Molalla River Watershed

Drinking Water Source

Protection Plan

for

Canby Utility, City of Molalla, and

Colton Water District

December 2022

Prepared for:

Clackamas Soil and Water Conservation District

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Appendix A: Molalla NWQI Agricultural Area Implementation Strategy

Acronyms and Abbreviations

Best management practices (BMPs)

Biological oxygen demand (BOD)

Bureau of Land Management (BLM)

Canby Utility (Canby)

Clackamas Soil and Water Conservation District (Clackamas SWCD)

Confined Animal Feeding Operation (CAFO)

Contaminant Candidate List (CCL)

Cubic feet per second (cfs)

Degrees Celsius (deg. C)

Degrees Fahrenheit (deg. F)

Disinfection By-Products (DBPs)

Dissolved oxygen (D.O.)

Designated Management Agency (DMA)

Environmental Cleanup Site Information (ECSI)

Environmental Protection Agency (EPA)

Haloacetic acids (HAAs)

Health-Based Screening Levels (HBSLs)

Human Health Benchmarks for Pesticides (HHBPs)

Instream water rights (ISWRs)

Maximum Contaminant Level (MCL)

Methylisoborneal (MIB)

Micrograms per liter (µg/L)

Milligrams per liter (mg/L)

Monitoring Trends in Burn Severity (MTBS)

National Water Quality Initiative (NWQI)

Natural Resource Conservation Service's (NRCS)

Nephelometric Turbidity Units (NTUs)

Oregon Department of Agriculture (ODA)

Oregon Department of Environmental Quality (ODEQ)

Oregon Department of Forestry (ODF)

Oregon Department of Geology and Mineral Industries (DOGMI)

Oregon Department of Transportation (ODOT)

Oregon Health Authority (OHA)

Oregon State Fire Marshal (OSFM)

Oregon Water Resources Department (OWRD)

Perfluorooctanoic acid (PFOA)

Perfluorooctanesulfonic acid (PFOS)

Polychlorinated biphenyls (PCBs)

Polycyclic aromatic hydrocarbons (PAHs)

Polyfluoroalkyl substances (PFAS)

Portland State University (PSU)

Royal Demolition Explosive (RDX)

Revised Universal Soil Loss Equation (RUSLE)

Total Maximum Daily Load (TMDL)

Total Organic Carbon (TOC)

Total Suspended Solids (TSS)

Trihalomethanes (THMs)

Urban Growth Boundary (UGB)

U.S. Forest Service (USFS)

U.S. Geological Survey (USGS)

Water Availability Basins (WABs)

Introduction

Three community water providers – Canby Utility, City of Molalla, and Colton Water District – supply drinking water to more than 28,000 residents in the Molalla River Watershed. The Clackamas Soil and Water Conservation District received a grant from the U.S. Department of Agriculture Natural Resource Conservation Service's National Water Quality Initiative (NWQI) to characterize the three community source water areas, assess drinking water quality concerns, and develop a Drinking Water Source Protection Plan. The plan is a road map of actions designed to protect and improve Molalla River Watershed drinking water quality.

Molalla Watershed
Drinking Water Source Protection Plan
Participating Organizations

Canby Utility (Canby)
City of Molalla
Colton Water District
Clackamas Soil and Water Conservation District (CSWCD)
Natural Resource Conservation Service (NRCS)
Clackamas County
Oregon Health Authority (OHA)
Oregon Department of Environmental Quality (DEQ)
Oregon Department of Forestry (ODF)
Oregon Department of Agriculture (ODA)
Molalla River Watch/Watershed Council
Bureau of Land Management (BLM)
U.S. Forest Service (USFS)

The **Molalla Watershed Drinking Water Source Protection Plan** was developed with input from the community water systems, land managers, environmental groups, and watershed residents (see sidebar). The plan is based upon information summarized in two reports. The **Phase I** report – *Molalla Watershed Characterization* – describes the watershed's landscape setting, geology, climate hydrology, and land uses; summarizes the three community source areas and the water treatment systems; and outlines how source water quality relates to drinking water quality.

The **Phase II** report – *Water Quality Characterization* – summarizes Molalla River watershed water quality conditions, describes how land uses can affect water quality, and outlines current and future threats to drinking water quality.

Both reports and the Source Water Protection Plan are available on the Molalla Watershed Source Water Protection Plan website: http://molallariverdrinkingwater.com

The Molalla Watershed Drinking Water Source Protection Plan (plan) builds on the watershed characterization and drinking water quality issues identified in the two phases. The plan:

- Identifies current and future sources and causes of surface water impairment;
- Evaluates the risks to drinking water quality;
- Characterizes areas with the greatest need for treatment or source area protection;
- Identifies water quality issues and source areas in need of additional assessment to identify treatments;
- Outlines best management practices (BMPs) and actions to address risks to drinking water quality;
- Establishes a monitoring framework for evaluating water quality contaminants and status over time;
- Describes landowner and watershed resident outreach activities; and
- Identifies potential funding sources.

It is important to note that the NRCS and CSWCD are non-regulatory entities that deliver services to agricultural producers and residents in Clackamas County. On-the-ground water quality protection strategies and actions will emphasize voluntary and non-regulatory approaches to engage agricultural, rural, urban, and other landowners in source water protection and improvement. NRCS's NWQI program provides resources to accelerate investment for voluntary conservation, where they can deliver the most significant benefits for drinking water quality.

While the Molalla River Watershed Drinking Water Source Protection Plan actions are non-regulatory, there are regulations that do apply to protecting and improving water quality in the Molalla River Watershed. For example, the local Agricultural Area Rules for Water Quality, administered by the Oregon Department of Agriculture (ODA), and the Forest Practices Act, administered by the Oregon Department of Forestry (ODF), prescribe rules (e.g., riparian vegetation standards) that are designed to protect water quality. These regulations complement the voluntary water quality protection actions implemented under this plan.

This plan covers all land uses – forest, urban, rural residential, and agricultural. See **Appendix A** for the Molalla NWQI implementation strategy focused specifically on agricultural areas within the Molalla River Watershed.

Molalla River Watershed Context

Water quality is critically important for humans as well as fish and other aquatic life. While this plan focuses on drinking water quality, the Molalla River supports various additional water uses. In addition to public drinking water, other designated beneficial uses for Molalla River water include providing habitat for salmon and trout migration, spawning, and rearing; irrigation and livestock watering; fishing; boating; and water contact recreation (Oregon Administrative Rules, Chapter 340, Division 41, Rule Number 340-41-0340).

Community Drinking Water Source Areas

The Molalla River is the drinking water source for the cities of Canby and Molalla. In addition to the Molalla River, Canby has a groundwater Springs Gallery available to augment river water. The Community of Colton's drinking water source is Jackson Creek, a tributary to the Molalla River. **Figure 1** shows the locations for the three community drinking water intakes and the comprehensive drinking water source areas, including all areas that contribute to water supplies for each community, from the intake upstream to the headwaters. The figure also shows the estimated area within the 8-hour-time-of-travel source area – within which potential water contaminants would reach each community's drinking water intake within 8 hours of contamination occurring at a given point. The 8-hour-time-of-travel source area is the critical source area for the watershed and the key focal area for actions to protect and improve water quality.

Table 1 outlines the three community water systems' contributing areas. For a detailed description of the source areas and Molalla River watershed, see the Phase I report, *Molalla Watershed Characterization*: http://molallariverdrinkingwater.com

Table 1. Drinking water source contributing areas for the three community systems.

Source Area	Contributing Area (Mi^2)
Canby Springs Gallery	1.82
Canby 8-hour-time-of-travel	13.30
Canby comprehensive	343.11
City of Molalla, 8-hour-time-of- travel	19.66
City of Molalla comprehensive	202.46
Colton 8-hour and comprehensive	3.29

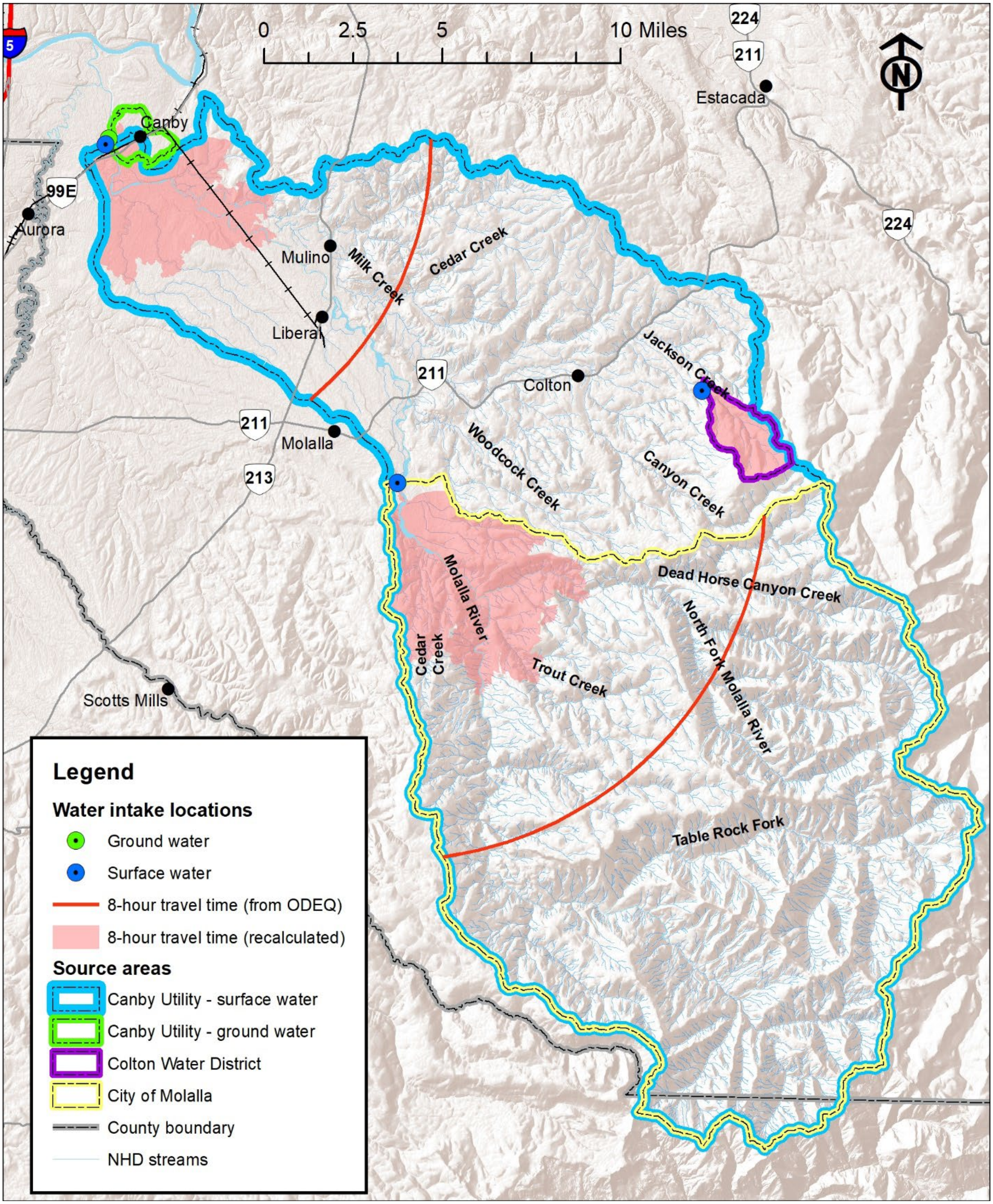


Figure 1. The Molalla River watershed, community drinking water intakes, and source areas.

Land Uses

Figure 2 shows the Molalla River watershed land uses. **Table 2** outlines the land ownership and management type (area and percent) within each community drinking water treatment system's 8-hour-time-of-travel source area. **Table 3** summarizes the comprehensive source areas (i.e., from the water system intake to the top of the Molalla River watershed) for Canby and the City of Molalla drinking water source areas.

Table 2. Summary of land ownership/administration (area and percent) within each community drinking water treatment system's 8-hour-time-of-travel source area.

	Canby 8-Hour Source Area		City of Molalla 8-Hour Source Area		Colton Source Area	
Ownership/Administration	**%**	**Mi^2**	**%**	**Mi^2**	**%**	**Mi^2**
Private urban lands	7.3	1.0	-	-	-	-
Private rural residential lands	3.6	0.5	47.3	9.3	-	-
Agriculture	88.4	11.8	1.1	0.2	-	-
Private industrial forest	-	-	41.4	8.1	72.0	2.4
Local government	0.6	0.1	0.1	0.0	-	-
State - Dept. of Forestry	-	-	-	-	-	-
State - other	-	-	0.1	0.0	-	-
Bureau of Land Management	-	-	10.1	2.0	28.0	0.9
U.S. Forest Service	-	-	-	-	-	-
SUM	**100.0**	**13.3**	**100.0**	**19.6**	**100.0**	**3.3**

Urban Lands

Urban lands encompass the smallest area of any land use in the Molalla River watershed. There are no urban areas within the City of Molalla or Colton source areas. Canby's 8-hour-time-of-travel source area is 7.3% urban, primarily consisting of areas within the City. In addition to the surface urban proportion of the water source area, Canby's groundwater Springs Gallery groundwater source area (1.82 mi^2) is entirely within the City of Canby (**Figure 2**).

Agricultural Lands

Figure 3 shows the locations of the major agricultural crop types in the Molalla River watershed. Agricultural lands cover about 13% of the watershed (44.9 mi^2; **Table 3**). Most of the agricultural land uses are concentrated in the lower watershed below the City of Molalla. Canby's 8-hour-time-of-travel source area is primarily in agricultural land uses (88%). Agricultural land uses comprise a very small area above the City of Molalla. The City of Molalla's 8-hour-time-of-travel source area is primarily in private rural residential (47%), and private forestry land uses (41%), with a very small proportion (1%) in agricultural land uses (**Table 2**).

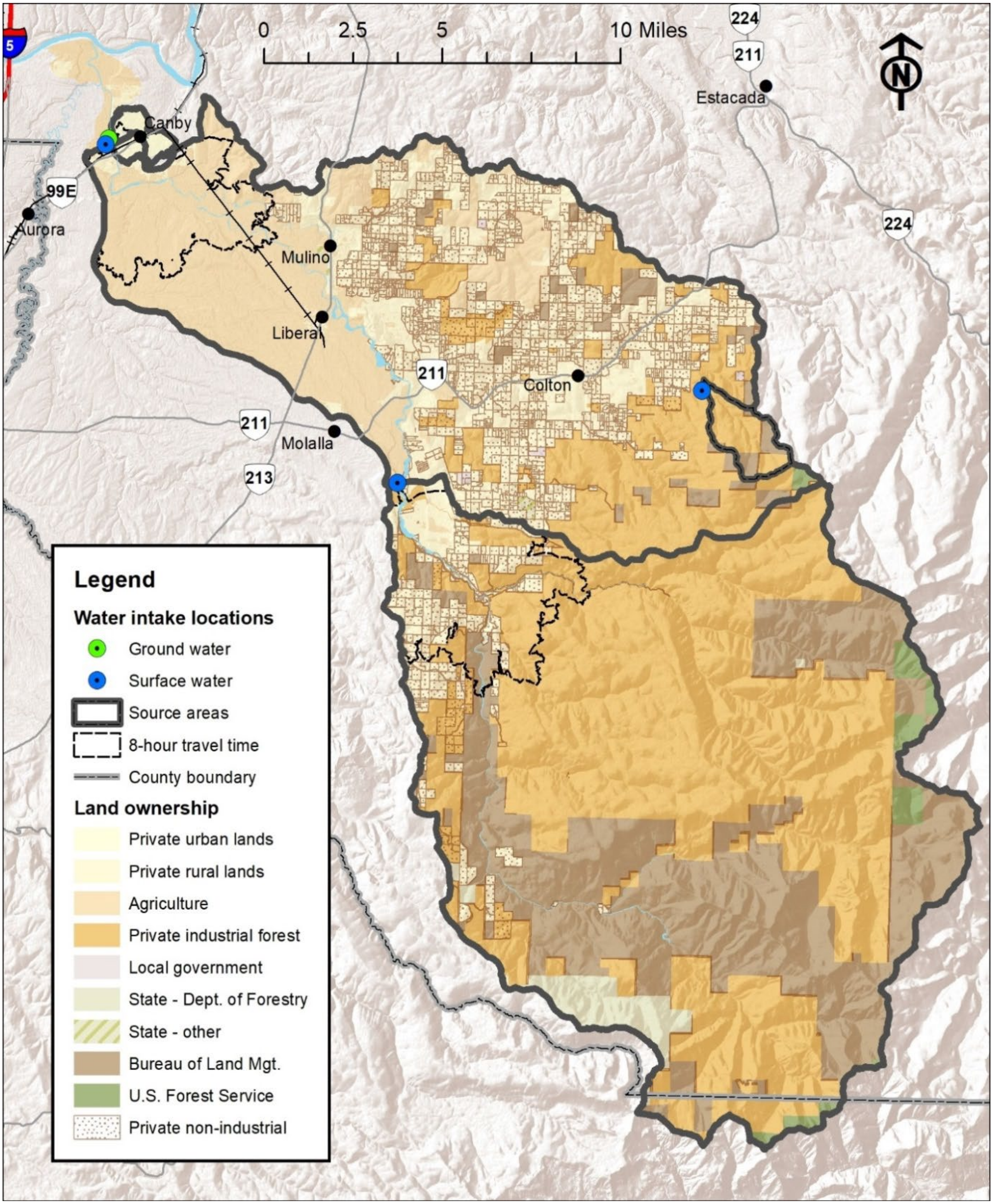


Figure 2. Molalla River watershed land uses and ownership with non-industrial forest overlay on private rural lands.

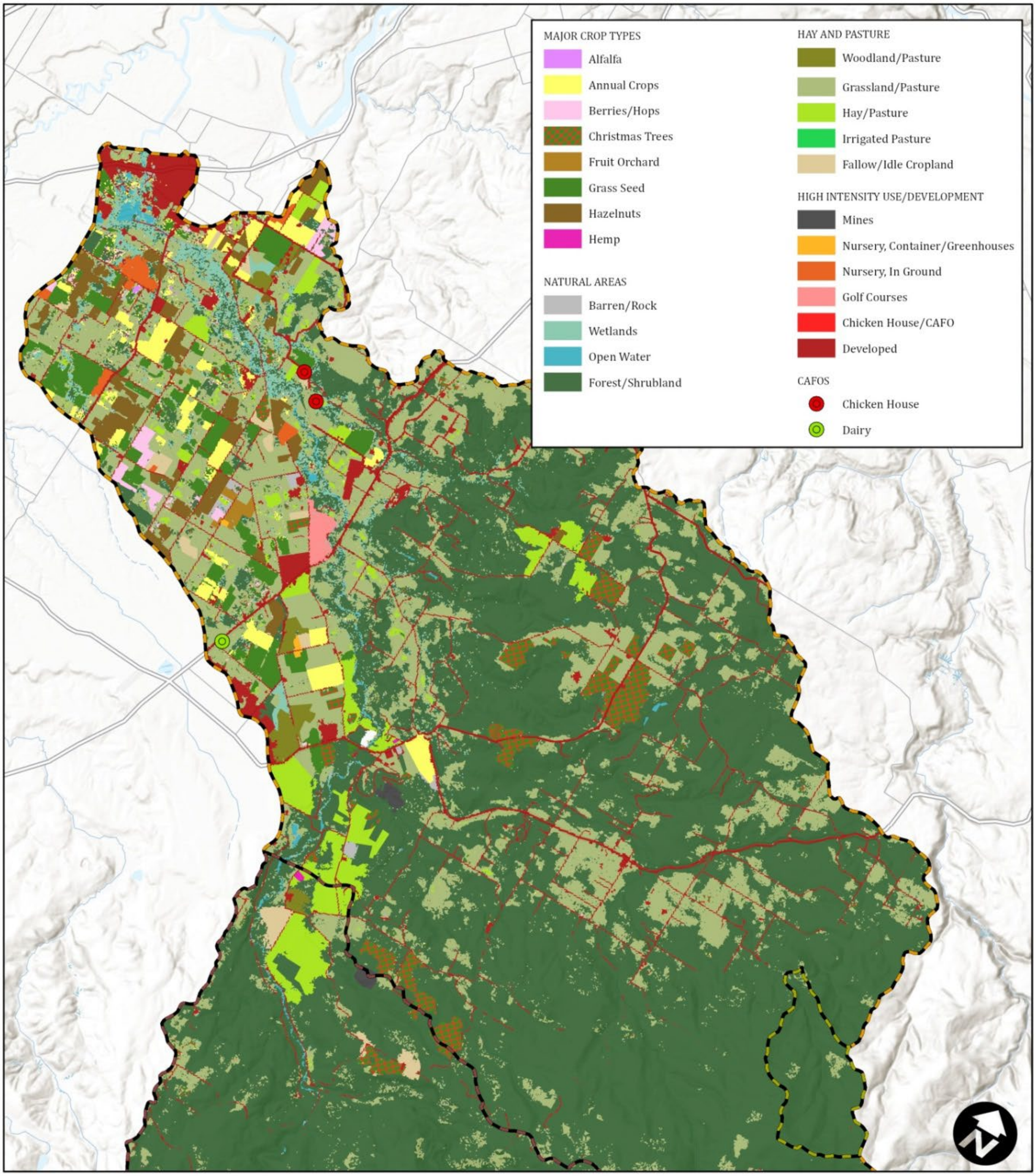
Table 3. Summary of land ownership/administration (area and percent) within the Canby and City of Molalla drinking water system comprehensive source areas.

	Canby Comprehensive Source Area		City of Molalla Comprehensive Source Area	
Ownership/Administration	**%**	**Mi^2**	**%**	**Mi^2**
Private urban lands	0.3	1.2	--	--
Private rural residential lands	20.6	70.7	6.5	13.1
Agriculture	13.1	44.9	0.1	0.2
Private industrial forest	42.1	144.4	56.1	113.5
Local government	0.1	0.5	0.0	0.0
State - Dept. of Forestry	1.6	5.7	2.8	5.7
State – other	0.1	0.4	0.0	0.0
Bureau of Land Management	20.8	71.3	32.6	66.0
U.S. Forest Service	1.2	4.2	1.9	3.9
SUM	**100.0**	**343.2**	**100.0**	**202.4**

Table 4 outlines the area covered by the various crop types within the watershed. Within the Canby drinking water source area, the lower watershed has the most significant area covered in crops. Lower watershed primary crop types include grassland pasture, hay pasture, Christmas trees, hazelnuts, and annual crop rotations. Most agricultural production is concentrated in areas along the Molalla River and southeast and east of Canby within Canby's 8-hour-time-of-travel source area. This area includes the largest variety of crop types in the watershed, including berries and hops, in-ground and container nurseries, hemp, vegetables, and other crops. Many of the crops are irrigated with water from the Molalla River.

Rural Residential Lands

Rural residential lands cover 20.6% of the Molalla River watershed (70.7 mi^2; **Table 3**). Rural residential properties are a relatively small proportion (3.6%) of Canby's 8-hour-time-of-travel source area. In contrast, rural residential lands are a significant proportion (47.3%) of the City of Molalla's 8-hour-time-of-travel source area.



Data Source: ESRI, 2020; NRCS, 2018

Figure 3. Molalla River watershed major crop types and land cover.

Table 4. Molalla River Watershed agricultural crop types and area (acres). I = Irrigated crops. CAFO = Confined Animal Feeding Operation.

Crop Type	Acres	Crop Type	Acres
Grassland/Pasture	26,405	Fruit Orchard	213
Hay/Pasture	3,150	Woodland/Pasture	56
Grass Seed	2,545	Nursery, container/Greenhouse (I)	30
Christmas Trees	2,170	Irrigated/Pasture (I)	27
Hazelnuts (I)	1,756	Other Hay/Non-Alfalfa, Irrigated (I)	27
Annual crop rotations (e.g., vegetables, row crops, strawberries, corn, etc.) (I)	1,588	Alfalfa	16
Fallow/Idle Cropland	601	Hemp (I)	15
Berries/Hops	468	Chicken House (CAFO)	8
Nursery, In-ground	308	Beef (CAFO)	8

Forest Management Lands

Forestry is the dominant land use in the Molalla River watershed. Forest lands cover nearly 65% of the watershed: Private industrial forest lands (42.1%; 144.4 mi^2; **Table 3**); BLM (20.8%; 71.3 mi^2); Oregon Department of Forestry (ODF; 1.6%; 5.7mi^2); and U.S. Forest Service (USFS; 1.2%; 4.2 mi^2). In addition to the industrial, federal, and state forest lands, there are substantial areas within rural residential properties managed as private non-industrial forests (**Figure 3**).

Canby's 8-hour-time-of-travel source area has almost no forest land uses. The Colton source area is entirely forest land uses within the 8-hour-time-of-travel source area. The City of Molalla's 8-hour-time-of-travel source area is primarily in private industrial forestry land uses (41%). Rural properties in this source area are managed as small woodlots and other private non-industrial forest lands (7.2 mi^2). Forest lands managed by the BLM (10%) are the other significant forest land ownership in the City of Molalla's 8-hour-time-of-travel source area.

Evaluation of Potential Drinking Water Source Contaminants

This plan does not evaluate finished drinking water (i.e., at the "tap") quality for the three community systems. All three water systems have demonstrated that their drinking water meets the Maximum Contaminant Levels (MCLs) and other applicable regulatory guidance. Instead, the plan evaluates water quality at the drinking water systems' intakes. The focus is on how current and future water quality at the water system intake influences water treatment and drinking water quality related to the MCLs or other guidelines. For example, the study does not evaluate the chemicals used as disinfectants in the drinking water treatment system. However, the study does consider how contaminants at the intake may affect disinfection by-products during treatment. For instance, natural organic matter in the system's raw water can create harmful disinfection by-products (DBPs) such as trihalomethanes and haloacetic acids.

Table 5 summarizes the potential contaminants and their effect on drinking water treatment or quality. For information on the MCLs and treatment considerations, see Appendix A, *Molalla Watershed Characterization*: http://molallariverdrinkingwater.com.

Table 5. Potential Molalla River Watershed contaminants and the effect on drinking water treatment or quality.

Contaminant or Contributor to Contaminants	Description
Turbidity	High turbidity levels are often associated with higher levels of disease-causing microorganisms such as viruses, parasites, and some bacteria. High turbidity levels can make it harder and more expensive to treat the water and increase the likelihood of producing DBPs. During periods of high turbidity in the Molalla River (which occur at times during the rainy season, but especially during heavy rain/runoff events), Canby's operation of the main river intake is curtailed, and the intake from the river infiltration gallery and Springs Gallery is used instead. In practice, the plant cannot adequately treat raw water with turbidity above 20 NTU. The City of Molalla cannot adequately treat raw water with turbidity above 50 NTU.
Total suspended solids and sediment	Total Suspended Solids (TSS) is the portion of fine particulate matter that remains in suspension in water. It measures a similar property to turbidity but provides an actual weight of particulate matter for a given sample volume (usually mg/L). Natural processes such as soil erosion and organic matter entering the river influence TSS and sediment levels. Land use practices can accelerate soil erosion and contribute to higher TSS levels than would be found naturally. Suspended solids interfere with effective drinking water treatment. Elevated TSS levels and high sediment loads interfere with coagulation, filtration, and disinfection. More chlorine is required to disinfect turbid water effectively. In addition, some contaminants, including pesticides and heavy metals (e.g., mercury), can bind to sediments.
Water temperatures	Water temperature patterns affect both aquatic life and other water quality parameters. Cool water temperatures are critical for trout and salmon populations. Elevated water temperatures can affect not only aquatic life but can also exacerbate water quality problems. Factors contributing to elevated water temperatures include reduced shade from stream-side vegetation removal and water withdrawals for irrigation. Higher water temperatures increase the amount of oxygen consumed by bacteria and other microorganisms. High water temperatures and nutrients (phosphorus and nitrogen) enrichment can contribute to the

Contaminant or Contributor to Contaminants	Description
	proliferation of nuisance algae in the river and low concentrations of dissolved oxygen from algal photosynthesis. High water temperatures can increase algal growth and other biological processes contributing to increased organic matter. Organic matter can contribute to the formation of chlorinated and brominated disinfectant DBPs, such as trihalomethanes (THMs) and haloacetic acids (HAAs).
Volatile organic compounds	Volatile organic compounds include benzene, benzene-derived compounds, and tetrachloroethylene. These chemicals come from discharge from factories and dry cleaners, and leaching from gas storage tanks, leaching from landfills, and other activities.
Other toxic organic compounds	Other toxic organic chemicals include dioxin, carbon tetrachloride, Di(2-ethylhexyl) phthalate, polychlorinated biphenyls (PCBs), styrene, and other organic chemicals. Sources for these chemicals include discharge from chemical plants and other industrial activities, landfill runoff, and emissions from waste incineration and other combustion.
Natural organic compounds, Total Organic Carbon (TOC)	Natural organic carbon is derived from leaching out of the forested areas, in-stream growth of benthic algae, and from other sources that contribute different and varying proportions of dissolved and particulate organic matter to the river. Organic matter concentrations in streams increase following rainfall events that deliver organic matter to the river. TOC can contribute to the formation of chlorinated and brominated DBPs, such as THMs and HAAs.
Pesticides: herbicides, fungicides, insecticides	This category includes herbicides, insecticides, and fungicides (collectively called pesticides). Examples of pesticides include atrazine, carbofuran, glyphosate, and simazine.
Inorganic compounds	Inorganic compounds include arsenic, barium, cadmium, chromium, copper, lead, mercury, and other compounds. In addition, nitrate and nitrite, which are also inorganic compounds, are covered below. Sources for inorganic compounds include road and stormwater runoff.
Nitrogen and phosphorus	Nitrogen and phosphorus are nutrients that are natural parts of aquatic ecosystems. Nitrate (measured as nitrogen), nitrite (measured as nitrogen), and phosphorus inputs to the stream network come from fertilizer applications, animal manure deposits, industrial/municipal discharge, and runoff and leachate from septic systems and landfills, and natural inputs from plants and trees. As a result of human activities and population growth, nitrate, in particular, is increasing in surface water and aquifers. Nitrate is the most common contaminant in groundwater aquifers worldwide. High nitrate levels can cause health problems in infants who receive formula mixed with contaminated water. Some adults are susceptible to the effects of nitrate. In addition, natural nitrogen and phosphorus support the growth of algae and aquatic plants, which provide food and habitat for fish and other aquatic organisms. Excess nitrogen and phosphorus in the river from human activities can stimulate algal growth and metabolism, sometimes resulting in nuisance algal blooms that can create water quality problems and other issues. Failing septic systems are a particular concern because of the number and geographic extent of rural residential properties with septic systems in the Molalla River watershed.
Drinking water contaminants of emerging concern –	Emerging contaminants are naturally occurring or human-made chemicals present in drinking water known or suspected to pose risks to human or aquatic health and are not yet subject to federal regulatory oversight. Drinking water contaminants of emerging concern in Oregon

Contaminant or Contributor to Contaminants	Description
e.g., pharmaceuticals, caffeine, and other potential contaminants	include per- and polyfluoroalkyl substances (PFAS), excessive manganese, and toxins produced by cyanobacteria (cyanotoxins). Pesticide degradants are also an emerging concern (including in groundwater). Excessive levels of manganese can cause health problems in infants and adults. The EPA has established health advisory levels for two PFAS – Perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) – and manganese in drinking water. Manganese is a natural compound found in the environment and food. Contaminants of emerging concern also include pharmaceuticals and personal care products that are increasingly detected at low levels in surface waters. There is concern that these compounds may have an impact on aquatic life. The EPA is evaluating the potential impact of these substances on aquatic life and is developing an approach for determining protective benchmarks for aquatic organisms. Failing septic systems can generate inputs of contaminants of concern (e.g., pharmaceuticals) to the Molalla River. Failing septic systems are a particular concern because of the number and geographic extent of rural residential properties with septic systems in the Molalla River watershed.
Bacteria, e.g., E. coli, and other microorganisms	Bacteria and other microorganisms that are regulated in drinking water include Cryptosporidium, Fecal coliform, and Giardia lamblia. Sources for these microorganisms are human and animal fecal waste runoff that enters the river. Also regulated are the Legionella bacteria and total Coliforms, both naturally present in the environment. Failing septic systems, livestock management, and other land use activities can generate inputs bacteria to the Molalla River.
Algae/Cyanobacteria – cyanotoxins and other compounds	Cyanobacteria are photosynthetic bacteria that reside in surface waters. Some species of cyanobacteria can produce neuro- and liver- toxins that are known to be harmful to human health above specific concentrations. The EPA has established health advisory levels for two cyanotoxins produced by cyanobacteria: microcystins and cylindrospermopsin. Limited sampling of water at the Canby water intake has detected measurable levels of methylisoborneal (MIB) and/or geosmin create taste and odor issues (T&O) in finished drinking water. These compounds, which are metabolites of algal activity, are often found in surface water supplies when elevated concentrations of cyanobacteria occur. Canby can experience algae and taste and odor issues during summer and early fall. Geosmin and MIB are not toxic to humans. Geosmin and MIB concentrations as low as five parts per trillion can be detected by the human nose and palate and impart the noticeable earthy/musty attribute. Pre-chlorination of the raw water supply can exacerbate the intensity of these taste and odor compounds. Canby has detected the presence of MIB and geosmin, beginning in 2014.
Dissolved oxygen (D.O.) and biological oxygen demand (BOD)	D.O. is a measure of how much oxygen is dissolved in the water – the amount of oxygen available to living aquatic organisms. D.O. is an important indicator of water quality, and it is essential for the survival of fish and other aquatic organisms. BOD represents the amount of oxygen consumed by bacteria and other microorganisms while decomposing organic matter under aerobic (oxygen is present) conditions at a specified temperature. Oxygen demand measures the number of oxidizable substances in a water sample that can lower D.O. concentrations. High water temperatures and other human-induced factors, such as the introduction of excess fertilizers to a water body, can reduce the dissolved oxygen in a water body. BOD is used as an index of the degree of organic pollution in water.
pH	The acidity or alkalinity of water is measured in pH values, of which a pH of 7.0 is neutral and lower values are more acid and higher values more alkaline. The normal range for pH in surface water systems is 6.5 to 8.5. High-pH water can cause pipes and water-using appliances to become encrusted with deposits, and it depresses the effectiveness of the disinfection of

Contaminant or Contributor to Contaminants	Description
	chlorine. Conversely, low-pH water will corrode or dissolve metals and other substances. Several factors can influence pH in surface waters. For example, Algal photosynthesis, which can be exacerbated by high water temperatures and nutrients in the water, can change pH values in water.

Water Quality Divers and Threats

Contaminant Spills

Hazard material spills, which can occur at retail establishments (e.g., gas stations) and industrial facilities, can result in transport of the contaminant (e.g., pesticides, volatile organic compounds, etc.) to surface or groundwater and potential conveyance to the community drinking water system intakes.

Roads

Road systems impact water quality through two primary avenues. First, roads allow hazardous substances to be brought into the proximity of the surface water system through the transportation of fuel, chemicals, and other substances, increasing the risk of contamination from spills. Roads also provide a source of contamination through runoff of accumulated contaminants from vehicles, generation of surface sediments, and delivery to streams and rivers through the road drainage system.

Road runoff can include metals (e.g., copper from vehicle brake pads), herbicides from roadside vegetation control, and nutrients. For example, a recent Oregon Department of Transportation (ODOT) study simulated long-term yields of total phosphorus from highways, non-highway roadways, and agricultural, developed, and undeveloped areas. The study showed that highway yields of phosphorus per unit area were larger than yields from other land covers because highways are entirely impervious and concentrate phosphorus delivery to streams. **Table 6** summarizes road density by source area.

Table 6. Road density by source area.

Source Area	Average Road Density (Mi/Mi^2)	Range (Mi/Mi^2)
Colton	5.5	3.2 - 8.7
City of Molalla (8-hr travel time)	4.5	3.4 - 6.0
City of Molalla (entire source area)	4.9	0.0 - 12.2
Canby (groundwater source area)	13.5	5.6 - 19.7
Canby (8-hr travel time)	6.0	2.1 - 8.9
Canby (entire source area)	4.5	0.7 - 19.6

Climate Change

The Molalla Watershed is especially vulnerable to climate change. Unlike the nearby Clackamas River system, the Molalla Watershed does not have a persistent high Cascade Mountain snowpack to sustain cool river flows into the summer. In addition, there is evidence that April 1 snowpack peak accumulations are generally declining.

The increasing probability of extreme rainfall events and flooding could contribute to higher sediment turbidity levels in the river. In addition, higher air temperatures and the increased likelihood of summer droughts associated with climate change will increase the probability of wildfire in the watershed.

It is predicted that higher summer and fall air temperatures, increased likelihood of extreme summer drought, and corresponding lower summer and fall flows will drive higher water temperatures and associated cyanobacteria blooms. To assess future water temperature patterns, historical Molalla Watershed temperature data were used with spatial statistical network models to evaluate future water temperatures under a climate change scenario. Under this scenario, higher water temperatures (> 21.0 deg. C; 69.8 deg. F) are predicted to extend above the City of Molalla into the upper watershed. August, and by extension early fall, water temperatures at or above 70 deg. F will become more common throughout the watershed. In addition to climate change, loss of shade from riparian vegetation and on-going water withdraws, which reduces the volume of water in the Molalla River and tributaries, will continue to increase water temperatures.

2020 Wildfires

On August 16, thunderstorms moved across Oregon, starting multiple fires in western Oregon, including the Beachie Creek and Riverside fires. On September 7, powerful east winds blew across Oregon, reaching speeds over 50 miles per hour, causing the fires to explode in size as they raced westward into the Molalla Watershed. The fires primarily impacted the upper forested watershed above the City of Molalla (**Figure 4**).

Erosion Threat Assessment and Reduction Team (ETART), comprised of federal and state personnel, evaluated the relative post-fire watershed vulnerability for public water systems[1]. In scoring the public water systems, the ETART team considered severity of erosion risk factors in the watershed, available alternate sources, anticipated raw water total organic carbon (TOC) increase, drinking water treatment technology, disinfection by-products (DBPs), water plant operator certification levels, and the general size of the population served. TOC increase and the sediment level of concern were determined by modeling soil erosion changes, the potential for debris flows, and sediment delivery for each evaluated community water system.

The ETART overall post-fire risk assessment for the Molalla River Watershed community water systems was as follows:

City of Molalla: High

Canby: Moderate

Community of Colton: Low

[1] Erosion Threat Assessment and Reduction Team (ETART). 2020. Water Quality/Drinking Water Supply Resource Report.

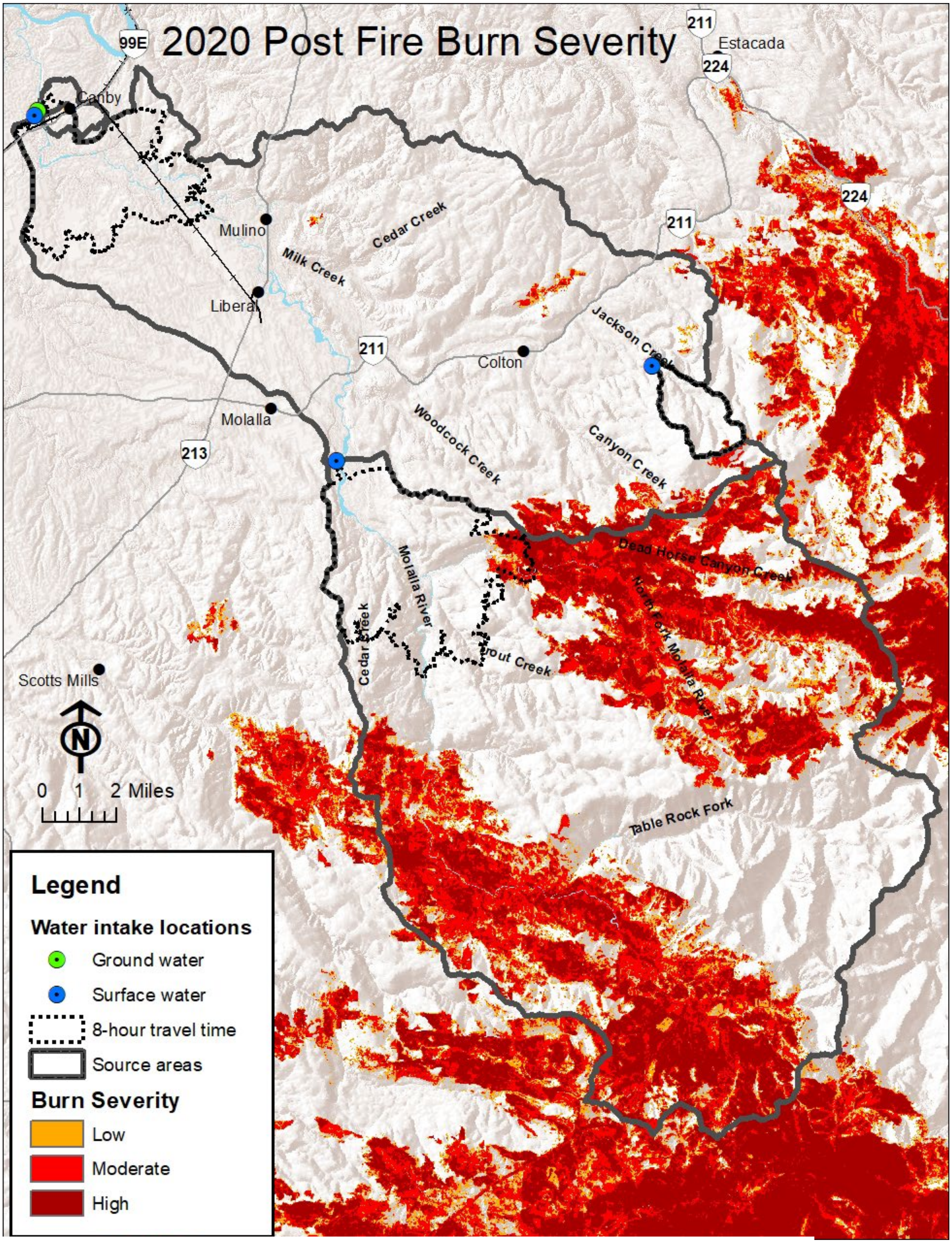


Figure 4. Molalla River Watershed wildfire burn severity for the Beachie Creek (southern potion of the watershed) and Riverside Fires. (Outlying fires include the Wilhoit, Unger, and Macksburg Road fires.)

Drinking Water Quality Contaminant Evaluation: Source Areas Status and Trends

Table 7 summarizes potential Molalla River Watershed drinking water quality contaminants, land use sources of the contaminant, threats, drivers, and trends – for example, is there evidence that the contaminant levels are increasing or decreasing? Is there evidence the contaminant is increasing now (e.g., higher water temperatures from land uses) and/or anticipated to increase in the future from threats (e.g., higher water temperatures from a warming climate).

Table 7. Summary of water quality contaminant, potential land use sources, threats and drivers, and trend. Trend = + (evidence of increasing/negative trend); Trend = -- (no clear trend).

Water Quality Contaminant	Land Use Sources	Threats and Drivers	Trend	Notes
Turbidity	Erosion from: Dirt and gravel forestry and rural residential roads; cattle, crops, and agricultural practices; rural residential and urban development. Agricultural development and management practices in the lower watershed sometimes include bare soil rotations or unvegetated ditches, all of which creates a greater risk of sediment delivery during rain events	Wildfire (exposed soils); climate change (high-intensity rainfall events); road management; degraded riparian areas	+	The 2020 wildfires burned forest floor organic matter and exposed mineral soil in places. Exposed soils and decaying root systems can contribute to debris torrents associated with high precipitation events; erosion and debris torrents will contribute to elevated sediment delivery to streams and increased turbidity levels. There is limited data to evaluate turbidity source areas.
Total suspended solids (TSS) and sediment	Wastewater treatment; dirt and gravel forestry and rural residential roads; cattle, animal management, crops, and agricultural practices; rural residential and urban development	Wildfire (exposed soils); climate change (high-intensity rainfall events); stormwater management; forest management; degraded riparian areas	+	No increases in TSS were detected at Canby intake following authorized City of Molalla wastewater discharges. Most of the highly erosive soils are within the agricultural areas in the lower watershed, primarily in the Canby Source area. Burned forest areas can contribute to elevated TSS levels. There is limited data to evaluate TSS and sediment source areas.
Water temperatures	Rural residential and agricultural activities: Loss of riparian shade; water withdrawals	Climate change (increased temperatures, lower flows); population growth and development (riparian vegetation loss)	+	The increased likelihood of summer drought and higher air temperatures under climate change appear to drive higher summer and early fall water temperatures in the Molalla River and tributary streams. In addition, water withdrawals, which affect the volume of water, can contribute to increased water temperatures.
Volatile organic compounds	Discharge from factories and dry cleaners; leaching from gas storage tanks; leaching from landfills and other activities; roads; cyanobacteria	Population growth and development; transportation spills; stormwater management	--	

Water Quality Contaminant	Land Use Sources	Threats and Drivers	Trend	Notes
Other toxic organic compounds	Leaching from landfills; runoff from impervious surfaces and roads; cleaners; septic systems	Population growth and development; transportation and other spills; stormwater management	--	
Natural organic compounds, Total Organic Matter (TOC)	Leaching out of the forested areas, in-stream growth of benthic algae, and from other sources that contribute dissolved and particulate total organic matter to the river	Wildfire; climate change (increased high-intensity rainfall events); Population growth and development	+	The recent fires could contribute to elevated levels of organic compounds entering the river.
Pesticides: herbicides, fungicides, insecticides	Application or spills in forest and agriculture applications; rural residential use and storage; roadside application	Population growth and development; transportation spills	--	
Inorganic compounds	Runoff from impervious surfaces and roads; septic systems	Population growth and development; stormwater management	--	
Nitrogen and phosphorous	Rural residential, agricultural, urban fertilizer applications to yards and crops; livestock operations; septic systems	Population growth and development; stormwater management	+	Willamette Basin studies have shown the highest nitrogen and phosphorus concentrations in the lower portions of watersheds, where most of the agriculture, urban development, and septic systems are. There are pronounced increases in both nitrogen and phosphorus as the Molalla River progresses downstream, presumably from significant inputs of nutrients from agricultural and rural residential land use sources.
Drinking water contaminants of emerging concern – e.g., pharmaceuticals, caffeine, and other	Septic systems; wastewater treatment	Population growth and development; aging and poorly maintained septic systems	+	Based on studies in the Willamette Basin and other watersheds, it appears contaminants of emerging concern are increasingly detected at low levels in surface waters.

Water Quality Contaminant	Land Use Sources	Threats and Drivers	Trend	Notes
potential contaminants				
Bacteria, e.g., E. coli, and other microorganisms	Septic systems; livestock operations; loss of riparian buffers	Population growth and development; aging and poorly maintained septic systems	+	The Canby Source Area has the highest density and number of septic systems
Algae/Cyanobacteria – cyanotoxins and other compounds affecting T&O	Elevated water temperatures or stagnant water from rural residential and agricultural activities: Loss of riparian shade; water withdrawals; nutrient inputs from agricultural and rural residential activities; inputs from gravel and agricultural ponds	Climate change (increased temperatures, lower flows); population growth and development (increased nutrients)	+	Detections of MIB and geosmin at Canby intake have increased over the last decade, which has generated T&O concerns. There is limited information on source area locations and mechanisms for the Cyanobacteria blooms.
Dissolved oxygen and biological oxygen demand (BOD)	Wastewater treatment; Loss of riparian shade; water withdrawals	Population growth and development; nutrients	--	No increases in BOD were detected at Canby intake following authorized City of Molalla wastewater discharges. However, high water temperatures and other human-induced factors, such as introducing excess fertilizers leading to more algal growth, can reduce the amount of dissolved oxygen in a water body.
pH	Loss of riparian shade; water withdrawals (increasing water temperatures); nutrient inputs driving increased algal biomass and changes in algal photosynthesis and respiration	Climate change (increased temperatures, lower flows); Population growth and development	--	Algal photosynthesis, which can be exacerbated by high water temperatures and nutrients in the water, can change water pH values.

Source Area Protection Plan Goals

Goal 1:

Identify, prevent, minimize and mitigate for activities that have known or potentially harmful impacts on drinking water quality so that the Molalla River and tributary streams are a high-quality drinking water source that meets current and future needs, meets human health requirements, and minimizes drinking water treatment costs.

Goal 2:

Promote public and landowner awareness of drinking water issues and engage stakeholders in stewardship actions that protect and restore the Molalla River Watershed.

Source Area Protection Plan Objectives

1. **Plan and implement actions that maintain source water quality in a way that balances risks with benefits in partnership with watershed stakeholders;**

2. **Prioritize source protection efforts that provide the greatest benefit to community water treatment;**

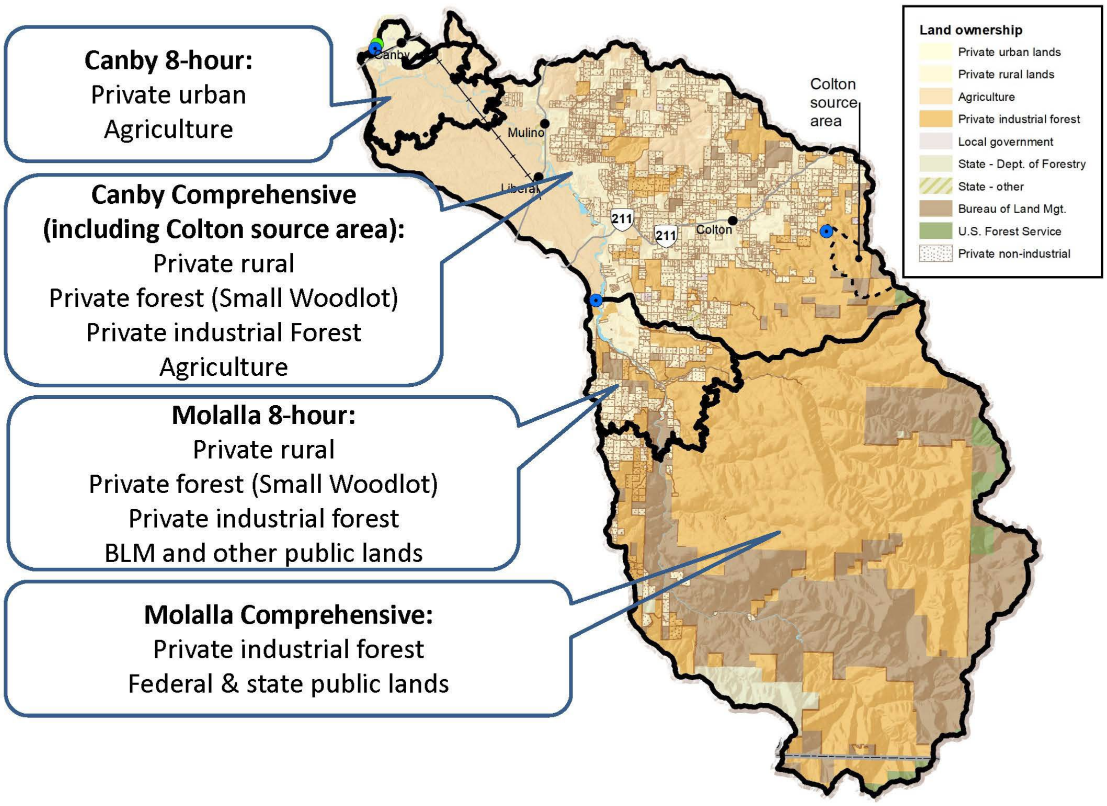
3. **Base source water actions on a long-term strategic approach that aligns watershed stakeholder priorities and leverages resources for the implementation of activities;**

4. **Promote public awareness and stewardship of a healthy watershed through targeted actions and programs; and**

5. **Assess source water quality and trends over time through ongoing monitoring, and consistent reporting.**

Source Area Protection Plan Activity Focus Areas

Focus Areas



Organization, Plan Duration, and Action Phasing

The Molalla Drinking Water Source Protection Technical Advisory Committee (TAC), comprised of representatives from the community water systems, Clackamas SWCD, NRCS, and other agencies and organizations (see sidebar, page 1), will guide plan implementation and on-the-ground actions. Clackamas SWCD will convene and facilitate the TAC meetings. The TAC organizations will lead and support the implementation of the plan and identify organizations responsible for securing funding and implementing actions.

The TAC will initially meet at least quarterly to discuss and evaluate implementation actions evaluate new information, identify future actions, assign responsible parties for implementation, and identify funding sources.

The plan will be phased in over four two-year phases, 2022 through 2029. The initial phases will focus on identifying turbidity and sediment source areas through storm-event monitoring, understanding the factors contributing to harmful algal blooms, communicating the plan's findings and activities to the broader community, and identifying landowners to implement actions. Later phases will focus on implementing actions to protect and improve water quality. The plan will adapt as new information on water quality status and trends, and project effectiveness becomes available.

Water Quality Contaminant Prioritization

The TAC prioritized water quality contaminants or issues to be addressed in the plan (**Table 8**). The contaminants were identified and prioritized based on the risks to the community water systems. Tier I contaminants are those that pose the most significant risks for drinking water treatment. In most cases, more information is necessary to identify source areas and to emphasize on-the-ground actions. Tier II contaminants will be addressed in later implementation phases.

The implementation plan table below outlines the Tier I and II contaminants, drivers and threats, implementation responsibilities, and potential funding sources. The table outlines the types of best management practices (BMPs) and locations needed to help meet the Drinking Water Source Protection Plan goals and objectives.

Table 8. TAC-prioritized water quality contaminants/issues to be addressed through actions to protect and improve water quality.

Priority Tier	Water Quality Contaminant or Issue	Notes
I	Turbidity/Sediment/ Total Suspended Sediment (TSS)	Little data on source areas. Assess sources to identify areas and actions (e.g., storm event monitoring). Storm event monitoring and evaluation will require technical expertise and funding.
	Water Temperatures	There are data on water temperature patterns, riparian shade, and water withdrawals (i.e., irrigated crops), but the information is not synthesized in framework useful for identifying source areas. Assess sources to identify areas and actions. Temperature source area analysis will require technical expertise and funding.
	Harmful Algal Blooms (HABs)	Assessment and research are necessary to identify the factors contributing to HABs, source areas, and potential actions to minimize HABs.
	Hazardous Materials and Spills	Hazardous materials spills from roads, commercial establishments, and industrial applications
	Bacteria (E. coli)	
II	Pesticides	Limited data on source areas and pesticide types and detections. Need to identify implementation lead.
	Nutrients (Phosphorus and Nitrogen)	Limited data on source areas and pesticide types and detections. Identify implementation lead.
	Monitoring Discharge Permit Reporting	Monitor Molalla River discharge permits for a variety of activities (e.g., municipal wastewater and floodplain gravel pits) that are managed in accordance with permits issued by the Oregon DEQ. Identify implementation lead.

The table below describes the Source Water Protection Plan implementation actions with proposed BMPs and other measures. See **Appendix A** for how "BMPs and Actions" in the Implementation Plan – for example, "enhance livestock management" and "implement measures to control riverbank erosion" – with specific NRCS practices. These practices are the particular treatments needed to implement the plan and include estimates of the extent required to treat the resource concerns and the estimated costs.

Implementation Plan

Priority Tier	Water Quality Contaminant or Issue	Description	Watershed Source Areas/Contributing Factors and Threats	Action Plan Watershed Focus Areas	BMPs and Actions	Phase				Potential Lead & Support Organizations	Funding Opportunities
						Phase I (2022 – 2023)	Phase II (2024 – 2025)	Phase III (2026 – 2027)	Phase IV (2028 – 2029)		
I	**Turbidity/Sediment/ Total Suspended Sediment (TSS)**	High levels of turbidity/TSS can make drinking water treatment difficult and, at extreme levels, can potentially curtail withdrawals of source water for a period of time. Potential to link to Mercury TMDL (sediments transport mercury; TSS is the surrogate measure). DMAs, including the County, could be involved in monitoring and other actions as part of implementing the TMDL	Source: All Watershed Areas <u>Contributing factors</u>: • 2020 wildfires • Roads, especially unimproved (dirt/gravel) roads • Agricultural practices: runoff from crops and nurseries • Livestock • Landslides • River and stream bank erosion <u>Threats</u>: • Climate change – increased storm intensity, continued wildfires • Population growth	All Watershed Areas with an emphasis on Canby Comprehensive and Molalla 8-hour	Conduct storm-event monitoring to identify turbidity source areas and potentially other contaminants (e.g., pesticides)					• CSWCD = Lead • Molalla River Watch/WC (Support) • DEQ (Basin Coordinator and Volunteer Monitoring Coordinator support) • ODA • Clackamas County • USGS	OWEB Mercury Designated Management Agency (DMA) support
				Canby 8-hour Canby Comprehensive	Based on storm event monitoring findings, identify actions for agricultural producers: • Implement crop filter strips • Enhance/protect riparian buffers • Enhance livestock management • Implement appropriate road drainage improvements • Implement measures to control river bank erosion					• CSWCD = Lead • Molalla River Watch/WC (Support) • ODA • DEQ • Clackamas County	NRCS cost-share OWEB
				Canby Comprehensive Molalla 8-hour	Based on storm event monitoring findings, identify rural residential lands and non-industrial forest (family, less than 100 ac.) uses:					• CSWCD = Lead • Molalla River Watch/WC (Support) • ODA	NRCS cost-share OWEB

Priority Tier	Water Quality Contaminant or Issue	Description	Watershed Source Areas/Contributing Factors and Threats	Action Plan Watershed Focus Areas	BMPs and Actions	Phase I (2022 – 2023)	Phase II (2024 – 2025)	Phase III (2026 – 2027)	Phase IV (2028 – 2029)	Potential Lead & Support Organizations	Funding Opportunities
					• Enhance livestock management • Implement appropriate road drainage improvements • Enhance/protect riparian buffers • Implement measures to control riverbank erosion • In-stream large wood placement to trap sediments						
				Canby Comprehensive Molalla Comprehensive	Forest land uses: • Replant burned areas and control erosion through mulching and other actions • Decommission roads where appropriate • Continued road maintenance • Implement road drainage improvements • Prevent landslides through appropriate road locations and design, leave trees, etc. • In-stream large wood placement to trap sediments					• Oregon Dept. of Forestry = Lead • Industrial forest landowners • BLM • U.S. Forest Service	Drinking Water Providers Partnership / nexus with USFS BLM for implementation (I.D. projects in the watershed) implementation
	Water Temperatures	High water temperatures can make treatment difficult and can exacerbate other issues: algal growth,	Source: All Watershed Areas <u>Contributing factors</u>: • 2020 wildfires	All Watershed Areas	Conduct stream temperature monitoring and riparian shade evaluation to identify source areas and treatments					• Molalla River Watch/WC • CSWCD (Support) • ODA	OWEB

Priority Tier	Water Quality Contaminant or Issue	Description	Watershed Source Areas/Contributing Factors and Threats	Action Plan Watershed Focus Areas	BMPs and Actions	Phase				Potential Lead & Support Organizations	Funding Opportunities
						Phase I (2022 – 2023)	Phase II (2024 – 2025)	Phase III (2026 – 2027)	Phase IV (2028 – 2029)		
		dissolved oxygen, etc. that contribute to other water quality issues. Actions to improve water temperatures (e.g., improve riparian buffers) can also address the temperature TMDL	• Riparian vegetation loss and decreased shading • Knotweed and other invasive infestation areas • Water withdrawals <u>Threats</u>: • Climate change – decreased summer flows, increased water temperatures, forest fires • Population growth	Canby Comprehensive Molalla 8-hour	Based on water temperature monitoring findings, work with agricultural producers to: • Create and enhance tributary and Molalla River riparian buffers • Implement irrigation efficiency projects and other measures to reduce water withdrawals					• Molalla River Watch/WC? • CSWCD (Support) • ODA	OWEB NRCS cost-share
				Canby Comprehensive Molalla 8-hour	Based on water temperature monitoring findings, work with rural Residential land uses to: • Create and enhance riparian buffers (focus on tributary streams) • Address knotweed and other weeds in riparian/ floodplain areas					• Molalla River Watch/WC • CSWCD (Support) • ODA	OWEB NRCS cost-share
	Harmful Algal Blooms (HABs)	Canby has detected algal cyanotoxins at its raw water intake and now regularly monitors for cyanotoxins since 2014. The regulated cyanotoxins microcystin and cylindrospermopsin have been detected, but at a concentration well	Source: All Watershed Areas <u>Contributing factors</u>: Unknown, but could include: • High water temperatures • Elevated nutrients • 2020 wildfires (increased nutrients) • Water withdrawals	Unknown but assumed to be all watershed areas	Conduct assessment and research to identify causal factors, source areas, and potential actions to minimize HABs					• Canby Utility • USGS	OWEB
				Unknown but assumed to be all watershed areas	Based on assessment and research findings, identify and actions					• Canby Utility • USGS	OWEB NRCS cost-share

Priority Tier	Water Quality Contaminant or Issue	Description	Watershed Source Areas/Contributing Factors and Threats	Action Plan Watershed Focus Areas	BMPs and Actions	Phase				Potential Lead & Support Organizations	Funding Opportunities
						Phase I (2022 – 2023)	Phase II (2024 – 2025)	Phase III (2026 – 2027)	Phase IV (2028 – 2029)		
		below human-health benchmarks. The City has also seen two other compounds that are metabolites of cyanobacteria activity: MIB and geosmin, both of which contribute to drinking water taste and odor issues	• Gravel and in-line pond contributions Threats: • Climate change – decreased summer flows, increased water temperatures • Population growth								
	Hazardous Materials and Spills	Hazardous material spills (e.g., petroleum products) can affect treatment and potentially curtail source water withdrawals for a period of time	Source: All Watershed Areas Contributing factors: • Road-related spills • Railroad related spills • Spills associated with industrial, agricultural, and other land uses Threats: • Population growth (increased road traffic)	All watershed areas with an emphasis on Canby and Molalla 8-hour travel areas	Roads, industrial/urban, rural residential, and agricultural land uses: • Improve spill response notifications • Provide information/ training on preventing and responding to industrial and agricultural hazardous substances spills • Sponsor and organize hazardous material pick-up and appropriate disposal					• Canby Utility? • City of Molalla? • CSWCD (quarterly convening) • Clackamas County • DEQ (assist with coordination) • ODOT (spill response plans)	
	Bacteria (E. coli)	High levels of bacteria can increase treatment costs; septic systems can release bacteria, nutrients, and toxics	Source: All Watershed Areas Contributing factors: • Poorly functioning septic systems • Livestock • Animal management • River corridor recreation	All watershed areas	Rural residential and agricultural land uses: • Provide information/ training on appropriate septic system operation and maintenance • Continue septic upgrade loan program (CSWCD) • Mange livestock wastes					• Canby Utility? • City of Molalla? • CSWCD • County • ODA	USDA: Loans / grants (Single Family Housing Repair Loans & Grants in Oregon)

Priority Tier	Water Quality Contaminant or Issue	Description	Watershed Source Areas/Contributing Factors and Threats	Action Plan Watershed Focus Areas	BMPs and Actions	Phase I (2022 – 2023)	Phase II (2024 – 2025)	Phase III (2026 – 2027)	Phase IV (2028 – 2029)	Potential Lead & Support Organizations	Funding Opportunities
			<u>Threats</u>: • Population growth: increased number of septic systems; increased recreational uses		Forest land uses in the river corridor: • Continue to provide and improve appropriate public toilet facilities						
II	**Pesticides**	Pesticides (herbicides, fungicides, insecticides) can enter the river due to runoff from agricultural fields, nurseries, yards, roadside ditches, and other areas. Low levels of herbicides have been detected in the past at the Canby intake	Source: All Watershed Areas <u>Contributing factors</u>: • Rural residential pesticide application • Crop/nursery pesticide application • Forestry pesticide application • Spills <u>Threats</u>: • Population growth • Climate change: increased prevalence of weed species	Canby and Molalla 8-hour travel areas Canby Compressive	Rural residential and agricultural land uses: • Provide information/ training on pesticide handling and application BMPs • Assist with incentives for applying nutrient BMPs • Periodically monitor for pesticides Forest land uses: • Continue to apply pesticide BMPs					• CSWCD = leading the conversation • Molalla River Watch/WC • ODA • DEQ (Pesticide Stewardship Program)	NRCS cost-share OWEB
	Nutrients (Phosphorus and Nitrogen)	Elevated levels of nitrite and phosphorous observed in samples that drained agricultural areas; anticipate higher nutrient levels from 2020 wildfires	Source: All Watershed Areas <u>Contributing factors</u>: • 2020 wildfires • Livestock manure management • Rural residential fertilizer application	Canby and Molalla 8-hour travel areas Canby Compressive	Rural residential and agricultural land uses: • Provide information/ training on livestock manure BMPs • Provide information/ training on fertilizer application BMPs					• CSWCD – Part of the conversation • ODA	NRCS cost-share OWEB

Priority Tier	Water Quality Contaminant or Issue	Description	Watershed Source Areas/Contributing Factors and Threats	Action Plan Watershed Focus Areas	BMPs and Actions	Phase I (2022 – 2023)	Phase II (2024 – 2025)	Phase III (2026 – 2027)	Phase IV (2028 – 2029)	Potential Lead & Support Organizations	Funding Opportunities
			• Agricultural fertilizer application Threats: • Population growth		• Assist with incentives for applying nutrient BMPs • Periodically monitor for nutrients Forest land uses: • Continue to apply pesticide BMPs • Track pesticide application on forest lands						
	Monitoring Discharge Permit Reporting	Molalla River discharge permits for a variety of activities (e.g., municipal wastewater and floodplain gravel pits) are managed in accordance with permits issued by the Oregon DEQ. The City of Molalla's treated effluent may be discharged to the Molalla River in accordance with permit requirements. DOGMI is the lead agency for gravel pits.	Source: All watershed areas Contributing factors: • Potential for gravel pits and agricultural ponds to affect water quality, including potentially contributing to HABs (needs to be studied) • There have been authorized releases of City of Molalla's treated effluent that are outside the permit dates and criteria (e.g., river flow levels) • The releases are subject to meeting specific water quality standards for TSS and BOD • To date, Canby has not observed BOD or TSS changes at their intake as a result of the City of	Canby and Molalla 8-hour travel areas Canby Compressive	Rural residential, agricultural, and urban land uses: • Monitor discharge permits for compliance • The City of Molalla will continue to notify the City of Canby of authorized treated wastewater releases • Canby will continue to monitor the City of Molalla's permit and evaluate if authorized discharges are meeting specific water quality standards for TSS and BOD at the intake					DEQ help support Canby Utility	

Priority Tier	Water Quality Contaminant or Issue	Description	Watershed Source Areas/Contributing Factors and Threats	Action Plan Watershed Focus Areas	BMPs and Actions	Phase I (2022 – 2023)	Phase II (2024 – 2025)	Phase III (2026 – 2027)	Phase IV (2028 – 2029)	Potential Lead & Support Organizations	Funding Opportunities
		The City of Molalla and Canby Utility will continue to cooperate under its active agreements.	Molalla authorized treated wastewater releases • Currently, the City of Molalla is designing an expanded wastewater treatment plant that will have the capacity to accommodate future growth Threats: • Population growth • Climate change: changes in river discharge (e.g., low flows in the spring)								

Monitoring and Evaluation

The Molalla River Watershed Drinking Water Source Protection Plan effectiveness, status, and trend monitoring framework encompasses two scales: 1) watershed-scale monitoring that evaluates potential water quality impairment source areas, and measures water quality status, trends, and improvements through time from conservation actions; and 2) site-level monitoring and analysis designed to learn from water quality BMP implementation and to capture and share best practices for on-the-ground work. The monitoring approach, to be implemented by the TAC, will outline interim metrics to track progress and BMP effectiveness. The monitoring approach will include implementation (practices implemented on vulnerable acres) and effectiveness metrics (i.e., estimates of the water quality impacts of implementation).

The monitoring and evaluation approach will consider the following:

- Investigate real-time monitors upstream of community water intakes for parameters such as turbidity, pH, and flow (e.g., velocity) to track the parameters over time and warn of high turbidity and high flow events in time to take protective measures such as filling pre-treatment storage.
- Monitoring organic carbon (TOC/or dissolved) and alkalinity of raw water throughout daily operations to ensure coagulant and disinfectant use is appropriate. The City of Molalla has TOC monitoring equipment in place and is working to implement monitoring. Canby collects TOC data.
- Exploring frequent testing of source water for nutrients (nitrogen and phosphorous), algal toxins, TOC, and other parameters to help characterize post-fire water quality patterns.
- Developing and implementing a storm event monitoring approach that identifies source areas for turbidity and potentially other water quality parameters (e.g., pesticides).
- Developing and implementing a harmful algal bloom research and assessment approach to identify HAB sources and describe treatments to reduce the risk of HABs and subsequent generation of cyanotoxins and drinking water taste and odor issues.

See **Appendix A** for an outline of interim metrics to track progress on plan implementation with agricultural producers. This includes both implementation of practices on vulnerable acres and effectiveness metrics.

Landowner and Stakeholder Outreach Strategy

The landowner and stakeholder outreach strategy describes landownership characteristics, identifies landowners within critical areas for Source Water Protection, describes landowners that are a high priority for outreach, and outlines strategies to engage agricultural producers and rural residential area landowners.

Description of Landownership Characteristics

There are four broad landowner categories within the Molalla Source Water Protection area:

- Agricultural producers – present throughout the source water areas with the exception of the upper forested portions of the watershed. The highest concentration of agricultural lands is in the lower watershed within Canby's 8-hour travel area.
- Rural residential area landowners – The largest category in terms of the number of landowners and, except for the upper forested portions of the watershed, rural residential land owners are present throughout the Source Water Protection Area. Rural residential lands include small tracts of forest lands (i.e., small woodlots less than 200 acres) often managed for timber production.
- Forest landowners – this category is present in the Canby comprehensive area and the Molalla comprehensive area, with the most significant forest ownerships in the upper watershed. This category includes industrial timber producers (primarily Weyerhaeuser and Port Blakely), and state forest lands (managed by the Oregon Dept. of Forestry), and forest lands managed by the federal government (primarily the Bureau of Land Management and a small area administered by the U.S. Forest Service).
- Urban landowners – The smallest landowner category and confined to lands within the City of Canby, most of which drain into the river downstream of the drinking water intake.

Identification of Landowners that are a High Priority for Outreach

Agricultural producers and rural residential landowners, which comprise the most extensive areas with critical water quality issues for source water protection, are the highest priority for outreach.

Strategies to Engage agricultural producers, rural residential area landowners, and watershed stakeholders,

The strategies to engage watershed stakeholders, agricultural producers, and rural residential area landowners are as follows:

- Reach out to agricultural producers by crop type with a description of the Source Area Protection Plan, an outline of actions producers can take to improve water quality and a summary of available funding assistance.
- Conduct broad community and landowner outreach by circulating materials describing Molalla River Watershed water quality issues and the Source Area Protection Plan; outline actions designed to protect and improve water quality; and provide information describing activities landowners and others can do to address water quality problems on their property.
- Describe the planned storm event monitoring design and purpose to landowners and other watershed stakeholders. Outline ways landowners and community members can participate in the storm event monitoring effort. Coordinate volunteer participation in the monitoring activities; summarize the monitoring findings; outline the identified source areas and

actions to address identified water quality issues; and distribute the monitoring results to landowners and watershed stakeholders.

- Describe the water temperature assessment design and purpose to landowners and other watershed stakeholders. Summarize the assessment findings; outline the identified water temperature source areas and actions to address riparian shading, and distribute the results to landowners and watershed stakeholders.
- Based on the stormwater event monitoring and water temperature assessment, identify agricultural producers and rural residential landowners to engage in water quality improvement actions within the identified critical source areas.

See **Appendix A** for an analysis of the agricultural producers available in the watershed to participate, their likely willingness to participate and an assessment of how critical area treatment is balanced with participation to achieve the most effective implementation prioritization.

National Environmental Policy Act

The National Environmental Policy Act (NEPA) is a United States environmental law promoting the environment's enhancement. Molalla Watershed Drinking Water Source Protection Plan water quality improvement actions implemented with federal funding must comply with NEPA. As a result, Clackamas SWCD projects funded through NRCS' NWQI or other federal funding must comply with NEPA.

Purpose and Need

The purpose of NRCS' NWQI in the Molalla River Watershed is to accelerate voluntary, on-farm conservation investments focused water quality improvements, monitoring, and assessment of resources where they can deliver the most significant benefits for clean water.

Molalla River and tributary water quality is generally trending in a negative direction. Turbidity levels, water temperatures, and other water quality parameters important for drinking water quality are declining. Therefore, there is a need to fund and implement projects on agricultural lands designed to improve water quality.

Resource Concerns

Resource concerns are documented in this plan and supporting documents. The primary resource concerns on agricultural lands include the following (also see **Appendix A**):

- Increased turbidity/sediment/total suspended sediment (TSS) loads from erosion
- Elevated water temperatures
- Increased frequency of Harmful Algal Blooms (HABs)
- Potential hazardous material spills
- Increased bacteria (E. coli) concentrations
- High levels of pesticides entering the river and tributaries

- Elevated nutrients (phosphorus and nitrogen)
- Reduced water quantities from groundwater and surface water depletion
- Increased invasive vegetation, natural plant community habitat fragmentation, forage quantity and quality
- Negative water quality impacts on Endangered Species Act (ESA) listed salmon and steelhead
- Increased impacts on cultural resources
- Impacts of climate change

Documenting Existing/Benchmark Conditions

The Implementation Plan and the Phase II report describe current and trending water quality and resource conditions. In addition, implemented (e.g., water temperature monitoring) and planned (e.g., evaluating cyanobacteria drinking water taste and odor sources) monitoring will further quantify conditions over time.

Implementation Alternatives

For this plan, there are two alternatives:

No-Action Alternative:

- Continue current funding and activities with agricultural producers to address resource concerns.

Alternative 1:

- Through improved funding and the application of appropriate practices, accelerate voluntary, on-farm conservation investments focused on water quality improvements, monitoring, and assessment resources where they can deliver the most significant benefits for clean water.

Effects Analysis

Documenting the environmental impact of implementing the No-Action Alternative and Alternative 1 focuses on evaluating three categories of effects[2]:

- Direct effects are caused by the alternative and occur at the same time and place.
- Indirect effects are caused by the alternative and are later in time or farther removed in distance, but are still reasonably foreseeable.

[2] NRCS. 2016. National Environmental Compliance Handbook. NRCS, Washington, D.C.

- Cumulative effects are those that result from all past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Cumulative effects are most appropriately analyzed on a watershed or area-wide level.

Table 9 summarizes the analysis of the effects of the alternatives.

Table 9. NEPA effects analysis.

Alternative and Resource Concerns	Direct Effects	Indirect Effects	Cumulative Effects
No Action Alternative			
• Water Quality	Current negative trends in water quality will continue	Elevated levels of water quality parameters (e.g., turbidity) will affect drinking water treatment	Climate change will increase the frequency and magnitude of high air temperatures, drought, and flooding events, contributing to accelerated declines in water quality
• Water Quantity	Current negative trends in surface and groundwater quantity will continue	Reduced river flows will exacerbate negative water quality trends (e.g., increased water temperatures), which will negatively affect water treatment	Climate change, combined with local population growth, will increase water demand and the frequency and magnitude of droughts, decreasing river flows and surface and groundwater supplies
• Invasive Vegetation	Current negative trends in invasive vegetation spread and new invasive species introductions will continue	Increased invasive vegetation (e.g., knotweed) will change riparian vegetation structure, contributing to less shade over channels and increased water temperatures	Elevated air temperatures from climate change will affect native vegetation (e.g., cedar trees) and reduce shading over streams, contributing to elevated water temperatures
• ESA-Listed Salmon & Steelhead	Elevated water temperatures will continue to affect ESA-listed salmon and steelhead, contributing to populations that will remain at low levels and continue overall declines	Loss of salmon and steelhead populations will continue to contribute to fewer carcasses and marine-derived nutrients (e.g., nitrogen) supporting food sources for birds (e.g., bald eagles) and other wildlife and less nutrients supporting riparian vegetation	Climate change, combined with local population growth, will increase air temperatures and corresponding water temperatures and continue to degrade and fragment habitats important to salmon and steelhead

Alternative and Resource Concerns	Direct Effects	Indirect Effects	Cumulative Effects
• Cultural Resources	Currently, most practices are not ground-disturbing at sufficient depths to affect cultural resources	Application of current practices over time (e.g., contributing soil erosion) could expose cultural resources over time	Application of current practices, combined with local population growth and development, could affect cultural resources over time
• Climate Change	No action will contribute to climate change conditions that will increase water demand and the frequency and magnitude of droughts, decreasing river flows and surface and groundwater supplies. Elevated air temperatures will contribute to increased water temperatures	Increased air temperatures from climate change will contribute to riparian tree mortality, which will decrease shade and increase water temperatures	Climate change, combined with local population growth, will increase water demand and the frequency and magnitude of droughts, decreasing river flows and surface and groundwater supplies
Alternative 1			
• Water Quality	Proposed BMPs will positively affect trends in water quality	Application of proposed practices will reduce the extent and magnitude of invasive vegetation, contributing to native trees and other native vegetation contributing to improved shade over channels and decreased water temperatures	Applying practices will help mitigate climate change trends through conserved water, invasive species control and other BMPs.
• Water Quantity	Proposed BMPs will reduce water demand and conserve surface and groundwater levels and supplies	Conserving water supplies will increase river flows during the summer, contributing to reduced water temperatures	Application of practices will help mitigate climate change trends through conserved water, creating improved summer river flows over time

Alternative and Resource Concerns	Direct Effects	Indirect Effects	Cumulative Effects
• Invasive Vegetation	Proposed BMPs will decrease invasive vegetation	Decreased invasive vegetation will help promote native vegetation, including trees that will shade channels and reduce water temperatures	Over time, reduced invasive vegetation will contribute to improved riparian structure and function, all of which will contribute to improved aquatic and terrestrial habitats supporting fish and wildlife
• ESA-Listed Salmon & Steelhead	Proposed BMPs will improve water temperatures and support improved river habitat that supports salmon and steelhead populations	Increased salmon and steelhead populations will contribute to increasing carcasses and marine-derived nutrients supporting food sources for birds and other wildlife, and contribute to more nutrients supporting riparian vegetation	Over time application of proposed BMPs will contribute to improved riparian structure and function, which will contribute to improved aquatic habitat supporting salmon and steelhead populations
• Cultural Resources	Most proposed practices are not ground-disturbing at sufficient depths to affect cultural resources	Protecting cultural resources will help facilitate Tribal involvement in implementation of the plan	Over time, Tribal involvement in watershed improvement actions will help increase the pace and magnitude of restoration activities
• Climate Change	Application of the proposed practices will contribute to mitigating climate change conditions, decreasing the frequency and magnitude of droughts, increasing river flows and surface and groundwater supplies	Improving water conservation in the face of climate change will increase river flows during the summer, contributing enhance drinking water quality	The proposed practices will help mitigate climate change, decreasing over time water demand, and improving river flows and surface and groundwater supplies

Appendix A

Molalla NWQI Agricultural Area Implementation Strategy

Molalla NWQI Agricultural Area Implementation Strategy

Background and Water Quality Characterization

The Clackamas Soil and Water Conservation District has been working with Cascade Environmental Group, LLC, and partners to assess watershed conditions and risks to drinking water quality from the Molalla River after receiving a National Water Quality Initiative (NWQI) assessment phase grant.

The purpose of this assessment and planning effort is to find ways to reduce or prevent water quality pollutants in the Molalla River, a drinking water source for the residents of Canby, Molalla, and Colton so they can get quality drinking water at reasonable treatment costs.

Available water quality data for the Molalla predominantly covers the lower mainstem. Dissolved Oxygen levels and E. coli bacteria have exceeded water quality standards. Turbidity and excess sediment are also concerns for drinking water during big storm events. Canby can avoid significant impacts from sediment by switching to their infiltration gallery intake (groundwater) during storm events, while Molalla shuts down it's intake during high turbidity events and relies on limited storage.

A Technical Advisory Committee (TAC) was formed to inform the NWQI assessment development and have expressed interest in pursuing grant funding to provide advance warning and trend data from real-time water quality monitoring. Parameters such as sediment, temperature, nutrients and chlorophyl would be monitored in the mainstem Molalla in real-time, while additional grab samples could be taken in other locations to determine potential sources for cyanotoxins detected in the lower mainstem. Temperature is also a pollutant of concern during summer low flow conditions and treating for bacteria such as E. coli during high temperatures requires more chlorine.

The Molalla Watershed is especially vulnerable to climate change because it lacks a high Cascade Mountain snowpack to sustain cool river flows into the summer (PSU 2018). In addition, there is evidence that April 1st snowpack peak accumulations are generally declining. It is predicted that higher summer and fall air temperatures and lower summer and fall flows will drive higher water temperatures and associated cyanobacteria blooms (Cascade Environmental Group 2019). Higher temperatures and an increased likelihood of summer droughts increase the probability of wildfire in the watershed (PSU 2018) as witnessed within the watershed in 2020. Studies have shown the increased turbidity risk following wildfires can last for several years, increasing the likelihood of higher sediment turbidity levels in the river.

Agricultural Area of Focus Description

Approximately 13% of the Molalla River Watershed area above the Canby intake (about 45 square miles or 28,800 ac), including land within the 8-hour distribution curve of both the Canby and the Molalla drinking water intakes, was identified in the Watershed Assessment Characterization as primarily agricultural in use. Because agricultural practices can have a large impact on water quality, and we can't realistically treat the entire watershed, this is the Agricultural Area of Focus (AAOF) we propose for using NRCS NWQI Implementation funding.

The AOF includes 1,759 privately owned tax lots between 2.5 and 195 acres in size with the median size being 8.9 acres and the average size being 16.9 acres. Over two thirds of these taxlots were in EFU zoning. There were 1,459 CLU field records (446 Farm #'s & 553 Tract #'s) within the AAOF. The average field acreage was 13.4 with the total number of acres equaling 19,522. In total, 68% of the AAOF acreage is in the USDA system, indicating that the majority of landowners/operators in the AAOF may have participated or be familiar with USDA Farm Bill programs.

Analysis of the AAOF included GIS and windshield verification of land uses. Most of the land appeared to be pasture/grassland (67%), with the next largest categories being hayland (8%), grass grown for seed (6%), Christmas trees (5%), hazelnuts/orchard (5%), Annual crops (4%). Berries, inground nurseries, container nurseries, hemp, beef, and chicken CAFOs, fallow, among others account for approximately 1% or less. There were more orchards, annual cropping, and nurseries in the prairies south of Canby, and more Christmas trees, livestock, pasture and haylands in the areas to the east.

Table 5. Molalla River watershed agricultural crop types and area (acres). I = Irrigated crops.

Crop Type	Acres	Crop Type	Acres
Grassland/Pasture	26,405	Fruit Orchard	213
Hay/Pasture	3,150	Woodland/Pasture	56
Grass Seed	2,545	Nursery, container/Greenhouse	30
Christmas Trees	2,170	Irrigated/Pasture (I)	27
Hazelnuts (I)	1,756	Other Hay/Non-Alfalfa, Irrigated (I)	27
Annual crop rotations (e.g., vegetables, row crops, strawberries, corn, etc.) (I)	1,588	Alfalfa	16
Fallow/Idle Cropland	601	Hemp (I)	15
Berries/Hops	468	Chicken House (CAFO)	8
Nursery, In-ground	308	Beef (CAFO)	8

Problem Statement

The Technical Advisory Committee for the Molalla River Drinking Water would like to improve and protect the drinking water resources of the Molalla River.

The major resource concerns for this area to be addressed are sediment loss, bank erosion from streams and conveyance channels, seasonal high-water table, and the potential contamination of surface waters from sediment, excess nutrients, bacteria (E. coli), algae, cyanotoxins, metals, pesticides, etc. to surface waters (runoff), and groundwater (leaching) and soil health (compaction, organic matter depletion).

The mainstem Molalla River is considered impaired by the DEQ for bacteria, temperature, and flow modifications, and has TMDLs for many other parameters such as nutrients and mercury. Invasive weed pressure is also very high, making riparian forest buffers more difficult to implement due to pervasive pressure from weeds like reed canary grass and Japanese knotweed.

Most of the flat agricultural production occurs in soils with a high erodibility rating, so soil loss is a major concern even in the low gradient prairies south and east of Canby. The primary season for excess precipitation is during the winter wet season.

Inefficient use of irrigation water, irrigation induced erosion, and a groundwater limited area (Gladtidings) were also identified within the AAOF as likely to contribute to drinking water issues.

Identified Resource Concerns:

Soil loss: Sheet and rill erosion, gully erosion, Irrigation induced erosion.

Soil health: soil compaction, OM depletion, Excess nutrients.

Water Quality: increased sedimentation, excess nutrients, bacteria, algae, cyanotoxins, metals, pesticides, toxins, temperature.

Water Quantity: inefficient irrigation water use, groundwater depletion, surface water depletion, limited water storage.

Plants: Invasive vegetation, natural plant community habitat fragmentation, forage quantity and quality.

CARTs Analysis of select practices Pasture/Hay systems, Molalla Subbasin:

PASTURE / HAY		
Resource Concern Treated	**Practice**	**CART Treatment Value**
	selected from BMP list to focus on the goal of mitigating or controlling soil loss, contaminated surface water runoff and leaching to groundwater	
Nutrients Transported to Surface Water (N& P)	Access Control (472)	0
	Cover Crop (340)	15N / 20P
	Filter Strip (393)	10N / 15P
	Forage and Biomass Planting (512)	5N / 5P
	Heavy Use Area Protection (561)	0
	Livestock Pipeline (516)	0
	Prescribed Grazing (528)	15N / 15P
	Roof Runoff Structure (558)	0
	Vegetated Treatment Area (635)	0
	Watering Facility (614)	0
Nutrients Transported to Ground Water (N & P)	Access Control (472)	0
	Cover Crop (340)	20N / 10P
	Filter Strip (393)	0
	Forage and Biomass Planting (512)	5N / 5P
	Heavy Use Area Protection (561)	0
	Livestock Pipeline (516)	0
	Prescribed Grazing (528)	15N / 15P
	Roof Runoff Structure (558)	0
	Vegetated Treatment Area (635)	0
	Watering Facility (614)	0
Pathogens and Chemicals From Manure,	Access Control (472)	0
Biosolids or Compost Applications	Cover Crop (340)	25S / 25G
Transported to Surface & Ground Water (S/G)	Filter Strip (393)	0
	Forage and Biomass Planting (512)	0
	Heavy Use Area Protection (561)	0
	Livestock Pipeline (516)	0
	Prescribed Grazing (528)	50S /50G
	Roof Runoff Structure (558)	0
	Vegetated Treatment Area (635)	50S / 50G
	Watering Facility (614)	0
Sediment Transported to Surface Water	Access Control (472)	5
(sediment from erosion)	Cover Crop (340)	0
	Filter Strip (393)	0
	Forage and Biomass Planting (512)	25
	Heavy Use Area Protection (561)	5
	Livestock Pipeline (516)	0
	Prescribed Grazing (528)	20
	Roof Runoff Structure (558)	0
	Vegetated Treatment Area (635)	0
	Watering Facility (614)	5
Field Pesticide Loss	Access Control (472)	0
pesticides transported to surface & ground	Cover Crop (340)	5E / 0D / 5L
water	Filter Strip (393)	15E / 25D/ 0L
	Forage and Biomass Planting (512)	10E / 0D / 10L
	Heavy Use Area Protection (561)	0
	Livestock Pipeline (516)	0
	Prescribed Grazing (528)	0
	Roof Runoff Structure (558)	0
	Vegetated Treatment Area (635)	0
	Watering Facility (614)	0
Storage and Handling of Pollutants	Access Control (472)	25 (nutrient/pathogen surface loss)
Nutrients and Petroleum, Heavy Metals and	Cover Crop (340)	0
Other Pollutants Transported to Surface &	Filter Strip (393)	0
Ground Water	Forage and Biomass Planting (512)	0
	Heavy Use Area Protection (561)	0
	Livestock Pipeline (516)	0
	Prescribed Grazing (528)	25 (nutrient/pathogen surface loss)
	Roof Runoff Structure (558)	25 (effluent to surface) 25 (nutrient/pathogen leaching)
	Vegetated Treatment Area (635)	25 (effluent to surface) 25 (nutrient/pathogen leaching)
	Watering Facility (614)	25 (nutrient/pathogen surface loss)
Soil Erosion	Access Control (472)	5
sheet and rill erosion	Cover Crop (340)	0
	Filter Strip (393)	0
	Forage and Biomass Planting (512)	25
	Heavy Use Area Protection (561)	5
	Livestock Pipeline (516)	0
	Prescribed Grazing (528)	20
	Roof Runoff Structure (558)	0
	Vegetated Treatment Area (635)	0
	Watering Facility (614)	5

CARTs Analysis of select practices Crop Systems, Molalla Subbasin:

CROP		
Resource Concern Treated	**Practice**	**CART Treatment Value**
	selected from BMP list to focus on the goal of mitigating or controlling soil loss, contaminated surface water runoff and groundwater leaching	
Nutrients Transported to Surface Water (N& P)	Conservation Cover (327)	0
	Cover Crops (340)	20 N / 15 P
	Filter Strip (393)	15 N / 10 P
	Irrigation Pipeline (430)	0
	Irrigation Water Management* (449)	10 N / 10 P
	Irrigaton system - microirrigation (441)	0
	Nutrient Management (590)	30 N / 30 P
	Residue and Tillage Management, No-till (329)	15 N / 15 P
	Riparian Forest Buffer (391)	15 N / 20 P
	Riparian Herbaceous Cover (390)	10 N / 15 P
Nutrients Transported to Ground Water (N & P)	Conservation Cover (327)	0
	Cover Crops (340)	20 N / 10 P
	Filter Strip (393)	0
	Irrigation Pipeline (430)	0
	Irrigation Water Management* (449)	10 N / 10 P
	Irrigaton system - microirrigation (441)	0
	Nutrient Management (590)	30 N / 30 P
	Residue and Tillage Management, No-till (329)	0
	Riparian Forest Buffer (391)	0
	Riparian Herbaceous Cover (390)	0
Pathogens and Chemicals From Manure,	Conservation Cover (327)	0
Biosolids or Compost Applications	Cover Crops (340)	25 S / 25 G
Transported to Surface & Ground Water (S/G)	Filter Strip (393)	0
	Irrigation Pipeline (430)	0
	Irrigation Water Management* (449)	0
	Irrigaton system - microirrigation (441)	0
	Nutrient Management (590)	50 S / 50 G
	Residue and Tillage Management, No-till (329)	0
	Riparian Forest Buffer (391)	0
	Riparian Herbaceous Cover (390)	0
Sediment Transported to Surface Water	Conservation Cover (327)	0
(sediment from erosion)	Cover Crops (340)	15
	Filter Strip (393)	15
	Irrigation Pipeline (430)	0
	Irrigation Water Management* (449)	5
	Irrigaton system - microirrigation (441)	0
	Nutrient Management (590)	0
	Residue and Tillage Management, No-till (329)	40
	Riparian Forest Buffer (391)	20
	Riparian Herbaceous Cover (390)	20
Field Pesticide Loss	Conservation Cover (327)	10 E / 0 D / 10 L
pesticides transported to surface & ground	Cover Crops (340)	5 E / 0 D / 5 L
water	Filter Strip (393)	15 E /25 D / 0 L
	Irrigation Pipeline (430)	0
	Irrigation Water Management* (449)	15 E / 0 D / 15 L
	Irrigaton system - microirrigation (441)	15 E / 0 D / 10 L
	Nutrient Management (590)	0
	Residue and Tillage Management, No-till (329)	10 E / 0 D / 5 L
	Riparian Forest Buffer (391)	15 E / 50 D / 5 L
	Riparian Herbaceous Cover (390)	10 E / 25 D / 5 L)
Storage and Handling of Pollutants	Conservation Cover (327)	0
Nutrients and Petroleum, Heavy Metals and	Cover Crops (340)	0
Other Pollutants Transported to Surface &	Filter Strip (393)	0
Ground Water	Irrigation Pipeline (430)	0
	Irrigation Water Management* (449)	0
	Irrigaton system - microirrigation (441)	0
	Nutrient Management (590)	0
	Residue and Tillage Management, No-till (329)	0
	Riparian Forest Buffer (391)	0
	Riparian Herbaceous Cover (390)	0
Soil Erosion	Conservation Cover (327)	80
sheet and rill erosion	Cover Crops (340)	15
	Filter Strip (393)	0
	Irrigation Pipeline (430)	0
	Irrigation Water Management* (449)	0
	Irrigaton system - microirrigation (441)	40
	Nutrient Management (590)	0
	Residue and Tillage Management, No-till (329)	20
	Riparian Forest Buffer (391)	0
	Riparian Herbaceous Cover (390)	0
	* IWM implemented as intermediate or advanced	

Recent Treatment in Source Water Protection Area

An analysis of activities within the Source Water Protection Area (SWPA) in the 5-year period from 2017-2021 resulted in the following table showing extents of Practiced installed by NRCS practice code. Results were compiled from reports provided by Natural Resources Conservation Service, Clackamas Soil and Water Conservation District, and Molalla River Watch.

Practices Installed in Molalla NWQI Area 2017-2021	Total
314 - Brush Management (ac)	455.4
315 - Herbaceous Weed control (ac)	111.2
325 - High Tunnel System (SqFt)	24258
327 - Conservation Cover (ac)	43.1
340 - Cover Crop (ac)	25.4
342 - Critical Area Planting (ac)	0.5
382 - Fence (ft)	3000
384 - Woody Residue Treatment (ac)	59.8
391 - Riparian Forest Buffer (ac)	19.4
395 - Stream Habitat Improvement & Management (ac)	1
472 - Use Exclusion (ac)	10
490 - Tree/Shrub Site Preparation (ac)	124.3
512 - Forage and Biomass Planting (ac)	0
528 - Prescribed Grazing (ac)	66
580 - Streambank & Shoreline Protection (ft)	250
590 - Nutrient Management (ac)	3.2
612 - Tree/Shrub Establishment (ac)	144.4
614 - Livestock Watering Facility (no.)	5
666 - Forest Stand Improvement (ac)	65.8

Goals & Objectives

Based on results from the Conservation Assessment Ranking Tools for pasture and hay land, we have determined that encouraging livestock producers to implement or improve grazing management or nutrient management plans will reduce contaminant transport offsite, resulting in improved drinking water source quality.

On cropland, we have determined that encouraging landowners/operators to implement cover crops, permanent conservation cover, field borders, field access roads, filter strips, improved irrigation efficiencies, and vegetated treatment area practices will return the most impact for protecting drinking water source quality.

We developed the following goals of working with producers based on the crop type land use percentages and an estimated participation rate of 2-3%, which has been our average rate of success in a previous Conservation Implementation Strategy within the source water area.

1) Work with 21 livestock producers on approximately 2,000 acres to improve practices on their land to improve soil health, irrigation water efficiency and decrease contaminated runoff. See sample budget and approximate cost:

This typical scenario is for a pasture/hay operator to improve grass forage and soil health.

practice	scenario	scheduled amount	units	amount per unit	# of years	total	notes
Forage biomass planting 512	renovate hayfields	50	ac	289	1	$ 14,450.00	
Heavy Use Area 561	prevent access to sensitive areas	10000	sf	1.21	1	$ 12,100.00	
Prescribed grazing 528	implement prescribed grazing	40	ac	39.44	4	$ 6,310.40	
382 Fence	install cross fencing	8,000	feet	4.89	1	$ 39,120.00	
livestock pipeline 516	install watering	5,000	feet	2.51	1	12550	
livestock water facility 614	install watering	5	No.	1647	1	$ 8,235.00	
						$ 92,765.40	

application year	number of applications for this scenario	estimated annual budget needed
2024	3	$278,296.20
2025	4	$371,061.60
2026	4	$371,061.60
2027	5	$463,827.00
2028	5	$463,827.00
		$1,948,073.40

2) Work with 3 grass seed producers on approximately 200 acres to improve nutrient, pest, or irrigation efficiency management practices or reduce erosion during establishment years at a cost of approximately $70,000.

3) Work with 3 hazelnut and/or berry producers on approximately 200 acres to improve irrigation water efficiency and in-row conservation cover or edge of field vegetative practices. See sample budget and approximate cost:

This typical scenario is for a berry or small hazelnut orchard (20-40 acres) that is converting from sprinkler to drip. Most scenarios of this nature are also going to need a VFD installation due to the change in pressure needs that occur when changing from sprinkler to drip. This is assuming that older pipeline will need be replaced but the current pump is still good (75% of the time).

practice	scenario	scheduled amount	units	amount per unit	# of years	total	notes
327 conservation cover	orchard or vineyard alleyways	10	ac	52.81	1	$ 528.10	estimate that 1/3 of berry/orchard space would be applicable for between row cover
441 irrigation system, micro irrigation	orchard/vineyard, >10 ac	30	ac	735.88	1	$ 22,076.40	
430 irrigation pipeline	PVC 4-12 inch, typical install	4937	lbs	1.47	1	$ 7,257.39	1320 feet (1/4 mile) of 6' pipe with all needed appurtenances installed in good soil conditions
533 pumping plant	VFD only <=15Hp	1	No.	1208.47	1	$ 1,208.47	standard irrigation industry recommendation to install VFD when changing irrigation systems that have significant pressure differences to save energy, water and the pump motor; typical size is less than 15 Hp
						$ 31,070.36	

application year	number of applications for this scenario	estimated annual budget needed
2024	1	$31,070.36
2025	0	$0.00
2026	1	$31,070.36
2027	0	$0.00
2028	1	$31,070.36
		$93,211.08

4) Work with 3 Christmas tree producers on approximately 200 acres to reduce sediment runoff, improve soil health or vegetation management practices such as in-row cover, filter strips, sediment basins at a cost of approximately $90,000.

5) Work with 2 Nurseries on approximately 100 acres to improve vegetation management, crop rotations, irrigation water efficiency or edge of field practices to reduce contaminated runoff or infiltration at a cost of approximately $150,000.

6) Work with 2 annual crop or hemp producers on approximately 100 acres to improve soil health, edge of field practices, crop rotations, irrigation water efficiency, nutrient management, or other appropriate conservation practices. See sample budget and approximate cost:

This typical scenario is for a larger field size (50-100 acres) production of vegetables or row crops that are currently irrigated under a big gun or wheel line. About 75% of these scenarios will need a VFD, pump and mainline improvements due to systems with a variety of pressure or pumps that are too large for the new system (oversized). A small amount of cover crop and residue management no-till / strip till (25%) adoption is being estimated due to the practice either already being adopted or participant reluctance to try

practice	scenario	scheduled amount	units	amount per unit	# of years	total	notes
340 Cover Crop	basic - organic and non-organic	20	Ac.	$29.49	3	$1,769.40	applied to entire crop field during the critical erosion period; this scenario assumes that cover crop has not been adopted as a regular practice on the farming unit
442 Sprinkler System	Linear Move System	1200	Ft.	$53.33	1	$63,996.00	average farm unit size of 75 acres used to estimate length
430 Irrigation Pipeline	PVC 4-12 inch, typical install	9874	lbs.	$1.47	1	$14,514.78	2640 feet of 6'' PVC pipeline is good soils: weight includes needed appurtenances
533 Pump Plant	Electric Pump 10-40 Hp	15	Hp	$264.12	1	$3,961.80	average size as outlined by local irrigation supply dealer for farm units under sprinkler systems greater than 50 acres in size
533 Pumping Plant	VFD > 15 Hp	15	Hp	$59.35	1	$890.25	average size as outlined by local irrigation supply dealer for farm units under sprinkler systems greater than 50 acres in size
329 Residue Management no-till / strip till	no-till / strip till	20	Ac.	11.08	3	$664.80	this practice needs to be available so that we can incentivize it to producers and demonstrate the effectiveness of increasing soil organic matter to improve infiltration and water retention
						$85,797.03	

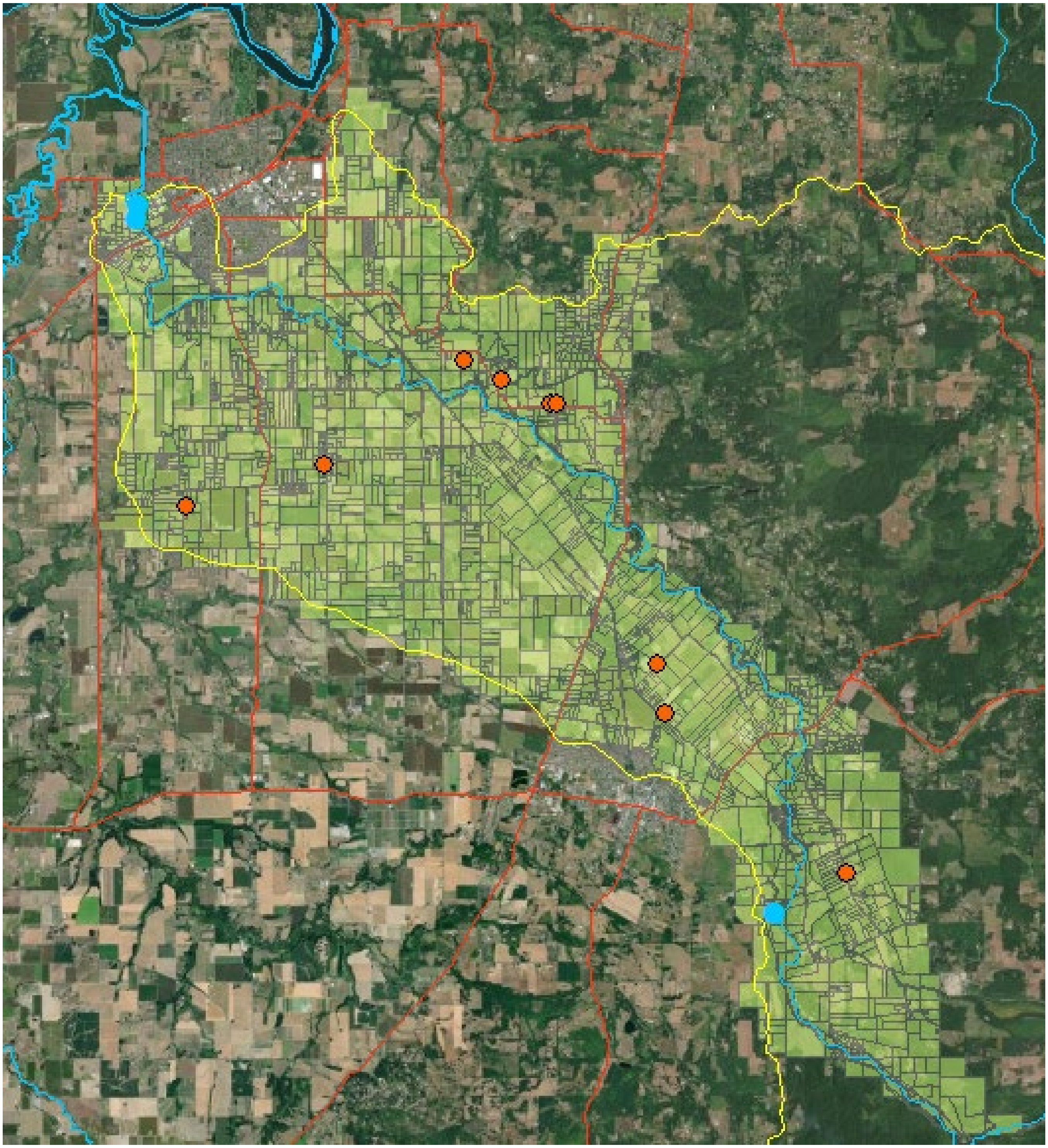
application year	number of applications for this scenario	estimated annual budget needed
2024	0	$0.00
2025	0	$0.00
2026	1	$85,797.03
2027	0	$0.00
2028	1	$85,797.03
		$171,594.06

The total estimated CIS project costs for all producers over 5 years is approximately 2.5 million.

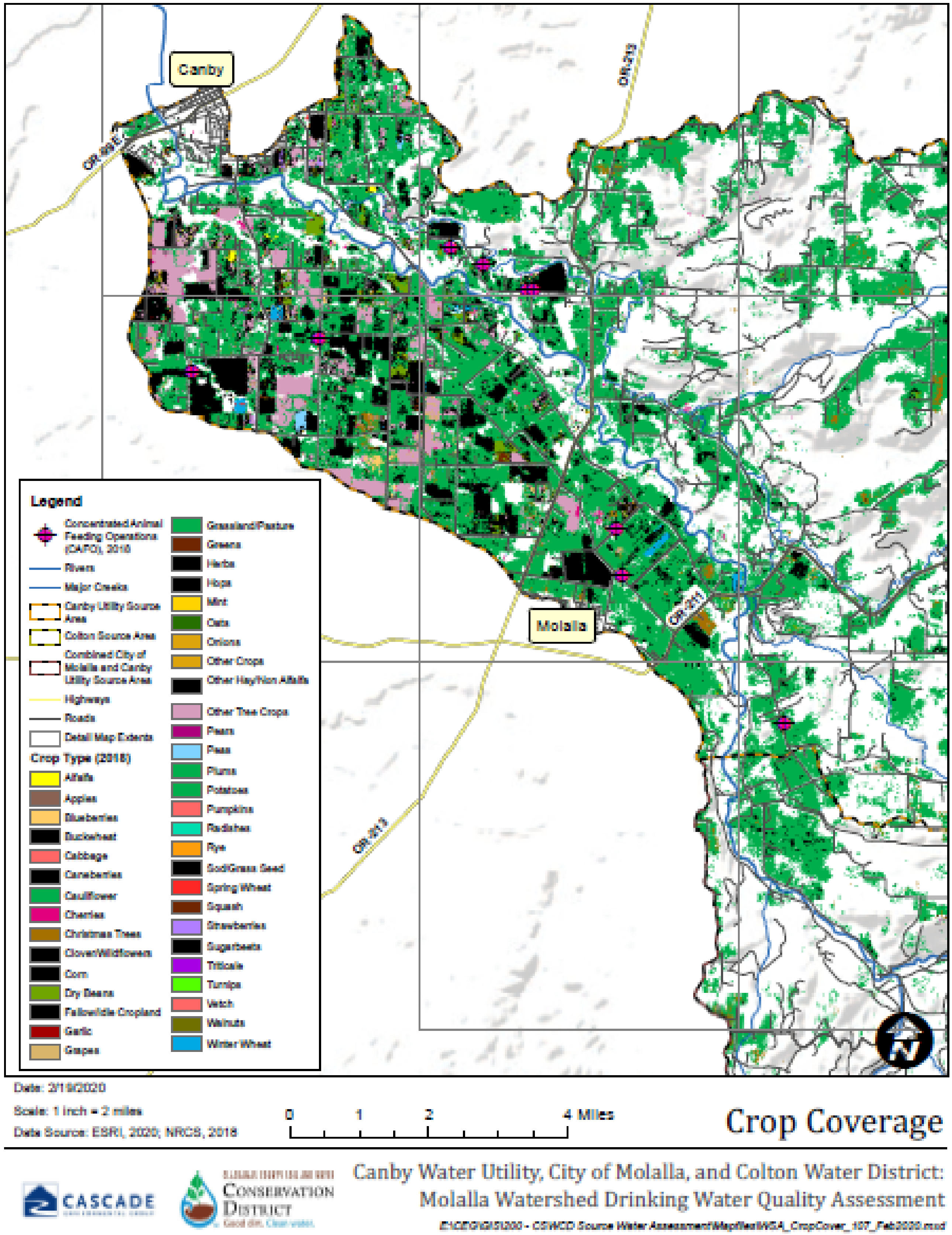
Proposed BMP practice codes

Access control	472	Irrigation pipeline	430
Access roads	590	Irrigation water management	449
Animal Trails and Walkways	575	Livestock watering facility	614
Brush management	314	Nutrient management	590
Conservation Cover	327	Pest management	595
Conservation Crop Rotation	328	Prescribed grazing	528
Cover Crops	340	Pumping plant	533
Critical area planting	342	Residue and Tillage Management, No-Till/Strip Till/Direct Seed	329
Fence	382	Riparian forest buffer	391
Field border	386	Riparian herbaceous cover	390
Filter strip	393	Roof runoff structure	558
Forage and Biomass Planting	512	Sediment basin	350
Grassed Waterway	412	Site prep	490
Heavy Use Area Protection	561	Structure for Water Control	587
Hedgerow Planting	422	Tree/shrub planting	612
Herbaceous weed mgmt.	315	Underground outlet	620
Irrigation system – Micro-irrigation	441	Vegetated Treatment Area	635
Irrigation system - Sprinkler	442	Residue and Tilliage Mgmt (No-till)	329
Livestock pipeline	516	Carbon Amendment	336

Landowners willing to work on voluntary conservation planning to improve vegetation and soil health and reduce contaminated runoff will be eligible for cost share with the above practices.



Taxlot map used within a 45 square mile area of Canby intake to produce tax lot ownership data. This also shows drinking Water intakes and Confined Animal Feeding Operations (CAFOs).



Crop Coverage map

Evaluation & Monitoring

Because continuous water quality monitoring data is not available for the Molalla River system it will be difficult to show direct quantitative correlations between practices that will be implemented as a result of the Drinking Water Source Protection Plan (DWSPP) and changes in drinking water source quality.

Outcomes will be measured through program participation and estimated from installed practices until more comprehensive water quality data can be obtained. The Molalla Drinking Water Project's Technical Advisory Committee has indicated a willingness to pursue continuous and specialized water quality monitoring in the basin to evaluate water quality limiting factors from the DWSPP.

As stated previously, the major resource concerns affecting drinking water source quality for the Molalla are sediment loss, bank erosion from streams and conveyance channels, seasonal high-water table, and the potential contamination of surface waters from sediment, excess nutrients, bacteria (E. coli), algae, cyanotoxins, metals, pesticides, etc. to surface waters (runoff), and groundwater (leaching) and soil health (compaction, organic matter depletion).

The following metrics will be used evaluate progress and trends in addressing resource concerns:

Metric	Desired Outcome
Participation in Programs	Increased quantity
Number of Conservation Practices Installed	Increased quantity
Funding Pursued or Secured	Increased dollar amount
Agricultural Acres Treated	Increased quantity
Non-NRCS Technical Assistance and Practices Installed	Increased quantity
Development of a Water Quality Partnership group from NWQI Technical Advisory Group	Increased organizational capacity, staff or accomplishments
Average turbidity in receiving waters	Trending down from baseline

These metrics will be assessed through communication between the Technical Advisory Committee members and watershed partner organizations, or through data from water providers. Metrics will expand to include other water quality parameters to the extent that baseline data is available with existing water monitoring done by DEQ or others in the subbasin.

Our Technical Advisory Committee and USGS are pursuing grants to fund a mainstem continuous monitoring station with real time reporting capabilities. If this were to happen, we would have additional reliable water quality data to help us determine these and additional trends.

Results from monitoring will inform implementation actions and the DWSPP will be adapted as needed to achieve the desired outcomes of the DWSPP.