### 6.1 Agriculture

*Vegetation Types*

Vegetation type within the project area does not vary largely when looking at the project area from a wide (30,000 foot) level. Based on the data layers displayed in figure 6.1, there are about ten different types, with Siskiyou-Sierra mixed conifer forests, Siskiyou mixed evergreen forests, and Oak-Douglas Fir pasture/urban areas as the dominant types (Figure 6.1). Additionally, there are also small patches of agricultural croplands and pasturelands, and more substantial areas of annual grasslands.

More specific vegetation data (e.g., parcel by parcel basis) is needed for a more detailed analysis and is identified as a gap for the project area.

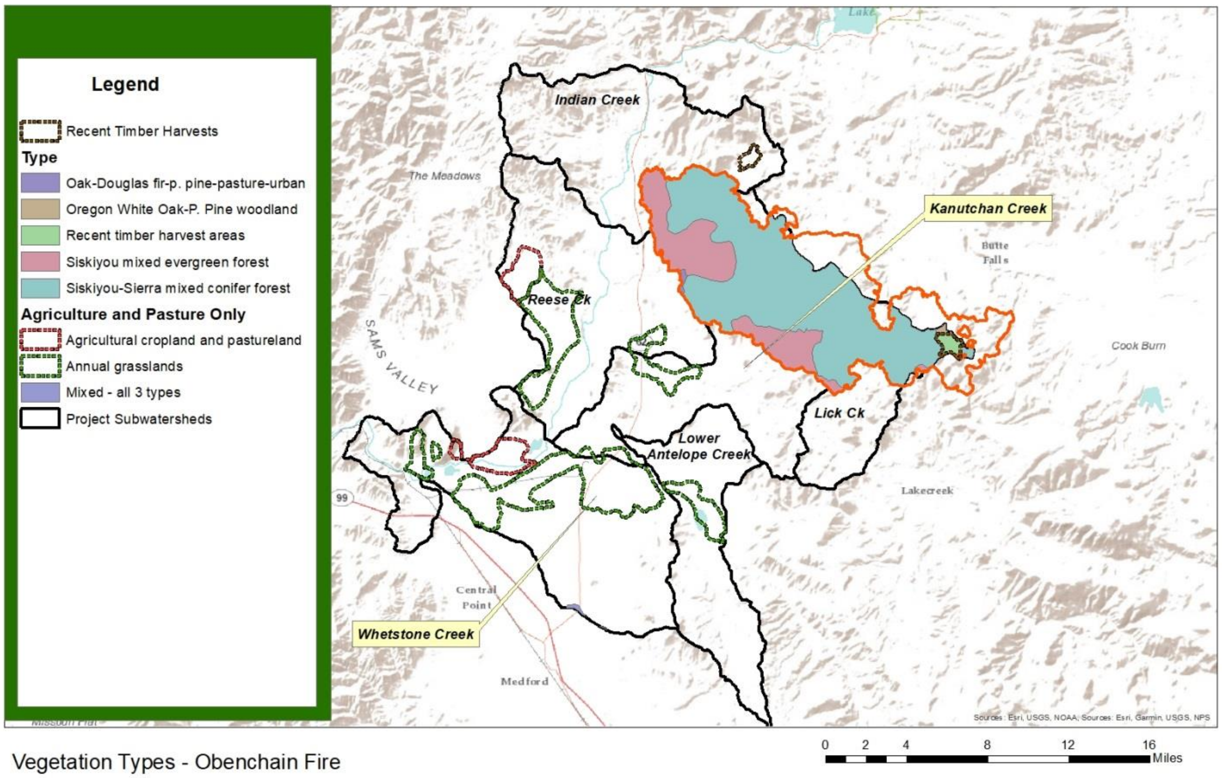
Figure 6.1: Vegetation Types in the Project Area




Vegetation Types - Highlighting Agriculture, Grasslands, and Pasture lands.

The South Obenchain Fire of September 2020 impacted much of the northeastern area, both Siskiyou-Sierra mixed conifer forests and Siskiyou mixed evergreen forests (Figure 6.2). With the loss of strong roots holding soils in place, erosion prevention and sediment control (EPSC) measures and seeding were implemented by JSWCD and other organizations within some areas where the fire burned. These EPSC measures were aimed at protecting steep slopes and the subsequent water quality impacts caused by sediments pouring into waterways.

Figure 6.2: Vegetation Types Highlighted within the Obenchain Fire Area




Vegetation Types - Obenchain Fire

*Crop Growing Operations*

According to Meghan Montgomery, Agricultural Resource Conservationist for JSWCD, agriculture within the project area, with the exception of the Whetstone Creek sub-basin, is comprised of mostly flood-irrigated pasture for hay and grazing-based operations, and non-irrigated dryland for rangeland grazing. At a smaller scale, there is also sprinkler-irrigated pasture for hay and grazing, drip-irrigated hemp and marijuana growing operations, limited amounts of irrigated row crops, and vineyards.

The Whetstone Creek sub-basin is comprised of irrigated agriculture, specifically pasture, hemp, orchards, and vineyards. Additionally, this sub-basin is also significantly impacted by urban inputs, such as industrial processes and commercial activities (per email on 8/26/2021).

Potential impacts based on land use/crop growing include bacteria, nutrients, herbicides, pesticides, etc. entering waterways along with runoff. In addition, active animal operations near streams have the potential to impact the riparian zones with damage to vegetation from browsing or trampling. In addition, depending on the method, operations could also result in erosion of soils from not providing any cover or conservation crops, from loss due to livestock and animals, and from runoff from irrigation practices.

The NRCS implements conservation practice standards and codes, essentially BMPs, to protect natural resources. For example, Feed Management (code 592) is a conservation code described as "the practice of managing the quantity and quality of available nutrients, feedstuffs, or additives fed to livestock and poultry for their intended purpose" (NRCS, 2021). Feed management reduces the quantity of nutrients (nitrogen and phosphorus) excreted in manure and prevents excess pathogens and chemicals in manure, biosolids, and compost. This practice can protect both air quality and water quality. For additional information on NRCS Practice Codes, see the Resource Guide at the end of this document.

Other potential practice codes to evaluate include 580 (streambank and shoreline protection), 382 (Fencing), 393 (filter strips), 659 (wetland enhancement), 342 (planting of critical areas), 327 and 328 (conservation crops), 340 (cover crops), and 612 (Tree/shrub establishment).

*Animal Feeding Operations*

There are two registered and permitted CAFOs located in the project area (locations are shown in Figure 3.1). In addition, there are other livestock operations that do not meet the CAFO criteria, which are summarized as housing more than 1,000 animal units (defined as an animal equivalent of 1,000 pounds live weight) for more than 45 days during the year, and therefore are not registered and are not required to hold permits (for more information see Table 6.1).

Livestock manure and urine can pollute both ground and surface water with nutrients and organic matter. The waste contains nitrogen and phosphorus, nutrients which can lead to cyanoHABs and subsequent fish kills. In addition to the nutrients, waste carries sediments, hormones, antibiotics, ammonia (another nutrient), heavy metals, and pathogens. Ammonia is highly toxic to fish and can be converted to nitrates that are poisonous to adults and deadly for infants. In addition to pathogens, "parasites from livestock waste can cause disease in humans. Giardia and Cryptosporidia are considered to be the two most important waterborne protozoa carried by livestock, according to the University of Minnesota Extension" (Oregon Public Broadcasting, OPB, 2012).

In order to acquire and maintain an Oregon CAFO permit, permittees must follow an Animal Waste Management Plan (AWMP) or a Nutrient Management Plan (NMP) to protect water quality. The minimum requirements of these plans include: strategies for collection, storage, transfer, and use; a description of the production area and land application locations; manure, litter, and process waste volumes; details on contaminated stormwater; nutrient content of manure, litter, and process waste water; farm nutrient balance (specific amounts of nitrogen, phosphorus, and potassium); animal mortality management; testing and monitoring; record keeping; and reporting to the Oregon Department of Agriculture. For the full AWMP and NMP Minimum Required Elements Worksheet, see the Resource Guide toward the end of this document.

Table 6.1: CAFO Criteria

| Animal Sector | Size Thresholds (number of animals) | | |
|---|---|---|---|
| | **Large CAFOs** | **Medium CAFOs[1]** | **Small CAFOs[2]** |
| cattle or cow/calf pairs | 1,000 or more | 300 - 999 | less than 300 |
| mature dairy cattle | 700 or more | 200 - 699 | less than 200 |
| veal calves | 1,000 or more | 300 - 999 | less than 300 |
| swine (weighing over 55 pounds) | 2,500 or more | 750 - 2,499 | less than 750 |
| swine (weighing less than 55 pounds) | 10,000 or more | 3,000 - 9,999 | less than 3,000 |
| horses | 500 or more | 150 - 499 | less than 150 |
| sheep or lambs | 10,000 or more | 3,000 - 9,999 | less than 3,000 |
| turkeys | 55,000 or more | 16,500 - 54,999 | less than 16,500 |
| laying hens or broilers (liquid manure handling systems) | 30,000 or more | 9,000 - 29,999 | less than 9,000 |
| chickens other than laying hens (other than a liquid manure handling systems) | 125,000 or more | 37,500 - 124,999 | less than 37,500 |
| laying hens (other than a liquid manure handling systems) | 82,000 or more | 25,000 - 81,999 | less than 25,000 |
| ducks (other than a liquid manure handling systems) | 30,000 or more | 10,000 - 29,999 | less than 10,000 |
| ducks (liquid manure handling systems) | 5,000 or more | 1,500 - 4,999 | less than 1,500 |

[1]Must also meet one of two "method of discharge" criteria to be defined as a CAFO or may be designated.
[2] Never a CAFO by regulatory definition, but may be designated as a CAFO on a case-by-case basis.

Detailed information and analysis on the CAFOs is currently a gap. Ongoing research is looking at how close the operations are to waterways, if there are manure management plans, and other information needed to evaluate potential risks and assign codes as needed.

### 6.2 Forestry

Research on this topic is ongoing and areas that are currently being actively managed or recently managed are being identified. Activities that occur on steep slopes, near waterways, on recently burned areas, or in fire prone areas are of particular concern. In addition, information on practices that are being used to manage the areas (equipment, herbicides, etc.) are also being collected and mapped.

### 6.3 Human-Built Environment

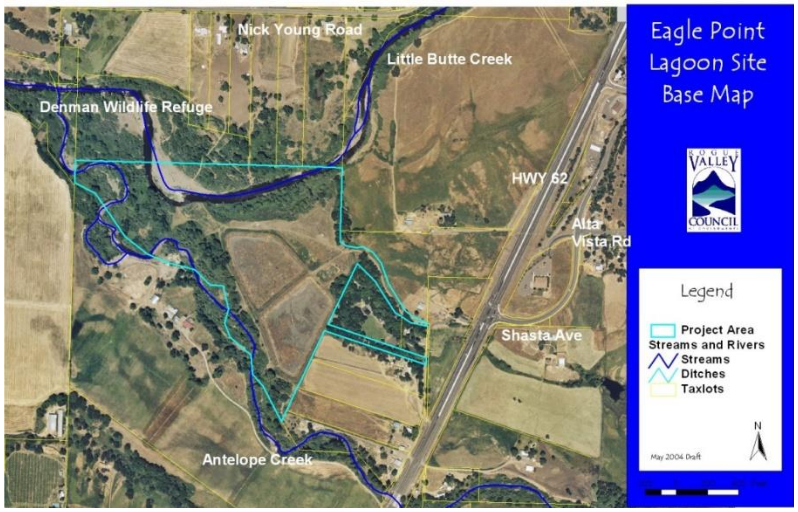
*Urban and Industrial Wastewater Lagoons*

There is an old sewage treatment lagoon downstream of the City of Eagle Point that was used by the City until the mid-1990's when the lagoon was shut down after the City connected to the Rogue Valley Sewer Services network. In 2004, the City commissioned RVCOG to complete a study. Full details on the study can be found in the report which is available digitally and in select libraries (e.g., RVCOG). A summary of the lagoon system and study results follows.

The lagoons are located on a 48-acre parcel owned by the City of Eagle Point located west of Highway 62 and south of the City of Eagle Point. Little Butte Creek flows along the northern section of the property, and Antelope Creek flows along the south (Figure 1-1). The parcel served as the primary sewage treatment system for the City from the 1950's to 1996. The system was incapable of handling flows in the winter as the City grew, resulting in the City connecting with the Rogue Valley Sewer Services (RVS) system in the mid 1990's.

The site consists of three treatment ponds (two large ponds and a smaller pond), relic treatment structures (pipes, aerators, small buildings), a storage area used by the City, and gravel access roads on the site. The parcel also includes grassed open areas, riparian areas, and wetlands. The site has not been actively used since connection to the RVS system, with the exception of the City storage area. With its location, current use, planned use, and decades of not being in use in mind, the site is not considered a low risk. The RRWC implemented an ecological restoration project at this site in 2018 to stabilize the eroding streambanks, reconnect side channels, and revegetate the riparian area.

Figure 6.3: Eagle Point Lagoon Site




As part of the study, limited soil samples were taken. Sampling indicated that there were only trace amounts of metals on site.

*Septic Systems*

Research on these topics is ongoing. As of the draft date, no specific information was identified.

*Active and Non-Active Landfills*

Dry Creek Landfill is located within the Lower Antelope Creek Subbasin. Monitoring data for the last decade was downloaded from AWQMS and contains samples of wells, rivers/streams, and leachate. In reviewing the well samples, detectable levels (noted above reporting or detection limits) of aluminum, ammonia, antimony, arsenic, barium, boron, cadmium, calcium, chemical oxygen demand, chloride, chloroethane, copper, lead, nickel, uranium, and others were reported.

In addition, while not landfills, Southern Oregon Sanitation is located in the Reese Creek Subbasin and Rogue Transfer and Recycling Station is located in the Whetstone Creek Subbasin. Materials of all types are deposited at these stations.

*Mining (Active/Abandoned), Petroleum Operations, and Underground Injection*

Research on these topics is ongoing. As of the draft date, no specific information was identified and is considered a gap.

*Potential Contaminant Sources (PCS) and Source Water Assessment Information*

High risk land uses were identified in the project by DEQ and others and are shown in Figure 3.1. Studies are underway in the project area commissioned by the Medford Water Commission to use this data and other information including the Hazardous Substance Information System/Fire Marshall Data base to delineate and rank potential risks to water intakes and source water areas.

A map showing information used in the rankings and the revised rankings is in development.

## 6.4 Contaminant Physical and Chemical Properties

Naturally-occurring contaminants and contaminants introduced by people can be present in water systems. Natural chemical or mineral contaminants may include arsenic and radon. Contaminants introduced by people result from land use, stormwater overflow, and other events happening near a source including spills and illegal dumping.

Both physical and chemical properties will influence modes of transport. Properties include solubility, size, and dissolvability.

## 6.5 Climate Change

Over the last 20 years, the region is beginning to see a change in climatic conditions that is impacting water supply and water quality. Warmer temperatures, less snow and snowpack, and less overall precipitation events have led to repeated droughts, insufficient recharge of surface water (reservoir systems) and groundwater aquifers, and increased frequency and intensity of wildfires.

*Drought*

According to current data from the National Oceanic and Atmospheric Administration (NOAA) regarding drought conditions in Oregon, this year is currently the $12^{th}$ driest year in 127 years of record with precipitation levels almost 7.5 inches below normal (Figure 6.4(a.)).

Figure 6.4 (a.): Current Drought Conditions for Jackson County

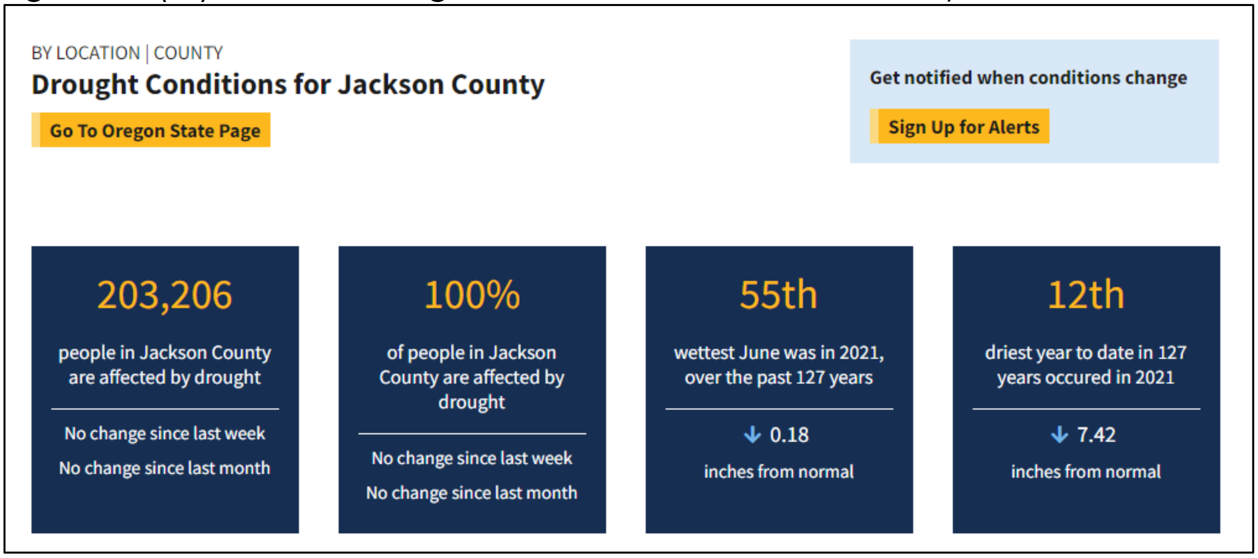



Figure 6.4 (b.) shows that over half of the County is in Extreme drought which includes most of the project area.

Figure 6.4 (b.): Map of Drought Conditions in Jackson County

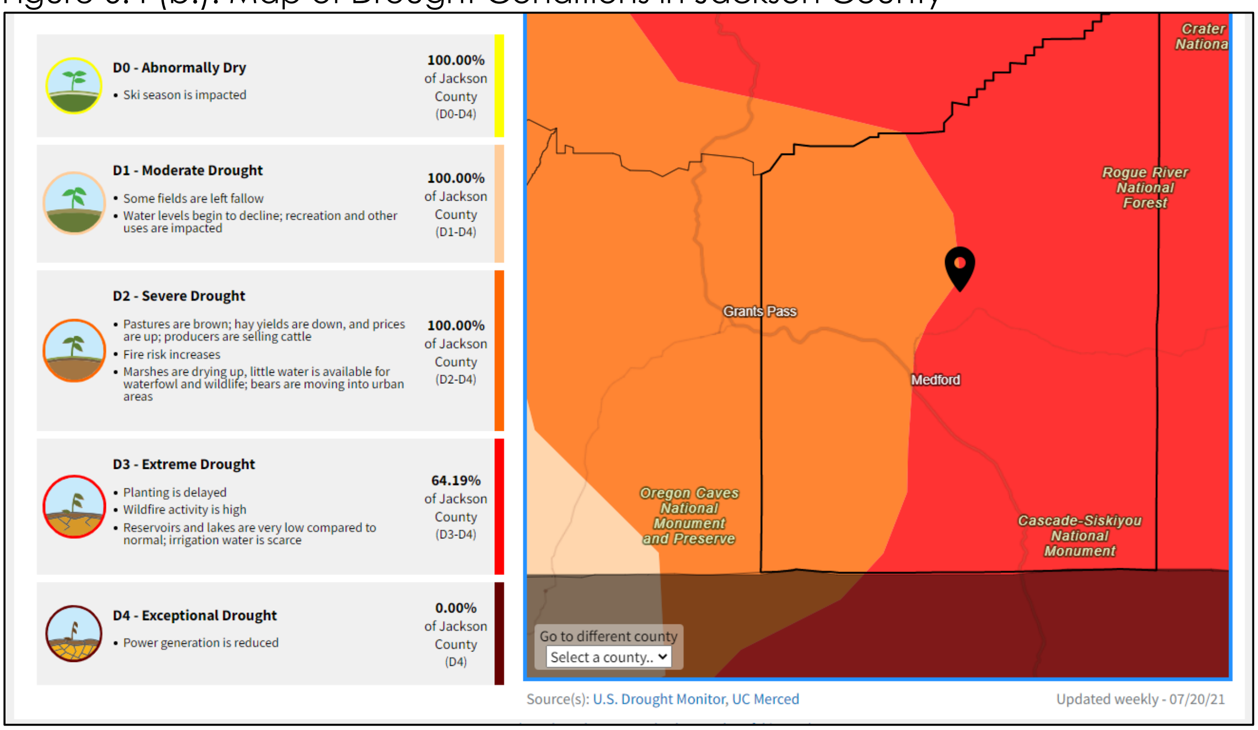



Figure 6.4 (c.) shows a similar pattern or drought impacting agriculture in the project area.

Figure 6.4 (c.): Drought Impact to Local Agriculture

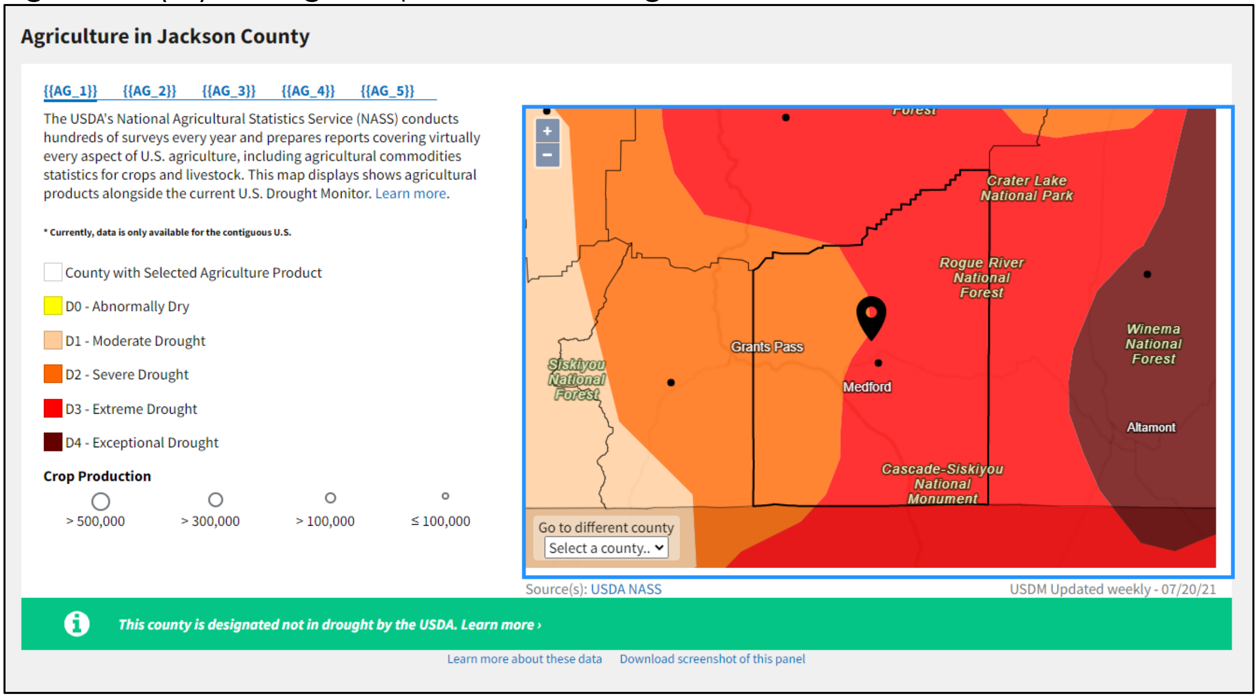
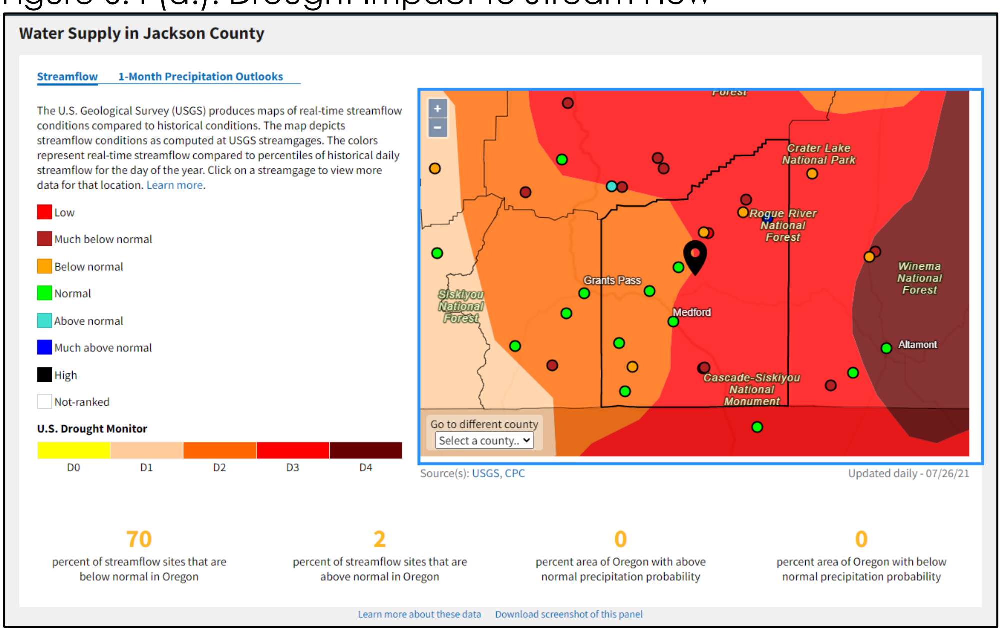



Figure 6.4 (d.) highlights that water supplies are being greatly impacted in the watershed, with monitoring points showing below normal to low stream flow.

Figure 6.4 (d.): Drought Impact to Stream Flow




Figures 6.5 (a.) and (b.) show that the conditions that we are experiencing this year have occurred numerous times over the last 20 years. For example, we have experienced extreme drought conditions in parts or all of 2001, 2002, 2014-

2016, 2019, 2020-2021. Less severe droughts have been recorded in 2002, 2005, 2010, 2011, 2013-2016, and 2019-2021.

Figure 6.5 (a.): Historical Extreme Drought Conditions 2001-2021

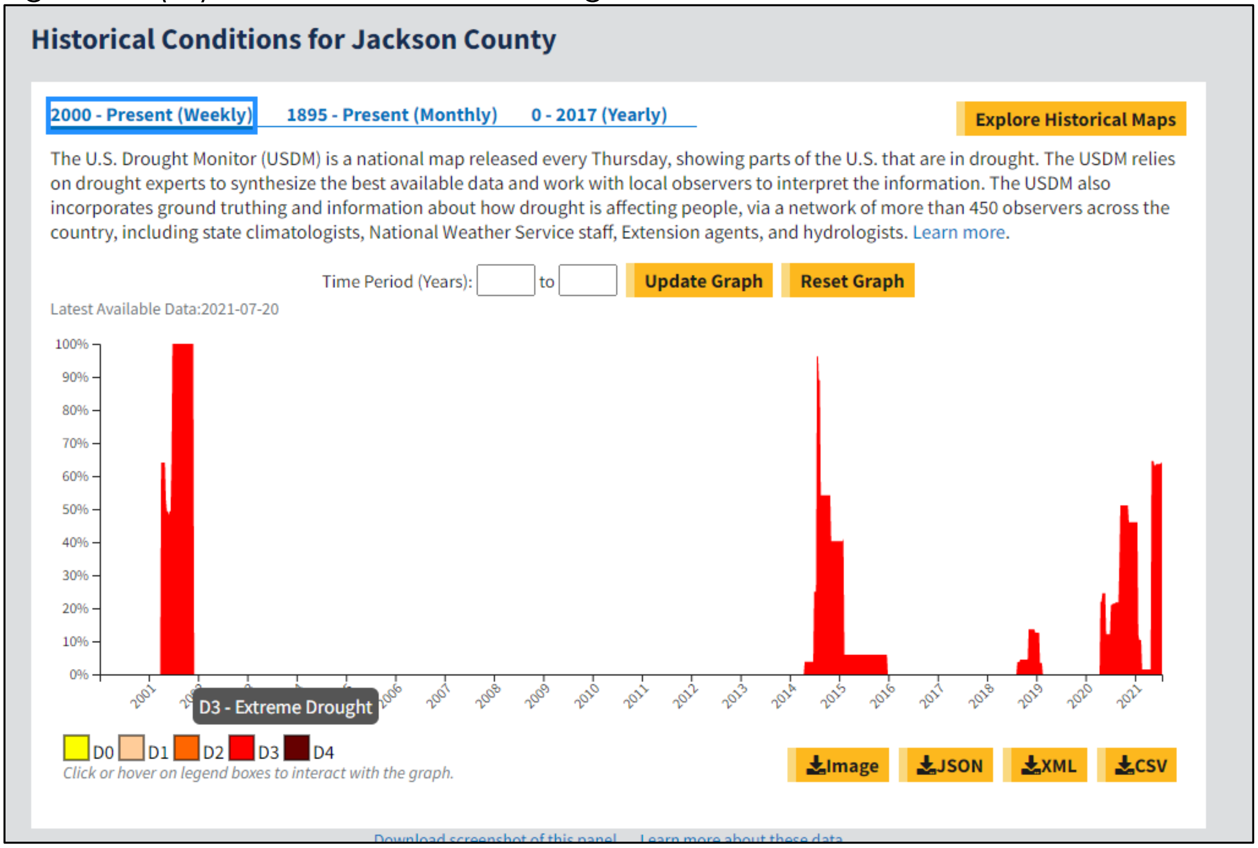
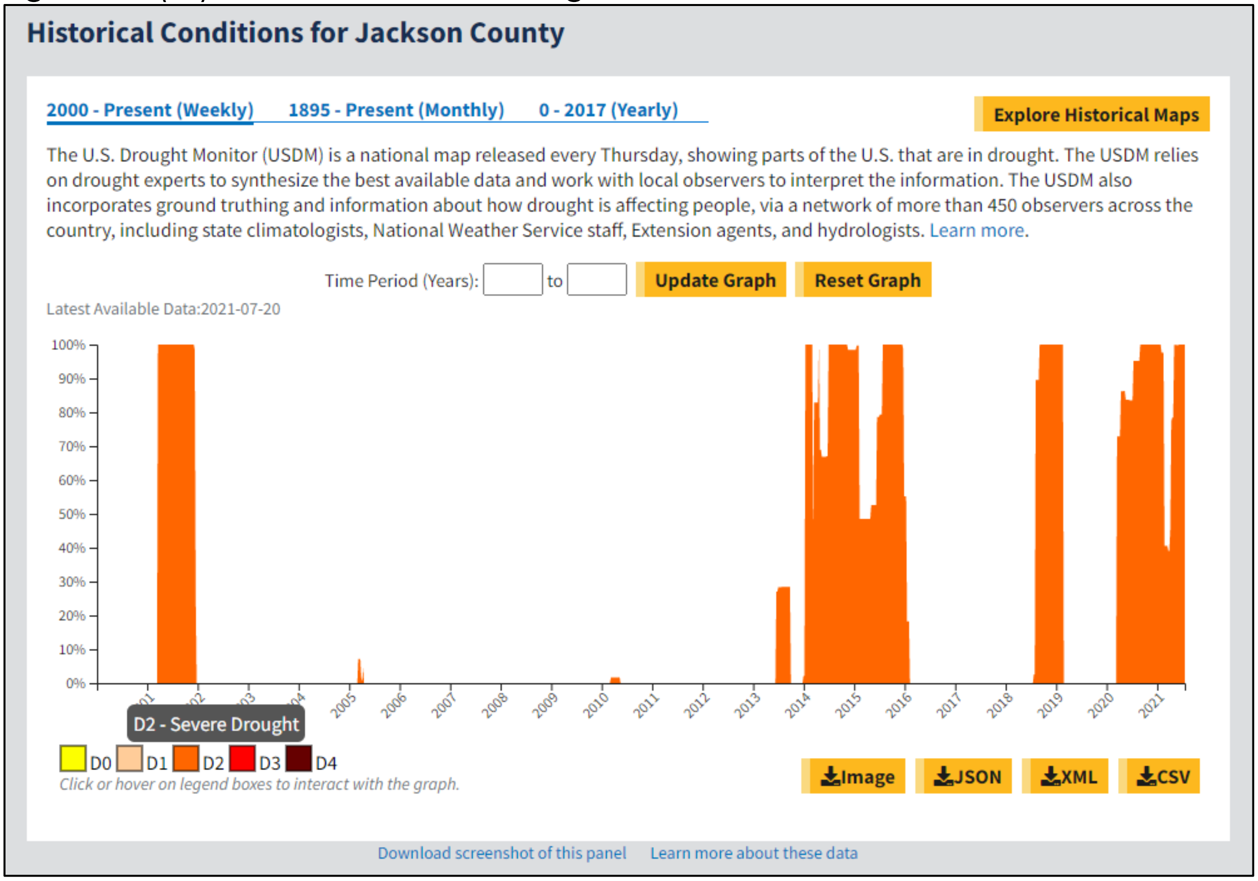


Figure 6.5 (b.): Historical Severe Drought Conditions 2001-2021




As of 2021, the OWRD reports that the request for Emergency Use Well Permits has drastically increased as the agricultural community searches for ways to find water. Wells are also reported to be increasingly dry resulting in the drilling of both new, deeper wells. In addition, the reported illegal use of wells has also increased (OWRD 2021).

To further illustrate the severity of the current drought, stream volumes in acre-feet in LBC near Lake Creek have been below average since November 2020 (depicted in Table 6.1 and Figures 6.6 (a.) and (b.)). Stream flow data for the Rogue River at Raygold are less promising, with stream volumes depicted as below average since approximately November 2019 (Figures 6.7 (a.) and (b.)).

Table 6.2: Little Butte Creek near Lake Creek – Stream Flow during Drought (October 2020 – September 2021)

**Nf Little Butte Ck Nr Lakecreek (14342500)**
**Oregon STREAMFLOW Site - 4571 ft**
**Reporting Frequency: Monthly; Date Range: Oct 2020 to Sep 2021**

(As of: Mon Aug 09 14:07:27 GMT-08:00 2021)
**Provisional data, subject to revision**

| Date | Stream Volume, Adjusted (ac_ft) | Normal Stream Volume, Adjusted (1981-2010) (ac_ft) | Stream Volume, Adjusted % of Normal (1981-2010) |
|---|---|---|---|
| Oct 2020 | 1329 | 1179 | 113 |
| Nov 2020 | 955 | 988 | 97 |
| Dec 2020 | 811 | 1101 | 74 |
| Jan 2021 | 791 | 1164 | 68 |
| Feb 2021 | 679 | 1114 | 61 |
| Mar 2021 | 620 | 1244 | 50 |
| Apr 2021 | 826 | 1444 | 57 |
| May 2021 | 1240 | 2036 | 61 |
| Jun 2021 | 2299 | 2582 | 89 |
| Jul 2021 | | 4080 | |
| Aug 2021 | | 4240 | |
| Sep 2021 | | 2880 | |

Figure 6.6 (a.): Little Butte Creek near Lake Creek – Stream Flow during Drought (October 2020 – September 2021)

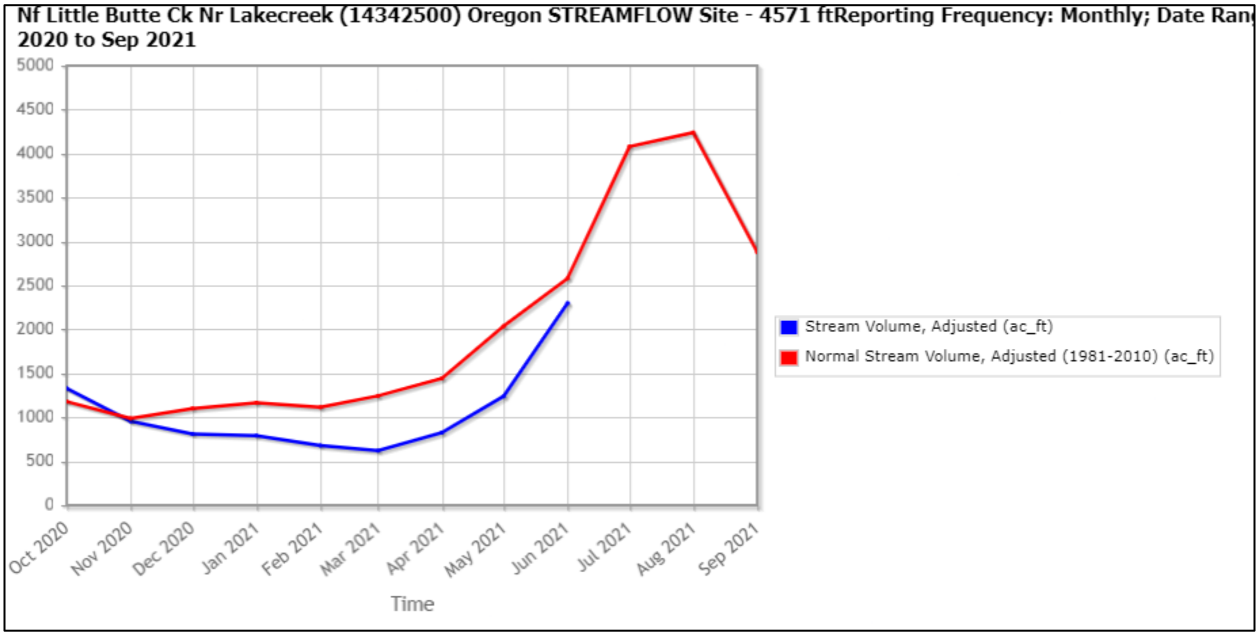



Figure 6.6 (b.): Little Butte Creek near Lake Creek – Stream Flow during Drought (October 2015 – October 2021)

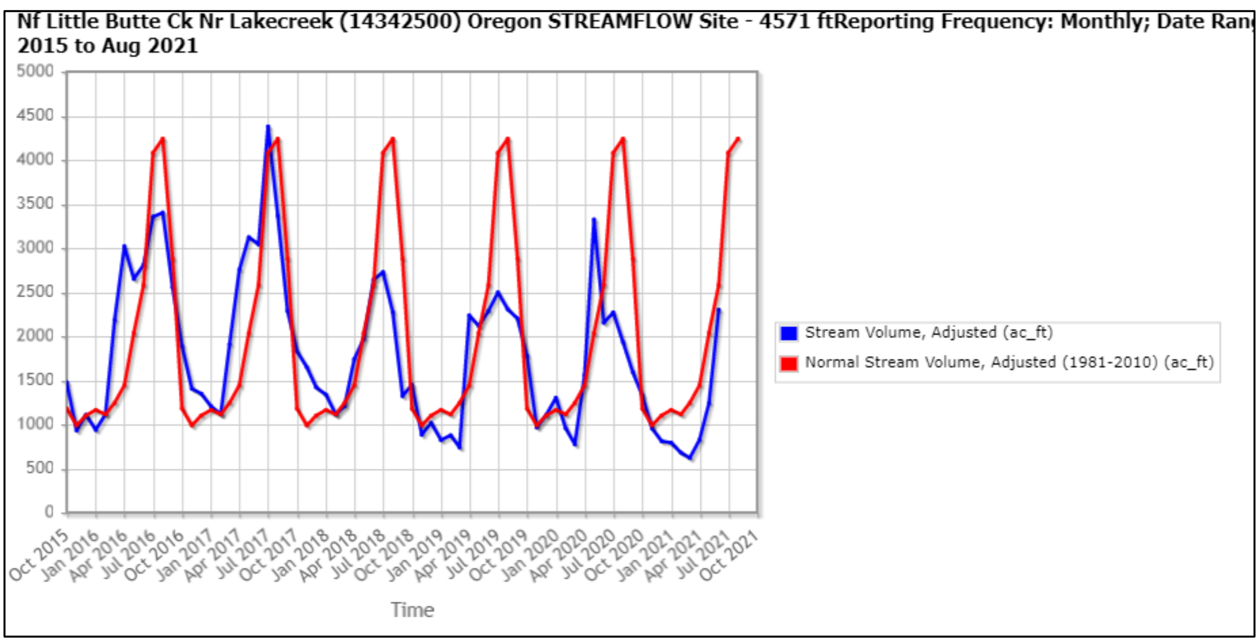


Figure 6.7 (a.): Rogue River at Raygold – Stream Flow during Drought (October 2020 – September 2021)

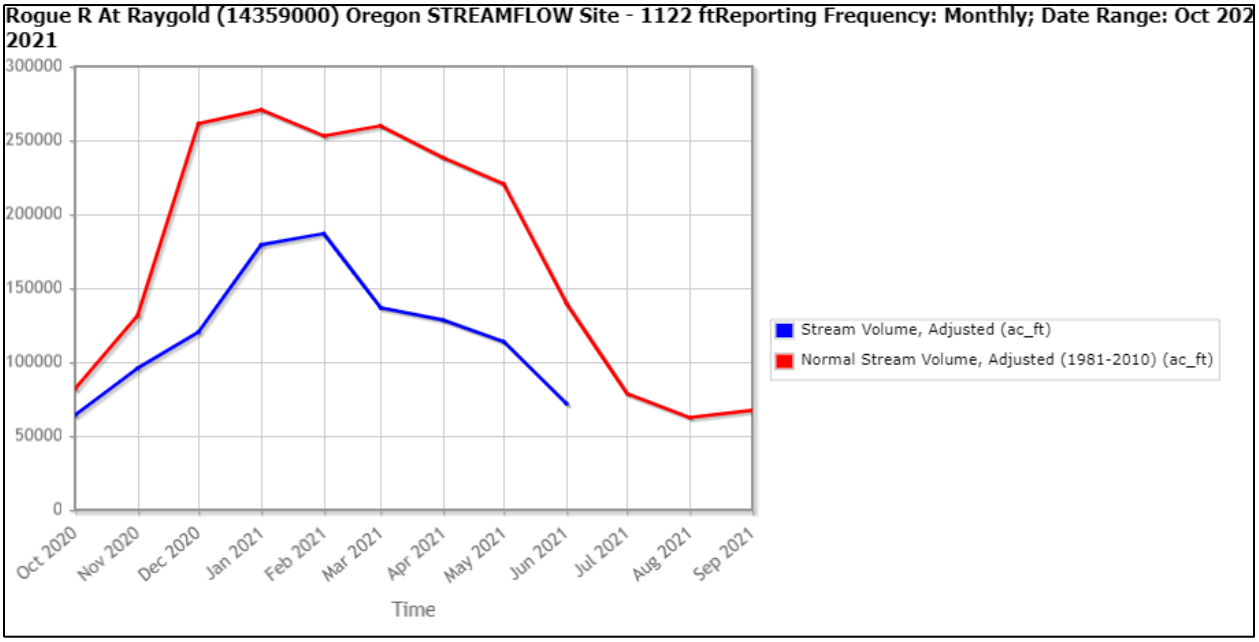
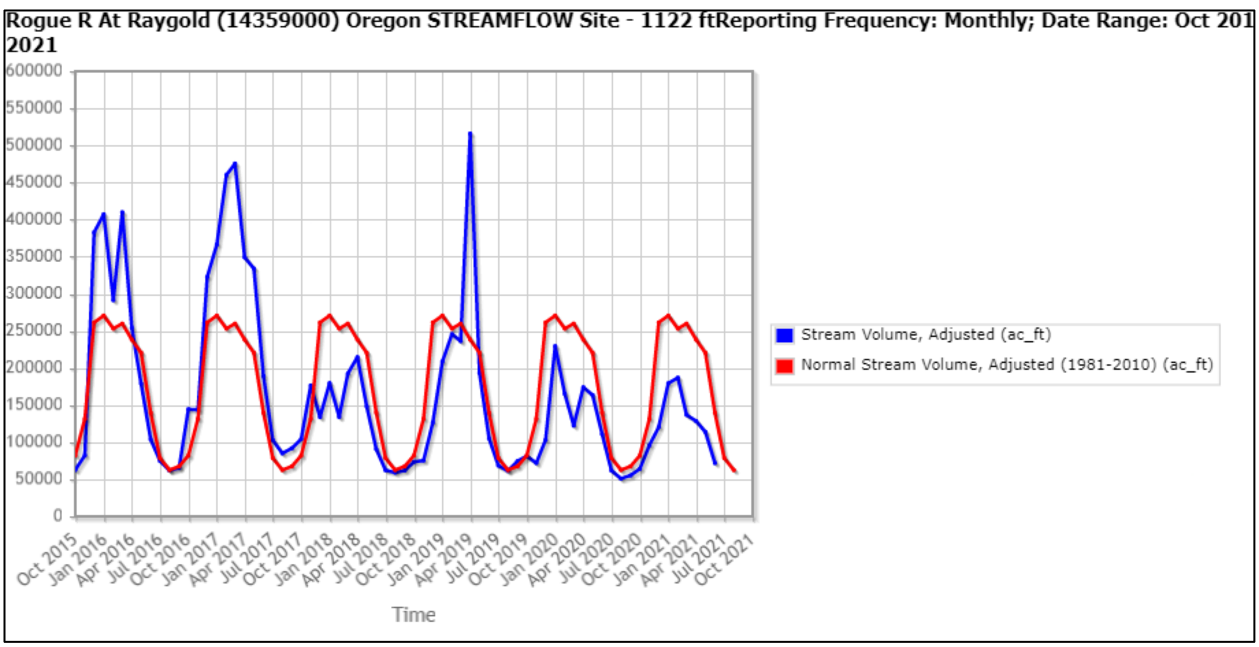


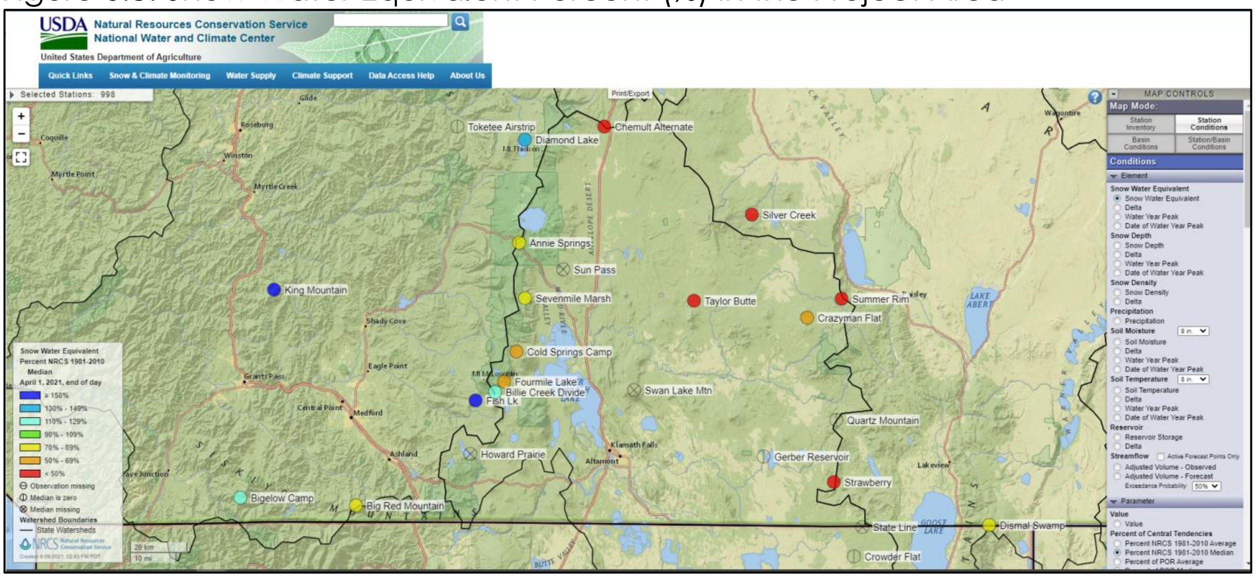

Figure 6.7 (b.): Rogue River at Raygold – Stream Flow during Drought (October 2015 – October 2021)



*Snowpack*

There has been a steady decline in snowpack over the last few decades based on SNOWTEL sites. Stations are reporting less snowpack overall and at higher elevations (e.g., lower elevation stations may no longer record snow levels that had historically had snow). Figure 6.8 shows several sites that have historically provided snow as water. While none of these sites lie directly within the project area, it is concerning that more than half are experiencing declining snow water equivalent percentages.

Figure 6.8: Snow Water Equivalent Percent (%) in the Project Area




For example, Annie Springs is currently providing only 70% to 89% of its historic snow as water, and is experiencing less than average precipitation events (Figures 6.9 and 6.10). On the opposite side of the spectrum, Fish Lake is providing more than 150% of its historic snow as water (shown in Figure 6.11).

Figure 6.9: Snow Water Equivalent at Annie Springs

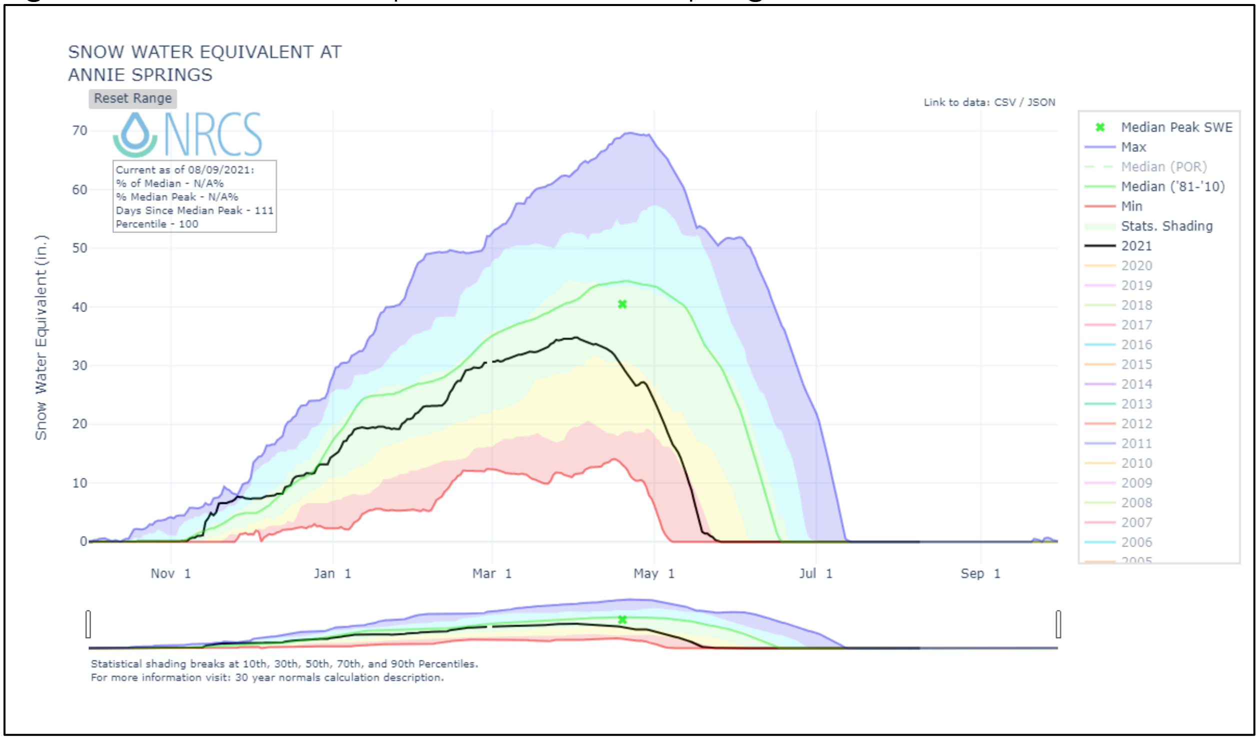



Figure 6.10: Precipitation at Annie Springs

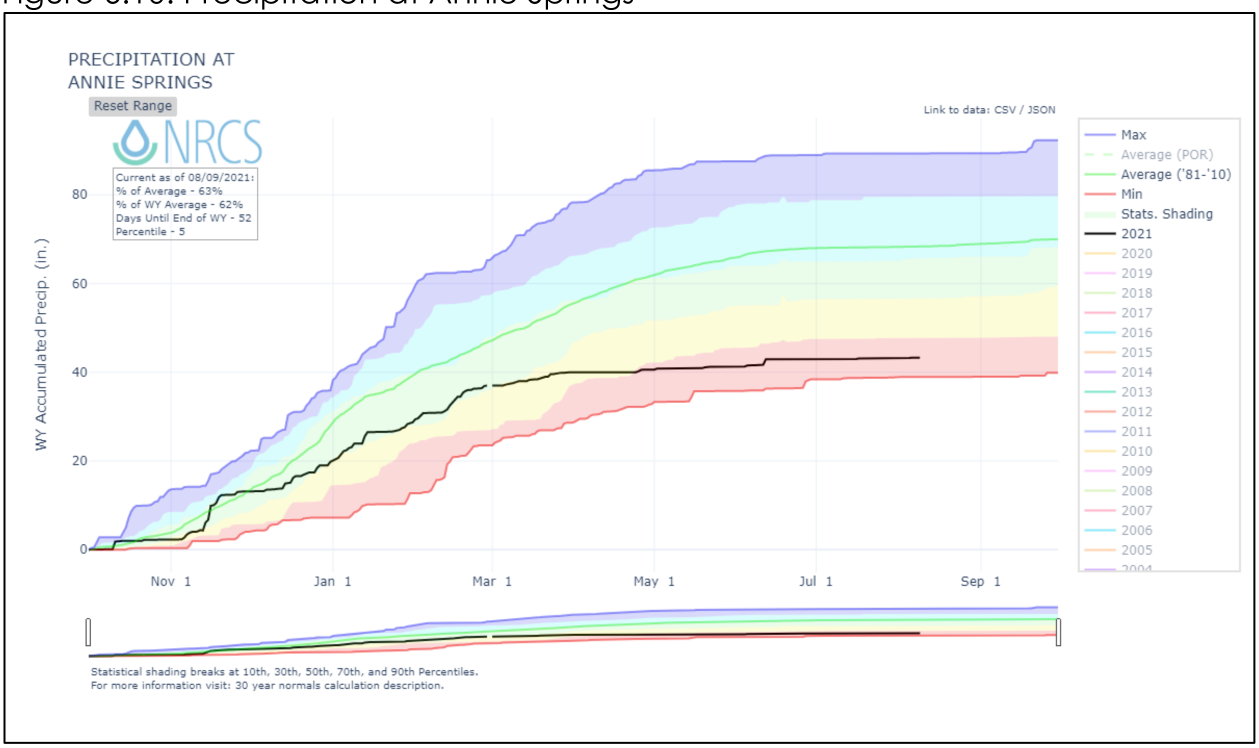
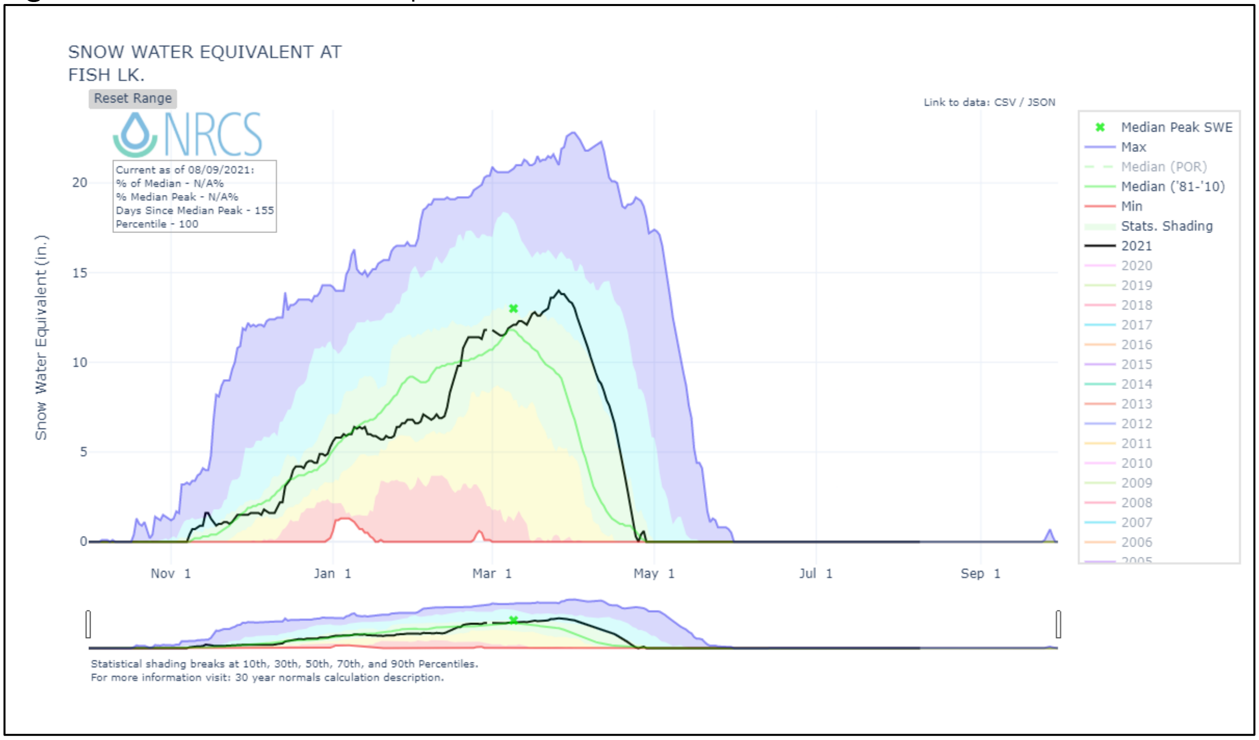


Figure 6.11: Snow Water Equivalent at Fish Lake

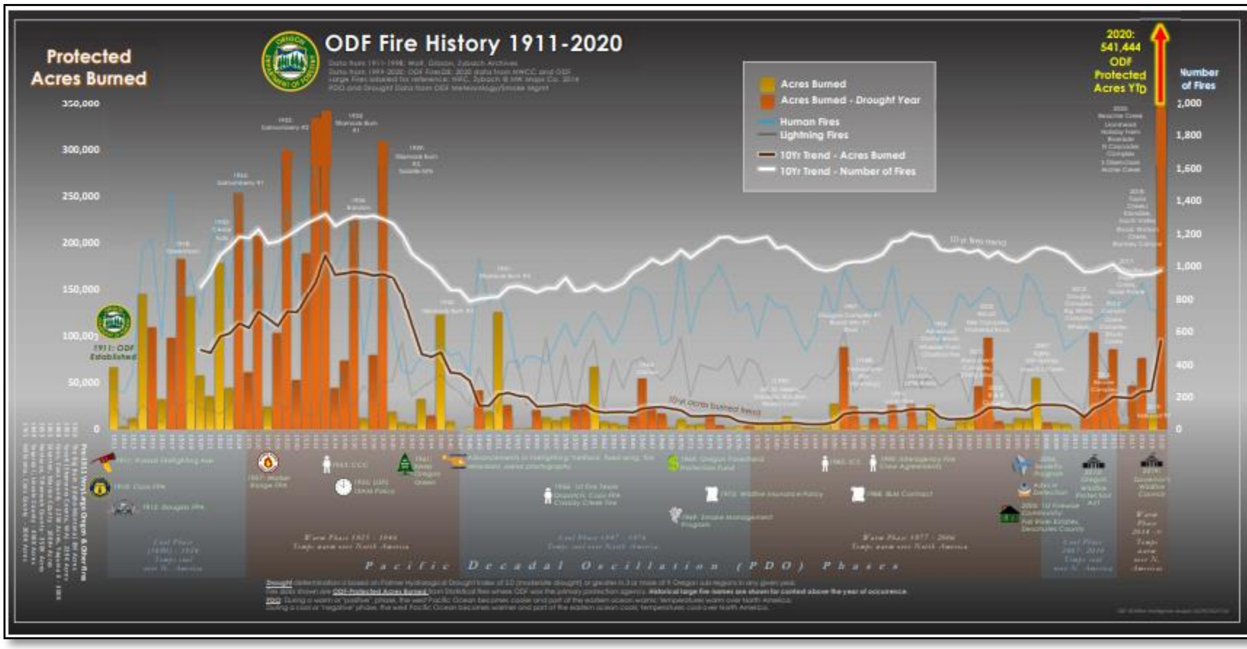



*Wildfires*

Oregon overall has seen an increased frequency in the number of fires, as well as larger fires, which are extremely devastating to local communities and forests. Figure 6.12 shows the recent uptick in the number of wildfires impacting the state, including the Beachie Creek, Lionshead, Holiday Farm, Riverside, North Cascades Complex, South Obenchain (southwestern Oregon), and Archie Creek (southwestern Oregon) fires of 2020. These fires began on September 7th, 2020 and were fueled by hot, dry, and windy conditions. Over one million acres were burned, which amounts to twice the 10-year average of burned acres (Oregon Office of Emergency Management, 2020).

Fire data for 2021 for all of Oregon (as of August 25th, 2021) shows that there have been 724 human-caused fires that have burned over 26,000 acres, and 191 lightning-caused fires that have burned over 159,000 acres. Southwestern Oregon alone has experienced 214 human-caused fires (247.23 acres burned), and 63 lightning-caused fires (58.73 acres burned) (Oregon Department of Forestry, 2021).

Figure 6.12: ODF Fire History – 1911-2020




**RESOURCE ANALYSIS AND SOURCE ASSESSMENT (Future Phase)**

## 7.0 SOURCE CAUSES OF THE SURFACE WATER CONTAMINATION PROBLEM

### 7.1 Agricultural Activities

### 7.2 Critical Agriculture Areas Identified Based on GIS Analysis

### 7.3 Commercial Forestry Activities

### 7.4 Aquifers/Areas Where Groundwater Quality is Impacted

## 8.0 ANALYSIS OF TREATMENT AND OPPORTUNITIES

### 8.1 Level of Treatment in the Watershed: Current Mitigation Programs

### 8.2 Chemical Collection

### 8.3 Water Quality and Agricultural Programs

### 8.4 Conservation Implementation Strategies (NRCS, ODA, JSWCD)

## Appendix A: PCS Information

### Potential Contaminant Sources and Potential Water Quality Impacts (High Risk to Groundwater and/or Surface Water)

| PCS Code | TYPE OF ACTIVITY | GW Risk | SW Risk | POTENTIAL WATER QUALITY IMPACTS |
|---|---|---|---|---|
| C03 | Automobiles - Gas Stations | H | M | Spills, leaks, or improper handling of fuels and other materials during transportation, transfer, and storage may impact the drinking water supply. |
| C07 | Chemical/Petroleum Processing/Storage | H | H | Spills, leaks, or improper handling of chemicals and other materials during transportation, use, storage and disposal may impact the drinking water supply. |
| C18 | Mining Activities - Gravel Mines/Gravel Pits | H | H | Spills, leaks, or improper handling of chemicals and wastes generated in mining operations or from heavy equipment may impact the drinking water supply. |
| C21 | Photo Processing/Printing | H | H | Spills, leaks, or improper handling of photographic chemicals during transportation, use, storage and disposal may impact the drinking water supply. |
| C25 | Wood Preserving/Treating | H | H | Spills, leaks, or improper handling of chemicals and other materials during transportation, use, storage and disposal may impact the drinking water supply. |
| C26 | Wood/Pulp/Paper Processing and Mills | H | H | Spills, leaks, or improper handling of wood preservatives and other chemicals during transportation, use, storage and disposal may impact the drinking water supply. |
| A03 | Confined Animal Feeding Operations (CAFOs) | H | H | Improper storage and management of animal wastes and wastewater in areas of concentrated animals may impact drinking water. |
| M31 | Large Capacity Septic Systems (serves > 20 people) - Class V UICs | H | M | If not properly sited, designed, installed, and maintained, septic systems can impact drinking water. |
| M32 | Construction/Demolition Areas | M | H | Construction/demolition activities may contribute to erosion and increased turbidity in surface water drinking water supplies. Equipment usage increases the risks of leaks or spills of fuels and other chemicals. |
| M04 | Stormwater Outfalls | L | H | Stormwater run-off may contain contaminants from residential (home sites and roads), commercial/industrial, and agricultural use areas. |
| M22 | Transportation - Stream Crossing - Perennial | L | H | Road building, maintenance & use may increase erosion & slope failure causing turbidity. Vehicle use increases the risk of leaks or spills of fuel & other chemicals. Over-application/improper handling of pesticides in right-of-way may also impact water. |

Appendix B: Dominant Soil Orders

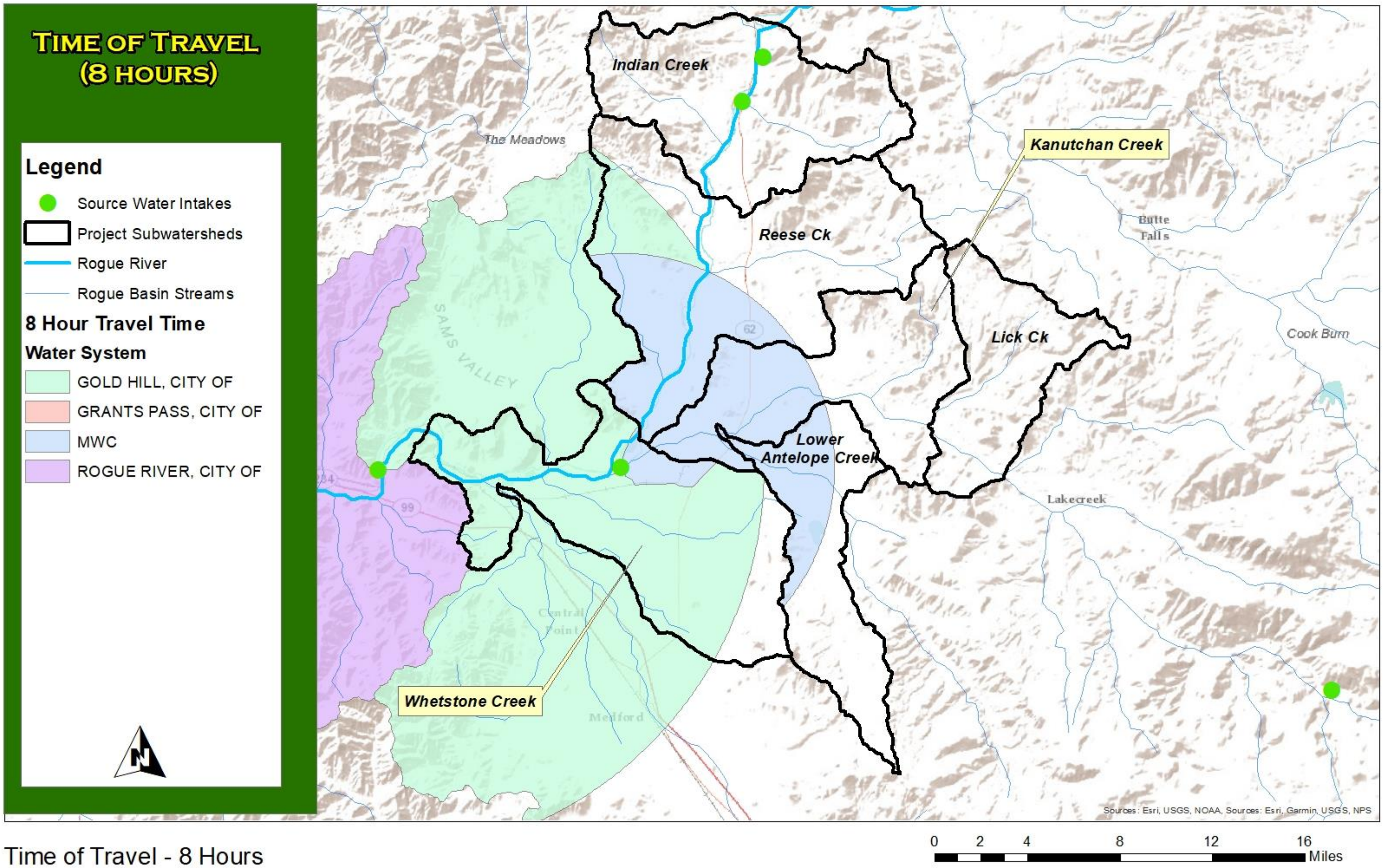
| Soil Order | Description | Soil Suborders |
|---|---|---|
| Alfisols | • Moderately leached soils,<br>• Subsurface horizon of accumulated clays,<br>• Relatively high native fertility for agriculture and silviculture,<br>• Formed under forest canopies in temperate humid and subhumid regions, and<br>• Occupy 13.9% of the land area in the U.S. | Aqualfs<br>Cryalfs<br>Udalfs<br>Ustalfs<br>Xeralfs |
| Inceptisols | • Soils with minimal horizon development,<br>• Found on fairly steep slopes, young geomorphic surfaces, and on resistant parent materials in mountainous areas,<br>• Widely distributed and occur across a wide range of ecological settings, and<br>• Occupy 9.7% of the land area in the U.S. | Aquepts<br>Gelepts<br>Cryepts<br>Ustepts<br>Xerepts<br>Udepts |
| Ultisols | • Strongly leached soils (loss of calcium, magnesium, and potassium),<br>• Subsurface horizon of accumulated clays with yellow and/or red coloration due to the presence of iron oxides,<br>• Acid forest soils with relatively low native fertility,<br>• Support productive forests, but not continuous agriculture,<br>• Found older, stable landscapes in humid temperate and tropical areas, and<br>• Occupy 9.2% of the land area in the U.S. | Aquults<br>Humults<br>Udults<br>Ustults<br>Xerults |

## Appendix C: Soil Type Details

| SYMBOL | NAME |
|---|---|
| 2A | Abin silty clay loam |
| 6B | Agate-Winlo complex |
| 10B | Barron coarse sandy loam |
| 17C | Brader-Debenger |
| 17E | Brader-Debenger loams |
| 19E | Bybee-Tatouche complex |
| 22A | Camas gravelly sandy loam |
| 21A | Camas sandy loam |
| 23A | Camas-Newberg-Evans |
| 27D | Carney clay |
| 28D | Carney cobbly clay |
| 29D | Carney cobbly clay, high precipitation |
| 30E | Carney-Tablerock association |
| 31A | Central Point sandy loam |
| 33A | Coker clay |
| 35A | Cove clay |
| 38C | Crater Lake-Alcot association |
| 43B | Darow silty clay loam |
| 44E | Debenger-Brader loams |
| 55A | Evans loam |
| 57E | Farva very cobbly loam |
| 64E | Freezener gravelly loam |
| 67G | Freezener-Geppert complex |
| 69E | Geppert very cobbly loam |
| 76A | Gregory silty clay loam |
| 81G | Heppsie clay |
| 82G | Heppsie-McMullin complex |
| 100A | Kubli loam |
| 101E | Langellain loam |
| 102D | Langellian-Brader loams |
| 108D | Manita loam |
| 109E | Manita-Vannoy complex |
| 110E | McMullin gravelly loam |
| 111G | McMullin-McNull gravelly loams |
| 112F | McMullin-Medco complex |
| 113E | McMullin-Rock outcrop complex |
| 115E | McNull gravelly loam |
| 114G | McNull loam |
| 117G | McNull-McMullin complex |
| 116E | McNull-McMullin gravelly loams |
| 118E | McNull-Medco complex |
| 119F | McNull-Medco complex, hi precipitation |
| 120C | Medco clay loam |
| 123F | Medco clay loam, high precipitation |
| 121E | Medco cobbly clay loam |
| 125F | Medco-McMullin complex |

| | |
|---|---|
| 126F | Medco-McNull complex |
| 128B | Medford clay loam, gravelly substratum |
| 127A | Medford silty clay loam |
| 133A | Newberg fine sandy loam |
| 139A | Padigan clay |
| 141A | Phoenix clay |
| 146 | Pits, gravel |
| 150E | Provig very gravelly loam |
| 151C | Provig-Agate complex |
| 152B | Randcore-Shoat complex |
| 154 | Riverwash |
| 158D | Ruch gravelly silt loam |
| 157B | Ruch silt loam |
| 163A | Sevenoaks loamy sand |
| 165E | Shefflein loam |
| 183E | Straight extremely gravelly loam |
| 185G | Straight-Shippa extremely gravelly loams |
| 186H | Tablerock-Rock outcrop association |
| 187A | Takilma cobbly loam |
| 189E | Tallowbox gravelly sandy loam |
| 190G | Tatouche gravelly loam |
| 195F | Vannoy silt loam |
| 197F | Vannoy-Voorhies |
| W | Water |
| 198A | Winlo very gravelly clay loam |

Appendix D: Time of Travel Map from Source Water Assessments (DEQ)




Time of Travel - 8 Hours

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Resource Guide

**Natural Resources Conservation Service Resources:**

- Conservation Practices
- National Water Quality Initiative
- Web Soil Survey

**National Oceanic and Atmospheric Administration:**

- Drought Conditions for Jackson County
- Northwest River Forecast Center – ESP Natural Forecast
- Northwest River Forecast Center – ESP Natural Volume Normals
- Weather & Hazards Data Viewer
- Advanced Hydrologic Prediction Service
- National Operational Hydrologic Remote Sensing Center

**Oregon Department of Agriculture**

- CAFO Animal Waste Management Plan (AWMP) or Nutrient Management Plan (NMP) Minimum Required Elements Worksheet

**Oregon Department of Environmental Quality Resources**, such as Status and Action Plans, Investigations, and other reports are listed below:

For information pertaining to water quality in the Rogue Basin, visit:

- Water Quality Status and Actions Plan: Rogue Basin (September 2011)
- 2011 Rogue Basin Groundwater Investigation (April 2013)
- Statewide Groundwater Monitoring Program: Mid-Rogue Basin 2015 (December 2016)
- TMDL – Rogue Basin

- **Rogue River Basin TMDL – Chapter 2: Temperature**
- **Rogue River Basin TMDL – Chapter 3: Bacteria**
- **Oregon Water Quality Index Data Summary – Water Years 2011-2020**

**Oregon Health Authority Resources:**

For information on OHA's **Domestic Well Safety**, visit:

- **Well Testing & Regulations**
- **Human Health & Well Water**
- **Nitrate in Well Water: What You Should Know**
- **Current Cyanobacteria Advisories**
- **Cyanotoxin Resources for Drinking Water**

**Oregon Water Resources Department (OWRD) Resources**:

For access to subsurface data managed by the state, visit: OWRD's **Groundwater Information System**

For flow and water level data, visit: OWRD's **Historical Streamflow and Lake Level Data**

For real-time hydrographics data from several gage stations in Oregon, visit OWRD's **Near Real Time Hydrographics Data**

For **WRIS Code information**

For **Surface Water**

For information on major and minor aquifers providing domestic and public water supplies within the project area, visit the following webpages:

- **Anglers Cove/Shady Cove Heights Water Company (SCHWC)** (well repot: location, owner, depth, water level, yield, completion date)
- **Country View Mobile Home Estates (CVMHE)**: **JACK 293** and **JACK 372**

- **Hiland Water Company** (well repot: location, owner, depth, water level, yield, completion date)

For information on surface and groundwater withdrawals for drinking water within the project area (system information, alerts, violations, coliform and chemical results, etc.), visit the following webpages:

- **Anglers Cove/SCHWC**
- **CVMHE**
- **Hiland Water Company**:
  2019 Shady Cove CCR
  2017 Shady Cove CCR
- **Medford Water Commission**

For information on surface and groundwater withdrawals/storage for agriculture and water rights within the project area, visit the following webpages:

- **OWRD - Surface water withdrawals for agriculture in the Rogue Basin**: 81 records ("points of diversion" selected, rather than "places of use")
- **OWRD – Groundwater withdrawals for agriculture in the Rogue Basin**: 126 records ("points of diversion" selected, rather than "places of use")
- **OWRD – Storage for agriculture in the Rogue Basin**: 55 records ("places of use" selected, rather than "points of diversion")

**U.S. Bureau of Reclamation Resources:**

- **Columbia-Pacific Northwest Region: Hydromet**

**U.S. Geological Survey (USGS) Resources**, such as Water-Supply Papers, Water-Resource Investigations, Bulletins, Professional Papers, Hydrologic Atlases, and other reports are listed below:

For information on stream flow, flood stage and flood-tracking, drought table and low-flow map, past-flow and runoff, annual summaries, and **WaterQualityWatch** (temperature and discharge information available for the Rogue Basin), visit: USGS's **WaterWatch**.

- **WaterQualityWatch**

- **WaterWatch**

For real-time data from stream gages within the Project Area, visit the following stream gage webpages:

- **14359000 – Rogue River at Raygold** near Central Point, Oregon
- **14339000 – Rogue River at Dodge Bridge** near Eagle Point, Oregon
- **14338000 – Elk Creek** near Trail, Oregon

For water quality information from domestic wells and principal aquifers, visit: USGS's **National Water Quality Assessment, USGS, DeSimone (2009)**

For **Harmful Algal Blooms and Drinking Water in Oregon**

For access to USGS's **National Land Cover Database (2016)**

For **Water Use Data for Oregon - Domestic**

For **Water Use Data for Oregon – Public Supply**

For geological information, such as **Jackson County, Oregon Geologic Units**

**Other Resources:**

**Incident Information System – South Obenchain Fire**

**Big Butte Springs**

**Rogue River**

**Southern Oregon Forest Restoration Collaborative: The Rogue Basin Action Plan for Resilient Watersheds and Forests in a Changing Climate**