Total Maximum Daily Loads for the Lower Columbia-Sandy Subbasin

Water Quality Management Plan: Bacteria and Temperature

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State of Oregon
DEQ Department of Environmental Quality

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1. Introduction

The Oregon Department of Environmental Quality developed this Water Quality Management Plan to guide implementation of the Lower Columbia-Sandy River Subbasin temperature and bacteria Total Maximum Daily Loads. A WQMP is an element of a TMDL, as described by OAR 340-042-0040(4)(l), which provides the framework for management strategies to attain and maintain water quality standards and is designed to work in conjunction with detailed implementation plans prepared by persons responsible for TMDL implementation.

In March 2005, DEQ issued a TMDL and associated WQMP for temperature in the Sandy River Basin and bacteria in three creeks within the watershed (DEQ, 2005). The U.S. Environmental Protection Agency approved the TMDL and WQMP in April 2005. In 2013, EPA disapproved the Natural Conditions Criterion contained in Oregon's water quality standard for temperature due to the 2012 U.S. District Court decision for Northwest Environmental Advocates v. EPA. On October 4, 2019, the U.S. District Court issued a judgment in the lawsuit requiring EPA and DEQ to reissue 15 Oregon temperature TMDLs that were based on the Natural Conditions Criterion, including the Lower Columbia-Sandy Subbasin.

Oregon's Environmental Quality Commission adopted this Lower Columbia-Sandy Subbasin WQMP, by reference, into rule as OAR 340-042-0090(4). This WQMP is intended to provide consolidated information for implementation of both the temperature and bacteria TMDLs. The WQMP replaces the temperature elements and carries forward the same bacteria management strategies from the 2005 WQMP for the Designated Management Agencies identified in the 2005 WQMP as responsible for implementing bacteria management strategies. This WQMP replaces the 2005 WQMP and will be amended, as needed, upon issuance of any future new or revised TMDLs within the Lower Columbia-Sandy Subbasin.

1.1 Condition assessment and problem description

The first element of the WQMP, per OAR 340-042-0040(4)(l)(A), is an assessment of water quality conditions in the Lower Columbia-Sandy Subbasin and a problem description. There are assessment units in the Lower Columbia-Sandy WQMP listed as impaired (category 5 or 4A) for temperature in Oregon's 2022 Integrated Report, which was approved by the EPA on September 1, 2022. There were portions of Beaver Creek, Kelly Creek and Cedar Creek listed as impaired for bacteria on Oregon's 2002 Section 303(d) list of impaired waterbodies. As required by Section 303(d) of the federal Clean Water Act, DEQ developed TMDLs for pollutants causing temperature (2024) and bacteria (DEQ, 2005) water quality impairments of waters within the Lower Columbia-Sandy Subbasin. These pollutants are heat or thermal loading from various sources and conditions, which contribute to impairments of the temperature criteria established to support aquatic life beneficial uses; and fecal bacteria, including E. coli bacteria, which contribute to impairments of the bacteria criteria established to support water contact recreation.

1.2 Goals and objectives

OAR 340-042-0040(4)(I)(B) requires identification of the goals and objectives of the WQMP.

The goal of this WQMP is to provide the framework for TMDL implementation to achieve and maintain the temperature and bacteria water quality standards within the Lower Columbia-Sandy Subbasin.

The primary objectives of this WQMP are to describe:

- Responsibilities for implementing the TMDLs;
- Management strategies and actions necessary to reduce excess pollutant loads to meet the TMDL allocations; and,
- A strategy to evaluate progress towards attaining relevant water quality standards throughout the Lower Columbia-Sandy Subbasin.

2. Proposed Management Strategies

As required by OAR 340-042-0040(4)(I)(C), the following section presents proposed management strategies, by pollutant source or category, that are designed to meet the load and wasteload allocations required by the Lower Columbia-Sandy Subbasin temperature and bacteria TMDLs.

OAR 340-042-0030(6) defines management strategies as “measures to control the addition of pollutants to waters of the state and includes application of pollutant control practices, technologies, processes, siting criteria, operating methods, best management practices or other alternatives.”

Table 1 includes proven strategies (and practices within the strategies) summarized by pollutant source. These strategies and practices are adapted from published sources. DEQ used the categories and terminology from Oregon Watershed Enhancement Board's Oregon Aquatic Habitat Restoration and Enhancement Guide and Oregon Watershed Restoration Inventory Online List of Treatments. Additional strategies included in Table 1 are supported by Oregon Department of Agriculture, U.S. Department of Agriculture Natural Resources Conservation Service, Oregon State University Extension Service, and other publicly available published sources. DEQ identified the strategies in Table 1 as appropriate for the conditions and sources within the subbasin. Therefore, these are considered priority strategies and practices that should receive special focus during implementation plan development. The bacteria sources and strategies are carried forward from the 2005 Sandy Basin bacteria TMDL and WQMP without change.

DEQ expects that entities identified in Section 5.1 will develop implementation plans that incorporate strategies and practices from Table 1 that are applicable to their jurisdiction. Implementation plans must include specifics on where and when priority and other strategies and practices will be applied, along with measurable objectives and milestones for documenting their implementation and gauging their effectiveness.

Table 1: Management strategies by sources

Pollutant	Source or activity	Management strategies
Heat (thermal loading)	Insufficient height, density, or width of riparian vegetation	The primary goal is to increase site effective shade (combination of vegetation height, buffer width and canopy density) through streamside vegetation management strategies using regulatory programs and voluntary activities, including incentive-based projects. Streamside tree planting (conifer and hardwood); streamside vegetation planting (shrub or herbaceous cover); streamside vegetation management (invasive thinning, removal or other treatment); voluntary streamside tree retention; streamside invasive plant control; streamside fencing (or other livestock streamside exclusion or management methods); identify and protect cold water refuges Increase site effective shade (combination of vegetation height, buffer width and canopy density) through streamside vegetation management strategies using regulatory programs and voluntary activities, including incentive-based projects; maintain plants until free to grow; monitor survival rates Develop, update and/or enforce streamside code/ordinance to ensure streamside native vegetation and intact bank conditions are protected or restored following site development; purchase, acquire, or designate conservation easements along streamside areas
	Water withdrawals and flow alteration	Pursue new instream water rights, as well as transfers and leases of existing water rights; water right application reviews; irrigation conservation and management; repair or replace leaking pipes and infrastructure; provide incentives for water conservation; implement water consumption restrictions during the summer months, such as lawn watering
	Channel modification and hydromodification	Conduct whole channel restorations (e.g., enhance channel, wetlands, and floodplain interactions, reduce width to depth channel ratios, bank stabilization, large wood placement, create/connect side channels, etc.); streamside road re-construction/obliteration activities; streamside fencing or other livestock exclusion or management methods; protect and enhance cold water refuges; remove in-channel ponds or modify pond structures to reduce temperature increases downstream; protect areas that do not require restoration actions
	Dam and reservoir management	Modifications to the quantity and nature of water releases to meet water quality standards for temperature
Bacteria	Urban stormwater	Implement stormwater management practices, including managing construction site runoff, implementing public education and outreach activities, and managing stormwater at new development and redevelopment projects

Pollutant	Source or activity	Management strategies
	Nonpoint sources and background	Managing pet waste Implement additional best management practices for livestock manure and pasture management and reduce livestock access to streams to reduce organic matter mobilization in runoff and direct deposition into surface waters Implement bacteria source tracking to identify the source of bacteria in surface waters Improve pastures and streamside zones to reduce surface erosion and provide adequate filtration capacity for organic matter and nutrients Assess onsite septic systems to identify those at the highest risk of malfunction or failure and connect to public sanitary sewer systems where possible

2.1 Streamside vegetation management strategies

DEQ's water quality analysis and modeling concluded that streamside vegetation planting and management are the strategies necessary to meet water quality standards in the temperature impaired sections of streams in the Lower Columbia-Sandy Subbasin. This is because streamside overstory vegetation reduces solar radiation loads to streams by providing shade. Protecting and restoring streamside overstory vegetation is essential to achieving the TMDL surrogate measure of effective shade.

The primary streamside vegetation planting and management strategies are summarized as follows:

- **Vegetation planting and establishment:** This strategy addresses locations that have little or no shade producing overstory vegetation and are therefore important locations for streamside tree and shrub planting projects. These sites may currently be dominated by invasive species.

- **Vegetation protection (enhancement, maintenance, and growth):** This strategy addresses streamside areas that have existing vegetation that needs to be protected from removal to maintain current shade levels. In some cases, protection is needed because effective shade can only be achieved with additional growth. Protecting and maintaining existing vegetation ensures that it can grow and mature, enhances vegetation success and survival, and provides for optimal ecological conditions.

- **Vegetation thinning and management:** This strategy addresses streamside areas that may need vegetation density reduction to achieve optimal benefits of shade in the long term. Current site conditions at some riparian areas have been shown to be overly dense with trees or dominated by invasive species that inhibit a healthy streamside community. In these situations, thinning may be an option to promote development of a healthy mature streamside forest. However, it must be ensured that riparian thinning and management actions will result in limited (i.e., quantity, duration, and spatial extent)

stream shade loss. TSD Appendix G presents material describing potential shade and temperature impacts resulting from riparian buffer management and actions to limit these effects.

2.2 Flow management strategies

DEQ's modeling, evaluation of water quality data, and research found that water withdrawals decrease the capacity of streams to assimilate pollutant loads (DEQ, 2024a). Because temperature is a flow-related parameter, water withdrawals can result in increased pollutant concentrations and warmer stream temperatures. In waterbodies where temperatures are already known to exceed standards, further withdrawals from the stream will reduce the stream's heat capacity and cause greater fluctuation in daytime and nighttime stream temperatures.

Water conservation is a best management practice that directly links the relationship between water quantity and water quality. Leaving water instream functions as a method to protect water quality from flow-related parameters of concern, such as temperature. Under state law, the first person to file for and obtain a water right on a stream is the last person to be denied water in times of low stream flows. Therefore, restoration of stream flows may require establishing instream water rights. One way this can be accomplished is by donating or purchasing out-of-stream rights and converting these rights to instream uses.

2.3 Hydromodification strategies

Hydromodification refers to alterations of natural hydrological processes which affect characteristics of a waterbody and impact water quality. Examples of hydromodification include the construction of dams and levees and modifying stream channel morphology. Hydromodification can affect the loading, timing, and delivery of nonpoint source pollutants, including temperature (EPA, 2007).

Altering channel morphology can impact stream temperature (Galli and Dubose, 1990). For example, streams with high width to depth ratios (i.e., wide, shallow streams) can allow solar radiation to increase stream temperature compared to channels that are narrow and deep (Larson and Larson, 1996). Activities that make streams more prone to bank erosion, such as uncontrolled livestock access, can also result in shallower streams and increased stream temperatures. Channelization can impact stream morphology by disconnecting streams from their floodplains due to activities such as urban development or road construction. Streams that have been disconnected from floodplains are not able to slow and store floodwaters during the rainy season or recharge groundwater to support summer flows (EPA, 2017).

Hydromodification management strategies can include streamside restoration, livestock fencing, flow augmentation, and reservoir operations, as well as channel or floodplain restoration projects. Note that permits are often needed to conduct stream restoration work involving removal and fill activities, and to ensure activities occur during the in-water work period to avoid harming fish. In addition, responsible persons, including DMAs need to conduct site-specific evaluations of streams to determine what specific channel modifications are appropriate to meet the desired future condition. For more information about hydromodification sources and impacts, see EPA's National Management Measures to Control Nonpoint Source Pollution from

Hydromodification (EPA, 2007), as well as a DEQ study, Water Temperature Impacts from In-Channel Ponds in Portland Metro and Northwest Region (DEQ, 2023a).

2.3.1 Large dam owners and reservoir management

There are approximately 11 reservoirs located in the Lower Columbia-Sandy project area that are large enough to require evaluation for dam safety. DEQ compiled this list of dams (Appendix A) from the U.S. Army Corps of Engineers National Inventory of Dams (NID) database and a similar database maintained by the Oregon Water Resources Department (OWRD), dam safety program. The OWRD prescribes dam safety rules that apply to large dams 10 feet or higher, or store 9.2 acre-feet or more (OAR 690-020-0000). "Dam" means a hydraulic structure built above the natural ground line that is used to impound water. Dams include all appurtenant structures, and together are sometimes referred to as "the works". Dams include wastewater lagoons and other hydraulic structures that store water, attenuate floods, and divert water into canals.

Dams of all sizes can increase stream temperatures, depending on factors such as specific dam and stream characteristics, and the location and number of dams in a watershed. For these reasons, DEQ expects all dam owners to manage their reservoirs to meet water quality standards, including standards for temperature. For details on reservoir operator implementation requirements, see Section 5.3.7.

2.4 Cold water refuges

Cold water refuges are areas within a water body with temperatures colder than the remainder of the water body and are used by migratory fish to escape warmer water temperatures. According to OAR 340-041-0002(10) "Cold Water Refugia" means those portions of a water body where, or times during the day when, the water temperature is at least 2 degrees Celsius colder than the daily maximum temperature of the adjacent well-mixed flow of the water body.

Due to their importance, these areas should be identified and protected when possible. EPA's Columbia River Cold Water Refuges Plan identifies the importance of the Sandy River as it relates to the Columbia River and includes a list of possible actions to protect cold water refuges in the Sandy River (EPA, 2021).

2.5 Point source priority management strategies

Point sources may be assigned wasteload allocations and/or other requirements under the TMDL. These point sources are required to have National Pollutant Discharge Elimination System permits for any wastewater discharges. Under federal rules, effluent limits within NPDES permits are required to be consistent with the assumptions and requirements of any available wasteload allocation.

The primary way DEQ addresses numeric wasteload allocations is by including effluent limits in permits (though different mechanisms may be used if they are consistent with the TMDL). There are several available pathways that may be used to achieve compliance with these limits and requirements, which can be incorporated into NPDES permits during renewal or issuance. These include, but are not limited to, immediate compliance with the limits, the use of

compliance schedules, water quality trading, and other pathways allowed under state and federal rules.

Water Quality Trading Opportunities

DEQ encourages Lower Columbia-Sandy Basin DMAs to develop water quality credit trading plans that meet the allocations in the TMDL. Water quality trading is a well-established feature of TMDL implementation in Oregon that is designed to achieve water quality goals more efficiently and with enhanced outcomes. Trading is allowed statewide as long as the requirements of OAR 340-039 are met. Trading is based on a more holistic understanding that pollutant sources are distributed throughout a watershed, and that eliminating these pollutant sources benefits the entire watershed. Trading programs allow facilities to meet their regulatory obligations by exchanging environmentally equivalent (or greater) pollution reductions from sources elsewhere in a watershed. Trading in Oregon includes the use of green infrastructure, enhancing the resilience of natural systems to the effects of climate change. Many trading plans achieve the higher levels of heat load reduction at a lower cost. For more information, please refer to DEQ's web page: https://www.oregon.gov/deq/wq/wqpermits/pages/trading.aspx

3. Timelines for Implementing Strategies

OAR 340-042-0040(4)(l)(D) requires schedules for implementing management strategies including permit revisions, achieving appropriate incremental and measurable water quality targets, implementing control actions, and completing measurable milestones. DEQ's water quality permitting program has responsibility for revising permits to comply with TMDLs. Timelines for implementation of management strategies by responsible persons, including DMAs is discussed separately.

3.1 DEQ permit revisions

NPDES permits have five-year terms. Table 2 includes a list of NPDES permittees in the Sandy Basin and their next expected permit renewal date. DEQ will include any updates to TMDL wasteload allocations in the permittee's next NPDES renewal permit after the TMDL has been approved.

The city of Sandy Wastewater Treatment Plant currently holds an NPDES permit for discharge to Tickle Creek (Clackamas Subbasin) but is under an EPA consent decree to upgrade and add treatment capacity. The city of Sandy has provided DEQ with an NPDES permit application for the upgrade and construction of a new outfall to the Sandy River. The discharge to the Sandy River is estimated to be a significant source of thermal load and has been allocated a portion of the cumulative human use allowance. Additional information regarding the new outfall is in the TMDL rule (DEQ, 2024), Sections 7.1 and 9.1.

Table 2: Sandy Subbasin permits and timelines

Permittee	Permit Type	DEQ file number	EPA permit number	Planned Issuance Date
Government Camp STP	NPDES-Dom-Da	34136	OR0027791	2025
Water Environment Services Hoodland STP	NPDES-Dom-Da	89941	OR0031020	2027
City of Troutdale WPCF	NPDES-Dom-C2a	39750	OR0020524	2023
OR Dept of Fish and Wildlife Sandy River Fish Hatchery	300-J	64550	ORG130009	TBD

3.2 Management strategies implemented by responsible persons

DEQ uses multiple sources to establish current conditions and track implementation progress in the Lower Columbia-Sandy Subbasin project area. One of these sources is the Oregon Watershed Enhancement Board's Oregon Watershed Restoration Inventory, which is a repository for storing watershed restoration activities. OWRI contains project level information from watershed councils, landowners and other groups who have implemented restoration projects to improve aquatic habitat and water quality conditions. Data available from OWRI indicate approximately 39 stream miles have been planted since 2005 in the project area (OWRI, 2023a).

For this TMDL, DEQ also conducted modelling across specific areas within the project area to assess current streamside shade. Where DEQ completed modeling, effective shade targets were calculated for specific water bodies. An effective mean shade was then calculated for DMAs where this modeling occurred, and a shade gap assessment was completed. A shade gap assessment was not completed for all DMAs. For the areas where a shade gap assessment was not completed, effective shade targets are determined through shade curves based on stream site characteristics. The shade gap results for the modeled areas include shade conditions that may have been impacted by streamside planting projects that were completed following the approval of the 2005 Sandy River Basin TMDL.

While DEQ was not able to directly quantify the impact that planting projects had on modeled streamside shade gaps, available data demonstrate that the pace and scale of streamside planting will need to increase to meet shade targets for this TMDL (see section 3.3).

3.3 Timeline for implementation of management strategies

This section of the WQMP includes an estimate of the timeline for implementation of management strategies that will be sufficient to support attainment of water quality standards. Estimating timeframes for meeting shade targets across the project area is influenced by several factors, including:

- The project area is large and the percent effective shade targets to be met are developed at a small scale or through shade curves.
- A shade gap analysis is unavailable for all streams in the Lower Columbia-Sandy Subbasin to gauge what percent of streamside areas across the project area are not currently meeting effective shade targets.
- DEQ is unable to determine whether the rate of previous streamside plantings will be similar to planting efforts following the adoption of this TMDL.
- DMAs that have a large percentage of private property within their jurisdiction will have challenges in meeting effective shade targets. It will likely take additional time to develop more protective streamside ordinances or regulations, work with landowners, or partner with other organizations to conduct streamside planting and restoration projects in these areas.
- It is unclear how much future planting will be targeted in priority shade gap areas, as opposed to implementing opportunistic planting projects.
- The scale of implementation, location, and water quality benefits from future in-stream restoration and flow augmentation projects are unknown.
- It is unclear what impacts climate change and forest pests, such as the emerald ash borer, will have on tree species.
- Frequency and magnitude of natural disturbances, such as wildfires.

DEQ expects responsible persons, including DMAs to consider the timeline projections and interim targets presented below in Table 3 in establishing commitments for streamside planting and protection in TMDL implementation plans. Based on DEQ analysis of the number of stream miles that will need restoration, and the pace of restoration logged in the Oregon Watershed Restoration Inventory database over the previous years of implementation, restoration will need to occur at an accelerated pace to meet the targets below. Timelines for attainment of percent cumulative effective shade were estimated based on time for trees to grow to heights sufficient to provide effective shade, and in considerations of the factors described above. Table 3 gives projections for meeting 10 percent of shade targets across the basin every 10 years beginning in 2030, which will result in meeting all shade targets in 90 years. It is important to note that meeting shade targets on all waterbodies may not be possible due to various factors, such as natural disturbances, the built environment, and private streamside ownership.

Table 3: Timelines to meet percent shade targets in the Lower Columbia-Sandy Subbasin TMDL in 10-year increments

Assessment Year	Percent Cumulative Shade Targets Met in Lower Columbia-Sandy Subbasin TMDL
2030	10%
2040	20%
2050	30%
2060	40%
2070	50%

Assessment Year	Percent Cumulative Shade Targets Met in Lower Columbia-Sandy Subbasin TMDL
2080	60%
2090	70%
2100	80%
2110	90%
2120	100%

4. Attaining Water Quality Standards

Based on the TMDLs analyses, achieving the excess load reductions identified will result in attainment of water quality standards. Each management strategy identified in this WQMP and in responsible persons' implementation plans represents part of a system of measures and practices that collectively reduce pollutant loads and improve water quality.

4.1 How management strategies support attainment of water quality standards

OAR 340-042-0040(4)(l)(E) requires an explanation of how implementing the proposed management strategies will result in attainment of water quality standards.

4.1.1 Implementation of vegetation management, flow management and hydromodification strategies for temperature reduction

DEQ identified priority implementation management strategies and specific practices in Table 1 and Section 2. DEQ expects these strategies and practices to increase site effective shade and address the excess solar radiation and shade deficits calculated along streams within the Lower Columbia-Sandy Subbasin. DEQ focused on the vegetation strategies described in Section 2.1 to estimate timelines for achieving surrogate effective shade targets (Table 3), and by extension solar radiation load reductions to meet temperature water quality standards. Some of these vegetation management strategies have been implemented at various locations over the past 18 years by responsible persons, including Designated Management Agencies that were identified in the 2005 TMDL.

DEQ developed site-specific effective shade targets and effective shade curves to meet temperature load allocations in the TMDL rule (Section 9 in the TMDL rule). Shade curves identify the relationship between stream width, orientation, and effective shade for specific streamside vegetation types. Effective shade curves are applicable to any stream that does not have site specific shade targets. Effective shade curves represent the maximum possible effective shade for a given vegetation type.

Landowners, foresters, restoration professionals and horticulturists have the expertise and experience needed to develop site-specific planting prescriptions that will ensure that the best

combination of streamside species are planted. Site-specific planting prescriptions will typically contain a higher diversity of shrub and overstory species than the vegetation types used in developing the shade curves. The overall goal is to establish and protect streamside vegetation to meet shade targets established for that site. Maintenance activities, such as removal of invasive species and watering newly established trees and shrubs will be important for trees to become fully established (free to grow).

In addition to streamside shading strategies, significant water quality benefits can be achieved through implementation of stream restoration and flow augmentation management strategies.

4.1.2 Continued implementation of bacteria management strategies

DEQ's 2005 TMDL and WQMP required strategies for managing bacteria from urban stormwater, pet waste, livestock and pastures, septic areas and sanitary sewer discharges in areas that discharge to Beaver, Kelly and Cedar Creeks. DEQ did not revise the 2005 bacteria TMDL and requires relevant responsible persons, including DMAs, to include these strategies in updated implementation plans, as appropriate to their jurisdictions, and continue to implement and report on their effectiveness.

4.2 Timelines for attaining water quality standards

OAR 340-042-0040(4)(I)(F) requires an estimated timeline for attaining water quality standards through implementation of the TMDL, WQMP and associated TMDL implementation plans.

Based on DEQ's source assessment and TMDL analyses (DEQ, 2024a), point sources and nonpoint sources contribute pollutant thermal loads in the Sandy River, Camp Creek, and Cedar Creek. Nonpoint sources contribute nearly all the excess thermal pollutant loading associated with temperature water quality impairments to most other impaired waterbodies in the Lower Columbia-Sandy Subbasin. Therefore, it is critical for nonpoint sources to make timely progress toward meeting the TMDL load allocations.

Because the Temperature TMDL calculated NPS load allocations using a percent effective shade surrogate measure, the estimated timelines to meet water quality standards are primarily based on streamside planting activities. However, other management strategies, including stream channel restoration and increasing instream flows will also help improve stream temperature conditions. Based on the Table 3 timeline to meet effective shade targets, temperature water quality standards for the Lower Columbia-Sandy subbasin will be met by 2120. This is a target date and is uncertain due to unknowns related to current conditions and the pace of future restoration activities. Achieving the identified timelines for cumulative effective shade and resulting water quality benefits will require active participation from all responsible persons, including DMAs, within the basin.

DEQ expects Designated Management Agencies responsible for implementing bacteria management strategies for Beaver, Kelly and Cedar Creeks to summarize evaluation of bacteria strategy performance since 2005 when identifying and prioritizing actions in implementation plans.

5. Implementation Responsibilities and Schedule

5.1 Identification of implementation responsibilities

OARs 340-042-0040(4)(I)(G) and 340-042-0080(1) require identification of persons, including Designated Management Agencies, responsible for implementing management strategies and preparing and revising implementation plans.

OAR 340-042-0030(2) defines Designated Management Agency as a federal, state or local governmental agency that has legal authority over a sector or source contributing pollutants and is identified as such by DEQ in a TMDL.

The TMDL rule includes numerous mentions of the term 'responsible person' with associated requirements. OAR 340-042-0025(2) indicates that responsible sources must meet TMDL load allocations through strategies developed in implementation plans. OAR 340-042-0030(9) defines 'reasonable assurance' as a demonstration of TMDL implementation by governments or individuals. OARs 340-042-0040(4)(I)(G) requires identification of persons, including DMAs, responsible for developing and revising implementation plans. OAR 340-042-0040(4)(I)(I) requires a schedule for submittal and revision of implementation plans by responsible persons, including DMAs. OAR 340-042-0080(4) reiterates the requirement for persons, including DMAs, responsible for development, submittal and revision of implementation plans, along with the required elements of those plans. For purposes of this Lower Columbia-Sandy Subbasin WQMP, 'responsible person' is defined as any entity responsible for any source of pollution addressed by the TMDL.

Unless otherwise specified, all responsible persons, including DMAs, are required to develop, submit, and revise, as needed, an implementation plan specific to the Lower Columbia-Sandy Subbasin TMDL. As required in OAR 340-042-0080(4)(a), implementation plans must include:

- Management strategies that the entity will use to achieve load allocations and reduce pollutant loading;
- Timelines for strategy implementation and a schedule for completing measurable milestones;
- A performance monitoring component with a plan for periodic review and plan revision;
- To the extent required by ORS 197.180 and OAR chapter 340, division 18, provide evidence of compliance with applicable statewide land use requirements; and
- Any other analyses or information specified in the WQMP.

Table 4 contains the list of DMAs that were named in the 2005 Sandy River Basin TMDL for bacteria for specific streams. These DMAs continue to be responsible for implementing an approved TMDL plan for bacteria.

Table 4: List of designated management agencies in the 2005 Sandy River Basin TMDL for bacteria

DMA	Geographic Coverage

Clackamas County	Cedar Creek
City of Sandy	Cedar Creek
Multnomah County	Beaver Creek, Kelly Creek
City of Gresham	Beaver Creek, Kelly Creek
City of Troutdale	Beaver Creek

Table 5 contains the complete list of responsible persons, including designated management agencies, and approximate jurisdictional land area percentages within the subbasin, where available. Some responsible persons, including DMAs are not required to submit implementation plans for temperature at this time for one or more of the following reasons:

1) Water protection actions implemented through permits (e.g., DOGAMI)
2) Limited ability or opportunity to conduct stream restoration activities (e.g., railroads)
3) DMA has limited streamside area under its jurisdiction

DEQ may require temperature implementation plans from these entities in the future if ownership or jurisdiction of streamside areas increases, or other data or information indicates a TMDL implementation plan is needed to achieve temperature allocations and shade targets identified in this TMDL. DEQ may revise the WQMP or issue individual orders to the DMA notifying them of the required schedule for submitting an implementation plan.

Table 5: List of responsible persons including designated management agencies

No.	Entity	Type	Approximate percentage of total subbasin area	Approximate percentage of acreage within 150' of streams	TMDL Plan Needed (X)	
					Temperature	Bacteria
1	U.S. Forest Service	Federal	70.38%	70.11%	X	
2	Oregon Department of Forestry	State	12.88%	13.62%	X	
3	U.S. Bureau of Land Management	Federal	4.16%	5.11%	X	
4	Oregon Department of Agriculture	State	3.81%	2.79%	X	
5	Clackamas County	County	2.93%	2.57%	X	X
6	Multnomah County	County	1.11%	0.88%	X	X
7	City of Portland	City	0.82%	1.04%	X	
8	Oregon Parks and Recreation Department	State	0.77%	0.65%	X	
9	Oregon Department of Transportation	State	0.74%	0.40%	X	
10	City of Gresham	City	0.78%	0.54%	X	X
11	City of Troutdale	City	0.50%	0.33%	X	X
12	City of Sandy	City	0.17%	0.18%	X	X
13	Union Pacific Railroad	Railroad	0.12%	0.07%		

No.	Entity	Type	Approximate percentage of total subbasin area	Approximate percentage of acreage within 150' of streams	TMDL Plan Needed (X)	
					Temperature	Bacteria
14	Oregon Department of Fish and Wildlife	State	0.06%	0.11%	X	
15	Port of Portland	Special District	0.04%	0.03%		
16	Clackamas Water Environment Services	Special District	not assessed	not assessed	X	
17	Oregon Department of State Lands	State	not assessed	not assessed		
18	Department of Geology and Mineral Industries	State	not assessed	not assessed		
19	Oregon Department of Environmental Quality	State	not assessed	not assessed		
20	Metro	Special District	not assessed	not assessed		

DEQ is the DMA for implementing point source wasteload allocations. DEQ implements wasteload allocations through issuance of NPDES permits, which does not require preparation of an implementation plan.

Table 5 is not an exhaustive list of every individual that is responsible for improving water quality in the Lower Columbia-Sandy River Subbasin. It may be necessary for all people that live, work and recreate in the watershed to take steps to reduce pollution and protect or restore water quality to attain standards and designated beneficial uses. Active participation may be needed to achieve long-term water quality improvements throughout the watershed.

Figure 1 is a map of the watershed showing areas by land use, ownership, or jurisdiction with responsibility for implementation of management strategies by the entities indicated.

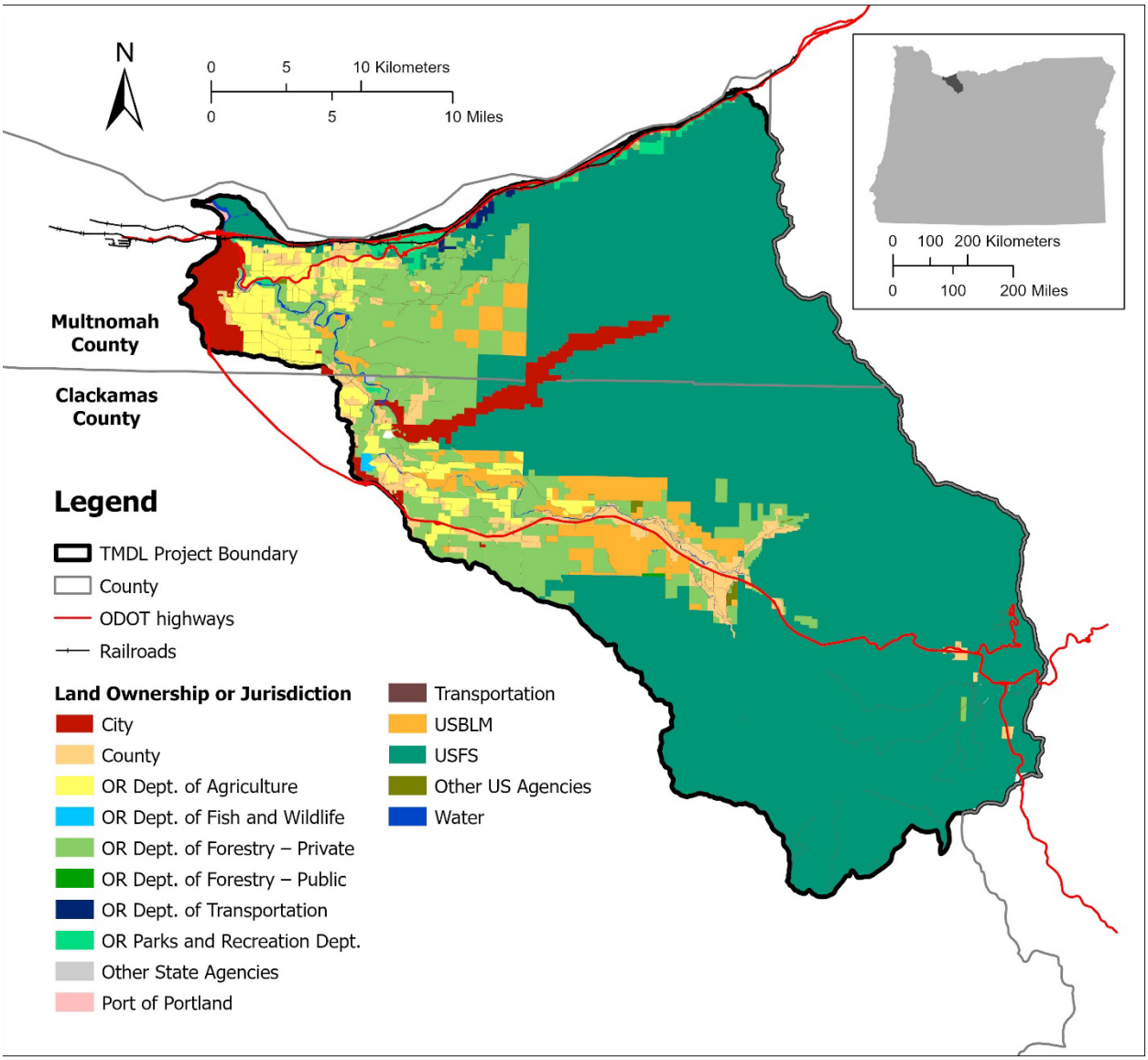

Figure 1: Lower Columbia-Sandy Subbasin land ownership or jurisdiction map

5.2 Existing implementation plans

OAR 340-042-0040(4)(l)(H) requires identification of any source or sector-specific implementation plans available at the time of TMDL issuance. Following issuance of the 2005 Sandy Basin TMDL and Water Quality Management Plan, responsible persons, including DMAs, developed implementation plans that included specific management strategies and reporting requirements. Table 6 identifies those entities with existing TMDL implementation plans. Existing DMAs that already have an implementation plan will need to update their current plan for temperature to ensure any new requirements in this WQMP are met.

Table 6: Responsible persons, including DMAs with existing implementation plans

No.	Responsible Person/DMA
1	Multnomah County
2	Clackamas County
3	Clackamas Water Environment Services
4	City of Portland
5	City of Troutdale
6	City of Gresham
7	City of Sandy

Additionally, certain statewide rules, programs and management plans for the forestry and agricultural sectors are in place and are intended, in part, to reduce or control nonpoint sources of pollution. The programs described in OAR 340-042-0080(2) and (3) represent existing implementation plans for non-federal forest and agricultural lands, and their sufficiency is discussed below.

5.2.1 Oregon Department of Forestry: adequacy of Forest Practices Act to meet TMDL load allocations and effective shade surrogate measures

Waterway protection measures were established in 1994 for state and private forest practices in Oregon, as codified in Oregon Revised Statutes 527.610 through 527.992, Oregon's Forest Practices Act (OAR 629-600 through 629-665) and Oregon's Plan for Salmon and Watersheds (Executive Order 99-01). As provided in ORS 527.770, forest operations conducted in accordance with the Forest Practices Act and other voluntary measures are generally considered to be in compliance with water quality standards. However, as provided in OAR 340-042-0080(2), revisions to the Forest Practices Act rules may be required when DEQ determines that these rules are not adequate to implement load allocations in an approved TMDL.

Periodic revisions to the Forest Practices Act rules occurred between the 1990s through 2022. With the publication of the Private Forest Accord Report and subsequent passage of Senate Bill 1501, 1502 and HB 4055, Forest Practices Act rule revisions were adopted by the Board of Forestry in October 2022 and additional amendments are anticipated through 2025. Implementation of these rules, including increased riparian widths and additional tree retention, may be effective at meeting shade allocations. The streamside vegetation retention and riparian management area distances in the current Forest Practices Act are summarized in Table 7. There are multiple other requirements or exceptions found in the forest practice rules not included in the table.

Table 7: **Summary of streamside vegetation retention riparian management area distances in Forest Practices Act rules OAR 629-643**

ODF Stream Type*	Standard Practice Vegetation Retention (Feet)	Small Forestland Option Vegetation Retention (Feet)
Large Type SSBT	110	100
Medium Type SSBT	110	80
Small Type SSBT	100	60
Large Type F	110	100
Medium Type F	110	70
Small Type F	100	50
Large Type N	75	70
Medium Type N	75	50
Small Type N	See Type Np	See Type Np
Small Type Np flows into to Type SSBT	75 feet vegetation retention for 500 feet upstream from the confluence with the Type SSBT, then 50 feet buffer retention for 650 feet upstream. Retention distance is the shorter of 1,150 feet (RH Max+) or the uppermost flow feature.	35 feet vegetation retention from the confluence with the Type SSBT to the upper most flow feature or 1,150 feet upstream (RH Max), whichever is shorter.
Small Type Np flows into to Type F	75 feet vegetation retention from the confluence with the Type F to the upper most flow feature or 600 feet upstream (RH Max), whichever is shorter.	35 feet vegetation retention from the confluence with the Type F to the upper most flow feature or 600 feet upstream (RH Max), whichever is shorter.
Small Type Ns	35' Equipment Limitation Zone (ELZ)	

***ODF Stream Type Definitions:**
SSBT—salmon, steelhead, or bull trout
F—fish-bearing (non-SSBT)
N—non-fish-bearing, non-domestic
Np—perennial, Type-N
Ns—seasonal, Type-N

+ "RH Max" means the maximum distance described for any particular small Type Np stream.

DEQ finds the no-harvest vegetation retention buffers of 100-110 feet (e.g., large SSBT, Large F, small and medium SSBT/F standard practice) may be sufficient to meet some shade targets, depending on density of residual trees, stream orientation, topography, and other site-specific factors (see Technical Support Document Appendix G). However, based on the findings in Appendix G, it is probable that in some cases these buffers will not provide shade equivalent to 120-foot no-harvest buffer. Smaller no-harvest buffers are progressively less likely to meet shade targets and more likely to result in temperature increases beyond the assigned TMDL human use allowance of (0.0°C) and equivalent load allocation for all fish-bearing and perennial non-fish-bearing streams. This is more pronounced for the Small Forestland Option. Adoption of forest conservation tax credits on small forestlands to align protections with standard practice will increase the effectiveness. Overall, required riparian protections under the Forest Practices Act are unlikely to consistently meet shade targets and load allocations.

For these reasons, ODF is required to develop a TMDL implementation plan to be submitted to DEQ for review and approval. See Table 10 for the schedule.

As agreed, in the 2021 Memorandum of Understanding between DEQ and ODF, DEQ will work with ODF to identify additional regulatory or non-regulatory measures that could be implemented by rule revisions, stewardship agreements, incentive programs or other means to provide reasonable assurance of achieving TMDL solar radiation load allocations. Collaboration on these additional measures may occur during development of ODF's implementation plan.

5.2.2 Oregon Department of Agriculture: adequacy of agricultural water quality management programs in attaining TMDL load allocations and effective shade surrogate measures

The Agricultural Water Quality Management Program was established in 1993 under ORS 568.900 to 568.933, ORS 561.191 and OAR chapter 603, divisions 90 and 95. Subsequently, the Oregon Department of Agriculture led the development of 38 watershed-based Agricultural Water Quality Area rules and Area Plans intended to implement the rules, with the Sandy Subbasin rules and plan established in 2001. Despite implementation of the area rules and plans, including required biennial review and revision of the Area Plan and implementation of other voluntary agricultural initiatives, water quality impairments continue in the Sandy River Subbasin. DEQ's 2020 Water Quality Status and Trends Report shows a degrading trend for temperature in the Sandy Subbasin (more than half the monitoring locations where data were assessed).

Since 2001 and through the present, the Sandy Subbasin Agricultural Water Quality Area rules and Plan do not identify quantitative targets for effective shade in riparian areas based on site specific factors, including stream width or orientation (nor for bacteria reduction). DEQ letters during biennial reviews of the Area Plan in 2012, 2015, 2017, 2019 and 2021 identified protecting, maintaining and establishing riparian vegetation to provide water quality functions as the highest priority for the Sandy Subbasin. Although ODA was not identified in the 2005 TMDL as an entity responsible for implementing bacteria reductions, DEQ's letters recommended actions that ODA could take to assist landowners in achieving the TMDL bacteria reduction targets. DEQ's letters each recommended establishment of measurable objectives, milestones and timelines to achieve TMDL load allocations for effective shade and bacteria reduction.

DEQ concluded that current ODA WQ program Area Rules, combined with implementation of Area Plan voluntary measures, are not adequate in all locations to meet the riparian vegetation requirements necessary to achieve TMDL effective shade targets, load allocations and temperature water quality criteria.

Therefore, ODA is required to develop a TMDL implementation plan for temperature to be submitted to DEQ for review and approval. DEQ encourages ODA to include management strategies with measurable objectives and timelines for bacteria reductions in the implementation plan. See Table 10 for schedule.

5.2.3 U.S. Bureau of Land Management: adequacy of streamside management strategies in attaining TMDL load allocations and effective shade surrogate measures

Streamside vegetation on BLM managed lands in the Lower Columbia-Sandy Subbasin are currently managed based on BLM's Northwestern and Coastal Oregon Resources Management Plan (BLM, 2016).

BLM defines riparian management areas called 'riparian reserves' using-slope distance from the ordinary high-water line on each side of a stream. Slope distance is specific to different types of waterbodies as summarized in Table 8. The slope distance or *riparian reserve distance* is defined based on site-potential tree height. Site-potential tree height is the average maximum height of the tallest dominant trees (200 years or older) for a given site's class. BLM states that site-potential tree heights generally range from 140 feet to 240 feet, depending on site productivity.

Management practices in riparian reserves varies, however, clearcut harvesting within the riparian reserve is prohibited. Some tree removal or thinning activities are allowed based on certain circumstances such as to protect public safety, or to keep roads and other infrastructure clear of debris. Tree removal for yarding corridors, skid trails, road construction, stream crossings and road maintenance or improvement are allowed where there is no operationally feasible and economically viable alternative. On fish bearing streams and perennial streams between 0 and 120 feet slope distance, there is no thinning except in cases of sudden oak death or for individual tree cutting or tipping that achieve restoration or habitat enhancement objectives. On intermittent, non-fish bearing streams, the same management strategy is applied but only from 0 to 50 feet.

Table 8. Summary of BLM riparian reserve buffer distance for different waterbody features

Feature	Riparian Reserve Distance measured as slope distance
Fish-bearing streams and perennial streams	One site-potential tree height distance from the ordinary high water line or from the outer edge of the channel migration zone for low-gradient alluvial shifting channels, whichever is greatest, on each side of the stream
Intermittent, non fish-bearing streams	Class I and II subwatersheds: One site-potential tree height distance from the ordinary high water line on each side of the stream
	Class III subwatersheds: 50 feet from the ordinary high water line on each side of a stream
Unstable areas that are above or adjacent to stream channels and are likely to deliver material such as sediment and logs to the stream if the unstable area fails	The extent of the unstable area; where there is stable area between such an unstable area and a stream, and the unstable area has the potential to deliver material such as sediment and logs to the stream, extend the Riparian Reserve from the stream to include the intervening stable area as well as the unstable area
Lakes, natural ponds and reservoirs > 1 acres, and wetland > 1 acres	100 feet extending from the ordinary high water line
Natural ponds < 1 acres, wetlands < 1 acres (including seeps and springs), and constructed water impoundments (e.g. canal ditches and pump chances) of any size	25 feet extending from the ordinary high water line

DEQ finds that BLM's streamside vegetation management strategies on fish-bearing streams and perennial streams are adequate and will likely lead to achievement of the TMDL load allocation and effective shade targets. Riparian reserves located on intermittent, non-fish bearing streams may not be adequate to achieve the load allocation or effective shade targets. Streamside management on intermittent streams is a concern because they may contain residual pools that support aquatic life; or be flowing during periods when the TMDL allocations

apply. The classification and mapping of intermittent streams often do not account for these situations. See Technical Support Document Section 2.4 for additional details. In locations where an intermittent stream has surface flow in Class III subwatersheds, a riparian reserve distance of 50 feet is unlikely to provide sufficient shade and will result in stream warming. In Class I and Class II subwatersheds, thinning is authorized between 50 and 120 feet slope distance and must maintain at least 30 percent canopy cover and 60 trees per acre expressed as an average. Thinning at these levels within 120 foot slope distance from the stream may reduce effective shade and contribute to stream warming (see summary in TMDL Technical Support Document Appendix G).

For these reasons, BLM is required to develop a TMDL implementation plan to be submitted to DEQ for review and approval. See Table 10 for schedule.

5.2.4 U.S. Forest Service: adequacy of streamside management strategies in attaining TMDL load allocations and effective shade surrogate measures

Streamside vegetation on USFS lands in the Willamette Subbasins currently managed based on Northwest Forest Plan (USFS and BLM, 1994). As part of the plan, the Aquatic Conservation Strategy was developed to restore and maintain the ecological health of watersheds and aquatic ecosystems, including salmon and steelhead habitat on federal lands managed by USFS. Maintaining and restoring water quality is one of the stated objectives of the Aquatic Conservation Strategy. These aquatic ecosystems and the streamside adjacent areas are called *riparian reserves.* Like BLM, USFS defines many of the reserve distances using site-potential tree height. The Northwest Forest Plan states a site-potential tree height is the average maximum height of the tallest dominant trees (200 years or older) for a given site class and is consistent with the BLM definition. The following text is a description of the riparian buffer distance for different types of waterbodies. The text was extracted from USFS and BLM (1994), Attachment A, Standards and Guidelines, Section C, pages C-3- through C-31.

> ***Fish-bearing streams*** *- Riparian Reserves consist of the stream and the area on each side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to the outer edges of riparian vegetation, or to a distance equal to the height of two site-potential trees, or 300 feet slope distance (600 feet total, including both sides of the stream channel), whichever is greatest.*
>
> ***Permanently flowing nonfish-bearing streams*** *- Riparian Reserves consist of the stream and the area on each side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to the outer edges of riparian vegetation, or to a distance equal to the height of one site-potential tree, or 150 feet slope distance (300 feet total, including both sides of the stream channel), whichever is greatest.*
>
> ***Constructed ponds and reservoirs, and wetlands greater than 1 acre*** *- Riparian Reserves consist of the body of water or wetland and: the area to the outer edges of the riparian vegetation, or to the extent of seasonally saturated soil, or the extent of unstable and potentially unstable areas, or to a distance equal to the height of one site-potential tree, or 150 feet slope distance from the edge of the wetland greater than 1 acre or the maximum pool elevation of constructed ponds and reservoirs, whichever is greatest.*

Lakes and natural ponds *- Riparian Reserves consist of the body of water and: the area to the outer edges of the riparian vegetation, or to the extent of seasonally saturated soil, or to the extent of unstable and potentially unstable areas, or to a distance equal to the height of two site-potential trees, or 300 feet slope distance, whichever is greatest.*

Seasonally flowing or intermittent streams, wetlands less than 1 acre, and unstable and potentially unstable areas *- This category applies to features with high variability in size and site-specific characteristics. At a minimum, the Riparian Reserves must include:*

- *The extent of unstable and potentially unstable areas (including earthflows),*
- *The stream channel and extent to the top of the inner gorge,*
- *The stream channel or wetland and the area from the edges of the stream channel or wetland to the outer edges of the riparian vegetation, and*
- *Extension from the edges of the stream channel to a distance equal to the height of one site-potential tree, or 100 feet slope distance, whichever is greatest.*

DEQ finds that USFS's streamside vegetation management strategies on fish-bearing streams, perennial streams, non-fish bearing streams, constructed ponds and reservoirs, lakes and natural ponds, and wetlands greater than 1 acre are adequate and will likely lead to achievement of the TMDL load allocation and effective shade targets. Vegetation management strategies on intermittent streams, and wetlands less than 1 acre may not be adequate to achieve the load allocation or effective shade targets (see summary in TMDL Technical Support Document Appendix G). Streamside management on intermittent streams is a concern because they may contain residual pools that support aquatic life; or be flowing during periods when the TMDL allocations apply. The classification and mapping of intermittent streams often do not account for these situations. See Technical Support Document Section 2.4 for additional details.

For these reasons, USFS is required to develop a TMDL implementation plan to be submitted to DEQ for review and approval. See Table 10 for schedule.

5.3 Implementation plan requirements

As required in OAR 340-042-0080(4)(a), implementation plans must include:

- Management strategies that the entity will use to achieve load allocations and reduce pollutant loading;
- Timeline for strategy implementation and a schedule for completing measurable milestones;
- Performance monitoring and a plan for periodic review and revision of implementation plans;
- To the extent required by ORS 197.180 and OAR chapter 340, division 18, provide evidence of compliance with applicable statewide land use requirements; and
- Any other analyses or information specified in the WQMP.

The following subsections provide detail on each component required by this WQMP that must be included in implementation plans. Some implementation requirements vary depending on the responsible person or DMA. DEQ will work with each entity required to develop a TMDL

implementation plan to ensure that all required elements are included with sufficient detail for their plan to be approved on the schedule required in Table 10.

TMDL implementation plans and annual reports must be posted to each DMA's website for public transparency. If a DMA does not have a website, these documents must be made available to the public in another manner.

Figure 2 is provided to help responsible persons, including DMAs determine the information and analyses they are responsible for submitting to DEQ.

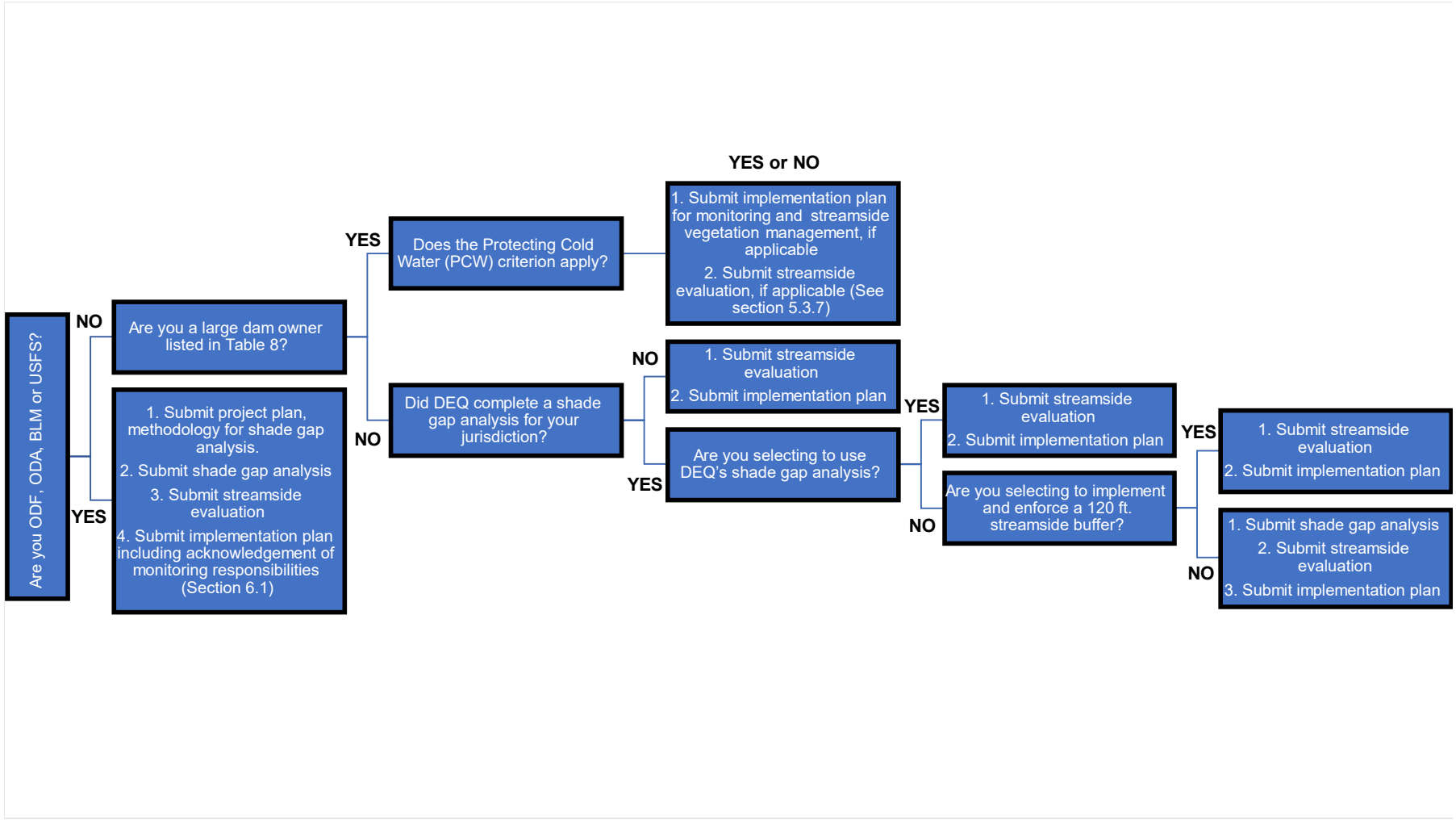

Figure 2: Decision support tree to help identify information and analyses requirements for different responsible persons and DMAs.

5.3.1 Management strategies

Each entity required to develop a TMDL implementation plan must include applicable priority management strategies from Table 1 and/or other practices and actions appropriate for activities and landscape conditions specific to the entities' pollutant sources or source sectors. Implementation plans must identify all streamside areas or streamside activities within an entity's jurisdiction or responsibility.

5.3.2 Streamside evaluation

Responsible persons including DMAs that are required to submit an implementation plan must complete a streamside evaluation. The streamside evaluation will use a review of current conditions to support implementation measurable objectives and milestones. The streamside evaluation must be included in the TMDL implementation plan.

Entities that have a DEQ shade gap analysis, and entities that must complete a shade gap analysis (see Section 5.3.4), must include the shade gap analysis results in their streamside evaluation. The streamside evaluation must also include the following data and information:

a. Quantify the streamside area in acres that needs enhancement (e.g., areas that do not currently meet shade targets, are comprised of non-native vegetation, need additional planting).
b. Quantify the streamside area in acres that may not need action beyond protection.
c. Quantify the streamside area in acres where physical constraints exist (e.g., buildings) that preclude implementation of vegetation management strategies that provide stream shade.
d. Quantify the streamside area in acres where jurisdictional constraints (e.g., private ownership) limit implementation of vegetation management strategies that provide stream shade.
e. Opportunities that may exist to address constraints to implementing vegetation management strategies that provide stream shade.
f. Any areas within your jurisdiction where there is the potential to implement best management practices such as in-stream restoration, flow augmentation projects, experimental temperature management techniques, as well as enhancing and protecting cold water refuges were identified.
g. An evaluation of the data from a - f to prioritize implementation. This evaluation must include a description of the rationale utilized to prioritize implementation, in addition to a description of the data and analysis methods used to estimate quantities **a – d** and the reasoning specific areas will or will not be prioritized for implementation actions. It is expected that DMAs prioritize areas with the greatest shade gaps for implementation of riparian restoration, unless physical, jurisdictional, or other identified constraints exist.
    i. Entities that have a DEQ shade gap analysis, and entities that must complete a shade gap analysis (ODA, ODF, USFS, and BLM), must include the shade gap analysis results in their streamside evaluation.
    ii. DEQ expects entities that do not have a DEQ shade gap analysis to use other available data to estimate the quantities outlined in items **a - d** and address these data in their streamside evaluation.

DEQ acknowledges that factors such as climate change and local geology, geography, soils, climate, legacy impacts, wildfires and floods may hinder achieving the target effective shade. No enforcement action will be taken by DEQ for reductions in effective shade caused by natural disturbances. Where natural disturbances have occurred, DEQ expects responsible persons, including DMAs to assess and prioritize these areas for streamside restoration following an event.

The streamside evaluation must be completed according to the timeline assigned in Table 10. The streamside evaluation will be utilized during the five-year review (see Section 5.3.9.2) to help assess progress in meeting implementation timelines, milestones, and measurable goals in subsequent five-year implementation cycles.

5.3.3 120-foot slope streamside buffer as an alternative to a streamside shade gap analysis

The responsible persons and DMAs that are required to complete a shade gap analysis (Section 5.3.4) and those that choose not to use DEQ's shade assessment (where available) for their prioritization framework (Section 5.3.2) may instead choose to establish and protect overstory, woody vegetation within a 120-foot slope buffer, as measured up-slope along the ground's contour (TSD Appendix G). The streamside buffer must be established through development of enforceable ordinances or regulations. The literature review found in the TSD (TSD Appendix G) indicates that potential shade loss associated with a 120-foot buffer will not cause stream temperature increases for most waterbodies. For this option, responsible persons, including DMAs, must ensure that any activity occurring within the 120-foot slope buffer would result in limited stream shade reduction and ensure that stream shade targets are still achieved at that location following management actions. Entities that choose this option must also complete a streamside evaluation, but do not have to complete a shade gap analysis (Section 5.3.2).

5.3.4 Streamside shade gap analysis

DEQ conducted a vegetation height and shade gap analysis within approximately 150-ft of specific modeled waterbodies in the Lower Columbia-Sandy Subbasin, as detailed in Section 9.1.4.3 of the TMDL rule. DEQ did not complete a shade gap analysis for the entire project area.

The shade gap analysis calculates the difference between current (i.e. assessed) effective shade versus the target effective shade. Where DEQ calculated a shade gap analysis, DEQ averaged the percent shade gap across all waterbodies within a DMA's jurisdiction. DEQ will provide the site-specific shade gap results upon request.

5.3.4.1 Streamside shade gap analysis methods for responsible persons and DMAs

If DEQ did not provide a shade gap analysis for a jurisdiction then that DMA is not required to complete a shade gap analysis unless they are named in Section 5.3.4.2. If DEQ has provided a shade gap analysis for a jurisdiction, then DMAs must either use DEQ's analysis to inform their streamside evaluation (Sec. 5.3.2), or location specific methods, such as ground measurements and remote sensing, to assess the current effective shade within their jurisdiction and whether effective shade allocations along Lower Columbia-Sandy Subbasin assessment units are met. These methods are described below.

1. Measure current effective shade at the stream surface using monitoring equipment, such as the Solar Pathfinder™, or using a hemispherical camera system and imagery analysis software.
    a. Determine general vegetation type, canopy density, stream width and stream orientation.
    b. Compare current effective shade results to either target effective shade from DEQ's shade gap analysis, or to the target percent effective shade values derived from the shade curves in the TMDL to assess the percent effective shade gap.
    c. Entities choosing to use this methodology must submit their assessment strategy to DEQ for approval. Assessments should conform to guidelines outlined in OWEB's Addendum to Water Quality Monitoring Technical Guide Book, Ch. 14: https://www.oregon.gov/oweb/Documents/Stream-Shade-Canopy-Cover-WQ-Monitoring-Guidebook-addendum-ch14.pdf (OWEB, 1999)
2. Conduct modeling using the Heat Source model (as used in this TMDL).
3. Another method approved by DEQ through the TMDL implementation plan approval process.

A project plan which includes a description of the assessment methodology must be submitted to DEQ for review and approval according to the timeline assigned in Table 10. Method documentation for Solar Pathfinder™ can be accessed at https://www.solarpathfinder.com/pdf/pathfinder-manual.pdf.

5.3.4.2 Shade gap analysis requirements for ODF, ODA, BLM, and USFS

Together, ODF, ODA, BLM and USFS collectively have jurisdiction of more than 90% of the land area within 150 feet of streams within the Lower Columbia-Sandy Subbasin project area. Increasing shade on streams within the extensive areas within their jurisdictions is important to achieving the surrogate shade measures of this TMDL. Therefore, ODF, ODA, BLM and USFS must complete a streamside evaluation (Section 5.3.2), as well as a shade assessment for streamside areas within their jurisdiction. The assessment must use methods described in Section 5.3.4.1 for determining whether effective shade allocations along the Lower Columbia-Sandy/Subbasin assessment units are met. A shade assessment is not needed for those areas where DEQ has completed a shade gap analysis, or for those areas where DEQ has determined the streamside buffers are sufficient (Section 5.2). The shade gap analysis requirement includes intermittent streams as defined in the TMDL. For more information on intermittent streams and which are included in temperature TMDLs see TSD Section 2.4. A project plan which includes a description of the shade gap assessment methodology, including any methodology that proposes target effective shade values different from the shade curves developed by DEQ, must be submitted to DEQ for review and approval according to the timeline assigned in Table 10.

5.3.5 Target effective shade values and shade curves

Shade curves, which are charts that represent the mean effective shade target for different mapping units, stream aspects, and active channel widths (TMDL Section 9.1.4.4), were developed (Figures 9-2 – 9-9 in the TMDL rule) to allow users to find target percent effective shade values for streams based on several stream characteristics. Unlike the site-specific shade targets and shade gap analysis (TMDL Section 9.1.4.3), shade curves do not calculate current effective shade. Any responsible person including DMAs can use DEQ shade curves,

site-specific shade targets, or other DEQ- approved method to assess and recommend an effective shade target for their jurisdiction.

TMDL implementation plans must include the mean effective shade targets calculated by DEQ, if available, (Table 9-10 in the TMDL rule document), or any updated effective shade target assessment approved or performed in the future.

5.3.6 Percent consumptive use

The TMDL rule includes a percent consumptive use surrogate measure, which can be used to ensure that water management and water withdrawal activities meet the portion of the human use allowance assigned to such uses in the TMDL. The percent consumptive use is the percent of natural surface flow that does not return to surface water after it has been withdrawn for a water use activity. The natural flow rate is based on the monthly median natural flow. As modeled for the Sandy River at the location of USGS gage 14142500 (Sandy River below Bull Run), the TMDL indicates that a consumptive use flow rate reduction of 1.90% will maintain the human use allowance associated with water withdrawal activities. DEQ anticipates using the consumptive use surrogate measure when reviewing new applications for water rights in the Lower Columbia-Sandy Subbasin. Additional detail regarding this surrogate measure is included in Section 9.1.4.5 of the TMDL rule.

5.3.7 TMDL implementation plan requirements for dam owners

DEQ is using a surrogate measure to implement the load allocation for dam and reservoir operations. This means that reservoir operations must not contribute any additional warming above the upstream temperatures entering the reservoir. Section 9.1.4.1 of the TMDL rule contains more information regarding dam and reservoir operations.

All dam and reservoir operators named in Table 9 must submit an implementation plan that addresses the monitoring and assessment requirements described in Section 5.3.7.1. If monitoring and assessment show that dam operations contribute additional warming above upstream temperatures entering the reservoir, then the operator can choose to either:

1. Complete a cumulative effects analysis which demonstrates that releasing waters warmer than the surrogate measure would not contribute to downstream exceedances of water quality standards, or
2. Update their TMDL implementation plan to include structural and operational strategies for mitigating temperature increases.

If a cumulative effects analysis demonstrates that dam operations will contribute to additional downstream warming, then the operator must update their implementation plan to include specific mitigation strategies for temperature. If DEQ determines sufficient data are available to demonstrate that stream temperature does not increase between a reservoir's inflow and outflow, then the reservoir operator may not be required to update their implementation plan for structural and operational management strategies.

Dam and reservoir operators that have jurisdiction over streamside areas must also develop a TMDL implementation plan to implement streamside management strategies even if a future updated TMDL implementation plan is not required for dam and reservoir management. See

Sections 5.3.2 through 5.3.4 for additional information regarding streamside management implementation plan requirements.

DEQ is not focusing implementation requirements on dams owned and operated by individuals or businesses (See Appendix A for the entire list of dams in the Lower Columbia-Sandy Subbasin project area). Additionally, DEQ is not requiring reservoir management plans for dams that are operated to manage seasonal flow to sustain ecological benefits associated with wetlands and marshes. DEQ encourages partnerships between DMAs and individual dam operators within their jurisdictions to evaluate ways in which these dams could be managed to reduce temperature impacts.

Table 9: Large dam owners responsible for monitoring and that may be required to submit an implementation plan that includes reservoir management strategies.

No.	Dam Name	Owner	Reservoir Storage (acre-ft)
1	Bull Run Lake Dam	City of Portland	14,500
2	Trillium Lake	Oregon Dept. of Fish and Wildlife	380
3	Wahkeena Rearing Reservoir	Oregon Dept. of Fish and Wildlife	180
4	Development No. 1 Dam	City of Portland	33,760
5	Development No. 2 Dam	City of Portland	25,000

5.3.7.1 Monitoring requirements for dam owners

Dams and reservoirs alter solar radiation flux and seasonally increase surface temperatures compared to free-flowing stream segments. Increased temperatures may lead to violations of water quality temperature standards and impact aquatic life. Water released from the hypolimnion of stratified reservoirs may cool downstream reaches during the summer leading to attainment of water quality standards. In the fall, a reservoir may become isothermal and contribute to stream warming downstream of the reservoir.

Section 9.1.4.1 of the TMDL rule identifies a temperature surrogate measure target for dam and reservoir operations. Attainment of this target requires assessment of temperatures up and downstream of the dam and reservoir based on the seven-day average of the daily maximum temperature (7DADM).

Dam owners in Table 9 will collect temperature data and potentially assess temperature dynamics associated with their dam and reservoir operations using a mechanistic model, empirical model, and/or analysis of continuous temperature data collected upstream, downstream, and in the reservoir. The assessment shall include:

1. Collection of continuous temperature data to characterize reservoir inflow and outflow temperatures. If multiple streams flow into the reservoir, 7DADM temperatures upstream of the reservoirs may be calculated as a flow weighted mean of temperatures from each inflowing tributary. The estimated free flowing (no dam) temperatures may be calculated using a mechanistic or empirical model to account for any warming or cooling that would occur through the reservoir reaches absent the dam and reservoir operations.
    a. Continuous temperature data must be collected for four consecutive years and must be collected during the critical period. Previously collected data can

be used as long as it meets DEQ QA/QC protocols and collected within the last five years.

2. Reservoir temperature profiles to sufficiently characterize timing and extent of thermal stratification, and

3. Measurement of reservoir water level fluctuations and outflow rates

Temperature data must be submitted to DEQ and uploaded to the Ambient Water Quality Monitoring System, or through another online publicly accessible database approved by DEQ. These data will be used for the following purposes:

1. establishing baseline conditions,
2. adaptive management, and
3. evaluation of site-specific approaches to reduce temperature impacts.

DEQ recommends dam owners develop a mechanistic or empirical model to predict and compare inflow and outflow temperatures. This model will be used to develop effective management strategies to reduce temperature.

For reservoirs on reaches where DEQ has determined that the protecting cold water criterion does not apply, operators are required to select one of the two following options. The first option is to ensure that discharges meet the temperature target surrogate measure (TMDL rule Section 9.1.4.1). The second option is to prepare a cumulative effects analysis to demonstrate that water releases that periodically exceed the ambient temperature criteria would not contribute to cumulative warming above water quality standards at downstream locations. Reservoir operators who choose this second option will be required to submit a QAPP to DEQ for review and approval. Required elements of the QAPP include descriptions of the dataset and cumulative effects approach that will be used to assess downstream temperature impacts.

5.3.7.2 Protecting cold water criterion

The “protecting cold water” criterion in OAR 340-041-0028(11) applies to waters of the state that have summer seven-day-average maximum ambient temperatures that are colder than the biologically based criteria. With some exceptions, these waters may not be warmed cumulatively by anthropogenic point and nonpoint sources by more than 0.3 degrees Celsius (0.5 degrees Fahrenheit) above the colder water ambient temperature. Reservoir operators on reaches where protecting cold water apply must meet the cold-water criterion. DEQ’s current assessment shows that the protecting cold water criterion does not likely apply at this time to any dams and reservoirs in the Lower Columbia-Sandy project area. Application of this criterion could change due to updated assessments in the future. Additional information can be found in the TMDL rule Section 9.1.4.1.

If DEQ determines sufficient data is available to demonstrate that stream temperature does not increase from upstream of dam to downstream of dam, then the reservoir operator may not be required to develop a TMDL implementation plan for dam management.

5.3.7.2 City of Portland

The TMDL rule includes a stream temperature surrogate measure for use by the city of Portland to implement the load allocation for dam and reservoir operations for the Bull Run project. Additional detail regarding this surrogate measure is included in Section 9.1.4.2 of the TMDL rule.

5.3.8 Timeline and schedule

Each implementation plan must include a commitment to enact specific management strategies on a reasonable timeline, with a schedule specified for meeting measurable milestones to demonstrate progress. To meet the intent of this requirement and be useful for the requirement to track and report progress, entities should develop management strategies using the SMART elements: Specific, Measurable, Achievable, Relevant, Time-bound (Doran, 1981).

Timelines and milestone schedules should be informed by the streamside evaluation, as described in Section 5.3.2 above, and should consider all relevant factors of an entity's specific situation. The due dates and timelines for specific information and analyses discussed in Sections 5.3.2 and 5.3.4 are shown in Table 10 below. DMA timelines in TMDL implementation plans that differ from timelines stated below must be approved by DEQ.

Table 10: Due dates for implementation plans and analyses. See sections 5.3.1 through 5.3.7 for more details.

Requirement	Due Date / Timeframe
TMDL implementation plan	18 months after EQC adoption of Willamette Mainstem TMDL*
Streamside Evaluation (Section 5.3.2)	Three years after EQC adoption of Willamette Mainstem TMDL
Project plan and description of the assessment methodology to be used to complete a shade gap analysis (Section 5.3.4)	18 months after EQC adoption of Willamette Mainstem TMDL
Streamside shade gap analysis (Section 5.3.4) and updated streamside evaluation OR 120 ft. streamside buffer that establishes and protects overstory, woody vegetation (Section 5.3.3)	Four years after implementation plan submission deadline
Reservoir operators named in Table 8 (Sec. 5.3.7): Quality Assurance Project Plan for temperature monitoring for each reservoir	18 months after EQC adoption of Willamette Mainstem TMDL. Following the temperature assessment, the DMA will consult with DEQ on a timeframe for submitting a cumulative effects analysis, or TMDL implementation plan as needed.

Requirement	Due Date / Timeframe
	Some reservoir operators must also submit a streamside evaluation and implementation plan for streamside management. See section 5.3.2 for details.
ODA, ODF, USFS, BLM: Quality Assurance Project Plans or project-specific Sampling and Analysis Plans for temperature (Sec. 6.1)	As directed by DEQ following development of a Willamette Basin wide monitoring strategy
***** The Willamette Mainstem TMDL is a separate temperature TMDL to be developed and approved following the Lower Columbia-Sandy Subbasin TMDL.	

5.3.9 Reporting of performance monitoring and plan review and revision

5.3.9.1 Reporting on performance monitoring

Each implementation plan must include a commitment to prepare annual reports on performance monitoring and a date by which they will be submitted to DEQ. These reports must include implementation tracking for each of the identified management strategies, progress toward timelines and measurable milestones specified in the implementation plan, and evaluation of the effectiveness of the strategies.

DMAs should track implementation actions by accounting for the number, type and location of projects, best management practices, education activities, or other actions taken to improve or protect water quality. While most DMAs will track implementation actions they are directly responsible for completing, some may need to track and report on actions that they implement through their support of other land managers (e.g., private landowners).

Oregon Watershed Restoration Inventory Reporting Requirement

Projects that implement temperature related practices listed in OWEB's OWRI Online List of Treatments must be reported once by DMAs to the OWRI database (OWEB, 2023 and 2023a) upon project completion. DEQ utilizes OWRI's database to track implementation activities for various reporting requirements. Responsible persons, including DMAs, must also include implementation activities in annual reports to DEQ to document progress and track implementation actions over time.

Documenting restoration activities in other publicly accessible databases is allowable when approved by DEQ.

Adaptive Management

Implementation plans must include a commitment to use adaptive management to evaluate the effectiveness of implementation activities in improving streamside conditions including stream shade. Annual reports must summarize the status and results of these evaluations on the relevant time scale. At a minimum, reports in year five must summarize implementation and effectiveness over the preceding four years.

5.3.9.2 Implementation plan review and revision

Implementation plans must be reviewed by each responsible person and DMA, revised to incorporate lessons learned, and approved by DEQ every five years. At a minimum, plans must be revised to reflect updated timelines for the continuation of implementation activities for the next five years. DEQ will use implementation and effectiveness evaluations from annual reports for this review. If implementation plan revisions are needed to correct deficiencies or otherwise ensure the plan is effective following the year five review, DEQ will identify a date for submission of the revised plan for DEQ approval.

5.3.10 Public involvement

As required in OAR 340-042-0040(4)(l)(L), implementation plans prepared by designated management agencies must include a plan to involve the public in implementation of management strategies. Public engagement and education must be included to meet this requirement.

5.3.11 Maintenance of strategies over time

As required in OAR 340-042-0040(4)(l)(M), implementation plans prepared by responsible persons, including designated management agencies, should include discussion of planned efforts to maintain management strategies over time.

5.3.12 Implementation costs and funding

As required in OAR 340-042-0040(4)(l)(N), this section provides a general discussion of costs and funding for implementing management strategies. Implementation of management strategies to reduce and prevent pollution into waters of the state may incur financial capital or operating costs. These costs vary in relation to pollutant sources and loading, proximity to waterways and type or extent of preventative controls already in place. Certain management practices, such as preventative infrastructure maintenance, may result in long-term cost savings to responsible persons, including DMAs, or landowners.

OAR 340-042-0040(4)(l)(N) also indicates that sector-specific or source-specific implementation plans may provide more detailed analyses of costs and funding for specific management strategies in the plan. DEQ requires each DMA to provide a fiscal analysis of the resources needed to develop, execute, and maintain the programs and projects described in implementation plans to the extent that these costs can be accounted for or estimated. DEQ recommends that all responsible persons prepare the following level of economic analysis.

- Staff salaries, supplies, volunteer coordination costs, regulatory fees
- Installation, operation and maintenance of management measures
- Monitoring, data analysis and plan revisions
- Public education and outreach efforts
- Ordinance development (if needed to implement a management strategy)

This analysis should be in five-year increments to estimate costs, demonstrate sufficient funding is available to begin implementation or that there is a plan for obtaining the necessary funding, and identify potential future funding sources to sustain management strategy implementation. DMAs may include actual costs spent on implementation activities as part of annual TMDL

reporting. This information may help DEQ estimate actual costs associated with implementing current and future temperature TMDLs.

There are multiple sources of local, state and federal funds available for implementation of pollutant management strategies and control practices. Table 11 provides a partial list of financial incentives, technical assistance programs, grant funding, and low interest loans for public entities available in Oregon that may be used to support implementation of assessment, pollution controls, and watershed restoration actions or land condition improvements that improve water quality in the Lower Columbia-Sandy Subbasin. Soil and water conservation districts and watershed councils are additional resources that may support responsible persons and DMAs in implementation of pollutant management strategies and control practices through the programs listed in Table 11.

Table 11: Partial list of funding programs available in the Lower Columbia-Sandy Subbasin

Program	General Description	Contact
Clean Water State Revolving Fund	Loan program for below-market rate loans for planning, design, and construction of various water pollution control activities.	DEQ
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
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
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
Drinking Water Source Protection Fund	These funds allow states to provide loans for certain source water assessment implementation activities, including source water protection land acquisition and other types of incentive-based source water quality protection measures.	Oregon Health Authority
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
Emergency Forest Restoration Program (EFRP)	Available through the USDA-Natural Resources Conservation Service. Helps owners of non-industrial private forests restore forest health damaged by natural disasters.	USDA
Oregon 319 Nonpoint Source Implementation Grants	Fund projects that reduce nonpoint source pollution, improve watershed functions and protect the quality of surface and groundwater, including restoration and education projects.	DEQ
Environmental Quality Incentives Program (EQIP).	Cost-shares water quality and wildlife habitat improvement activities, including conservation tillage,	NRCS

Program	General Description	Contact
	nutrient and manure management, fish habitat improvements, and riparian plantings.	
Agriculture Water Quality Support Grant	Provides capacity to support voluntary agricultural water quality work in small watersheds and to meet the goals of the Agricultural Water Quality Management Area Plans and the SIA initiative.	ODA
Agricultural Conservation Easement Program (ACEP)	Provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits.	NRCS
Farm and Ranchland Protection Program (FRPP)	Cost-shares purchases of agricultural conservation easements to protect agricultural land from development.	NRCS, SWCDs, ODF
Federal Reforestation Tax Credit	Provides federal tax credit as incentive to plant trees.	Internal Revenue Service
Grassland Reserve Program (GRP)	Provides incentives to landowners to protect and restore pastureland, rangeland, and certain other grasslands.	NRCS
Landowner Incentive Program (LIP)	Provides funds to enhance existing incentive programs for fish and wildlife habitat improvements.	U.S. Fish and Wildlife Service
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 percent local match requirement on all grants.	OWEB
Oregon Watershed Enhancement Board Small Grant Program	Provides grants up to $10,000 for priority watershed enhancement projects identified by local focus group.	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
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
ODF Small Forestland Investment in Stream Habitat (SFISH) Grants	Provides funding for Small Forestland Owners (SFO's) to improve road conditions and stream crossings as part of forest operations.	ODF
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
Forest Stewardship Program	Provides cost share dollars through USFS funds to family forest landowners to have management plans developed.	ODF

Program	General Description	Contact
Western Bark Beetle Mitigation	ODF administers a cost share program for forest management practices pertaining to bark beetle mitigation for forest health and is funded through the USFS.	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
Wetlands Reserve Program (WRP)	Provides cost-sharing to landowners who restore wetlands on agricultural lands.	NRCS
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
Funding Resources for Watershed Protection and Restoration	EPA's Funding Resources for Watershed Protection and Restoration (EPA, 2023) contains links to multiple funding sources	Various

5.4 Schedule for implementation plan submittal

OAR 340-042-0040(4)(l)(I) specifies that the WQMP contain a schedule for submittal of implementation plans. As stated in OAR 340-042-0080(4)(a), entities identified in the WQMP with responsibility for developing implementation plans are required to prepare and submit an implementation plan for DEQ approval according to the schedule in the WQMP.

Within 18 months of EQC adoption of the Willamette Basin mainstem TMDL (planned for February 2025), persons, including DMAs, responsible for developing implementation plans must submit implementation plans to DEQ for review and approval.

OAR 340-012-0055(e) identifies failure to timely submit or implement a TMDL implementation plan, as required by DEQ order or rule, as a Class II violation. OAR 340-012-0053(1) identifies failure to report by the reporting deadline, as required by DEQ order or rule, as a Class I violation.

Should a sector or sector-wide DMA fail to submit an approvable TMDL implementation plan or fail to timely implement the plan, DEQ may pursue enforcement under OAR 340-012-0055(2)(e) or identify individual sources (landowners/operators) as persons responsible for developing and implementing TMDL implementation plans to address the load allocations relevant for the sector. DEQ may revise the WQMP or issue individual orders to identify additional responsible persons and notify them of the required schedule for submitting source-specific implementation plans.

Following the issuance of the TMDL and this WQMP, DEQ may determine that nonpoint source implementation plans are not necessary for certain entities identified in the WQMP based on available information or new information provided by those entities. For these entities, DEQ will provide a written determination of why a plan is not required. This determination could be based on a variety of factors, such as inaccurate identification within the geographic scope of the TMDLs, or documentation that an entity is not a source of pollution or does not discharge pollutants to a waterbody within the geographic scope of a TMDL.

Once approved, DEQ expects implementation plans to be fully implemented according to the timelines and schedules for achieving measurable milestones specified within the plans. Implementation plans must be reviewed and revised as appropriate for DEQ approval every five years and submitted on the date specified in DEQ's approval letter for an implementation plan.

6. Monitoring and Evaluation of Progress

OAR 340-042-0040(4)(l)(K) requires that the WQMP include a plan to monitor and evaluate progress toward achieving the TMDL allocations and associated water quality standards for the impairments addressed in the TMDL. Additional objectives of monitoring efforts are to assess progress towards reducing excess pollutant loads and to better understand variability associated with environmental or anthropogenic factors. This section summarizes DEQ's approach, including the required elements of identification of monitoring responsibilities and the plan and schedule for reviewing monitoring information to make TMDL revisions, as appropriate.

There are two fundamental components to DEQ's approach to monitoring and evaluating TMDL progress:

1. Tracking the implementation and effectiveness of activities committed to by responsible persons in DEQ-approved implementation plans, and
2. Periodically monitoring the physical, chemical and biological parameters necessary to assess water quality status and trends for the impairments that constitute the basis for this TMDL.

All responsible persons, including DMAs, are responsible for tracking the implementation and effectiveness of their actions and meeting milestones where established. The streamside evaluation (section 5.3.2) will provide a baseline for DMA implementation plans against which DMA progress will be assessed. DEQ acknowledges that it will take decades for restored streamside areas to provide mature, overstory woody vegetation that shades streams, so DEQ will rely on tracking implementation compliance through DEQ approved implementation plans, annual reports, and comprehensive year five reviews (section 5.3.9) in the coming years.

DEQ effective shade targets are regulatory and can be used to assess implementation progress in the future. In areas where stream temperature criteria are not met, DEQ will assess the status of current conditions and effective shade targets as part of the adaptive management process. DEQ will also evaluate other restoration efforts that have been implemented to improve stream temperature, for example channel morphology and stream flow restoration, protection and enhancement of cold-water refuges, etc. In cases where DEQ determines implementation actions are not making sufficient progress, DEQ will rely on the adaptive management process and our enforcement authority to assess compliance with the load allocations.

With input from partners, DEQ will develop an overarching sampling and analysis plan to finalize the first iteration of the Lower Columbia-Sandy Subbasin Monitoring Strategy, after the issuance of the Willamette Basin Mainstem Temperature TMDL and WQMP. DEQ will continue to work with partners to implement the sampling and analysis plan and refine the strategy as needed. Although DEQ encourages responsible persons, including DMAs, to conduct physical, chemical

or biological monitoring to better evaluate how implementation actions may impact water quality conditions, DEQ is only requiring the DMAs listed under section 6.1 to conduct water column monitoring associated with this TMDL.

6.1 Persons responsible for monitoring

Section 5.1 identifies the Designated Management Agencies and other persons responsible for developing TMDL implementation plans and implementing the management strategies described on the timelines committed to in approved plans. Section 5.3 details the content required in implementation plans and annual reports, as well as the schedules for their submittal.

DEQ is requiring USFS, BLM, ODF, and ODA to undertake monitoring actions in areas within their jurisdiction or ownership to help determine the status of instream water quality and landscape conditions associated with water quality. Combined, the USFS, BLM, ODF, and ODA have jurisdiction over more than 90% of the streamside areas within the Lower Columbia-Sandy Subbasin. For this reason, DEQ considers it appropriate for these agencies to collaborate with DEQ on the Monitoring Strategy. The city of Portland (Portland Water Bureau) has specific monitoring requirements related to reservoir management of the Bull Run project (see below). DEQ encourages and invites other DMAs to collaborate with DEQ on collecting water quality data, especially DMAs that have been collecting temperature data as part of TMDL implementation or other related programs.

This effort will be iterative, starting with the review of existing data and monitoring locations, then adjusted as needed to improve understanding of current water quality status and to develop a temperature trend monitoring network. DEQ expects to refine this monitoring strategy over time and modify as necessary.

Objectives for monitoring and assessment will be described in DMA implementation plans and will include, but are not limited to:

1. Provide information necessary to determine locations for applying management strategies or to assess the effectiveness of those strategies.
2. Refine information on source-specific or sector-specific pollutant loading.
3. Provide information necessary to demonstrate progress towards meeting load allocations.
4. Provide information used to identify roles and participate in a collaborative effort among responsible persons to characterize water quality status and trends.
5. Provide information integral to an adaptive management approach to inform and adjust management strategies over time.

Environmental media and water column monitoring activities conducted by ODA, ODF, BLM, USFS, or other DMAs to meet TMDL objectives, data collection and management must be performed in adherence to Quality Control procedures and Quality Assurance protocols established by DEQ, U.S. EPA, or other appropriate organizations. This requirement will be met through developing or adapting Quality Assurance Project Plans and/or project-specific Sampling and Analysis Plans and submitting the plans to DEQ for review and approval based on a schedule determined by DEQ once development of the Monitoring Strategy has been initiated. USFS, BLM, ODF, ODA, or other DMAs can also agree to participate in a collaborative monitoring plan under an umbrella QAPP. DEQ staff will coordinate QAPP development with

USFS, BLM, ODF, and ODA upon request in advance of submission. Resources for developing QAPPs and sampling and analysis plans are available on DEQ's water quality monitoring website (DEQ, 2023).

At a minimum, USFS, BLM, ODF, and ODA must acknowledge in their implementation plans their responsibility in collaborating with DEQ to develop the Lower Columbia-Sandy Subbasin Temperature Monitoring Strategy. DEQ encourages these agencies to begin evaluating their existing temperature monitoring networks, if any, and explore opportunities to establish future long-term monitoring sites. Data collected by DMAs participating in the monitoring strategy must be in a format accessible to DEQ.

Specific City of Portland (Portland Water Bureau) Monitoring Requirements

The city of Portland is responsible for reservoir management of the Bull Run project and manages flow releases to meet temperature standards. To implement and assess the temperature surrogate measure in TMDL Section 9.1.4.2, DEQ requires the city to collect stream temperature and discharge data to:

1. Establish a continuous temperature monitoring site at the lamprey barrier downstream of Bull Run reservoir #2.
2. Maintain a continuous discharge and temperature monitoring site at the location of USGS gage 14141500 if that gage is discontinued or until DEQ approves an alternative approach to calculate the free flowing no dam temperatures.
3. Use the USGS defined QA/QC protocol for their gages or develop a monitoring QAPP for DEQ's approval.
4. Submit data to DEQ through the Ambient Water Quality Monitoring System, or to another publicly accessible database approved by DEQ.

6.2 Plan and schedule for reviewing monitoring information and revising the TMDL

DEQ recognizes that it will take time before management practices identified in a WQMP are fully implemented and effective in reducing and controlling pollution. DEQ also recognizes that despite best efforts, natural events beyond the control of humans may interfere with or delay attainment of the TMDL. Such events include, but are not limited to, floods, fire, insect infestations, and drought. In addition, DEQ recognizes that technology and practices for controlling nonpoint source pollution will continue to develop and improve over time. DEQ will use adaptive management to refine implementation as technology, and knowledge about these approaches progress.

Adaptive management is a process that acknowledges and incorporates improved technologies and practices over to refine implementation. A conceptual representation of the TMDL adaptive management process is presented in Figure 3.

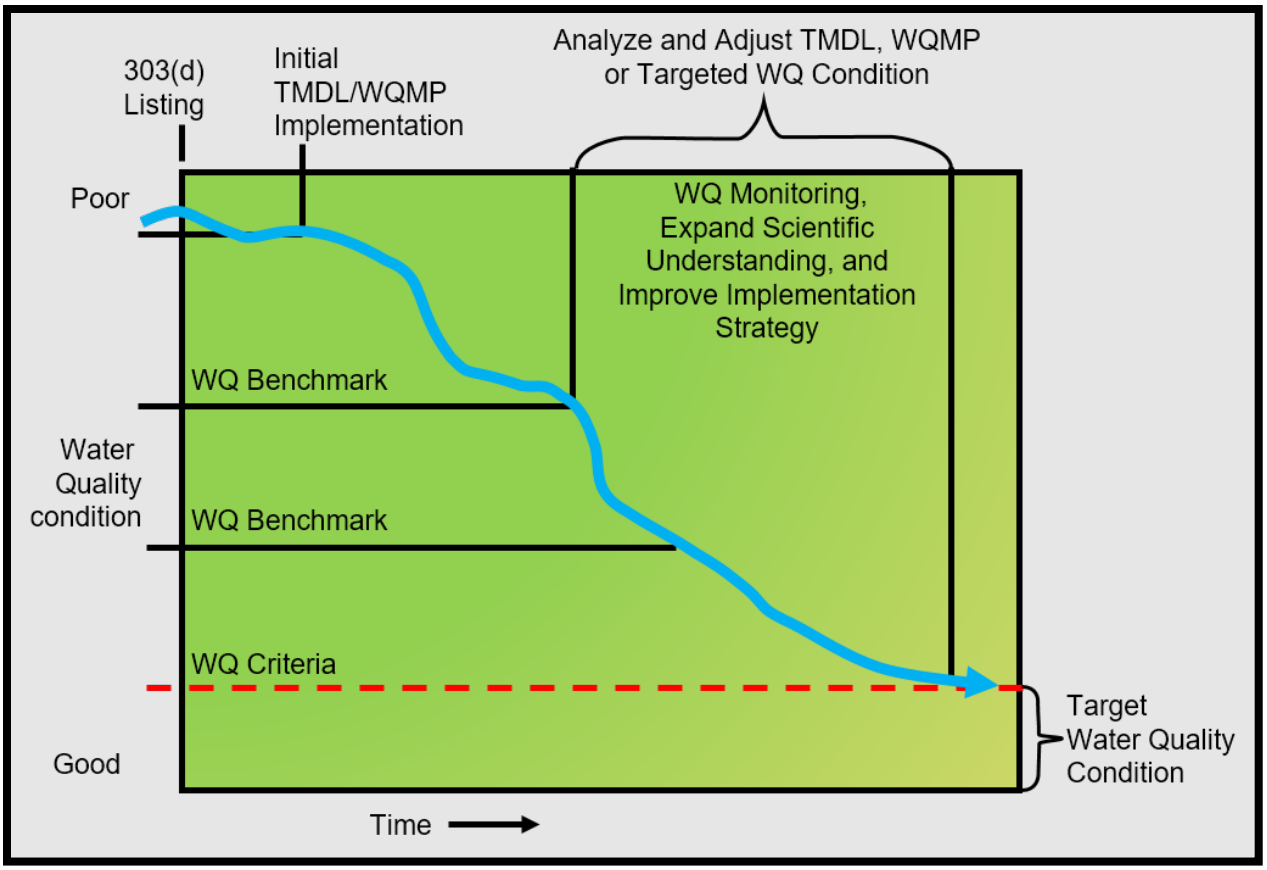

Figure 3: Conceptual representation of adaptive management

DEQ considers entities complying with DEQ-approved TMDL implementation plans to be in compliance with the requirements in the TMDLs. The annual reports and Year Five Reviews submitted to DEQ by each of the responsible persons, including DMAs, in the Lower Columbia-Sandy Subbasin will be evaluated individually and collectively. DEQ will use this information to determine whether management actions are supporting progress towards TMDL objectives, or if changes in management actions and/or TMDLs are needed.

DEQ will review annual reports, participate with responsible persons, including DMAs, in review of monitoring information, and participate in implementing the Lower Columbia-Sandy Subbasin Monitoring Strategy.

Every five years, DEQ will collectively evaluate annual reports and all available monitoring data and information to assess progress on meeting the goals of the TMDLs and WQMP.

- DEQ will require responsible persons including DMAs to revise their implementation plans to address deficiencies where DEQ determines that implementation plans, or effectiveness of management strategies are inadequate.
- DEQ and partners will revise sampling and analysis plans or other aspects of the Monitoring Strategy where progress toward meeting Monitoring Strategy objectives is not being made.
- DEQ will consider TMDL revisions if DEQ's evaluation of water monitoring data and supporting information indicate that the TMDL load allocations for a given pollutant-impairment are insufficient to meet state numeric criteria or narrative criteria, or insufficient to protect the designated beneficial uses.

- DEQ will follow all public participation requirements, including convening a local technical or rulemaking advisory committee to provide input on TMDL revisions per OAR 340-042-0040(7).

7. Reasonable Assurance of Implementation

OAR 340-042-0030(9) defines Reasonable Assurance as “a demonstration that a TMDL will be implemented by federal, state or local governments or individuals through regulatory or voluntary actions including management strategies or other controls.” OAR 340-042-0040(4)(l)(J) requires a description of reasonable assurance that management strategies and sector-specific or source-specific implementation plans will be carried out through regulatory or voluntary actions. As a factor in consideration of allocation distribution among sources, OAR 340-042-0040(6)(g) states that “to establish reasonable assurance that the TMDL’s load allocations will be achieved requires determination that practices capable of reducing the specified pollutant load: (1) exist; (2) are technically feasible at a level required to meet allocations; and (3) have a high likelihood of implementation.” This three-point test is consistent with EPA past practice on determining reasonable assurance in the Chesapeake Bay TMDL (EPA, 2010) and supports federal antidegradation rules and Oregon’s antidegradation policy (OAR 340-041-0004).

The Clean Water Act section 303(d) requires that a TMDL be “established at a level necessary to implement the applicable water quality standard.” Federal regulations define a TMDL as “the sum of the individual wasteload allocations for point sources and load allocations for nonpoint sources and natural background” [40 CFR 130.2(i)]. For TMDL approval, EPA guidance documents and memos on the TMDL process requires determinations that allocations are appropriate to implement water quality standards and reasonable assurance that nonpoint source controls will achieve load reductions, when WLAs are based on an assumption that nonpoint source load reductions will occur (EPA, 1991, 2002 and 2012).

Although TMDL implementation is anticipated to improve rather than lower water quality, federal antidegradation rules at 40 CFR 131.12(a)(2), require states to “assure that there shall be achieved the highest statutory and regulatory requirements for all new and existing point sources and cost-effective and reasonable best management practices for nonpoint source control,” when allowing any lowering of water quality.

When a TMDL is developed for waters impaired by point sources only, the existence of the NPDES regulatory program and the issuance of NPDES permits provide the reasonable assurance that the wasteload allocations in the TMDL will be achieved. That is because federal regulations implementing the Clean Water Act require that water quality-based effluent limits in permits be consistent with “the assumptions and requirements of any available [wasteload allocation]” in an approved TMDL [40 CFR 122.44(d)(1)(vii)(B)].

Where a TMDL is developed for waters impaired by both point and nonpoint sources, it is the state’s best professional judgment as to the three-point test in OAR 340-042-0040(6)(g) on reasonable assurance that the TMDL’s load allocations will be achieved.

Where there is a demonstration that nonpoint source load reductions can and will be achieved; a determination that reasonable assurance exists and greater loads to point sources is appropriate. Without a demonstration of reasonable assurance that relied-upon nonpoint source reductions will occur, reductions to point sources wasteload allocations are needed.

The Lower Columbia-Sandy Subbasin TMDLs were developed to address both point and nonpoint sources with load reduction allocations proportional to estimated source contributions and in consideration of opportunities for effective measures to reduce those contributions. There are several elements that combine to provide the reasonable assurance to meet federal and state requirements, including for antidegradation. Education, outreach, technical and financial assistance, permit administration, permit enforcement, responsible person's implementation and DEQ enforcement of TMDL implementation plans will all be used to ensure that the goals of this TMDL are met.

7.1 Accountability framework

Reasonable assurance that needed load reductions will be achieved for nonpoint sources is based primarily on an accountability framework incorporated into the WQMP, together with the implementation plans of persons responsible for implementation. This approach is similar to the accountability framework adopted by EPA for the Chesapeake Bay TMDL, which was adopted in 2010 (EPA, 2010). Figure 4 presents the accountability framework elements, which are intended to work in concert to demonstrate reasonable assurance of implementation.

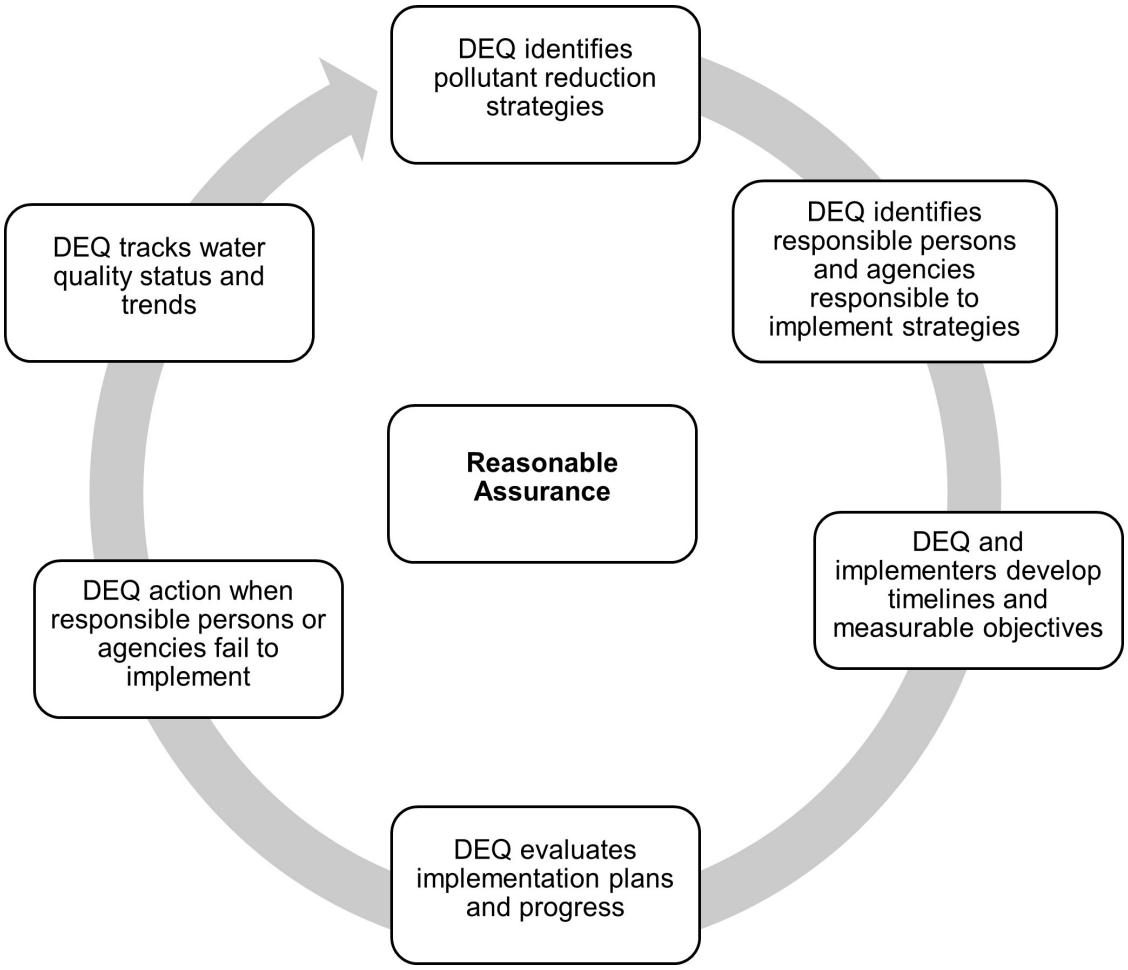

Figure 4: Representation of the reasonable assurance accountability framework led by DEQ

Pollutant reduction strategies are identified in Section 2 and more specific strategies, practices and actions will be detailed in each required implementation plan, to be submitted per the timelines in Section 5.4. These strategies and actions are comprehensively implemented through a variety of regulatory and non-regulatory programs. Many of these are existing strategies and actions that are already being implemented within the watershed and demonstrate reduced pollutant loading. These strategies are technically feasible at an appropriate scale to meet the allocations. A high likelihood of implementation is demonstrated because DEQ reviews the individual implementation plans and proposed actions for adequacy and establishes a monitoring and reporting system to track implementation and respond to any inadequacies.

In Oregon, forestry and agricultural related nonpoint source best management strategies are implemented through the state Forest Practices Act and agricultural Water Quality Management Area Plans and Rules. In Sections 5.2.1 and 5.2.2 DEQ determined that ODF and ODA must also develop and implement TMDL implementation plans that describe strategies specific to the Lower Columbia-Sandy Subbasin TMDLs. This adds to the accountability for implementation of cost-effective and reasonable best management and further assures that antidegradation requirements and narrative criteria will be met.

The persons, including Designated Management Agencies, responsible for implementation of pollutant reduction strategies are identified in Section 5. General timelines, milestones and measurable objectives will be specified in each required implementation plan. Attaining the relevant water quality criteria are provided in Sections 3 and 4.2, respectively. These elements support timely action by both DEQ and other entities responsible for implementation so that enforcement and adaptive management actions can be triggered and evaluation of attainment of TMDL goals occurs.

DEQ periodically reviews reporting by persons and agencies responsible for implementing pollutant reduction strategies to track the management strategies and actions being implemented and evaluate achievements against established timelines and milestones.

Following up on reviews to track progress of implementation plans, DEQ will take appropriate action if the DMAs or responsible persons fail to develop or effectively implement their implementation plan or fulfill milestones. DEQ's actions can include enforcement or engagement in voluntary initiatives. DEQ uses both, as appropriate within the process, to achieve optimal pollutant reductions. In some cases, DEQ will also take enforcement actions where necessary based on authorities listed in Section 8 or raise issues to the Environmental Quality Commission, as provided in OAR 340-042-0080.

DEQ tracks water quality status and trends concurrently with implementation of management strategies. DEQ relies on a system of interconnected evaluations, which include DMAs meeting measurable objectives, effectiveness demonstration of pollutant management strategies, accountability of implementation, periodically assessing progress on Oregon's Nonpoint Source Program Five-Year Plan Goals (approved by EPA), discharge monitoring and instream monitoring. DEQ also periodically evaluates water quality data collected through ambient and specific monitoring programs, including monitoring plans developed specifically for the Lower Columbia-Sandy Subbasin, as presented in Section 6. DEQ regularly prepares Status and Trends reports and conducts water quality assessments on status of all waterways with adequate data in Oregon every two years, as required by the Clean Water Act for submittal to EPA for approval as DEQ's Integrated Report. Together, these data and evaluations allow refinement of focus on specific geographic areas or water quality issues and appropriate implementation of adaptive management actions to attain, over time, the objectives of the TMDL.

7.2 Reasonable assurance conclusions

DEQ's implementation approach is multi-faceted and requires many targeted management practices across the entire basin to reduce anthropogenic pollutants, regardless of source origination.

The management strategies and practices that must be employed to reduce excess solar radiation loading are spatially distributed and involve multiple responsible persons. Also, highly variable lag times are anticipated following the establishment of shade-producing vegetation to decrease solar radiation reaching streams. For these reasons, there is some uncertainty about the pace of achieving the needed reductions necessary in the Lower Columbia-Sandy Subbasin to attain water quality criteria. DEQ's WQMP addresses this uncertainty by including an extensive monitoring, reporting, and adaptive component that is designed to match the accountability framework used by EPA in its Chesapeake Bay TMDL (2010).

The rationale described in this document stems from robust evaluations, implements an accountability framework and provides opportunities for adaptive management to maximize pollutant reductions. In addition, DMAs and other groups have been continuing to implement on-the-ground actions since the establishment of the 2005 Sandy River Basin TMDL. Together this approach provides reasonable assurance to meet state and federal requirements, including for antidegradation, and attain the goals of the TMDL.

8. Legal Authorities

As required in Oregon Administrative Rule 340-042-0040(4)(l)(O), this section cites legal authorities relating to implementation of management strategies.

Clean Water Act, Section 303(d)

The DEQ is the Oregon state agency responsible for implementing the Clean Water Act in Oregon. The EPA delegates many Clean Water Act authorities to the State of Oregon which is administered by the Oregon Environmental Quality Commission through Oregon Revised Statute. Section 303(d) of the 1972 Federal Clean Water Act as amended requires states to develop a list of rivers, streams and lakes that cannot meet water quality standards without application of additional pollution controls beyond the existing requirements on industrial sources and sewage treatment plants. These waters are referred to as “water quality limited.” Water quality limited waterbodies must be identified by the EPA or by a state agency which has been delegated this responsibility by EPA. In Oregon, the responsibility to delegate water quality limited waterbodies rests with DEQ and DEQ’s list of water quality limited waters is updated every two years. The list is referred to as the 303(d) list. Section 303 of the Clean Water Act further requires that TMDLs be developed for all waters on the 303(d) list. The Oregon Environmental Quality Commission granted the DEQ Director authority to develop TMDLs and issue them as orders (OAR 340-042-0060). DEQ was granted authority by the commission to implement TMDLs through OAR 340-042 with special provisions for agricultural lands and nonfederal forestland as governed by the Agriculture Water Quality Management Act and the Forest Practices Act, respectively. The EPA has the authority under the Clean Water Act to approve or disapprove TMDLs that states submit. When a TMDL is officially submitted by a state to EPA, EPA has 30 days to take action on the TMDL. In the case where EPA disapproves a TMDL, EPA must issue a TMDL within 30 days. A TMDL defines the amount of pollution that can be present in the waterbody without causing water quality standards to be violated. A WQMP is developed to describe a strategy for reducing water pollution to the level of the load allocations and waste load allocations prescribed in the TMDL, which is designed to restore the water quality and result in compliance with the water quality standards. In this way, the designated beneficial uses of the water will be protected for all citizens.

Endangered Species Act, Section 6

Section 6 of the 1973 federal Endangered Species Act, as amended, encourages states to develop and maintain conservation programs for federally listed threatened and endangered species. In addition, Section 4(d) of the ESA requires the National Marine Fisheries Service to list the activities that could result in a “take” of species they are charged with protecting. With

regard to this TMDL, NMFS' protected species are salmonid fish. NMFS also described certain precautions that, if followed, would preclude prosecution for take even if a listed species were harmed inadvertently. Such a provision is called a limit on the take prohibition. The intent is to provide local governments and other entities greater certainty regarding their liability for take.

NMFS published their rule in response to Section 4(d) in July of 2000 (see 65 FR 42421, July 10, 2000). The NMFS 4(d) rule lists 12 criteria that will be used to determine whether a local program incorporates sufficient precautionary measures to adequately conserve fish. The rule provides for local jurisdictions to submit development ordinances for review by NMFS under one, several or all of the criteria. The criteria for the Municipal, Residential, Commercial and Industrial Development and Redevelopment limit are listed below:

1. Avoid inappropriate areas such as unstable slopes, wetlands, and areas of high habitat value;
2. Prevent stormwater discharge impacts on water quality;
3. Protect riparian areas;
4. Avoid stream crossings – whether by roads, utilities, or other linear development;
5. Protect historic stream meander patterns;
6. Protect wetlands, wetland buffers, and wetland function;
7. Preserve the ability of permanent and intermittent streams to pass peak flows (hydrologic capacity);
8. Stress landscaping with native vegetation;
9. Prevent erosion and sediment run-off during and after construction;
10. Ensure water supply demand can be met without affecting salmon needs;
11. Provide mechanisms for monitoring, enforcing, funding and implementing; and
12. Comply with all other state and federal environmental laws and permits.

Oregon Revised Statute Chapter 468B

DEQ is authorized by law to prevent and abate water pollution within the State of Oregon. Particularly relevant provisions of this chapter include:

ORS 468B.020 Prevention of pollution

(A) Pollution of any of the waters of the state is declared to be not a reasonable or natural use of such waters and to be contrary to the public policy of the State or Oregon, as set forth in ORS 468B.015.

(B) In order to carry out the public policy set forth in ORS 468B.015, the Department of Environmental Quality shall take such action as is necessary for the prevention of new pollution and the abatement of existing pollution by:

a) Fostering and encouraging the cooperation of the people, industry, cities and counties, in order to prevent, control and reduce pollution of the waters of the state; and

b) Requiring the use of all available and reasonable methods necessary to achieve the purposes of ORS 468B.015 and to conform to the standards of water quality and purity established under ORS 468B.048.

ORS 468B.110 provides DEQ and the EQC with authority to take actions necessary to achieve and maintain water quality standards, including issuing TMDLs and establishing wasteload allocations and load allocations.

NPDES and WPCF Permits

DEQ administers two different types of wastewater permits in implementing Oregon Revised Statute (ORS) 468B.050. These are: the NPDES permits for waste discharge into waters of the United States; and Water Pollution Control Facilities permits for waste disposal on land. The NPDES permit is also a federal permit and is required under the Clean Water Act. The WPCF permit is a state program.

401 Water Quality Certification

Section 401 of the CWA requires that any applicant for a federal license or permit to conduct any activity that may result in a discharge to waters of the state must provide the licensing or permitting agency a certificate from DEQ that the activity complies with water quality requirements and standards. These include certifications for hydroelectric projects and for 'dredge and fill' projects. The legal citations are: 33 U.S.C. 1341; ORS 468B.035 – 468B.047; and OAR 340-048-0005 – 340-048-0040.

USACE Dam Operation and Management

In association with other federal statues, including House Document No. 531 Volume V, the River and Harbor Act, the Flood Control Act, and the Water Resources Development Act, the USACE is charged with operating its projects in compliance with the federal Clean Water Act, and in accordance with all federal, State, interstate and local requirements, administrative authority, and process and sanctions respecting the control and abatement of water quality pollution as per Title 1 Section 313 (33 U.S.C. 1323).

Oregon Forest Practices Act

The Oregon Department of Forestry is the designated management agency for regulating land management actions on non-federal forestry lands that impact water quality (ORS 527.610 to 527.992, and OAR 629 Divisions 600 through 665). The Board of Forestry has adopted water protection rules, including but not limited to OAR Chapter 629, Divisions 625, 630, and 635-660, which describe best management practices for forest operations. The Oregon Environmental Quality Commission, Board of Forestry, DEQ, and ODF have agreed that these pollution control measures will primarily be relied upon to result in achievement of state water quality standards. Statutes and rules also include provisions for adaptive management that provide for revisions to FPA practices where necessary to meet water quality standards. These provisions are described in ORS 527.710, ORS 527.765, OAR 629-035-0100, and OAR 340-042-0080.

Agricultural Water Quality Management Act

The Oregon Department of Agriculture is responsible for the prevention and control of water pollution from agricultural activities as directed and authorized through the Agricultural Water Quality Management Act, adopted by the Oregon legislature in 1993 (ORS 568.900 to ORS 568.933). It is the lead state agency for regulating agriculture for water quality (ORS 561.191). The Agricultural Water Quality Management Plan Act directs the ODA to work with local

communities to develop water quality management plans for specific watersheds that have been identified as violating water quality standards and have agriculture water pollution contributions. The agriculture water quality management plans are expected to identify problems in the watershed that need to be addressed and outline ways to correct the problems. Water Quality area rules for areas within the Sandy Basin include OAR 603-095-1300 to 1380.

Local Ordinances

Local governments are expected to describe in their Implementation plans their specific legal authorities to carry out the management strategies chosen to meet the TMDL allocations. If new or modified local codes or ordinances are required to implement the plan, the DMA will identify code development as a management strategy. Legal authority to enforce the provisions of a city's NPDES permit would be a specific example of legal authority to carry out management strategies.

9. References

BLM (U.S. Department of the Interior, Bureau of Land Management). 2016. *Northwestern & Coastal Oregon record of decision and resource management plan.*

DEQ. 2005. Sandy River Subbasin TMDL. Oregon Department of Environmental Quality. March 2005.

DEQ. 2024a. Lower Columbia-Sandy Temperature TMDL Technical Support Document. Oregon Department of Environmental Quality.

DEQ. 2024. Lower Columbia-Sandy Temperature TMDL. Oregon Department of Environmental Quality.

DEQ. 2023a. Water Temperature Impacts From In-Channel Ponds in Portland Metro and Northwest Region. February 2023.

DEQ. 2023. Volunteer Monitoring Resources webpage. https://www.oregon.gov/deq/wq/Pages/WQ-Monitoring-Resources.aspx. Accessed January 20, 2023.

Doran, George T. 1981. There's a S.M.A.R.T. way to write management's goals and objectives. Management Review. 70. Pages 35-36. https://community.mis.temple.edu/mis0855002fall2015/files/2015/10/S.M.A.R.T-Way-Management-Review.pdf. Accessed January 20, 2023.

EPA. 1991. Guidance for Water Quality-based Decisions: The TMDL Process. EPA/440/4-91-001. Washington, D.C.

EPA. 2002. Guidelines for Reviewing TMDLs under Existing Regulations issued in 1992. May 20, 2002.

EPA. 2007. National Management Measures to Control Nonpoint Source Pollution from Hydromodification. EPA 841-B-07-002. National Management Measures to Control Nonpoint Source Pollution from Hydromodification (epa.gov)

EPA 2010. Chesapeake Bay Total Maximum Daily Load for Nitrogen, Phosphorus and Sediment. https://www.epa.gov/chesapeake-bay-tmdl/chesapeake-bay-tmdl-document

EPA. 2012. Supplemental Information for Reviewing Reasonable Assurance in TMDLs. Office of Wetlands, Oceans and Watersheds. February 15, 2012.

EPA. 2017. Causal Analysis/Diagnosis Decision Information System (CADDIS): *Vol. 2: Sources, Stressors, and Responses - Temperature*. https://www.epa.gov/caddis-vol2/temperature

EPA. 2021. Columbia River Cold Water Refuges Plan. https://www.epa.gov/sites/default/files/2021-01/documents/columbia-river-cwr-plan-final-2021.pdf

EPA. 2023. Funding Resources for Watershed Protection and Restoration webpage. https://www.epa.gov/nps/funding-resources-watershed-protection-and-restoration. Accessed January 20, 2023.

Galli J., and R. Dubose. 1990. Thermal Impacts Associated with Urbanization and Stormwater Management Best Management Practices. Metropolitan Washington Council of Governments, Department of Environmental Programs, Washington DC.

Larson, L.L., and S.L. Larson. 1996. Riparian Shade and Stream Temperature: A Perspective. Rangelands, 18(4):149-152.

OWEB. 1999. Addendum to Water Quality Monitoring Technical Guide Book: Chapter 14 Stream Shade and Canopy Cover Monitoring Methods. https://www.oregon.gov/oweb/Documents/Stream-Shade-Canopy-Cover-WQ-Monitoring-Guidebook-addendum-ch14.pdf

OWEB. 2023. Oregon Watershed Restoration Inventory. https://www.oregon.gov/oweb/data-reporting/Pages/owri.aspx.

OWEB. 2023a. Oregon Watershed Restoration Inventory Online. https://apps.wrd.state.or.us/apps/oweb/owrio/default.aspx.

USFS and BLM (U.S. Department of Agriculture, Forest Service; U.S. Department of the Interior, Bureau of Land Management). 1994. *Record of decision for amendments to Forest Service and Bureau of Land Management planning documents within the range of the northern spotted owl*.

Appendix A: List of Large Reservoirs in the Lower Columbia-Sandy Subbasin TMDL Project Area

DEQ compiled this list of dams from the U.S. Army Corps of Engineers National Inventory of Dams (NID) database and a similar database maintained by the Oregon Water Resources Department (OWRD), dam safety program. DEQ requires the dams in bold to conduct monitoring related to temperature. Depending on analytical or modeling results, reservoir owners or operators may be required to develop a TMDL plan for temperature.

No.	Reservoir Name	NID ID	Owner Names	Owner Types	Primary Purpose	NID Reservoir Storage (Acre-Ft)
1	Mt. Hood Community College Dam	OR02466	Mt. Hood Community College	Local Government	Irrigation	25
2	Kelly Creek Regional Detention Pond	OR03793	City of Gresham	Public Utility; Local Government	Irrigation	67
3	Bull Run Lake Dam	OR00300	City of Portland	Local Government	Water Supply	14,500
4	Belchers Dam	OR00726	Darrold Belcher/Dan Belcher	Private	Irrigation	30
5	Osburn Reservoir	OR00436	Tom Lehman	Private	Recreation	52
6	Trillium Lake	OR00350	Oregon Dept. of Fish and Wildlife	State	Recreation	380
7	Wahkeena Rearing Reservoir	OR00362	Oregon Dept. of Fish and Wildlife	State	Other	180
8	Diack Reservoir	OR01543	Samuel L. Diack	Private	Irrigation	20
9	Sester, William H. Reservoir 1	OR00450	William H. Sester	Private	Irrigation	55
10	Development No. 1 Dam	OR00327	City of Portland	Local Government	Water Supply	33,760
11	Development No. 2 Dam	OR00317	City of Portland	Local Government	Water Supply	25,000