Middle Willamette Agricultural Water Quality Management Area Plan

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Developed by the

Oregon Department of Agriculture

Middle Willamette Local Advisory Committee

With support from the

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Acronyms and Terms Used in this Document

Ag Water Quality Program – Agricultural Water Quality Management Program
Area Plan – Agricultural Water Quality Management Area Plan
Area Rules – Agricultural Water Quality Management Area Rules
CAFO – Confined Animal Feeding Operation
CNPCP – Coastal Nonpoint Pollution Control Program
CWA – Clean Water Act
CZARA – Coastal Zone Act Reauthorization Amendments
DEQ – Oregon Department of Environmental Quality
DMA – Designated Management Agency
GWMA – Groundwater Management Area
HABs – Harmful Algal Blooms
LAC – Local Advisory Committee
LMA – Local Management Agency
Management Area – Agricultural Water Quality Management Area
MOA – Memorandum of Agreement
NPDES – National Pollution Discharge Elimination System
NRCS – Natural Resources Conservation Service
OAR – Oregon Administrative Rules
ODA – Oregon Department of Agriculture
ODF – Oregon Department of Forestry
OHA – Oregon Health Authority
ORS – Oregon Revised Statute
OWEB – Oregon Watershed Enhancement Board
PMP – Pesticides Management Plan
PSP – Pesticides Stewardship Partnership
RCA – Required Corrective Action
SIA – Strategic Implementation Area
SWCD – Soil and Water Conservation District
TMDL – Total Maximum Daily Load
USDA – United States Department of Agriculture
US EPA – United States Environmental Protection Agency
WPCF – Water Pollution Control Facility
WQPMT – Water Quality Pesticides Management Team

Foreword

This Agricultural Water Quality Management Area Plan (Area Plan) provides guidance for addressing water quality related to agricultural activities in the Agricultural Water Quality Management Area (Management Area). The Area Plan identifies strategies to prevent and control water pollution from agricultural lands through a combination of outreach programs, suggested land treatments, management activities, compliance, and monitoring.

The Area Plan is neither regulatory nor enforceable (Oregon Revised Statute (ORS) 568.912(1)). It references associated Agricultural Water Quality Management Area Rules (Area Rules), which are Oregon Administrative Rules (OARs) enforced by the Oregon Department of Agriculture (ODA).

Required Elements of Area Plans

Area Plans must describe a program to achieve the water quality goals and standards necessary to protect designated beneficial uses related to water quality as required by state and federal law (OAR 603-090-0030(1)). At a minimum, an Area Plan must:

- Describe the geographical area and physical setting of the Management Area.
- List water quality issues of concern.
- List impaired beneficial uses.
- State that the goal of the Area Plan is to prevent and control water pollution from agricultural activities and soil erosion and to achieve applicable water quality standards.
- Include water quality objectives.
- Describe pollution prevention and control measures deemed necessary by ODA to achieve the goal.
- Include an implementation schedule for measures needed to meet applicable dates established by law.
- Include guidelines for public participation.
- Describe a strategy for ensuring that the necessary measures are implemented.

Plan Content

Chapter 1: Agricultural Water Quality Management Program Purpose and Background. The purpose is to have consistent and accurate information about the Ag Water Quality Program.

Chapter 2: Local Background. Provides the local geographic, water quality, and agricultural context for the Management Area. Describes the water quality issues, Area Rules, and available practices to address water quality issues.

Chapter 3: Local Goals, Objectives, and Implementation Strategies. Presents goal(s), measurable objectives, and timelines, along with strategies to achieve these goal(s) and objectives.

Chapter 4: Local Implementation, Monitoring, and Adaptive Management. ODA and the Local Advisory Committee (LAC) will work with knowledgeable sources to summarize land condition and water quality status and trends to assess progress toward the goals and objectives in Chapter 3.

Chapter 1: Agricultural Water Quality Management Program Purpose and Background

1.1 Purpose of Agricultural Water Quality Management Program and Applicability of Area Plans

As part of Oregon's Agricultural Water Quality Management Program (Ag Water Quality Program), the Area Plan guides landowners and partners such as Soil and Water Conservation Districts (SWCDs) in addressing water quality issues due to agricultural activities. The Area Plan identifies strategies to prevent and control water pollution from agricultural activities and soil erosion (ORS 568.909(2)) on agricultural and rural lands within the boundaries of this Management Area (OAR 603-090-0000(3)) and to achieve and maintain water quality standards (ORS 561.191(2)). The Area Plan has been developed and revised by ODA and the LAC, with support and input from the SWCD and the Oregon Department of Environmental Quality (DEQ). The public was invited to participate in the original development and approval of the Area Plans and is invited to participate in the biennial review process. The Area Plan is implemented using a combination of outreach, conservation and management activities, compliance with Area Rules developed to implement the Area Plan, monitoring, evaluation, and adaptive management.

The provisions of the Area Plan do not establish legal requirements or prohibitions (ORS 568.912(1)). Each Area Plan is accompanied by Area Rules that describe local agricultural water quality regulatory requirements. ODA will exercise its regulatory authority for the prevention and control of water pollution from agricultural activities under the Ag Water Quality Program's general regulations (OAR 603-090-0000 to 603-090-0120) and under the Area Rules for this Management Area (OAR 603-090-0000 to 603-090-0120)). The Ag Water Quality Program's general rules guide the Ag Water Quality Program, and the Area Rules for the Management Area are the regulations that landowners are required to follow. Landowners will be encouraged through outreach and education to implement conservation management activities.

The Area Plan and Area Rules apply to all agricultural activities on non-federal and non-Tribal Trust land within this Management Area including:

- Farms and ranches.
- Rural properties grazing a few animals or raising crops.
- Agricultural lands that lay idle or on which management has been deferred.
- Agricultural activities in urban areas.
- Agricultural activities on land subject to the Forest Practices Act (ORS 527.610).

Water quality on federal lands in Oregon is regulated by DEQ and on Tribal Trust lands by the respective tribe, with oversight by the United States Environmental Protection Agency (US EPA).

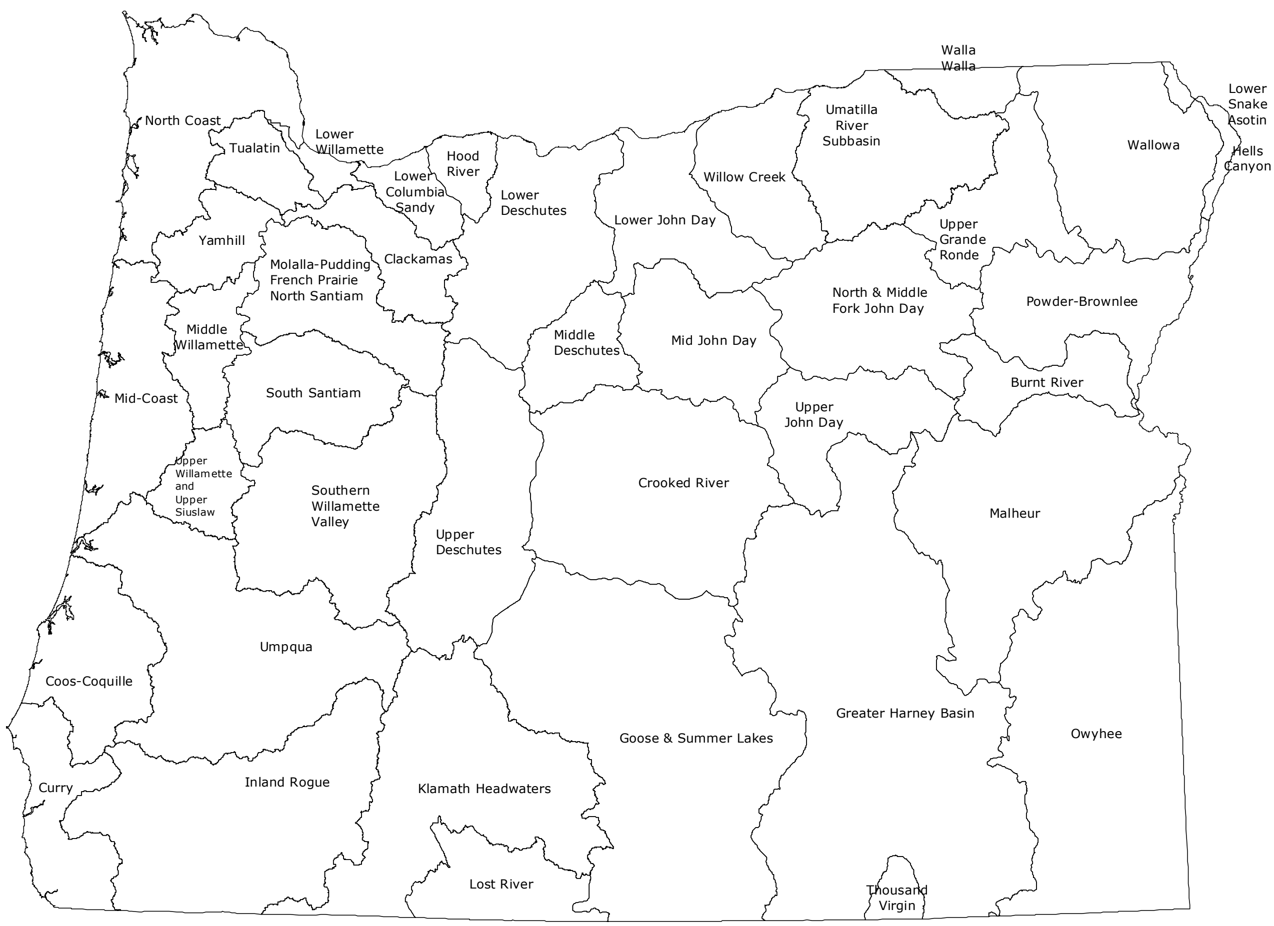
1.2 History of the Ag Water Quality Program

In 1993, the Oregon Legislature passed the Agricultural Water Quality Management Act directing ODA to develop plans to prevent and control water pollution from agricultural activities and soil erosion; to achieve water quality standards; and to adopt rules as necessary (ORS 568.900 through ORS 568.933). Senate Bill 502 was passed in 1995 to clarify that ODA is the lead agency for regulating agriculture with respect to water quality (ORS 561.191). The Area Plan and Area Rules were developed and subsequently revised pursuant to these statutes.

Between 1997 and 2004, ODA worked with LACs and SWCDs to develop Area Plans and Area Rules in 38 watershed-based Management Areas across Oregon (Figure 1). Since 2004, ODA, LACs, SWCDs, and other partners have focused on implementation including:

- Providing education, outreach, and technical assistance to landowners.
- Implementing projects to improve agricultural water quality.
- Investigating complaints of potential violations of Area Rules.
- Conducting biennial reviews of Area Plans and Area Rules.
- Monitoring, evaluation, and adaptive management.
- Developing partnerships with state and federal agencies, tribes, watershed councils, and others.

Figure 1: Map of 38 Agricultural Water Quality Management Areas



1.3 Roles and Responsibilities

1.3.1 Oregon Department of Agriculture

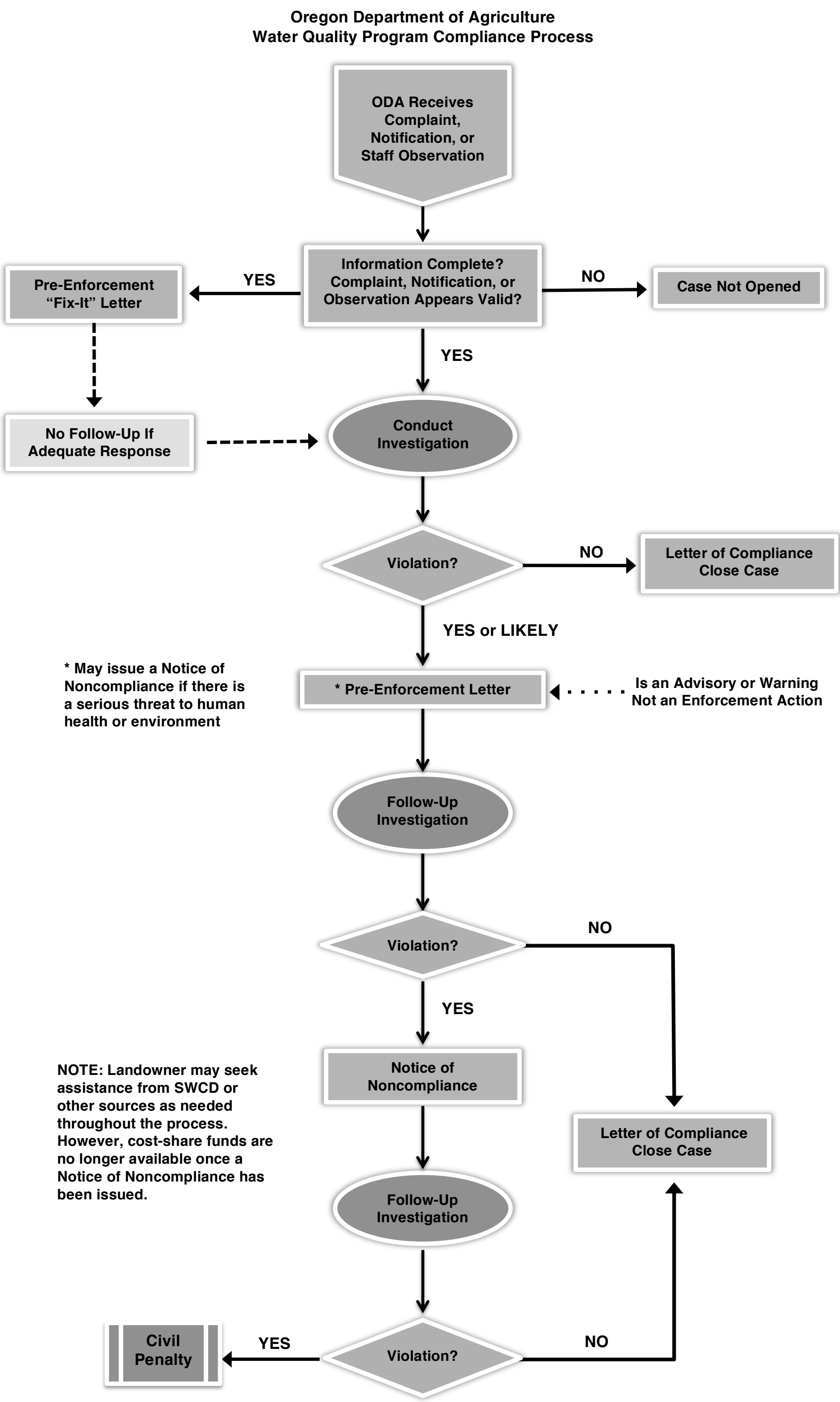
The Oregon Department of Agriculture is the agency responsible for implementing the Ag Water Quality Program (ORS 568.900 to 568.933, ORS 561.191, OAR 603-090, and OAR 603-095). The Ag Water Quality Program was established to develop and carry out a water quality management plan for the prevention and control of water pollution from agricultural activities and soil erosion. State and federal laws drive the establishment of a Ag Water Quality Management Plan, which include:

- State water quality standards.
- Load allocations for agricultural nonpoint source pollution assigned under Total Maximum Daily Loads (TMDLs) issued pursuant to the Clean Water Act (CWA), Section 303(d).
- Approved management measures for Coastal Zone Act Reauthorization Amendments (CZARA).
- Agricultural activities detailed in a Groundwater Management Area (GWMA) Action Plan (if DEQ has established a GWMA and an Action Plan has been developed).

The Oregon Department of Agriculture has the legal authority to develop and implement Area Plans and Area Rules for the prevention and control of water pollution from agricultural activities and soil erosion, where such plans are required by state or federal law (ORS 568.909 and ORS 568.912). ODA bases Area Plans and Area Rules on scientific information (ORS 568.909). ODA works in partnership with SWCDs, LACs, DEQ, and other partners to implement, evaluate, and update the Area Plans and Area Rules. ODA is responsible for any actions related to enforcement or determination of noncompliance with Area Rules (OAR 603-090-0080 through OAR 603-090-0120). ORS 568.912(1) and ORS 568.912(2) give ODA the authority to adopt rules that require landowners to perform actions necessary to prevent and control pollution from agricultural activities and soil erosion.

The Area Rules are a set of standards that landowners must meet on all agricultural or rural lands. ("Landowner" includes any landowner, land occupier or operator per OAR 603-95-0010(24)).
All landowners must comply with the Area Rules. The ODA will use enforcement where appropriate and necessary to gain compliance with Area Rules. Figure 2 outlines ODA's compliance process. ODA will pursue enforcement action only when reasonable attempts at voluntary solutions have failed (OAR 603-090-0000(5)(e)). If a violation is documented, ODA may issue a pre-enforcement notification or an enforcement Order such as a Notice of Noncompliance. If a Notice of Noncompliance is issued, ODA will direct the landowner to remedy the condition through required corrective actions (RCAs) under the provisions of the enforcement procedures outlined in OAR 603-090-060 through OAR 603-090-120. If a landowner does not implement the RCAs, ODA may assess civil penalties for continued violation of the rules. If and when other governmental policies, programs, or rules conflict with the Area Plan or Area Rules, ODA will consult with the appropriate agencies to resolve the conflict in a reasonable manner.

Figure 2: Compliance Flow Chart



1.3.2 Local Management Agency

A Local Management Agency (LMA) is an organization that ODA designated to assist with the implementation of an Area Plan (OAR 603-090-0010). The Oregon Legislature's intent is for SWCDs to be LMAs to the fullest extent practical, consistent with the timely and effective implementation of Area Plans (ORS 568.906). SWCDs have a long history of effectively assisting landowners to voluntarily address natural resource concerns. Currently, all LMAs in Oregon are SWCDs.

The day-to-day implementation of the Area Plan is accomplished through an intergovernmental agreement between ODA and each SWCD. Each SWCD implements the Area Plan by providing outreach and technical assistance to landowners. SWCDs also work with ODA and the LAC to establish implementation priorities, evaluate progress toward meeting Area Plan goals and objectives, and revise the Area Plan and Area Rules as needed.

1.3.3 Local Advisory Committee

For each Management Area, the director of ODA appoints a LAC (OAR 603-090-0020) with as many as 12 members to assist with the development and subsequent biennial reviews of the local Area Plan and Area Rules. The LAC serves in an advisory role to the director of ODA and to the Board of Agriculture. LACs are composed primarily of agricultural landowners in the Management Area and must reflect a balance of affected persons.

The LAC may meet as frequently as necessary to carry out their responsibilities, which include but are not limited to:

- Participate in the development and ongoing revisions of the Area Plan.
- Participate in the development and revisions of the Area Rules.
- Recommend strategies necessary to achieve the goals and objectives in the Area Plan.
- Participate in biennial reviews of the progress of implementation of the Area Plan and Area Rules.
- Submit written biennial reports to the Board of Agriculture and the ODA director.

1.3.4 Agricultural Landowners

The emphasis of the Area Plan is on voluntary action by landowners to control the factors affecting water quality in the Management Area. Each landowner in the Management Area is required to comply with the Area Rules. In addition, landowners need to select and implement a suite of measures to protect water quality. The actions of each landowner will collectively contribute toward achievement of the water quality standards.

Technical and financial assistance is available to landowners who want to work with SWCDs (or other local partners) to achieve land conditions that contribute to good water quality. Landowners also may choose to improve their land conditions without assistance.

Under the Area Plan and Area Rules, agricultural landowners are not responsible for mitigating or addressing factors that do not result from agricultural activities, such as:

- Conditions resulting from unusual weather events.
- Hot springs, glacial melt water, extreme or unforeseen weather events, and climate change.
- Septic systems and other sources of human waste.
- Public roadways, culverts, roadside ditches and shoulders.
- Dams, dam removal, hydroelectric plants, and non-agricultural impoundments.

- Housing and other development in agricultural areas.
- Other circumstances not within the reasonable control of the landowner.

However, agricultural landowners may be responsible for some of these impacts under other legal authorities.

1.3.5 Public Participation

The public was encouraged to participate when ODA, LACs, and SWCDs initially developed the Area Plans and Area Rules. In each Management Area, ODA and the LAC held public information meetings, a formal public comment period, and a formal public hearing. ODA and the LACs modified the Area Plans and Area Rules, as needed, to address comments received. The director of ODA adopted the Area Plans and Area Rules in consultation with the Board of Agriculture.

The Oregon Department of Agriculture, LACs, and SWCDs conduct biennial reviews of the Area Plans and Area Rules. Partners, stakeholders, and the general public are invited to participate in the process. Any future revisions to the Area Rules will include a formal public comment period and a formal public hearing.

1.4 Agricultural Water Quality

The CWA directs states to designate beneficial uses related to water quality for every waterbody, decide on parameters to measure to determine whether beneficial uses are being met, and set water quality standards based on the beneficial uses and parameters.

1.4.1 Point and Nonpoint Sources of Water Pollution

There are two types of water pollution. Point source water pollution emanates from clearly identifiable discharge points or pipes. Significant point sources are required to obtain permits that specify their pollutant limits. Agricultural operations regulated as point sources include permitted Confined Animal Feeding Operations (CAFOs), and many are regulated under ODA's CAFO Program. Pesticide applications in, over, or within three feet of water also are regulated as point sources. Irrigation water flows from agricultural fields may be at a defined outlet but they do not currently require a permit.

Nonpoint water pollution originates from the general landscape and is difficult to trace to a single source. Nonpoint water pollution sources include runoff from agricultural and forest lands, urban and suburban areas, roads, and natural sources. In addition, groundwater can be polluted by nonpoint sources including agricultural amendments (fertilizers and manure).

1.4.2 Beneficial Uses and Parameters of Concern

Beneficial uses related to water quality are defined by DEQ in OARs for each basin. They may include: public and private domestic water supply, industrial water supply, irrigation, livestock watering, fish and aquatic life, wildlife and hunting, fishing, boating, water contact recreation, aesthetic quality, hydropower, and commercial navigation and transportation. The most sensitive beneficial uses usually are fish and aquatic life, water contact recreation, and public and private domestic water supply. These uses generally are the first to be impaired because they are affected at lower levels of pollution. While there may not be severe impacts on water quality from a single source or sector, the combined effects from all sources can contribute to the impairment of beneficial uses in the Management Area. Beneficial uses that have the potential to be impaired in this Management Area are summarized in Chapter 2.

Many water bodies throughout Oregon do not meet state water quality standards. Many of these water bodies have established water quality management plans that document needed pollutant reductions. The most common water quality concerns related to agricultural activities are temperature, bacteria, biological criteria, sediment and turbidity, phosphorous, algae, pH, dissolved oxygen, harmful algal blooms (HABs), nitrates, pesticides, and mercury. These parameters vary by Management Area and are summarized in Chapter 2.

1.4.3 Impaired Water Bodies and Total Maximum Daily Loads (TMDLs)

Every two years, DEQ is required by the CWA to assess water quality in Oregon. Clean Water Act Section 303(d) requires DEQ to identify a list of waters that do not meet water quality standards. The resulting list is commonly referred to as the 303(d) list. In accordance with the CWA, DEQ must establish TMDLs for pollutants specific to the pollutants that led to the placement of a waterbody on the 303(d) list.

A TMDL includes an assessment of water quality data and current conditions and describes a plan to achieve conditions so that water bodies will meet water quality standards. TMDLs specify the daily amount of pollution a water body can receive and still meet water quality standards. In the TMDL, point sources are allocated pollution limits as "waste load allocations" that are then incorporated in NPDES waste discharge permits, while a "load allocation" is attributed to nonpoint sources (agriculture, forestry, and urban). The agricultural sector is responsible for helping achieve the pollution limit by achieving the load allocation assigned to agriculture specifically, or to nonpoint sources in general, depending on how the TMDL was written.

Total Maximum Daily Loads generally apply to an entire basin or subbasin, not just to an individual water body on the 303(d) list. Water bodies will be listed as achieving water quality standards when data show the standards have been attained.

As part of the TMDL process, DEQ identifies the Designated Management Agency (DMA) or parties responsible for submitting TMDL implementation plans. TMDLs designate the local Area Plan as the implementation plan for the agricultural component of this Management Area. Biennial reviews and revisions to the Area Plan and Area Rules must address agricultural or nonpoint source load allocations from relevant TMDLs.

The list of impaired water bodies (303(d) list), the TMDLs, and the agricultural load allocations for the TMDLs that apply to this Management Area are summarized in Chapter 2.

1.4.4 Oregon Water Pollution Control Law – ORS 468B.025 and ORS 468B.050

In 1995, the Oregon Legislature passed ORS 561.191. This statute states that any program or rules adopted by ODA "shall be designed to assure achievement and maintenance of water quality standards adopted by the Environmental Quality Commission."

To implement the intent of ORS 561.191, ODA incorporated ORS 468B.025 and 468B.050 into all of the Area Rules.

ORS 468B.025 states that:
(1) Except as provided in ORS 468B.050 or 468B.053, no person shall:
(a) Cause pollution of any waters of the state or place or cause to be placed any wastes in a location where such wastes are likely to escape or be carried into the waters of the state by any means.

(b) Discharge any wastes into the waters of the state if the discharge reduces the quality of such waters below the water quality standards established by rule for such waters by the Environmental Quality Commission.
(2) No person shall violate the conditions of any waste discharge permit issued under ORS 468B.050."

ORS 468B.050 identifies the conditions when a permit is required. A permit is required for CAFOs that meet minimum criteria for confinement periods and have large animal numbers or have wastewater facilities. The portions of ORS 468B.050 that apply to the Ag Water Quality Program state that:
"(1) Except as provided in ORS 468B.053 or 468B.215, without holding a permit from the Director of the Department of Environmental Quality or the State Department of Agriculture, which permit shall specify applicable effluent limitations, a person may not:
(a) Discharge any wastes into the waters of the state from any industrial or commercial establishment or activity or any disposal system."

Definitions used in ORS 468B.025 and 468B.050:

"Wastes" means sewage, industrial wastes, and all other liquid, gaseous, solid, radioactive or other substances, which will or may cause pollution or tend to cause pollution of any waters of the state. Additionally, OAR 603-095-0010(53) includes but is not limited to commercial fertilizers, soil amendments, composts, animal wastes, vegetative materials, or any other wastes.

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

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

1.4.5 Streamside Vegetation and Agricultural Water Quality

Across Oregon, the Ag Water Quality Program emphasizes streamside vegetation protection and enhancement to prevent and control water pollution from agriculture activities and to prevent and control soil erosion. Streamside vegetation can provide three primary water quality functions: shade for cool stream temperatures, streambank stability, and filtration of pollutants. Other water quality functions from streamside vegetation include: water storage in the soil for cooler and later season flows, sediment trapping that can build streambanks and floodplains, narrowing and deepening of channels, and biological uptake of sediment, organic material, nutrients, and pesticides.

Additional reasons for the Ag Water Quality Program's emphasis on streamside vegetation include:

- Streamside vegetation improves water quality related to multiple pollutants, including: temperature (heat), sediment, bacteria, nutrients, toxics, and pesticides.
- Streamside vegetation provides fish and wildlife habitat.

- Landowners can improve streamside vegetation in ways that are compatible with their operation. Streamside conditions may be improved without the removal of the agricultural activity, such as with managed grazing.
- Streamside vegetation condition is measurable and can be used to track progress in achieving desired site conditions.

Site-Capable Vegetation

The Ag Water Quality Program uses the concept of "site-capable vegetation" to describe the vegetation that agricultural streams can provide to protect water quality. Site-capable vegetation is the vegetation that can be expected to grow at a particular site, given natural site factors (e.g., elevation, soils, climate, hydrology, wildlife, fire, floods) and historical and current human influences that are beyond the program's statutory authority (e.g., channelization, roads, modified flows, previous land management). Site-capable vegetation can be determined for a specific site based on: current streamside vegetation at the site, streamside vegetation at nearby reference sites with similar natural characteristics, Natural Resources Conservation Service (NRCS) soil surveys and ecological site descriptions, and/or local or regional scientific research.

The goal for Oregon's agricultural landowners is to provide the water quality functions (e.g., shade, streambank stability, and filtration of pollutants) produced by site-capable vegetation along streams flowing through agricultural lands. The Area Rules for each Management Area require that agricultural activities provide the water quality functions equivalent to what site-capable vegetation would provide.

Occasionally, mature site-capable vegetation such as tall trees may not be needed for narrow streams. For example, shrubs and grass may provide shade, protect streambanks, and filter pollutants. However, on larger streams, mature site-capable vegetation is needed to provide the water quality functions.

In many cases, invasive, non-native plants, such as introduced varieties of blackberry and reed canarygrass, grow in streamside areas. This type of vegetation has established throughout much of Oregon due to historic and human influences and may provide some of the water quality functions of site-capable vegetation. ODA's statutory authority does not require the removal of invasive, non-native plants, however, ODA recognizes removal as a good conservation activity and encourages landowners to remove these plants. Voluntary programs through SWCDs and watershed councils provide technical assistance and financial incentives for weed control and restoration projects. In addition, the Oregon State Weed Board identifies invasive plants that can negatively impact watersheds. Public and private landowners are responsible for eliminating or intensively controlling noxious weeds as may be provided by state and local law enacted for that purpose. For further information, visit www.oregon.gov/ODA/programs/weeds.

1.5 Other Water Quality Programs

The following programs complement the Ag Water Quality Management Program and are described here to recognize their link to agricultral lands.

1.5.1 Confined Animal Feeding Operation Program

The Oregon Department of Agriculture is the lead state agency for the CAFO Program. The CAFO Program was developed to ensure that operators do not contaminate ground or surface water with animal manure or process wastewater. Since the early 1980s, CAFOs in Oregon have been registered to a general Water Pollution Control Facility (WPCF) permit designed to protect water quality. A properly maintained CAFO must implement a site-specific suite of structural and management practices to protect ground or surface water. To assure continued protection of ground and surface water, the 2001 Oregon State Legislature directed ODA to convert the CAFO Program from a WPCF permit program to a federal

National Pollutant Discharge Elimination System (NPDES) program. Oregon Department of Agriculture and DEQ jointly issue the NPDES CAFO Permit, which complies with all CWA requirements for CAFOs. In 2015, ODA and DEQ jointly issued a WPCF general CAFO Permit as an alternative for CAFOs that are not subject to the federal NPDES CAFO permit requirements. Currently, ODA can register CAFOs to either the WPCF or NPDES CAFO permit.

Either of the Oregon CAFO permits require the registrant to operate according to a site-specific, ODA-approved, Animal Waste Management Plan that is incorporated into the CAFO permit by reference. You can view the CAFO program site at http://www.oregon.gov/ODA/programs/NaturalResources/Pages/CAFO.aspx

1.5.2 Groundwater Management Areas

Groundwater Management Areas are designated by DEQ where groundwater has elevated contaminant concentrations resulting, at least in part, from nonpoint sources. After the GWMA is declared, a local groundwater management committee comprised of affected and interested parties is formed. The committee works with and advises the state agencies that are required to develop an action plan that will reduce groundwater contamination in the area.

Oregon has designated three GWMAs because of elevated nitrate concentrations in groundwater: Lower Umatilla Basin, Northern Malheur County, and Southern Willamette Valley. Each GWMA has a voluntary action plan to reduce nitrates in groundwater. After a scheduled evaluation period, if DEQ determines that voluntary efforts are not effective, mandatory requirements may become necessary.

1.5.3 The Oregon Plan for Salmon and Watersheds

In 1997, Oregonians began implementing the Oregon Plan for Salmon and Watersheds referred to as the Oregon Plan (www.oregon-plan.org). The Oregon Plan seeks to restore native fish populations, improve watershed health, and support communities throughout Oregon. The Oregon Plan has a strong focus on salmonids because of their great cultural, economic, and recreational importance to Oregonians and because they are important indicators of watershed health. ODA's commitment to the Oregon Plan is to develop and implement Area Plans and Area Rules throughout Oregon.

1.5.4 Pesticide Management and Stewardship

The ODA Pesticides Program holds the primary responsibility for registering pesticides and regulating their use in Oregon under the Federal Insecticide Fungicide Rodenticide Act. ODA's Pesticide Program administers regulations relating to pesticide sales, use, and distribution, including pesticide operator and applicator licensing as well as proper application of pesticides, pesticide labeling, and registration.

In 2007, the interagency Water Quality Pesticide Management Team (WQPMT) was formed to expand efforts to improve water quality in Oregon related to pesticide use. The WQPMT includes representation from ODA, ODF, DEQ, and Oregon Health Authority (OHA). The WQPMT facilitates and coordinates activities such as monitoring, analysis and interpretation of data, effective response measures, and management solutions. The WQPMT relies on monitoring data from the Pesticides Stewardship Partnership (PSP) program and other monitoring programs to assess the possible impact of pesticides on Oregon's water quality. Pesticide detections in Oregon's streams can be addressed through multiple programs and partners, including the PSP program.

Through the PSP, state agencies and local partners work together to monitor pesticides in streams and to improve water quality (www.oregon.gov/deq/wq/programs/Pages/Pesticide.aspx). ODA, DEQ, and

Oregon State University Extension Service work with landowners, SWCDs, watershed councils, and other local partners to voluntarily reduce pesticide levels while improving water quality and crop management. Since 2000, the PSPs have made noteworthy progress in reducing pesticide concentrations and detections.

Oregon Department of Agriculture led the development and implementation of a Pesticides Management Plan (PMP) for the state of Oregon (www.oregon.gov/ODA/programs/Pesticides/water/pages/AboutWaterPesticides.aspx). The PMP, completed in 2011, strives to protect drinking water supplies and the environment from pesticide contamination, while recognizing the important role that pesticides have in maintaining a strong state economy, managing natural resources, and preventing human disease. By managing the pesticides that are approved for use by the US EPA and Oregon in agricultural and non-agricultural settings, the PMP sets forth a process for preventing and responding to pesticide detections in Oregon's ground and surface water resources.

1.5.5 Drinking Water Source Protection

Oregon implements its drinking water protection program through a partnership between DEQ and OHA. The program provides individuals and communities with information and technical assistance to protect the quality of Oregon's drinking water. The DEQ and OHA encourage preventive management strategies to ensure that all public drinking water resources are kept safe from current and future contamination. For more information see: http://www.oregon.gov/deq/wq/programs/Pages/dwp.aspx.

1.5.6 Oregon's Coastal Management Program and the Coastal Zone Management Act Reauthorization Amendments of 1990

The mission of the Oregon Coastal Management Program is to work in partnership with coastal local governments, state and federal agencies, and other partners and stakeholders to ensure that Oregon's coastal and ocean resources are managed, conserved, and developed consistent with statewide planning goals. Oregon's Coastal Nonpoint Pollution Control Program (CNPCP) has been developed in compliance with requirements of Section 6217 of the federal CZARA. The US EPA and the National Oceanic and Atmospheric Administration administer CZARA at the federal level. The federal requirements are designed to restore and protect coastal waters from nonpoint source pollution and require coastal states to implement a set of management measures based on guidance published by the US EPA. The guidance contains measures for agricultural activities, forestry activities, urban areas, marinas, hydro-modification activities, and wetlands. In Oregon, the Department of Land Conservation and Development and DEQ coordinate the program. The geographical boundaries for the CNPCP include the North Coast, Mid-Coast, South Coast, Rogue, and Umpqua basins. Oregon has identified the ODA coastal Area Plans and Area Rules as the state's strategy to address agricultural measures. The Area Plan and Area Rules are designed to meet the requirements of CZARA and to implement agriculture's part of Oregon's CNPCP.

Additional information about CZARA and Oregon's CNPCP can be found at: www.oregon.gov/LCD/OCMP/pages/watqual_intro.aspx

1.6 Partner Agencies and Organizations

1.6.1 Oregon Department of Environmental Quality

The US EPA delegated authority to Oregon to implement the federal CWA in our state. DEQ is the lead state agency with overall authority to implement the CWA in Oregon. DEQ coordinates with other state agencies, including ODA and ODF, to meet the requirements of the CWA. The DEQ sets water quality standards and develops TMDLs for impaired waterbodies, which ultimately are approved or disapproved by the EPA. In addition, DEQ develops and coordinates programs to address water quality including NPDES permits for point sources, the CWA Section 319 grant program, Source Water Protection, the CWA Section 401 Water Quality Certification, and GWMAs. DEQ also coordinates with ODA to help ensure successful implementation of Area Plans.

A Memorandum of Agreement (MOA) between DEQ and ODA recognizes that ODA is the state agency responsible for implementing the Ag Water Quality Program. ODA and DEQ updated the MOA in 2012.

The MOA includes the following commitments:

- ODA will develop and implement a monitoring strategy, as resources allow, in consultation with DEQ.
- ODA will evaluate the effectiveness of Area Plans and Area Rules in collaboration with DEQ.
    - ODA will determine the percentage of lands achieving compliance with Area Rules.
    - ODA will determine whether the target percentages of lands meeting the desired land conditions, as outlined in the goals and objectives of the Area Plans, are being achieved.
- ODA and DEQ will review and evaluate existing information to determine:
    - Whether additional data are needed to conduct an adequate evaluation.
    - Whether existing strategies have been effective in achieving the goals and objectives of the Area Plans.
    - Whether the rate of progress is adequate to achieve the goals of the Area Plans.

The Environmental Quality Commission, which serves as DEQ's policy and rulemaking board, may petition ODA for a review of part or all of any Area Plan or Area Rules. The petition must allege, with reasonable specificity, that the Area Plan or Area Rules are not adequate to achieve applicable state and federal water quality standards (ORS 568.930(3)(a)).

1.6.2 Other Partners

Oregon Department of Agriculture and SWCDs work in close partnership with local, state, and federal agencies and organizations, including: DEQ (as indicated above), the United States Department of Agriculture (USDA) NRCS and Farm Service Agency, watershed councils, Oregon State University Agricultural Experiment Stations and Extension Service, tribes, livestock and commodity organizations, conservation organizations, and local businesses. As resources allow, SWCDs and local partners provide technical, financial, and educational assistance to individual landowners for the design, installation, and maintenance of effective management strategies to prevent and control agricultural water pollution.

1.7 Measuring Progress

Agricultural landowners have been implementing effective conservation projects and management activities throughout Oregon to improve water quality for many years. However, it has been challenging for ODA, SWCDs, and LACs to measure progress towards improved water quality. ODA is working with SWCDs, LACs, and other partners to develop and implement strategies that will produce measurable outcomes. ODA also is working with partners to develop monitoring methods to document progress.

1.7.1 Measurable Objectives

Measurable objectives allow the Ag Water Quality Program to better evaluate progress towards improved water quality. A measurable objective is a numeric long-term desired outcome to achieve by a specified date. Milestones are the interim steps needed to make progress toward the measurable objective and consist of numeric short-term targets to reach by specific dates. Together, the milestones define the timeline needed to achieve the measurable objective.

The Oregon Department of Agriculture, LAC, and LMA will establish measurable objectives and associated milestones for each Area Plan. Many of these measurable objectives relate to land conditions and primarily are implemented through focused work in small geographic areas (section 1.7.3), with a long-term goal of developing measurable objectives and monitoring methods at the Management Area scale.

At each biennial review, ODA and its partners will evaluate progress toward the most recent milestone(s) and why they were or were not achieved. ODA, the LAC, and LMA will evaluate whether changes are needed to keep on track for achieving the measurable objective(s) and will revise strategies to address obstacles and challenges.

The measurable objectives and associated milestones for the Area Plan are in Chapter 3 and progress toward achieving the measurable objectives and milestones is summarized in Chapter 4.

1.7.2 Land Conditions and Water Quality

Land conditions can serve as useful surrogates (indicators) for water quality parameters. For example, streamside vegetation generally is used as a surrogate for water temperature, because shade blocks solar radiation from warming the stream. In addition, sediment can be used as a surrogate for pesticides and phosphorus because they often adhere to sediment particles.

The Ag Water Quality Program focuses on land conditions, in addition to water quality data, for several reasons:

- Landowners can see land conditions and have direct control over them.
- It can be difficult to separate agriculture's influence on water quality from other land uses.
- There is generally a lag time between changes on the landscape and the resultant improvements in the water. Extensive monitoring of water quality is needed to evaluate progress, which is expensive and may fail to demonstrate improvements in the short term.
- Improved land conditions can be documented immediately, but there may be significant lag time before water quality improves or water quality impacts due to other sources.
- Reductions in water quality from agricultural activities are primarily through changes in land conditions and management activities.

Water quality monitoring data will help ODA and partners to measure progress or identify problem areas in implementing Area Plans. However, as described above, water quality monitoring may be less likely to document the short-term effects of changing land conditions on water quality parameters such as temperature, bacteria, nutrients, sediment, and pesticides.

1.7.3 Focused Implementation in Small Geographic Areas

Focus Areas

A Focus Area is a small watershed with water quality concerns associated with agriculture. Through the Focus Area process, the SWCD delivers systematic, concentrated outreach and technical assistance in a small geographic area. A key component of this approach is measuring conditions before and after implementation to document the progress made with available resources. The Focus Area approach is consistent with other agencies' and organizations' efforts to work proactively in small geographic areas and is supported by a large body of scientific research (e.g. Council for Agricultural Science and

Technology, 2012. Assessing the Health of Streams in Agricultural Landscapes: The Impacts of Land Management Change on Water Quality. Special Publication No. 31. Ames, Iowa).

Systematic implementation in Focus Areas provides the following advantages:

- Measuring progress is easier in a small watershed than across an entire Management Area.
- Water quality improvement may be faster since small watersheds generally respond more rapidly.
- A proactive approach can address the most significant water quality concerns.
- Partners can coordinate and align technical and financial resources.
- Partners can coordinate and identify appropriate conservation practices and demonstrate their effectiveness.
- A higher density of projects allows neighbors to learn from neighbors.
- A higher density of projects leads to opportunities for increasing the connectivity of projects.
- Limited resources can be used more effectively and efficiently.
- Work in one Focus Area, followed by other Focus Areas, will eventually cover the entire Management Area.

Soil and Water Conservation Districts select a Focus Area in cooperation with ODA and other partners. The scale of the Focus Area matches the SWCD's capacity to deliver concentrated outreach and technical assistance, and to complete (or initiate) projects. The current Focus Area for this Management Area is described in Chapter 3. The SWCD will also continue to provide outreach and technical assistance to the entire Management Area.

<u>Strategic Implementation Areas</u>
Strategic Implementation Areas (SIAs) are small watersheds selected by ODA in cooperation with partners based on a statewide review of water quality data and other available information. ODA conducts an evaluation of likely compliance with Area Rules, and contacts landowners with the results and next steps. Landowners have the option of working with the SWCD or other partners to voluntarily address water quality concerns. ODA follows up, as needed, to enforce Area Rules. Finally, ODA completes a post-assessment to document progress made in the watershed. Chapter 3 describes any SIAs in this Management Area.

1.8 Monitoring, Evaluation, and Adaptive Management

The Oregon Department of Agriculture, LAC, and LMA will assess the effectiveness of the Area Plan and Area Rules by evaluating the status and trends in agricultural land conditions and water quality (Chapter 4). This assessment will include an evaluation of progress toward measurable objectives. ODA will utilize other agencies' and organizations' local monitoring data when available. ODA, DEQ, SWCDs, and LACs will examine these results during the biennial review and will revise the goal(s), measurable objectives, and strategies in Chapter 3 as needed.

1.8.1 Agricultural Water Quality Monitoring

As part of monitoring water quality status and trends, DEQ regularly collects water samples at over 130 sites on more than 50 rivers and streams across the state. Sites are present across the major land uses (forestry, agriculture, rural residential, and urban/suburban). Sites are visited every other month throughout the year and represent a snapshot of water quality conditions. Parameters consistently measured include alkalinity, biochemical oxygen demand (BOD), chlorophyll a, specific conductance, dissolved oxygen (DO), DO percent saturation, *E. coli*, ammonia, nitrate and nitrite, pH, total phosphorus, total solids, temperature, and turbidity.

Other partners may have water quality data that is described in Chapter 3 and presented in Chapter 4.

1.8.2 Statewide Aerial Photo Monitoring of Streamside Vegetation

Starting in 2003, ODA began evaluating streamside vegetation conditions using aerial photos. Stream segments representing 10 to 15 percent of the agricultural lands in each Management Area were randomly selected for long-term aerial photo monitoring. Stream segments are generally 3-5 miles long. ODA evaluates streamside vegetation at specific points within 30-, 60-, and 90-foot bands along both sides of stream segments from the aerial photos and assigns each segment a score based on streamside vegetation. The score can range from 70 (all trees) to 0 (all bare ground). The same stream segments are re-photographed and re-scored every five years to evaluate changes in streamside vegetation conditions over time. Because site-capable vegetation varies across the state, there is no single "correct" streamside vegetation index score. The purpose of this monitoring is to measure positive or negative change for an individual reach.

1.8.3 Biennial Reviews and Adaptive Management

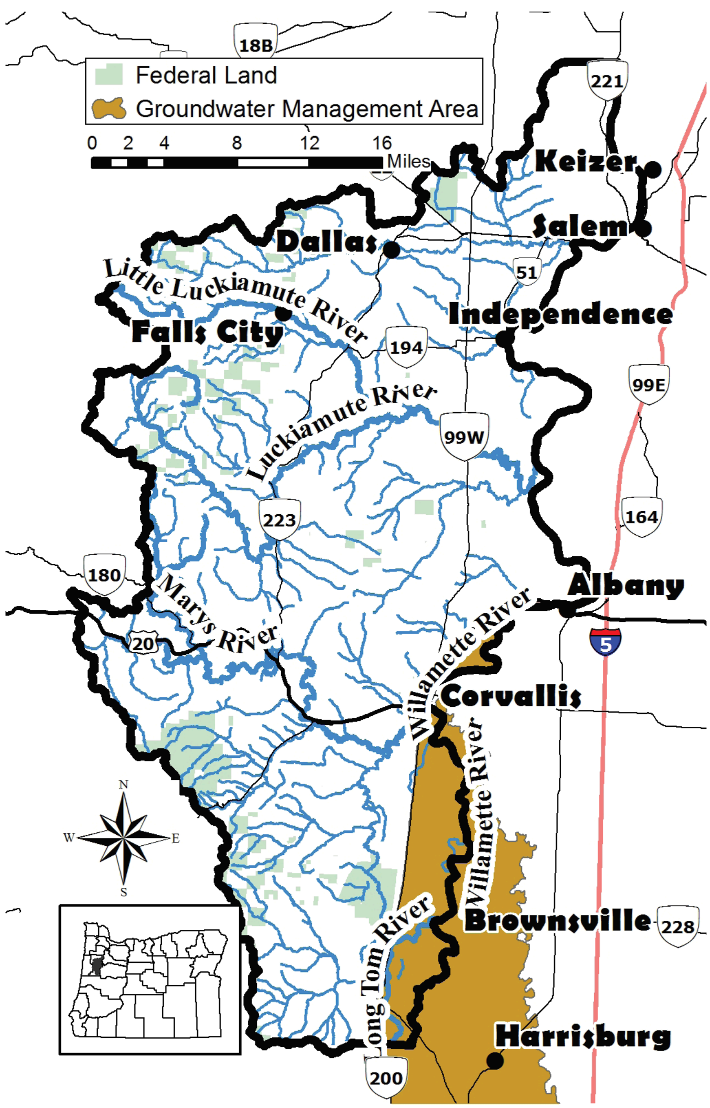
All Area Plans and Area Rules around the state undergo biennial reviews by ODA and the LAC. As part of each biennial review, ODA, DEQ, SWCDs, and the LAC discuss and evaluate the progress on implementation of the Area Plan and Area Rules. This evaluation includes discussion of enforcement actions, land condition and water quality monitoring, and outreach efforts over the past biennium. ODA and partners evaluate progress toward achieving measurable objectives, and revise implementation strategies as needed. The LAC submits a report to the Board of Agriculture and the director of ODA describing progress and impediments to implementation, and recommendations for modifications to the Area Plan or Area Plans necessary to achieve the goal of the Area Plan. ODA and partners will use the results of this evaluation to update the measurable objectives and implementation strategies in Chapter 3.

Chapter 2: Local Background

The Management Area includes the Ash, Dixon, Frazier, Glenn, Luckiamute, Marys, Rickreall, and Spring Valley watersheds, as well as several small streams that drain directly into the Willamette River. A small part of the northern Long Tom watershed is also within the Management Area. The Management Area includes much of Benton and Polk counties and a small portion of east Lincoln County. Included in the Management Area are the communities of Adair Village, Airlie, Buena Vista, Blodgett, Corvallis, Dallas, Eola, Independence, Kings Valley, Monmouth, Monroe, north Albany, Philomath, Rickreall, and West Salem.

Boundaries of the Management Area are the crest of the Coast Range to the west, the Willamette River to the east, the Yamhill River watershed boundary to the north, and the Lane-Benton county line (approximately) to the south. Figure 3 shows the area in more detail.

Figure 3. Middle Willamette Agricultural Water Quality Management Area



2.1 Local Roles and Responsibilities

2.1.1 Local Advisory Committee

The Area Plan was developed with the assistance of the LAC. The LAC was formed in November 2000 to assist with the development of the Area Plan and Area Rules and with subsequent biennial reviews.

Table 1. Current LAC members are:

Name	Location	Description
Eric Horning (Chair)	Monroe	Row Crops/Grass Seed/Cattle
Frank Bricker	Albany	Rye Grass/Wheat
Madeline Hall	Monmouth	Sheep/Eggs
Frank Nusbaum	Monroe	Grass Seed/Christmas Trees/ Beef Cattle/Woodland
Larry Venell	Corvallis	Grass Seed/Row Crops
Frank Pender	Dallas	Small Woodland
Scott Setniker	Independence	Irrigated Crops
Mark Taratoot	Corvallis	City of Corvallis/Mary's River Watershed Council
Lowell Ford	Dallas	Wine Grapes
George Ice, Alternate	Monroe	Hybrid Poplar/Timber
Peter Cheeke, Alternate	Corvallis	Beef Cattle/Hay

2.1.2 Local Management Agency

The implementation of the Area Plan is accomplished through an Intergovernmental Agreement between ODA and the Benton and Polk SWCD(s). This Intergovernmental Agreement defines the SWCD(s) as the LMA(s) for implementation of the Area Plan. The SWCD(s) were also involved in development of the Area Plan and Area Rules.

2.2 Area Plan and Rules: Development and History

The director of ODA approved the Area Plan and Area Rules in October 2002.

Since approval, the LAC met in 2004, 2008, 2010, 2012, 2014 and 2016 to review the Area Plan and Area Rules. The biennial review process includes an assessment of progress toward achieving the goals and objectives in the Area Plan (Chapters 3 and 4).

2.3 Geographical and Physical Setting

Physical Features

The Luckiamute River, Marys River, and Rickreall Creek are the largest drainages in the Management Area. Each stream's headwaters are in the Coast Range and are relatively fast flowing. These streams flow down steep gradients until they reach the Willamette Valley floor. The streams then meander slowly through agricultural, rural, and urban lands, eventually emptying into the Willamette River.

Marys River

The Marys River mainstem flows nearly twenty miles through the Coast Range and foothills before reaching the Willamette Valley floor near Philomath. It then passes through developed lands, including parks, industrial areas, agricultural areas, and downtown Corvallis, where it reaches its confluence with the Willamette River.

A major tributary, Muddy Creek, also originates in the Coast Range. Headwater streams flow for a few miles through mountain forestlands, then through rural residential areas, pasture lands, Christmas tree farms, and mixed coniferous and deciduous woodlands in the foothills. On the valley floor, Muddy Creek flows primarily through agricultural areas and Finley National Wildlife Refuge.

Luckiamute River
The Luckiamute River flows southeast through the Coast Range for approximately fifteen miles. Most of its headwater streams are deeply incised with narrow ridge-tops and floodplains (USDA, 1962). The river then flows northeast through Kings Valley, where its gradient flattens significantly, and passes through pastures, cropland and small woodlands. The river flows southeast after its intersection with Highway 99W and after passing through more agricultural lands and wetlands, empties into the Willamette River north of Albany.

Major tributaries include the Little Luckiamute River and Soap Creek. The Little Luckiamute River flows down a steep gradient through the Coast Range. It then reaches Falls City and its gradient flattens as it flows through the Coast Range foothills. Its confluence with the Luckiamute River is southwest of Monmouth. Soap Creek drains much of McDonald and Dunn forests, as well as Soap Creek Ranch, then flows through more agricultural lands and reaches the Luckiamute near its confluence with the Willamette River.

Long Tom River
Part of the lower Long Tom River watershed, the area approximately north of the Lane-Benton County line, is within the Management Area. This portion of the river has a very flat gradient and meanders across a broad floodplain. Two small tributaries, Miller Creek and Shafer Creek, join the mainstem in this area. This part of the watershed is mostly agricultural land.

Table 2. Acreages and major tributaries of watersheds in the Management Area (Benton and Polk County Geographic Information Systems Departments, 2001).

Watershed	Length (mi)	Area (acres)	Intermittent/ Perennial	Major tributaries
Marys River	40	191,360	Perennial	Newton Creek, Blakesley Creek, Oak/Squaw Creek, Tumtum River, Horton Creek, Wren Creek, Shotpouch Creek, Bark Creek, Laskey Creek, Mulkey Creek, LaBare Creek, Oleman Creek, Norton Creek, Greasy Creek (includes Rock Creek), Woods Creek, and Muddy Creek (includes North Fork, Middle Fork, South Fork, Evergreen Creek, Bull Run Creek, Beaver Creek, Reese/Oliver Creek, Gray Creek, and Hammer Creek)
Luckiamute River	58	198,400	Perennial	Little Luckiamute River (includes Cooper Creek, Fern Creek and Teal Creek), Jont Creek, Dry Creek, McTimmonds Creek, Pedee Creek, Ritner Creek, Bump Creek, Berry Creek, Maxfield Creek, Price Creek, Plunkett Creek, Vincent Creek, Soap Creek
Rickreall Creek	32	64,230	Perennial	Baskett Slough Creek (includes Goodwin Branch, McNary Branch, Mud Slough), Hayden Slough (Includes Oak Point Creek)
Long Tom River	9	5,300	Perennial	Shafer Creek, Miller Creek
Ash Creek	8	34,110	Perennial	North Fork, Middle Fork, South Fork
Glenn Creek	7	7,620	Perennial	Gibson Creek
Spring Valley Creek	9	16,194	Perennial	Walker Creek, King Creek
Frazier Creek	7	24,140	Perennial	Bowers Slough, Jackson Creek
Dixon Creek	4	2,632	Perennial	
"North Albany" Streams	N/A	5,055	Intermittent	N/A

Table 3. Average Gradients of the Marys, Luckiamute, and Rickreall mainstems in the Coast Range, foothills, and Willamette Valley (Oregon Water Resources Board, 1963).

Water Body	Gradient Coast Range ft/mile	Gradient Foothills ft/mile	Gradient Willamette Valley ft/mile
Luckiamute River	340	56	5
Marys River	N/A	14	6
Rickreall Creek	490	55	11

Rickreall Creek
Rickreall Creek's headwaters are on Laurel Mountain in the Coast Range and 3,600 feet above sea level. The Creek flows northeast, flattening just west of Dallas and meandering toward its confluence with the Willamette River. Most of the watershed west of Dallas is commercial timber and much of the land east of Dallas is in agriculture. Baskett Slough Creek is a major tributary that flows through agricultural lands and a large wildlife refuge before reaching Rickreall Creek near its confluence with the Willamette River.

Small Willamette River Tributary Streams
Several smaller streams within the Management Area flow directly into the Willamette River, including Ash Creek, Glenn Creek, Frazier Creek, Dixon Creek, and Spring Valley Creek. Most of these streams drain agricultural, rural residential, and urban lands. The north, middle, and south forks of Ash Creek flow just north and south of Monmouth. The mainstem flows through Independence and into the Willamette River. Glenn Creek, and its tributary Gibson Creek, drain through West Salem and adjacent agricultural and rural residential areas. Frazier Creek drains part of the McDonald research forest, rural residential areas north of Corvallis, and agricultural bottomlands along the Willamette River. Dixon Creek is almost entirely an urban stream that drains through most of north Corvallis.

Southern Willamette Valley Groundwater Management Area (GWMA)
A small portion of the GWMA is within the Management Area. Starting in the south, the GWMA includes land bounded on the west by Territorial Highway from Highway 36 north to Monroe, Highway 99W from Monroe to Corvallis, and Highway 20 from Corvallis to Albany. On the east, the GWMA is bounded by I-5 from just south of Coburg north to the intersection of I-5 with Muddy Creek, and then follows Muddy Creek until it's confluence with the Willamette River near Corvallis. From the north, the eastern boundary is the Willamette River until its intersection with Highway 20. The southern boundary of the GWMA also includes several surface roads south of Junction City. See Figure 4, page 33 for a map of the GWMA.

Geology and Soils

Coast Range
The Coast Range was created by compression and uplift as the Juan de Fuca, Kula, and Farallon plates subducted under the North American plate along the Pacific coast. The mountains are composed primarily of sedimentary rocks such as shale, sandstone, and siltstone, as well as some volcanic material.

Soils in the Coast Range Mountains formed primarily from sedimentary material as well as some volcanic material. They are relatively unstable and subject to puddling and active erosion. Soils in the Coast Range foothills formed from alluvial and colluvial deposits, which have been weathered extensively. They are less subject to slumping than soils in steeper areas.

Willamette Valley
Willamette Valley lowlands are composed of alluvial material deposited during the Missoula floods and by the rivers and their tributaries. The alluvial material is underlain by sedimentary and volcanic formations, deposited through erosion as uplift processes created the Coast Range. Depending on the composition of the deposited material, soils in bottomlands and terraces range from excessively drained loams and well-drained gravelly loams to poorly drained silty clay loams and silt loams (Knezevich 1975; Knezevich 1982).

Climate

Like most of Western Oregon, the climate of the Management Area is relatively mild throughout the year. Temperatures rarely fall below zero during the winter and exceed 90°F for only a few days during the summer each year (Taylor and Hannan, 1999). Average summer temperatures range from the low 50s to low 80s, and average temperatures in the winter are generally between the low 30s to about 40°F. The mean growing season (the 32°F frost-free period) is 150 to 180 days on the Valley floor to 110 to 130 days in the foothills (Taylor and Hannan, 1999).

Precipitation in the Management Area ranges from approximately 40 to 45 inches on the Valley floor to 60 to 120 inches in the foothills and Coast Range. Approximately 70 percent of the precipitation falls during November through March. Less than five percent of the precipitation occurs from June through August (Knezevich 1975; Knezevich 1982). Most of the precipitation is in the form of rain on the Willamette Valley floor. The amount of snowfall increases with elevation.

Land Use/Land Ownership

Agriculture and Forestry

Forestry and agriculture are the predominant land uses in the area. Most of the approximately 277,500 acres of forestlands in the area are located in the Coast Range and foothills (Benton and Polk County Geographic Information Systems Departments, 2001). Major forest landowners and managers include the Bureau of Land Management, the U.S. Forest Service, Weyerhaeuser, Starker Forests, Georgia Pacific, Forest Capital, and numerous individual private forest landowners.

Forest management on both federal and private lands has changed significantly in the past few decades. In federal forests, management objectives have diversified in recent years, and fish and wildlife habitat has increased in priority. While timber harvest still occurs, there is less emphasis on timber production. Private landowners, from industrial timber companies to small woodland owners, are not only regulated by the Forest Practices Act but have also made voluntary efforts to manage forestlands for multiple objectives including water quality.

Agricultural lands are scattered throughout the foothills and cover much of the Valley floor. They account for approximately 227,000 acres in the Management Area (Benton and Polk County Geographic Information Systems Departments, 2001). A wide variety of commodities can be grown in the area's highly productive agricultural soils.

Major crops in the area include grass seed, small grains, fruit and nut orchards, row crops such as sweet corn, broccoli and snap beans, hay, cattle, sheep, nursery products, wine grapes, Christmas trees, and dairy products. Along the Marys River mainstem, most of the agricultural land is in pasture or hay land. Sheep, cattle, and horses are pastured on ranches and small hobby farms. In the Muddy Creek watershed, row crops, grass seed, Christmas trees, and orchards are some of the main crops. In the Luckiamute watershed, agricultural land in the Coast Range foothills is mostly pasture and hay land. From Kings Valley eastward, grass seed, Christmas trees, nursery crops, vineyards, meadowfoam, row crops, livestock, and hay are predominant. Above Dallas, agricultural land in the Rickreall Creek watershed is mostly pasture and hay land. Below Dallas, major crops include grass seed, row crops, orchards and vineyards, small grains, dairy, and nursery stock.

Industrial

Industrial sites, totaling approximately 1,900 acres, are located throughout the Management Area, mostly near urban areas or in rural areas on the Willamette Valley floor (Benton and Polk County Geographic

Information Systems Departments, 2001). Major industrial sites include lumber mills, waste disposal sites, food processing businesses, and high-tech equipment production facilities such as Hewlett-Packard. Many of these companies, including Georgia Pacific, Smurfit Newsprint, and Valley landfills have permits for wastewater discharge in or near waterbodies.

Roads
There is an extensive network of roads throughout the Management Area, including highways, city and county roads, private residential, forest, and farm roads, and roads on federal and state lands. Major highways in the area include OR 99W, OR 221, OR 22, OR 51, US 20, and OR 34.

Natural Areas
There are several wildlife areas in the Management Area. The Oregon Department of Fish and Wildlife manages E.E. Wilson Wildlife Area near Adair Village. The Wildlife Area provides recreational opportunities such as hunting, fishing, and wildlife viewing, and also provides habitat for migratory waterfowl, songbirds, reptiles, amphibians, and fish. The two U.S. Fish and Wildlife Service refuges in the area, Baskett Slough and William Finley, are located in agricultural areas near Dallas and Monroe, respectively. Besides the seasonal wetlands that host migratory waterfowl, habitats at the refuges include oak savannah, ash swales, and mixed oak and maple woodland.

Primary management objectives of the wildlife areas include the protection of dusky Canada geese and other waterfowl. Canada geese populations in the Willamette Valley are estimated to be five to ten times higher than historical levels (Budeau, 2001). The water quality impacts of these population increases are unknown; however, recent studies indicated that goose droppings contain high concentrations of fecal bacteria. The U.S. Department of Agriculture's Wildlife Research Center initiated a Canada Goose Disease Surveillance Study in 2006 that will evaluate goose droppings from sites throughout the United States, including two sites in Oregon.

Outside of designated wildlife areas, there are many other natural areas in the Management Area on public and private lands. Many private landowners in the area have maintained or restored riparian areas and seasonal wetlands on their property.

Urban
North Albany, Corvallis, and West Salem are the largest urban areas in the Management Area. There are also several smaller cities and rural communities, including Adair Village, Airlie, Alpine, Dallas, Philomath, Maple Grove, Monroe, Falls City, Monmouth, Rickreall, Independence, Kings Valley, Wren, Pedee, and Suver. The population of Polk and Benton counties is 165,790 (Center for Population Studies, 2013). Parts of these counties fall outside of the Management Area but the bulk of the population from these counties falls within the Management Area.

Wastewater treatment plants exist for most incorporated cities within the area. Treatment plants for the cities of Falls City, Philomath, Independence, Monmouth, and Dallas discharge in or near the Little Luckiamute River, Marys River, Willamette River, Ash Creek, and Rickreall Creek, respectively. In addition, the Corvallis wastewater treatment plant discharges into the Willamette River.

Commercial
Most commercial lands within the Management Area are within urban areas. There are a few unincorporated commercial lands in Polk County along Highway 22 near Grand Ronde, Rickreall, Eola, and Highway 99W near Lewisburg.

Rural Residential
Rural residential lands in the area total approximately 27,930 acres (Benton and Polk County Geographic Information Systems Departments, 2001). Many rural residential lands are in transitional areas between farm and forestlands in the foothills of the Coast Range or in agricultural areas.

Water Resources

Water Availability

Like most streams with headwaters in the Coast Range, rainfall provides much of the surface water supply in Management Area watersheds. Seasonal fluctuations in stream flow are much more pronounced in the Luckiamute, Marys, and Rickreall Creek watersheds than in streams with headwaters in the Cascade Mountains because snowmelt supplies a relatively small portion of the stream flow. For example, flow in the Luckiamute River during the highest flow month is 54 times the flow during the lowest flow month, much "flashier" than the high-flow, low-flow difference of just five times in the McKenzie River. Table 4 lists minimum, maximum, and average flows for several waterbodies in the area.

Groundwater resources in much of the area are relatively meager because there are few porous, permeable geologic formations to absorb and transmit water, except on the Valley floor near the Willamette River. Alluvial material in the valleys and along major streams and rivers are the most abundant source of groundwater; however, on the east foothills of the Coast Range yields are still relatively low because the material is of the same geologic origin as material throughout the Coast Range.

Table 4. Minimum, maximum, and average flow in several waterbodies in the Management Area

Water Body	Average Summer Flow (cfs)	Average Winter Flow (cfs)	Minimum Flow (cfs)	Maximum Flow (cfs)	Average Annual Flow (cfs)
Long Tom River @ Monroe	70	1,842	7	19,300	760
Marys River @ Philomath	50	1,121	4	13,600	467
Luckiamute River @ Suver	109	2,154	.065	32,900	877
Rickreall Creek above Dallas	12	1,042	0	5,600	146

Flow is in cubic feet per second (cfs). Figures are derived from U.S. Geological Survey stream gage data, gathered from the year the gage was installed until the present (U.S. Geological Survey, 2001).

Table 5. Water allocations in several waterbodies in the Management Area

Water Body	Irrigation	Fish and Wildlife	Agriculture	Industrial	Municipal
Ash Creek	11 cfs 15 af	2 cfs 15 af	.05 cfs 35 af	.01 cfs 0 af	4 cfs 0 af
Dixon Creek	2 cfs 2 af	0 cfs 0 af	0 cfs 0 af	.55 cfs 0 af	0 cfs 0 af
Glenn Creek	15 cfs 228 af	.2 cfs 3 af	.01 cfs 2 af	0 cfs 0 af	2 cfs 0 af
Frazier Creek	6 cfs 2 af	.03 cfs 17.3 af	0 cfs 0 af	0 cfs 0 af	0 cfs 0 af
Luckiamute River	171 cfs 1,318 af	3 cfs 456 af	.45 cfs 165 af	6 cfs 61 af	8.5 cfs 0 af
Marys River	111 cfs 318 af	11 cfs 1,008 af	.33 cfs 11 af	11 cfs 449 af	20 cfs 257 af
Rickreall Creek	101 cfs 2,147 af	.88 cfs 1,345 af	7 cfs 41 af	.45 cfs 74 af	15 cfs 2,780 af

Allocations are in cubic feet per second (cfs) or acre-feet (af) (Oregon Water Resources Department, 1990).

Water Use

Consumptive uses of water in the Management Area include irrigation, domestic use, municipal use, and commercial use. Non-consumptive uses include recreation, power generation, and fish and wildlife habitat. Sources of appropriated water are reservoirs, surface water, and groundwater. Table 5 summarizes water allocations in the area. Allocations in cubic feet per second represent the maximum amount of water that may be withdrawn at any given time; allocations in acre-feet represent the total amount of water that may be withdrawn during a water year.

Several cities withdraw drinking water from Management Area streams. The city of Dallas withdraws drinking water from Mercer Reservoir on Rickreall Creek. Philomath receives its drinking water from the Marys River. Corvallis, Monroe, and Adair Village also utilize surface water as their drinking water source. Rickreall, Monmouth and Independence utilize groundwater as their drinking water source. The Luckiamute Domestic Water Cooperative provides groundwater for rural residences in southern Polk County. In addition, 45 entities, such as schools, camps, industry, and campgrounds rely on groundwater wells. Rural residents mainly rely on individual private groundwater wells as their drinking water source.

2.4 Agricultural Water Quality

2.4.1 Water Quality Issues

The DEQ evaluates data from its own monitoring program, the Oregon Department of Fish and Wildlife, and the city of Corvallis and other partners to determine the listing status of stream segments in the Management Area. Several stream segments were determined to exceed state standards for temperature, bacteria, and dissolved oxygen.

Water quality concerns occur seasonally throughout the Management Area. Temperature standard violations in Rickreall Creek, Marys River, and Long Tom River occur during the summer months and on the mainstem Willamette River. In addition, there are temperature violations year-round on the following creeks; Little Luckiamute, Little Muddy Creek, Luckiamute River, Maxfield Creek, McTimmonds Creek, Oak Creek, Pedee Creek, Ritner Creek, and Soap Creek. Bacteria problems have been identified during the fall, winter, and spring, when storm-related runoff and discharges are most likely to occur from a variety of sources in Oak Creek and the Luckiamute, Marys, and Long Tom rivers. Dissolved oxygen concerns occur in Glenn, Gibson, and Soap creeks and in the Marys River. Mercury concern is a Willamette Basin-wide parameter because of potential bioaccumulation and human consumption of fish. Some seasonal variation in water quality likely occurred before European settlement of the area because of seasonal fluctuations in stream flow and other factors.

Groundwater quality concerns include nitrate, and these concerns are especially elevated in the Southern Willamette Valley Groundwater Management Area. Nitrate levels of up to two parts-per-million (ppm) in groundwater may be naturally-occurring but are considered to be safe for consumption. High levels of nitrate may present a serious health concern for infants, pregnant or nursing women, and other sensitive populations.

2.4.1.1 Beneficial Uses

Beneficial uses impacted by these water quality concerns include fish and aquatic life, water contact recreation, fish consumption and human health concerns for drinking water.

Temperature
DEQ developed the temperature TMDL to protect salmon spawning in the fall, migration and rearing year-round as the most sensitive beneficial uses in the Upper and Middle Willamette Subbasin. On agricultural lands, absence of streamside vegetation, water withdrawals, and land management that leads to widened stream channels contribute to elevated stream temperatures. DEQ has identified the existing nonpoint source pollution sources as solar heating of the Area's waterways due to a lack of riparian vegetation from forestry, agriculture, rural-residential, and urban activities.

EPA disapproved the "natural conditions criterion," a key provision of Oregon's temperature standard on August 8, 2013. DEQ can no longer use the natural conditions criterion to account for warmer temperatures in Oregon's rivers, lakes and streams. Until the pending litigation on the temperature TMDL is resolved, the future status of existing TMDLs based on the natural conditions criteria is uncertain. At present, nonpoint source temperature reduction targets from existing approved TMDLs continue to apply and should be implemented. Management practices and stream restoration to reduce temperatures in impaired waters are needed whether the ultimate regulatory goal is natural conditions or the numeric criteria. Also, the cold water protection criterion has not changed and is still effective.

Bacteria
DEQ has set the bacteria TMDL to protect human water contact recreation (risk of infection and disease to people who come in contact with fresh water while fishing, swimming, or boating) as the most sensitive beneficial use. On agricultural lands, *E. coli* generally comes from livestock waste, either deposited directly into waterways or carried to waterways via runoff and soil erosion. Runoff and soil erosion from agricultural lands may also carry bacteria from other sources. There are numerous sources of bacteria in streams, including humans (from recreation or failing septic systems) and wildlife.

Mercury
Human fish consumption is the most sensitive beneficial use for which DEQ has set the Willamette mercury TMDL. Primary sources of mercury include air deposition from national and international sources, discharge from specific legacy mining sites, and erosion of soils containing mercury. In addition, some fertilizers have minimal ammounts of mercury in them. Mercury contributions from agricultural lands originate primarily through soil erosion and transport.

Following a Court decision, the Willamette mercury TMDL was suspended and is being re-developed by DEQ (https://law.lclark.edu/live/files/23881-hernandez-ruling-april-13-2017pdf). DEQ and EPA are revising the TMDL to meet Oregon's current water quality criterion for methylmercury, which is eight times more stringent than the criterion in effect in 2006. EPA approved Oregon's revisions to its methylmercury fish tissue concentration criterion for the protection of human health in October 2011. In April 2017, the US District Court issued a ruling requiring EPA to revise the TMDL by April 2019 and allowing the 2006 TMDL to remain in effect until EPA issues or approves the revised TMDL. Mercury Category 4 TMDL listings, however, have been revised to reflect Category 5 303(d) water quality limited. For additional information see http://www.oregon.gov/deq/wq/tmdls/Pages/willhgtmdlac2018.aspx.

Dissolved Oxygen
Based on the 303(d) listing for dissolved oxygen, a TMDL was established for dissolved oxygen in December 1993 for Rickreall Creek. Dissolved oxygen levels were below state standards in Rickreall Creek downstream of the Dallas Seweage Treatment Plant, and did not protect beneficial uses for resident aquatic life or steelhead. In the TMDL, the city of Dallas Sewage Treatment Plant received a waste load allocation that, if met, would likely eliminate dissolved oxygen standard violations in Rickreall Creek. DEQ has identified multiple nonpoint sources of pollutants, including storm water discharges, agricultural run-off, and insufficient riparian vegetation.

2.4.1.2 WQ Parameters and 303(d) list

Every two years, DEQ is required to assess water quality and report to the U.S. EPA on the condition of Oregon's waters. DEQ prepares an Integrated Report in accordance with Clean Water Action (CWA) Sections 303(d), 305(b), and 314. The Integrated Report includes an assessment of each water body where data are available, the list of waters identified under Section 303(d) as water quality limited and needing a TMDL, as well as waters with established TMDLs that are expected to improve water quality. The current 2012 Integrated Report can be accessed at http://www.oregon.gov/deq/wq/Pages/2012-Integrated-Report.aspx

The 2012 Integrated Report identifies over ten 303(d) listed stream segments that need a TMDL in the Management Area. The water quality impairments identified for streams in the Management Area include: dissolved oxygen, biological criteria, metals (lead, copper, iron and mercury). The Management Area also has over 16 stream segments with approved TMDLs for temperature and/or bacteria. Rickreall Creek also has a TMDL for dissolved oxygen. The mainstem Willamette River (river mile 0 – 186.4) has a TMDL for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (2,3,7,8,-TCDD). The TMDL identifies this as being attributable to discharge from chlorine-bleaching pulp mills. For a complete list, access the 2012 database: http://www.deq.state.or.us/wq/assessment/rpt2012/search.asp#db.

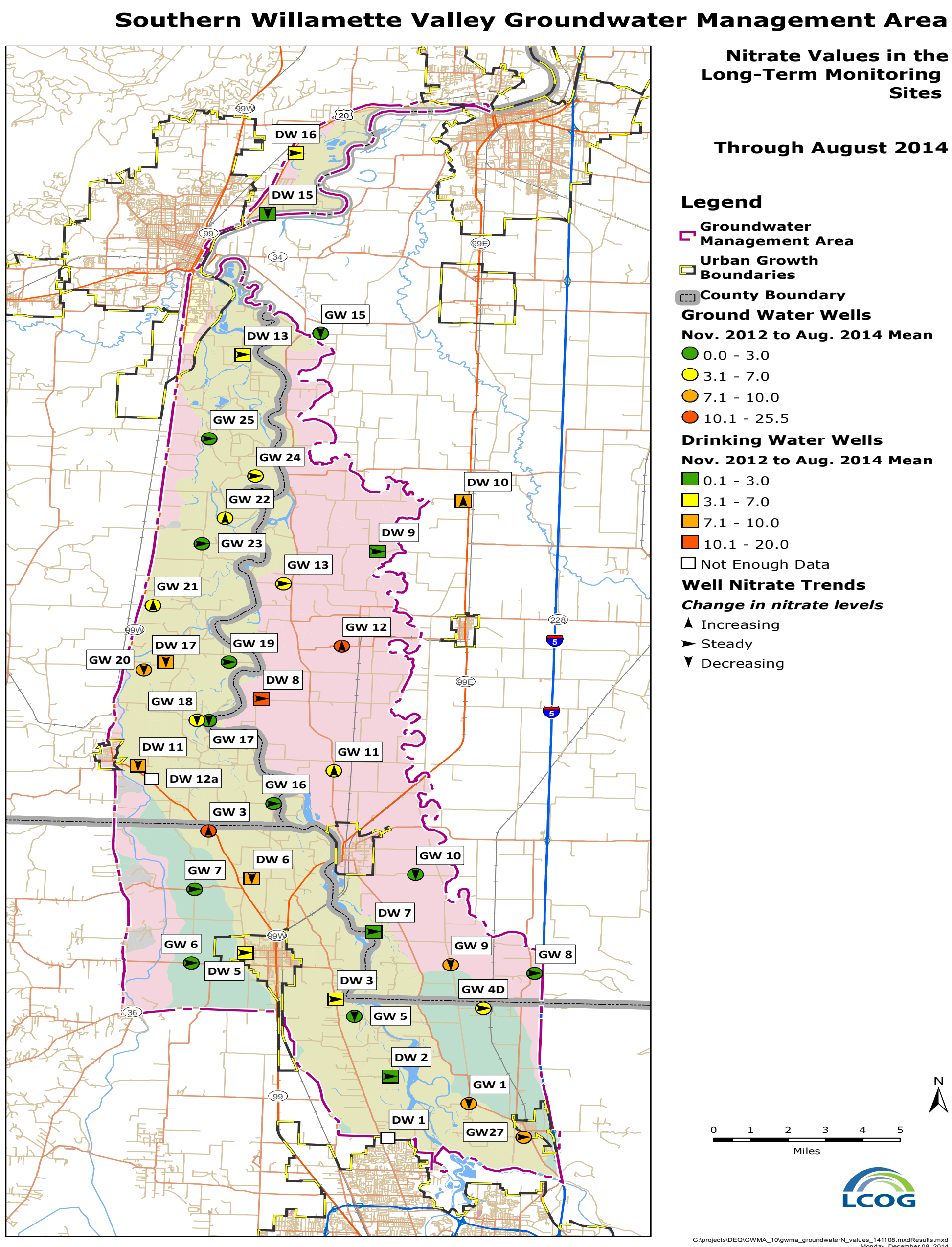
2.4.1.3 GWMA Background and Sources of Impairment

The Southern Willamette Valley Groundwater Management Area (GWMA) was declared in 2004 because of high nitrate contamination in a 230 square mile area of the Willamette Valley (Figure 4). A multi-year, multi-stakeholder process is addressing the nitrate contamination issue. The GWMA encompasses portions of Lane, Linn, and Benton counties and includes five cities (Corvallis, Harrisburg, Monroe, Junction City, and Coburg, Figure 4). Scientific studies have found nitrate to be associated with methemoglobinemia (blue baby syndrome), diabetes, negative reproductive outcomes, and various forms of cancer. Public water suppliers must test their water regularly but rural home owners are not required to do so and are often unaware of contamination issues.

Extensive testing in 2000-02 by DEQ concluded that nitrate was a contaminant of concern in groundwater in the Southern Willamette Valley. Nitrate was found at greater than 7 mg/L in more than 20 percent of samples analyzed in 2000 and 2001. Those with high levels were re-sampled in 2002 and more than 90 percent of those samples were still above 7mg/L. Nitrate was found at many locations at concentrations greater than the public drinking water standard (10 mg/L) and at more than three times the standard in several locations. DEQ now monitors the GWMA groundwater quality quarterly by sampling at 41 well locations. Our pollutant load reduction target is to reduce all nitrate levels in the groundwater to less than 7mg/L.

Information about the GWMA can be found at http://wellwater.oregonstate.edu/swvgwma.

Figure 4. Map of the SWV GWMA



2.4.2 Basin TMDLs and Agricultural Load Allocations

DEQ completed the Willamette Basin TMDLs – for temperature, bacteria, and mercury - and the US Environmental Protection Agency (EPA) approved the TMDLs in September of 2006. These TMDLs include temperature, bacteria and mercury loads specific to the Upper Willamette Subbasin. In addition, DEQ has defined a TMDL for dissolved oxygen for Rickreall Creek in 1994. The load allocations and reductions needed to meet water quality standards and protect beneficial uses are summarized in Table 6.

Table 6: Nonpoint Source Agricultural TMDL Load Allocations/Reductions

TMDL	Basin/Watershed	Allocations
Bacteria *(E. coli)*	Middle and Upper Subbasins Mainstem Willamette, including: Glenn Creek, Luckiamute River, Rickreall Creek, Spring Valley, Long Tom, Marys River and their tributaries	Bacteria load reductions as high as 84% are needed to meet the water quality criteria in the Upper Willamette overall. Geographic focused percent reductions include: Long Tom 47% and Luckiamute 63%. Bacteria load reductions as high as 95% are needed to meet the water quality criteria in the Middle Willamette during the Summer. Bacteria load reductions as high as 61% are needed to meet the water quality criteria in the Middle Willamette during the fall-winter-spring.
Dioxin (2,3,7,8-TCDD)	Middle and Upper Subbasins Mainstem Willamette (river mile 84-149)	Established for eight chlorine-bleach pulp mill point sources. Insufficient information to establish additonal allocations for other point and nonpoint sources. TMDL reserve held to capture contributions from these other potential sources.
Dissolved Oxygen	Rickreall Creek	Reduce oxygen-demanding pollutants into Rickreall Creek (e.g., nutrients, bacterial pollution). Riparian protection and restoration measures developed to address stream temperature concerns in the basin will benefit dissolved oxygen levels. Implementation of best management practices designed to reduce nonpoint sources of pollution support dissolved oxygen improvements.
Mercury	Middle and Upper Subbasins Mainstem Willamette, including: Glenn Creek, Luckiamute River, Rickreall Creek, Spring Valley, Long Tom, Marys River and their tributaries	Currently 27% Willamette Basinwide Reduction; Best Management Practices employed to minimize soil erosion and control the use of products that contain mercury, such as some fertilizers. Refer to litigation information above in 2.4.1.1.
Temperature	Middle and Upper Subbasins Mainstem Willamette, including: Glenn Creek, Luckiamute River, Rickreall Creek, Spring Valley, Long Tom, Marys River and their tributaries	Preservation of effective shade levels. Preservation and attainment on smaller tributaries associated with system potential vegetation will eliminate most anthropogenic nonpoint source heat loads. 91% thermal pollution is from nonpoint sources. Surrogate measure is percent effective shade targets and a heat load equivalent of 0.05 ºC of the Human Use Allowance. Other important measures— preserving and restoring cool water refuges where salmonids rear and migrate to when the river warms up in the summer; protect and restore instream flow quantity. Refer to litigation information above in 2.4.1.1.

2.4.3 Sources of Impairment

There are many factors that may affect water quality in the Management Area. Sources impacting temperature include wastewater treatment plants, industrial operations, removal of riparian vegetation, seasonal reductions in stream flow, and stream channel and floodplain alteration. Contributors to bacteria and nutrient concerns include wastewater treatment plant overflows during heavy rains or generalized leaching to groundwater, legal and illegal waste dumping sites, leaching septic systems, leaching of fertilizers to groundwater, runoff from urban and rural areas and roads, runoff from agricultural lands, and natural sources such as geese and other wildlife. Elevated stream temperatures, as well as nutrient levels, can contribute to low dissolved oxygen levels. Mercury can enter waterbodies from industrial and municipal wastewater discharges, erosion of soils that naturally contain mercury, runoff of atmospherically deposited mercury, and runoff from abandoned mines.

2.5 Voluntary and Regulatory Measures

The focus of the Agricultural Water Quality Management Program is voluntary and cooperative efforts by landowners, SWCDs, ODA, and others to protect water quality. However, the Agricultural Water Quality Management Act also provides for a regulatory backstop to ensure prevention and control of water pollution from agricultural sources in cases where landowners or operators refuse to correct problem conditions. The Area Rules serve as this backstop while allowing landowners flexibility in how they protect water quality. Area Rules are goal-oriented and describe characteristics that should be achieved on agricultural lands, rather than practices that must be implemented.

In this section, there are five Prevention and Control Measures that describe water quality issues, relevant definitions, and water quality concerns affected. Area Rules are referenced in each Prevention and Control Measure. Each Area Rule has a border around it and appears in italics.

The Prevention and Control Measures and Area Rules relate directly to water quality concerns identified on the 303(d) list in the Management Area, for the dissolved oxygen TMDL for Rickreall Creek in 1994, and for the bacteria, mercury and temperature TMDLs that were established in September 2006 for the Willamette Basin. In addition, nitrate is discussed because of potential impacts to groundwater. Area Rules are not listed specific to mercury, dissolved oxygen, or nitrate, but prevention and control measures for erosion target these. Specific management practices are listed in Appendix E.

2.5.1 Nutrients and Manure Management

Bacteria Issue:

Animal and human wastes are a potential source for about 150 diseases (Terrell and Perfetti, 1989). The most commonly used indicator of animal or human waste pollution in a waterbody is the organism *Escherichia coli* (*E. coli*). It is a type of fecal coliform bacteria. These bacteria reside in the intestines of warm-blooded animals, including humans, livestock, wild birds, and mammals. The presence of *E. coli* alone does not confirm the contamination of waters by pathogens. It does, however, indicate contamination by sewage or animal manure and the potential for health risks.

Numerous factors influence the nature and amount of bacteria that reach waterways. Some of these factors are climate, topography, soil types, infiltration rates, animal species, and animal health. Typically, bacteria levels in streams are elevated after the first major storm event of the rainy season.

Bacteria also settle into sediments in a streambed and can live there for an extended period of time. If sediments are disturbed by increased stream turbulence following a runoff event, human or animal traffic, or other means, sediment-bound bacteria may be re-suspended into the water column (Sherer et al 1992). Sediment disturbance may account for erratic bacteria levels typically measured in water quality monitoring programs.

Oregon’s water quality standard for bacteria was established to protect the most sensitive beneficial use affected by bacteria levels, water contact recreation. Appendix A includes detailed information about the bacteria standard. Within the Management Area, the Luckiamute River from mouth to Pedee Creek and the Marys River from mouth to Greasy Creek exceed water quality standards for bacteria during the fall, winter, and spring.

Livestock manure is a potential source of bacteria, nutrients, and oxygen-consuming material. If stored and applied at agronomic rates, manure can be a beneficial source of nitrogen and phosphorus, as well as organic matter (Mikkelsen and Gilliam, 1995). Nothing in this prevention and control measure is intended to discourage the use of manure or other amendments; rather, it seeks to ensure that they are applied correctly.

Nitrate Issue:

Nitrate is a form of oxidized nitrogen that is soluble in water (can be an issue in surface or ground water). Oregon Groundwater Quality Protection Rules (OAR 340-40) has a numerical groundwater quality reference level for nitrate of 10 mg/L, which is the minimum standard for point sources that were permitted prior to 1989. Public drinking water systems must adhere to the EPA Maximum Contaminant Limit for nitrate of 10 mg/L, which was established due to health concerns. Individuals with household wells are not required to adhere to any drinking water standards.

Nitrate is highly soluble in water, easily mobile in the soil, and can potentially leach through the soil and into the groundwater. Potential sources of nitrate pollution include fertilizer, animal waste, septic systems, and wastewater.

Area Rule

OAR 603-095-2340
(1)(a) Effective upon rule adoption, no person subject to these rules shall violate any provision of ORS 468B.025 or ORS 468B.050.

Definitions

See page 8 for definitions of waste, pollution, and waters of the state.

Other substances that will or may cause pollution include eroded sediment, commercial fertilizers, soil amendments, composts, animal wastes, and vegetative materials.

Parameters That May Be Affected by this Prevention and Control Measure:

Dissolved oxygen, bacteria, nutrients, toxics.

2.5.2 Streamside Area Management

Across Oregon, the Ag Water Quality Program emphasizes streamside vegetation protection and enhancement to prevent and control agricultural water pollution. Streamside vegetation provides three primary water quality functions: shade for cooler stream temperatures, streambank stability, and filtration of pollutants. Other water quality functions include: water storage for cooler and later season flows, sediment trapping that builds streambanks and floodplains, narrowing and deepening of channels, and biological uptake of sediment, organic material, nutrients, and pesticides.

Additional reasons for the Ag Water Quality Program's emphasis on streamside vegetation include:

- Streamside vegetation improves water quality related to multiple pollutants, including: temperature (heat), sediment, bacteria, nutrients, toxics, and pesticides.
- Streamside vegetation provides fish and wildlife habitat.
- Landowners can improve streamside vegetation in ways that are compatible with their operation.
- Streamside vegetation condition can be monitored readily to track the status and trends of agriculture's progress in addressing water quality concerns.

Issue

The importance and effect of stream temperatures on aquatic life, including salmonids, has been the subject of much debate in recent years. There is general agreement that salmonids and other coldwater aquatic organisms require cool water temperatures to survive. Dissolved oxygen levels, which are necessary to support fish and other aquatic life, have an inverse relationship with stream temperatures; as water temperature falls, dissolved oxygen levels rise. Elevated stream temperatures, in addition to affecting the metabolic processes of aquatic animals, cause further physical stress by lowering the dissolved oxygen available for respiration.

It is very difficult to determine exact temperature requirements of coldwater aquatic life in natural settings, where temperatures may vary several degrees in a stream reach. Temperature important to protect coldwater aquatic life is described in Appendix A.

For many years, researchers have investigated factors that influence stream temperatures. Several authors emphasize the importance of water stored in the landscape and its importance in maintaining stream temperatures (Krueger et al, 1999; Moore and Miner, 1997; Naiman and Decamps, 1997). Clark (1998) explains that watershed conditions strongly influence riparian areas by affecting the infiltration of precipitation and the storage and release of water. Adequate ground cover in upland areas increases the likelihood of precipitation infiltrating the soil profile and decreases the possibility of overland flow, soil loss and resulting sediment delivery to streams. Many studies also highlight the significance of streamside shade in the maintenance of stream temperatures (Brown, 1969; Beschta, 1997). Other influences on stream temperature include stream channel width, stream depth, channel substrate, air temperature, and elevation (Bilby, 1984; Chen et al, 1998; Larson and Larson, 1996; Krueger et al, 1999; Ward, 1995). For a more complete list of factors that affect stream temperature, consult Appendix F.

<u>Site Capable Vegetation</u>
The Ag Water Quality Program uses the concept of "site-capable vegetation" to describe the vegetation that agricultural streams can provide to protect water quality. Site-capable vegetation is the vegetation that can be expected to grow at a particular site, given natural site factors (e.g., elevation, soils, climate, hydrology, wildlife, fire, floods) and historical and current human influences (e.g., channelization, roads, modified flows, past land management). Site-capable vegetation can be determined for a specific site based on: current streamside vegetation at the site, streamside vegetation at nearby reference sites with similar natural characteristics, NRCS soil surveys and ecological site descriptions, and local or regional scientific research. ODA does not consider invasive, non-native plants such as introduced varieties of reed canary grass and blackberry to be site-capable vegetation.

The goal for Oregon's agricultural landowners is to provide the water quality functions (e.g., shade, streambank stability, and filtration of pollutants) produced by site-capable vegetation along all streams flowing through agricultural lands. The agricultural water quality regulations for each Management Area require that agricultural activities provide the water quality functions equivalent to what site-capable vegetation would provide.

In some cases, for narrow streams, mature site-capable vegetation such as tall trees may not be needed. For example, shrubs and grass may provide shade, protect streambanks, and filter pollutants. However, on larger streams, mature site-capable vegetation is needed to provide the water quality functions.

Appendix G provides a description of what site capability within the management area and provides examples.

Area Rule

OAR 603-095-2340 ***(1)(b) By January 1, 2003, agricultural activities shall allow the growth and establishment of vegetation along perennial streams consistent with site capability to promote infiltration of overland flow, streambank stability and provide moderation of solar heating. Minimal breaks in shade vegetation for essential management activities are considered appropriate.***

Definitions

Site Capability - The vegetation, ecological, and functional status that an area is capable of producing/attaining given political, social, or economical constraints, which are often referred to as limiting factors. For more information, please see Appendix G.

Perennial stream – Natural channel in which water flows continuously and which is shown on a United States Geological Survey quadrangle map.

Parameters That May Be Affected by this Measure:
Temperature, dissolved oxygen, sediment, nutrients, turbidity, chlorophyll a.

2.5.3 Soil Erosion Prevention and Control

Mercury

Issue

Mercury is a metal, liquid at room temperature, commonly used in the recent past for thermometers. It continues to have many dental, medical, and industrial uses. In addition, it is found naturally in the soils of the Willamette Valley. It is also found in fossil fuels and is released into the air upon combustion. In the air, mercury can travel over continents and oceans to be deposited on land, added to naturally occurring mercury, and is carried by stormwater and erosion into Oregon's waterways. Fish consumption is the most common way humans are exposed to elevated levels of mercury (Oregon Department of Environmental Quality, 2007).

Mercury is also a severe poison. According to DEQ (2007), small children and fetuses are most sensitive to mercury's toxic effects.

Mercury from point and non-point sources is bioaccumulating in fish tissue to levels that adversely affect public health. Mercury binds to particles; thus, there are both higher levels of total suspended solids as well as higher mercury levels in the wet season. In setting the TMDL for mercury, DEQ has found that erosion of native soil makes up almost 48 percent of the mercury in the Willamette Basin. Some industrial facilities and domestic wastewater treatment facilities also discharge mercury, but at low levels.

The current DEQ mercury TMDL consists of interim targets and allocations. DEQ plans to finalize these after additional data collection and public outreach (Oregon Department of Environmental Quality, 2007).

Refer to ORS 468B.025 and 468B.050 for the Administrative Rules and Statutes that apply to mercury, dissolved oxygen, and nitrate in this area.

Dissolved Oxygen

Dissolved oxygen refers to the amount of oxygen that is dissolved in water. Oregon's dissolved oxygen standards protect cool and coldwater aquatic life, which require relatively high levels of dissolved oxygen to breathe.

Dissolved oxygen levels can vary over the course of the day based on algal growth and decay. An increase in available nutrients may result in elevated algal production, eventually depleting dissolved oxygen when algae decay. Temperature and dissolved oxygen exhibit an inverse relationship; as water temperature falls, dissolved oxygen levels rise; as water temperature rises, dissolved oxygen levels fall. Elevated stream temperatures, in addition to affecting the metabolic processes of aquatic animals, cause further physical stress by lowering the dissolved oxygen available for respiration.

Area Rule

OAR 603-095-2349(1)
Effective upon rule adoption, no person subject to these rules shall violate any provision of ORS 468B.025 or 468B.050.

2.5.4 Preferred Management Practices

The following tables are intended as recommendations for landowners to meet Area Rules and generally maintain and enhance natural resources on their property. The practices below benefit a variety of water quality parameters, not just those parameters of concern within the Management Area. The tables provide some idea of the water quality benefits of each practice as well as potential costs and benefits to landowners. The tables are organized by resource, such as nutrients and manure.

Landowners who want more information on any of the following practices, or who are looking for other ideas for water quality improvement and conservation on their lands, may contact several agencies and organizations that provide technical assistance (Appendix C) or read some of the publications cited below. Also, please consult Appendix D for a list of cost-sharing programs that cover many of these practices.

Table 7. Riparian Areas and Streams

Practice	Resource Concerns Addressed	Potential Benefits of Practice to Producer	Potential Costs of Practice to Producer
a. Preserve existing vegetation.	Functions currently provided are protected.	Ensures compliance with regulations.	Unable to use land for production.
b. Light rotational grazing in riparian area; timed when growth is palatable to animals and when riparian areas are not saturated (Adams, 1994; Chaney, Elmore and Platts, 2003; Rogers and Stephenson, 1998).	Helps establish desirable riparian vegetation, promotes streambank integrity; helps filter nutrients and sediment from runoff; helps reduce stream temperatures by providing shade.	May lessen streambank erosion and loss of pastures; allows limited use of riparian area for grazing, improves wildlife habitat, and may control weeds. Practice may be eligible for cost-sharing programs.	May require time and financial investment for livestock control and off-stream watering facilities.
c. Livestock exclusion from riparian area; establish off-stream watering facilities (NRCS, 1997g and 1997h).	Helps promote desirable riparian vegetation; promotes streambank integrity; helps filter nutrients and sediment from runoff; may help narrow channel and reduce erosion in channel.	May lessen streambank erosion and loss of pastures; less time involved in managing livestock grazing in riparian area, improves wildlife habitat. Practice may be eligible for cost-sharing programs.	May require higher weed control costs than seasonal riparian grazing. May require financial investment for livestock control and off-stream watering facilities.
d. Remove invasives and plant perennial vegetation in riparian area. Recommend using native vegetation, or if using non-native vegetation, avoid using invasives (Guard, 1995; Pojar and MacKinnon, 1994).	Helps establish perennial riparian vegetation rapidly; promotes streambank integrity; may help narrow channel and reduce erosion in channel.	May lessen streambank erosion and loss of pastures. If livestock are excluded from riparian area, area may be eligible for federal cost-share programs. Some alternative perennial agricultural products may be harvested from riparian areas. Practice may be eligible for cost-sharing programs.	Costs of vegetation and weed control. May require financial investment for riparian fencing and off-stream watering facilities while vegetation establishes.

Table 8. Nutrient and Manure Management

Practice	Resource Concerns Addressed	Benefits to Producer	Costs to Producer
a. Apply nutrients according to soil test results (Hart, Pirelli, and Cannon, 1995; Marx, Hart, and Stevens, 1999; NRCS, 1997i; Waskom, 1994).	Helps prevent nutrient runoff into waters of the state and leaching into groundwater.	May help reduce fertilizer costs; ensures that plants receive needed nutrients for growth; makes plants more competitive against weeds. Practice may be eligible for cost-sharing programs.	Costs of soil testing; time associated with taking soil samples.
b. Store manure under a tarp or roof; preferably on an impervious surface such as concrete or plastic and away from seasonally flooded areas (Gamroth and Moore, 1996; Godwin and Moore, 1997; Moore and Wilrich, 1993).	Helps prevent nutrient and bacteria runoff into waters of the state and leaching into groundwater.	Prevents nutrient leaching so manure applied on crops or pasture has higher nutrient content; may save some fertilizer costs; producers may be eligible for cost-sharing programs.	Cost of constructing manure storage facilities.
c. Establish animal heavy-use areas where animals are confined during the winter to protect other pastures from trampling and compaction. Limit livestock access to pastures when soils are saturated; cover heavy-use areas with rock, hogged fuel, and/or geotextile. Clean manure regularly from heavy-use area (NRCS, 1997d).	Helps prevent sediment, nutrient and bacteria runoff into waters of the state and leaching into groundwater. Helps protect streamside areas.	Protects pastures from compaction during the winter, improving growth. May improve animal health by covering heavy-use areas with material so animals are not wading in mud. Practice may be eligible for cost-sharing programs.	Cost of fencing heavy-use area; cost of feeding hay during the winter; cost of materials for protecting heavy-use area.
d. Site barns and heavy-use areas away from streams and seasonally flooded areas (Godwin and Moore, 1997).	Helps prevent sediment, nutrient, and bacteria runoff into waters of the state. Helps protect streamside areas.	Helps prevent flooding in barns and heavy-use areas. Practice may be eligible for cost-sharing programs.	Need either off-stream watering facility or other source of water for livestock.
e. Prevent silage leaching and/or store and manage leachate from silage and other vegetative materials (Bruneau, Hodges, and Lucas, 1995; Feise, Adams, and LaSpina, 1993).	Helps prevent nutrient runoff into waters of the state and leaching into groundwater.	Preventing leaching maintains higher nutrient content of ensiled feed material. Practice may be eligible for cost-sharing programs.	May require cost of facility development and purchase of moisture-absorbing materials.
f. Installing gutters and downspouts in areas with high livestock use. Connect downspout water to drainage system or, if possible, route clean downspout to a location where it can soak into the ground (NRCS, 1997f).	Helps prevent sediment, nutrient and bacteria runoff into waters of the state. Helps protect streamside areas.	May improve animal health by lessening mud during the winter, so animals are not wading in mud. Practice may be eligible for cost-sharing programs.	Cost of installation and maintenance of gutters and downspouts.

Practice	Resource Concerns Addressed	Benefits to Producer	Costs to Producer
g. Cover heavily used animal walkways with sand, rock, and/or geotextile (NRCS, 1997c).	Helps prevent sediment, nutrient and bacteria runoff into waters of the state. Helps protect streamside areas.	Can improve animal health because animals are not wading in mud. Can help prevent animal health problems such as scratches, hoof or foot rot, and worms. Practice may be eligible for cost-sharing programs.	Cost of sand, rock or other materials. Owners should be aware that feeding equine species on sand may result in sand colic.

Table 9. Erosion and Sediment Control

Practice	Resource Concerns Addressed	Benefits to Producer	Costs to Producer
a. Grazing management: graze pasture plants to appropriate heights, rotate animals between several pastures; provide access to water in each pasture (Ko, 1999; Lundin, 1996; Hirschi, 1997).	Helps prevent sediment, nutrient, and bacteria runoff into waters of the state. Helps protect streamside areas.	May improve pasture production; easy access to water may increase livestock production as well. May improve composition of pasture plants and help prevent weed problems. Practice may be eligible for cost-sharing programs.	Cost of installing fencing, watering facilities for rotational grazing system; time involved in moving animals through pastures.
b. Farm road construction: construct fords appropriately, install water bars or rolling dips to divert runoff to roadside ditches (Blinn, 1998;).	Helps prevent sediment runoff to waters of the state.	May help prevent water damage on farm roads. Practice may be eligible for cost-sharing programs.	Cost of installation and maintenance.
c. Plant appropriate vegetation along drainage ditches; seed ditches following construction (NRCS, 1997a).	Helps prevent sediment runoff into waters of the state.	May help prevent ditch bank erosion and slumping. Practice may be eligible for cost-sharing programs.	Costs of establishing vegetation.
d. Plant cover crops on erosion-sensitive areas (NRCS, 1997b; Hirschi, 1997).	Helps prevent sediment runoff into waters of the state; filters nutrients and slows runoff.	May reduce weed problems; prevents loss of applied nutrients. Practice may be eligible for cost-sharing programs.	Costs of establishing cover crops; cover crops may compromise primary crop.
e. Irrigate pasture or crops according to soil moisture and plant water needs (Hansen and Trimmer, 1997; Trimmer and Hansen, 1994).	Helps prevent irrigation return flow and associated nutrients and sediment to waters of the state.	May reduce costs of irrigation; may help crop or pasture production. Practice may be eligible for cost-sharing programs. May reduce the amount of fertilizer needed.	Installation/ maintenance cost. Monitoring time.
f. Install/maintain diversions or French drains to prevent unwanted drainage into barnyards and heavy-use areas (NRCS, 1997e).	Helps prevent nutrient runoff into waters of the state.	Decreases mudiness and shortens saturation period in protected areas. Practice may be eligible for cost-sharing programs.	Cost of installation.
g. In areas where gullies repeatedly appear, install underground outlet or grassed waterway to capture and convey water (NRCS, 1997j and 1997k; Hirschi, 1997).	Prevents gully erosion and sediment runoff to waters of the state.	Prevents loss of soil and fertilizers, lessens inconvenience of driving equipment over gullies. Practice may be eligible for cost-sharing programs.	For underground outlet, costs of installing inlets and plastic pipe; for grassed waterways, costs of installation, seeding, weed control, and any land put out of production.
f. Install and manage field borders/filter strips along field boundaries (NRCS, 2001)	Controls sediment and nutrient movement to waters of the state. Erosion control during high water events.	Prevents loss of soil and fertilizers. Practice may be eligible for cost-sharing programs.	Cost of installation. Cost of management.

Table 10. Pest Management

Practice	Resource Concerns Addressed	Benefits to Producer	Costs to Producer
a. Apply pesticides and herbicides according to the label. Use the correct rate and timing. Comply with label restrictions and precautions.	Reduces risk of pesticide runoff to streams or other water resources.	Compliance with federal and Oregon law; reduces health risks to applicator, may decrease costs.	N/A
b. Triple rinse pesticide application equipment; apply rinsates to sites; dispose of or recycle clean containers according to Oregon law	Reduces risk of pesticide runoff to streams.	Dilutes pesticide residues; correct disposal of rinsate ensures compliance with federal and Oregon law; eliminates disposal costs of collected rinsates identified as hazardous waste.	Triple rinsing creates more volume that must be disposed of.
c. Calibrate, maintain, and correctly operate application equipment.	Reduces risk of pesticide runoff to streams.	May reduce use and therefore cost of pesticides; reduces health risks to applicator. If not calibrated correctly, a second application may be necessary, increasing use and cost.	Time used to calibrate equipment.
d. Integrated pest management practices such as pheromone traps, beneficial insect release, and field monitoring. (either in combination with pesticide use or as a replacement to pesticide use)	Reduces risk of pesticide runoff to streams, may reduce loss of non-target species.	May improve effectiveness of pest control system. Practice may be eligible for cost-sharing programs.	Time involved to scout fields is usually offset by reduced or more effective pesticide use.
e. Store and mix pesticides on leak-proof facilities.	Reduces risk of pesticide runoff to streams.	Helps protect drinking water; reduces health risks to applicator.	Cost of installation and maintenance.
f. Store petroleum products such as fuel and oil in leak proof containers and facilities; clean up spills of petroleum products properly.	Reduces risk of runoff of petroleum products to streams or soil contamination.	Helps protect drinking water, reduces health risks to landowner or operator.	

Hirschi, 1994 and 1997

Table 11. Nutrient and Irrigation Efficiencies

Practice	Resource Concerns Addressed	Benefits to Producer	Costs to Producer
a. Apply fertilizer at the correct rate and time applications for crop uptake.	Reduces the risk of excess nitrogen in the soil at the end of the growth season.	Precise application saves the producer money in fertilizer costs.	Time related to precision application.
b. Sample soil prior to fertilizer application to know existing nutrients.	Prevents the application of excess nutrients.	Precise application can save the producer money in fertilizer costs.	Cost of soil sampling and analysis.
c. Plant winter cover crops to take up excess nitrogen left over after crops are harvested.	Takes up extra nitrogen and limits potential for leaching into ground water.	Stores extra nitrogen in plant matter for later release when cover crop is incorporated into the soil.	Cost of seed and fuel to plant cover crop. Note: this can be offset by a reduction in fertilizer.
d. Properly maintain irrigation systems to prevent over-irrigation.	Prevents leaching of excess nitrogen past the root zone.	Uniform irrigation application and save producer money on nitrogen costs. Reduce plant mortality due to overwatering.	Replacement nozzles at least every four years is recommended.
e. Monitor soil water content and adjust irrigation schedules to maintain soil water content in an appropriate range in the root zone.	Prevents over-irrigation and leaching of excess nitrogen past the root zone.	Allows accurate irrigation application and keeps nutrients available to crops. Protects drinking water.	Soil monitoring equipment and time to evaluate soil water content.
f. Schedule irrigation applications based on expected evapotranspiration rates.	Prevents over-irrigation and leaching of excess nitrogen past the root zone.	Allows accurate irrigation application and keeps nutrients available to crops. Reduce plant mortality due to overwatering.	Time to evaluate expected evapotranspiration rates.

Selker et al, 2004

Chapter 3: Strategic Initiatives

Mission

The mission of the Area Plan is to ensure that water quality goals are met while promoting the flexibility and economic viability of agriculture. The Area Plan is designed to achieve applicable chemical, physical, and biological water quality standards.

Goal

Prevent and control water pollution from agricultural activities and soil erosion, and to achieve applicable water quality standards.

Achieving the following land conditions on agricultural lands throughout the management area contribute to good water quality and serve to meet the goal:

- Streamside vegetation along streams on agricultural properties provides streambank stability, filtration of overland flow, and moderation of solar heating
- No visible sediment loss from cropland through precipitation or irrigation induced erosion.
- No significant bare areas due to livestock overgrazing within 50 feet of streams on pasturelands and/or rangelands.
- Active gullies have healed or do not exist on pasturelands.
- Livestock manure is stored under cover and in a location that minimizes risk to surface and groundwater.
- Livestock manure applied annually at agronomic rates.

3.1 Measurable Objectives

3.1.1 Management Area

ODA is working with SWCDs and LACs throughout Oregon towards establishing long-term Measurable Objectives to achieve desired conditions. At the current time, ODA and the SWCDs are using Focus Area milestones to serve as a stepping stone to show progress.

3.1.2 Focus Area(s)

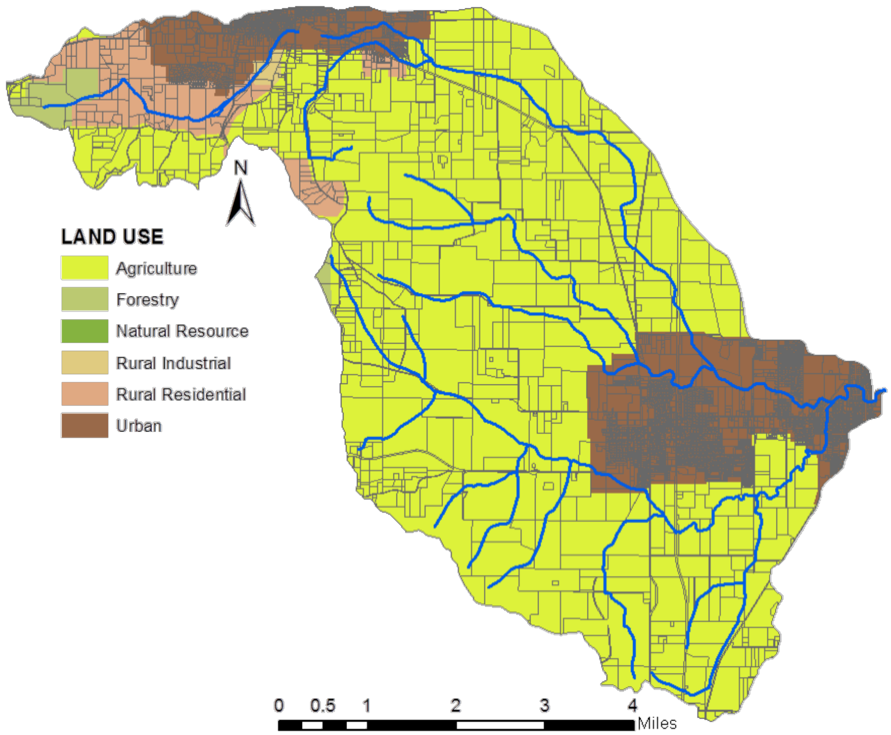
Two Focus Areas have been selected within the Middle Willamette Management Area. Work in Polk SWCD's Ash Creek Focus Area was completed. Benton SWCD continues work in the Jackson-Frazier Focus Area. The Focus Areas are described below with results and analyses provided in Chapter 4.

3.1.2.1 Ash Creek Focus Area

- Ash Creek is a perennial stream system that is a tributary to the Willamette River. The Ash Creek watershed encompasses the municipalities of Monmouth, Independence, and the southern portion of Dallas (Figure 5). The SWCD chose Ash Creek as their Focus Area in 2012 because the watershed is predominantly in an agricultural land use and the Ash Creek Water Control District has a long history of working with landowners in the watershed to address flooding. This has been accomplished in the past by removing vegetation and channelizing the stream. Although this reduces the imminent damage from floods, it has inherent effects on overall stream function, in particular temperature and sedimentation. The primary concern to address in the Ash Creek Focus Area is stream temperature, with sediment, bacteria, nutrients and pesticides identified as secondary concerns. The SWCD plans to implement strategies and actions that include landowner engagement, project planning, implementation and maintenance and networking with partners.

Ash Creek Focus Area Milestone: By June 30, 2017, increase streamside trees and shrubs by 25-acres.

Figure 5. Ash Creek Focus Area

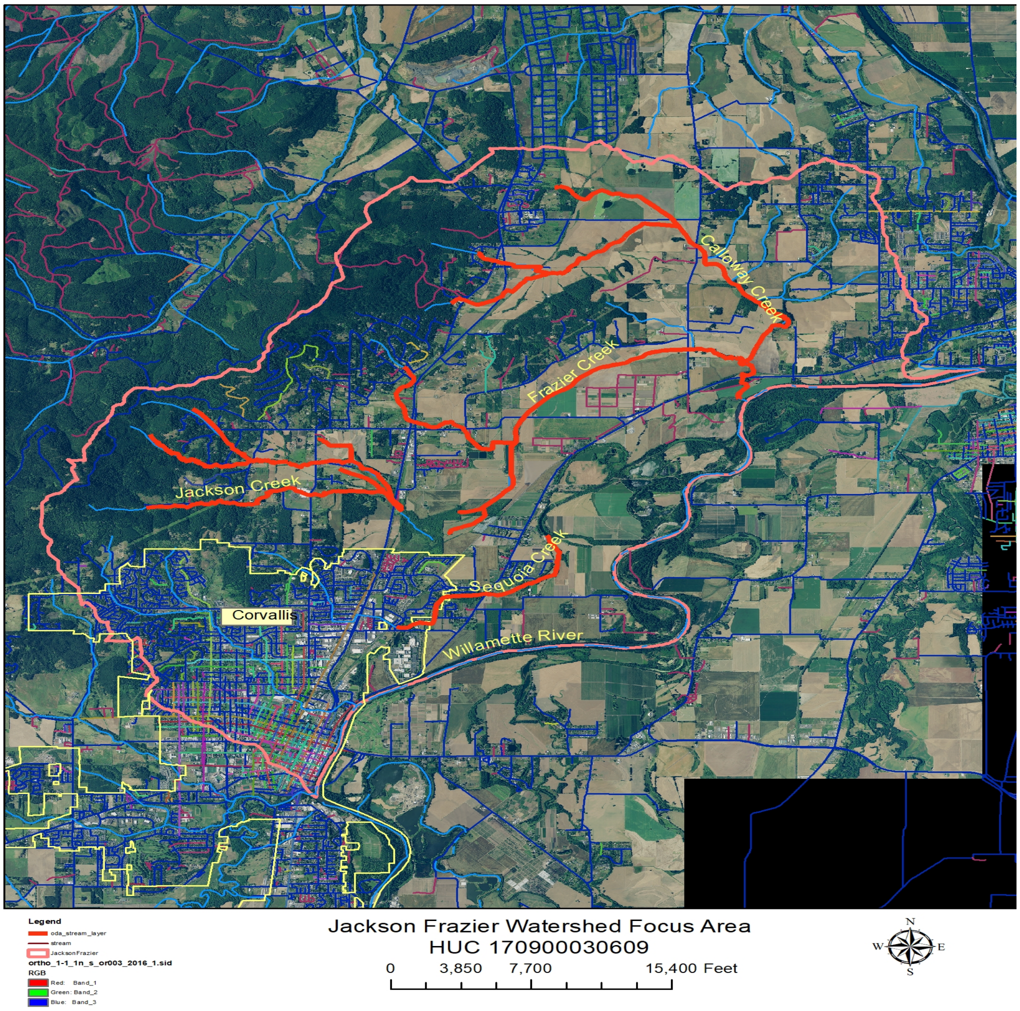


3.1.2.2 Jackson-Frazier Focus Area

The Jackson-Frazier Focus Area encompasses a complex network of streams and wetlands to the north of the Corvallis city limits. By using this watershed as their Focus Area, the SWCD has a unique opportunity to educate and work with the rural residential and agricultural producers to improve and protect the integrity of the upper reaches of a rural watershed as it becomes developed in the next forty years. The watershed is limited due to temperature and also nitrites in groundwater. A number of partnerships exists for the SWCD to draw from and collaborate. A portion of the Focus Area is also within the southern Willamette Valley (SWV) GWMA and the SWCD, along with other partners, assessed barriers to best management practices implementation and has conducted workshops to educate the public about SWV GWMA issues. The SWCD plans to implement strategies and actions that include landowner engagement, project planning, implementation and maintenance and networking with partners.

Focus Area Milestones:
By June 30, 2017, reduce undesirable conditions (bare ag + grass ag) by 10-acres.
By June 30, 2019, reduce undesirable vegetation (bare ag + grass ag) by 10-acres.

Figure 6. Jackson-Frazier Focus Area



3.1.3 GWMA Action Plan

In December 2006, after significant debate and research, the GWMA stakeholder committee Action Plan for the GWMA was finalized and accepted. This Action Plan is not a regulatory document but includes many recommendations and voluntary strategies to address the issue of excess nitrate in regional groundwater. The Action Plan provides recommendations and strategies to reduce nitrate inputs from four focus sectors: (1) agricultural, (2) residential, (3) commercial / industrial / municipal, and (4) public water supplies. The GWMA Action Plan Addendum can be found at: http://wellwater.oregonstate.edu/sites/wellwater.oregonstate.edu/files/actionplanaddendum_draft.pdf. Strategies and actions that Benton SWCD may contribute towards achieving GWMA actions are included on Table 12 below and results for the biennium are provided in 4.2.

Based on well results ODA consulted with individual landowners up gradient of Well # GW-20 to explore modifying practices to help reduce nitrate results in that vicinity. Over time, monitoring will be reviewed and shared with the landowners to see whether various practices are helping to improve water quality.

3.2 Strategies and Activities

SWCDs implement a number of strategies and activities each biennium that are intended to help reach the water quality goals of the Area Plan. Table 12 provides an indication of the strategies and types of actions that SWCDs undertake to help achieve water quality goals. A summary of accomplishments and a discussion of strategy effectiveness is provided in Chapter 4.

Table 12. SWCD Strategies and Actions

Strategy	Activity
Community & Landowner Engagement	Outreach to individual farmers
	Community and landowner engagement events and activities
	Publish handouts (fact sheets, brochures, guides, handbooks, etc.)
	Water quality monitoring reports
	SWCD newsletters
	Newspaper articles (sediment sources, water quality)
	Website development and launch
	Multi-stakeholder meetings and technical work groups
Land Stewardship and Water Quality Projects	Technical assistance provided to individual landowners
	Water quality projects developed
	Water quality projects implemented
	Site visits to follow up and conduct maintenance work
	Invasive species control projects
Monitoring	Water quality field work (installation, sampling, etc.)
	Effectiveness monitoring of restoration sites
	Conducted ODA Temperature monitoring
	Focus Area streamside vegetation assessments
	Provide summary of water quality monitoring, focus area and compliance results for LAC
Funding and Grants	Grant applications submitted
	Grant applications awarded
	Cost-share enrollment assistance & information provided (CREP, EQUIP, etc.)

3.3 Monitoring and Evaluation

Water quality in the Management Area currently is monitored by EPA, DEQ, ODA, ODFW, Luckiamute Watershed Council and Mary's River Watershed Council. These groups primarily measure surface water temperature, pH, dissolved oxygen, total suspended solids, total phosphorus, and bacteria and some also monitor aquatic habitat, physical stream habitat and air temperature and ground water monitoring wells.

<u>3.3.1 DEQ Surface Water Quality Monitoring</u>

DEQ Nonpoint Source Program staff and basin coordinators provide data and analyses to ODA in status and trends reports during the biennial review process for area plans. These reports are designed to help ODA and agricultural land managers identify and implement strategies and actions that will protect water quality in their local agricultural management areas.

DEQ retrieved data from DEQ, EPA, and USGS databases for January 1, 2000 to January 1, 2017 for the Management Area. Parameters included temperature, pH, dissolved oxygen, total suspended solids, total

phosphorus and bacteria. Monitoring stations which had at least two years of recent data and/or at least eight years of data fit the criteria to assess status and trends (see flow chart in full report). Key conclusions are provided in Chapter 4 and the full report can be found at http://www.oregon.gov/deq/wq/programs/Pages/wqstatustrends.aspx.
The report will be updated for future biennial reviews.

3.3.2 SWV GWMA Monitoring

DEQ currently collects quarterly samples from 12 groundwater monitoring wells installed in the southern Willamette Valley (SWV), in addition to annual well sampling at 27 locations and six surface water locations. Some locations are also sampled for chloride and phosphorous. This program includes monitoring 23 shallow monitoring wells, 16 domestic wells, and six surfacewater sites. The domestic wells are generally installed deeper than the monitoring wells. EPA continues to provide stable isotopic analyses on surface and groundwater samples collected by DEQ's laboratory. Data from nitrogen isotope ratios will assist in identifying nitrate contamination sources and help to focus efforts at reducing nitrate levels in the SWV GWMA. For monitoring and evaluation results, see Chapter 4.

Chapter 4: Implementation, Monitoring, and Adaptive Management

4.1 Progress Toward Measurable Objectives

4.1.1 Management Area

ODA is working with SWCDs and LACs throughout Oregon towards establishing long-term Measurable Objectives to achieve desired conditions. At the current time, ODA and the SWCDs are using Focus Area milestones to serve as a stepping stone to show progress.

4.1.2 Focus Areas

4.1.2.1 Jackson-Frazier Focus Area

Over the biennium, Benton SWCD has:

- Conducted five workshops with 351 participants
- Sequoia Creek Tour, attended by 65 people
- Worked with several landowners on water quality projects (riparian, soil erosion, streambank erosion, wetland restoration)
- Four acres of riparian restoration along Frazier Creek including a grass waterway
- Partnered with Benton County Parks to update the management & restoration plan for Jackson-Frazier County Park
- NRCS is working with landowners in the SWV GWMA to implement Nutrient and Irrigation Management on 430 acres
- Other work includes Oak Savanna restoration on 30 acres

The SWCD increased trees (+3.7 acres) and shrubs (+0.1 acre) replacing streamside areas that were previously in a grass crop. Additional watershed improvements were made outside the streamside areas. These include a 30-acre oak savanna, nutrient management and irrigation water management on 430 acres.

Achieving greater success with regard to increased streamside vegetation has been impeded by:

- A lack of incentives to take high-value farmland out of production in order to expand streamside vegetation buffers.
- A lack of interest to learn about water quality issues and solutions. The SWCD hosted several workshops but few farmers attended.

The SWCD has decided to continue work in the Focus Area in order to capitalize on momentum with partners to do work in the Jackson-Frazier wetland and the potential to build relationships through doing upland or other work that farmers need that is also beneficial for watershed health. This wetland is surrounded by farmland and a suburb and may serve to inspire others to participate. Benton SWCD is adding the Sequoia Creek, already within the Focus Area, as a new potential source of farmland projects.

4.1.2.2 Ash Creek Focus Area

Polk SWCD closed the Ash Creek Focus Area at the end of the 2015-2017 biennium. Over the biennium, the District conducted outreach, submitted monitoring and grant applications, planted trees and shrubs, and carried out irrigation, weed control, and mulching on 0.06 acres. The District had set a milestone of increasing the tree and shrub vegetation by 25 acres. Lessons learned from the experience indicate:

- The Focus Area size was too large with many landowners. This inhibited the SWCD's ability to work directly with individual landowners.
- Some landowners were not motivated to plant native riparian vegetation.
- Some landowners were initially interested but were not financially capable of providing a match. Attempts to secure OWEB Small Grants were unsuccessful resulting in confirming the landowners' general distrust of government processes, fearing loss of privacy and time.
- Many landowners requested technical assistance from the SWCD but for projects that were not related to improving streamside vegetation.
- Landowners have observed that streamside vegetation seems to slow water flow that results in flooding.
- Landowners were more receptive to Ash Creek Water Control District projects and funding as this allows greater flexibility and discretion; however, the water control district is more interested in working in urban areas.

4.2 SWV GWMA

While nitrate contamination trends appear to be decreasing at some monitoring locations, there are some areas in the GWMA where nitrate levels continue to increase and other areas where no change in nitrate concentration is evident. In the spring of 2009, DEQ completed a Synoptic Sampling Event where approximately 100 domestic wells in the GWMA were tested at the same time as the long-term monitoring wells. The mean nitrate concentration for the event was 5.5 mg/L, while the highest level of nitrate was close to 35 mg/L; the threshold for drinking water is 10mg/L, as measured by nitrogen (NO_3-N).

In early 2010, an evaluation of the accomplishments in regards to the Action Plan was completed. This evaluation included reporting of agricultural accomplishments by the ODA's Water Quality and CAFO programs, the NRCS, and the Linn, Benton, and Upper Willamette SWCDs. This evaluation found that 65 percent of the agricultural measures of implementation had been completed. Based on the Action Plan evaluation, it was determined that an update to the Action Plan was needed.

On October 26, 2011, an agriculture workgroup met to review and update the agricultural section of the GWMA Action Plan. The agriculture workgroup consisted of ODA staff, SWCD staff, NRCS staff, and seven local agricultural producers. The purpose of the agriculture workgroup meeting was to review updates to the Action Plan and review research needs. The workgroup asked that information on precision agricultural practices that producers are implementing be included in the Action Plan. The goals of the Action Plan were updated to be consistent with the statutes related to the ODA's Agricultural Water Quality Program and statutes related to the GWMA. Research needs that were identified include: additional research to understand what is happening below the root zone of crop plants and the effects of various recommended management practices on leaching of nutrients from the soil. The GWMA Action Plan addendum should be finalized in early 2018.

A new lysimeter project started in late 2013 and has grown to include 15 actively managed agricultural fields; many of them were part of the 1990-era study conducted by OSU to examine the influence of current crops and nutrient management on nitrate leaching below the rooting zone. The current study represents current crops in the areas and includes five grass fields, three vegetable fields, two peppermint and wheat fields, and one each of hazelnuts, blueberries, and one control field. New nutrient management practices include slow release fertilizers and precision agriculture approaches in some of the fields. This work will examine the nitrogen balances and rate of N leaching at the field level from the 1990's to the present. Data from this study will be incorporated into the USDA-Agricultural Policy Environmental Extender (APEX) model. Data from the 1990's study has already been used to calibrate the APEX model to the Willamette Valley. Data from the current study is being used to validate APEX with final goals of the project to provide information and tools that will help farmers, managers, and conservation groups quantify the water quality benefits of management practices they are conducting or funding.

4.2.1 Activities and Accomplishments

Table 13 provides a summary of SWCD activities and accomplishment to conduct community and landowner engagement, implement projects, monitor and secure funding. SWV GWMA actions are included on this table. For activities and accomplishments for the Focus Areas, see 4.1.2.

Table 13. SWCD Strategy and Action Targets

Community & Landowner Engagement	Events & Activities: 74 # People participating in community & landowner engagement: 1,153 participants Native plant sales: Two native plant sales and one native bulb sale with 677 attendees Handouts published: 29 with 2,415 distributed Newsletters distributed: 4 with over 1,500 distributed Multi-stakeholder meetings & technical workgroups: 100+ Includes 2 SWV GWMA Nutrient Management Workshop & Technical Team meetings
Land Stewardship & Water Quality Projects	Technical assistance provided: 599 Onsite evaluations: 266 Note that when these occur in the SWV GWMA information is provided Voluntary conservation plans developed: 16 conservation plans Acres in voluntary conservation plans: 365-acres Water quality projects implemented: 21 Riparian forest buffers: 12 (14.5-acres + 0.1-acre wetland) Irrigation efficiency & nutrient management: 442-acres Invasive species control: 13-acres Assist with ODA compliance site visits: 4 site visits
Monitoring	Assist with SWV GWMA nitrate leaching field tests Streamside vegetation assessment in focus areas
Funding	Ash Creek Water Control District: $2,251 ODA Fertilizer grant within the SWV GWMA: $14,163 OWEB small grants: $28,736 + $9,114 + $7,492 + $10,000 + $10,000 OWEB Technical Assistance: $13,859 OWEB restoration grants: $322,239 OWEB SIP: $103,214 Benton SWCD CIP: $3,000 BLM Drinking Water Partnership Providers: $100,000 Spirit Mountain Community Fund: $35,000 BPA & OR Weed Board: $94,518

4.2.2 Projects Over Time

The Oregon Watershed Restoration Inventory database (OWRI) contains information about completed restoration projects that were implemented in Oregon beginning in 1995. The complete dataset consists of point, line, and polygon features. Data for projects not funded by the Oregon Watershed Enhancement Board (OWEB) are acquired through a voluntary "Annual Call for Data"; while reporting is required for projects funded by OWEB and Oregon Department of Fish and Wildlife R & E grant programs. Restoration practitioners submit a standardized reporting form and attach project location maps. Once acquired, data sheets and maps are each assigned a unique project identification number. This number links spatial project data with tabular project data that are stored in a relational database using Microsoft SQL software. Information about the OWRI and access to the database can be found at http://www.oregon.gov/oweb/monitor/pages/owri.aspx. Figure 7 illustrates riparian and upland projects done on agricultural lands between 1995 to 2017.

Figure 7. Riparian and Upland OWEB Projects

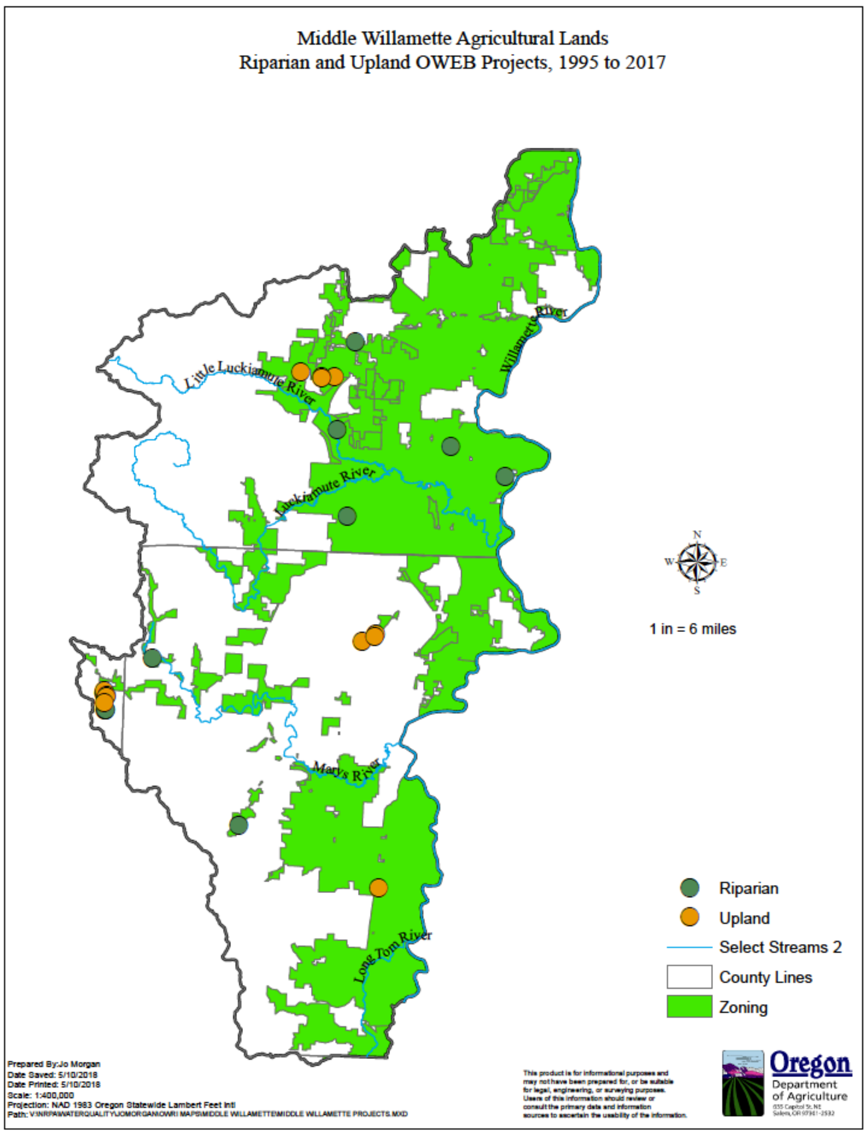
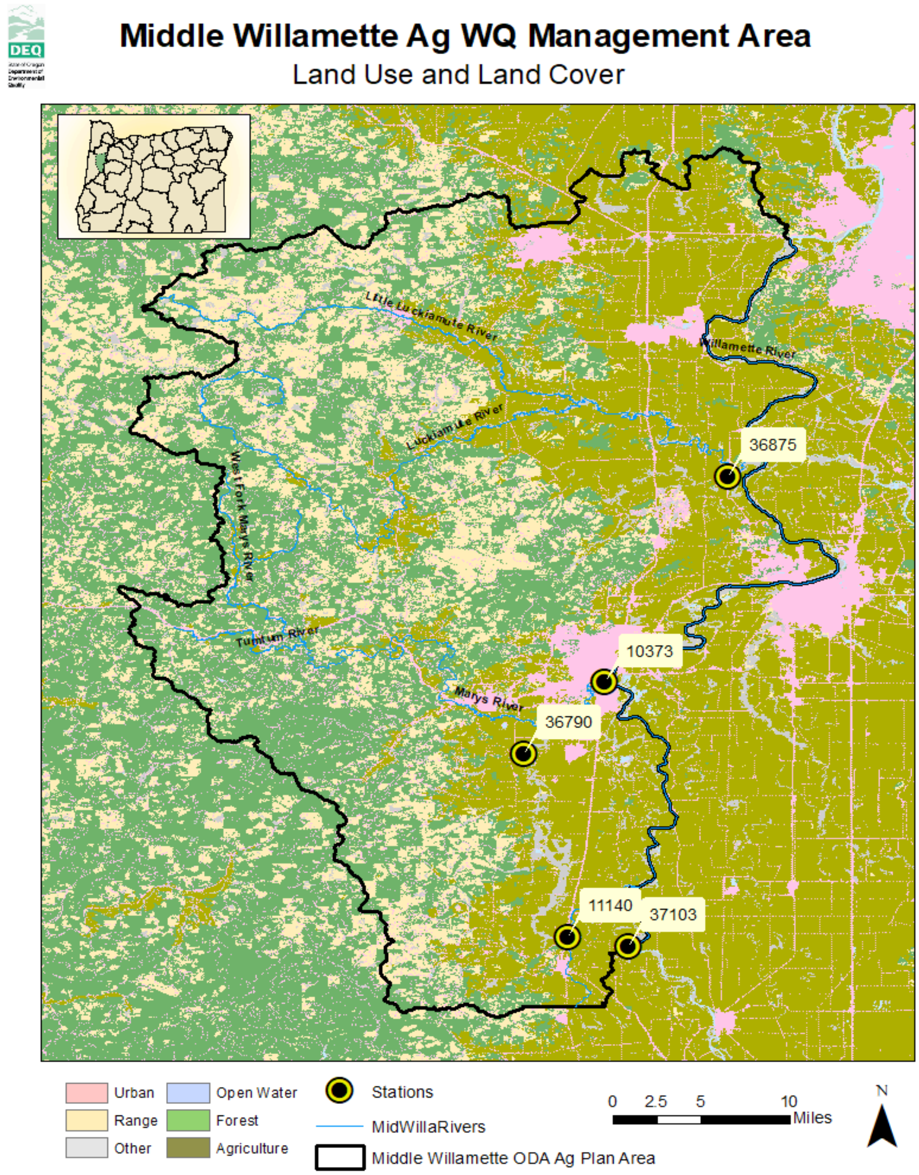


Figure 8. Middle Willamette Ag WQ Management Area Monitoring Stations and Land Use



4.3 Monitoring—Status and Trends

4.3.1 DEQ Water Quality

For this biennial review, DEQ reviewed data from 131 monitoring sites, of which five had sufficient data for status and trends analysis *(DEQ. Middle Willamette AgWQ Management Area: DEQ's Water Quality Status and Trends Analysis for the Oregon Department of Agriculture's Biennial Review of the Agricultural Area Rules and Plans. 45 pp. 2018)* at http://www.oregon.gov/deq/wq/programs/Pages/wqstatustrends.aspx

Table 14. Middle Willamette Stations Reviewed for Status and Trends

Site ID	Site Description	Temperature	pH	Dissolved Oxygen	*E. coli**
36790	Muddy Creek S of Corvallis Airport	--	Meets	Exceeds	0/35
11140	Long Tom River at Stow Pit Rd (Monroe)	--	Meets	Exceeds	7/109
36875	Luckiamute River at Buena Vista Road	--	Meets	Exceeds	0/37
10373	Mary's River at 99W (Corvallis)	--	Meets	Exceeds	2/105
37103	Willamette River at Goracke Road	--	Meets	Exceeds	

*# exceeding standard/N[1]
Note: There are no standards to compare data against for Total Suspended Solids and phosphorus.

Although all five stations fit the decision criteria, there are not enough monitoring stations with sufficient data to assess status and/or trends within the Middle Willamette AgWQ Management Area (Figure 8 and Table 13).

No monitoring stations have sufficient data to calculate the seven-day average daily maximum for temperature and assess against the applicable water quality standards. Additional continuous temperature, dissolved oxygen, and pH data would be useful in the AgWQ Management Area to better understand in-stream diurnal fluctuations. Additional data is needed to evaluate the surrogate site potential vegetation on the agricultural land, which would require remote sensing data to determine tree heights and calculate effective shade against the proposed continuous water quality data and focused restoration areas.

Conclusions

What are the overall trends?

E. coli: Four monitoring stations within the Middle Willamette AgWQ Management Area have sufficient data to fit the criteria to assess water quality status and/or trends of *E. coli*, relative to the Oregon water quality standard. The fifth station, 37103 does not collect samples for *E coli*. Two monitoring stations (11140 and 10373) have sufficient data to determine trends, though both sites do not have significant trends. Stations 36875 and 36790 do not have exceedances of the water quality standard within the last two years. Station 11140 had seven single exceedances out of 109 observations and station 10373 had 2 single exceedances out of 105 observations. Station 11140 is located within a predominantly agricultural area and more information would be helpful to understand whether farming practices could be changed to address an apparent increasing trend based on the geometric mean. Five samples within 90-days may be too general to help identify whether a problem exists or not.

Temperature: Although monitoring stations met the decision criteria, no monitoring stations have sufficient data to calculate the 7DADM and assess water quality status and trends of temperature.

pH: Five monitoring stations have sufficient data to fit the criteria to assess water quality status and/or trends of pH, relative to the applicable Oregon water quality standard. Two monitoring stations have sufficient data to assess trends (11140 and 10373). Station 11140 has a significant positive trend, while station 10373 does not have a significant trend. All monitoring stations meet the water quality standard within the last two years.

Dissolved Oxygen: Five monitoring stations have sufficient data to fit the criteria to assess water quality status and/or trends of dissolved oxygen, relative to the applicable Oregon water quality standard. Two monitoring stations have sufficient data to assess trends (11140 and 10373). Station 10373 has a significant improving trend, while station 11140 does not have a significant improving trend. All monitoring stations have at least one exceedance of the water quality standard within the last two years. One exceedance does not provide enough information or context to know whether this is something that actions on the part of growers would result in addressing the exceedances.

Total Phosphorus: Five monitoring stations within the Middle Willamette AgWQ Management Area have sufficient data to assess water quality status, though there is no total phosphorus water quality standard nor TMDL load allocation to compare the data. Stations 11140 and 10373 have sufficient data to assess trends in data, though neither are significant.

Total Suspended Solids: Four monitoring stations within the Middle Willamette AgWQ Management Area have sufficient data to assess water quality status; though there is no total suspended solids water quality standard nor TMDL load allocation Quality to compare the data. The fifth station, 37103 does not collect samples for TSS. Stations 11140 and 10373 have sufficient data to assess trends in data, station 11140 has a significant positive (degrading) trend, and station 10373 does not have a significant trend.

4.3.2 Land Conditions

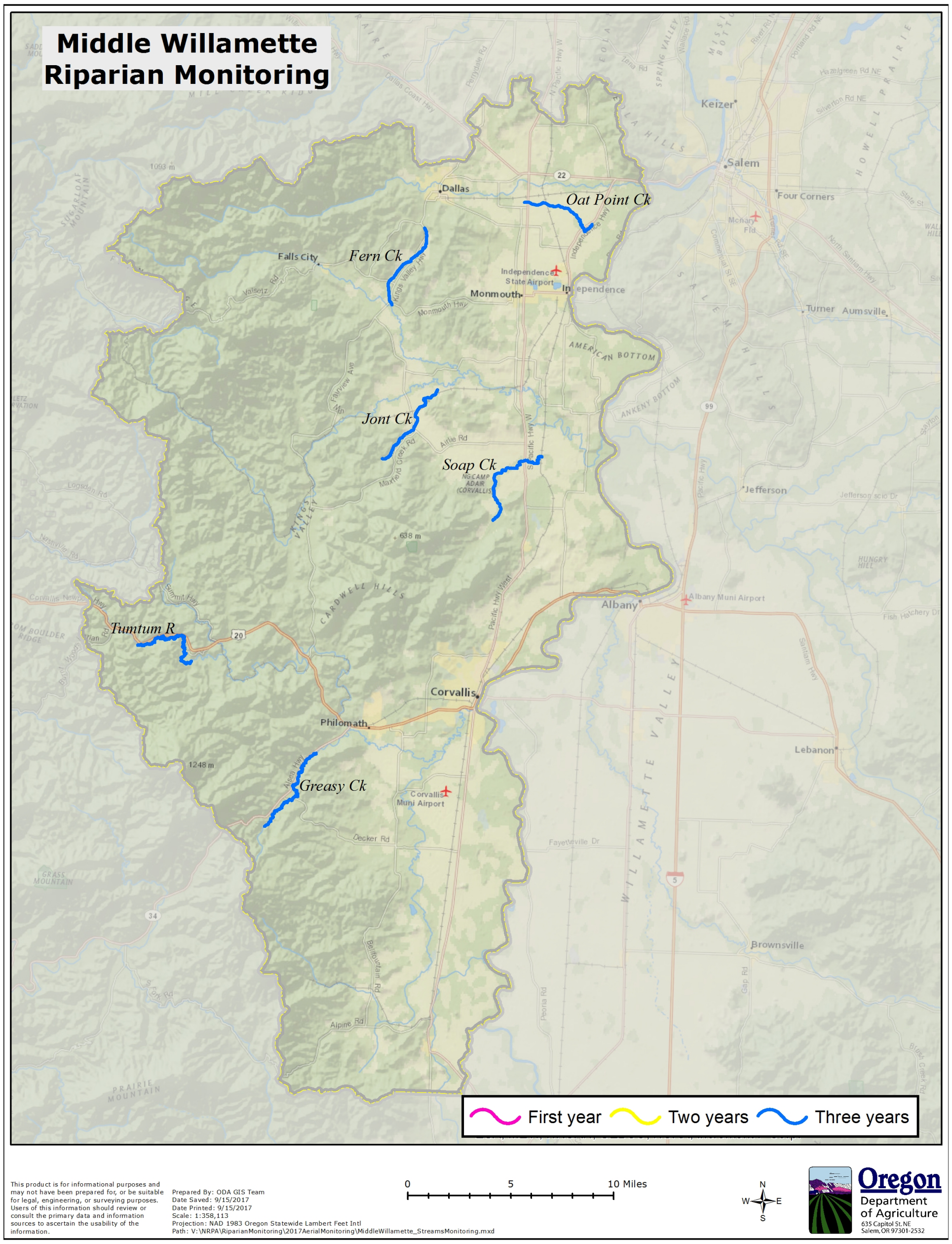
The ODA Aerial Photo monitoring assessed six streams in the Middle Willamette Basin in 2007, 2012, and 2017. The highest riparian index score was calculated for Greasy Creek with 62.41, while the lowest was for Oak Point Creek with a score of 40.21. Greasy Creek had tree cover ranging from 51 to 89 percent, while Oak Point had 19-38 percent trees. Soap Creek had the highest percentage of bare agricultural land with values ranging from 9-10 percent, though its riparian score was still respectable at 60.33.

The ODA Aerial Photo monitoring has been completed and a final study will be available in Spring 2018. These sites will not be monitored on a routine basis but could be revisited at some point in the future. (Table 14 and Figure 8.

Table 15: ODA Aerial Photo Monitoring Results

Stream	Measured Scores		
	2007	2012	2017
Fern Creek	46.81	45.32	44.71
Greasy Creek	62.41	60.30	60.17
Jont Creek	52.60	52.81	51.35
Oak Point Creek	40.21	40.24	41.77
Soap Creek	60.33	60.84	59.98
Tum Tum	60.13	59.05	59.14

Figure 9. Map of the ODA Aerial Monitoring Sites in the Middle Willamette



4.4 Biennial Reviews and Adaptive Management

1) Land condition and water quality monitoring:

DEQ's development of a status and trend analysis based on existing data was well done. This is a tremendous asset for the LAC and agency staff as we all try to evaluate what is working and what is not. It is disappointing that only five stations could be found in the entire basin where monitoring of some water quality parameters could be used to assess status and trends. The LAC agrees that there is not enough data to assess status and trends across the basin, especially since even these five stations do not provide coverage of status or trends for all water quality parameters of concern. The LAC would like to see some thought into what information would be needed to assess status and trends either for a sub-basin within our management area or the entire area that better characterizes potential agricultural impacts

Data are needed to evaluate the surrogate site capable vegetation on the agricultural land, which would require remote sensing data to determine tree heights and calculate effective shade against the proposed continuous water quality data and focused restoration areas. The LAC recommends monitoring at a scope and scale to provide:

- Increased source analyses,
- Reasonable assurance of meeting goals,
- Clear goals and priorities for nonpoint sources,
- Effectiveness monitoring,
- Inclusion of stream flow and precipitation data,
- Consider frequency, duration and magnitude of any water parameter exceedance,
- Assess what water quality is achievable.

2) ***Area Plan implementation progress and effectiveness:***

Which strategies have been most effective and why?

Both SWCDs indicate that partnering with other organizations has helped to build relationships, offer networking opportunities and provide funding for various water quality improvement projects. Work with the EPA has led to greater understanding of the effects of varous practices relative to the SWV GWMA.

Which strategies have not been effective? Are there cultural, economic or environmental factors that are limiting our effectiveness?

A persistent distrust of government programs seems to be prevalent among the farming community. These beliefs may be based in times when agencies have asked landowners to straighten streams and remove stream structure and are now asking them to do the opposite. In addition, government grants come with requirements that farmers believe restrict their ability to make future choices for their lands and come with bureaucratic hoops that can seem onerous.

The vision for the implementation of the Agricultural Water Quality Management Act was to provide rules to prevent harm, but that additional work would be done voluntarily with financial assistance as available. Growers are doing a good job complying with the rules and some landowners are willing to take on voluntary projects to do the proactive work of restoring their part of the watershed. There is more willingness to do the additional work, but we are hampered by a lack the financial ability to contribute a share of the project cost. Existing grant funds are limited and competition for these funds is intense. On agricultural working lands, it is difficult to convince a farmer to give up a significant amount of land that is in production, yet without the extra incentive, grant applications fall short of those on lands where the landowners are willing to do more to protect water quality.

What changes would make Area Plan implementation more effective?

Incentive payments (rental payment) through CREP and EQIP for taking riparian areas out of production are not enough for producers to consider stop farming these areas. It has been difficult to sell CREP in areas where a crop is grown. More information needed on vegetation required along seasonal ditches.

3) Compliance with water quality rules:

There were five compliance cases initiated over the biennium. Two of these were referred to other programs or agencies for processing (CAFO and Pesticides Program and Department of State Lands). Thirteen cases received Letters of Compliance, inclusive of those that were initiated during the prior biennium. All cases opened within the biennium have gained compliance and are closed.

The cases involved:

- Streamside ground cover vegetation setbacks along intermittent streams necessary to filter surface runoff,
- Upslope soil erosion due to bare fields going into the winter months.

The ODA has not conducted a Strategic Implementation Area (SIA) assessment in the Middle Willamette Management Area. An assessment in a small watershed could provide a better understanding of the level of compliance as well as document the effectiveness of ODA, the SWCD's and the LAC's efforts to provide outreach to expand understanding, acceptance and support for water quality rule compliance.

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Appendix A: Common Agricultural Water Quality Parameters of Concern

The following parameters are used by DEQ in establishing the 303(d) List and assessing and documenting waterbodies with TMDLs. Note: This is an abbreviated summary and does not contain all parameters or detailed descriptions of the parameters and associated standards. Specific information about these parameters and standards can be found at http://www.deq.state.or.us/wq/assessment/rpt2012/search.asp.

Parameters

Bacteria: *Escherichia coli (E. coli)* is measured in streams to determine the risk of infection and disease to people. Bacteria sources include humans (recreation or failing septic systems), wildlife, and agriculture. On agricultural lands, *E. coli* generally comes from livestock waste, which is deposited directly into waterways or carried to waterways by livestock via runoff and soil erosion. Runoff and soil erosion from agricultural lands can also carry bacteria from other sources.

Biological Criteria: To assess a stream's ecological health, the community of benthic macroinvertebrates is sampled and compared to a reference community (community of organisms expected to be present in a healthy stream). If there is a significant difference, the stream is listed as water quality limited. These organisms are important as the basis of the food chain and are very sensitive to changes in water quality. This designation does not always identify the specific limiting factor (e.g., sediment, nutrients, or temperature).

Dissolved Oxygen: Dissolved oxygen criteria apply to specific designated uses (such as fish spawning), and are applied in the time periods when the designated use is present and in the segment that is designated for that use. The dissolved oxygen spawning criteria are applied in the waters and in the time periods when salmon, steelhead, bull trout, or resident trout spawning uses are present. The dissolved oxygen criteria applicable to other designated fish uses are applied year-round.
During non-spawning periods, the dissolved oxygen criteria depends on a stream's designation as providing for cold, cool, or warm water aquatic life, each defined in OAR 340 Division 41.

Harmful Algal Blooms (HABs): Some species of algae, such as cyanobacteria or blue-green algae, can produce toxins or poisons that can cause serious illness or death in pets, livestock, wildlife, and humans. As a result, they are classified as Harmful Algal Blooms (HABs). Several beneficial uses are affected by HABs: aesthetics, livestock watering, fishing, water contact recreation, and drinking water supply. The Public Health Department of the Oregon Health Authority is the agency responsible for posting warnings and educating the public about HABs. Under this program, a variety of partners share information, coordinate efforts and communicate with the public. Once a water body is identified as having a HAB, DEQ is responsible for investigating the cause(s), identifying sources of pollution, and writing a pollution reduction plan.

Mercury: Mercury occurs naturally and is used in many products. It enters the environment through human activities and from volcanoes, and can be carried long distances by atmospheric air currents. Mercury passes through the food chain readily, and has significant public health and wildlife impacts from consumption of contaminated fish. Mercury in water comes from erosion of soil that carries naturally occurring mercury (including erosion from agricultural lands and streambanks) and from deposition on land or water from local or global atmospheric sources. Mercury bio-accumulates in fish, and if ingested, can cause health problems.

Nitrate: While nitrate occurs naturally, the use of synthetic and natural fertilizers can increase nitrate in drinking water (ground and/or surface water). Applied nitrate that is not taken up by plants is readily carried by runoff to streams or infiltrates into ground water. High nitrate levels in drinking water cause a range of human health problems, particularly with infants, the elderly, and pregnant and nursing women.

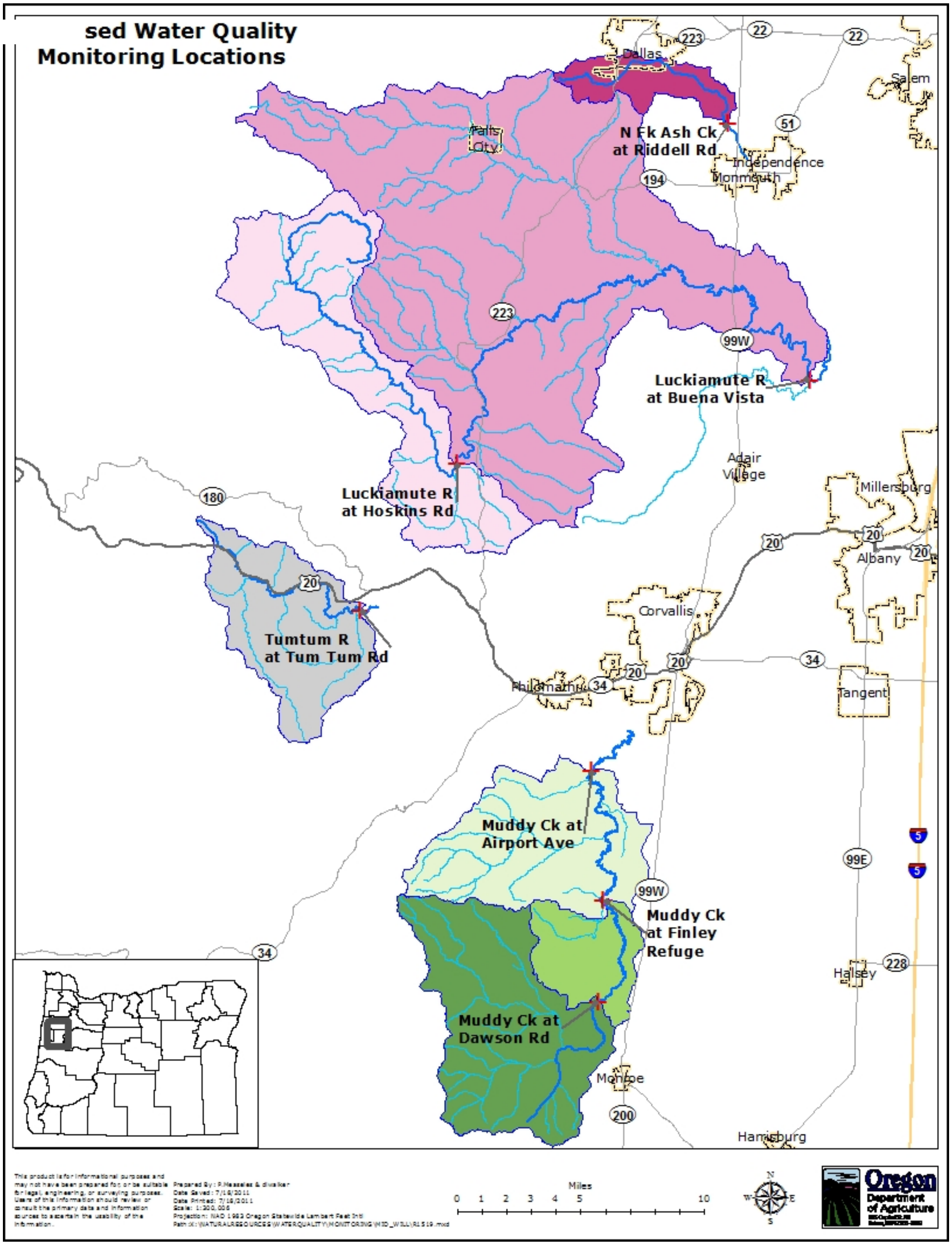
Pesticides: Agricultural pesticides of concern include substances in current use and substances no longer in use but that persist in the environment. Additional agricultural pesticides without established standards have also been detected. On agricultural lands, sediment from soil erosion can carry these pesticides to water. Agricultural pesticide applications, mixing-loading, and disposal activities may also contribute to pesticide detections in surface water. For more information, see: www.deq.state.or.us/wq/standards/toxics.htm.

Phosphorous/Algae/pH/Chlorophyll a: Excessive algal growth can contribute to high pH and low dissolved oxygen. Native fish need dissolved oxygen for successful spawning and moderate pH levels to support physiological processes. Excessive algal growth can also lead to reduced water clarity, aesthetic impairment, and restrictions on water contact recreation. Warm water temperatures, sunlight, high levels of phosphorus, and low flows encourage excessive algal growth. Agricultural activities can contribute to all of these conditions.

Sediment and Turbidity: Sediment includes fine silt and organic particles suspended in water, settled particles, and larger gravel and boulders that move at high flows. Turbidity is a measure of the lack of clarity of water. Sediment movement and deposition is a natural process, but high levels of sediment can degrade fish habitat by filling pools, creating a wider and shallower channel, and covering spawning gravels. Suspended sediment or turbidity in the water can physically damage fish and other aquatic life, modify behavior, and increase temperature by absorbing incoming solar radiation. Sediment comes from erosion of streambanks and streambeds, agricultural land, forestland, roads, and developed areas. Sediment particles can transport other pollutants, including bacteria, nutrients, pesticides, and toxic substances.

Temperature: Oregon’s native cold-water aquatic species, including salmonids, are sensitive to water temperature. Several temperature criteria have been established to protect various life stages and fish species. Many conditions contribute to elevated stream temperatures. On agricultural lands, inadequate streamside vegetation, irrigation water withdrawals, warm irrigation water return flows, farm ponds, and land management that leads to widened stream channels contribute to elevated stream temperatures. Elevated stream temperatures also contribute to excessive algal growth, which leads to low dissolved oxygen levels and high pH levels.

Appendix B: Middle Willamette Water Quality Monitoring Project



Mid-Willamette Basin Monitoring: October 2011 through May 2013 Summary

Muddy Creek at Dawson

Date	Turbidity (NTU)	*E. coli* (MPN)	Total P (mg/l)	NO3 (mg/l)	DO (mg/l)	Conductivity	pH
10/31/11	8.800	212.000	0.199	0.060	6.000	80.100	6.830
11/21/11	13.000	214.000	0.390	0.370	9.440	74.800	6.850
12/19/11	7.900	224.000	0.044	0.690	10.100	86.200	6.000
2/22/12	16.100	64.000	0.109	0.540	9.650	59.200	6.930
3/18/12	22.800	456.000	0.077	0.400	8.650	72.600	6.670
5/25/12	10.900	264.000	0.145	0.140	5.750	56.100	6.930
10/3/12	28.200	112.000	0.092	0.380	6.540	39.800	7.000
10/29/12	20.000	524.000	0.187	0.900	8.420	68.000	7.020
12/19/12	21.000	116.000	0.000	2.500	5.560	57.200	6.840
2/27/13	42.000	66.000	0.297	2.250	10.900	59.100	6.970
4/29/13	15.800	108.000	0.130	1.320	8.460	60.300	7.280
5/29/13	29.000	368.000	1.700	1.630	6.970	119.000	7.500
Mean	19.625	227.333	0.281	0.932	8.037	69.367	6.902
Median	11.950	219.000	0.127	0.385	9.045	73.700	6.840
St. dev.	5.538	126.426	0.125	0.237	1.912	11.752	0.357

Muddy Creek at Finley Wildlife Refuge

Date	Turbidity (NTU)	*E. coli* (MPN)	Total P (mg/l)	NO3 (mg/l)	DO (mg/l)	Conductivity	pH
11/21/11	15.900	116.000	0.003	0.350	8.710	74.800	6.700
12/19/11	10.800	136.000	0.025	0.650	10.400	89.000	7.000
2/22/12	15.800	56.000	0.139	0.550	9.410	65.900	6.810
3/18/12	11.500	60.000	0.112	0.470	8.110	58.800	6.550
5/25/12	14.350	24.000	0.155	0.200	8.860	61.000	6.940
10/3/12	26.000	232.000	0.150	1.350	5.920	80.000	6.970
10/29/12	17.500	128.000	0.211	0.750	8.060	71.800	7.010
12/19/12	30.000	106.000	0.000	2.090	7.400	58.400	6.810
2/27/13	19.000	72.000	0.344	2.570	8.640	85.000	6.930
4/29/13	16.900	38.000	0.120	2.570	7.520	67.200	7.200
5/29/13	18.000	42.000	0.594	3.090	6.060	98.100	7.200
Mean	17.688	96.167	0.186	1.223	8.039	74.250	6.899
Median	15.075	88.000	0.126	0.410	8.785	70.350	6.755
St. dev.	2.433	49.229	0.132	0.230	1.043	11.916	0.171

Muddy Creek at Airport Road

Date	Turbidity (NTU)	*E. coli* (MPN)	Total P (mg/l)	NO3 (mg/l)	DO (mg/l)	Conductivity	pH
10/31/11	10.300	18.000	0.000	0.030	6.720	98.500	6.900
11/21/11	9.230	120.000	0.090	0.110	9.330	79.300	6.760
12/19/11	11.400	96.000	0.007	0.570	9.700	92.000	7.000
2/22/12	16.000	20.000	0.083	0.590	10.000	73.800	6.880
3/18/12	13.100	36.000	0.076	0.510	8.720	61.300	6.570
5/25/12	12.100	72.000	0.100	0.570	8.680	76.400	6.910
10/3/12	10.900	44.000	0.095	0.570	5.860	97.200	6.990
10/29/12	10.400	104.000	0.259	1.360	8.340	83.300	7.060
12/19/12	28.700	98.000	0.034	2.650	9.100	68.500	6.790
2/27/13	24.000	80.000	0.179	3.040	9.780	84.500	6.990
4/29/13	15.700	40.000	0.070	2.680	7.860	82.800	7.220
5/29/13	16.000	46.000	0.228	3.600	8.170	87.500	7.330
Mean	14.819	64.500	0.102	1.357	8.522	82.092	6.950
Median	11.750	54.000	0.080	0.540	9.025	77.850	6.890
St. dev.	2.372	42.378	0.044	0.256	1.171	13.323	0.152

Tumtum River at Tumtum Road

Date	Turbidity (NTU)	*E. coli* (MPN)	Total P (mg/l)	NO3 (mg/l)	DO (mg/l)	Conductivity	pH
11/21/11	3.950	18.000	0.000	0.950	10.560	78.000	6.860
12/19/11	2.300	12.000	0.053	0.420	10.600	73.600	6.900
2/22/12	20.000	32.000	0.118	0.840	10.400	58.200	--
3/18/12	14.000	60.000	0.015	0.810	10.480	57.500	6.740
5/25/12	3.090	128.000	0.000	0.410	10.480	65.000	7.130
10/29/13							
Mean	7.545	42.333	0.031	0.583	10.220	70.367	6.888
Median	3.520	25.000	0.008	0.615	10.480	69.300	6.860
St. dev.	7.597	46.345	0.047	0.338	0.699	12.591	0.148

Luckiamute at Hoskins Road

Date	Turbidity (NTU)	*E. coli* (MPN)	Total P (mg/l)	NO3 (mg/l)	DO (mg/l)	Conductivity	pH
10/31/11	1.320	24.000	0.000	0.120	10.900	68.400	7.030
11/21/11	2.320	80.000	0.000	0.600	10.440	58.900	6.670
12/19/11	2.000	108.000	0.031	0.330	10.500	59.700	7.000
2/22/12	111.000	72.000	1.000	0.650	11.400	43.700	6.970
3/18/12	5.500	16.000	0.000	0.370	11.050	48.100	6.820
5/25/12	1.320	16.000	0.000	0.130	11.260	53.400	7.120
10/3/12	1.740	19.000	0.000	0.000	9.640	65.900	7.240

10/29/12	53.400	60.000	0.326	3.310	10.160	44.700	6.830
12/19/12	8.000	8.000	0.000	1.660	11.300	46.600	7.110
2/27/13	2.700	6.000	0.020	1.520	11.200	48.800	7.150
4/29/13	2.010	26.000	0.000	1.350	10.200	52.400	7.390
5/29/13	12.000	64.000	0.144	0.960	10.400	47.600	7.400
Mean	16.943	41.583	0.127	0.917	10.704	53.183	7.061
Median	2.160	48.000	0.000	0.350	10.975	56.150	6.985
St. dev.	44.325	39.226	0.406	0.225	0.392	8.876	0.163

Luckiamute at Buena Vista Road

Date	Turbidity (NTU)	*E. coli* (MPN)	Total P (mg/l)	NO3 (mg/l)	DO (mg/l)	Conductivity	pH
11/21/11	7.680	100.000	0.000	1.020	10.380	79.400	6.860
12/19/11	4.600	96.000	0.000	0.360	11.400	77.800	7.100
2/22/12	18.800	20.000	0.073	0.630	10.100	61.900	7.100
3/18/12	22.200	54.000	0.104	0.710	10.140	72.900	6.980
5/25/12	7.430	74.000	0.000	0.210	9.040	79.800	6.970
10/3/12	3.340	4.000	0.026	0.440	9.020	99.800	7.370
10/29/12	26.800	448.000	0.274	3.060	9.400	56.800	7.050
12/19/12	29.000	128.000	0.014	4.100	10.700	53.000	7.020
2/27/13	12.000	14.000	0.081	2.570	11.700	82.200	7.450
4/29/13	5.500	30.000	0.000	2.100	8.950	80.400	7.430
5/29/13	7.900	58.000	0.039	1.210	9.380	52.300	7.450
Mean	12.344	87.333	0.051	1.378	9.968	73.833	7.153
Median	7.555	64.000	0.000	0.495	10.120	78.600	7.020
St. dev.	7.950	35.117	0.047	0.338	0.821	9.169	0.093

N. Fork Ash Creek at Ridell Rd/Hoffman Road

Date	Turbidity (NTU)	*E. coli* (MPN)	Total P (mg/l)	NO3 (mg/l)	DO (mg/l)	Conductivity	pH
10/31/11	21.200	50.000	1.000	0.000	1.830	274.700	6.930
11/21/11	29.800	98.000	1.010	0.620	7.980	284.100	6.840
12/19/11	13.000	138.000	0.088	2.580	9.300	178.000	6.900
2/22/12	22.500	116.000	0.138	1.460	11.630	118.800	7.350
3/18/12	16.900	18.000	0.081	1.200	12.040	111.000	7.220
5/25/12	3.030	280.000	0.000	0.260	10.990	179.000	7.030
10/3/12	9.300	5.000	0.163	0.000	11.040	318.300	8.810
10/29/12	13.200	280.000	0.105	7.070	9.280	128.100	7.350
12/19/12	23.000	50.000	0.010	5.370	11.000	62.200	7.230
2/27/13	14.000	14.000	0.086	5.540	11.900	136.900	7.380
4/29/13	4.300	20.000	0.000	1.160	10.000	182.300	7.770
5/29/13	6.000	110.000	0.169	0.390	9.460	287.000	7.900
Mean	14.686	98.250	0.238	2.138	9.704	188.367	7.393

Median	19.050	107.000	0.113	0.910	10.145	178.500	6.980
St. dev.	9.161	91.281	0.481	0.942	3.812	74.296	0.200

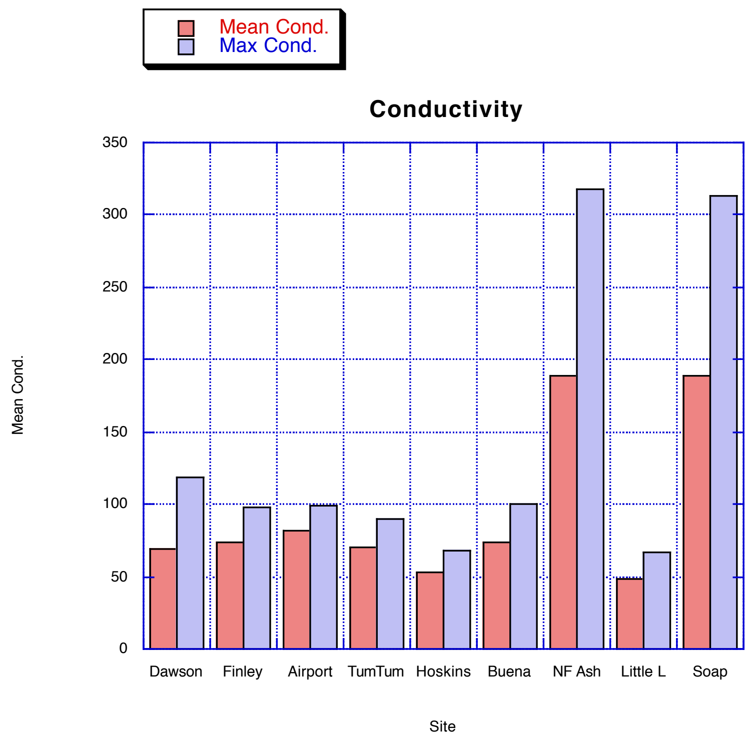
Little Luckiamute at Smith Road

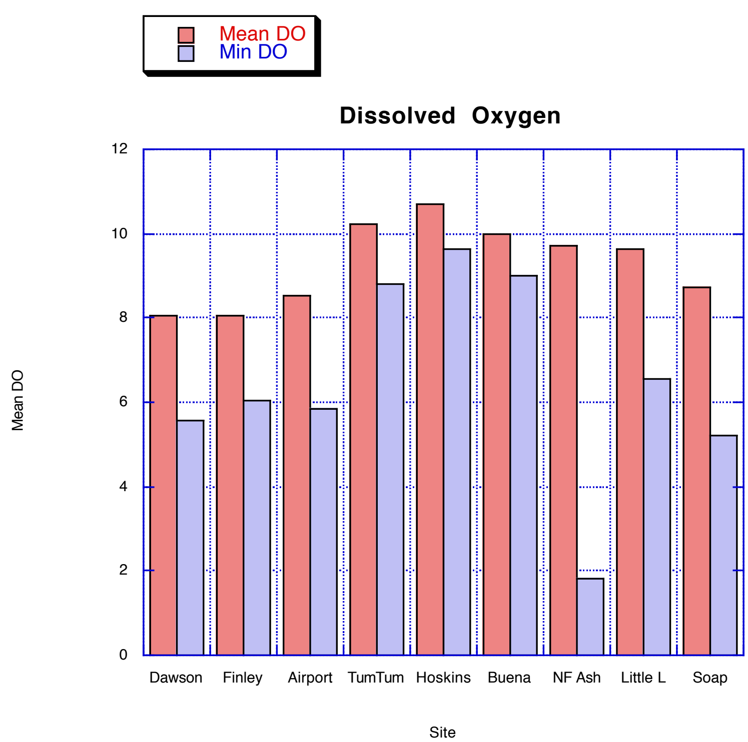
Date	Turbidity (NTU)	*E. coli* (MPN)	Total P (mg/l)	NO3 (mg/l)	DO (mg/l)	Conductivity	pH
10/3/12	3.180	70.000	0.000	0.080	6.540	66.900	7.240
10/29/12	97.000	408.000	0.792	1.030	9.840	31.300	6.870
12/19/12	29.000	52.000	0.040	1.430	10.400	46.600	7.100
2/27/13	6.300	8.000	0.038	0.960	11.700	49.700	6.950
4/29/13	4.140	36.000	0.000	0.910	9.420	54.600	7.240
5/29/13	18.000	102.000	0.223	0.450	10.000	38.600	7.500
Mean	26.270	112.667	0.182	0.810	9.650	47.950	7.150
Median	12.150	61.000	0.039	0.935	9.920	48.150	7.170
St. dev.	36.056	148.101	0.310	0.475	1.712	12.433	0.228

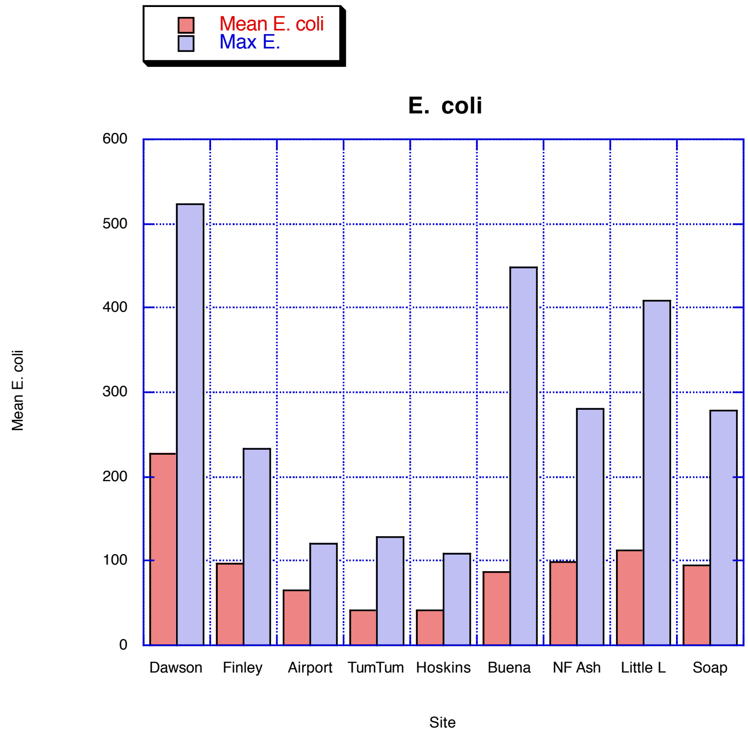
Soap Creek at Corvallis Road

Date	Turbidity (NTU)	*E. coli* (MPN)	Total P (mg/l)	NO3 (mg/l)	DO (mg/l)	Conductivity	pH
10/3/12	5.400	4.000	0.069	0.840	5.200	312.700	7.570
10/29/12	22.400	278.000	0.411	4.930	9.400	---	7.350
12/19/12	22.000	68.000	0.000	5.700	10.500	75.200	7.220
2/27/13	15.000	22.000	0.088	2.600	11.200	153.000	5.400
4/29/13	6.870	98.000	0.080	2.320	7.330	197.800	7.810
5/29/13	11.000	104.000	0.491	2.950	8.650	203.000	7.730
Mean	13.778	95.667	0.190	3.223	8.713	188.340	7.180
Median	13.000	83.000	0.084	2.775	9.025	197.800	7.460
St. dev.	7.336	97.893	0.206	1.789	2.196	86.341	0.900

Graphs of Data



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Max E.
E. coli
Mean E. coli
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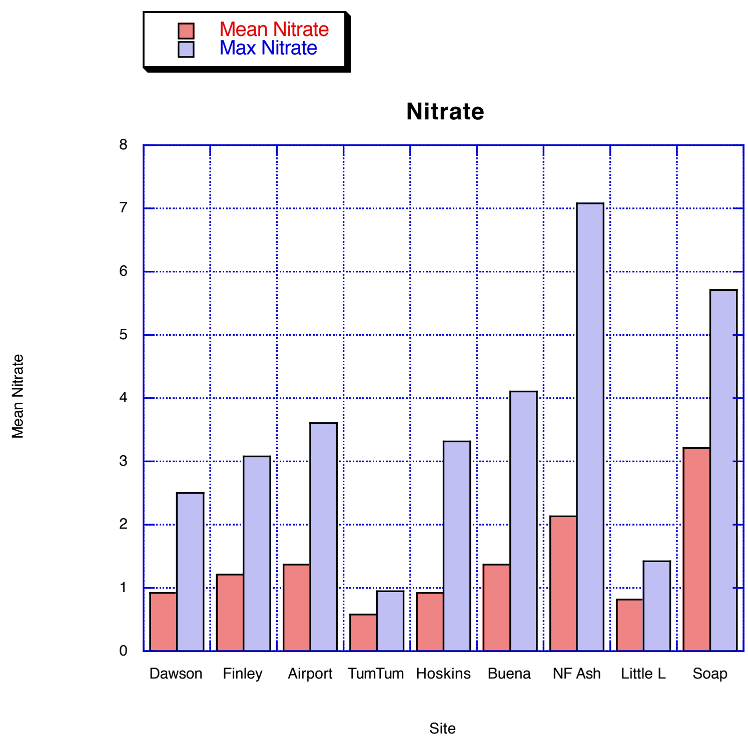
500
400
300
200
100
0
Dawson
Finley
Airport
TumTum
Hoskins
Buena
NF Ash
Little L
Soap
Site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Max Nitrate
Nitrate
Mean Nitrate
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7
6
5
4
3
2
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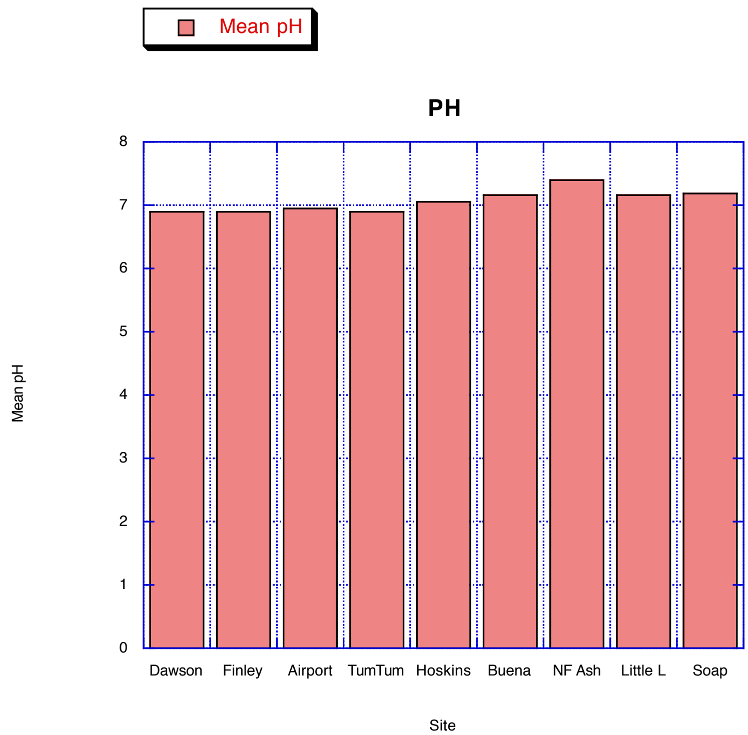
TumTum
Hoskins
Buena
NF Ash
Little L
Soap
Site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PH
Mean pH
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1
2
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8
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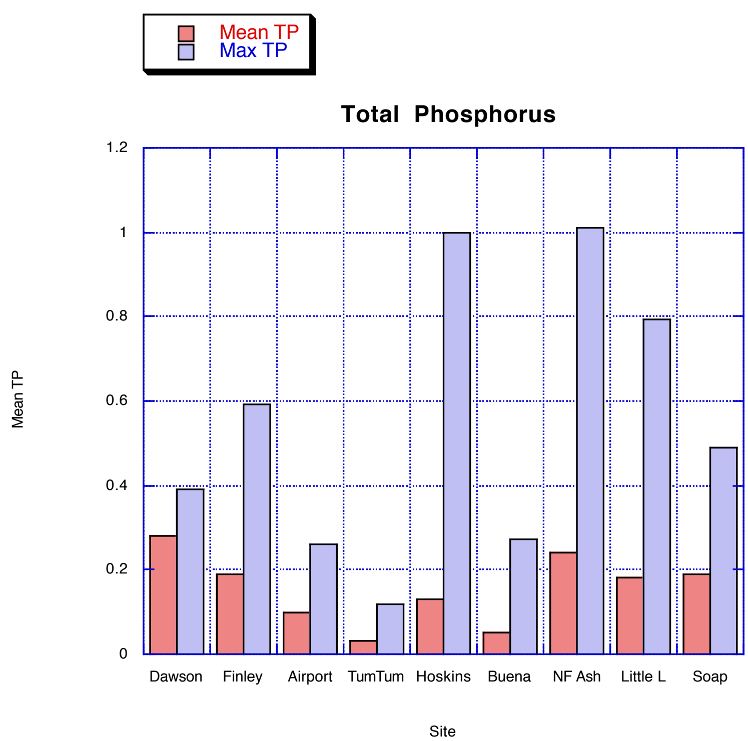
NF Ash
Little L
Soap
Site


Mean TP
Max TP
Total Phosphorus
Mean TP
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0.4
0.6
0.8
1
1.2
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Finley
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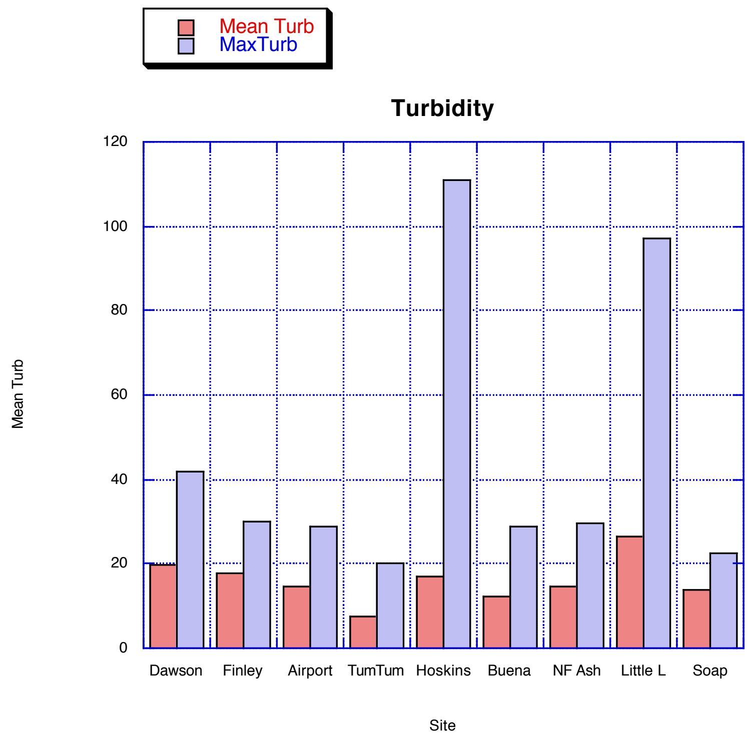
TumTum
Hoskins
Buena
NF Ash
Little L
Soap
Site


Mean Turb
MaxTurb
Turbidity
120
100
80
60
40
20
0
Mean Turb
Dawson
Finley
Airport
TumTum
Hoskins
Buena
NF Ash
Little L
Soap
Site

Appendix C: Educational and Technical Services

Soil and Water Conservation Districts (SWCDs)
Provide technical assistance in a wide variety of agricultural and natural resource areas and assists landowners in accessing federal and local funding programs.

Benton Soil and Water Conservation District (Benton SWCD)
456 SW Monroe Ave., Suite 110
Corvallis, OR 97333
(541) 753-7208

Polk Soil and Water Conservation District (Polk SWCD)
580 Main Street, Suite A
Dallas, OR 97338
(503) 623-9680

Farm Services Agency (FSA)
Maintains agricultural program records and administers federal cost-share programs. Maintains up-to-date aerial photographs and agricultural and forestlands slides.

Benton County
33630 McFarland Rd.
Tangent, OR 97389
(551) 967-5925

Polk County
580 Main Street, Suite A
Dallas, OR 97338
(503) 623-2396

Natural Resources Conservation Service (NRCS)
Provides information on soil types, soils mapping, and interpretation. Administers and provides assistance in developing conservation plans for federal programs such as the Conservation Reserve Program, Conservation Reserve Enhancement Program, the Environmental Quality Incentives Program, and the Wetlands Reserve Program. Makes technical determinations on wetlands and highly erodible lands.

Benton County
33630 McFarland Rd.
Tangent, OR 97389
(541) 967-5925

Polk County
580 Main Street, Suite A
Dallas, OR 97338
(503) 623-5534

Oregon Department of Agriculture (ODA)
635 Capitol St NE
Salem, OR 97301
(503) 986-4700 (Natural Resources Division)
(503) 986-4635 (Pesticides Division)
The Natural Resources Division is responsible for developing and implementing Management Area Plans and Rules across Oregon, the Confined Animal Feeding Operation Program, and for providing support to Oregon's Soil and Water Conservation Districts.

The Pesticides Division regulates the sale and use of pesticides; tests and licenses all users of restricted-use pesticides, is responsible for fertilizer registration, and investigates incidents of alleged pesticide misuse.

Oregon Department of Environmental Quality (DEQ)
750 Front St NE, #120
Salem, OR 97301-1039
(503) 378-8240
http://www.deq.state.or.us
Responsible for protecting Oregon's water and air quality, cleaning up spills and releases of hazardous materials, and managing the proper disposal of solid and hazardous wastes. Maintains a list of water quality limited streams and establishes Total Maximum Daily Loads for water quality limited waterbodies.

Oregon Department of Fish and Wildlife (ODFW)
7118 NE Vanderberg Avenue
Corvallis, OR 97330-9446
(541) 757-4186
http://www.dfw.state.or.us
Works with landowners to protect and enhance habitat for a variety of fish and wildlife species, manages recreational fishing and hunting programs, monitors fish and wildlife populations, conducts education and information programs, and administers wildlife habitat tax deferral program.

Oregon Department of Forestry (ODF)
825 Oak Villa Rd.
Dallas, OR 97338
(503) 623-8146
http://www.odf.state.or.us
Implements Oregon forest practices laws, administers Oregon forestry property tax programs, provides forest management technical assistance to landowners, and administers or assists with several federal and local cost-sharing programs.

Oregon Department of State Lands (DSL)
775 Summer Street NE Suite 100
Salem, OR 97301-1279
(503) 986-5200
http://oregon.gov/dsl
Administers Oregon fill and removal law and provides technical assistance to landowners.

Oregon State University Extension Service (OSUES)
Offers educational programs, seminars, classes, tours, publications, and individual assistance to guide landowners in meeting natural resource management goals.

Benton County
1849 NW 9th St.
Corvallis, OR 97330
(541) 766-6750

Linn County
4th and Lyons
P.O. Box 765
Albany, OR 97321
(541) 967-3871

Polk County
182 SW Academy, Suite 222
P.O. Box 640
Dallas, OR 97338
http://www.extension.oregonstate.edu/polk/
(503) 623-8395

Oregon Water Resources Department (WRD)
725 Summer St. NE, Suite A
Salem, OR 97301
(503) 986-0900
http://www.wrd.state.or.us
Provides information on streamflows and water rights, issues water rights, and monitors water use.

Oregon Watershed Enhancement Board (OWEB)
http://www.oweb.state.or.us
775 Summer St. NE, Suite 360
Salem, OR 97301-1290
(503) 986-0178
Provides funding for a variety of watershed enhancement, assessment, monitoring and educational activities. Provides support to watershed councils throughout Oregon.

Watershed Councils
Watershed councils bring diverse interests together to cooperatively monitor and address local watershed conditions. Collect watershed condition data, conduct education programs, and train and involve volunteers.

Glenn/Gibson Watershed Council
580 Main Street, Suite A
Dallas, OR 97338
rickreallwc@hotmail.com
(503) 623-9680 ext. 112

Luckiamute Watershed Council
Western Oregon University
345 N Monmouth Ave

Monmouth, OR 97361
(503) 838-8804
lwc@wou.edu

Marys River Watershed Council
101 SW Western Blvd, Suite 105
Corvallis, OR 97303
(541)-758-7597
deb@mrwc.org

Rickreall Watershed Council
580 Main Street, Suite A
Dallas, OR 97338
(503) 623-9680 x 112
rickreallwc@hotmail.com

Appendix D: Conservation Funding Programs

The following is a list of some conservation funding programs available to landowners and organizations in Oregon. For more information, please refer to the contact agencies for each program. Additional programs may become available after the publication of this document. For more current information, please contact one of the organizations listed below.

Program	**General Description**	**Contact**
Conservation Reserve Enhancement Program (CREP)	Provides annual rent to landowners who enroll agricultural lands along streams. Also cost-shares conservation practices such as riparian tree planting, livestock watering facilities, and riparian fencing.	NRCS, SWCDs, ODF
Conservation Reserve Program (CRP)	Competitive CRP provides annual rent to landowners who enroll highly erodible lands. Continuous CRP provides annual rent to landowners who enroll agricultural lands along seasonal or perennial streams. Also cost-shares conservation practices such as riparian plantings.	NRCS, SWCDs
Conservation Stewardship Program (CSP)	Provides cost-share and incentive payments to landowners who have attained a certain level of stewardship and are willing to implement additional conservation practices.	NRCS, SWCDs
Emergency Watershed Protection Program (EWP)	Available through the USDA-Natural Resources Conservation Service. Provides federal funds for emergency protection measures to safeguard lives and property from floods and the products of erosion created by natural disasters that cause a sudden impairment to a watershed.	NRCS, SWCDs
Environmental Protection Agency Section 319 Grants	Fund projects that improve watershed functions and protect the quality of surface and groundwater, including restoration and education projects.	DEQ, SWCDs, Watershed Councils
Environmental Quality Incentives Program (EQIP).	Cost-shares water quality and wildlife habitat improvement activities, including conservation tillage, nutrient and manure management, fish habitat improvements, and riparian plantings.	NRCS, SWCDs
Farm and Ranchland Protection Program (FRPP)	Cost-shares purchases of agricultural conservation easements to protect agricultural land from development.	NRCS, SWCDs
Federal Reforestation Tax Credit	Provides federal tax credit as incentive to plant trees.	Internal Revenue Service
Forest Resource Trust	State assistance up to 100 percent of the costs to convert non-stocked forestland to timber stands. Available to non-industrial private landowners.	ODF
Grassland Reserve Program (GRP)	Provides incentives to landowners to protect and restore pastureland, rangeland, and certain other grasslands.	NRCS, Farm Service Agency, SWCDs
Landowner Incentive Program (LIP)	Provides funds to enhance existing incentive programs for fish and wildlife habitat improvements.	U.S. Fish and Wildlife Service, ODFW

Oregon Watershed Enhancement Board (OWEB)	Provides grants for a variety of restoration, assessment, monitoring, and education projects, as well as watershed council staff support. 25% local match requirement on all grants.	SWCDs, Watershed Councils, OWEB
Oregon Watershed Enhancement Board Small Grant Program	Provides grants up to $10,000 for priority watershed enhancement projects identified by local focus group.	SWCDs, Watershed Councils, OWEB
Partners for Wildlife Program	Provides financial and technical assistance to private and non-federal landowners to restore and improve wetlands, riparian areas, and upland habitats in partnership with the U.S. Fish and Wildlife Service and other cooperating groups.	U.S. Fish and Wildlife Service, NRCS, SWCDs
Public Law 566 Watershed Program	Program available to state agencies and other eligible organizations for planning and implementing watershed improvement and management projects. Projects should reduce erosion, siltation, and flooding; provide for agricultural water management; or improve fish and wildlife resources.	NRCS, SWCDs
Resource Conservation & Development (RC & D) Grants	Provides assistance to organizations within RC & D areas in accessing and managing grants.	Resource Conservation and Development
State Forestation Tax Credit	Provides for reforestation of under-productive forestland not covered under the Oregon Forest Practices Act. Situations include brush and pasture conversions, fire damage areas, and insect and disease areas.	ODF
State Tax Credit for Fish Habitat Improvements	Provides tax credit for part of the costs of voluntary fish habitat improvements and required fish screening devices.	ODFW
Stewardship Incentive Program (SIP)	Cost-sharing program for landowners to protect and enhance forest resources. Eligible practices include tree planting, site preparation, pre-commercial thinning, and wildlife habitat improvements.	NRCS, SWCDs, ODF
Wetlands Reserve Program (WRP)	Provides cost-sharing to landowners who restore wetlands on agricultural lands.	NRCS, SWCDs
Wildlife Habitat Incentives Program	Provides cost-share for wildlife habitat enhancement activities.	NRCS, SWCDs
Wildlife Habitat Tax Deferral Program	Maintains farm or forestry deferral for landowners who develop a wildlife management plan with the approval of the Oregon Department of Fish and Wildlife.	ODFW, SWCDs, NRCS

Appendix E: Resource Management Practices

The following is a list of possible resource management practices according to type of operation.

Field and Vegetable Crop Production

Possible practices to reduce erosion and sediment delivery from agricultural and rural land:

- Residue management.
- Grassed waterways.
- Cover cropping.
- Crop rotations.
- Conservation tillage.
- Vegetative buffer strips.
- Straw mulch.
- Irrigation scheduling using soil moisture instrumentation.
- Subsurface drainage – surface inlets and diversions.

Possible practices to limit movement of nutrients and pesticides from agricultural lands to streams:

- Vegetative buffer strips.
- Irrigation water management.
- Nutrient management.
- Equipment calibration and maintenance.
- Integrated pest management.
- Proper storage of pesticides, fertilizer, and fuel.

Possible practices to manage and conserve irrigation water and prevent nitrate leaching into groundwater:

- Irrigation scheduling based on site-specific factors that influence crop production, such as:
    - Evapotranspirational demands (crop type, stage of growth, percent ground shade, weather conditions).
    - Soil conditions (percolation rate, water holding capacity).
    - Recent applications of crop nutrients or farm chemicals.
- Properly maintain Irrigation system to ensure performance (uniformity, efficiency, and application rate).
- Irrigation scheduling using:

Soil probes
Evaporation pans
Neutron probes
Infrared guns
Tensiometers
Other soil monitoring devices.

- Contour cropping
- Plant winter cover crops

Livestock

Possible practices to ensure proper animal waste storage and utilization or disposal:

- Vegetative buffer strips.
- Manure management – clean water diversions, manure collection, storage and application; facilities operation and maintenance.
- Apply manure to cropland at rates that do not exceed agronomic needs for nitrogen and phosphorus based on soil and/or tissue tests for the crop to be grown.
- Pasture management/prescribed grazing.

- Establish animal heavy use areas during the winter away from waterways.
- Limit livestock access to pastures while soil is saturated.

Possible practices to manage livestock access to streams, wetlands, and riparian areas:

- Off-stream watering.
- Seasonal grazing.
- Exclusion – temporary or permanent.

Nurseries

Possible practices to reduce erosion and sediment delivery from nurseries:

- Use ground cloth and/or gravel in container nurseries as a surface covering.
- Gravel or sod road surfaces and staging areas.
- Designed drainage systems to handle runoff from greenhouse and building roofs.
- Grass ditches, waterways, and buffer strips adjacent to streams and ponds.
- Land leveling.
- Limit irrigation runoff from fields.
- Manage cultivation timing and methods.
- Subsurface tile drainage.

Possible practices to manage and conserve irrigation water:

- Recycle irrigation water in container nurseries.
- Monitor soil moisture to balance irrigation applications with crop needs.
- Monitor and record water use.
- Maintain irrigation delivery systems regularly for maximum efficiency.
- Use cultivation to conserve soil moisture in field operations.

Possible practices to limit movement of nutrients and pesticides from nurseries to streams:

- Apply fertilizer based on competent advice and nutrient levels determined by soil and tissue tests.
- Time fertilizer applications to promote optimum plant utilization and limit leaching.
- Protect water sources from contamination through use of backflow prevention devices where fertigation is practiced.
- Restrict irrigation water from leaving the property through irrigation management and water recycling.
- Make banded fertilizer application when feasible.
- Calibrate application machinery prior to use.
- Monitor and record application rates.
- Use timed release fertilizers.
- Maintain organic content of soil mixes and fields to hold nutrients for plant utilization.
- Use Integrated Pest Management Practices.
- Scout crops to determine presence of insects and disease.
- Trap to quantify pest populations.
- Establish economic thresholds for various crops.
- Use traps, pheromone disrupters, and beneficial insects as alternatives to chemicals.
- Rotate chemicals used in applications.
- Make application as per label instructions.
- Have trained applicators apply, or supervise the application of, pesticides.
- Calibrate equipment and use equipment suited for specific types of applications (i.e., ground, foliar, drench, etc.)

Possible practices for other nursery management issues:

- Recycle nursery wastes and byproducts to restrict their impact on the environment.
- Empty chemical containers.

- Plant tissue and residues (through composting)
- Paper products.
- Plastic products – poly, pots & flats.
- Metal, glass, wood, tires, and oils.
- Cover cropping to reduce erosion, build soil organic matter, provide habitat for beneficial insects and wildlife, and control weeds.
- Install fish screens at pump intakes to protect small fish and other aquatic life.
- Control noxious weeds to prevent degradation of protective native vegetation near riparian areas.
- Set aside less productive land for conservation and wildlife habitat enhancement.

Streamside Areas

Possible practices to protect and/or restore ecological functions in riparian and wetland areas:

- Control of undesirable vegetation and preservation of desirable vegetation.
- Planting native trees and shrubs.
- Allowing snags (dead trees) to remain standing unless safety factors indicate otherwise.
- Allowing fallen trees to remain on the ground or in the stream unless removal is essential for traffic, navigation, or serious flooding reasons.

Possible practices to reduce erosion and sedimentation, provide filtering, and moderate water heating:

- Buffer zones.
- Grassed waterways.
- Streambank protection.
- Subsurface tile drainage.
- Allow marginally productive or poorly drained lands in floodplains to revert to riparian or wetland status.

Vineyards, Berries, Christmas Trees, and Orchards

Possible practices to reduce erosion and sediment delivery:

- Annual and perennial cover crops.
- Conservation tillage.
- Deep ripping a field to improve water infiltration.
- Subsurface drainage or tiling.
- Strip cropping.
- Straw mulch.
- Catch basins.
- Grassed waterways.
- Vegetative filter strips.
- Straw bales.

Possible practices to limit over-application of pesticides and nutrients:

- Mechanical weed control.
- Apply herbicide under the vine row or spot treat weeds.
- Adopt methods to monitor disease and pest pressure.
- Make pesticide applications at label recommended rates.
- Rotate pest control methods to reduce development of resistance.
- Encourage an open canopy – reduces disease pressure, improves spray penetration and fruit quality.
- Encourage use of new, low impact products.
- Apply nutrients when there is a maximum uptake by the crop.
- Use organic nutrient sources.

- Conduct soil tests at least every seven years.
- Conduct tissue analyses at least every three years.
- Apply fertilizer based on competent advice and nutrient levels determined by soil and tissue tests.
- Recycle all organic matter.

Possible practices to manage and conserve irrigation water.

- Irrigate only young vineyards except where shallow soils or drought conditions exist.
- Use water sensing devices or physiological indicators to help schedule water applications.

Possible management practices to encourage botanical diversity within and around the borders of the vineyard and provide favorable habitat for beneficial insects:

- Alternate mowing (the oldest inter-row is mowed when the youngest inter-row begins flowering).
- Botanical diversity in cover.

Other Management Areas – Roads, Staging Areas, and Farmsteads

There are other land uses associated with agriculture that do not fall under a specific type of operation, such as access roads and staging areas. Several practices may be applicable to these areas.

Example practices to minimize soil erosion from access roads:

- Encourage landowners to cooperate with county or state roads departments to implement roadside management practices.
- Plant and maintain grass cover where appropriate.
- Appropriate culvert construction and design.
- Water bars
- Grading roads
- Manage runoff and contaminants in the farmstead area.

Appendix F: References for Water Quality Improvement Practices

Below is a list of some selected references with more specific information on water quality and natural resources improvement practices. Copies of many of these publications are available from the local Oregon State University Extension office or local Soil and Water Conservation District. Underlined publications are also available online on the publishing agency's website.

General Water Quality Protection

Adams, E.B. 1992. Farming practices for groundwater protection. Washington State University, Spokane, Washington.

Hermanson, R.E. 1994. Care and feeding of septic tanks. Washington State University, Spokane, Washington.

Hirschi, M. et al. 1994. 50 ways farmers can protect their groundwater. University of Illinois, Urbana, Illinois.

Hirschi, M., et al. 1997. 60 ways farmers can protect surface water. University of Illinois, Urbana, Illinois.

Ko, L. 1999. Tips on land and water management for small acreages in Oregon. Oregon Association of Conservation Districts, Portland, Oregon.

U.S. Department of Agriculture Natural Resources Conservation Service. 1998. National Handbook of Conservation Practices. U.S. Department of Agriculture Natural Resources Conservation Service, Portland, Oregon.

Riparian Areas and Streams

Adams, E.B. 1994. Riparian Grazing. Washington State University, Spokane, Washington.

Darris, D. and S.M. Lambert. 1993. Native willow varieties for the Pacific Northwest. U.S. Department of Agriculture Soil Conservation Service, Corvallis Plant Materials Center, Corvallis, Oregon.

Nash, E. and T. Mikalsen, eds. 1994. Guidelines for streambank restoration. Georgia Soil and Water Commission, Atlanta, Georgia.

South Santiam Watershed Council. 1998. Guide for using Willamette Valley native plants along your stream. Linn Soil and Water Conservation District, Tangent, Oregon.

Nutrient and Manure Management

Godwin, D. and J.A. Moore. 1997. Manure management in small farm livestock operations: protecting surface and groundwater. Oregon State University, Corvallis, Oregon.

Hart, J. 1995. How to take a soil sample...and why. Oregon State University, Corvallis, Oregon.

Hart, J. 1999. Analytical laboratories serving Oregon. Oregon State University, Corvallis, Oregon.

Marx, E.S., J. Hart, and R.G. Stevens. 1999. Soil Test Interpretation Guide. Oregon State University, Corvallis, Oregon.

Moore, J. and T. Willrich. 1993. Manure management practices to reduce water pollution. Oregon State University, Corvallis, Oregon.

Sattell, R. et al. 1999. Nitrogen scavenging: using cover crops to reduce nitrate leaching in western Oregon. Oregon State University, Corvallis, Oregon.

Grazing and Pasture Management

Ursander, D. et al. 1997. Pastures for Profit: a guide to rotational grazing. University of Wisconsin, Madison, Wisconsin.

Erosion and Sediment Control

Hansen, H. and W. Trimmer. 1997. Irrigation runoff control strategies. Oregon State University, Corvallis, Oregon.

Trimmer, W. and H. Hansen. 1994. Irrigation scheduling. Oregon State University, Corvallis, Oregon.

Pesticide Management and Integrated Pest Management

Kerle, E.A., J.J. Jenkins, and P.A. Vogue. 1996. Understanding pesticide persistence and mobility for groundwater and surface water protection. Oregon State University, Corvallis, Oregon.

Menzies, G., C.B. MacConnell, and D. Havens. 1994. Integrated pest management: effective options for farmers.

Appendix G: Site Capability

Streamside vegetation generally affects water quality. The primary water quality-related functions provided by streamside vegetation are shade, bank stability, filtration of sediment and nutrients, and infiltration of runoff water. Absent of human influence, different riparian sites have varying abilities to support these functions. This ability is referred to as **site potential**, or the highest ecological status an area can attain. The site potential is influenced by physical and biological factors such as elevation, aspect, geology, climate, and the current plant community. It is also influenced by disturbances found in riparian systems, such as flooding, and the complex variation of these disturbances.

Site conditions that affect the establishment and development of streamside vegetation are further modified by human infrastructure, such as roads, power and telephone lines, and irrigation and drainage systems. When infrastructure limits a site's ability to achieve or maintain its vegetative potential, the resulting condition is called the **site capability**. This capability determines what can be expected in terms of vegetation, such as the types of bank-stabilizing shrub species, and the functions the site can provide.

Example

Historically, Llama Creek meandered through a narrow coastal valley until it reached the Pacific Ocean. Historical vegetation along Llama Creek included a canopy of Douglas fir, western red cedar, big leaf maple and alder in the headwaters, and a combination of alder, willow, red osier dogwood, grasses, and sedges in the lower reaches (site potential). The vegetation provided many functions, including shade, bank stability, infiltration of runoff water, and filtration of sediment and nutrients.

In the upper reaches of Llama Creek, there are generally more of the younger age classes and less of the older age classes of vegetation than there were historically, but vegetation is still composed mostly of Douglas fir, western red cedar, big leaf maple and alder. Streamside sites in upper Llama Creek are still able to produce plant communities that were historically present, and those plant communities provide the water quality-related functions listed above.

Over the past few decades, the lower reaches of Llama Creek were channelized and straightened. As a result, streambanks eroded, lower Llama Creek became much wider and shallower, and the water table dropped. Presently, lower Llama Creek is capable of supporting those plant species that can establish and grow under the constraints of a lower water table and competitive pressure from invasive plant species. Depending on the site, the plant community will likely include blackberry, native shrubs, herbaceous species, and tree species capable of establishing and growing in these modified conditions. Some sites dominated by blackberry and other invasive vegetation do not provide riparian functions at the same level as the historic plant community, but at other sites the vegetation still promotes infiltration of runoff water, filters sediment and nutrients from runoff, provides shade, and provides for some bank stability.

How site capability applies in an Agricultural Water Quality Management Area

Site capability can be applied in several ways in an Agricultural Water Quality Management Area. It can be used in voluntary conservation and outreach projects to illustrate the vegetation landowners might expect given a management regime and the capability of a site. For example, it could predict the likelihood of success of "passive restoration," which involves reducing management pressure on the existing plant community, versus more "active restoration," which involves reducing management pressure, planting desirable vegetation, and/or controlling undesirable vegetation. Site capability can also predict the consequences or benefits of planting desirable species in specific locations in a riparian area. It can also help provide a clearer picture of the functions a near-stream area can be reasonably expected to provide given natural limiting factors such as soil type and climate, and legacy conditions such as channel deepening or streambank erosion associated with natural events or past management activities.

Appendix H: Factors that Affect Stream Temperature

(Krueger et al, 1999)

Physical
Weather
Season
Year
Climate
Cloudiness
Wind
Position on the landscape
Microclimate
Time of day/angle of the sun
Sunlight, shade, reflection
Daytime/nighttime temperatures
Morning temperature
Elevation
Soil temperature
Air temperature
Latent heat
Time of exposure
Penetration of light (short vs. long waves)

Stream Structure
Morphology (differing potentials)
Flow
Gradient
Depth
Volume
Width
Sinuosity
Ponds, glides, riffles (mixing)

Local
Storage (dams)
Effluent (interflow)
Influent
Hyporrheic
Soil structure
Soil physics/geology
Streambed
Temperature at the source
Physical limits to heating
Roughness
Debris
Refugia (variation in stream)
Catastrophic events
Condition of uplands
Vegetation +/- (potentials)
Bank stability
Turbidity/pollution

Management
Land uses (roads, agriculture, forestry)
Water management (regulated flows)
Irrigation

Physical
Weather
Season
Year
Climate
Cloudiness
Wind
Position on the landscape
Microclimate
Time of day/angle of the sun
Sunlight, shade, reflection
Daytime/nighttime temperatures
Morning temperature
Elevation
Soil temperature
Air temperature
Latent heat
Time of exposure
Penetration of light (short vs. long waves)

Stream Structure
Morphology (differing potentials)
Flow
Gradient
Depth
Volume
Width
Sinuosity
Ponds, glides, riffles (mixing)

Local
Storage (dams)
Effluent (interflow)
Influent
Hyporrheic
Soil structure
Soil physics/geology
Streambed
Temperature at the source
Physical limits to heating

Roughness
Debris
Refugia (variation in stream)
Catastrophic events
Condition of uplands
Vegetation +/- (potentials)
Bank stability

Turbidity/pollution

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