Modeling Quality Assurance Project Plan

South Umpqua and Umpqua Subbasins Temperature Total Maximum Daily Load

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State of Oregon
DEQ Department of Environmental Quality

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Abbreviations

AWQMS	Ambient Water Quality Monitoring System
BLM	United States Bureau of Land Management
DEQ	Oregon Department of Environmental Quality
DMR	Discharge Monitoring Report
EQC	Oregon Environmental Quality Commission
NCDC	National Climatic Data Center
NPDES	National Pollutant Discharge Elimination System
OAR	Oregon Administrative Rule
OWRD	Oregon Water Resources Department
QAPP	Quality Assurance Project Plan
RAWS	Remote Automatic Weather Stations
STP	Sewage Treatment Plant
TIR	Thermal Infrared Radiometry
TMDL	Total Maximum Daily Load
UBWC	Umpqua Basin Watershed Council
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USGS	United States Geological Survey
WRIS	Water Rights Information System
WWTP	Waste water treatment plant

1 Introduction

This Quality Assurance Project Plan (QAPP) summarizes the modeling approach to be used for the temperature TMDL replacement project applicable within the South Umpqua Subbasin (17100302) and the Umpqua Subbasin (17100303). The modeling approach to be used in the North Umpqua Subbasin (17100301) is described in the modeling QAPP DEQ22-HQ-0006-QAPP (DEQ, 2022).

A TMDL is a water quality restoration plan and the calculation of the maximum amount of a pollutant that a waterbody can receive while still meeting water quality standards for that particular pollutant. The maximum amount of loading a waterbody can receive is called the loading capacity. Loading from all pollutant sources must not exceed the loading capacity (TMDL) of a waterbody, including an appropriate margin of safety.

Load allocations are portions of the loading capacity that are allocated to background sources or non-point sources, such as urban, rural agriculture, or forestry activities. Wasteload allocations are portions of the total load, which are allocated to NPDES permitted sources, such as wastewater treatment plants or industries. Wasteload allocations are used to establish effluent limits in NPDES discharge permits. Allocations may also be reserved for future uses, called reserve capacity. Allocations are quantified measures that assure water quality standards will be met and may distribute the pollutant loads between nonpoint and point sources. This general TMDL concept is represented by Equation 1.

$$TMDL = \sum WLA + \sum LA + Reserve\ Capacity + MOS \qquad \text{Equation 1}$$

Where $\sum WLA$ is the sum of wasteload allocations (NPDES permitted sources), $\sum LA$ is the sum of load allocations (nonpoint sources and background), *Reserve Capacity* is allocations reserved for future uses, and *MOS* is a margin-of-safety to account for uncertainty. For a temperature TMDL, these elements establish the maximum thermal loads that a waterbody may receive without exceeding applicable water quality standards for temperature designed to protect aquatic life and other beneficial uses.

The Clean Water Act requires TMDLs be developed for waterbodies that do not meet water quality standards and are listed as water quality impaired on the State's 303(d) list. The South Umpqua and Umpqua Subbasins include several waterbodies listed on the Oregon 2018/2020 Section 303(d) Category 5 list as water quality limited for temperature (Table 1). A TMDL was previously developed for the South Umpqua and Umpqua Subbasins (DEQ, 2006) but it must be replaced due to recent litigation.

In 2013, the United States Environmental Protection Agency (USEPA) disapproved the Natural Conditions Criterion contained in Oregon's water quality standard for temperature due to the 2012 U.S. District Court decision for NWEA v. EPA, 855 F. Supp. 2d 1199 (D. Or., 2012). This portion of the temperature water quality standard was used in most temperature TMDLs issued from 2003 through 2012. On October 4, 2019, the U.S. District Court issued a judgment for NWEA v. EPA, No. 3:12-cv-01751-HZ (D. Or., Oct. 4, 2019) and required DEQ and USEPA to replace 15 Oregon temperature TMDLs that were based on the Natural Conditions Criterion and to reissue the temperature TMDLs based on the remaining elements of the temperature water quality standard.

This QAPP is consistent with DEQ's and USEPA's modeling QAPP guidance (DEQ, 2017; EPA, 2016) and documents the analysis and numerical modeling approach that will support the updated South Umpqua and Umpqua Subbasins TMDL as well as other project details. In particular, this QAPP details the following:

- Definition of the issue and objectives, including the spatial and temporal extents of the water quality impairments (Section 2);
- A high-level description of the key processes and variables for temperature (Section 3);
- The overarching technical approach, including the appropriate modeling and analytical tools to be used (Section 4);
- The data sources for defining and creating inputs to the model, including data that were used in the modeling for the original TMDL. Examples of these inputs include meteorological data, stream flow and temperature, point sources and vegetation characteristics (Sections 5 and 6);
- How the analysis and modeling will be evaluated for acceptability (Sections 7 and 9);
- Scenarios for evaluating management strategies for reducing anthropogenic thermal loads (Section 10);
- Various aspects for managing the TMDL development project, including documentation (Section 8), the project team (Section 11), data and records management (Sections 12 and 13); and
- Aspects relating to this QAPP and its role in the project (Sections 14 and 15).

2 Problem definition and management objectives

Multiple waterbodies in the South Umpqua and Umpqua Subbasins do not meet the water quality standards for temperature and are listed as Category 5, water quality limited on Oregon’s 2018/2020 Section 303(d) list (Table 1). The temperature water quality standards are set at a level to protect the most sensitive beneficial uses. The beneficial uses most sensitive to water temperature are fish and aquatic life. The temperature water quality standards in the South Umpqua and Umpqua Subbasins include the numeric criteria identified below. The numeric temperature criteria are based on a seven-day average daily maximum continuous measurement of temperature.

- Salmon and Steelhead Spawning: 13.0 deg-C (OAR 340-041-0028(4)(a))
- Core Cold Water Habitat: 16.0 deg-C (OAR 340-041-0028(4)(b))
- Salmon and Trout Rearing and Migration: 18.0 deg-C (OAR 340-041-0028(4)(c))

Where and when the applicable criteria apply are based on the designated fish uses maps in OAR 340-041-0320 Figure 320A, Figure 320B and Figure 320C. The fish use designations and applicable criteria are shown in the HTML interactive map that accompanies this QAPP and is referenced in Appendix D.

The temperature standard authorizes insignificant additions of heat from human sources in waters that exceed the applicable temperature criteria as follows: Following a temperature TMDL or other cumulative effects analysis, the Human Use Allowance (HUA) will restrict all NPDES point sources and nonpoint sources to a cumulative increase of no greater than 0.3 deg-C (OAR 340-041-0028(12)(b)).

As described in Chapter 1, the U.S. Environmental Protection Agency (USEPA) and State of Oregon (OR) are required to revise the water temperature TMDL for the South Umpqua and Umpqua Subbasins. In revising the TMDL, all of the allocations will be updated to target the applicable biologically-based numeric criteria (BBNC) and Human Use Allowance (HUA) water quality temperature standards.

Since the issuance of the original TMDL, the extent and number of waterbodies that are identified as water quality limited for temperature has changed. As part of the TMDL update, DEQ will address all current temperature listings based on the most recent integrated report list. The current listings, as they pertain to the South Umpqua and Umpqua Subbasins QAPP project area, were obtained from Oregon's 2018/2020 Integrated Report and are summarized in Table 1. The listings are also shown in the HTML interactive map that accompanies this QAPP and referenced in Appendix D.

To the extent existing data and information allow, the primary analysis and modeling objectives for this TMDL include:

1) Complete a source assessment and cumulative effects analysis to characterize or identify:

    a. Anthropogenic sources of stream temperature warming;
    b. How much warming comes from background sources;
    c. How much warming comes from each anthropogenic source or source category;
    d. The cumulative warming from all anthropogenic sources combined;
    e. Where along the stream anthropogenic warming occurs;
    f. Where the point of maximum stream warming is located; and
    g. The amount of stream warming that exceeds the human use allowance and applicable water quality standards.

2) Determine TMDL elements and allocations that attain the applicable temperature criteria by identifying:

    a. The thermal loading capacity for each temperature listed waterbody;
    b. The excess thermal load exceeding the loading capacity for each temperature listed waterbody;
    c. The thermal load and wasteload allocations necessary to meet the applicable water quality standards for each listed waterbody;
    d. Any surrogate measures;
    e. Any reserve capacity;
    f. Any margin of safety; and
    g. The seasonal variation and critical conditions corresponding to the time period when the applicable temperature criteria are exceeded.

3) Support development of the TMDL Water Quality Management Plan and evaluate implementation options.

    a. Evaluate existing land management plans, TMDL implementation plans, or rules for sufficiency in minimizing anthropogenic warming to the level established by the TMDL allocations.
    b. Identify additional management strategies or surrogate measures.
    c. Identify under what timeline and where management strategies need to be implemented.

The effort currently described in the QAPP includes use of existing models and the development of new models or new model scenarios.

Table 1: South Umpqua and Umpqua Subbasins assessment units that are classified as water quality limited category 5 for temperature based on the Section 303(d) 2018/2020 Integrated Report.

Assessment Unit Name	Assessment Unit ID	Year Listed	Use Period
Applegate Creek	OR_SR_1710030206_02_105415	2010	Year Round
Ash Creek-South Umpqua River Watershed	OR_WS_171003020303_02_105687	2018	Year Round
Bear Creek	OR_SR_1710030208_02_104754	2010	Year Round
Beaver Creek	OR_SR_1710030202_02_105375	2010	Year Round
Beaver Creek	OR_SR_1710030202_02_105375	2018	Spawning
Big Tom Folley Creek	OR_SR_1710030303_02_105144	2010	Year Round
Black Rock Fork	OR_SR_1710030201_02_105371	2010	Spawning, Year Round
Black Rock Fork Watershed	OR_WS_171003020102_02_105676	2018	Year Round
Boulder Creek	OR_SR_1710030203_02_105382	2010	Year Round
Boulder Creek	OR_SR_1710030203_02_105386	2010	Year Round
Boulder Creek	OR_SR_1710030203_02_105382	2018	Spawning
Boulder Creek Watershed	OR_WS_171003020301_02_105685	2010	Year Round
Brush Creek	OR_SR_1710030303_02_105132	2010	Year Round
Brush Creek	OR_SR_1710030303_02_105133	2010	Year Round
Buck Creek	OR_SR_1710030305_02_105164	2010	Year Round
Buckeye Creek	OR_SR_1710030201_02_105373	2010	Year Round
Buckeye Creek	OR_SR_1710030201_02_105373	2018	Spawning
Buckeye Creek Watershed	OR_WS_171003020104_02_105678	2010	Year Round
Bull Run	OR_SR_1710030207_02_105422	2010	Year Round
Burn Creek	OR_SR_1710030306_02_105169	2010	Year Round
Calapooya Creek	OR_SR_1710030301_02_105443	2010	Year Round
Calapooya Creek	OR_SR_1710030301_02_106418	2010	Year Round
Calapooya Creek	OR_SR_1710030301_02_105442	2018	Year Round
Camp Creek	OR_SR_1710030305_02_105158	2010	Year Round
Canyon Creek	OR_SR_1710030205_02_105394	2010	Spawning, Year Round
Canyon Creek	OR_SR_1710030205_02_105410	2010	Year Round
Canyon Creek Watershed	OR_WS_171003020507_02_106347	2010	Spawning, Year Round
Castle Rock Fork Watershed	OR_WS_171003020101_02_105675	2010	Year Round
Castle Rock Fork Watershed	OR_WS_171003020101_02_105675	2018	Spawning

Assessment Unit Name	Assessment Unit ID	Year Listed	Use Period
Cattle Creek-Cow Creek Watershed	OR_WS_171003020903_02_104858	2010	Spawning, Year Round
Cedar Creek	OR_SR_1710030307_02_105185	2010	Year Round
Cleghorn Creek	OR_SR_1710030306_02_105174	2010	Spawning
Coffee Creek	OR_SR_1710030205_02_105413	2010	Spawning, Year Round
Coffee Creek Watershed	OR_WS_171003020501_02_105695	2010	Year Round
Cow Creek	OR_SR_1710030209_02_106367	2010	Year Round
Cow Creek	OR_SR_1710030206_02_105417	2018	Year Round
Dads Creek	OR_SR_1710030207_02_104742	2010	Year Round
Dads Creek-Cow Creek Watershed	OR_WS_171003020706_02_104851	2010	Year Round
Days Creek	OR_SR_1710030205_02_105399	2010	Year Round
Days Creek Watershed	OR_WS_171003020505_02_105697	2010	Year Round
Deadman Creek	OR_SR_1710030203_02_105381	2010	Year Round
Deadman Creek	OR_SR_1710030203_02_105381	2018	Spawning
Deadman Creek Watershed	OR_WS_171003020305_02_105689	2010	Spawning, Year Round
Deer Creek	OR_SR_1710030213_02_106417	2010	Spawning, Year Round
Dismal Creek-Cow Creek Watershed	OR_WS_171003020602_02_105700	2010	Year Round
Doe Creek	OR_SR_1710030209_02_106336	2010	Year Round
Drew Creek	OR_SR_1710030204_02_105393	2010	Year Round
Drew Creek Watershed	OR_WS_171003020403_02_105693	2010	Year Round
Dumont Creek	OR_SR_1710030203_02_105380	2018	Year Round
Dumont Creek Watershed	OR_WS_171003020302_02_105686	2010	Spawning, Year Round
East Fork Stouts Creek	OR_SR_1710030205_02_105402	2010	Year Round
Elk Creek	OR_SR_1710030204_02_105390	2010	Year Round
Elk Creek	OR_SR_1710030204_02_105391	2010	Year Round
Elk Creek	OR_SR_1710030303_02_105453	2010	Year Round
Elk Creek	OR_SR_1710030303_02_106420	2010	Year Round
Elk Valley Creek-West Fork Cow Creek Watershed	OR_WS_171003020803_00_104855	2010	Year Round
Falcon Creek	OR_SR_1710030202_02_105377	2018	Spawning, Year Round
Flat Creek	OR_SR_1710030204_02_105392	2018	Year Round

Assessment Unit Name	Assessment Unit ID	Year Listed	Use Period
Fortune Branch-Cow Creek Watershed	OR_WS_171003020703_02_106349	2010	Year Round
Francis Creek-South Umpqua River Watershed	OR_WS_171003020304_02_105688	2010	Year Round
Franklin Creek	OR_SR_1710030308_02_105205	2010	Year Round
Halfway Creek	OR_SR_1710030306_02_105173	2010	Year Round
Halfway Creek-Smith River Watershed	OR_WS_171003030602_02_105296	2010	Year Round
Headwaters Smith River Watershed	OR_WS_171003030601_02_105295	2010	Spawning
Hinkle Creek	OR_SR_1710030301_02_105436	2018	Year Round
Hubbard Creek	OR_SR_1710030302_02_105115	2018	Year Round
Jackson Creek	OR_SR_1710030202_02_105378	2010	Year Round
Jackson Creek	OR_SR_1710030202_02_105379	2010	Spawning, Year Round
Jackson Creek	OR_SR_1710030202_02_105378	2018	Spawning
Lake Creek	OR_SR_1710030305_02_105155	2010	Year Round
Little Wolf Creek	OR_SR_1710030302_02_105113	2010	Year Round
Little Wolf Creek	OR_SR_1710030302_02_105113	2018	Spawning
Lookingglass Creek	OR_SR_1710030212_02_105090	2010	Year Round
Lost Creek-Umpqua River Watershed	OR_WS_171003030205_02_105279	2010	Year Round
Lower Elk Creek Watershed	OR_WS_171003020404_02_105694	2018	Spawning, Year Round
Lower Jackson Creek Watershed	OR_WS_171003020205_02_105684	2018	Year Round
Lower South Myrtle Creek Watershed	OR_WS_171003021002_02_105704	2010	Year Round
Lutsinger Creek	OR_SR_1710030304_02_105151	2010	Year Round
Martin Creek	OR_SR_1710030209_02_104763	2010	Spawning, Year Round
McGinnis Creek-Cow Creek Watershed	OR_WS_171003020603_02_105701	2010	Year Round
Mehl Creek-Umpqua River Watershed	OR_WS_171003030208_02_105318	2010	Year Round
Middle Creek	OR_SR_1710030209_02_104762	2010	Spawning, Year Round
Middle Creek Watershed	OR_WS_171003020901_02_104857	2010	Year Round
Middle Elk Creek Watershed	OR_WS_171003020402_02_105692	2018	Year Round

Assessment Unit Name	Assessment Unit ID	Year Listed	Use Period
Middle Fork North Fork Smith River	OR_SR_1710030307_02_105186	2010	Year Round
Middle Fork North Fork Smith River	OR_SR_1710030307_02_105192	2010	Year Round
Middle Fork of South Fork Deer Creek	OR_SR_1710030213_02_105433	2010	Year Round
Mitchell Creek	OR_SR_1710030209_02_104758	2010	Year Round
Newton Creek-South Umpqua River Watershed	OR_WS_171003021305_02_105321	2018	Year Round
North Fork Deer Creek	OR_SR_1710030213_02_105434	2018	Year Round
North Fork Smith River	OR_SR_1710030307_02_105187	2010	Year Round
North Fork Tom Folley Creek	OR_SR_1710030303_02_105143	2010	Year Round
North Myrtle Creek	OR_SR_1710030210_02_105431	2010	Year Round
North Myrtle Creek	OR_SR_1710030210_02_106416	2018	Year Round
North Sister Creek	OR_SR_1710030306_02_105183	2010	Year Round
Olalla Creek	OR_SR_1710030212_02_105091	2010	Year Round
Olalla Creek	OR_SR_1710030212_02_105094	2010	Year Round
Oldham Creek Watershed	OR_WS_171003030104_02_105708	2010	Year Round
Quartz Creek Watershed	OR_WS_171003020103_02_105677	2010	Year Round
Quines Creek	OR_SR_1710030207_02_105423	2010	Year Round
Quines Creek	OR_SR_1710030207_02_105425	2010	Year Round
Quines Creek-Cow Creek Watershed	OR_WS_171003020702_02_106348	2010	Year Round
Rader Creek	OR_SR_1710030302_02_105112	2010	Year Round
Rice Creek	OR_SR_1710030211_02_105087	2010	Year Round
Riffle Creek	OR_SR_1710030207_02_104743	2010	Year Round
Riffle Creek	OR_SR_1710030207_02_104747	2010	Year Round
Riffle Creek-Cow Creek Watershed	OR_WS_171003020707_02_104852	2010	Year Round
Roberts Creek	OR_SR_1710030213_02_105104	2018	Year Round
Saint John Creek-South Umpqua River Watershed	OR_WS_171003020504_02_105814	2010	Year Round
Sand Creek	OR_SR_1710030303_02_106435	2010	Year Round
Shively Creek	OR_SR_1710030205_02_105396	2010	Year Round
Shively Creek	OR_SR_1710030205_02_105407	2010	Year Round
Skillet Creek-South Umpqua River Watershed	OR_WS_171003020105_02_105679	2018	Spawning, Year Round
Skull Creek	OR_SR_1710030207_02_104741	2010	Year Round

Assessment Unit Name	Assessment Unit ID	Year Listed	Use Period
Slide Creek	OR_SR_1710030210_02_105428	2010	Year Round
Smith River	OR_SR_1710030306_02_105167	2010	Year Round
Smith River	OR_SR_1710030306_02_105175	2010	Year Round
Smith River	OR_SR_1710030306_02_105180	2010	Year Round
Smith River	OR_SR_1710030307_02_105196	2010	Year Round
Snow Creek	OR_SR_1710030206_02_105414	2010	Year Round
Soup Creek	OR_SR_1710030305_02_105163	2010	Year Round
South Fork Middle Creek	OR_SR_1710030209_02_104757	2010	Year Round
South Fork Smith River	OR_SR_1710030306_02_105181	2010	Year Round
South Fork Smith River	OR_SR_1710030306_02_105182	2010	Year Round
South Myrtle Creek	OR_SR_1710030210_02_105432	2010	Year Round
South Myrtle Creek	OR_SR_1710030210_02_105432	2018	Spawning
South Sister Creek	OR_SR_1710030306_02_105170	2010	Year Round
South Sister Creek Watershed	OR_WS_171003030603_02_105297	2010	Year Round
South Umpqua River	OR_SR_1710030201_02_105374	2010	Year Round
South Umpqua River	OR_SR_1710030203_02_105389	2010	Year Round
South Umpqua River	OR_SR_1710030205_02_106333	2010	Year Round
South Umpqua River	OR_SR_1710030211_02_105320	2010	Year Round
South Umpqua River	OR_SR_1710030213_02_105102	2010	Year Round
South Umpqua River	OR_SR_1710030201_02_105374	2018	Spawning
Squaw Creek	OR_SR_1710030202_02_105376	2018	Year Round
Stouts Creek Watershed	OR_WS_171003020503_02_105696	2010	Year Round
Thompson Creek	OR_SR_1710030212_02_105096	2010	Year Round
Tributary to Middle Fork North Fork Smith River	OR_SR_1710030307_02_105201	2010	Year Round
Umpqua River	OR_EB_1710030307_01_107227	2010	Year Round
Umpqua River	OR_EB_1710030308_01_100287	2010	Year Round
Umpqua River	OR_SR_1710030302_05_105126	2010	Year Round
Umpqua River	OR_SR_1710030304_05_105153	2010	Year Round
Union Creek	OR_SR_1710030209_02_104755	2010	Year Round
Upper Elk Creek Watershed	OR_WS_171003020401_02_105691	2010	Year Round
Upper North Fork Smith River Watershed	OR_WS_171003030705_02_105302	2010	Year Round
Upper North Myrtle Creek Watershed	OR_WS_171003021003_02_105705	2010	Year Round
Upper Pass Creek Watershed	OR_WS_171003030304_02_105710	2010	Year Round

Assessment Unit Name	Assessment Unit ID	Year Listed	Use Period
Upper South Myrtle Creek Watershed	OR_WS_171003021001_02_105703	2010	Year Round
Upper South Myrtle Creek Watershed	OR_WS_171003021001_02_105703	2018	Spawning
West Branch North Fork Smith River	OR_SR_1710030307_02_105189	2010	Year Round
West Fork Canyon Creek	OR_SR_1710030205_02_106334	2010	Spawning, Year Round
West Fork Cow Creek	OR_SR_1710030208_02_104751	2010	Year Round
West Fork Cow Creek	OR_SR_1710030208_02_104752	2010	Year Round
West Fork Smith River	OR_SR_1710030307_02_105197	2010	Year Round
West Fork Smith River Watershed	OR_WS_171003030701_02_105299	2010	Year Round
Windy Creek	OR_SR_1710030207_02_104748	2010	Year Round
Windy Creek	OR_SR_1710030207_02_104748	2018	Spawning
Wolf Creek	OR_SR_1710030302_02_105124	2010	Year Round
Wolf Creek Watershed	OR_WS_171003030204_02_105278	2010	Year Round
Wood Creek	OR_SR_1710030207_02_104740	2010	Spawning, Year Round
Wood Creek	OR_SR_1710030205_02_105397	2018	Year Round
Yellow Creek	OR_SR_1710030302_02_105123	2018	Year Round
Yellow Creek Watershed	OR_WS_171003030206_02_105280	2010	Year Round

3 Conceptual model: key processes and variables

The current theory to explain the nature of heat is called the kinetic-molecular theory. The modern version of this theory was developed in the mid-19th century by Rudolf Clausis, James Clerk Maxwell, and Ludwig Boltzmann. The theory is based on the assumption that all matter is composed of a tiny population of molecules that are always in motion. The molecules in hot objects are moving faster and hence have greater kinetic energy than the molecules in cold objects. Individual molecules have a certain amount of kinetic energy based on their mass and velocity. The thermal energy of an object is determined by adding up the kinetic energy of all the molecules in that object. When a hot and cold object come into contact with each other, the molecules collide and the kinetic energy flows from the molecules with more kinetic energy to molecules with less kinetic energy. This type of flow of kinetic energy is called heat.

Temperature is an intensive property and much like concentration measures the “strength” rather than “quantity” of kinetic energy. The temperature of an object is the measure of the average kinetic energy of all the molecules in that object. Hot water has greater average kinetic energy than cold water but may not have greater total kinetic energy. For example, a small pot of water with a temperature near the boiling point has a higher average kinetic energy than a swimming pool at room temperature. The swimming pool has a much larger quantity of molecules and therefore a higher total kinetic energy than the pot of water.

Temperature is the water quality parameter of concern, but heat, in particular heat from human activities or anthropogenic sources, is the pollutant of concern. Water temperature change (ΔTw) is a function of the heat transfer in a discrete volume and may be described in terms of changes in heat per unit volume. Conversely, a change in volume can result in water temperature change for a defined amount of heat exchange. With this basic conceptual framework of water temperature change, it is possible to discuss stream temperature change as a function of two variables: heat and mass transfer.

Water Temperature Change as a Function of Heat Exchange and Volume,

$$\Delta Tw = \frac{\Delta Heat}{Density \times Specific\ Heat \times \Delta Volume} \qquad \text{Equation 2}$$

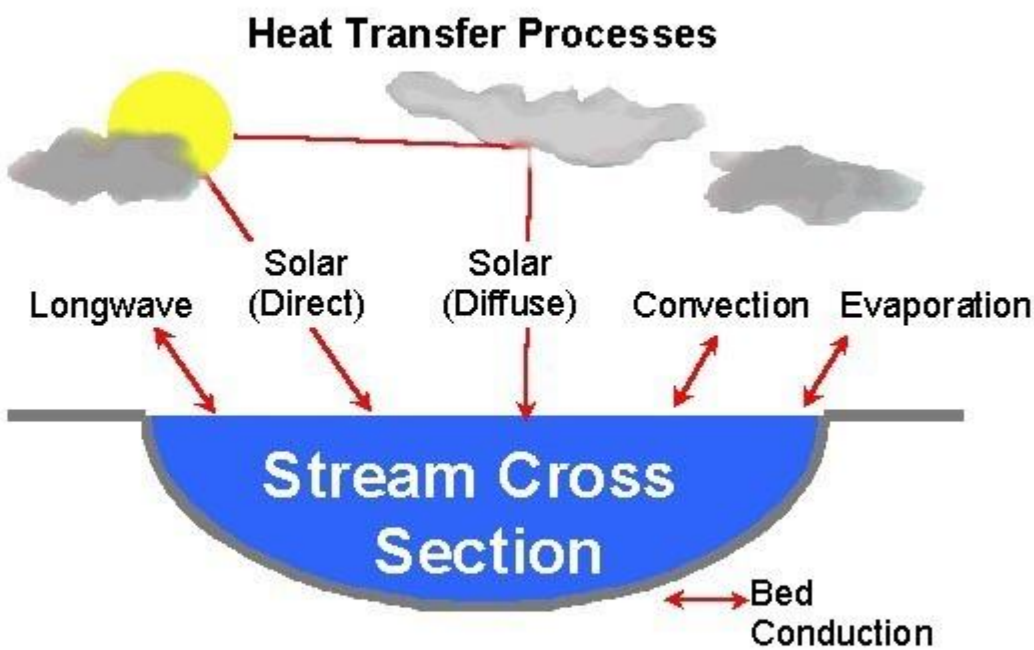

Figure 1: Major heat transfer processes.

Heat transfer relates to processes that change heat in a defined water volume. There are several thermodynamic pathways that can introduce or remove heat from a stream. These different processes are shown in Figure 1. For any given stream reach heat exchange is closely related to the season, time of day and the surrounding environment and the stream characteristics. Heat transfer can be dynamic and change over relatively small distances and time periods. Equation 3 describes the several heat transfer processes that change stream temperature (Wunderlich, 1972; Jobson and Keefer, 1979; Beschta and Weatherred, 1984; Sinokrot and Stefan, 1993; Boyd, 1996; Johnson, 2004; Hannah et al., 2008; Benyahya et al., 2012).

$$\Phi_{total} = \Phi_{solar} + \Phi_{longwave} + \Phi_{streambed} + \Phi_{convection} + \Phi_{evaporation}$$ Equation 3

Where,
Φ_{total} = Net heat energy flux (+/-)
Φ_{solar} = Shortwave direct and diffuse solar radiation (+ only)
$\Phi_{longwave}$ = Longwave (thermal) radiation (+/-)
$\Phi_{streambed}$ = Streambed conduction (+/-)
$\Phi_{convection}$ = Stream/air convection[1] (+/-)
$\Phi_{evaporation}$ = Evaporation (+/-)

[1]Air/Water convection includes both turbulent and free surface conduction.

Mass transfer relates to transport of flow volume downstream, instream mixing and the introduction or removal of water from a stream. For instance, flow from a tributary will cause a temperature change if the temperature is different from the receiving water. Mass transfer commonly occurs in stream systems as a result of:

- Advection,
- Dispersion,
- Groundwater exchange,
- Hyporheic flows,
- Surface water exchange (e.g. tributary input, precipitation), and
- Other human related activities that alter stream flow volume.

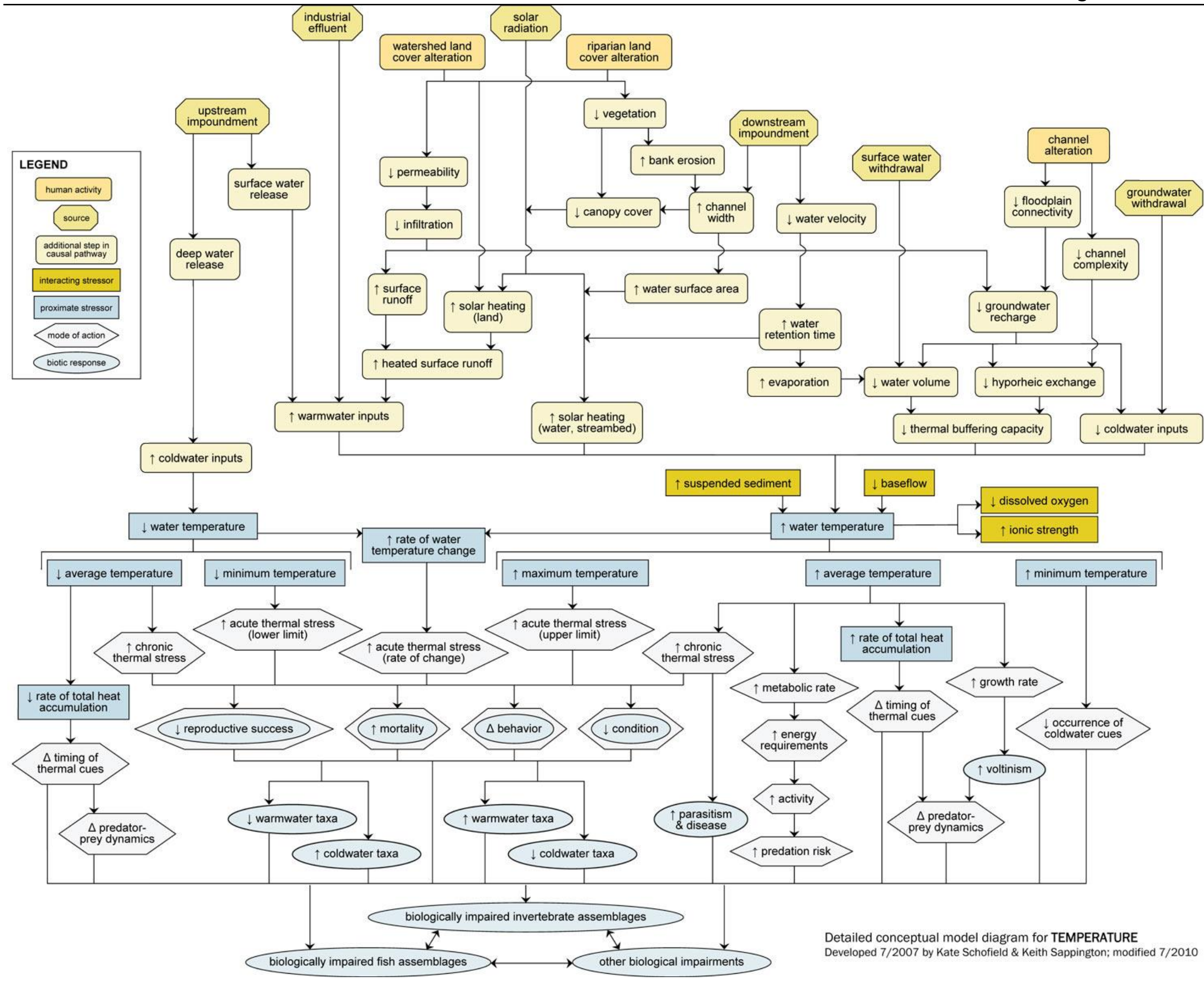

Figure 2: Conceptual diagram that identifies the key processes and variables that drive stream temperature changes and the biological responses (Schofield and Sappington, 2010).

Stream temperature is influenced by both human and natural factors. Figure 2 is a conceptual diagram that identifies the key process and variables that drive stream temperature. Human sources and natural sources are identified. Near the bottom of the diagram the biological responses are identified.

Anthropogenic Nonpoint Sources: Temperature increases from human-caused nonpoint sources are caused by increases in solar radiation loading to the stream network from the disturbance or removal of near-stream vegetation, channel modification and widening, reductions to the stream flow rate or volume, changes in hyporheic flows and channel connectivity, reductions in cold groundwater inflows, and changes to meteorological conditions, such as those caused by climate change.

Background Sources: Background sources include all sources of pollution or pollutants not originating from human activities. In the context of a TMDL, background sources may also include anthropogenic sources of a pollutant that DEQ or another Oregon state agency does not have authority to regulate, such as pollutants emanating from another state, tribal lands, or sources otherwise beyond the jurisdiction of the state (OAR 340-042-0030(1)). Additionally, effective shade levels on smaller streams are more sensitive to riparian disturbances and so the differences between current condition solar flux and background solar flux can be larger.

Anthropogenic Point Sources: Temperature increases from point sources are those caused by warm water discharges from NPDES permitted facilities, such as industrial outfalls, municipal waste water treatment plants (WWTP), and other point sources.

4 Technical approach

4.1 Overview

Stream temperature TMDLs are generally scaled to a subbasin or basin scale since stream temperatures are affected by cumulative interactions between upstream and local sources. For this reason the TMDL considers all surface waters that affect the temperatures of 303(d) listed waterbodies. For example, the Umpqua River is water quality limited for temperature. To address this listing in the TMDL, all upstream waterbodies are considered in the TMDL analysis and TMDL allocations are applied throughout the entire stream network and include all waters of the state.

An important step in the TMDL is to perform a source assessment which quantifies the background and anthropogenic contributions to stream heating. Models provide a way to evaluate potential sources of stream warming and, to the extent existing data allow, the amount of pollutant loading from these sources. The model that is selected for the TMDL analysis should support the needs of the project. Section 4.2 describes the model framework needs for this project and the models that will be used to support the TMDL.

TMDLs also require identification of seasonal variation and critical conditions. The TMDL analysis will determine seasonal variation by including a statistical summary and visual plots summarizing the instream temperatures and flow rates observed at various monitoring locations. The time period when the applicable temperature criteria are exceeded will be described in relation to the critical conditions.

The TMDL will establish a loading capacity which specifies the amount of a pollutant or pollutants that a waterbody can receive and still meet water quality standards. The pollutant addressed in the temperature TMDL is heat. The TMDL will divide the loading capacity into thermal wasteload allocations for NPDES permittees and load allocations for background and nonpoint sources of heat to ensure that the applicable temperature standards are achieved. Anthropogenic nonpoint and NPDES permitted point sources are not permitted to heat a waterbody more than 0.3 deg-C above the applicable criteria, cumulatively at the point of maximum impact. The portion of the human use allowance allocated to each source will be determined in the TMDL with the modeling approach supporting assessment of different allocation options. The modeling approach may also be used to support development of TMDL surrogate measures such as effective shade targets. Nonpoint source allocations can be translated into surrogate measures when a pollutant is difficult to measure, highly variable, or difficult to monitor (OAR 340-042-0040(5)(b)). Thermal load allocations for nonpoint sources can be difficult to measure and monitor. Attainment of the surrogate measures ensures compliance with the nonpoint source allocations.

Stream temperatures for the Umpqua Basin TMDL and WQMP (DEQ, 2006) were simulated using the computer models (Heat Source version 6 temperature model and Heat Source version 7 temperature model). The model extents include most of the main rivers and their larger tributaries that contain or influence primary fish habitat. Site-specific load allocations will be developed for the streams that are simulated. Other streams are assigned generalized load allocations based on effective shade surrogate measures that target site potential or restored vegetation types. Numeric or narrative wasteload allocations will be developed for all NPDES permittees.

4.2 Model selection

The modeling framework needs for this project include:

1) Prediction of hourly stream temperatures over a period of months and at a no greater than 500 meter longitudinal resolution.

2) Prediction of hourly solar radiation flux and daily effective shade at a no greater than 100 meter longitudinal resolution.

3) Ability to evaluate hourly stream temperature response from changes in streamside vegetation.

4) Ability to evaluate hourly stream temperature response from changes in water withdrawals and tributary stream flow within the upstream catchment.

5) Ability to evaluate hourly stream temperature response from changes in channel morphology within the upstream catchment.

6) Ability to evaluate hourly stream temperature response from changes in effluent temperature and flow discharge from NPDES permitted facilities.

The Heat Source stream thermodynamics model (Boyd and Kasper, 2003) was used to model several streams for the development of TMDLs in the South Umpqua and Umpqua Subbasins (DEQ, 2006a). Because these models already exist and meet all the model framework needs, Heat Source was selected for stream temperature simulation in the project area. The Heat Source model was originally developed at Oregon State University as a master’s thesis where it was evaluated and approved by an academic committee (Boyd, 1996). Development of the model continued and in 1999 DEQ submitted the model equations and methodology for peer review (DEQ, 1999) and again in 2004 to the Independent Multidisciplinary Science Team (IMST, 2004) where the model was found to be scientifically sound.

The Heat Source model has been used in numerous stream temperature related studies including Loheide and Gorelick (2006), Diabat et al. (2013), Holzapfel et al. (2013), Lawrence et al. (2014), Bond et al. (2015), Woltemade and Hawkins (2016), Justice et al. (2017), and Wondzell et al. (2019). Heat Source has also been used in numerous Oregon TMDLs (DEQ, 2001, 2002, 2003, 2005, 2006, 2007, 2008, 2010, 2018, 2019).

4.3 Software Development Quality Assessment

We do not anticipate any new software development or model code changes as part of this project.

5 Data availability and quality

This chapter describes the data that is available to support the TMDL project and the quality assurance procedures used when collecting or reviewing the available data.

5.1 Meteorology

Meteorological data includes air temperature, sky conditions, cloudiness, relative humidity, and wind speed. Table 59 through Table 62 in Appendix A list the stations where meteorological data available in the South Umpqua and Umpqua Subbasins, including 64 stations from National Oceanic and Atmospheric Association (NOAA)'s National Climatic Data Center (NCDC), 2 stations from National Interagency Fire Center's Remote Automatic Weather Stations (RAWS), 32 stations from University of Utah MesoWest database, and 3 stations from DEQ's files. The meteorological monitoring stations are also shown in the HTML interactive map that accompanies this QAPP and is referenced in Appendix D. The station IDs in Table 59 are the NCDC ID, which may differ from the station identifiers used by other sources.

The meteorological data obtained from the NCDC includes the Local Climatological Dataset (NOAA, 2005) and the Global Integrated Surface Dataset (NOAA, 2001). The Local Climatological Dataset includes quality controlled meteorological data from airports and other prominent weather stations managed by the National Weather Service, Federal Aviation Administration, and the U.S. Department of Defense. The Global Integrated Surface Dataset provides a long-term record of hourly, sub-hourly and synoptic weather observations from a variety of meteorological networks around the world. The dataset includes observations from the World Meteorological Organization, Automated Surface Observing System, Automated Weather Observing Stations, U.S. Climate Reference Network, and others.

5.2 Thermal Infrared Radiometry (TIR) data

DEQ contracted with Watershed Sciences, Inc. to provide airborne Thermal Infrared Radiometry (TIR) imagery of spatial temperature patterns within the South Umpqua and Umpqua Subbasins (Watershed Sciences, 2001; Watershed Sciences, 2003). TIR data is used to characterize the thermal regime of the streams and habitat quality. All streams and the TIR collection dates are summarized in Table 2.

Table 2: Streams and the TIR collection dates in the South Umpqua and Umpqua Subbasins.

Stream	Survey Extent	Date	Time	Survey Distance
Calapooya Creek	Mouth to forks	2002-07-24	15:33-16:49	34 mi
Cow Creek	Mouth to Galesville Reservoir	2000-07-25	14:14-15:33	59.56 mi
Elk Creek	Mouth to Yoncalla Creek	2002-07-24	13:49-14:40	26 mi
Hinkle Creek	Mouth to headwater of both North and South forks (low altitude)	2002-07-26	13:20-13:32	6.5 mi
Hinkle Creek	Mouth to headwater of both North and South forks (high altitude)	2002-07-26	13:40-13:59	6.5 mi
Jackson Creek	Mouth to Falcon Creek	2002-07-27	15:43-16:36	20 mi
Myrtle Creek	Mouth to forks	2002-07-27	14:33-14:36	1 mi

Stream	Survey Extent	Date	Time	Survey Distance
Olalla Creek	Mouth to Berry Creek	2002-07-27	13:39-14:23	19.7 mi
South Umpqua River	Mouth to upstream of Boulder Creek	2002-07-28	14:10-17:26	91 mi
Umpqua River	Hedden County Park to North Fork	2002-07-23	14:33-16:07	81.5 mi

5.3 Continuous stream temperature data

All available continuous stream temperature data were retrieved from DEQ's Ambient Water Quality Monitoring System (AWQMS), USGS's National Water Information System (NWIS), or were obtained during the data solicitation for DEQ's temperature TMDL replacement project. Some temperature data presented in this QAPP were retrieved from DEQ's files and were not available in AWQMS or USGS's database.

The data retrieval period for continuous stream temperature data is from January 1, 1990 to December 31, 2020. Data retrieved from the AWQMS database has a Data Quality Level (DQL) of A, B or E and a result status of "Final" or "Provisional". The data quality level criteria are outlined in DEQ's Data Quality Matrix for Field Parameters (DEQ, 2013). The TMDL program uses waterbody results with a data quality level of A, B, or E (DEQ, 2021). Data of unknown quality are used after careful review.

Appendix B summarizes 384 locations where continuous stream temperature data were collected in the South Umpqua and Umpqua Subbasins and the organizations that collected that data in Table 63, and when data were collected at each location in Table 64. The location of these stations is shown in the HTML interactive map that accompanies this QAPP and referenced in Appendix D.

5.4 Stream flow data

Table 65 in Appendix C lists the stations where continuous flow volume data were available in the South Umpqua and Umpqua Subbasins, including 17 stations from USGS. Table 67 lists the years that continuous stream flow data were collected at each location. The location of these stations is shown in the HTML interactive map that accompanies this QAPP and referenced in Appendix D. Table 66 lists the locations where instantaneous flow volume measurements made by DEQ were available. DEQ relies upon the quality control checks implemented by USGS and OWRD. DEQ-collected stream flow measurements utilize field and quality control methods outlined in DEQ's Mode of Operations Manual (DEQ, 2020).

5.5 Point source discharges

Table 3 identifies all the active individual NPDES permittees in the South Umpqua and Umpqua Subbasins. Table 4 lists the registrants covered under the general NPDES GEN01, GEN04, and GEN05 permits in the South Umpqua and Umpqua Subbasins. This group of general permits are highlighted because the permits require temperature monitoring at a frequency of at least one grab sample per month. The location of these NPDES permittees is shown in the HTML interactive map that accompanies this QAPP and is referenced in Appendix D. Many of these permittees submit Discharge Monitoring Reports (DMRs) as a condition of their permit. Depending on the monitoring requirements in the permit, some permittees are required to report effluent temperature and effluent flow rates in the DMR. The frequency and type of reporting varies by permit and permit type. Some permits only require monthly, weekly, or daily grab samples while others require summary statistics such as daily maximum, daily mean, or seven-day average daily maximum. The NPDES permits require data be collected and reported on the DMR using appropriate methods based on a quality assurance and quality control plan. Where possible, DEQ will utilize any continuous effluent data that has been provided to DEQ. When continuous data is not available, DMR data will be utilized to characterize point source discharges. Table 5 lists the current number of registrants for all the other general NPDES permits in the South Umpqua and Umpqua Subbasins that are not listed in Table 4.

Table 3: Summary of individual NPDES permitted discharges in the South Umpqua and Umpqua Subbasins.

Facility Name (Facility Number)	Latitude/Longitude	Permit Type and Description	Stream River Mile
Brandy Bar Landing, Inc. (10696)	43.7/-124.101	NPDES-DOM-Da: Sewage - less than 1 MGD	Umpqua River RM 19.8
Canyonville STP (13745)	42.9422/-123.28	NPDES-DOM-Da: Sewage - less than 1 MGD	South Umpqua River RM 50.6
Drain STP (25282)	43.6562/-123.321	NPDES-DOM-Da: Sewage - less than 1 MGD	Elk Creek RM 23.8
Glendale STP (33733)	42.7434/-123.429	NPDES-DOM-Da: Sewage - less than 1 MGD	Cow Creek RM 40
Green Diamond Performance Materials, Inc. (36535)	42.9393/-123.424	NPDES-IW-B15: All facilities not elsewhere classified which dispose of process wastewater (includes remediated groundwater) - Tier 2 sources	Crawford Creek RM 0.5
Hoover Treated Wood Products, Inc. (105306)	43.1087/-123.416	NPDES-IW-B21: Timber and Wood Products - Wood preserving	South Umpqua River RM 23.2
Myrtle Creek STP (59643)	43.0216/-123.296	NPDES-DOM-C2a: Sewage - 1 MGD or more but less than 2 MGD	South Umpqua River RM 38.6
Oakland STP (62855)	43.4189/-123.306	NPDES-DOM-Da: Sewage - less than 1 MGD	Calapooya Creek RM 13.9
R.U.S.A. Roseburg STP (76771)	43.2092/-123.396	NPDES-DOM-Ba: Sewage - 5 MGD or more but less than 10 MGD	South Umpqua River RM 7.6
Reedsport STP (74319)	43.7054/-124.097	NPDES-DOM-Da: Sewage - less than 1 MGD	Umpqua River RM 11.3

Facility Name (Facility Number)	Latitude/Longitude	Permit Type and Description	Stream River Mile
Rice Hill East Lagoon (73705)	43.5392/-123.288	NPDES-DOM-Db: Sewage - less than 1 MGD with discharging lagoons	Yoncalla Creek RM 7.8
Rice Hill West Lagoon (75064)	43.5469/-123.289	NPDES-DOM-Db: Sewage - less than 1 MGD with discharging lagoons	Yoncalla Creek RM 7.5
Riddle STP (75227)	42.9508/-123.357	NPDES-DOM-Da: Sewage - less than 1 MGD	Cow Creek RM 1.9
Sutherlin STP (86662)	43.397/-123.36	NPDES-DOM-C2a: Sewage - 1 MGD or more but less than 2 MGD	Calapooya Creek RM 9.8
USFS - Umpqua National Forest; Tiller Ranger Station STP (90944)	42.9278/-122.949	NPDES-DOM-Da: Sewage - less than 1 MGD	South Umpqua River RM 74.7
Winchester Bay STP (98090)	43.6734/-124.189	NPDES-DOM-Da: Sewage - less than 1 MGD	Umpqua River RM 0.6
Winston-Green WWTF (98400)	43.1367/-123.4	NPDES-DOM-C2a: Sewage - 1 MGD or more but less than 2 MGD	South Umpqua River RM 20.6
Yoncalla STP (99492)	43.604/-123.278	NPDES-DOM-Db: Sewage - less than 1 MGD with discharging lagoons	Yoncalla Creek RM 4

Table 4: Summary of current registrants under the general NPDES GEN01, GEN04, and GEN05 permits in the South Umpqua and Umpqua Subbasins.

Facility Name (Facility Number)	Latitude/Longitude	Permit Type and Description	Stream River Mile
C & D LUMBER CO (104601)	42.9672/-123.354	GEN05: Industrial Wastewater; NPDES boiler blowdown	Lane Creek RM 0.4
D. R. JOHNSON LUMBER CO. - RIDDLE SITE (100167)	42.9604/-123.358	GEN04: Industrial Wastewater; NPDES log ponds	Lane Creek RM 1.1
DILLARD COMPLEX (76790)	42.9356/-123.4	GEN01: Industrial Wastewater; NPDES cooling water	South Umpqua River RM 28.1
DILLARD COMPLEX (76790)	42.9356/-123.4	GEN04: Industrial Wastewater; NPDES log ponds	South Umpqua River RM 27.7
GLENDALE PLYWOOD VENEER (35145)	42.7444/-123.422	GEN04: Industrial Wastewater; NPDES log ponds	Cow Creek RM 38

Facility Name (Facility Number)	Latitude/Longitude	Permit Type and Description	Stream River Mile
GLENDALE SAWMILL (86464)	42.737/-123.408	GEN04: Industrial Wastewater; NPDES log ponds	Cow Creek RM 40.9
HERBERT LUMBER CO (38154)	42.971/-123.357	GEN04: Industrial Wastewater; NPDES log ponds	Lane Creek RM 0.5
NORDIC VENEER, INC. (61205)	43.2166/-123.271	GEN04: Industrial Wastewater; NPDES log ponds	Deer Creek RM 3
PLANT #4 (9294)	43.6585/-123.323	GEN04: Industrial Wastewater; NPDES log ponds	Elk Creek RM 23.2
RIDDLE PLYWOOD #4 (76812)	42.9252/-123.498	GEN04: Industrial Wastewater; NPDES log ponds	Cow Creek RM 3
SWANSON GROUP MFG. ROSEBURG (85780)	43.181/-123.366	GEN04: Industrial Wastewater; NPDES log ponds	South Umpqua River RM 14.1
UMPQUA LUMBER CO. (51360)	43.0833/-123.367	GEN04: Industrial Wastewater; NPDES log ponds	South Umpqua River RM 31.3
UMPQUA LUMBER CO. (51360)	43.0833/-123.367	GEN05: Industrial Wastewater; NPDES boiler blowdown	South Umpqua River RM 31.6

Table 5: Summary of the current number of registrants for all the other general NPDES permits in the South Umpqua and Umpqua Subbasins that are not listed in Table 4.

Permit Type and Description	Current Number of Registrants
GEN02: Industrial Wastewater; NPDES filter backwash	10
GEN09: Industrial Wastewater; NPDES seafood processing	2
GEN12A: Stormwater; NPDES sand & gravel mining	7
GEN12C: Stormwater; NPDES construction more than 1 acre disturbed ground	35
GEN12Z: Stormwater; NPDES specific SIC codes	28
GEN17A: Industrial Wastewater; NPDES wash water	2

5.6 Water rights/surface water diversions

Data on surface water diversion rates (usage) and the points of diversion (location) are available from the Oregon Water Resources Department (OWRD). OWRD regulates all commercial, industrial, domestic, and agricultural water use in the state of Oregon through water rights.

Estimates of water diversion rates and location of points of diversion can be derived from the following OWRD sources:

- Water Rights Information System (WRIS) – the WRIS database contains all permitted or certificated water rights. Data in the WRIS corresponding to quantities of water for use are expressed as maximum use allowable, generally as monthly, seasonal or annual rates or volumes. These maximum values may not correspond to actual usage, which will likely vary based on factors such as irrigation application rate or household consumer demand. DEQ may choose to incorporate the maximum amount allowable or some lesser quantity provided sufficient information is available to support those rates in the modeling. Water rights information can also be accessed using their online mapping application (https://apps.wrd.state.or.us/apps/gis/wr/Default.aspx).
- Water Use Reports – some, but not all, water rights holders must monitor and report the water they use to the state, typically on a monthly or yearly basis, as a requirement of their water rights. These water use reports will be used to develop withdrawal time series based on available information.

5.7 Effective shade measurements

Effective shade is the percent of potential daily solar radiation flux that is blocked by vegetation and topography. DEQ and/or partner agency staff used an instrument called a solar pathfinder to collect effective shade measurements in the field. The effective shade measurement methods and quality control procedures used are outlined in the Water Quality Monitoring Technical Guide Book (OWEB, 1999) and the solar pathfinder manual (Solar Pathfinder, 2016). Table 6 lists the locations where effective shade measurements were collected and the effective shade value for July 2002.

Table 6: Effective shade data collected in the South Umpqua and Umpqua Subbasins.

Station ID	Station	Latitude/Longitude	Effective Shade	Data Source
No Station ID	Calapooya Creek above White Creek	43.4744/-123.049	89%	DEQ File
No Station ID	Calapooya Creek at I-5	43.4159/-123.325	12%	DEQ File
No Station ID	Calapooya Creek at Oakland Bridge	43.4252/-123.303	21%	DEQ File
No Station ID	Calapooya Creek at Sutherlin Intake / Nonpareil	43.4078/-123.175	64%	DEQ File
No Station ID	Jackson Creek at Campground	42.9758/-122.687	65%	DEQ File
No Station ID	Jackson Creek downstream of Falcon Creek at Bridge	42.9981/-122.554	66%	DEQ File
No Station ID	Jackson Creek near mouth at Forest Service Boundary	42.9635/-122.86	62%	DEQ File
No Station ID	Jackson Creek upstream of Beaver Creek	42.9586/-122.784	60%	DEQ File

Station ID	Station	Latitude/Longitude	Effective Shade	Data Source
No Station ID	Lookingglass Creek at mouth	43.1185/-123.429	8%	DEQ File
No Station ID	Lookingglass Creek at RM 5.7	43.1562/-123.481	79%	DEQ File
No Station ID	Lookingglass Creek at RM 5.7	43.1562/-123.481	45%	DEQ File
No Station ID	Olalla Creek at County gage, downstream of Berry Creek	43.0389/-123.544	67%	DEQ File
No Station ID	Olalla Creek at County gage, downstream of Berry Creek	43.0389/-123.544	49%	DEQ File
No Station ID	Olalla Creek at County gage, downstream of Berry Creek	43.0389/-123.544	36%	DEQ File
No Station ID	Olalla Creek at HWY 42	43.1135/-123.508	45%	DEQ File
No Station ID	South Umpqua at Days Creek Cutoff Bridge	43.2101/-123.354	10%	DEQ File
No Station ID	South Umpqua River above Jackson	42.9339/-122.992	35%	DEQ File
No Station ID	South Umpqua River at Roseburg	42.9738/-122.876	1%	DEQ File
No Station ID	South Umpqua River below Tiller	42.9336/-122.992	13%	DEQ File

6 Model development and calibration

Waterbodies where model development was initiated for the Umpqua Basin TMDL and WQMP (DEQ, 2006) are listed in Table 7. The extent and location of these models is shown in the HTML interactive map that accompanies this QAPP and is referenced in Appendix D.

Table 7: Waterbodies where a model has already been developed.

Model Version	Model Waterbody
Heat Source version 6 temperature model	North Fork Smith River, Smith River, West Fork Smith River
Heat Source version 7 temperature model	Calapooya Creek, Cow Creek, Elk Creek, Jackson Creek, Olalla-Lookingglass Creek, South Umpqua River, Umpqua River

The setup and calibration for the models listed in Table 7 was completed by DEQ and documented in the Umpqua Basin TMDL and WQMP (DEQ, 2006). Adjustments to the existing calibrated models are unlikely to occur as part of this project. However, if it is determined that the model calibration needs to be updated, the model inputs that are expected to be modified are described in Section 6.1. DEQ will follow the model acceptance criteria and model fit statistics described in Chapter 7.2.

DEQ will develop effective shade curves for all other waterbodies that were not specifically listed in Table 7. Effective shade curves represent the maximum possible effective shade for different vegetation types, stream widths, and stream aspect. Every combination of these conditions are modeled in Heat Source to develop the estimated effective shade. The results are summarized in a shade curve plot. The results can also be summarized in a lookup table with additional combinations of vegetation height, density, and buffer width included. Effective shade curves were developed for the original Umpqua Basin TMDL and WQMP (DEQ, 2006). Adjustments to the existing shade curve models are unlikely to occur as part of this project. However, if it is determined that the models need to be updated DEQ will follow the procedures outlined in this QAPP.

6.1 General model inputs and parameters

6.1.1 Heat Source version 6

Table 8 summarizes all of the user entered model inputs required to run Heat Source version 6; and identifies the subset of inputs that could possibly be modified to improve the calibration of the model. It should be noted, it is unlikely all of these will be used as calibration parameters; rather this list identifies the candidate model inputs that will be considered for adjustment through the calibration process. The following bulleted list of input categories and specific inputs describes the general form and function of the inputs, and why the inputs are candidates for adjustment during calibration:

- Morphology – The morphology inputs that could be used as calibration parameters include upstream and downstream channel elevations, Manning’s *n*, and rating curve coefficients *a* and *b* for a power function. Channel hydraulics are important for predicting stream temperatures because they govern the surface area of water that could be exposed to solar radiation, the residence time for exposure, and the degree of light penetration into the water column. Field data for these inputs are often difficult to collect over large spatial scales, and values can vary significantly on a small scale. Heat Source is a one-dimensional model and complex channel configurations are represented as a trapezoidal pattern. Adjustments to inputs that affect channel hydraulics are often necessary to calibrate the model.

- Meteorology – The meteorological input modified in calibration is wind speed. Wind speed can vary significantly on a small geographic scale and the distance to the source of the meteorological data is often much greater than the small-scale localized weather. Hence, adjusting wind is an appropriate calibration method to account for more site-specific weather patterns.

- Mass and thermal flux – Mass and thermal inflows and outflows are inputs often adjusted during the calibration process. These inflows of heat and water consist of tributary and groundwater inflows as well as diversions (i.e., water rights withdrawals) and groundwater losses. The temporal and geographic extents of flow gaging and temperature monitoring on tributaries or groundwater are generally sparse. An effective way of improving the calibration is to complete a flow mass balance with available data, and then add, subtract, or adjust flows either globally or in specific locations within the bounds of the flow mass balance and available measurements, and the temperature response predicted by the model.

- Vegetation – Vegetation characteristics input into the model are often derived from aerial imagery or LiDAR. The vegetation characteristics determine the degree to which near-stream vegetation has the capacity to block incidental solar radiation on the surface of the modeled waterbody. Three vegetation inputs incorporated into the model calibration process are the vegetation density, overhang, and height. Field measurements offer a general understanding of vegetation characteristics within the watershed, however variability in these parameters can be significant on smaller geographic scales. To improve the model fit these model inputs may be modified on a global scale for different vegetation classes within the bounds of available data.

Table 8: Summary of model inputs required for Heat Source version 6.

Input Type	Input	Units	Calibration Parameter
General	Model Date	date (mm/dd/yyyy)	NO
General	Longitudinal Stream Sample Distance	meters	NO
General	Number of Tributary Inflow Sites	-	NO
General	Number of Meteorological Data Sites	-	NO
General	Total Longitudinal Distance	meters	NO
General	Stop Distance	meters	NO
General	Latitude	decimal degrees	NO
General	Longitude	decimal degrees	NO
General	Riparian Zone Width	meters	NO
Meteorological Data	Meteorological Data Model Kilometers	kilometers	NO
Meteorological Data	Wind Speed	meters/second	YES
Meteorological Data	Relative Humidity	proportion (0-1)	NO
Meteorological Data	Air Temperature	degrees Celsius	NO
Boundary Condition	Boundary Condition Inflow Rate	cubic meters/second	NO
Boundary Condition	Water Temperature	degrees Celsius	NO
Tributary	Tributary Inflow Model Kilometers	kilometers	NO
Tributary	Tributary Inflow Rate	cubic meters/second	YES
Tributary	Water Temperature	degrees Celsius	YES
Land Cover Data	Topographic Shade Angle - West	degrees	NO
Land Cover Data	Topographic Shade Angle - South	degrees	NO
Land Cover Data	Topographic Shade Angle - East	degrees	NO
Land Cover Data	Landcover Code	-	NO
Land Cover Codes	Landcover Height	meters	YES
Land Cover Codes	Canopy Density	proportion (0-1)	YES

Input Type	Input	Units	Calibration Parameter
Land Cover Codes	Landcover Overhang	meters	YES
Morphology Data	Channel Bed Elevation	meters	NO
Morphology Data	Manning’s Roughness Coefficient, n	seconds/meter	YES
Morphology Data	Near-stream Disturbance Zone (NSDZ) Width	meters	NO
Morphology Data	Rating Curve Coefficient, a	unitless	YES
Morphology Data	Rating Curve Coefficient, b	unitless	YES
Morphology Data	Percent Bedrock	proportion (0-1)	NO
Morphology Data	Channel Aspect	degrees	NO
Morphology Data	Channel Incision	meters	NO
Morphology Data	Valley Length (optional)	meters	NO

6.1.2 Heat Source version 7

The model parameters for Heat Source version 7 are similar to Heat Source version 6 with a few notable exceptions:

- Model period can be up to 21 days where Heat Source version 6 only models a single day;
- Star pattern landcover input with variable landcover height, density, and ground elevation inputs;
- allows for variable flow rate time series on the boundary conditions and tributary inputs;
- requires input of latitude, longitude, and aspect for each node of the model;
- uses Manning’s equation exclusively to calculate channel hydraulics and omits the ability to specify rating curve coefficients for certain aspects of channel hydraulics;
- includes cloudiness (as a percentage of clear sky) as a meteorological input—Heat Source version 6 assumes the clear sky conditions;
- allows specifically for groundwater (accretion) and diversion inputs to the model; and
- specifies additional morphology data such as bed sediment parameters and channel gradient.

Table 9 summarizes the list of the model parameters that are different between Heat Source version 6 and Heat Source version 7.

Table 9: Summary of the model inputs that are different between Heat Source version 6 and Heat Source version 7.

Input Type	Input	Units	V6	V7	Calibration Parameter
General	Riparian Zone Width	meters	YES	NO	NO

Input Type	Input	Units	V6	V7	Calibration Parameter
Morphology Data	Percent Bedrock	proportion (0-1)	YES	NO	NO
Morphology Data	Channel Incision	meters	YES	NO	NO
Morphology Data	Valley Length	meters	YES	NO	NO
Meteorological Data	Cloudiness	proportion (0-1)	NO	YES	YES
Accretion	Accretion Inflow Rate	cubic meters/second	NO	YES	YES
Accretion	Water Temperature	degrees Celsius	NO	YES	YES
Accretion	Withdrawal flow rate	cubic meters/second	NO	YES	YES
Morphology Data	Channel Gradient	meters/meters	NO	YES	YES
Morphology Data	Channel Angle z	meters/meters	NO	YES	YES
Morphology Data	Bed Particle Size	millimeters	NO	YES	YES
Morphology Data	Percent Embeddedness	proportion (0-1)	NO	YES	YES
General	Stream Length	kilometers	NO	YES	NO
General	Modeling Start Date	date (mm/dd/yyyy)	NO	YES	NO
General	Simulation Period	days	NO	YES	NO
General	Flush Initial Condition	days	NO	YES	NO
General	Time Zone	-	NO	YES	NO
General	Model Time Step	minutes	NO	YES	NO
General	Model Distance Step	meters	NO	YES	NO
General	Include Evaporation Losses From Flow (True/False)	-	NO	YES	NO
General	Evaporation Method (Mass Transfer/Penman)	-	NO	YES	NO
General	Wind Function Coefficient a	unitless	NO	YES	NO
General	Wind Function Coefficient b	unitless	NO	YES	NO
General	Include Deep Alluvium Temperature (True/False)	-	NO	YES	NO
General	Deep Alluvium Temperature	degrees Celsius	NO	YES	NO

Input Type	Input	Units	V6	V7	Calibration Parameter
General	Distance Between Transect Samples	meters	NO	YES	NO
Accretion	Stream Kilometers	kilometers	NO	YES	NO
Land Cover Codes	Landcover Code	-	NO	YES	NO
Morphology Data	Stream Kilometers	kilometers	NO	YES	NO
Morphology Data	Sediment Thermal Conductivity	watts/meters/degrees Celsius	NO	YES	NO
Morphology Data	Rosgen Level I Stream Type	-	NO	YES	NO
Morphology Data	Width to Depth Ratio	meters	NO	YES	NO
Morphology Data	X Factor	unitless	NO	YES	NO

6.2 Data gaps

Non-steady state stream models typically require a significant amount of data because of the large spatial and temporal extents the models typically encompass. As the model size or modeling period increase, the amount of information needed to parameterize it also increases. Often it is not possible to parameterize a model entirely from field data because it can be resource intensive or impractical to collect everything that is needed. In general, these data gaps may be considered and addressed in a number of ways. Table 10 summarizes methods that are used to derive the data needed to parameterize the model.

To the greatest extent possible, the method used to derive the model parameters for the existing TMDL models have been summarized in the boundary conditions and tributary inputs tables in the sections of model inputs in the current Chapter 6.

Table 10: Methods to derive model parameters for data gaps.

Method	Possible Parameters	Description
Direct surrogate	Tributary temperatures, meteorological inputs, sediment	Often, neighboring or nearby tributary watersheds share climatological and landscape features. Model parameters that have an incomplete record or no data may be parameterized using data from a neighboring or nearby location where data is available.
Calibration adjustment	All inputs	In some instances, a significant input may be required for appropriate representation in the modeling, however little may be known about the nature of that input. An example of this is groundwater influx and temperature. Datasets for these inputs can be estimated by adjusting the necessary values within acceptable ranges during the calibration process.

Method	Possible Parameters	Description
Literature-based values	All inputs	Literature values are often used for model parameters or unquantified model inputs when little is known about the site-specific nature of those inputs. Examples of these types of parameters include stream bed heat transfer properties, hyporheic characteristics or substrate porosity (Bencala and Walters, 1983; Hart, 1995; Pelletier et al., 2006; Sinokrot and Stefan, 1993).
Mass balance	Tributary temperature and flow	On main stem modeled reaches, tributary stream flow or temperature can be estimated using a mass balance approach assuming either flow or temperature data for the tributary are known. If estimating temperature, flow is required, and if estimating flow, temperature is required. Often TIR data are used to estimate tributary flow because upstream, downstream and tributary temperatures are known, and upstream and tributary flows are known (or estimated).
Simple linear regression	Tributary temperature and flow	Parameters such as flow and temperature in neighboring or nearby tributaries often demonstrate similar diurnal patterns or hydrographs which allow for the development of suitable mathematical relationships (simple linear regression) in order to fill the data gaps for those inputs. This method requires at least some data exist for the incomplete dataset in order to develop the relationship.
Drainage area ratio	Tributary flow	For ungaged tributaries, flows can be estimated using the ratio between the watershed drainage areas of the ungaged location and from a nearby gaged tributary (Ries et al., 2017; Risley, 2009; Gianfagna, 2015). For example, if the watershed area upstream of a gaged tributary is 10 square kilometers, and the watershed area of an ungaged tributary is 5, the flows in the ungaged tributary are estimated to be half of those in the gaged tributary. The method is typically used to calculate low flow or flood frequency statistics. In that context a weighting factor is recommended when the drainage area ratio of the two sites is between 0.5 and 1.5. Weighting factors can be evaluated if instantaneous observed flows are available at the ungaged location.
Flow-probability-probability-flow (QPPQ)	Tributary flow	The flow-probability-probability-flow (QPPQ) method makes use of relating flow duration curves between a gaged tributary and an ungaged tributary (Lorenz and Ziegeweid, 2016). The flow duration curve at ungaged sites is estimated using regression approaches (Risley et al., 2008) and the online USGS tool StreamStats (Ries et al., 2017).

Method	Possible Parameters	Description
Adiabatic adjustment	Air temperature	Air temperature can vary significantly throughout a watershed, particularly with large differences in elevation from headwaters to the mouth of the drainage. To account for these differences, air temperatures can be adjusted using an equation that relates air temperature measured at a meteorological station to a location of a given elevation using the dry adiabatic lapse rate of 9.8 °C/km and the differences in elevation.
GIS Data	Channel position, Channel width, Landcover, Gradient, Elevation, Topographic shade angles	Several landscape scale GIS data sets can be used to derive a number of model parameters. Digital orthophotos quads (DOQs) are used to classify landcover and estimate vegetation type, height, density, and overhang. DOQs can also be used to determine stream position, stream aspect, and channel width. A digital elevation model (DEM) consists of digital information that provides a uniform matrix of terrain elevation values. It provides basic quantitative data for deriving surface elevation, stream gradient, and maximum topographic shade angles.

6.3 Effective shade curves and lookup tables

Effective shade curves are plots that present the maximum possible effective shade as a function of different types of natural near-stream vegetation, active channel widths, and stream aspect. Channel width is plotted on the x-axis, effective shade is on the y-axis, and a separate symbol and/or line color is used for each stream aspect. Separate plots are produced for each type of natural vegetation that is expected in the TMDL project area. The plots are called effective shade curves because the pattern on the plot resembles a gentle downward slopping curve. As channel width increases effective shade gets smaller. The plots are produced from the output of Heat Source version 6 shade models that have been parameterized with every combination of the previously mentioned conditions. The effective shade curve approach can be used almost anywhere to quantify the amount of background solar radiation loading and the effective shade necessary to eliminate temperature increases from anthropogenic disturbance or removal of near-stream vegetation.

This model approach can also be used to develop a lookup table to determine the effective shade resulting from other combinations vegetation height, vegetation density, vegetation overhang, and vegetation buffer widths that are different from background conditions. The lookup table provides a convenient way for readers of the TMDL to estimate the effective shade for current conditions without using the model. The lookup table can also be used as a reverse lookup to determine what vegetation height, buffer width, or vegetation density would achieve a certain effective shade.

6.3.1 Model domain

The model domain is not specific to any single waterbody but will be parameterized using a latitude and longitude located in the TMDL watershed to ensure that the modeled solar altitude and sun angles are appropriate for the area.

6.3.2 Spatial and temporal resolution

The model input spatial resolution (*dx*) is 30 meters. Outputs are generated every 100 meters. The spatial resolution is not very meaningful however, since each output distance step will represent a unique combination of the different modeled vegetation and channel conditions. The model time step (*dt*) is 1 minute and outputs are generated every hour.

6.3.3 Source characteristics

The effective shade curve approach can be used almost anywhere in the watershed to quantify the amount of background solar radiation loading and the effective shade necessary to eliminate temperature increases from anthropogenic disturbance or removal of near-stream vegetation.

The lookup tables can be used to estimate existing shade or current solar loading. Other potential sources of thermal loading and the temperature response will not be evaluated by this model.

6.3.4 Time frame of simulation

The model period is a single day in late July or early August. This time frame was chosen to characterize the solar loading when maximum stream temperatures are observed, the sun altitude angle is highest, and the period of solar exposure is longest.

6.3.5 Important assumptions

Models used to develop effective shade curves assume no cloud cover and no topographic shade. The modeled terrain is flat so there is no difference in ground elevation between the stream and the adjacent vegetation buffer area. The vegetation density, vegetation height, vegetation overhang, and vegetation buffer width are assumed to be equal on both sides of the stream. The width of the active channel is assumed to be equal to the distance between near-stream vegetation on either side of the stream.

Effective shade curves were developed for the original Umpqua Basin TMDL and WQMP (DEQ, 2006). Adjustments to the existing shade curve models are unlikely to occur as part of this project. However, if it is determined that the models need to be updated DEQ will follow the procedures outlined in this QAPP.

6.3.6 Model inputs

There are two categories of models each with different sets of inputs:

- Effective shade curves: Model input values for vegetation height, vegetation density, vegetation overhang, and vegetation buffer width correspond to the restored streamside vegetation types expected in areas that are currently lacking streamside vegetation because of anthropogenic disturbance. The specific values will be determined during the TMDL process and will likely be the same or similar to the values presented in the Umpqua Basin TMDL and WQMP (DEQ, 2006). The other model inputs are the same as what is described in Table 11.
- Effective shade lookup tables: Model input values to be used for the lookup tables are described in Table 11.

Table 11: Range of model inputs to be used for effective shade lookup tables.

Model Input	Value Range
Vegetation height (meters)	0 - 90 (or expected maximum)

Model Input	Value Range
Vegetation density (percent)	0 -100
Vegetation overhang (meters)	0 - 3 (or expected maximum)
Vegetation buffer width (meters)	0 - 45
Active channel width (meters)	0 - 100 (or expected maximum)
Stream aspect (degrees)	North/South (0/180); Northeast/Southwest (45/225); East/West (90/270); Southeast/Northwest (135/315)
Topographic shade angles (degrees)	0
Cloudiness	0

6.4 Calapooya Creek

The Calapooya Creek model is a temperature model developed using Heat Source 7.0. The model was developed by DEQ.

6.4.1 Model domain

The extent of the model domain is Calapooya Creek from the confluence of North Fork Calapooya Creek to the mouth of Calapooya Creek at the confluence of the Umpqua River. The model extent is shown in the HTML interactive map that accompanies this QAPP and is referenced in Appendix D.

6.4.2 Spatial and temporal resolution

The model input spatial resolution (*dx*) is 50 meters. Outputs are generated every 100 meters. The model time step (*dt*) is 1 minute and outputs are generated every hour.

A *dx* of 50 meters was chosen to capture the range of solar flux input caused by the varied vegetation conditions along the length of the stream. The high resolution *dx* will allow evaluation of multiple vegetation management scenarios for each designated management agency.

6.4.3 Source characteristics

The primary sources of thermal loading contributing to temperatures exceedances along the Calapooya Creek include increases in solar radiation loading from the disturbance or removal of near-stream vegetation, point source discharges, reductions to stream flow rate or volume, and background sources (DEQ, 2006). Other potential sources include channel modification and widening, and warming caused by climate change. The contribution of these latter potential sources may be investigated as part of the model scenarios.

There are two permitted individual NPDES point sources along the model extent. Detail about each point source is summarized in Table 12.

Table 12: Summary of individual NPDES permitted discharges in the Calapooya Creek.

Facility Name (Facility Number)	Latitude/Longitude	Permit Type and Description	Stream/River Mile
Oakland STP (62855)	43.4189/-123.306	NPDES-DOM-Da: Sewage - less than 1 MGD	Calapooya Creek RM 13.9
Sutherlin STP (86662)	43.397/-123.36	NPDES-DOM-C2a: Sewage - 1 MGD or more but less than 2 MGD	Calapooya Creek RM 9.8

The majority land uses along the Calapooya Creek are forestry and agriculture accounting for about 86 percent of the near-stream area. Table 13 summarizes all the land uses within 100 meters of the digitized Calapooya Creek centerline. Land uses were summarized using the 2016 National Land Cover Database (Yang et al., 2018). Note that Shrub/Scrub and Herbaceous land uses can be areas where forest clearcuts have occurred and would be classified as forest after regrowth.

Table 13: Summary of land uses along the model extent within 100 meters of the digitized Calapooya Creek centerline based on the 2016 National Land Cover Database (Yang et al., 2018).

2016 NLCD Land Cover	Acres	Percent of Total Acres
Hay/Pasture	1218.7	41.8
Evergreen Forest	557.5	19.1
Emergent Herbaceous Wetlands	268.4	9.2
Woody Wetlands	215.7	7.4
Herbaceous	177.2	6.1
Shrub/Scrub	151.5	5.2
Mixed Forest	123.9	4.2
Developed, Open Space	110.5	3.8
Deciduous Forest	46.7	1.6
Developed, Low Intensity	28.2	1
Barren Land	12.2	0.4
Cultivated Crops	3.3	0.1
Developed, Medium Intensity	1.6	0.1

Anthropogenic related stream warming caused by nonpoint sources is closely associated with the uses, the activities, and the condition of vegetation adjacent to the stream. How activities and uses are managed in these areas is partially determined by a variety of different rules and management plans established by the landowner and any agency with land use authority. To better understand the spatial distribution of different agency rules or management plans along the model extent DEQ mapped known designated management agencies (Table 14).

A designated management agency is defined in OAR 340-042-0030(2) as a federal, state, or local governmental agency that has legal authority over a sector or source contributing pollutants. Typically, persons or designated management agencies that are identified in the TMDL Water Quality Management Plan (WQMP) are responsible for developing TMDL implementation plans and implementing management strategies to reduce pollutant loading. Table 14 summarizes the potential designated management agencies and responsible persons along the Calapooya Creek model extent.

Table 14: Summary of potential designated management agencies (DMAs) or responsible persons along the model extent within 100 meters of the digitized Calapooya Creek centerline.

DMA or Responsible Person	Acres	Percent of Total Acres
Oregon Department of Agriculture	2750.6	76.1
Oregon Department of Forestry - Private Forestland	461.4	12.8
Douglas County	272.3	7.5
U.S. Bureau of Land Management	78.1	2.2
City of Oakland	24.6	0.7
Oregon Department of Transportation	13.5	0.4
Central Oregon & Pacific Railroad	9	0.2
City of Sutherlin	2.8	0.1
U.S. Government	<0.05	<0.05

6.4.4 Time frame of simulation

The model period is July 12, 2002 to July 31, 2002.

6.4.5 Important assumptions

The effort currently described in the QAPP includes use of existing models. Key calibration assumptions made during the model setup and calibration process were documented in the original TMDL (DEQ, 2006), the model user guide (Boyd and Kasper, 2003) or in Section 6 and Section 7 of this document.

6.4.6 Model inputs

Table 15 summarizes the current configuration of the model input parameters and the source of these data. Temperature, flow, and meteorological input parameters are summarized to improve documentation of the TMDL approach.

Table 15: Boundary condition and tributary inputs to the existing Calapooya Creek Heat Source model.

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Calapooya Creek downstream of the North Fork	59.6	Boundary Condition	Flow	Derived data.	Constant flow input of 0.141 cms.
Calapooya Creek downstream of the North Fork	59.6	Boundary Condition	Water Temperature	DEQ	
White Creek	57.7	Tributary	Flow	Derived data.	Flow input is 0.
Coon Creek	55.7	Tributary	Flow	Derived data.	Constant flow input of 0.022 cms.

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Timothy Creek	54.3	Tributary	Flow	Derived data.	Flow input is 0.
Hinkle Creek	50.6	Tributary	Flow	Derived data.	Constant flow input of 0.027 cms.
Gassy Creek	45.3	Tributary	Flow	Derived data.	Constant flow input of 0.022 cms.
Banks Creek	40.2	Tributary	Flow	Derived data.	Constant flow input of 0.01 cms.
Foster Creek	38.5	Tributary	Flow	Derived data.	Constant flow input of 0.017 cms.
Oldham Creek	30.6	Tributary	Flow	Derived data.	Constant flow input of 0.02 cms.
Pollock Creek	26.4	Tributary	Flow	Derived data.	Constant flow input of 0.06 cms.
Cabin Creek	24.3	Tributary	Flow	Derived data.	Flow input is 0.
Cook Creek	14.5	Tributary	Flow	Derived data.	Flow input is 0.
Dodge Canyon Creek	13.8	Tributary	Flow	Derived data.	Flow input is 0.
White Creek	57.7	Tributary	Water Temperature	DEQ	
Coon Creek	55.7	Tributary	Water Temperature	Derived data.	Temperature data copied from White Creek.
Timothy Creek	54.3	Tributary	Water Temperature	Derived data.	Temperature data copied from White Creek.
Hinkle Creek	50.6	Tributary	Water Temperature	USFS	
Gassy Creek	45.3	Tributary	Water Temperature	DEQ	

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Banks Creek	40.2	Tributary	Water Temperature	Derived data.	Temperature data copied from Gassy Creek.
Foster Creek	38.5	Tributary	Water Temperature	Derived data.	Temperature data copied from Gassy Creek.
Oldham Creek	30.6	Tributary	Water Temperature	Derived data.	Temperature data copied from Gassy Creek.
Pollock Creek	26.4	Tributary	Water Temperature	DEQ	
Cabin Creek	24.3	Tributary	Water Temperature	Derived data.	Temperature data copied from Pollock Creek.
Cook Creek	14.5	Tributary	Water Temperature	Derived data.	Temperature data copied from Pollock Creek.
Dodge Canyon Creek	13.8	Tributary	Water Temperature	Derived data.	Temperature data copied from Pollock Creek.
KRBG - Roseburg Regional Airport	0.6, 16.15, 24.6, 59, 59.15	Meteorological	Air Temperature, Relative Humidity, Wind Speed	NCDC	

Hourly meteorology inputs into the model include air temperature, relative humidity, and wind speed. Air temperature data were modified using the dry adiabatic lapse rate to adjust for differences in elevation between the measurement location and the model input location. Wind speeds were adjusted to improve the calibration using a wind-sheltering coefficient to represent difference in wind speed between the measurement location and above the stream within the riparian area.

6.4.7 Model calibration

The expected model calibration sites and data sources are summarized in Table 16. The model location in the table below describes the distance of each input from the most downstream model node. Effective shade model calibrations sites are summarized in Table 6. The model inputs and parameters that are expected to be modified to improve model fit are described in Section 6.1.

Table 16: Calibration sites and parameters used in the existing Calapooya Creek Heat Source model.

Model Location Name (Station ID)	Model Location (kilometers)	Calibration Parameter	Data Source
Calapooya Creek downstream of the North Fork	59.6	Flow	DEQ
Calapooya Creek Upper	59.15	Water Temperature	DEQ
Calapooya Creek downstream of Forks (29000)	59	Water Temperature	BLM
Calapooya Creek above White Creek	57.85	Flow, Effective Shade	DEQ
Calapooya Creek at Sutherlin Intake / Nonpareil	41.25	Flow, Effective Shade	DEQ
Calapooya Creek above Cabin Creek (30154-ORDEQ)	24.6	Water Temperature	Partnership for the Umpqua Rivers
Calapooya Creek at Oakland Bridge	23.65	Flow, Effective Shade	DEQ
Calapooya Creek at I-5	20.65	Flow, Effective Shade	DEQ
Calapooya Creek near Oakland	16.15	Flow	DEQ
Calapooya Creek near Oakland (14320700)	16.15	Water Temperature	Douglas County
Calapooya Creek at Umpqua	0.7	Flow	DEQ
Calapooya Creek at Umpqua River (10996-ORDEQ)	0.6	Water Temperature	DEQ
Model extent	Model extent	Water Temperature (TIR)	Watershed Sciences (2003)

6.5 Cow Creek

The Cow Creek model is a temperature model developed using Heat Source 7.0. The model was developed by DEQ.

6.5.1 Model domain

The extent of the model domain is Cow Creek from Galesville Reservoir to mouth of Cow Creek at the confluence of the South Umpqua River. The model extent is shown in the HTML interactive map that accompanies this QAPP and is referenced in Appendix D.

6.5.2 Spatial and temporal resolution

The model input spatial resolution (*dx*) is 50 meters. Outputs are generated every 100 meters. The model time step (*dt*) is 1 minute and outputs are generated every hour.

A *dx* of 50 meters was chosen to capture the range of solar flux input caused by the varied vegetation conditions along the length of the stream. The high resolution *dx* will allow evaluation of multiple vegetation management scenarios for each designated management agency.

6.5.3 Source characteristics

The primary sources of thermal loading contributing to temperatures exceedances along the Cow Creek include increases in solar radiation loading from the disturbance or removal of near-stream vegetation, point source discharges, reductions to stream flow rate or volume, and background sources (DEQ, 2006). Other potential sources include channel modification and widening, and warming caused by climate change. The contribution of these latter potential sources may be investigated as part of the model scenarios.

There are two permitted individual NPDES point sources along the model extent. Detail about each point source is summarized in Table 17.

Table 17: Summary of individual NPDES permitted discharges in the Cow Creek.

Facility Name (Facility Number)	Latitude/Longitude	Permit Type and Description	Stream/River Mile
Glendale STP (33733)	42.7434/-123.429	NPDES-DOM-Da: Sewage - less than 1 MGD	Cow Creek RM 40
Riddle STP (75227)	42.9508/-123.357	NPDES-DOM-Da: Sewage - less than 1 MGD	Cow Creek RM 1.9

The majority land use along the Cow Creek is forestry accounting for about 66 percent of the near-stream area. Table 18 summarizes all the land uses within 100 meters of the digitized Cow Creek centerline. Land uses were summarized using the 2016 National Land Cover Database (Yang et al., 2018). Note that Shrub/Scrub and Herbaceous land uses can be areas where forest clearcuts have occurred and would be classified as forest after regrowth.

Table 18: Summary of land uses along the model extent within 100 meters of the digitized Cow Creek centerline based on the 2016 National Land Cover Database (Yang et al., 2018).

2016 NLCD Land Cover	Acres	Percent of Total Acres
Evergreen Forest	1224.5	25.6
Woody Wetlands	802.0	16.8
Hay/Pasture	586.0	12.3
Herbaceous	532.2	11.1
Developed, Open Space	497.5	10.4
Shrub/Scrub	497.5	10.4
Emergent Herbaceous Wetlands	332.9	7
Developed, Low Intensity	173.2	3.6
Mixed Forest	100.3	2.1
Developed, Medium Intensity	17.1	0.4
Barren Land	11.3	0.2
Deciduous Forest	4.9	0.1

2016 NLCD Land Cover	Acres	Percent of Total Acres
Developed, High Intensity	0.9	<0.05

Anthropogenic related stream warming caused by nonpoint sources is closely associated with the uses, the activities, and the condition of vegetation adjacent to the stream. How activities and uses are managed in these areas is partially determined by a variety of different rules and management plans established by the landowner and any agency with land use authority. To better understand the spatial distribution of different agency rules or management plans along the model extent DEQ mapped known designated management agencies (Table 19).

A designated management agency is defined in OAR 340-042-0030(2) as a federal, state, or local governmental agency that has legal authority over a sector or source contributing pollutants. Typically, persons or designated management agencies that are identified in the TMDL Water Quality Management Plan (WQMP) are responsible for developing TMDL implementation plans and implementing management strategies to reduce pollutant loading. Table 19 summarizes the potential designated management agencies and responsible persons along the Cow Creek model extent.

Table 19: Summary of potential designated management agencies (DMAs) or responsible persons along the model extent within 100 meters of the digitized Cow Creek centerline.

DMA or Responsible Person	Acres	Percent of Total Acres
Oregon Department of Agriculture	2116.9	39.8
Oregon Department of Forestry - Private Forestland	1176.3	22.1
Central Oregon & Pacific Railroad	721	13.6
Douglas County	587.3	11
U.S. Bureau of Land Management	551.9	10.4
Oregon Department of Transportation	109	2
City of Glendale	33.3	0.6
City of Riddle	17.7	0.3
Oregon Department of Forestry - State Forestland	2.7	0.1
U.S. Government	1.9	<0.05
Union Pacific Railroad	0.8	<0.05
State of Oregon	0.5	<0.05

6.5.4 Time frame of simulation

The model period is July 12, 2002 to July 31, 2002.

6.5.5 Important assumptions

The effort currently described in the QAPP includes use of existing models. Key calibration assumptions made during the model setup and calibration process were documented in the original TMDL (DEQ, 2006), the model user guide (Boyd and Kasper, 2003) or in Section 6 and Section 7 of this document.

6.5.6 Model inputs

Table 20 summarizes the current configuration of the model input parameters and the source of these data. Temperature, flow, and meteorological input parameters are summarized to improve documentation of the TMDL approach.

Table 20: Boundary condition and tributary inputs to the existing Cow Creek Heat Source model.

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Cow Creek below Galesville dam (30148-ORDEQ)	97	Boundary Condition	Flow	DEQ	
Cow Creek below Galesville dam (30148-ORDEQ)	97	Boundary Condition	Water Temperature	DEQ	
Glendale STP	65.97	Point Source	Flow	DEQ	
Riddle STP	3.22	Point Source	Flow	DEQ	
Riddle STP	3.22	Point Source	Water Temperature	Derived data.	July 2001 NPDES Discharge Monitoring Report.
Whitehorse Creek	93	Tributary	Flow	Derived data.	Flow input is constant.
Russell Creek	91	Tributary	Flow	Derived data.	Flow input is constant.
Starveout Creek	87.25	Tributary	Flow	Derived data.	Flow input is constant.
Booth Gulch	86.9	Tributary	Flow	Derived data.	Flow input is constant.
Clear Creek	86.2	Tributary	Flow	Derived data.	Flow input is constant.
Wildcat Creek	85.3	Tributary	Flow	Derived data.	Flow input is constant.
Mynatt Creek	83.2	Tributary	Flow	Derived data.	Flow input is constant.
Quines Creek	83.1	Tributary	Flow	Derived data.	Flow input is constant.

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Unknown creek at model kilometer 80.3	80.3	Tributary	Flow	Derived data.	Flow input is constant.
McCullum Creek	79.25	Tributary	Flow	Derived data.	Flow input is constant.
Fortune Creek	78.45	Tributary	Flow	Derived data.	Flow input is constant.
Woodford Creek	75.65	Tributary	Flow	Derived data.	Flow input is constant.
Swamp Creek	74.05	Tributary	Flow	Derived data.	Flow input is constant.
Windy Creek	66.75	Tributary	Flow	Derived data.	Flow input is constant.
Mill Creek	66.55	Tributary	Flow	Derived data.	Flow input is constant.
Section Creek	64.95	Tributary	Flow	Derived data.	Flow input is constant.
Spring at model kilometer 63.75	63.75	Tributary	Flow	Derived data.	Flow input is constant.
McCullough Creek	62.65	Tributary	Flow	Derived data.	Flow input is constant.
Totten Creek	61.95	Tributary	Flow	Derived data.	Flow input is constant.
Rattlesnake Creek	58.1	Tributary	Flow	Derived data.	Flow input is constant.
Panther Creek	57.9	Tributary	Flow	Derived data.	Flow input is constant.
Perkins Creek	57.5	Tributary	Flow	Derived data.	Flow input is constant.
Battle Creek	55.5	Tributary	Flow	Derived data.	Flow input is constant.
Marion Creek	55	Tributary	Flow	Derived data.	Flow input is constant.
Tuller Creek	53.85	Tributary	Flow	Derived data.	Flow input is constant.
Dads Creek	52.05	Tributary	Flow	Derived data.	Flow input is constant.

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Skull Creek	48.85	Tributary	Flow	Derived data.	Flow input is constant.
Sled Creek	47.55	Tributary	Flow	Derived data.	Flow input is constant.
Riffle Creek	47.25	Tributary	Flow	Derived data.	Flow input is constant.
Susan Creek	44.95	Tributary	Flow	Derived data.	Flow input is constant.
Middle Creek	43.05	Tributary	Flow	Derived data.	Flow input is constant.
West Fork Cow	42.5	Tributary	Flow	Derived data.	Flow input is constant.
Unknown creek at model kilometer 38.6	38.6	Tributary	Flow	Derived data.	Flow input is constant.
Dutchman Creek	38.5	Tributary	Flow	Derived data.	Flow input is constant.
Darby Creek	36.6	Tributary	Flow	Derived data.	Flow input is constant.
Unknown creek at model kilometer 35	35	Tributary	Flow	Derived data.	Flow input is constant.
Union Creek	32.95	Tributary	Flow	Derived data.	Flow input is constant.
Unknown creek at model kilometer 32.9	32.9	Tributary	Flow	Derived data.	Flow input is constant.
Boulder Creek	31.8	Tributary	Flow	Derived data.	Flow input is constant.
Cattle Creek	30.35	Tributary	Flow	Derived data.	Flow input is constant.
Little Dads Creek	29.5	Tributary	Flow	Derived data.	Flow input is constant.
Table Creek	29.1	Tributary	Flow	Derived data.	Flow input is constant.
Iron Mountain Creek	22.8	Tributary	Flow	Derived data.	Flow input is constant.
Smith Creek	22.5	Tributary	Flow	Derived data.	Flow input is constant.

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Buck Creek	19.95	Tributary	Flow	Derived data.	Flow input is constant.
Doe Creek	19.55	Tributary	Flow	Derived data.	Flow input is constant.
Salt Creek	18.2	Tributary	Flow	Derived data.	Flow input is constant.
Island Creek	16.15	Tributary	Flow	Derived data.	Flow input is constant.
Rattlesnake Creek	13.9	Tributary	Flow	Derived data.	Flow input is constant.
Beatty Creek	13.1	Tributary	Flow	Derived data.	Flow input is constant.
Squaw Creek	12.5	Tributary	Flow	Derived data.	Flow input is constant.
Crawford Creek	11.75	Tributary	Flow	Derived data.	Flow input is constant.
Rail Gulch	10.7	Tributary	Flow	Derived data.	Flow input is constant.
Council Creek	10.15	Tributary	Flow	Derived data.	Flow input is constant.
Catching Creek	8.6	Tributary	Flow	Derived data.	Flow input is constant.
Russell Creek	7.65	Tributary	Flow	Derived data.	Flow input is constant.
Unknown creek at model kilometer 7.1	7.1	Tributary	Flow	Derived data.	Flow input is constant.
Jerry Creek	6.75	Tributary	Flow	Derived data.	Flow input is constant.
Mitchell Creek	1.4	Tributary	Flow	Derived data.	Flow input is constant.
Whitehorse Creek (C36-UBWC)	93	Tributary	Water Temperature	Umpqua Basin Watershed Council	
Russell Creek	91	Tributary	Water Temperature	Derived data.	Temperature data input copied from Whitehorse Creek (C36-UBWC).

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Starveout Creek	87.25	Tributary	Water Temperature	Derived data.	Temperature data input copied from Whitehorse Creek (C36-UBWC).
Booth Gulch	86.9	Tributary	Water Temperature	Derived data.	Temperature data input copied from McCullough Creek (C16-UBWC).
Clear Creek	86.2	Tributary	Water Temperature	Derived data.	Temperature data input copied from McCullough Creek (C16-UBWC).
Wildcat Creek	85.3	Tributary	Water Temperature	Derived data.	Temperature data input copied from McCullough Creek (C16-UBWC).
Mynatt Creek	83.2	Tributary	Water Temperature	Derived data.	Temperature data input copied from McCullough Creek (C16-UBWC).
Quines Creek (C34-UBWC)	83.1	Tributary	Water Temperature	Umpqua Basin Watershed Council	
Unknown creek at model kilometer 80.3	80.3	Tributary	Water Temperature	Derived data.	Temperature data input copied from McCullough Creek (C16-UBWC).

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
McCullum Creek	79.25	Tributary	Water Temperature	Derived data.	Temperature data input copied from McCullough Creek (C16-UBWC).
Fortune Creek	78.45	Tributary	Water Temperature	Derived data.	Temperature data input copied from McCullough Creek (C16-UBWC).
Woodford Creek	75.65	Tributary	Water Temperature	Derived data.	Temperature data input copied from McCullough Creek (C16-UBWC).
Swamp Creek	74.05	Tributary	Water Temperature	Derived data.	Temperature data input copied from McCullough Creek (C16-UBWC).
Windy Creek (C24-UBWC)	66.75	Tributary	Water Temperature	Umpqua Basin Watershed Council	
Mill Creek	66.55	Tributary	Water Temperature	Derived data.	Temperature data input copied from McCullough Creek (C16-UBWC).
Glendale STP	65.97	Tributary	Water Temperature	July 2001 NPDES DMRs	
Section Creek	64.95	Tributary	Water Temperature	Derived data.	Temperature data input copied from McCullough Creek (C16-UBWC).

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Spring at model kilometer 63.75	63.75	Tributary	Water Temperature	DEQ	
McCullough Creek (C22-UBWC)	62.65	Tributary	Water Temperature	Umpqua Basin Watershed Council	
Totten Creek	61.95	Tributary	Water Temperature	Derived data.	Temperature data input copied from McCullough Creek (C16-UBWC).
Rattlesnake Creek	58.1	Tributary	Water Temperature	Derived data.	Temperature data input copied from McCullough Creek (C16-UBWC).
Panther Creek	57.9	Tributary	Water Temperature	Derived data.	Temperature data input copied from McCullough Creek (C16-UBWC).
Perkins Creek	57.5	Tributary	Water Temperature	Derived data.	Temperature data input copied from McCullough Creek (C16-UBWC).
Battle Creek	55.5	Tributary	Water Temperature	Derived data.	Temperature data input copied from McCullough Creek (C16-UBWC).
Marion Creek	55	Tributary	Water Temperature	Derived data.	Temperature data input copied from McCullough Creek (C16-UBWC).

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Tuller Creek	53.85	Tributary	Water Temperature	Derived data.	Temperature data input copied from McCullough Creek (C16-UBWC).
Dads Creek	52.05	Tributary	Water Temperature	Derived data.	Temperature data input copied from Skull Creek (C21-UBWC).
Skull Creek (C21-UBWC)	48.85	Tributary	Water Temperature	Umpqua Basin Watershed Council	
Sled Creek	47.55	Tributary	Water Temperature	Derived data.	Temperature data input copied from Skull Creek (C21-UBWC).
Riffle Creek (C20-UBWC)	47.25	Tributary	Water Temperature	Umpqua Basin Watershed Council	
Susan Creek	44.95	Tributary	Water Temperature	Derived data.	Temperature data input copied from Skull Creek (C21-UBWC).
Middle Creek (C16-UBWC)	43.05	Tributary	Water Temperature	Umpqua Basin Watershed Council	
West Fork Cow (C14-UBWC)	42.5	Tributary	Water Temperature	Umpqua Basin Watershed Council	
Unknown creek at model kilometer 38.6	38.6	Tributary	Water Temperature	DEQ	

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Dutchman Creek	38.5	Tributary	Water Temperature	Derived data.	Temperature data input copied from Table Creek (C11-UBWC).
Darby Creek	36.6	Tributary	Water Temperature	Derived data.	Temperature data input copied from Table Creek (C11-UBWC).
Unknown creek at model kilometer 35	35	Tributary	Water Temperature	Derived data.	Temperature data input copied from Cattle Creek.
Union Creek (BLM13)	32.95	Tributary	Water Temperature	BLM	
Unknown creek at model kilometer 32.9	32.9	Tributary	Water Temperature	Derived data.	Temperature data input copied from Cattle Creek (C12-UBWC).
Boulder Creek	31.8	Tributary	Water Temperature	Derived data.	Temperature data input copied from Cattle Creek (C12-UBWC).
Cattle Creek (C12-UBWC)	30.35	Tributary	Water Temperature	Umpqua Basin Watershed Council	
Little Dads Creek	29.5	Tributary	Water Temperature	Derived data.	Temperature data input copied from Table Creek (C11-UBWC).
Table Creek (C11-UBWC)	29.1	Tributary	Water Temperature	Umpqua Basin Watershed Council	
Iron Mountain Creek (C10-UBWC)	22.8	Tributary	Water Temperature	Umpqua Basin Watershed Council	

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Smith Creek	22.5	Tributary	Water Temperature	Derived data.	Temperature data input copied from Table Creek (C11-UBWC).
Buck Creek (C09-UBWC)	19.95	Tributary	Water Temperature	Umpqua Basin Watershed Council	
Doe Creek (C08-UBWC)	19.55	Tributary	Water Temperature	Umpqua Basin Watershed Council	
Salt Creek	18.2	Tributary	Water Temperature	Derived data.	Temperature data input copied from Buck Creek (C09-UBWC).
Island Creek	16.15	Tributary	Water Temperature	Derived data.	Temperature data input copied from Russell Creek (C05-UBWC).
Rattlesnake Creek	13.9	Tributary	Water Temperature	Derived data.	Temperature data input copied from Russell Creek (C05-UBWC).
Beatty Creek	13.1	Tributary	Water Temperature	Derived data.	Temperature data input copied from Buck Creek (C09-UBWC).
Squaw Creek	12.5	Tributary	Water Temperature	Derived data.	Temperature data input copied from Russell Creek (C05-UBWC).
Crawford Creek	11.75	Tributary	Water Temperature	Derived data.	Temperature data input copied from Buck Creek (C09-UBWC).

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Rail Gulch	10.7	Tributary	Water Temperature	Derived data.	Temperature data input copied from Buck Creek (C09-UBWC).
Council Creek	10.15	Tributary	Water Temperature	Derived data.	Temperature data input copied from Russell Creek (C05-UBWC).
Catching Creek (C06-UBWC)	8.6	Tributary	Water Temperature	Umpqua Basin Watershed Council	
Russell Creek (C05-UBWC)	7.65	Tributary	Water Temperature	Umpqua Basin Watershed Council	
Unknown creek at model kilometer 7.1	7.1	Tributary	Water Temperature	Derived data.	Temperature data input copied from Buck Creek (C09-UBWC).
Jerry Creek (C04-UBWC)	6.75	Tributary	Water Temperature	Umpqua Basin Watershed Council	
Mitchell Creek	1.4	Tributary	Water Temperature	Derived data.	Temperature data input copied from Russell Creek (C05-UBWC).
KRBG - Roseburg Regional Airport	0.6, 3.95, 6.55, 19.5, 43.1, 66.9, 83.4, 93.1, 96.95	Meteorological	Relative Humidity, Wind Speed	NCDC	
No Station ID	0.6, 3.95, 6.55, 19.5, 43.1, 66.9, 83.4, 93.1, 96.95	Meteorological	Air Temperature	Insight Consultants	

Hourly meteorology inputs into the model include air temperature, relative humidity, and wind speed. Air temperature data were modified using the dry adiabatic lapse rate to adjust for differences in elevation between the measurement location and the model input location. Wind speeds were adjusted to improve the calibration using a wind-sheltering coefficient to represent difference in wind speed between the measurement location and above the stream within the riparian area.

6.5.7 Model calibration

The expected model calibration sites and data sources are summarized in Table 21. The model location in the table below describes the distance of each input from the most downstream model node. Effective shade model calibrations sites are summarized in Table 6. The model inputs and parameters that are expected to be modified to improve model fit are described in Section 6.1.

Table 21: Calibration sites and parameters used in the existing Cow Creek Heat Source model.

Model Location Name (Station ID)	Model Location (kilometers)	Calibration Parameter	Data Source
Cow Creek below Galesville dam (30148-ORDEQ)	96.95	Water Temperature	DEQ
Cow Creek near Azalea	94.2	Flow	DEQ
Cow Creek above Whitehorse (C35-UBWC)	93.1	Water Temperature	Umpqua Basin Watershed Council
Cow Creek above Quines Creek near Azalea, OR	83.45	Flow	DEQ
Cow Creek above Quines (only 7/31) (C33-UBWC)	83.4	Water Temperature	Umpqua Basin Watershed Council
Cow Creek above Windy Creek at Glendale, Or	66.95	Flow	DEQ
Cow Creek above Windy (C25-UBWC)	66.9	Water Temperature	Umpqua Basin Watershed Council
Cow Creek below McCullough	62.55	Flow	DEQ
Cow Creek below Dads Creek nearr Glendale, Or	50.8	Flow	DEQ
Cow Creek above Middle (C15-UBWC)	43.1	Water Temperature	Umpqua Basin Watershed Council
Cow Creek above Middle Creek near Glendale, OR	43.1	Flow	DEQ
Cow Creek above Union Creek near Riddle, OR	33	Flow	DEQ
Cow Creek above Doe Creek near Riddle, Or	19.65	Flow	DEQ
Cow Creek above Doe (C07-UBWC)	19.5	Water Temperature	Umpqua Basin Watershed Council
Cow Creek near Riddle	10.5	Flow	DEQ
Cow Creek Below Jerry (C03-UBWC)	6.55	Water Temperature	Umpqua Basin Watershed Council
Cow Creek above Canyonville Bridge (C02-UBWC)	3.95	Water Temperature	Umpqua Basin Watershed Council

Model Location Name (Station ID)	Model Location (kilometers)	Calibration Parameter	Data Source
Cow Creek near Riddle, Or	3.8	Flow	DEQ
Cow Creek Near Mouth (10997-ORDEQ)	0.6	Water Temperature	DEQ
Model extent	Model extent	Water Temperature (TIR)	Watershed Sciences (2001)

6.6 Elk Creek

The Elk Creek model is a temperature model developed using Heat Source 7.0. The model was developed by DEQ.

6.6.1 Model domain

The extent of the model domain is Elk Creek from the confluence of Wise Creek to the mouth of Elk Creek at the confluence of the Umpqua River. The model extent is shown in the HTML interactive map that accompanies this QAPP and is referenced in Appendix D.

6.6.2 Spatial and temporal resolution

The model input spatial resolution (*dx*) is 50 meters. Outputs are generated every 100 meters. The model time step (*dt*) is 1 minute and outputs are generated every hour.

A *dx* of 50 meters was chosen to capture the range of solar flux input caused by the varied vegetation conditions along the length of the stream. The high resolution *dx* will allow evaluation of multiple vegetation management scenarios for each designated management agency.

6.6.3 Source characteristics

The primary sources of thermal loading contributing to temperatures exceedances along the Elk Creek include increases in solar radiation loading from the disturbance or removal of near-stream vegetation, point source discharges, and background sources (DEQ, 2006). Other potential sources include channel modification and widening, reductions to stream flow rate, and warming caused by climate change. The contribution of these latter potential sources may be investigated as part of the model scenarios.

There is one permitted individual NPDES point source along the model extent. Detail about the point source is summarized in Table 22.

Table 22: Summary of individual NPDES permitted discharges in the Elk Creek.

Facility Name (Facility Number)	Latitude/Longitude	Permit Type and Description	Stream/River Mile
Drain STP (25282)	43.6562/-123.321	NPDES-DOM-Da: Sewage - less than 1 MGD	Elk Creek RM 23.8

The majority land use along the Elk Creek is forestry accounting for about 69 percent of the near-stream area. Table 23 summarizes all the land uses within 100 meters of the digitized Elk Creek centerline. Land uses were summarized using the 2016 National Land Cover Database (Yang et al., 2018). Note that

Shrub/Scrub and Herbaceous land uses can be areas where forest clearcuts have occurred and would be classified as forest after regrowth.

Table 23: Summary of land uses along the model extent within 100 meters of the digitized Elk Creek centerline based on the 2016 National Land Cover Database (Yang et al., 2018).

2016 NLCD Land Cover	Acres	Percent of Total Acres
Evergreen Forest	827.8	37.8
Hay/Pasture	291.3	13.3
Mixed Forest	281.1	12.8
Developed, Open Space	226.0	10.3
Woody Wetlands	156.6	7.1
Shrub/Scrub	125.7	5.7
Herbaceous	117.2	5.3
Emergent Herbaceous Wetlands	73.4	3.4
Developed, Low Intensity	66.7	3
Developed, Medium Intensity	10.7	0.5
Deciduous Forest	10.2	0.5
Developed, High Intensity	4.2	0.2

Anthropogenic related stream warming caused by nonpoint sources is closely associated with the uses, the activities, and the condition of vegetation adjacent to the stream. How activities and uses are managed in these areas is partially determined by a variety of different rules and management plans established by the landowner and any agency with land use authority. To better understand the spatial distribution of different agency rules or management plans along the model extent DEQ mapped known designated management agencies (Table 24).

A designated management agency is defined in OAR 340-042-0030(2) as a federal, state, or local governmental agency that has legal authority over a sector or source contributing pollutants. Typically, persons or designated management agencies that are identified in the TMDL Water Quality Management Plan (WQMP) are responsible for developing TMDL implementation plans and implementing management strategies to reduce pollutant loading. Table 24 summarizes the potential designated management agencies and responsible persons along the Elk Creek model extent.

Table 24: Summary of potential designated management agencies (DMAs) or responsible persons along the model extent within 100 meters of the digitized Elk Creek centerline.

DMA or Responsible Person	Acres	Percent of Total Acres
Oregon Department of Agriculture	1325.3	49.7
Oregon Department of Forestry - Private Forestland	441.8	16.6
Douglas County	303.6	11.4
U.S. Bureau of Land Management	301	11.3
Oregon Department of Transportation	167.6	6.3
City of Drain	45.7	1.7
Oregon Parks and Recreation Department	41	1.5
Central Oregon & Pacific Railroad	17.3	0.6

DMA or Responsible Person	Acres	Percent of Total Acres
City of Elkton	17.3	0.6
Oregon Department of Forestry - State Forestland	3.2	0.1
State of Oregon	1.6	0.1

6.6.4 Time frame of simulation

The model period is July 12, 2002 to July 31, 2002.

6.6.5 Important assumptions

The effort currently described in the QAPP includes use of existing models. Key calibration assumptions made during the model setup and calibration process were documented in the original TMDL (DEQ, 2006), the model user guide (Boyd and Kasper, 2003) or in Section 6 and Section 7 of this document.

6.6.6 Model inputs

Table 25 summarizes the current configuration of the model input parameters and the source of these data. Temperature, flow, and meteorological input parameters are summarized to improve documentation of the TMDL approach.

Table 25: Boundary condition and tributary inputs to the existing Elk Creek Heat Source model.

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Elk Creek at Wise Creek	44.5	Boundary Condition	Flow	Derived data.	Constant flow input of 0.03 cms.
Elk Creek at Wise Creek	44.5	Boundary Condition	Water Temperature	Derived data.	Temperature input estimated from 1998 data to approximate 2002 conditions.
Yoncalla Creek	42.85	Tributary	Flow	Derived data.	Constant flow input.
Pass Creek	39.25	Tributary	Flow	Derived data.	Constant flow input.
Billy Creek	36.65	Tributary	Flow	Derived data.	Constant flow input.
Hardscrabble Creek	33.45	Tributary	Flow	Derived data.	Constant flow input.
Parker Creek	25	Tributary	Flow	Derived data.	Constant flow input.
Green Creek	21.95	Tributary	Flow	Derived data.	Constant flow input.

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Brush Creek	20.1	Tributary	Flow	Derived data.	Constant flow input.
Tom Folly Creek	13.85	Tributary	Flow	Derived data.	Constant flow input.
Yoncalla Creek	42.85	Tributary	Water Temperature	Derived data.	Pass Creek (30161-ORDEQ) temperature data input as surrogate.
Pass Creek (30161-ORDEQ)	39.25	Tributary	Water Temperature	DEQ	
Billy Creek	36.65	Tributary	Water Temperature	Derived data.	Pass Creek (30161-ORDEQ) temperature data input as surrogate.
Hardscrabble Creek	33.45	Tributary	Water Temperature	Derived data.	Pass Creek (30161-ORDEQ) temperature data input as surrogate.
Parker Creek	25	Tributary	Water Temperature	Derived data.	Pass Creek (30161-ORDEQ) temperature data input as surrogate.
Green Creek	21.95	Tributary	Water Temperature	Derived data.	Pass Creek (30161-ORDEQ) temperature data input as surrogate.
Brush Creek	20.1	Tributary	Water Temperature	Derived data.	Pass Creek (30161-ORDEQ) temperature data input as surrogate.
Tom Folly Creek	13.85	Tributary	Water Temperature	Derived data.	Pass Creek (30161-ORDEQ) temperature data input as surrogate.
KRBG - Roseburg Regional Airport	3.35, 9.9, 42.55, 44.4	Meteorological	Air Temperature, Relative Humidity, Wind Speed	NCDC	

Hourly meteorology inputs into the model include air temperature, relative humidity, and wind speed. Air temperature data were modified using the dry adiabatic lapse rate to adjust for differences in elevation between the measurement location and the model input location. Wind speeds were adjusted to improve the calibration using a wind-sheltering coefficient to represent difference in wind speed between the measurement location and above the stream within the riparian area.

6.6.7 Model calibration

The expected model calibration sites and data sources are summarized in Table 26. The model location in the table below describes the distance of each input from the most downstream model node. Effective shade model calibrations sites are summarized in Table 6. The model inputs and parameters that are expected to be modified to improve model fit are described in Section 6.1.

Table 26: Calibration sites and parameters used in the existing Elk Creek Heat Source model.

Model Location Name (Station ID)	Model Location (kilometers)	Calibration Parameter	Data Source
Elk Creek at Umpqua River near Elkton	3.35	Water Temperature	DEQ
Elk Creek at Boswell Road Bridge		Effective Shade	DEQ
Elk Creek at Forest Service Road 3230 near the mouth		Effective Shade	DEQ
Elk Creek downstream of Walker Creek at Elk Head Rd		Effective Shade	DEQ
Model extent	Model extent	Water Temperature (TIR)	Watershed Sciences (2003)

6.7 Jackson Creek

The Jackson Creek model is a temperature model developed using Heat Source 7.0. The model was developed by DEQ.

6.7.1 Model domain

The extent of the model domain is Jackson Creek from the confluence of Falcon Creek to the mouth of Jackson Creek at the confluence of the South Umpqua River. The model extent is shown in the HTML interactive map that accompanies this QAPP and is referenced in Appendix D.

6.7.2 Spatial and temporal resolution

The model input spatial resolution (*dx*) is 50 meters. Outputs are generated every 100 meters. The model time step (*dt*) is 1 minute and outputs are generated every hour.

A *dx* of 50 meters was chosen to capture the range of solar flux input caused by the varied vegetation conditions along the length of the stream. The high resolution *dx* will allow evaluation of multiple vegetation management scenarios for each designated management agency.

6.7.3 Source characteristics

The primary sources of thermal loading contributing to temperatures exceedances along the Jackson Creek include increases in solar radiation loading from the disturbance or removal of near-stream vegetation, and background sources (DEQ, 2006). Other potential sources include channel modification and widening, reductions to stream flow rate, and warming caused by climate change. The contribution of these latter potential sources may be investigated as part of the model scenarios.

There are no permitted individual NPDES point sources along the model extent.

The majority land use along the Jackson Creek is forestry accounting for about 100 percent of the near-stream area. Table 27 summarizes all the land uses within 100 meters of the digitized Jackson Creek centerline. Land uses were summarized using the 2016 National Land Cover Database (Yang et al., 2018). Note that Shrub/Scrub and Herbaceous land uses can be areas where forest clearcuts have occurred and would be classified as forest after regrowth.

Table 27: Summary of land uses along the model extent within 100 meters of the digitized Jackson Creek centerline based on the 2016 National Land Cover Database (Yang et al., 2018).

2016 NLCD Land Cover	Acres	Percent of Total Acres
Evergreen Forest	1517.8	92.1
Shrub/Scrub	65.2	4
Mixed Forest	29.1	1.8
Herbaceous	22.0	1.3
Deciduous Forest	13.3	0.8

Anthropogenic related stream warming caused by nonpoint sources is closely associated with the uses, the activities, and the condition of vegetation adjacent to the stream. How activities and uses are managed in these areas is partially determined by a variety of different rules and management plans established by the landowner and any agency with land use authority. To better understand the spatial distribution of different agency rules or management plans along the model extent DEQ mapped known designated management agencies (Table 28).

A designated management agency is defined in OAR 340-042-0030(2) as a federal, state, or local governmental agency that has legal authority over a sector or source contributing pollutants. Typically, persons or designated management agencies that are identified in the TMDL Water Quality Management Plan (WQMP) are responsible for developing TMDL implementation plans and implementing management strategies to reduce pollutant loading. Table 28 summarizes the potential designated management agencies and responsible persons along the Jackson Creek model extent.

Table 28: Summary of potential designated management agencies (DMAs) or responsible persons along the model extent within 100 meters of the digitized Jackson Creek centerline.

DMA or Responsible Person	Acres	Percent of Total Acres
U.S. Forest Service	1439.7	87.9
Oregon Department of Forestry - Private Forestland	183.7	11.2
Douglas County	14.8	0.9

6.7.4 Time frame of simulation

The model period is July 12, 2002 to July 31, 2002.

6.7.5 Important assumptions

The effort currently described in the QAPP includes use of existing models. Key calibration assumptions made during the model setup and calibration process were documented in the original TMDL (DEQ, 2006), the model user guide (Boyd and Kasper, 2003) or in Section 6 and Section 7 of this document.

6.7.6 Model inputs

Table 29 summarizes the current configuration of the model input parameters and the source of these data. Temperature, flow, and meteorological input parameters are summarized to improve documentation of the TMDL approach.

Table 29: Boundary condition and tributary inputs to the existing Jackson Creek Heat Source model.

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Jackson Creek at Falcon Creek	33.5	Boundary Condition	Flow	Derived data.	Constant flow input of 0.15576 cms.
Jackson Creek at Falcon Creek (21506-ORDEQ)	33.5	Boundary Condition	Water Temperature	DEQ	
Falcon Creek	33.1	Tributary	Flow	Derived data.	Constant flow input.
Spring at model kilometer 32.35	32.35	Tributary	Flow	Derived data.	Constant flow input.
Unnamed tributary at model kilometer 31.8	31.8	Tributary	Flow	Derived data.	Constant flow input.
Unnamed tributary at model kilometer 31.7	31.7	Tributary	Flow	Derived data.	Constant flow input.
Spring at model kilometer 30.55	30.55	Tributary	Flow	Derived data.	Constant flow input.
Cougar Creek	29.7	Tributary	Flow	Derived data.	Constant flow input.

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Unknown tributary at model kilometer 28.4	28.4	Tributary	Flow	Derived data.	Constant flow input.
Spring at model kilometer 27.8	27.8	Tributary	Flow	Derived data.	Constant flow input.
Spring at model kilometer 27.5	27.5	Tributary	Flow	Derived data.	Constant flow input.
Paradise Creek	26.65	Tributary	Flow	Derived data.	Constant flow input.
Twomile Creek	24.25	Tributary	Flow	Derived data.	Constant flow input.
Edan Creek	24.2	Tributary	Flow	Derived data.	Constant flow input.
Unnamed tributary at model kilometer 23.45	23.45	Tributary	Flow	Derived data.	Constant flow input.
Unnamed tributary at model kilometer 22.65	22.65	Tributary	Flow	Derived data.	Constant flow input.
Spring at model kilometer 22.15	22.15	Tributary	Flow	Derived data.	Constant flow input.
Luck Creek	22.1	Tributary	Flow	Derived data.	Constant flow input.
Crooked Creek	20.55	Tributary	Flow	Derived data.	Constant flow input.
Tallow Creek	19.5	Tributary	Flow	Derived data.	Constant flow input.
Ralph Creek	18.9	Tributary	Flow	Derived data.	Constant flow input.
Squaw Creek	18.25	Tributary	Flow	Derived data.	Constant flow input.
Black Canyon Creek	17.55	Tributary	Flow	Derived data.	Constant flow input.

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Deep Cut Creek	15.85	Tributary	Flow	Derived data.	Constant flow input.
Whiskey Creek	15.45	Tributary	Flow	Derived data.	Constant flow input.
Unnamed tributary at model kilometer 14.35	14.35	Tributary	Flow	Derived data.	Constant flow input.
Freezeout Creek	13.4	Tributary	Flow	Derived data.	Constant flow input.
Poole Creek	13.1	Tributary	Flow	Derived data.	Constant flow input.
Coffin Creek	11.05	Tributary	Flow	Derived data.	Constant flow input.
Surveyor Creek	10.9	Tributary	Flow	Derived data.	Constant flow input.
Bullock Creek	8.55	Tributary	Flow	Derived data.	Constant flow input.
Beaver Creek	6.75	Tributary	Flow	Derived data.	Constant flow input.
Nichols Creek	5.8	Tributary	Flow	Derived data.	Constant flow input.
Chapman Creek	4.4	Tributary	Flow	Derived data.	Constant flow input.
Unknown tributary at model kilometer 3.5	3.5	Tributary	Flow	Derived data.	Constant flow input.
Falcon Creek	33.1	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.
Spring at model kilometer 32.35	32.35	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.
Unnamed tributary at model kilometer 31.8	31.8	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Unnamed tributary at model kilometer 31.7	31.7	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.
Spring at model kilometer 30.55	30.55	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.
Cougar Creek	29.7	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.
Unknown tributary at model kilometer 28.4	28.4	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.
Spring at model kilometer 27.8	27.8	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.
Spring at model kilometer 27.5	27.5	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.
Paradise Creek	26.65	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.
Twomile Creek	24.25	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.
Edan Creek	24.2	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.
Unnamed tributary at model kilometer 23.45	23.45	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Unnamed tributary at model kilometer 22.65	22.65	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.
Spring at model kilometer 22.15	22.15	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.
Luck Creek	22.1	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.
Crooked Creek	20.55	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.
Tallow Creek	19.5	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.
Ralph Creek	18.9	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.
Squaw Creek	18.25	Tributary	Water Temperature	USFS	Data not in AWQMS.
Black Canyon Creek	17.55	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.
Deep Cut Creek	15.85	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.
Whiskey Creek	15.45	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Unnamed tributary at model kilometer 14.35	14.35	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.
Freezeout Creek	13.4	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.
Poole Creek	13.1	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.
Coffin Creek	11.05	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.
Surveyor Creek	10.9	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.
Bullock Creek	8.55	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.
Beaver Creek	6.75	Tributary	Water Temperature	USFS	Data not in AWQMS.
Nichols Creek	5.8	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.
Chapman Creek	4.4	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.
Unknown tributary at model kilometer 3.5	3.5	Tributary	Water Temperature	Derived data.	Data derived from a mass balance model and TIR.
KRBG - Roseburg Regional Airport	2.4, 2.5, 11.7, 26.3, 33.2	Meteorological	Air Temperature, Relative Humidity, Wind Speed	NCDC	

Hourly meteorology inputs into the model include air temperature, relative humidity, and wind speed. Air temperature data were modified using the dry adiabatic lapse rate to adjust for differences in elevation between the measurement location and the model input location. Wind speeds were adjusted to improve the calibration using a wind-sheltering coefficient to represent difference in wind speed between the measurement location and above the stream within the riparian area.

6.7.7 Model calibration

The expected model calibration sites and data sources are summarized in Table 30. The model location in the table below describes the distance of each input from the most downstream model node. Effective shade model calibrations sites are summarized in Table 6. The model inputs and parameters that are expected to be modified to improve model fit are described in Section 6.1.

Table 30: Calibration sites and parameters used in the existing Jackson Creek Heat Source model.

Model Location Name (Station ID)	Model Location (kilometers)	Calibration Parameter	Data Source
Jackson Creek at Campground	33.25	Effective Shade	DEQ
Jackson Creek downstream of Falcon Creek at Bridge	33.25	Flow	DEQ
Jackson Creek abv Falcon Creek (21506-ORDEQ)	33.2	Water Temperature	DEQ
Jackson Creek at Campground	19.65	Flow	DEQ
Jackson Creek downstream of Falcon Creek at Bridge	19.65	Effective Shade	DEQ
Jackson Creek near mouth at Forest Service Boundary	10.2	Effective Shade	DEQ
Jackson Creek upstream of Beaver Creek	10.2	Flow	DEQ
Jackson Creek abv Mouth (17164-ORDEQ)	2.5	Water Temperature	DEQ
Jackson Creek abv Mouth (Telequa Store) (17164)	2.4	Water Temperature	USFS
Jackson Creek near mouth at Forest Service Boundary	2.3	Flow	DEQ
Jackson Creek upstream of Beaver Creek	2.3	Effective Shade	DEQ
Model extent	Model extent	Water Temperature (TIR)	Watershed Sciences (2003)

6.8 North Fork Smith River

The North Fork Smith River model is a temperature model developed using Heat Source 6.5.1. The model was developed by DEQ.

6.8.1 Model domain

The extent of the model domain is the North Fork Smith River from the confluence of Kentucky Creek to the mouth at the confluence of the Smith River. The model extent is shown in the HTML interactive map that accompanies this QAPP and is referenced in Appendix D.

6.8.2 Spatial and temporal resolution

The model input spatial resolution (*dx*) is 100 meters. Outputs are generated every 100 meters. The model time step (*dt*) is 1 minute and outputs are generated every hour.

A *dx* of 100 meters was chosen to capture the range of solar flux input caused by the varied vegetation conditions along the length of the stream. The high resolution *dx* will allow evaluation of multiple vegetation management scenarios for each designated management agency.

6.8.3 Source characteristics

The primary sources of thermal loading contributing to temperatures exceedances along the North Fork Smith River include increases in solar radiation loading from the disturbance or removal of near-stream vegetation, and background sources (DEQ, 2006). Other potential sources include channel modification and widening, reductions to stream flow rate, and warming caused by climate change. The contribution of these latter potential sources may be investigated as part of the model scenarios.

There are no permitted individual NPDES point sources along the model extent.

The majority land use along the North Fork Smith River is forestry accounting for about 93 percent of the near-stream area. Table 31 summarizes all the land uses within 100 meters of the digitized North Fork Smith River centerline. Land uses were summarized using the 2016 National Land Cover Database (Yang et al., 2018). Note that Shrub/Scrub and Herbaceous land uses can be areas where forest clearcuts have occurred and would be classified as forest after regrowth.

Table 31: Summary of land uses along the model extent within 100 meters of the digitized North Fork Smith River centerline based on the 2016 National Land Cover Database (Yang et al., 2018).

2016 NLCD Land Cover	Acres	Percent of Total Acres
Evergreen Forest	915.8	58.5
Mixed Forest	349.6	22.3
Shrub/Scrub	115.6	7.4
Developed, Open Space	76.1	4.9
Emergent Herbaceous Wetlands	36.3	2.3
Deciduous Forest	26.7	1.7
Woody Wetlands	25.1	1.6
Herbaceous	17.8	1.1
Hay/Pasture	2.9	0.2
Developed, Low Intensity	0.4	<0.05

Anthropogenic related stream warming caused by nonpoint sources is closely associated with the uses, the activities, and the condition of vegetation adjacent to the stream. How activities and uses are managed in these areas is partially determined by a variety of different rules and management plans established by the landowner and any agency with land use authority. To better understand the spatial distribution of different agency rules or management plans along the model extent DEQ mapped known designated management agencies (Table 32).

A designated management agency is defined in OAR 340-042-0030(2) as a federal, state, or local governmental agency that has legal authority over a sector or source contributing pollutants. Typically, persons or designated management agencies that are identified in the TMDL Water Quality Management Plan (WQMP) are responsible for developing TMDL implementation plans and implementing management strategies to reduce pollutant loading. Table 32 summarizes the potential designated management agencies and responsible persons along the North Fork Smith River model extent.

Table 32: Summary of potential designated management agencies (DMAs) or responsible persons along the model extent within 100 meters of the digitized North Fork Smith River centerline.

DMA or Responsible Person	Acres	Percent of Total Acres
U.S. Forest Service	1328.1	78
Oregon Department of Forestry - Private Forestland	374.5	22

6.8.4 Time frame of simulation

The model period is for a single day: August 09, 1999.

6.8.5 Important assumptions

The effort currently described in the QAPP includes use of existing models. Key calibration assumptions made during the model setup and calibration process were documented in the original TMDL (DEQ, 2006), the model user guide (Boyd and Kasper, 2003) or in Section 6 and Section 7 of this document.

6.8.6 Model inputs

Table 33 summarizes the current configuration of the model input parameters and the source of these data. Temperature, flow, and meteorological input parameters are summarized to improve documentation of the TMDL approach.

Table 33: Boundary condition and tributary inputs to the existing North Fork Smith River Heat Source model.

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source
Kentucky Creek at Falls Trailhead (407025)	0	Boundary Condition	Flow	USFS - Siuslaw National Forest
Kentucky Creek at Falls Trailhead (407025)	0	Boundary Condition	Water Temperature	USFS - Siuslaw National Forest
Middle Fork of the North Fork Smith River	10.8	Tributary	Flow	DEQ

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source
North Fork Smith River upstream of Kentucky Creek	2.1	Tributary	Flow	DEQ
Middle Fork of the North Fork Smith River	10.8	Tributary	Water Temperature	DEQ
North Fork Smith River upstream of Kentucky Creek	2.1	Tributary	Water Temperature	DEQ
No Station ID	0, 8.2, 10.7, 19.8, 27.7, 35	Meteorological	Air Temperature, Relative Humidity, Wind Speed	DEQ

Hourly meteorology inputs into the model include air temperature, relative humidity, and wind speed. Air temperature data were modified using the dry adiabatic lapse rate to adjust for differences in elevation between the measurement location and the model input location. Wind speeds were adjusted to improve the calibration using a wind-sheltering coefficient to represent difference in wind speed between the measurement location and above the stream within the riparian area.

6.8.7 Model calibration

The expected model calibration sites and data sources are summarized in Table 34. The model location in the table below describes the distance of each input from the most upstream model node. Effective shade model calibrations sites are summarized in Table 6. The model inputs and parameters that are expected to be modified to improve model fit are described in Section 6.1.

Table 34: Calibration sites and parameters used in the existing North Fork Smith River Heat Source model.

Model Location Name (Station ID)	Model Location (kilometers)	Calibration Parameter	Data Source
North Fork Smith River at approximately RM 5.2 (407030)	35.0	Water Temperature, Flow	DEQ
North Fork Smith River downstream of Paxton Creek (407029)	27.7	Water Temperature, Flow	DEQ
North Fork Smith River downstream of the West Branch (407026)	19.8	Water Temperature, Flow	DEQ
North Fork Smith River upstream of the Middle Fork of the North Fork Smith (407027)	10.7	Water Temperature, Flow	USFS -Siuslaw National Forest
North Fork Smith River 1.5 Miles up NF Trail (USFS Site) (1358)	8.2	Water Temperature	USFS -Siuslaw National Forest

6.9 Olalla-Lookingglass Creek

The Olalla-Lookingglass Creek model is a temperature model developed using Heat Source 7.0. The model was developed by DEQ.

6.9.1 Model domain

The extent of the model domain is Olalla-Lookingglass Creek from the confluence of Berry Creek to the mouth of Olalla-Lookingglass Creek at the confluence of the South Umpqua River. The model extent is shown in the HTML interactive map that accompanies this QAPP and is referenced in Appendix D.

6.9.2 Spatial and temporal resolution

The model input spatial resolution (*dx*) is 50 meters. Outputs are generated every 100 meters. The model time step (*dt*) is 1 minute and outputs are generated every hour.

A *dx* of 50 meters was chosen to capture the range of solar flux input caused by the varied vegetation conditions along the length of the stream. The high resolution *dx* will allow evaluation of multiple vegetation management scenarios for each designated management agency.

6.9.3 Source characteristics

The primary sources of thermal loading contributing to temperatures exceedances along the Olalla-Lookingglass Creek include increases in solar radiation loading from the disturbance or removal of near-stream vegetation, reductions to stream flow rate or volume, and background sources (DEQ, 2006). Other potential sources include channel modification and widening, and warming caused by climate change. The contribution of these latter potential sources may be investigated as part of the model scenarios.

There are no permitted individual NPDES point sources along the model extent.

The majority land uses along the Olalla-Lookingglass Creek are agriculture and forestry accounting for about 79 percent of the near-stream area. Table 35 summarizes all the land uses within 100 meters of the digitized Olalla-Lookingglass Creek centerline. Land uses were summarized using the 2016 National Land Cover Database (Yang et al., 2018). Note that Shrub/Scrub and Herbaceous land uses can be areas where forest clearcuts have occurred and would be classified as forest after regrowth.

Table 35: Summary of land uses along the model extent within 100 meters of the digitized Olalla-Lookingglass Creek centerline based on the 2016 National Land Cover Database (Yang et al., 2018).

2016 NLCD Land Cover	Acres	Percent of Total Acres
Hay/Pasture	815.1	47
Emergent Herbaceous Wetlands	210.6	12.1
Woody Wetlands	183.5	10.6
Evergreen Forest	167.9	9.7
Developed, Open Space	121.4	7
Mixed Forest	106.1	6.1
Herbaceous	54.7	3.2
Shrub/Scrub	39.6	2.3

2016 NLCD Land Cover	Acres	Percent of Total Acres
Developed, Low Intensity	29.4	1.7
Developed, Medium Intensity	3.8	0.2
Deciduous Forest	2.7	0.2
Barren Land	1.3	0.1

Anthropogenic related stream warming caused by nonpoint sources is closely associated with the uses, the activities, and the condition of vegetation adjacent to the stream. How activities and uses are managed in these areas is partially determined by a variety of different rules and management plans established by the landowner and any agency with land use authority. To better understand the spatial distribution of different agency rules or management plans along the model extent DEQ mapped known designated management agencies (Table 36).

A designated management agency is defined in OAR 340-042-0030(2) as a federal, state, or local governmental agency that has legal authority over a sector or source contributing pollutants. Typically, persons or designated management agencies that are identified in the TMDL Water Quality Management Plan (WQMP) are responsible for developing TMDL implementation plans and implementing management strategies to reduce pollutant loading. Table 36 summarizes the potential designated management agencies and responsible persons along the Olalla-Lookingglass Creek model extent.

Table 36: Summary of potential designated management agencies (DMAs) or responsible persons along the model extent within 100 meters of the digitized Olalla-Lookingglass Creek centerline.

DMA or Responsible Person	Acres	Percent of Total Acres
Oregon Department of Agriculture	1406.1	56.7
Douglas County	649.1	26.2
Oregon Department of Forestry - Private Forestland	285.4	11.5
City of Winston	92.3	3.7
Oregon Department of Transportation	29.9	1.2
U.S. Bureau of Land Management	16.2	0.7

6.9.4 Time frame of simulation

The model period is July 12, 2002 to July 31, 2002.

6.9.5 Important assumptions

The effort currently described in the QAPP includes use of existing models. Key calibration assumptions made during the model setup and calibration process were documented in the original TMDL (DEQ, 2006), the model user guide (Boyd and Kasper, 2003) or in Section 6 and Section 7 of this document.

6.9.6 Model inputs

Table 37 summarizes the current configuration of the model input parameters and the source of these data. Temperature, flow, and meteorological input parameters are summarized to improve documentation of the TMDL approach.

Table 37: Boundary condition and tributary inputs to the existing Olalla-Lookingglass Creek Heat Source model.

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Olalla Creek at Berry Creek	35.2	Boundary Condition	Flow	Derived data.	Constant flow input of 0.05664 cms.
Olalla Creek at Berry Creek (27918-ORDEQ)	35.2	Boundary Condition	Water Temperature	DEQ	
Unknown creek at model kilometer 34.6	34.6	Tributary	Flow	DEQ	
Bushnell Creek	32.1	Tributary	Flow	DEQ	
Byron Creek	31.6	Tributary	Flow	DEQ	
Berry Creek	30.8	Tributary	Flow	DEQ	
Unknown creek at model kilometer 29.1	29.1	Tributary	Flow	DEQ	
Unknown creek at model kilometer 26.8	26.8	Tributary	Flow	DEQ	
Unknown creek at model kilometer 24.9	24.9	Tributary	Flow	DEQ	
Unknown creek at model kilometer 23.75	23.75	Tributary	Flow	DEQ	
Unknown creek at model kilometer 23	23	Tributary	Flow	DEQ	
McNabb Creek	21.75	Tributary	Flow	DEQ	
Perron Creek	20.85	Tributary	Flow	DEQ	
Tenmile Creek	20.45	Tributary	Flow	DEQ	
Unknown creek at model kilometer 14.3	14.3	Tributary	Flow	DEQ	
Lookingglass Creek	11.6	Tributary	Flow	DEQ	
Morgan Creek	10.75	Tributary	Flow	DEQ	

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Unknown creek at model kilometer 9.85	9.85	Tributary	Flow	DEQ	
Applegate Creek	1.1	Tributary	Flow	DEQ	
Unknown creek at model kilometer 34.6	34.6	Tributary	Water Temperature	DEQ	
Bushnell Creek	32.1	Tributary	Water Temperature	DEQ	
Byron Creek	31.6	Tributary	Water Temperature	DEQ	
Berry Creek	30.8	Tributary	Water Temperature	DEQ	
Unknown creek at model kilometer 29.1	29.1	Tributary	Water Temperature	DEQ	
Unknown creek at model kilometer 26.8	26.8	Tributary	Water Temperature	DEQ	
Unknown creek at model kilometer 24.9	24.9	Tributary	Water Temperature	DEQ	
Unknown creek at model kilometer 23.75	23.75	Tributary	Water Temperature	DEQ	
Unknown creek at model kilometer 23	23	Tributary	Water Temperature	DEQ	
McNabb Creek	21.75	Tributary	Water Temperature	DEQ	
Perron Creek	20.85	Tributary	Water Temperature	DEQ	
Tenmile Creek	20.45	Tributary	Water Temperature	DEQ	
Unknown creek at model kilometer 14.3	14.3	Tributary	Water Temperature	DEQ	
Lookingglass Creek	11.6	Tributary	Water Temperature	DEQ	
Morgan Creek	10.75	Tributary	Water Temperature	DEQ	

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Unknown creek at model kilometer 9.85	9.85	Tributary	Water Temperature	DEQ	
Applegate Creek	1.1	Tributary	Water Temperature	DEQ	
KRBG - Roseburg Regional Airport	0.1, 11.6, 30.2, 35.15	Meteorological	Air Temperature, Relative Humidity, Wind Speed	NCDC	

Hourly meteorology inputs into the model include air temperature, relative humidity, and wind speed. Air temperature data were modified using the dry adiabatic lapse rate to adjust for differences in elevation between the measurement location and the model input location. Wind speeds were adjusted to improve the calibration using a wind-sheltering coefficient to represent difference in wind speed between the measurement location and above the stream within the riparian area.

6.9.7 Model calibration

The expected model calibration sites and data sources are summarized in Table 38. The model location in the table below describes the distance of each input from the most downstream model node. Effective shade model calibrations sites are summarized in Table 6. The model inputs and parameters that are expected to be modified to improve model fit are described in Section 6.1.

Table 38: Calibration sites and parameters used in the existing Olalla-Lookingglass Creek Heat Source model.

Model Location Name (Station ID)	Model Location (kilometers)	Calibration Parameter	Data Source
Olalla Creek (27918-ORDEQ)	35.15	Water Temperature	DEQ
Olalla Creek above Bushnell Creek	33.1	Flow	DEQ
Olalla Creek downstream of Berry Creek	30.2	Flow	DEQ
Olalla Creek near Tenmile, Oregon	30.2	Water Temperature	Douglas County
Olalla Creek upstream of Berry Creek	29.45	Flow	DEQ
Olalla Creek downstream of HWY 42	18.9	Flow	DEQ
Lookingglass Creek along HWY at RM 5.7	9.3	Flow	DEQ
Lookingglass Creek at mouth	0.15	Flow	DEQ
Lookingglass Creek at Hwy 42 at Winston OR (12248-ORDEQ)	0.1	Water Temperature	DEQ

Model Location Name (Station ID)	Model Location (kilometers)	Calibration Parameter	Data Source
Lookingglass Creek near Winston	0.1	Flow	DEQ
Lookingglass Creek at mouth		Effective Shade	DEQ
Lookingglass Creek at RM 5.7		Effective Shade	DEQ
Model extent	Model extent	Water Temperature (TIR)	Watershed Sciences (2003)
Olalla Creek above Bushnell Creek		Effective Shade	DEQ
Olalla Creek at County gage, downstream of Berry Creek		Effective Shade	DEQ
Olalla Creek at HWY 42		Effective Shade	DEQ
Olalla Creek below County gage		Effective Shade	DEQ

6.10 Smith River

The Smith River model is a temperature model developed using Heat Source 6.5.1. The model was developed by DEQ.

6.10.1 Model domain

The extent of the model domain is the Smith River from the confluence of Peterson Creek (river mile 87) to the confluence of Johnson Creek (river mile 31). The model extent is shown in the HTML interactive map that accompanies this QAPP and is referenced in Appendix D.

6.10.2 Spatial and temporal resolution

The model input spatial resolution (*dx*) is 100 meters. Outputs are generated every 100 meters. The model time step (*dt*) is 1 minute and outputs are generated every hour.

A *dx* of 100 meters was chosen to capture the range of solar flux input caused by the varied vegetation conditions along the length of the stream. The high resolution *dx* will allow evaluation of multiple vegetation management scenarios for each designated management agency.

6.10.3 Source characteristics

The primary sources of thermal loading contributing to temperatures exceedances along the Smith River include increases in solar radiation loading from the disturbance or removal of near-stream vegetation, and background sources (DEQ, 2006). Other potential sources include channel modification and widening, reductions to stream flow rate, and warming caused by climate change. The contribution of these latter potential sources may be investigated as part of the model scenarios.

There are no permitted individual NPDES point sources along the model extent.

The majority land use along the Smith River is forestry accounting for about 88 percent of the near-stream area. Table 39 summarizes all the land uses within 100 meters of the digitized Smith River centerline. Land uses were summarized using the 2016 National Land Cover Database (Yang et al., 2018). Note that Shrub/Scrub and Herbaceous land uses can be areas where forest clearcuts have occurred and would be classified as forest after regrowth.

Table 39: Summary of land uses along the model extent within 100 meters of the digitized Smith River centerline based on the 2016 National Land Cover Database (Yang et al., 2018).

2016 NLCD Land Cover	Acres	Percent of Total Acres
Evergreen Forest	1806.7	42
Mixed Forest	1312.1	30.5
Developed, Open Space	491.7	11.4
Woody Wetlands	244.6	5.7
Shrub/Scrub	213.3	5
Herbaceous	143.4	3.3
Deciduous Forest	45.8	1.1
Hay/Pasture	22.0	0.5
Emergent Herbaceous Wetlands	16.9	0.4
Developed, Low Intensity	3.3	0.1
Developed, Medium Intensity	0.4	<0.05

Anthropogenic related stream warming caused by nonpoint sources is closely associated with the uses, the activities, and the condition of vegetation adjacent to the stream. How activities and uses are managed in these areas is partially determined by a variety of different rules and management plans established by the landowner and any agency with land use authority. To better understand the spatial distribution of different agency rules or management plans along the model extent DEQ mapped known designated management agencies (Table 40).

A designated management agency is defined in OAR 340-042-0030(2) as a federal, state, or local governmental agency that has legal authority over a sector or source contributing pollutants. Typically, persons or designated management agencies that are identified in the TMDL Water Quality Management Plan (WQMP) are responsible for developing TMDL implementation plans and implementing management strategies to reduce pollutant loading. Table 40 summarizes the potential designated management agencies and responsible persons along the Smith River model extent.

Table 40: Summary of potential designated management agencies (DMAs) or responsible persons along the model extent within 100 meters of the digitized Smith River centerline.

DMA or Responsible Person	Acres	Percent of Total Acres
Oregon Department of Forestry - Private Forestland	2154.3	51.4
U.S. Bureau of Land Management	2039.7	48.6

6.10.4 Time frame of simulation

The model period is for a single day: July 16, 2000.

6.10.5 Important assumptions

The effort currently described in the QAPP includes use of existing models. Key calibration assumptions made during the model setup and calibration process were documented in the original TMDL (DEQ, 2006), the model user guide (Boyd and Kasper, 2003) or in Section 6 and Section 7 of this document.

6.10.6 Model inputs

Table 41 summarizes the current configuration of the model input parameters and the source of these data. Temperature, flow, and meteorological input parameters are summarized to improve documentation of the TMDL approach.

Table 41: Boundary condition and tributary inputs to the existing Smith River Heat Source model.

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Smith River upstream of Peterson Creek (24101-ORDEQ)	0	Boundary Condition	Flow	DEQ	
Smith River upstream of Peterson Creek (24101-ORDEQ)	0	Boundary Condition	Water Temperature	DEQ	
West Fork at Mouth	82.4	Tributary	Flow	DEQ	
South Sister Creek	67.8	Tributary	Flow	DEQ	
Big Creek	52.1	Tributary	Flow	DEQ	
South Fork at Mouth	12.3	Tributary	Flow	DEQ	
West Fork at Mouth (24115-ORDEQ)	82.4	Tributary	Water Temperature	DEQ	
South Sister Creek (24127-ORDEQ)	67.8	Tributary	Water Temperature	DEQ	
Big Creek (24125-ORDEQ)	52.1	Tributary	Water Temperature	DEQ	
South Fork at Mouth (24103-ORDEQ)	12.3	Tributary	Water Temperature	DEQ	
No Station ID	0, 12.2, 14.9, 25.7, 37, 40.8, 52, 67.7, 75.2, 82.3, 88.9	Meteorological	Air Temperature, Relative Humidity, Wind Speed	DEQ	

Hourly meteorology inputs into the model include air temperature, relative humidity, and wind speed. Air temperature data were modified using the dry adiabatic lapse rate to adjust for differences in elevation between the measurement location and the model input location. Wind speeds were adjusted to improve the calibration using a wind-sheltering coefficient to represent difference in wind speed between the measurement location and above the stream within the riparian area.

6.10.7 Model calibration

The expected model calibration sites and data sources are summarized in Table 42. The model location in the table below describes the distance of each input from the most upstream model node. Effective shade model calibrations sites are summarized in Table 6. The model inputs and parameters that are expected to be modified to improve model fit are described in Section 6.1.

Table 42: Calibration sites and parameters used in the existing Smith River Heat Source model.

Model Location Name (Station ID)	Model Location (kilometers)	Calibration Parameter	Data Source
Smith River upstream of Johnson Creek (24116-ORDEQ)	88.9	Water Temperature, Flow	DEQ
Smith River upstream of West Fork Smith (24118-ORDEQ)	82.3	Water Temperature, Flow	DEQ
Smith River upstream of Carpenter Creek (24148-ORDEQ)	75.2	Water Temperature, Flow	DEQ
Smith River upstream of South Sister Creek (24126-ORDEQ)	67.7	Water Temperature, Flow	DEQ
Smith River upstream of Big Creek (24124-ORDEQ)	52.0	Water Temperature, Flow	DEQ
Smith River upstream of Halfway Creek (24123-ORDEQ)	40.8	Water Temperature, Flow	DEQ
Smith River upstream of Cleghorn Creek (24122-ORDEQ)	37.0	Water Temperature, Flow	DEQ
Smith River upstream of Yellow Creek (24121-ORDEQ)	25.7	Water Temperature, Flow	DEQ
Smith River downstream Salmonberry Creek (24120-ORDEQ)	14.9	Water Temperature, Flow	DEQ
Smith River upstream of South Fork Smith (24102-ORDEQ)	12.2	Water Temperature, Flow	DEQ

6.11 South Umpqua River

The South Umpqua River model is a temperature model developed using Heat Source 7.0. The model was developed by DEQ.

6.11.1 Model domain

The extent of the model domain is the South Umpqua River from the confluence of Black Rock Creek to the mouth of the South Umpqua River at the confluence of the Umpqua River. The model extent is shown in the HTML interactive map that accompanies this QAPP and is referenced in Appendix D.

6.11.2 Spatial and temporal resolution

The model input spatial resolution (*dx*) is 50 meters. Outputs are generated every 100 meters. The model time step (*dt*) is 1 minute and outputs are generated every hour.

A *dx* of 50 meters was chosen to capture the range of solar flux input caused by the varied vegetation conditions along the length of the stream. The high resolution *dx* will allow evaluation of multiple vegetation management scenarios for each designated management agency.

6.11.3 Source characteristics

The primary sources of thermal loading contributing to temperatures exceedances along the South Umpqua River include increases in solar radiation loading from the disturbance or removal of near-stream vegetation, point source discharges, and background sources (DEQ, 2006). Other potential sources include channel modification and widening, reductions to stream flow rate, and warming caused by climate change. The contribution of these latter potential sources may be investigated as part of the model scenarios.

There are six permitted individual NPDES point sources along the model extent. Detail about each point source is summarized in Table 43.

Table 43: Summary of individual NPDES permitted discharges in the South Umpqua River.

Facility Name (Facility Number)	Latitude/Longitude	Permit Type and Description	Stream/River Mile
Canyonville STP (13745)	42.9422/-123.28	NPDES-DOM-Da: Sewage - less than 1 MGD	South Umpqua River RM 50.6
Hoover Treated Wood Products, Inc. (105306)	43.1087/-123.416	NPDES-IW-B21: Timber and Wood Products - Wood preserving	South Umpqua River RM 23.2
Myrtle Creek STP (59643)	43.0216/-123.296	NPDES-DOM-C2a: Sewage - 1 MGD or more but less than 2 MGD	South Umpqua River RM 38.6
R.U.S.A. Roseburg STP (76771)	43.2092/-123.396	NPDES-DOM-Ba: Sewage - 5 MGD or more but less than 10 MGD	South Umpqua River RM 7.6
USFS - Umpqua National Forest; Tiller Ranger Station STP (90944)	42.9278/-122.949	NPDES-DOM-Da: Sewage - less than 1 MGD	South Umpqua River RM 74.7
Winston-Green WWTF (98400)	43.1367/-123.4	NPDES-DOM-C2a: Sewage - 1 MGD or more but less than 2 MGD	South Umpqua River RM 20.6

The majority land uses along the South Umpqua River are forestry and agriculture accounting for about 75 percent of the near-stream area. Table 44 summarizes all the land uses within 100 meters of the digitized South Umpqua River centerline. Land uses were summarized using the 2016 National Land Cover Database (Yang et al., 2018). Note that Shrub/Scrub and Herbaceous land uses can be areas where forest clearcuts have occurred and would be classified as forest after regrowth.

Table 44: Summary of land uses along the model extent within 100 meters of the digitized South Umpqua River centerline based on the 2016 National Land Cover Database (Yang et al., 2018).

2016 NLCD Land Cover	Acres	Percent of Total Acres
Evergreen Forest	2403.0	34.4
Hay/Pasture	1638.2	23.5
Developed, Open Space	597.1	8.6
Emergent Herbaceous Wetlands	550.6	7.9
Woody Wetlands	383.2	5.5
Herbaceous	331.4	4.7
Developed, Low Intensity	316.7	4.5
Shrub/Scrub	226.4	3.2
Mixed Forest	143.9	2.1
Developed, Medium Intensity	126.3	1.8
Barren Land	117.6	1.7
Deciduous Forest	107.0	1.5
Developed, High Intensity	29.6	0.4
Cultivated Crops	7.1	0.1

Anthropogenic related stream warming caused by nonpoint sources is closely associated with the uses, the activities, and the condition of vegetation adjacent to the stream. How activities and uses are managed in these areas is partially determined by a variety of different rules and management plans established by the landowner and any agency with land use authority. To better understand the spatial distribution of different agency rules or management plans along the model extent DEQ mapped known designated management agencies (Table 45).

A designated management agency is defined in OAR 340-042-0030(2) as a federal, state, or local governmental agency that has legal authority over a sector or source contributing pollutants. Typically, persons or designated management agencies that are identified in the TMDL Water Quality Management Plan (WQMP) are responsible for developing TMDL implementation plans and implementing management strategies to reduce pollutant loading. Table 45 summarizes the potential designated management agencies and responsible persons along the South Umpqua River model extent.

Table 45: Summary of potential designated management agencies (DMAs) or responsible persons along the model extent within 100 meters of the digitized South Umpqua River centerline.

DMA or Responsible Person	Acres	Percent of Total Acres
Oregon Department of Agriculture	3016.6	38.8
U.S. Forest Service	1625.9	20.9
Douglas County	1170	15
Oregon Department of Forestry - Private Forestland	629.2	8.1
Oregon Department of Transportation	449.6	5.8
U.S. Bureau of Land Management	233.7	3
City of Roseburg	195.5	2.5
Central Oregon & Pacific Railroad	158	2

DMA or Responsible Person	Acres	Percent of Total Acres
City of Myrtle Creek	141.6	1.8
City of Winston	101	1.3
State of Oregon	30.3	0.4
Cow Creek Band of Umpqua Indians	15.9	0.2
Bonneville Power Administration	4.5	0.1
U.S. Government	2.9	<0.05
Oregon Department of Fish and Wildlife	0.8	<0.05
City of Canyonville	0.3	<0.05

6.11.4 Time frame of simulation

The model period is July 12, 2002 to July 31, 2002.

6.11.5 Important assumptions

The effort currently described in the QAPP includes use of existing models. Key calibration assumptions made during the model setup and calibration process were documented in the original TMDL (DEQ, 2006), the model user guide (Boyd and Kasper, 2003) or in Section 6 and Section 7 of this document.

6.11.6 Model inputs

Table 46 summarizes the current configuration of the model input parameters and the source of these data. Temperature, flow, and meteorological input parameters are summarized to improve documentation of the TMDL approach.

Table 46: Boundary condition and tributary inputs to the existing South Umpqua River Heat Source model.

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
South Umpqua River at Black Rock Creek	164.7	Boundary Condition	Flow	Derived data.	Flow derived from Tiller monitoring station minus a back calculated mass balance.
South Umpqua River at Black Rock Creek	164.7	Boundary Condition	Water Temperature	Derived data.	Temperature derived from the average temperatures of Black Rock and Castle Rock Creek.
Canyonville STP	81.2	Point Source	Flow	DEQ	

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Umpqua Lumber	50.2	Point Source	Flow	DEQ	Flow input is 0.
Rosburg Forest Products - Dillard	44.5	Point Source	Flow	DEQ	Flow input is 0.
Beaver State Sand and Gravel	34.05	Point Source	Flow	DEQ	Flow input is 0.
Winston-Green WWTP	33.05	Point Source	Flow	DEQ	
Durham School Services	29.3	Point Source	Flow	DEQ	Flow input is 0.
Lone Rock Timber Company	24.85	Point Source	Flow	DEQ	Flow input is 0.
Roseburg Landfill - Douglas County	22.45	Point Source	Flow	DEQ	
RUSA	12.15	Point Source	Flow	DEQ	
Umpqua Sand and Gravel	3.9	Point Source	Flow	DEQ	Flow input is 0.
Canyonville STP	81.2	Point Source	Water Temperature	NPDES DMRs	
Umpqua Lumber	50.2	Point Source	Water Temperature	NPDES DMRs	
Rosburg Forest Products - Dillard	44.5	Point Source	Water Temperature	NPDES DMRs	
Beaver State Sand and Gravel	34.05	Point Source	Water Temperature	NPDES DMRs	
Winston-Green WWTP	33.05	Point Source	Water Temperature	NPDES DMRs	
Durham School Services	29.3	Point Source	Water Temperature	NPDES DMRs	
Lone Rock Timber Company	24.85	Point Source	Water Temperature	NPDES DMRs	

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Roseburg Landfill - Douglas County	22.45	Point Source	Water Temperature	NPDES DMRs	
RUSA	12.15	Point Source	Water Temperature	NPDES DMRs	
Umpqua Sand and Gravel	3.9	Point Source	Water Temperature	NPDES DMRs	
Buckeye Creek	152.1	Tributary	Flow	DEQ	
Ash Creek	149.75	Tributary	Flow	DEQ	Flow input is 0.
Unnamed Site at model kilometer 149.2	149.2	Tributary	Flow	DEQ	Flow input is 0.
Coffeepot Creek	148.75	Tributary	Flow	DEQ	Flow input is 0.
Unnamed Site at model kilometer 146.75	146.75	Tributary	Flow	DEQ	Flow input is 0.
Unnamed tributary at model kilometer 145.15	145.15	Tributary	Flow	DEQ	Flow input is 0.
Boulder Creek	143.7	Tributary	Flow	DEQ	
Zinc Creek	142.55	Tributary	Flow	DEQ	Flow input is 0.
Dumont Creek	139.95	Tributary	Flow	DEQ	
Unknown Site at model kilometer 137.8	137.8	Tributary	Flow	DEQ	Flow input is 0.
Francis Creek	137.5	Tributary	Flow	DEQ	Flow input is 0.
Unnamed tributary at model kilometer 135.3	135.3	Tributary	Flow	DEQ	Flow input is 0.
Unknown Site at model kilometer 134.8	134.8	Tributary	Flow	DEQ	Flow input is 0.
Collins Creek	130.05	Tributary	Flow	DEQ	
Deadman Creek	129.35	Tributary	Flow	DEQ	

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Jackson Creek	128.95	Tributary	Flow	DEQ	
Dompier Creek	124.6	Tributary	Flow	DEQ	
Tiller Ranger Station	121.5	Tributary	Flow	DEQ	
Salt Creek	120.95	Tributary	Flow	DEQ	
Elk Creek	119.95	Tributary	Flow	DEQ	
Slate Creek	118.6	Tributary	Flow	DEQ	Flow input is 0.
Hatchet Creek	117.85	Tributary	Flow	DEQ	
Coffee Creek (WRD 7/18/02)	115	Tributary	Flow	DEQ	
Corn creek	112.05	Tributary	Flow	DEQ	Flow input is 0.
Lick Creek	110.3	Tributary	Flow	DEQ	
Stouts Creek	109	Tributary	Flow	DEQ	
Saint John Creek	108.4	Tributary	Flow	DEQ	Flow input is 0.
Coon Creek	108.35	Tributary	Flow	DEQ	Flow input is 0.
Ash Creek	105.45	Tributary	Flow	DEQ	Flow input is 0.
Lavadoure Creek	104.3	Tributary	Flow	DEQ	Flow input is 0.
Poole Creek	102.9	Tributary	Flow	DEQ	Flow input is 0.
Shively Creek	100.9	Tributary	Flow	DEQ	Flow input is 0.
Bland Branch	99.1	Tributary	Flow	DEQ	Flow input is 0.
Hammon Creek	98.5	Tributary	Flow	DEQ	Flow input is 0.
Unknown Site at model kilometer 97.3	97.3	Tributary	Flow	DEQ	Flow input is 0.
Slimwater Creek	96.1	Tributary	Flow	DEQ	Flow input is 0.
Beals Creek	95.4	Tributary	Flow	DEQ	
Days Creek (WRD 8/6/02)	92.2	Tributary	Flow	DEQ	
Stinger Creek	90.35	Tributary	Flow	DEQ	
Packard Gulch	88.3	Tributary	Flow	DEQ	
Unknown Site at model kilometer 85.8	85.8	Tributary	Flow	DEQ	Flow input is 0.
Morgan Creek	85.15	Tributary	Flow	DEQ	

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Small Creek	82.95	Tributary	Flow	DEQ	
Oshea Creek	81.75	Tributary	Flow	DEQ	
Canyon Creek (WRD 7/30/02)	81.05	Tributary	Flow	DEQ	Flow input is 0.
Jordan Creek	80.35	Tributary	Flow	DEQ	
Cow Creek (WRD 8/05/02)	74.75	Tributary	Flow	DEQ	
Lane Creek	70.4	Tributary	Flow	DEQ	Flow input is 0.
Myrtle Creek	61.9	Tributary	Flow	DEQ	
Unknown Site at model kilometer 56.5	56.5	Tributary	Flow	DEQ	Flow input is 0.
Trib Farm drainage	52.4	Tributary	Flow	DEQ	Flow input is 0.
Clark Branch	51.05	Tributary	Flow	DEQ	
tributary at model kilometer 48.75	48.75	Tributary	Flow	DEQ	
Willis Creek	46.2	Tributary	Flow	DEQ	
Rice Creek	44.8	Tributary	Flow	DEQ	
Kent Creek	41.75	Tributary	Flow	DEQ	
Brockway Creek	40.75	Tributary	Flow	DEQ	
Lookingglass Creek (WRD 7/31/02)	39.9	Tributary	Flow	DEQ	
Marsters Creek	27.8	Tributary	Flow	DEQ	
Roberts Creek	25.55	Tributary	Flow	DEQ	
Parrott Creek	20.05	Tributary	Flow	DEQ	Flow input is 0.
Deer Creek	17.7	Tributary	Flow	DEQ	
Newton Creek	13.85	Tributary	Flow	DEQ	Flow input is 0.
Slyman Creek	11.75	Tributary	Flow	DEQ	Flow input is 0.
Stockler Creek	3.35	Tributary	Flow	DEQ	Flow input is 0.
Champagne Creek	0.8	Tributary	Flow	DEQ	
Buckeye Creek (UmpNF-013)	152.1	Tributary	Water Temperature	USFS	

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Ash Creek	149.75	Tributary	Water Temperature	Derived data.	Temperature data copied from Buckeye Creek (UmpNF-013).
Unnamed Site at model kilometer 149.2	149.2	Tributary	Water Temperature	Derived data.	Temperature data copied from Buckeye Creek (UmpNF-013).
Coffeepot Creek	148.75	Tributary	Water Temperature	Derived data.	Temperature data copied from Buckeye Creek (UmpNF-013).
Unnamed Site at model kilometer 146.75	146.75	Tributary	Water Temperature	Derived data.	Temperature data copied from Buckeye Creek (UmpNF-013).
Unnamed tributary at model kilometer 145.15	145.15	Tributary	Water Temperature	Derived data.	Temperature data copied from Buckeye Creek (UmpNF-013).
Boulder Creek (UmpNF-007)	143.7	Tributary	Water Temperature	USFS	
Zinc Creek	142.55	Tributary	Water Temperature	Derived data.	Temperature data copied from Buckeye Creek (UmpNF-013).
Dumont Creek (UmpNF-036)	139.95	Tributary	Water Temperature	USFS	
Unknown Site at model kilometer 137.8	137.8	Tributary	Water Temperature	Derived data.	Temperature data copied from Dumont Creek (UmpNF-036).
Francis Creek	137.5	Tributary	Water Temperature	Derived data.	Temperature data copied from Dumont Creek (UmpNF-036).
Unnamed tributary at model kilometer 135.3	135.3	Tributary	Water Temperature	Derived data.	Temperature data copied from Dumont Creek (UmpNF-036).

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Unknown Site at model kilometer 134.8	134.8	Tributary	Water Temperature	Derived data.	Temperature data copied from Dumont Creek (UmpNF-036).
Collins Creek	130.05	Tributary	Water Temperature	Derived data.	Temperature data copied from Dumont Creek (UmpNF-036).
Deadman Creek (UmpNF-031)	129.35	Tributary	Water Temperature	USFS	
Jackson Creek	128.95	Tributary	Water Temperature	Derived data.	Temperature data from Jackson Creek Heat Source model output.
Dompier Creek	124.6	Tributary	Water Temperature	Derived data.	Temperature data copied from Deadman Creek (UmpNF-031).
Tiller Ranger Station	121.5	Tributary	Water Temperature	DEQ	
Salt Creek	120.95	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Elk Creek	119.95	Tributary	Water Temperature	DEQ	
Slate Creek	118.6	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Hatchet Creek	117.85	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Coffee Creek (WRD 7/18/02)	115	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Corn creek	112.05	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Lick Creek	110.3	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Stouts Creek	109	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Saint John Creek	108.4	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Coon Creek	108.35	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Ash Creek	105.45	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Lavadoure Creek	104.3	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Poole Creek	102.9	Tributary	Water Temperature	DEQ	
Shively Creek	100.9	Tributary	Water Temperature	Derived data.	Temperature data copied from Poole Creek.
Bland Branch	99.1	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Hammon Creek	98.5	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Unknown Site at model kilometer 97.3	97.3	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Slimwater Creek	96.1	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Beals Creek	95.4	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Days Creek (WRD 8/6/02)	92.2	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Stinger Creek	90.35	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Packard Gulch	88.3	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Unknown Site at model kilometer 85.8	85.8	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Morgan Creek	85.15	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Small Creek	82.95	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Oshea Creek	81.75	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Canyon Creek (WRD 7/30/02)	81.05	Tributary	Water Temperature	DEQ	
Jordan Creek	80.35	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Cow Creek (WRD 8/05/02)	74.75	Tributary	Water Temperature	DEQ	
Lane Creek	70.4	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Myrtle Creek	61.9	Tributary	Water Temperature	DEQ	
Unknown Site at model kilometer 56.5	56.5	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Trib Farm drainage	52.4	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Clark Branch	51.05	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
tributary at model kilometer 48.75	48.75	Tributary	Water Temperature	DEQ	
Willis Creek	46.2	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source	Note
Rice Creek	44.8	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Kent Creek	41.75	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Brockway Creek	40.75	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Lookingglass Creek (WRD 7/31/02)	39.9	Tributary	Water Temperature	DEQ	
Marsters Creek	27.8	Tributary	Water Temperature	DEQ	
Roberts Creek	25.55	Tributary	Water Temperature	DEQ	
Parrott Creek	20.05	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Deer Creek	17.7	Tributary	Water Temperature	DEQ	
Newton Creek	13.85	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Slyman Creek	11.75	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Stockler Creek	3.35	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
Champagne Creek	0.8	Tributary	Water Temperature	Derived data.	Temperature data copied from Elk Creek.
10444-ORDEQ	61.95	Meteorological	Air Temperature	DEQ	
12574-ORDEQ	79.95	Meteorological	Air Temperature	DEQ	
KRBG - Roseburg Regional Airport	0.15, 40, 61.95, 79.95, 120, 131.45, 154.25, 164.7	Meteorological	Air Temperature, Cloudiness, Relative Humidity, Wind Speed	NCDC	

Hourly meteorology inputs into the model include air temperature, cloudiness, relative humidity, and wind speed. Air temperature data were modified using the dry adiabatic lapse rate to adjust for differences in elevation between the measurement location and the model input location. Wind speeds were adjusted to improve the calibration using a wind-sheltering coefficient to represent difference in wind speed between the measurement location and above the stream within the riparian area.

6.11.7 Model calibration

The expected model calibration sites and data sources are summarized in Table 47. The model location in the table below describes the distance of each input from the most downstream model node. Effective shade model calibrations sites are summarized in Table 6. The model inputs and parameters that are expected to be modified to improve model fit are described in Section 6.1.

Table 47: Calibration sites and parameters used in the existing South Umpqua River Heat Source model.

Model Location Name (Station ID)	Model Location (kilometers)	Calibration Parameter	Data Source
South Umpqua River above South Umpqua Falls (SU88)	154.25	Water Temperature	USFS
South Umpqua River above Smolt Trap (30144-ORDEQ)	131.45	Water Temperature	DEQ
South Umpqua River above Jackson	129.6	Flow, Effective Shade	DEQ
South Umpqua River upstream of Tiller	120.5	Flow	DEQ
South Umpqua River at Tiller Reservoir (29809)	120	Water Temperature	USFS
South Umpqua River below Tiller	116.25	Flow, Effective Shade	DEQ
South Umpqua at Days Creek Cutoff Bridge	88.35	Effective Shade	DEQ
South Umpqua River at Days Creek Cutoff Bridge	88.35	Flow	DEQ
South Umpqua River at Canyonville	80.75	Flow	DEQ
South Umpqua River at Canyonville (12574-ORDEQ)	79.95	Water Temperature	DEQ
South Umpqua River at Riddle	74.1	Flow	DEQ
South Umpqua River above Myrtle Creek (10444-ORDEQ)	61.95	Water Temperature	DEQ
South Umpqua River upstream of Lookingglass Creek (30145-ORDEQ)	40	Water Temperature	DEQ
South Umpqua River at Brockway	33.55	Flow	DEQ
South Umpqua River at Roseburg	18.75	Flow, Effective Shade	DEQ
South Umpqua River above the mouth (30163-ORDEQ)	0.15	Water Temperature	DEQ

Model Location Name (Station ID)	Model Location (kilometers)	Calibration Parameter	Data Source
Model extent	Model extent	Water Temperature (TIR)	Watershed Sciences (2003)

6.12 Umpqua River

The Umpqua River model is a temperature model developed using Heat Source 7.0. The model was developed by DEQ.

6.12.1 Model domain

The extent of the model domain is the Umpqua River from the confluence of the North and South Umpqua Rivers downstream to Mill Creek near tidewater. The model extent is shown in the HTML interactive map that accompanies this QAPP and is referenced in Appendix D.

6.12.2 Spatial and temporal resolution

The model input spatial resolution (*dx*) is 50 meters. Outputs are generated every 100 meters. The model time step (*dt*) is 1 minute and outputs are generated every hour.

A *dx* of 50 meters was chosen to capture the range of solar flux input caused by the varied vegetation conditions along the length of the stream. The high resolution *dx* will allow evaluation of multiple vegetation management scenarios for each designated management agency.

6.12.3 Source characteristics

The primary sources of thermal loading contributing to temperatures exceedances along the Umpqua River include increases in solar radiation loading from the disturbance or removal of near-stream vegetation, and background sources (DEQ, 2006). Other potential sources include channel modification and widening, reductions to stream flow rate, and warming caused by climate change. The contribution of these latter potential sources may be investigated as part of the model scenarios.

There are no permitted individual NPDES point sources along the model extent.

The majority land uses along the Umpqua River are forestry and agriculture accounting for about 64 percent of the near-stream area. Table 48 summarizes all the land uses within 100 meters of the digitized Umpqua River centerline. Land uses were summarized using the 2016 National Land Cover Database (Yang et al., 2018). Note that Shrub/Scrub and Herbaceous land uses can be areas where forest clearcuts have occurred and would be classified as forest after regrowth.

Table 48: Summary of land uses along the model extent within 100 meters of the digitized Umpqua River centerline based on the 2016 National Land Cover Database (Yang et al., 2018).

2016 NLCD Land Cover	Acres	Percent of Total Acres
Hay/Pasture	714.8	19.7
Emergent Herbaceous Wetlands	665.4	18.4
Evergreen Forest	540.9	14.9

2016 NLCD Land Cover	Acres	Percent of Total Acres
Herbaceous	383.9	10.6
Developed, Open Space	345.8	9.6
Woody Wetlands	259.3	7.2
Barren Land	241.7	6.7
Mixed Forest	226.6	6.3
Shrub/Scrub	173.2	4.8
Developed, Low Intensity	37.4	1
Deciduous Forest	15.6	0.4
Cultivated Crops	10.0	0.3
Developed, Medium Intensity	5.1	0.1
Developed, High Intensity	0.4	<0.05

Anthropogenic related stream warming caused by nonpoint sources is closely associated with the uses, the activities, and the condition of vegetation adjacent to the stream. How activities and uses are managed in these areas is partially determined by a variety of different rules and management plans established by the landowner and any agency with land use authority. To better understand the spatial distribution of different agency rules or management plans along the model extent DEQ mapped known designated management agencies (Table 49).

A designated management agency is defined in OAR 340-042-0030(2) as a federal, state, or local governmental agency that has legal authority over a sector or source contributing pollutants. Typically, persons or designated management agencies that are identified in the TMDL Water Quality Management Plan (WQMP) are responsible for developing TMDL implementation plans and implementing management strategies to reduce pollutant loading. Table 49 summarizes the potential designated management agencies and responsible persons along the Umpqua River model extent.

Table 49: Summary of potential designated management agencies (DMAs) or responsible persons along the model extent within 100 meters of the digitized Umpqua River centerline.

DMA or Responsible Person	Acres	Percent of Total Acres
Oregon Department of Agriculture	1891.5	52.3
Oregon Department of Transportation	446.1	12.3
Oregon Department of Forestry - Private Forestland	439.5	12.1
U.S. Bureau of Land Management	421	11.6
Douglas County	364.6	10.1
Oregon Department of State Lands - Waterway	22.8	0.6
State of Oregon	7.9	0.2
Oregon Parks and Recreation Department	6.4	0.2
Coos Bay Rail Link	5.8	0.2
Oregon Department of Forestry - State Forestland	5.3	0.1
City of Elkton	3.8	0.1
U.S. Forest Service	1.9	0.1

DMA or Responsible Person	Acres	Percent of Total Acres
Bonneville Power Administration	1.8	<0.05
U.S. Government	1.3	<0.05

6.12.4 Time frame of simulation

The model period is July 12, 2002 to July 31, 2002.

6.12.5 Important assumptions

The effort currently described in the QAPP includes use of existing models. Key calibration assumptions made during the model setup and calibration process were documented in the original TMDL (DEQ, 2006), the model user guide (Boyd and Kasper, 2003) or in Section 6 and Section 7 of this document.

6.12.6 Model inputs

Table 50 summarizes the current configuration of the model input parameters and the source of these data. Temperature, flow, and meteorological input parameters are summarized to improve documentation of the TMDL approach.

Table 50: Boundary condition and tributary inputs to the existing Umpqua River Heat Source model.

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source
Umpqua River at the confluence of the North and South Forks	139.45	Boundary Condition	Flow	DEQ
Umpqua River at the confluence of the North and South Forks	139.45	Boundary Condition	Water Temperature	DEQ
South Umpqua River	139.4	Tributary	Flow	DEQ
Calapooya Creek at Umpqua	125.05	Tributary	Flow	DEQ
Cougar Creek	109.7	Tributary	Flow	DEQ
Wolf Creek	104.55	Tributary	Flow	DEQ
Yellow Creek	86.15	Tributary	Flow	DEQ
Elk Creek	38.4	Tributary	Flow	DEQ
South Umpqua River (30163-ORDEQ)	139.4	Tributary	Water Temperature	DEQ
Calapooya Creek at Umpqua (10996-ORDEQ)	125.05	Tributary	Water Temperature	DEQ
Cougar Creek	109.7	Tributary	Water Temperature	DEQ
Wolf Creek (27902-ORDEQ)	104.55	Tributary	Water Temperature	BLM
Yellow Creek	86.15	Tributary	Water Temperature	DEQ

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source
Elk Creek (29293-ORDEQ)	38.4	Tributary	Water Temperature	DEQ
KRBG - Roseburg Regional Airport	18.6, 37.85, 81, 113.9, 130	Meteorological	Air Temperature, Relative Humidity, Wind Speed	NCDC

Hourly meteorology inputs into the model include air temperature, relative humidity, and wind speed. Air temperature data were modified using the dry adiabatic lapse rate to adjust for differences in elevation between the measurement location and the model input location. Wind speeds were adjusted to improve the calibration using a wind-sheltering coefficient to represent difference in wind speed between the measurement location and above the stream within the riparian area.

6.12.7 Model calibration

The expected model calibration sites and data sources are summarized in Table 51. The model location in the table below describes the distance of each input from the most downstream model node. Effective shade model calibrations sites are summarized in Table 6. The model inputs and parameters that are expected to be modified to improve model fit are described in Section 6.1.

Table 51: Calibration sites and parameters used in the existing Umpqua River Heat Source model.

Model Location Name (Station ID)	Model Location (kilometers)	Calibration Parameter	Data Source
Umpqua River above Calapooya Creek (30157-ORDEQ)	130	Water Temperature	DEQ
Umpqua River at Bottle Creek boat launch	113.9	Water Temperature	Watershed Sciences (2003)
Umpqua River at Camp	81	Water Temperature	Watershed Sciences (2003)
Umpqua River near Elkton, OR (14321000)	51.65	Flow	USGS
Umpqua River at Elkton	37.85	Water Temperature	Watershed Sciences (2003)
Umpqua River at USGS Gage near Elkton	20.32	Flow	DEQ
Main Stem Umpqua River above Scottsburg (30159-ORDEQ)	18.6	Water Temperature	DEQ
Model extent	Model extent	Water Temperature (TIR)	Watershed Sciences (2003)

6.13 West Fork Smith River

The West Fork Smith River model is a temperature model developed using Heat Source 6.5.1. The model was developed by DEQ.

6.13.1 Model domain

The extent of the model domain is the West Fork Smith River from river mile 11.5 to the mouth at the confluence of the Smith River. The model extent is shown in the HTML interactive map that accompanies this QAPP and is referenced in Appendix D.

6.13.2 Spatial and temporal resolution

The model input spatial resolution (*dx*) is 100 meters. Outputs are generated every 100 meters. The model time step (*dt*) is 1 minute and outputs are generated every hour.

A *dx* of 100 meters was chosen to capture the range of solar flux input caused by the varied vegetation conditions along the length of the stream. The high resolution *dx* will allow evaluation of multiple vegetation management scenarios for each designated management agency.

6.13.3 Source characteristics

The primary sources of thermal loading contributing to temperatures exceedances along the West Fork Smith River include increases in solar radiation loading from the disturbance or removal of near-stream vegetation, and background sources (DEQ, 2006). Other potential sources include channel modification and widening, reductions to stream flow rate, and warming caused by climate change. The contribution of these latter potential sources may be investigated as part of the model scenarios.

There are no permitted individual NPDES point sources along the model extent.

The majority land use along the West Fork Smith River is forestry accounting for about 83 percent of the near-stream area. Table 52 summarizes all the land uses within 100 meters of the digitized West Fork Smith River centerline. Land uses were summarized using the 2016 National Land Cover Database (Yang et al., 2018). Note that Shrub/Scrub and Herbaceous land uses can be areas where forest clearcuts have occurred and would be classified as forest after regrowth.

Table 52: Summary of land uses along the model extent within 100 meters of the digitized West Fork Smith River centerline based on the 2016 National Land Cover Database (Yang et al., 2018).

2016 NLCD Land Cover	Acres	Percent of Total Acres
Evergreen Forest	385.4	42
Mixed Forest	333.6	36.4
Developed, Open Space	150.6	16.4
Shrub/Scrub	23.4	2.6
Woody Wetlands	12.0	1.3
Deciduous Forest	9.1	1
Herbaceous	1.8	0.2
Developed, Low Intensity	1.3	0.1

Anthropogenic related stream warming caused by nonpoint sources is closely associated with the uses, the activities, and the condition of vegetation adjacent to the stream. How activities and uses are managed in these areas is partially determined by a variety of different rules and management plans established by the landowner and any agency with land use authority. To better understand the spatial distribution of different agency rules or management plans along the model extent DEQ mapped known designated management agencies (Table 53).

A designated management agency is defined in OAR 340-042-0030(2) as a federal, state, or local governmental agency that has legal authority over a sector or source contributing pollutants. Typically, persons or designated management agencies that are identified in the TMDL Water Quality Management Plan (WQMP) are responsible for developing TMDL implementation plans and implementing management strategies to reduce pollutant loading. Table 53 summarizes the potential designated management agencies and responsible persons along the West Fork Smith River model extent.

Table 53: Summary of potential designated management agencies (DMAs) or responsible persons along the model extent within 100 meters of the digitized West Fork Smith River centerline.

DMA or Responsible Person	Acres	Percent of Total Acres
U.S. Bureau of Land Management	561.3	61.1
Oregon Department of Forestry - Private Forestland	357.5	38.9

6.13.4 Time frame of simulation

The model period is for a single day: July 16, 2000.

6.13.5 Important assumptions

The effort currently described in the QAPP includes use of existing models. Key calibration assumptions made during the model setup and calibration process were documented in the original TMDL (DEQ, 2006), the model user guide (Boyd and Kasper, 2003) or in Section 6 and Section 7 of this document.

6.13.6 Model inputs

Table 54 summarizes the current configuration of the model input parameters and the source of these data. Temperature, flow, and meteorological input parameters are summarized to improve documentation of the TMDL approach.

Table 54: Boundary condition and tributary inputs to the existing West Fork Smith River Heat Source model.

Model Location Name (Station ID)	Model Location (kilometers)	Input Type	Model Input	Data Source
West Fork Smith River at River Mile 9.8 (24147-ORDEQ)	0	Boundary Condition	Water Temperature	DEQ
No Station ID	0, 10, 18.8	Meteorological	Air Temperature, Relative Humidity, Wind Speed	DEQ

Hourly meteorology inputs into the model include air temperature, relative humidity, and wind speed. Air temperature data were modified using the dry adiabatic lapse rate to adjust for differences in elevation between the measurement location and the model input location. Wind speeds were adjusted to improve the calibration using a wind-sheltering coefficient to represent difference in wind speed between the measurement location and above the stream within the riparian area.

6.13.7 Model calibration

The expected model calibration sites and data sources are summarized in Table 55. The model location in the table below describes the distance of each input from the most upstream model node. Effective shade model calibrations sites are summarized in Table 6. The model inputs and parameters that are expected to be modified to improve model fit are described in Section 6.1.

Table 55: Calibration sites and parameters used in the existing West Fork Smith River Heat Source model.

Model Location Name (Station ID)	Model Location (kilometers)	Calibration Parameter	Data Source
West Fork River at mouth (24115-ORDEQ)	18.8	Water Temperature	DEQ
West Fork Smith River nr. Scottsburg (14323096)	17.5	Flow	Douglas County
West Fork Smith River upstream of Moore Creek (24146-ORDEQ)	10.0	Water Temperature	DEQ

7 Model evaluation and acceptance

7.1 Model uncertainty and sensitivity

Model uncertainty can arise from a number of sources including error associated with measuring field parameters used for model input or calibration, lack of knowledge on the appropriate value to use for model parameters or constants, or an imperfect mathematical formulation in the model of real world physical processes. A model's sensitivity is the degree to which predictions are affected by changes in a single or multiple input parameters.

In many cases, the major source of uncertainty is due to uncertainty in spatial representation of the river channel and adjacent landcover (e.g., bathymetry, vegetation height and density) from lack of data or simplification, configuration of the boundary conditions (e.g., uncertainty in estimation of ungaged tributary flows or temperatures), and uncertainty from limited amount or spatial distribution of observed data used for calibration. These sources of uncertainty are largely unavoidable, but do not invalidate the use of the model for decision purposes.

During the calibration process, it is good practice to evaluate and minimize uncertainty associated with the model parameters to the greatest extent practical (Beck, 1987; EPA, 2009). During the model calibration process, the responsiveness of the model predictions to various assumptions and rate constants should be evaluated. The model setup should include parameters based on literature recommendations and best professional judgment.

Reducing uncertainty in measured field parameters used for model input and calibration is accomplished in the following ways:

- Data used for the TMDL must have been collected based on a project plan with quality assurance and quality control protocols for collecting and analyzing samples.

- The sampling and laboratory analysis must follow widely accepted scientific methods and protocols. These may include DEQ's Mode of Operations Manual (DEQ, 2020), USEPA's methods (EPA, 1983), USGS's published techniques of water-resources investigations, the USGS National Field Manual, or Standard Methods for the Examination of Water and Wastewater. All acceptable methods include applicable precision and accuracy checks.

- When possible, accuracy and precision should be evaluated using DEQ's data validation criteria as outlined in DEQ Data Quality Matrix for Field Parameters (DEQ, 2013). The TMDL program uses waterbody results that demonstrate a data quality level of A, B, or E with careful review (DEQ, 2021). For continuous temperature data a data quality of A or B corresponds to an absolute accuracy 1.0 deg-C and absolute precision 2.0 deg-C. Data of unknown quality lacking audit and pre and post accuracy checks may also be used following a careful review where it is determined the results appear reasonable and free of issues based on professional judgment.

Uncertainties in the mathematical formulation are addressed by using open source models that allow free and transparent inspection of model code, and models that have had their methodologies peer reviewed and evaluated.

It is not anticipated that additional uncertainty or sensitivity analyses will be performed on the existing calibrated models.

7.2 Model acceptance

This section identifies the model acceptance criteria. Model acceptance relies on satisfying seven (7) conditions:

1) Incorporation of all available field observations of the system (e.g., geometry, flow, boundary inputs/withdrawals, and meteorology) for the time period simulated.

2) Model parameters and unmeasured boundary conditions that are within literature-supported and physically defensible ranges.

3) Model predicted results have been compared with the associated observed measurements using graphical presentations. Visual comparisons are useful in evaluating model performance over the appropriate temporal or spatial scales.

4) Goodness of fit statistics have been calculated comparing the model predicted results to the associated observed measurements. The calibration goodness of fit statistics are shown in Equation 4 through Equation 8.

5) Goodness of fit statistics have been used to inform the appropriate use of the model. Where a model achieves an excellent or good fit it can generally assume a strong role in decision making about appropriate management options. Conversely, where a model achieves only a fair or poor fit it should assume a much less prominent role in decision making about appropriate management options. If a desired level of quality is not achieved on some or all measures, the model might still be useful; however, a detailed description of its potential range of applicability will be provided.

6) Written documentation of all important elements in the model, including model setup, model parameterization, key assumptions, and known areas of uncertainty.

7) Peer review as described in Section 9.

Equation 5 through Equation 8 are the goodness of fit statistics to be calculated for each calibrated temperature model. Equation 4 through Equation 7 are the goodness of fit statistics to be calculated for each calibrated shade model.

Coefficient of Determination – R squared (R^2): A coefficient of determination, or R^2, of one indicates a perfect fit. R^2 is a measure of how well predicted values fit the observed data. It compares the variations in the residuals to the variation of the observed data.

$$R^2 = 1 - \frac{\sum(X_{obs} - X_{mod})^2}{\sum\left(X_{obs} - \overline{X_{obs}}\right)^2} \qquad \text{Equation 4}$$

Mean Error (ME): A mean error of zero indicates a perfect fit. A positive value indicates on average the model predicted values are less than the observed data. A negative value indicates on average the model predicted values are greater than the observed data. The mean error statistic may give a false ideal value of zero (or near zero) if the average of the positive deviations between predictions and observations is about equal to the average of the negative deviations in a data set. Because of this, the mean absolute error (MAE) statistic should be used in conjunction with mean error to evaluate model performance.

$$ME = \frac{1}{n}\sum(X_{mod} - X_{obs}) \qquad \text{Equation 5}$$

Mean Absolute Error (MAE): A mean absolute error of zero indicates a perfect fit. The magnitude of the mean absolute error indicates the average deviation between model predicted values and observed data. The mean absolute error cannot give a false zero.

$$MAE = \frac{1}{n}\sum|X_{mod} - X_{obs}| \qquad \text{Equation 6}$$

Root Mean Square Error (RMSE): A root mean square error of zero indicates a perfect fit. Root mean square error is a measure of the magnitude of the difference between model predicted values and observed data.

$$RMSE = \sqrt{\frac{1}{n}\sum(X_{mod} - X_{obs})^2} \qquad \text{Equation 7}$$

Nash-Sutcliffe efficiency coefficient (NS): Nash-Sutcliffe efficiencies can range from -∞ to 1. An efficiency of 1 corresponds to a perfect match of modeled predicted value to the observed data. An efficiency of 0 indicates that the model predictions are as accurate as the mean of the observed data, whereas an efficiency less than zero occurs when the observed mean is a better predictor than the model.

$$NS = 1 - \frac{\sum(X_{obs} - X_{mod})^2}{\sum\left(X_{obs} - \overline{X_{obs}}\right)^2} \qquad \text{Equation 8}$$

where,
X_{mod} = The model predicted results;
X_{obs} = The observed or measured results;
$\overline{X}_{obs}$ = The mean of the observed or measured temperature;
n = The sample size.

8 Documentation in model reports

Model documentation will consist of a series of TMDL technical appendices describing the model setup, model calibration results, model scenario setup, and model scenario results.

The model setup and calibration documentation will include details on the calibrated model domain and layout; spatial and temporal resolution; timeframe of simulation; summary of data used for model inputs; summary of methods used to fill data gaps; summary of data used for calibration; time series plots comparing observed and model predicted temperatures and other parameters as appropriate; goodness-of-fit statistics, and plots and tables summarizing temperature and effective shade model results.

The model scenario setup and scenario results documentation will include a description of the scenario, what model elements were modified for the scenario; tables, plots, or narrative summarizing the final values for any modified inputs or parameters; methods or data sources used to setup the scenario; and plots and tables that summarize the scenario results.

When no changes or minor changes are made to the existing TMDL models, the existing TMDL technical appendices will be amended as necessary to document any changes to the existing calibration or management scenarios. For more extensive changes or entirely new models new technical appendices may need to be developed to document the models and results.

9 Peer review

Peer review of the models and model results will be conducted in the following ways:

DEQ will conduct internal peer review during the modeling process with input from USEPA Region 10 as needed. For models being developed by USEPA's contractor, Tetra Tech, USEPA and DEQ will peer review all contractor developed models and model documentation.

DEQ will consider feedback on model scenarios and results from the TMDL advisory group and make changes as appropriate.

DEQ will review and respond to any public comments received on the model and model results, and make changes as appropriate.

10 Management scenarios

Management scenarios described in this section summarize the means by which sources of stream warming and different management alternatives will be evaluated. Some of these model scenarios may not be developed due to lack of sufficient data and information, because the management scenario is not applicable to the specific waterbody, or because it is determined the scenario will require an effort and timeline that does not align with the project schedule or available resources. In some cases, the management scenario has already been developed as part of the previous TMDL and does not need further adjustment. DEQ will review all available data and information during model development and document final model scenario decisions, setup, and results in the TMDL technical appendix.

10.1 Current conditions

This scenario evaluates the stream temperature response under current existing conditions. This scenario is similar to the calibrated model except that some sources conditions will be modified, may be removed, or new ones added to reflect the current conditions or discharge loads if they are significantly different from the calibrated model. Elements of this scenario or scenarios may include:

- Updating the South Umpqua River model to characterize current discharges from Canyonville STP, Winston Green Waste Water Treatment Facility, Hoover Treated Wood Products, Myrtle Creek STP, R.U.S.A. Roseburg STP, and the Umpqua National Forest Tiller Ranger Station STP.
- Updating the Calapooya Creek model to characterize current discharges from Oakland STP, and Sutherlin STP.
- Updating the Cow Creek model to characterize current discharges from Glendale STP, and Riddle STP.
- Updating the Elk Creek model to characterize the current discharge from Drain STP.
- Updating model vegetation heights based on recently collected LiDAR to characterize current vegetation conditions.

10.2 Background

This scenario evaluates the stream temperature response from background sources only. Background sources include all sources of pollution or pollutants not originating from human activities. Background sources may also include anthropogenic sources of a pollutant that DEQ or another Oregon state agency does not have authority to regulate, such as pollutants emanating from another state, tribal lands, or sources otherwise beyond the jurisdiction of the state (OAR 340-042-0030(1)). This scenario essentially combines the following model scenarios: restored vegetation, restored stream flow, improvements to channel morphology, and potentially elements of the climate scenario. The background scenario will be compared to the current conditions model scenario to determine the point of maximum impact, and the amount of cumulative warming originating from human activities that DEQ or another Oregon state agency have authority to regulate.

10.3 Restored vegetation

This scenario evaluates the stream temperature response with streamside vegetation at restored conditions. The stream temperature warming or cooling contributed by removal of streamside vegetation is evaluated by comparing this scenario to the current condition model. Elements of this scenario or scenarios may include:

- Restoring streamside vegetation in areas along the model extent that are currently characterized as lacking streamside vegetation because of anthropogenic disturbance. The restored vegetation type, height, density, and overhang values will be determined during the TMDL process and will likely be the same or similar to the values presented in the Umpqua Basin TMDL and WQMP (DEQ, 2006).
- Model inputs for land cover height, canopy density, and overhang will be modified to reflect the restored conditions.
- All other model inputs will be the same as the current condition model.

10.4 Protected vegetation

This set of scenarios evaluate the amount of effective shade contributed by streamside vegetation along the stream that is currently protected by statue, rule, ordinance, or some other approved management plan (voluntary or regulatory). Multiple scenarios may be developed to evaluate different aspects of management plans and protection policies. The purpose of this scenario is to determine the amount of effective shade contributed by streamside vegetation in protected areas and if existing management strategies are sufficient to achieve TMDL allocations and surrogate measure effective shade targets. This scenario may be a subset of the TMDL implementation scenario. Attainment of the effective shade targets and allocations assigned to riparian management nonpoint sources are evaluated by comparing this scenario to the background model scenario. Elements of this scenario or scenarios may include:

- Identifying streamside vegetation areas along the model extent that are protected and will not be removed. The exact definition of a protected area will be determined during the TMDL process.
- Model inputs for land cover height, density, and overhang outside protected areas will be set to zero.
- Model inputs for land cover height, density, and overhang inside protected areas will be set to current conditions or restored conditions depending on the scenario.
- All other model inputs will be the same as the current condition model.

10.5 Stream flow

This scenario evaluates the stream temperature response from water withdrawals. The stream temperature warming or cooling is evaluated by comparing the water withdrawal scenario to a model scenario with the stream flow rates set to a natural flow. Assumptions and methods used to estimate natural stream flow will be documented in the TMDL.

10.6 Tributary temperatures

This scenario evaluates the stream temperature response from restoration actions on tributaries. The stream temperature warming or cooling contributed by removal of streamside vegetation on tributaries is evaluated by comparing this scenario to the current condition model. Assumptions and methods used to estimate restored tributary conditions will be documented in the TMDL. Elements of this scenario or scenarios may include:

- Tributary inputs will be set to reflect restored temperature and flow conditions. The tributary flow will reflect maintaining all currently permitted water withdrawals as instream flow.
- All other model inputs will be the same as the current condition model.

10.7 Climate

This scenario evaluates the stream temperature response from changes in air temperature and relative humidity connected to human caused changes to global or micro climate conditions. Warming or cooling from climate related impacts will be evaluated by comparing this scenario to the current conditions model scenario. Assumptions and methods used to develop this scenario will be documented in the TMDL. Elements of this scenario or scenarios may include:

- Model inputs for air temperature and relative humidity may be modified to reflect potential conditions or conditions without climate change impacts assuming enough information exists that would allow downscaling to the site specific conditions in model extent.
- Model inputs for groundwater or stream flow may also be modified if sufficient information exists that would allow downscaling to the site specific conditions in model extent.
- All other model inputs will be the same as the current condition model.

10.8 Channel morphology

This scenario evaluates stream temperature response from improvements to channel morphology, including projects to restore cold water refuges. The warming or cooling from channel morphology improvements is evaluated by comparing this scenario to the current conditions model scenario. Assumptions and methods used to develop this scenario will be documented in the TMDL. Elements of this scenario or scenarios may include:

- Modifying channel width and/or depth to reflect locations where improvements to channel morphology are needed. The location of channel morphology projects will be determined during the TMDL process.
- Model configurations for channel width, bank angle, channel position, Manning's *n*, gradient, elevation, porosity, percent hyporheic flow, hyporheic zone thickness, land cover height, density, and overhang may be modified in areas with improved channel morphology.
- All other model inputs will be the same as the current condition model.

10.9 No point sources

This scenario evaluates the stream temperature response from removing point source heat load. The stream temperature warming or cooling from permitted NPDES point sources is evaluated by comparing this scenario to the current conditions model scenario. Elements of this scenario or scenarios may include:

- Removal of all point sources from the model.
- All other model inputs will be the same as the current condition model.

10.10 TMDL wasteload allocations

This scenario evaluates stream temperature warming or cooling from the TMDL wasteload allocations. These scenarios will be compared to the no point source model scenario to evaluate attainment of the human use allowance allocations. Numeric or narrative wasteload allocations will be developed for all NPDES permittees, but some of the permittees may not be included in this model scenario due to availability of effluent data, lack of discharge, or because the discharge is not a significant source or thermal loading. Elements of this scenario or scenarios may include:

- Modifying point source discharges to reflect proposed or existing TMDL wasteload allocations.
- All other model inputs will be the same as the current condition model.

10.11 TMDL implementation plans

This set of scenarios evaluate the stream temperature response from proposed or existing DMA and responsible person management plans, TMDL implementation plans, or rules. These scenarios will be compared to the background model scenario to evaluate attainment of the human use allowance allocations or surrogate measures. It is likely that multiple model scenarios will be developed evaluating a single implementation plan or multiple implementation plans together. Assumptions and methods used to develop this scenario will be documented in the TMDL. Elements of this scenario or scenarios may include:

- Modifying streamside vegetation, instream flow, and/or channel morphology to reflect the proposed or existing implementation plan. Translating the plan elements to the modeled landscape conditions will be determined during the TMDL process.
- Model inputs for land cover height, density, overhang, boundary condition flow and temperature, channel width, bank angle, Manning’s *n*, porosity, percent hyporheic flow, and hyporheic zone thickness, may be modified.
- All other model inputs will be the same as the current calibrated model.

DEQ may also rely upon the results of relevant studies, reports, or published articles to supplement the model scenario; or as the primary source of information for locations or situations where the model results are not applicable.

11 Project organization

11.1 Project team/roles

Project roles and responsibilities are described in Table 56.

Table 56: The roles and responsibilities of each team member involved in the temperature TMDL replacement project.

Name	Position	Role and Responsibilities
Jennifer Wigal	Water Quality Administrator, Oregon DEQ	Sponsor 1. Provide guidance to team and project manager 2. Approve project plan and changes to the project, scope, budget, and schedule (pending manager elevation as necessary) 3. Sustain support of decision makers at their level, all stakeholders 4. Remove roadblocks 5. Communicate progress to other managers and WQ Director 6. Review project status 7. Manage resistance 8. Ensure communication with employees affected by changes 9. Provide forum to listen to concerns
Gene Foster	Manager, Watershed Management, Oregon DEQ	Manager 1. Review and approve team work products 2. Communicate progress to other managers 3. Approve project plan, changes to the project, and any changes that affect scope and schedule 4. Approve development and finalization of solutions to issues that occur during the project 5. Decide measures of project success
Michele Martin	Project Manager, Water Quality, Oregon DEQ	Project Manager 1. Facilitate meetings, effective meeting management 2. Provide feedback and leadership in the development of meeting agendas, activities during meetings, and tasks. 3. Provide feedback on project planning and design 4. Keep sponsor informed 5. Develop project charter 6. Develop project plan (including major tasks, milestones, project schedule, communication plan, risk analysis, etc.)

Name	Position	Role and Responsibilities
		7. Develop team meeting agendas 8. Keep track of meeting decisions and notes (very brief), and team ideas 9. Ensure team's work drives towards outcomes and deliverables 10. Sustain engagement of team members and team performance 11. Control project scope (with Technical Lead) 12. Coordinate team communication: Emails, SharePoint, shared drives 13. Closeout project and document lessons learned
Ryan Michie	Senior Water Quality Analyst, Watershed Management, Oregon DEQ	Project Technical Lead 1. Lead, oversee, and direct development of the project QAPP 2. Lead, oversee, and direct the public data solicitation process 3. Coordination with EPA and Contractor 4. Lead, oversee, and direct DEQ technical staff 5. Perform model calibration/evaluation 6. Run model scenarios 7. Analyze and interpret model results 8. Lead, oversee, and direct TMDL document writing 9. Participate and present at TMDL public meetings 10. Respond to public comments
Jim Bloom	Senior Water Quality Analyst, Watershed Management, Oregon DEQ	1. Develop and configure models 2. Perform model calibration/evaluation 3. Run model scenarios 4. Analyze and interpret model results 5. Write TMDL 6. Participate and present at TMDL public meetings 7. Respond to public comments
Erin Costello	Water Quality Analyst, Watershed Management, Oregon DEQ	1. Write QAPP 2. Develop and configure models 3. Perform model calibration/evaluation 4. Run model scenarios 5. Analyze and interpret model results 6. Write TMDL 7. Participate and present at TMDL public meetings 8. Respond to public comments

Name	Position	Role and Responsibilities
David Fairbarin	Water Quality Analyst, Watershed Management, Oregon DEQ	1. Write QAPP 2. Develop and configure models 3. Perform model calibration/evaluation 4. Run model scenarios 5. Analyze and interpret model results 6. Write TMDL 7. Participate and present at TMDL public meetings 8. Respond to public comments
Yuan Grund	Water Quality Analyst, Watershed Management, Oregon DEQ	1. Write QAPP 2. Perform data evaluation 3. Run model scenarios 4. Analyze and interpret model results
Heather Tugaw	Basin Coordinator, Oregon DEQ	1. Review QAPP and TMDL 2. Write WQMP 3. TMDL Advisory Committee coordinator 4. Participate and present at TMDL public meetings 5. Respond to public comments
Chris Moore	DEQ QAPP Officer, Oregon DEQ	Review QAPP
Dianne Lloyd	Oregon Department of Justice	Legal Counsel
Rob Burkhardt	Water Quality Specialist, Oregon DEQ	Project team point of contact to NPDES permit program and permittees Review wasteload allocations
Tetra Tech	Contractor	TMDL development support
Claire Schary	EPA Region 10	Non-technical TMDL reviewer
Ben Cope	EPA Region 10 QAPP Officer for Modeling Projects	EPA Modeling Lead 1. Review QAPPs 2. Review EPA Contractor work products
Jayshika Ramrakha	EPA Region 10 EPA Task Order Manager	Direct EPA Contractor
TMDL Advisory Committee	Each TMDL will have a local, public advisory committee	1. Participate in TMDL Advisory Committee Meetings 2. Provide input to DEQ on TMDL and WQMP elements

11.2 Expertise and special training requirements

Additional expertise or special training is not necessary at this time.

DEQ staff involved in developing and configuring models, performing model calibration, running model scenarios, and analyzing and interpreting model results have experience in these tasks from numerous other modeling projects. The Project Manager has extensive experience managing large complex projects and will ensure strict adherence to the project protocols.

11.3 Reports to management

The DEQ Project Manager (or designee) will provide progress reports to DEQ Management and USEPA as needed based on new project information. As appropriate, these reports will provide information on the following:

- Adherence to project schedule and/or budget.
- Deviations from approved QAPP, as determined from project assessment and oversight activities.
- The impact of any deviations on model application quality and uncertainty.
- The need for and results of response actions to correct any deviations.
- Potential uncertainties in decisions based on model predictions and data.
- Data quality assessment findings regarding model input data and model outputs.

11.4 Project schedule

The project schedule for the South Umpqua and Umpqua Subbasins TMDL is scheduled to occur in two phases. The pre TMDL project phase, and the TMDL and WQMP development phase.

Pre TMDL project phase

The pre TMDL project phase will generally occur between January 2020 through the end of August 2022. In this phase most of the planning and technical work occurs. Specific tasks include:

Task P1 Data gathering and project organization.

P1.1 Organize and gather effluent data from all active NPDES permittees in the temperature TMDL replacement project area.

P1.2 Organize and gather all available and relevant river temperature, stream flow, habitat, effective shade, and channel morphology.

P1.3 Complete an open data solicitation. During the solicitation period, the public may submit continuous stream temperature data and NPDES effluent data to DEQ in the watersheds subject to the temperature TMDL replacements.

P1.4 Review data collected. Data submitted to DEQ will be screened for completeness and quality, and whether the results are within the typical range expected for that season and time of day.

P1.5 Stream temperature data will be made available in DEQ’s Ambient Water Quality Monitoring System database (AWQMS).

Task P2 Develop modeling Quality Assurance Project Plans (QAPPs). The modeling QAPPs will identify the available data and overall technical approach to be taken for each TMDL project.

Task P3 Mapping of Designated Management Agencies (DMAs) and Responsible Persons for counties that are within the project area. All Oregon counties are within the project area except Tillamook, Clatsop, and Deschutes counties.

Task P4 Development of computer code to streamline analysis tasks and TMDL document production.

Task P5 Development of template TMDL and WQMP section outlines and language.

Task P6 Implement Modeling QAPPs. This task is a follow-up to Task P2. Gathering of new data and completion of new technical work described in the modeling QAPPs.

TMDL and WQMP development phase

The TMDL and WQMP development phase is scheduled to begin in 2023 with USEPA's final agency action approving or disapproving of the TMDL no later than February 28, 2025. In this phase, the draft TMDL and WQMP documents will be written; a TMDL advisory committee will be convened to discuss the updated TMDL allocations, any revisions to the WQMP, and potential fiscal impacts in the case of a rulemaking process; and finally DEQ will conduct a public comment period. DEQ will respond to all public comments received, revise the TMDL and WQMP as necessary, and issue the final TMDL to USEPA for their action.

12 Data management

DEQ does not anticipate collecting additional field samples. Water quality data gathered and used for this project will be managed in DEQ's AWQMS database or the project files.

The modeling software to be used for this project is available on DEQ's TMDL program website (https://www.oregon.gov/deq/wq/tmdls/Pages/TMDLs-Tools.aspx).

Model-generated data resulting from testing, calibration, and scenarios will be stored in spreadsheets and text files by DEQ in the TMDL project directory. Metadata describing the content, date, and personnel involved in modeling will be documented alongside raw and summarized data.

Secondary data developed as part of this task will be maintained as hardcopy only, both hardcopy and electronic, or electronic only, depending on their nature.

All electronic data will be maintained on DEQ's computers and servers. DEQ's computers are serviced by in-house specialists. When a problem with DEQ's computers and servers occurs, in-house computer specialists diagnose the problem and correct it if possible. When outside assistance is necessary, the computer specialists call the appropriate vendor. For other computer equipment requiring outside repair and not covered by a service contract, local computer service companies are used on a time-and-materials basis.

Routine maintenance of DEQ's computers and servers is performed by in-house computer specialists. Electric power to each computer flows through a surge suppressor to protect electronic components from potentially damaging voltage spikes. All computer users have been instructed on the importance of routinely archiving work assignment data files from hard drive to server storage. The office network server is backed up on tape nightly during the week. Screening for viruses on electronic files loaded on DEQ's computers or the network is standard policy. Automated screening systems have been placed on all computer systems and are updated regularly to ensure that viruses are identified and destroyed. Annual maintenance of software is performed to keep up with evolutionary changes in computer storage, media, and programs.

13 Recordkeeping and archiving

All data and documents generated during the course of the TMDL project will be archived according to the current Oregon State Archives Records Retention Schedules. Generally TMDL documents will be retained until 15 years after the TMDL is no longer operational.

Records that are stored in electronic format will be located in either the TMDL project folder or Master TMDL folder located on DEQ's TMDL server. The TMDL project folder will contain at minimum the following subfolders: “Project Plans”, “Data”, “NPDES”, “Models”, and “Meetings”. Alternative names and additional subfolders can be used as appropriate. The Master TMDL folder will contain the written TMDL documents (Word, PDF) along with supporting written documents that support the public comment period and TMDL issuance. The contents and organization of these subfolders is described below.

Project Plans: All documents related to project planning, project proposals, project schedules, and the modeling QAPPs. Each will reside in their relevant subfolders. The final versions of documents will be clearly identified from drafts and ideally located in separate folders.

Data: All field data organized or collected in support of the TMDL project. This may include water quality samples, field sheets, photos, monitoring metadata, third party sampling project plans, or other documentation. The data should be organized by parameter and data source if possible.

NPDES: All available NPDES effluent data, discharge monitoring reports, copies of NPDES permits, and related information. Data and permit information will be organized for each permittee and located in separate subfolders.

Models: All models used for the TMDL project including calibration and scenario models. The models should be organized into subfolders for each model domain and model scenario. Draft models and the final TMDL models will be clearly identified and ideally saved in separate folders. The model folders should include:

- The model with all input and output files and any executable code used;
- Copy of all raw and summarized data (including GIS files) used for model input with data source and location metadata included;
- Scripts or spreadsheets used to transform raw data or used to derive model inputs;
- Key assumptions and documentation for the model setup and parameterization;
- Documentation of newly developed model code or modifications to the existing model; and
- Identification of staff that completed the model.

Meetings: All documents produced for external meetings including agendas, presentations, posters, and meeting handouts. Material for each meeting will be saved in a subfolder organized by date and meeting type. For example the folder name for the first meeting of the TMDL advisory group would be “2022-08-15 Temperature AG 1”. Draft documents and final documents will be clearly identified and ideally saved in separate folders.

TMDL documents: At each key stage of TMDL and WQMP development copies of the following documents will be saved in separate subfolders within the project folder on the Master TMDL directory. The final versions of documents will be clearly identified from drafts and ideally saved in separate folders.

- Public Comment Draft:
  - Briefing memo to DEQ Water Quality Division Administrator or Director on public comment draft
  - Draft TMDL and WQMP Report (Both Word and PDF)
  - Draft TMDL Appendices (Both Word and PDF)
  - Public Notice document
  - TMDL Summary Fact Sheet
  - News release
  - GovDelivery Notice and email
  - Other public notification emails
  - Mailing List (if used)
  - Public Comments Errata
- Public Comments Received: Copy of all public comments received
- Final TMDL and WQMP documents:
  - Briefing memo to DEQ Water Quality Division Administrator or Director on final TMDL
  - Signed TMDL order (both Word and PDF)
  - TMDL issuance letter to USEPA (both Word and PDF)
  - USEPA approval letter (USEPA)
  - Response to Comment Document (both Word and PDF)
  - TMDL and WQMP Report (both Word and PDF)
  - TMDL Appendices (both Word and PDF)
  - TMDL Summary Fact Sheet
  - News release
  - GovDelivery Notice and email
  - Other public notification emails
  - Relevant EQC agenda documents
  - Designated Management Agency/Responsible Person notification letters (both Word and PDF)
  - Addendums
  - Errata
  - Petitions
  - Director’s Petition Action (acceptance or rejection of petition)
  - Response to Petition

– ATTAINS upload files

14 QAPP review and approval

The DEQ Project Technical Lead will distribute the draft QAPP to the respective DEQ and USEPA project team members for review. Comments will be provided to the Project Technical Lead for further discussion. When possible, revision and submittal of the final plan will be made within 10 business days of receipt of comments. Following approval, the Project Technical Lead will distribute the final, signed copy to the respective DEQ and USEPA project team members.

USEPA has an independent responsibility for this QAPP and must complete a separate approval protocol. USEPA approval is necessary for USEPA contractors to begin any modeling work.

Official copies of the final, approved QAPP will be retained in DEQ's document control system. If any change(s) to the QAPP are required during the project, they must be described in a memorandum and approved by the signatories to this QAPP and attached to the QAPP.

15 Implementation and adaptive management

DEQ plans to develop a Risk Management Plan to identify project constraints, the risks that may arise during project implementation, and potential solutions. Identified project constraints include the abbreviated project schedule with hard deadlines established via court order, limited resources, uncertain funding from USEPA, and a complex TMDL technical effort which may require additional time and public process. Projects risks from these constraints and proposed solutions are described in Table 57.

Table 57: Projects risks and proposed solutions.

Risk Description	Solution
Extended public process for complex TMDLs	Communication to DEQ manager and external contacts as deemed necessary by the manager
Team member availability: Inadequate resources to effectively produce the TMDL	Dedicate additional resources to support the effort from internal staff
Delivery commitment	Designate the projects as priority and dedicate additional resources to support the effort from internal staff or contractor (depending on contractor funding)
Scope creep: Working on the TMDLs could be an opportunity for attempts to add additional technical work that are outside the project scope	Sponsor and Manager to address scope creep with stakeholders as necessary

Should a situation arise that requires a significant change in the technical approach, the project team will update the QAPP as needed through revisions or addenda.

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17 Revision history

Table 58: QAPP revision history.

Revision	Date	Changes	Editor
1.0	4.14.2022	New QAPP	R. Michie

Appendix A Meteorology data summary

Table 59: Meteorological stations and data available in the National Climatic Data Center (NCDC) database in the South Umpqua and Umpqua Subbasins.

Station ID	Station	Latitude/Longitude
20015820	GLENDALE	42.7333/-123.433
20015834	DEVILS FLAT	42.8167/-123.05
20015852	TILLER	42.9333/-122.95
20015853	RIDDLE 4 SW	42.9167/-123.433
20015867	RIDDLE	42.95/-123.35
20015870	TILLER 15 ENE	43/-122.7
20015871	UPPER OLALLA	43.0333/-123.55
20015882	WINSTON 1 N	43.1333/-123.4
20015884	RESTON	43.1333/-123.617
20015888	SOUTH DEER CREEK	43.1667/-123.217
20015889	LOOKINGGLASS	43.1833/-123.483
20015890	FLOURNOY VALLEY	43.1833/-123.55
20015905	ROSEBURG KQEN	43.2167/-123.383
20015906	ROSEBURG OAK ST BRIDGE	43.2167/-123.35
20015909	ROSEBURG REGIONALAP	43.2333/-123.367
20015923	WINCHESTER 3 W	43.2681/-123.409
20015938	UMPQUA BRIDGE	43.3655/-123.469
20015943	SUTHERLIN 12 ENE	43.4333/-123.067
20015944	SUTHERLIN 2 W	43.3963/-123.36
20015945	OAKLAND	43.4228/-123.3
20015975	ELKTON 4 S	43.5833/-123.55
20015982	ELKTON 3 SW	43.6/-123.583
20015990	DRAIN	43.66/-123.325
20015999	CURTIN NEAR	43.7333/-123.2
20016013	DRAIN 10 NNW	43.7789/-123.427
20016525	GARDINER 1 N	43.75/-124.117
20016528	MYRTLE CREEK 8 NE	43.0833/-123.167
30000906	REEDSPORT 1 ENE	43.7042/-124.094
30002005	CANYONVILLE 2S	42.9417/-123.28
30014750	MYRTLE CREEK 7NE	43.0392/-123.265
30014862	ELKTON 1SW	43.6425/-123.583

Station ID	Station	Latitude/Longitude
30017098	GLENDALE 1.6 SE	42.7216/-123.404
30027141	ROSEBURG 6.0 SSW	43.1398/-123.404
30027522	ROSEBURG 6.2 S	43.1305/-123.355
30030151	ROSEBURG 2 SW	43.2125/-123.384
30032256	OAKLAND 6.9 NNW	43.51/-123.362
30033102	OAKLAND 0.1 NNE	43.4248/-123.294
30036413	MYRTLE CREEK 1.8NNE	43.051/-123.273
30040038	ROSEBURG 1.9 SE	43.2028/-123.327
30040785	ROSEBURG 3.9 SSW	43.1664/-123.386
30043805	RIDDLE 2.4 SE	42.9246/-123.335
30049547	MYRTLE CREEK 1.9SSW	43.0017/-123.3
30050549	ROSEBURG 3.8 SSW	43.1678/-123.385
30055021	TENMILE 1.8 NE	43.1099/-123.547
30055850	OAKLAND 4.5 W	43.4256/-123.386
30060237	ROSEBURG 1.2 WNW	43.225/-123.381
30063603	DAYS CREEK 1 N	42.9419/-123.031
30066822	ELKTON 4.1 SSW	43.582/-123.598
30069826	GLENDALE 6 NE	42.7783/-123.319
30072097	WINSTON 0.3 NW	43.1235/-123.415
30074996	MT. YONCALLA OREGON	43.6389/-123.326
30075715	BUCKEYE OREGON	43.0361/-122.655
30075841	ELKTON OREGON	43.6292/-123.631
30075974	SILVER BUTTE OREGON	42.8589/-123.378
30079306	REEDSPORT 0.8 SW	43.6918/-124.125
30079461	SCOTTSBURG 1.6 SSW	43.654/-123.817
30079512	UMPQUA 1 W	43.3711/-123.501
30079803	ROSEBURG 6.6 WNW	43.2668/-123.471
30083778	ROSEBURG 4.5 WSW	43.1923/-123.439
30084229	DILLARD 0.3 N	43.1068/-123.428
30108043	DAYS CREEK 7.7 ESE	42.9414/-123.029
30108478	ROSEBURG 1.1 NW	43.2291/-123.376
30112135	ROSEBURG 5.7 WNW	43.2575/-123.458
30121309	ROSEBURG 10.6 E	43.2191/-123.147

Table 60: Meteorological stations and data, including humidity, precipitation, temperature, wind direction, and wind speed, available in the Remote Automatic Weather Station (RAWS) database in the South Umpqua and Umpqua Subbasins.

Station ID	Station	Latitude/Longitude	Agency
orOCHR	CHARLOTTE RIDGE	43.6692/-123.944	S&PF
orODEV	DEVILS GRAVEYARD	43.7203/-123.63	BLM

Table 61: Meteorological stations and data, including air temperature, precipitation, relative humidity, wind speed and wind direction, available in the MesoWest database in the South Umpqua and Umpqua Subbasins.

Station ID	Station	Latitude/Longitude
2106P	ROSEBURG- LAURELWOOD	43.2154/-123.351
A4203	ROSEBURG - GARDEN VALLEY BLVD.	43.2266/-123.365
A4747	ROSEBURG FIRE DEPT	43.1529/-123.382
C1063	CW1063 REEDSPORT	43.7051/-124.095
COOPREEO3	REEDSPORT 1ENE	43.7/-124.09
D6983	DW6983 WINSTON	43.125/-123.446
D7774	DW7774 ROSEBURG	43.2866/-123.437
D9562	DW9562 WOLF CR.	42.9421/-123.35
DRANX	DRAN DRAIN	43.6972/-123.349
E3213	EW3213 GLENDALE	42.7411/-123.43
E8909	EW8909 OAKLAND	43.4272/-123.289
KRBG	ROSEBURG REGIONAL AIRPORT	43.2337/-123.358
OD113	I5 AT RICE HILL MP 147.2	43.5265/-123.31
OD114	I5 AT CANYON MT MP90.1	42.8269/-123.26
OD116	OR38 AT WELLS CREEK ROAD MP18.7	43.6749/-123.804
OD122	OR38 SB AT ELKTON MP35.5	43.6347/-123.564
OD125	I5 AT BARTON RD MP83.5	42.7669/-123.332
OD153	I5 AT ROBERTS MOUNTAIN MP116.51	43.1114/-123.354
OD168	OR138 WB AT GREEN VALLEY (MARVIN HILL) MP16.7	43.4589/-123.436
OD170	I5 NB AT GARDEN VALLEY MP125	43.2271/-123.362
OD171	US101 AT REEDSPORT MP211.3	43.7011/-124.108
ODT49	I5 SB AT WARDS BUTTE (COTTAGE GROVE) MP168	43.7522/-123.145
ODT77	OR42 WB AT CAMAS MT MP57.34	43.0652/-123.65
PC027	NE AZALEA	42.7957/-123.256
PC031	HAPPY VALLEY	43.1629/-123.402
PC040	DAYS CREEK	42.9774/-123.187
PKFO3	BUCKEYE	43.0364/-122.655
RDLO3	COW CREEK NEAR RIDDLE 4SW	42.9236/-123.428
SVFO3	SILVER BUTTE	42.8588/-123.378

Station ID	Station	Latitude/Longitude
TILO3	SOUTH UMPQUA RIVER AT TILLER	42.9306/-122.947
TT582	UMPQUA PORTABLE 2	42.9297/-122.946
YNFO3	MT. YONCALLA	43.6383/-123.327

Table 62: Meteorological data provided to DEQ from the various sources for the South Umpqua and Umpqua Subbasins.

Source	Latitude/Longitude	Available Data
10444-ORDEQ, DEQ	43.025/-123.296	Air Temperature
12574-ORDEQ, DEQ	42.9462/-123.291	Air Temperature
INSIGHT CONSULTANTS		Air Temperature

Appendix B Continuous stream temperature data summary

Table 63: Continuous temperature monitoring stations in the South Umpqua and Umpqua Subbasins currently available in public databases and DEQ files.

Station ID	Station	Latitude/Longitude	Organization
10442-ORDEQ	South Umpqua at Melrose Road	43.2418/-123.412	DEQ
10444-ORDEQ	South Umpqua at Myrtle Creek	43.025/-123.296	DEQ
10996-ORDEQ	Calapooya Creek at Umpqua	43.3666/-123.461	DEQ
10997-ORDEQ	Cow Creek at mouth	42.9429/-123.337	DEQ
11304-ORDEQ	Elk Creek at Hayhurst Road (Drain)	43.6584/-123.339	DEQ
11315-ORDEQ	Roberts Creek at Carnes Road in Green	43.1596/-123.382	DEQ
11316-ORDEQ	Myrtle Creek at mouth	43.023/-123.296	DEQ
11522-ORDEQ	South Umpqua at Stewart Park Road (Roseburg)	43.2175/-123.367	DEQ
12134-ORDEQ	Harvey Creek at River Mile 0.5	43.6903/-123.945	DEQ
12247-ORDEQ	Rice Creek at junction of Willis Creek Road & Rice Creek Road	43.0836/-123.415	DEQ
12248-ORDEQ	Lookingglass Creek at Hwy 42 at Winston OR	43.1176/-123.428	DEQ
12277-ORDEQ	Lookingglass Creek upstream of Applegate Creek	43.1172/-123.44	DEQ
12570-ORDEQ	Canyon Creek 60 feet upstream of mouth	42.9422/-123.282	DEQ
12574-ORDEQ	South Umpqua River at Stanton Park (upstream end)	42.9462/-123.291	DEQ
12796-ORDEQ	Calapooya Creek at Driver Valley Road (Medley Bridge)	43.4431/-123.242	DEQ
12800-ORDEQ	Calapooya Creek at Oakland drinking water intake	43.4211/-123.308	DEQ
12803-ORDEQ	Calapooya Creek at Sutherlin drinking water intake	43.4086/-123.164	DEQ

Station ID	Station	Latitude/Longitude	Organization
12899-ORDEQ	Myrtle Creek 200 feet upstream of Myrtle Creek STP outfall	43.0225/-123.296	DEQ
12913-ORDEQ	Cow Creek 150 yards upstream of Riddle outfall	42.9496/-123.358	DEQ
13050-ORDEQ	Cow Creek 100 feet upstream of Glendale STP outfall	42.743/-123.429	DEQ
13245-ORDEQ	Calapooya Creek at I-5 Bridge	43.416/-123.325	DEQ
17164-ORDEQ	Jackson Creek at Road Mile 1.3	42.9629/-122.859	DEQ
17166-ORDEQ	Boulder Creek at mouth	43.0529/-122.778	DEQ
21506-ORDEQ	Jackson Creek above Falcon Creek (tributary of South Umpqua)	42.9989/-122.553	DEQ
21824-ORDEQ	School Hollow Creek at River Mile 1.64	43.0555/-123.178	DEQ
21825-ORDEQ	South Fork Smith River at River Mile 0.83	43.774/-123.464	DEQ
21828-ORDEQ	Dumont Creek at River Mile 4.95	43.0946/-122.819	DEQ
21831-ORDEQ	Halfway Creek tributary at River Mile 0.29	43.7493/-123.585	DEQ
23836-ORDEQ	Wood Creek at River Mile 1.18 (Windy, Cow, South Umpqua, Umpqua)	42.7817/-123.396	DEQ
23837-ORDEQ	Wolf Creek at River Mile 3.5 (Umpqua)	43.456/-123.611	DEQ
24101-ORDEQ	Smith River upstream of Peterson Creek	43.7714/-123.367	DEQ
24102-ORDEQ	Smith River upstream of South Fork Smith	43.7825/-123.469	DEQ
24103-ORDEQ	South Fork at Mouth	43.7826/-123.47	DEQ
24115-ORDEQ	West Fork at Mouth	43.8057/-123.766	DEQ
24115-ORDEQ	West Fork River at mouth	43.8055/-123.766	DEQ
24116-ORDEQ	Smith River upstream of Johnson Creek	43.8066/-123.802	DEQ
24118-ORDEQ	Smith River upstream of West Fork Smith	43.8081/-123.762	DEQ
24120-ORDEQ	Smith River downstream Salmonberry Creek	43.8017/-123.482	DEQ

Station ID	Station	Latitude/Longitude	Organization
24121-ORDEQ	Smith River upstream of Yellow Creek	43.7914/-123.548	DEQ
24122-ORDEQ	Smith River upstream of Cleghorn Creek	43.7625/-123.539	DEQ
24123-ORDEQ	Smith River upstream of Halfway Creek	43.7695/-123.592	DEQ
24124-ORDEQ	Smith River upstream of Big Creek	43.7693/-123.654	DEQ
24125-ORDEQ	Big Creek	43.769/-123.654	DEQ
24126-ORDEQ	Smith River upstream of South Sister Creek	43.8214/-123.671	DEQ
24127-ORDEQ	South Sister Creek	43.8278/-123.68	DEQ
24146-ORDEQ	West Fork Smith River upstream of Moore Creek	43.8449/-123.74	DEQ
24147-ORDEQ	West Fork Smith River at River Mile 9.8	43.8643/-123.703	DEQ
24148-ORDEQ	Smith River upstream of Carpenter Creek	43.8026/-123.726	DEQ
24405-ORDEQ	Calapooya at Umpqua Landing	43.3658/-123.468	DEQ
25172-ORDEQ	Elk Creek at Harold Wooley Bridge	43.6626/-123.489	DEQ
25173-ORDEQ	Elk Creek below Yoncalla Creek	43.6407/-123.298	DEQ
25180-ORDEQ	South Umpqua River at Roseburg Fairgrounds	43.1946/-123.355	DEQ
25187-ORDEQ	South Fork of Deer Creek near mouth, South Umpqua River	43.2019/-123.242	DEQ
25188-ORDEQ	North Fork Deer Creek near mouth, South Umpqua	43.2016/-123.241	DEQ
25390-ORDEQ	Wind Creek	43.6517/-124.096	DEQ
25950-ORDEQ	Deer Creek at Fowler Bridge, Roseburg (South Umpqua, Umpqua)	43.2125/-123.34	DEQ
26853-ORDEQ	Ash Creek	43.0923/-122.714	DEQ
26973-ORDEQ	Jackson Creek above Twomile Creek	42.9978/-122.644	DEQ
27831-ORDEQ	Wells Creek nr Mouth	43.675/-123.798	DEQ

Station ID	Station	Latitude/Longitude	Organization
27838-ORDEQ	Cattle Creek	42.8795/-123.555	DEQ
27839-ORDEQ	Coffee Creek	43.0048/-122.998	DEQ
27840-ORDEQ	Curtain Creek	43.086/-123.021	DEQ
27841-ORDEQ	West Fork Deadman Creek	43.0224/-122.926	DEQ
27843-ORDEQ	Dutchman Creek	42.839/-123.623	DEQ
27844-ORDEQ	East Fork Shively Creek	42.9012/-123.152	DEQ
27845-ORDEQ	East Fork Stouts Creek	42.9144/-123.048	DEQ
27847-ORDEQ	Fate Creek	42.9996/-123.103	DEQ
27849-ORDEQ	Iron Mountain Creek	42.9082/-123.527	DEQ
27850-ORDEQ	Johnson Creek	43.0857/-123.023	DEQ
27851-ORDEQ	Kent Creek	43.0566/-123.469	DEQ
27852-ORDEQ	Lavadoure Creek	42.949/-123.106	DEQ
27853-ORDEQ	Upper Louis Creek	43.1063/-123.087	DEQ
27854-ORDEQ	Martin Creek	42.8369/-123.491	DEQ
27855-ORDEQ	Middle Fork Deadman Creek	43.0227/-122.927	DEQ
27856-ORDEQ	Middle Creek	42.8474/-123.433	DEQ
27857-ORDEQ	Mitchell Creek	42.9117/-123.34	DEQ
27858-ORDEQ	Poole Creek	42.9293/-123.109	DEQ
27859-ORDEQ	Rice Creek	43.0232/-123.469	DEQ
27860-ORDEQ	Riser Creek	43.1086/-123.129	DEQ
27861-ORDEQ	South Fork Middle Creek	42.8462/-123.435	DEQ

Station ID	Station	Latitude/Longitude	Organization
27862-ORDEQ	Shively Creek	42.9013/-123.153	DEQ
27863-ORDEQ	Slide Creek	43.1037/-123.127	DEQ
27864-ORDEQ	St. John Creek	42.9424/-123.049	DEQ
27865-ORDEQ	Stouts Creek	42.9145/-123.049	DEQ
27866-ORDEQ	Tributary to Tenmile Creek	43.1462/-123.652	DEQ
27867-ORDEQ	Thompson Creek	42.9888/-123.556	DEQ
27869-ORDEQ	Tributary to North Myrtle Creek	43.1389/-123.123	DEQ
27870-ORDEQ	Union Creek	42.8673/-123.577	DEQ
27872-ORDEQ	Upper Days Creek	43.0537/-123.002	DEQ
27873-ORDEQ	Upper South Myrtle Creek	43.0842/-123.021	DEQ
27874-ORDEQ	Weaver Creek	43.0846/-123.073	DEQ
27875-ORDEQ	West Fork Canyon Creek	42.8838/-123.267	DEQ
27877-ORDEQ	Gossett Creek	43.4796/-123.123	DEQ
27882-ORDEQ	Yellow Creek above Bear Creek	43.5133/-123.432	DEQ
27883-ORDEQ	Yellow Creek-Smith	43.8079/-123.551	DEQ
27887-ORDEQ	Upper Wolf Creek	43.4671/-123.611	DEQ
27888-ORDEQ	Shingle Creek	43.5337/-123.164	DEQ
27891-ORDEQ	Tributary to Little South Fork Smith River	43.77/-123.471	DEQ
27893-ORDEQ	Rader Creek	43.4687/-123.611	DEQ
27895-ORDEQ	Miner Creek	43.4452/-123.608	DEQ
27898-ORDEQ	Martin Creek	43.5526/-123.5	DEQ

Station ID	Station	Latitude/Longitude	Organization
27899-ORDEQ	Lower North Fork Tom Folley	43.7216/-123.492	DEQ
27900-ORDEQ	Lower Cleghorn Creek	43.7702/-123.537	DEQ
27901-ORDEQ	Lower Big Tom Folley	43.6854/-123.512	DEQ
27902-ORDEQ	Little Wolf Creek	43.4344/-123.586	DEQ
27905-ORDEQ	Halfway Creek	43.7576/-123.595	DEQ
27906-ORDEQ	Gassy Creek	43.3822/-123.107	DEQ
27907-ORDEQ	Foster Creek	43.3737/-123.191	DEQ
27910-ORDEQ	Elk Creek	43.5173/-123.162	DEQ
27914-ORDEQ	Coffee Creek (new)	42.956/-122.988	DEQ
27916-ORDEQ	Dompier Creek	42.9595/-122.919	DEQ
27917-ORDEQ	East Fork Poole Creek	42.9309/-123.108	DEQ
27918-ORDEQ	Olalla Creek	43.0031/-123.558	DEQ
27919-ORDEQ	Slide Creek (middle)	43.0974/-123.138	DEQ
27921-ORDEQ	Thompson Creek (middle)	42.9914/-123.523	DEQ
27922-ORDEQ	Thompson Creek (upper)	42.9853/-123.514	DEQ
27923-ORDEQ	Upper Days Creek at gage	43.0115/-123.068	DEQ
27924-ORDEQ	Upper Days Creek (sec 23)	43.0391/-123.021	DEQ
27925-ORDEQ	Upper Martin Creek	42.8121/-123.475	DEQ
27926-ORDEQ	Upper North Myrtle Creek (sec 13)	43.136/-123.124	DEQ
27927-ORDEQ	Upper North Myrtle Creek (sec 13)	43.1551/-123.125	DEQ
27928-ORDEQ	Upper South Myrtle Creek (below Johnson)	43.0847/-123.024	DEQ

Station ID	Station	Latitude/Longitude	Organization
27929-ORDEQ	Upper South Myrtle Creek (sec 11)	43.0703/-123.038	DEQ
27930-ORDEQ	Tributary to West Fork Canyon Creek	42.8831/-123.267	DEQ
27933-ORDEQ	Summit Creek mouth	43.7821/-123.39	DEQ
27935-ORDEQ	North Fork Tom Folley NWNE	43.7145/-123.492	DEQ
27938-ORDEQ	Berry Creek	43.0417/-123.623	DEQ
27939-ORDEQ	Buck Fork Creek	43.1323/-123.118	DEQ
27940-ORDEQ	Byron Creek	43.0275/-123.523	DEQ
27941-ORDEQ	Canyon Creek (lower)	42.9121/-123.265	DEQ
27942-ORDEQ	Cattle Creek near mouth	42.8818/-123.558	DEQ
27944-ORDEQ	Deadman Creek (below junction)	43.0198/-122.915	DEQ
27945-ORDEQ	Doe Creek near mouth	42.9243/-123.504	DEQ
27946-ORDEQ	Letitia Creek	43.0504/-123.09	DEQ
27947-ORDEQ	Louis Creek (lower)	43.0655/-123.145	DEQ
27949-ORDEQ	Middle Creek (lower)	42.819/-123.588	DEQ
27950-ORDEQ	Middle Creek below South Fork Middle	42.8466/-123.436	DEQ
27951-ORDEQ	North Myrtle Creek (lower)	43.0881/-123.167	DEQ
27952-ORDEQ	Olalla Creek above Thompson Creek	42.9884/-123.559	DEQ
27953-ORDEQ	Shively Creek (lower)	42.9028/-123.154	DEQ
27954-ORDEQ	Slide Creek near mouth	43.0846/-123.168	DEQ
27956-ORDEQ	South Umpqua River below Cow Creek	42.9557/-123.328	DEQ
27957-ORDEQ	South Umpqua River above Cow Creek	42.9519/-123.324	DEQ

Station ID	Station	Latitude/Longitude	Organization
27959-ORDEQ	Weaver Creek (lower)	43.0629/-123.07	DEQ
27961-ORDEQ	Willingham Creek	42.9577/-123.587	DEQ
27962-ORDEQ	South Fork Smith River at gage	43.7785/-123.466	DEQ
27965-ORDEQ	Upper South Fork Smith River	43.7418/-123.412	DEQ
27984-ORDEQ	Packard Creek at Ownership Body	43.6469/-123.508	DEQ
28019-ORDEQ	Upper North Fork Smith River	43.8876/-123.829	DEQ
28036-ORDEQ	North Branch of North Fork Smith River	43.8735/-123.803	DEQ
28038-ORDEQ	Franklin Creek	43.6674/-123.917	DEQ
28048-ORDEQ	unnamed	43.8741/-123.823	DEQ
28049-ORDEQ	Ceder Creek	43.8712/-123.864	DEQ
28055-ORDEQ	North Fork Smith River	43.8771/-123.828	DEQ
28056-ORDEQ	Middle Fork Smith River	43.8719/-123.803	DEQ
28126-ORDEQ	West Branch, North Fork Smith River	43.8811/-123.878	DEQ
28127-ORDEQ	West Branch, North Fork Smith River	43.894/-123.883	DEQ
28128-ORDEQ	West Branch, North Fork Smith River	43.8912/-123.88	DEQ
28133-ORDEQ	West Branch, North Fork Smith River	43.8907/-123.879	DEQ
28134-ORDEQ	West Branch, North Fork Smith River	43.8998/-123.888	DEQ
28135-ORDEQ	West Branch, North Fork Smith River	43.8909/-123.88	DEQ
28136-ORDEQ	West Branch, North Fork Smith River	43.8803/-123.877	DEQ
28430-ORDEQ	Scholfield Creek downstream of Miller Creek	43.648/-124.044	DEQ
28432-ORDEQ	Otter Creek at River Mile 3 (Smith, Umpqua)	43.7244/-123.987	DEQ

Station ID	Station	Latitude/Longitude	Organization
28435-ORDEQ	North Fork Smith River (mouth of Harlan Creek)	43.8537/-123.917	DEQ
28436-ORDEQ	North Fork Smith River below Paxton Creek	43.8791/-123.899	DEQ
28437-ORDEQ	Lake Creek downstream of Craig Creek	43.5414/-123.821	DEQ
28438-ORDEQ	North Fork Lake Creek at mouth, upstream of Loon Lake (Umpqua)	43.5422/-123.821	DEQ
28439-ORDEQ	Mehl Creek at River Mile 0.6 (Umpqua)	43.5796/-123.594	DEQ
28440-ORDEQ	Haines Creek between Hwy 138 and Azalea Drive (Umpqua)	43.6208/-123.564	DEQ
28441-ORDEQ	Haines Creek near Elkton	43.6263/-123.565	DEQ
28442-ORDEQ	Elk Creek (River Mile 11.9)	43.6582/-123.498	DEQ
28998-ORDEQ	Elk Creek above Pass Creek (drain)	43.6592/-123.316	DEQ
29000-ORDEQ	Calapooya Creek above White Creek	43.4796/-123.035	DEQ
29220-ORDEQ	Jackson Creek downstream of Beaver Creek	42.9513/-122.818	DEQ
29225-ORDEQ	Cow Creek downstream of Galesville Reservoir at Long Fiber Park near Whitehorse Creek	42.8178/-123.184	DEQ
29227-ORDEQ	Cow Creek at Brandt Bridge (below Dads Creek; near road RR crossing)	42.7715/-123.551	DEQ
29231-ORDEQ	Cow Creek below McCullough Creek	42.7459/-123.456	DEQ
29271-ORDEQ	Jackson Creek downstream off Black Canyon Creek	42.9634/-122.704	DEQ
29286-ORDEQ	Elk Creek 1.8 miles upstream of Elkton, OR	43.6562/-123.562	DEQ
29293-ORDEQ	Elk Creek		DEQ
29820-ORDEQ	Hinkle Creek at Mouth (RM 0.14)	43.4379/-123.093	DEQ
30143-ORDEQ	Windy Creek at Glendale	42.7468/-123.413	DEQ
30144-ORDEQ	South Umpqua above smolt trap	42.9849/-122.862	DEQ
30145-ORDEQ	South Umpqua above Lookingglass	43.1169/-123.429	DEQ

Station ID	Station	Latitude/Longitude	Organization
30146-ORDEQ	Jackson Creek above Falcon Creek	43.0014/-122.548	DEQ
30147-ORDEQ	Camp Creek at mouth	43.6096/-123.836	DEQ
30148-ORDEQ	Cow Creek below Galesville	42.8496/-123.18	DEQ
30149-ORDEQ	Pass Creek at Curtain Bridge	43.7317/-123.201	DEQ
30151-ORDEQ	Elk Creek near Lanie Creek	43.5473/-123.181	DEQ
30154-ORDEQ	Calapooya Creek above Cabin Creek	43.4315/-123.304	DEQ
30155-ORDEQ	North Myrtle Creek-air temperature	43.0232/-123.283	DEQ
30157-ORDEQ	Umpqua River above Calapooya Creek	43.3628/-123.466	DEQ
30159-ORDEQ	Main Stem Umpqua River abv Scottsburg	43.6624/-123.701	DEQ
30160-ORDEQ	Elk Creek near Drew, OR	42.8465/-122.854	DEQ
30161-ORDEQ	Pass Creek at mouth	43.661/-123.316	DEQ
30163-ORDEQ	South Umpqua River above mouth	43.2669/-123.448	DEQ
30696-ORDEQ	South Umpqua River at Old Hwy 99 Bridge Crossing, River Mile 24.6	43.1133/-123.417	DEQ
31694-ORDEQ	Newton Creek at mouth, NW Jefferson Street, Roseburg, OR	43.2255/-123.382	DEQ
33227-ORDEQ	Calapooya Creek at Hinkle Creek Road	43.4384/-123.093	DEQ
33247-ORDEQ	Myrtle Creek South Fork at Neal Lane Bridge below golf course (South Umpqua)	43.0169/-123.274	DEQ
33248-ORDEQ	Myrtle Creek South Fork at Days Creek Cutoff Road above golf course (South Umpqua)	43.0152/-123.261	DEQ
33249-ORDEQ	Myrtle Creek South Fork at River Mile 5.4 (South Umpqua)	43.0224/-123.21	DEQ
33251-ORDEQ	Myrtle Creek South Fork at BLM 23 1 Road at River Mile 14 (South Umpqua)	43.0398/-123.074	DEQ
33252-ORDEQ	Weaver Creek at Hidden Homestead Road near mouth (South Myrtle, South Umpqua)	43.0523/-123.067	DEQ

Station ID	Station	Latitude/Longitude	Organization
33431-ORDEQ	Lutsinger Creek (ODFW)	43.6332/-123.718	DEQ
33452-ORDEQ	Clear Creek (ODFW)	42.7955/-123.245	DEQ
33575-ORDEQ	Myrtle Creek at north end of North Myrtle Park (South Umpqua)	43.0782/-123.194	DEQ
34124-ORDEQ	Louis Creek at South Myrtle Creek Road (S. Myrtle, Umpqua)	43.0355/-123.148	DEQ
34127-ORDEQ	Days Creek above Woods Creek (South Umpqua)	42.9807/-123.15	DEQ
34129-ORDEQ	South Umpqua at Canyonville Park	42.9402/-123.265	DEQ
36302-ORDEQ	S Umpqua upstream of ODOT Lawson Bar	42.9473/-123.336	DEQ
36310-ORDEQ	South Umpqua River at Lawson Bar just u/s of Cow Creek	42.9478/-123.337	DEQ
37477-ORDEQ	North Myrtle Creek at Evergreen Park	43.0231/-123.283	DEQ
37488-ORDEQ	Days Cr above Fate Cr	42.9905/-123.099	DEQ
37490-ORDEQ	Days Cr above Perdue Cr	42.9851/-123.124	DEQ
37493-ORDEQ	Yellow Cr near Mouth	43.4912/-123.485	DEQ
37508-ORDEQ	Umpqua River at James Wood Boat Ramp	43.4055/-123.536	DEQ
38046-ORDEQ	Mehl Creek at Mehl Road	43.5795/-123.595	DEQ
38048-ORDEQ	Umpqua River Below Osprey Boat Ramp	43.4664/-123.545	DEQ
38319-ORDEQ	Wolf Cr above Little Wolf Cr near Umpqua OR	43.4344/-123.587	DEQ
40110-ORDEQ	Days CK at first bridge	42.9812/-123.145	DEQ
40111-ORDEQ	Woods CK at Mouth	42.981/-123.15	DEQ
40112-ORDEQ	Days CK 175 Meters DS Days Creek Road BR	43.0096/-123.068	DEQ
40113-ORDEQ	Days CK at RM 8.84	43.0273/-123.041	DEQ
40114-ORDEQ	Fate CK 205 Meters US of Days Creek RD	42.9897/-123.103	DEQ

Station ID	Station	Latitude/Longitude	Organization
40115-ORDEQ	Days CR Trib RM 7.94	43.0199/-123.055	DEQ
40116-ORDEQ	Days CR 95 Meters US of first May Creek Rd Bridge	43.0064/-123.07	DEQ
40117-ORDEQ	Days CR at RM 5.01	42.9921/-123.091	DEQ
40118-ORDEQ	Days CR at second bridge on Days Creek Rd	42.9828/-123.138	DEQ
40119-ORDEQ	South Umpqua River at RM 60	42.9492/-123.157	DEQ
40120-ORDEQ	South Umpqua 100 m US of Myrtle CR	43.0226/-123.297	DEQ
40121-ORDEQ	South Umpqua River 0 M DS I5	42.9931/-123.322	DEQ
40123-ORDEQ	South Umpqua River at RM 59	42.955/-123.176	DEQ
40124-ORDEQ	South Umpqua River 651 Meters US of Cor Cr	42.9457/-123.331	DEQ
40210-ORDEQ	Rice Cr 290m DS of Porter Cr	43.0604/-123.428	DEQ
40354-ORDEQ	South Umpqua at Oak Ave. Bridge	43.2116/-123.35	DEQ
40357-ORDEQ	Myrtle Creek Upstream of Railroad Trestle	43.0215/-123.295	DEQ
40507-ORDEQ	Yellow Creek 790 m above Umpqua River	43.4931/-123.478	DEQ
40518-ORDEQ	Calapooya Creek at Driver Valley Rd bridge	43.4003/-123.374	DEQ
40519-ORDEQ	Hubbard Creek at Hubbard Creek Rd. Bridge	43.3854/-123.54	DEQ
40520-ORDEQ	Umpqua River at RM 49.58	43.6143/-123.604	DEQ
407026	North Fork Smith River downstream of the West Branch	43.8804/-123.876	DEQ
407029	North Fork Smith River downstream of Paxton Creek	43.8731/-123.91	DEQ
407030	North Fork Smith River at approximately RM 5.2	43.8083/-123.761	DEQ
41074-ORDEQ	Rice Cr 410m US from mouth	43.0814/-123.416	DEQ
41075-ORDEQ	Rice Cr at Rice Cr Rd	43.0676/-123.421	DEQ

Station ID	Station	Latitude/Longitude	Organization
41076-ORDEQ	Rice Cr 55m US of lowest Rice Cr Rd crossing	43.0672/-123.421	DEQ
41077-ORDEQ	Rice Cr 100m US of lowest Rice Cr Rd crossing	43.0671/-123.421	DEQ
41078-ORDEQ	Rice Cr 250m US of lowest Rice Cr Rd Crossing	43.066/-123.422	DEQ
41079-ORDEQ	Rice Cr 275m US of lowest Rice Cr Rd Crossing	43.066/-123.422	DEQ
41080-ORDEQ	Rice Cr 400m US of lowest Rice Cr Rd Crossing	43.0651/-123.423	DEQ
41081-ORDEQ	Rice Cr 575m US of lowest Rice Cr Rd Crossing	43.0638/-123.424	DEQ
41082-ORDEQ	Rice Cr 610m US of lowest Rice Cr Rd Crossing	43.0637/-123.424	DEQ
41083-ORDEQ	Rice Cr 615m US of lowest Rice Cr Rd Crossing	43.0637/-123.425	DEQ
41084-ORDEQ	Rice Cr 540m DS of Porter Cr	43.062/-123.427	DEQ
41085-ORDEQ	Rice Cr 490m DS of Porter Cr	43.0616/-123.427	DEQ
41086-ORDEQ	Rice Cr 435m DS of Porter Cr	43.0613/-123.427	DEQ
41087-ORDEQ	Rice Cr 430m DS of Porter Cr	43.0612/-123.427	DEQ
No Station ID	Calapooya Creek downstream of the North Fork		DEQ
No Station ID	Calapooya Creek Upper		DEQ
No Station ID	White Creek		DEQ
No Station ID	Gassy Creek		DEQ
No Station ID	Pollock Creek		DEQ
No Station ID	Spring at model kilometer 63.75		DEQ
No Station ID	Unknown creek at model kilometer 38.6		DEQ
No Station ID	Elk Creek at Umpqua River near Elkton		DEQ
No Station ID	Middle Fork of the North Fork Smith River		DEQ

Station ID	Station	Latitude/Longitude	Organization
No Station ID	North Fork Smith River upstream of Kentucky Creek		DEQ
No Station ID	Unknown creek at model kilometer 34.6		DEQ
No Station ID	Bushnell Creek		DEQ
No Station ID	Byron Creek		DEQ
No Station ID	Berry Creek		DEQ
No Station ID	Unknown creek at model kilometer 29.1		DEQ
No Station ID	Unknown creek at model kilometer 26.8		DEQ
No Station ID	Unknown creek at model kilometer 24.9		DEQ
No Station ID	Unknown creek at model kilometer 23.75		DEQ
No Station ID	Unknown creek at model kilometer 23		DEQ
No Station ID	McNabb Creek		DEQ
No Station ID	Perron Creek		DEQ
No Station ID	Tenmile Creek		DEQ
No Station ID	Unknown creek at model kilometer 14.3		DEQ
No Station ID	Lookingglass Creek		DEQ
No Station ID	Morgan Creek		DEQ
No Station ID	Unknown creek at model kilometer 9.85		DEQ
No Station ID	Applegate Creek		DEQ
No Station ID	Tiller Ranger Station		DEQ
No Station ID	Elk Creek		DEQ
No Station ID	Poole Creek		DEQ

Station ID	Station	Latitude/Longitude	Organization
No Station ID	Canyon Creek (WRD 7/30/02)		DEQ
No Station ID	Cow Creek (WRD 8/05/02)		DEQ
No Station ID	Myrtle Creek		DEQ
No Station ID	tributary at model kilometer 48.75		DEQ
No Station ID	Lookingglass Creek (WRD 7/31/02)		DEQ
No Station ID	Marsters Creek		DEQ
No Station ID	Roberts Creek		DEQ
No Station ID	Deer Creek		DEQ
No Station ID	Umpqua River at the confluence of the North and South Forks		DEQ
No Station ID	Cougar Creek		DEQ
No Station ID	Yellow Creek		DEQ
29000	Calapooya Creek downstream of Forks	43.4777/-123.037	BLM
BLM13	Union Creek	42.8667/-123.575	BLM
14320700	Calapooya Creek near Oakland		Douglas County
No Station ID	Olalla Creek near Tenmile, Oregon		Douglas County
No Station ID	Glendale STP		July 2001 NPDES DMRs
C02-UBWC	Cow Creek above Canyonville Bridge	42.9461/-123.363	Umpqua Basin Watershed Council
C03-UBWC	Cow Creek Below Jerry	42.9344/-123.389	Umpqua Basin Watershed Council
C04-UBWC	Jerry Creek	42.9381/-123.392	Umpqua Basin Watershed Council
C05-UBWC	Russell Creek	42.927/-123.395	Umpqua Basin Watershed Council
C06-UBWC	Catching Creek	42.92/-123.406	Umpqua Basin Watershed Council
C07-UBWC	Cow Creek above Doe	42.9239/-123.503	Umpqua Basin Watershed Council

Station ID	Station	Latitude/Longitude	Organization
C08-UBWC	Doe Creek	42.9243/-123.503	Umpqua Basin Watershed Council
C09-UBWC	Buck Creek	42.9247/-123.508	Umpqua Basin Watershed Council
C10-UBWC	Iron Mountain Creek	42.9083/-123.527	Umpqua Basin Watershed Council
C11-UBWC	Table Creek	42.8931/-123.559	Umpqua Basin Watershed Council
C12-UBWC	Cattle Creek	42.8819/-123.557	Umpqua Basin Watershed Council
C14-UBWC	West Fork Cow	42.8119/-123.6	Umpqua Basin Watershed Council
C15-UBWC	Cow Creek above Middle	42.8121/-123.594	Umpqua Basin Watershed Council
C16-UBWC	Middle Creek	42.8122/-123.594	Umpqua Basin Watershed Council
C20-UBWC	Riffle Creek	42.783/-123.58	Umpqua Basin Watershed Council
C21-UBWC	Skull Creek	42.7731/-123.572	Umpqua Basin Watershed Council
C22-UBWC	McCullough Creek	42.8122/-123.594	Umpqua Basin Watershed Council
C24-UBWC	Windy Creek	42.7404/-123.418	Umpqua Basin Watershed Council
C25-UBWC	Cow Creek above Windy	42.7402/-123.418	Umpqua Basin Watershed Council
C33-UBWC	Cow Creek above Quines (only 7/31)	42.781/-123.271	Umpqua Basin Watershed Council
C34-UBWC	Quines Creek	42.779/-123.274	Umpqua Basin Watershed Council
C35-UBWC	Cow Creek above Whitehorse	42.8177/-123.184	Umpqua Basin Watershed Council
C36-UBWC	Whitehorse Creek	42.8173/-123.184	Umpqua Basin Watershed Council
17164	Jackson Creek abv Mouth (Telequa Store)	42.9629/-122.859	USFS
29809	South Umpqua River at Tiller Reservoir	42.9279/-122.949	USFS
No Station ID	Hinkle Creek		USFS
No Station ID	Squaw Creek		USFS

Station ID	Station	Latitude/Longitude	Organization
No Station ID	Beaver Creek		USFS
SNF-107	4078	43.8744/-123.858	USFS
SNF-108	0257-Unamed Ck_LTWT	43.874/-123.824	USFS
SU88	South Umpqua River above South Umpqua Falls	43.0556/-122.68	USFS
UmpNF-001	Anderson Creek at the mouth WT	42.8639/-122.881	USFS
UmpNF-003	Beaver Creek on 3114_LTWT	42.9427/-122.819	USFS
UmpNF-005	Black Canyon Creek at the mouth WT	42.9628/-122.703	USFS
UmpNF-006	Black Rock Fork at the Mouth_LTWT	43.1077/-122.59	USFS
UmpNF-007	Boulder Creek at the Mouth_LTWT	43.0534/-122.777	USFS
UmpNF-012	Brownie Creek at the mouth LTWT	42.8617/-122.876	USFS
UmpNF-013	Buckeye Creek at the Mouth_LTWT	43.0479/-122.701	USFS
UmpNF-015	Callahan Creek at the mouth WT	42.8978/-122.933	USFS
UmpNF-017	Castle Rock Fork at the Mouth_LTWT	43.1071/-122.588	USFS
UmpNF-025	Cow Creek above dismal Creek_LTWT	42.8133/-123.051	USFS
UmpNF-026	Coyote Creek Watershed #1_LTWT	43.0173/-122.716	USFS
UmpNF-027	Coyote Creek Watershed #2 LTWT	43.0143/-122.716	USFS
UmpNF-028	Coyote Creek Watershed #3 LTWT	43.0138/-122.712	USFS
UmpNF-029	Coyote Creek Watershed #4 LTWT	43.0136/-122.711	USFS
UmpNF-031	Deadman Creek at the mouth LTWT	42.9723/-122.878	USFS
UmpNF-032	Deep Cut Creek at the mouth WT	42.964/-122.723	USFS
UmpNF-034	Diamond Creek at the mouth WT	42.8198/-122.853	USFS
UmpNF-035	Drew Creek at the mouth WT	42.8903/-122.922	USFS

Station ID	Station	Latitude/Longitude	Organization
UmpNF-036	Dumont Creek at the Mouth_LTWT	43.036/-122.811	USFS
UmpNF-037	Elk Creek at Tiller_LTWT	42.9244/-122.948	USFS
UmpNF-038	Falcon Creek at the mouth WT	42.9985/-122.554	USFS
UmpNF-040	Flat Creek Near Mouth WT	42.834/-122.849	USFS
UmpNF-042	French Creek at the mouth WT	43.1465/-122.536	USFS
UmpNF-045	Jackson Creek above Faclon above Structure WT	43.002/-122.547	USFS
UmpNF-046	Jackson Creek above Falcon below Structure WT	43.0009/-122.55	USFS
UmpNF-047	Jackson Creek above Falcon Creek WT	42.9989/-122.553	USFS
UmpNF-048	Jackson Creek above Luck Creek Fish Structure WT	42.9887/-122.665	USFS
UmpNF-049	Jackson Creek below Luck Creek Fish Structure WT	42.9884/-122.665	USFS
UmpNF-050	Jackson Creek near the Mouth_LTWT	42.9636/-122.86	USFS
UmpNF-051	Joe Hall Creek at the mouth WT	42.8677/-122.882	USFS
UmpNF-068	Quartz Creek at the Mouth_LTWT	43.0804/-122.65	USFS
UmpNF-074	South Umpqua at Three C Rock SIde Channel WT	42.9659/-122.887	USFS
UmpNF-075	South Umpqua at Three C Rock WT	42.9656/-122.886	USFS
UmpNF-076	South Umpqua at Tiller Ranger Station_LTWT	42.9277/-122.95	USFS
UmpNF-077	South Umpqua River above South Umpqua Falls_LTWT	43.0555/-122.682	USFS
UmpNF-078	Squaw Creek at the Mouth_LTWT	42.9685/-122.701	USFS
UmpNF-081	Trib to Joe Hall at Singing Falls WT	42.8705/-122.877	USFS
UmpNF-085	Zinc Creek at the mouth WT	43.0446/-122.785	USFS
1358	North Fork Smith River 1.5 Miles up NF Trail (USFS Site)	43.8902/-123.828	USFS -Siuslaw National Forest

Station ID	Station	Latitude/Longitude	Organization
407025	Kentucky Creek at Falls Trailhead	43.9287/-123.792	USFS -Siuslaw National Forest
407027	North Fork Smith River upstream of the Middle Fork of the North Fork Smith	43.876/-123.828	USFS -Siuslaw National Forest
14308600	S. Umpqua River at Days Creek, OR	42.9673/-123.168	USGS
14312260	S. Umpqua River Nr Roseburg OR, OR	43.2229/-123.415	USGS
14320934	Little Wolf Creek Near Tyee, OR	43.4312/-123.587	USGS
14321000	Umpqua River Near Elkton, OR	43.586/-123.555	USGS
No Station ID	Umpqua River at Bottle Creek boat launch		Watershed Sciences (2003)
No Station ID	Umpqua River at Camp		Watershed Sciences (2003)
No Station ID	Umpqua River at Elkton		Watershed Sciences (2003)

Table 64: Summary of existing temperature data in the South Umpqua and Umpqua Subbasins. Columns Jan – Dec indicate the number of daily maximum temperature results in each month. Data from the DEQ file that are not in the databases were not summarized in the table.

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	14312260	S. Umpqua River Nr Roseburg OR, OR	26	28	31	30	31	25	28	23	28	29	30	27
1990	14321000	Umpqua River Near Elkton, OR	31	28	31	30	31	30	31	31	30	31	30	31
1991	14308600	S. Umpqua River at Days Creek, OR								16	16	21		
1991	14312260	S. Umpqua River Nr Roseburg OR, OR	28	27	30	30	31	28	31	31	22	23	29	31
1991	14321000	Umpqua River Near Elkton, OR	31	28	31	30	31	30	29	17	30	31	30	31
1992	14308600	S. Umpqua River at Days Creek, OR					2	30	11	31	30	25		
1992	14312260	S. Umpqua River Nr Roseburg OR, OR	31	29	31	30	31	30	16	30	29	31	26	31
1992	14321000	Umpqua River Near Elkton, OR	31	29	31	30	31	30	31	31	29			
1993	14312260	S. Umpqua River Nr Roseburg OR, OR	28	28	31	28	31	28	31	24	30	24	30	27
1994	14312260	S. Umpqua River Nr Roseburg OR, OR	28	20	23	30	31	30	28	22	29	31	21	31
1995	14312260	S. Umpqua River Nr Roseburg OR, OR	16	3	31	30	31	30	31	31	30			
1998	30161-ORDEQ	Pass Creek at mouth							22	31	23			
1999	21824-ORDEQ	School Hollow Creek at River Mile 1.64						15	31	31	29			
1999	21825-ORDEQ	South Fork Smith River at River Mile 0.83						16	31	31	7			
1999	21831-ORDEQ	Halfway Creek tributary at River Mile 0.29						16	31	31	30	5		
1999	27838-ORDEQ	Cattle Creek						12	31	31	30	6		
1999	27839-ORDEQ	Coffee Creek						6	31	31	30	26		
1999	27840-ORDEQ	Curtain Creek						27	31	31	30	4		
1999	27841-ORDEQ	West Fork Deadman Creek						8	31	31	30	5		
1999	27843-ORDEQ	Dutchman Creek						5	31	31	30	6		

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1999	27844-ORDEQ	East Fork Shively Creek				8	31	30	31	31	30	5		
1999	27845-ORDEQ	East Fork Stouts Creek						7	31	31	30	5		
1999	27847-ORDEQ	Fate Creek				7	31	30	31	31	30	4		
1999	27849-ORDEQ	Iron Mountain Creek						15	31	31	30	6		
1999	27850-ORDEQ	Johnson Creek						27	31	31	30	4		
1999	27851-ORDEQ	Kent Creek						22	31	31	30	6		
1999	27852-ORDEQ	Lavadoure Creek				8	31	30	19					
1999	27853-ORDEQ	Upper Louis Creek						23	31	31	30	17		
1999	27854-ORDEQ	Martin Creek						9	31	31	30	6		
1999	27855-ORDEQ	Middle Fork Deadman Creek						8	31	31	30	5		
1999	27856-ORDEQ	Middle Creek						9	31	31	30	6		
1999	27857-ORDEQ	Mitchell Creek						5	31	31	30	5		
1999	27858-ORDEQ	Poole Creek						1	31	31	30	5		
1999	27859-ORDEQ	Rice Creek						22	31	31	30	6		
1999	27860-ORDEQ	Riser Creek						23	31	31	30	17		
1999	27861-ORDEQ	South Fork Middle Creek						9	31	31	30	6		

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1999	27862-ORDEQ	Shively Creek				8	31	30	31	31	30	5		
1999	27863-ORDEQ	Slide Creek						23	31	31	30	17		
1999	27864-ORDEQ	St. John Creek						7	31	31	30	5		
1999	27865-ORDEQ	Stouts Creek						7	31	31	30	5		
1999	27866-ORDEQ	Tributary to Tenmile Creek						12	31	31	30	13		
1999	27867-ORDEQ	Thompson Creek						16	31	31	30	13		
1999	27869-ORDEQ	Tributary to North Myrtle Creek						21	31	31	30	17		
1999	27870-ORDEQ	Union Creek						15	31	31	30	6		
1999	27872-ORDEQ	Upper Days Creek				7	31	30	31	31	30	4		
1999	27873-ORDEQ	Upper South Myrtle Creek						27	31	31	30	4		
1999	27874-ORDEQ	Weaver Creek						27	31	31	30	4		
1999	27875-ORDEQ	West Fork Canyon Creek						21	31	31	30	4		
1999	27877-ORDEQ	Gossett Creek									30	7		
1999	27882-ORDEQ	Yellow Creek above Bear Creek							31	31	30	5		
1999	27883-ORDEQ	Yellow Creek-Smith							19	31	30	19		
1999	27887-ORDEQ	Upper Wolf Creek							30	31	30	4		

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1999	27888-ORDEQ	Shingle Creek							24	31	30	19		
1999	27891-ORDEQ	Tributary to Little South Fork Smith River							19	31	30	19		
1999	27893-ORDEQ	Rader Creek							30	31	30	4		
1999	27895-ORDEQ	Miner Creek							31	31	30	4		
1999	27898-ORDEQ	Martin Creek							30	31	1			
1999	27899-ORDEQ	Lower North Fork Tom Folley							23	31	30	19		
1999	27900-ORDEQ	Lower Cleghorn Creek							23	31	26			
1999	27901-ORDEQ	Lower Big Tom Folley							23	31	30	19		
1999	27902-ORDEQ	Little Wolf Creek							31	31	30	4		
1999	27905-ORDEQ	Halfway Creek							23	31	30	19		
1999	27906-ORDEQ	Gassy Creek							25	31	30	7		
1999	27907-ORDEQ	Foster Creek									30	7		
1999	27910-ORDEQ	Elk Creek							24	31	30	19		
1999	28019-ORDEQ	Upper North Fork Smith River							24	31	30	19		
1999	28036-ORDEQ	North Branch of North Fork Smith River							30	31	30	19		
1999	28048-ORDEQ	unnamed						1	31	31	30	19		

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1999	28049-ORDEQ	Ceder Creek						1	31	31	30	19		
1999	28055-ORDEQ	North Fork Smith River							30	31	30	19		
1999	28056-ORDEQ	Middle Fork Smith River							30	31	30	19		
1999	30154-ORDEQ	Calapooya Creek above Cabin Creek						13	31	31	7			
1999	30161-ORDEQ	Pass Creek at mouth						13	31	31	14			
1999	37477-ORDEQ	North Myrtle Creek at Evergreen Park							31	31	13			
2000	23836-ORDEQ	Wood Creek at River Mile 1.18 (Windy, Cow, South Umpqua, Umpqua)						17	31	31	20			
2000	27838-ORDEQ	Cattle Creek				4	31	30	31	31	30	29		
2000	27841-ORDEQ	West Fork Deadman Creek						18	31	31	11			
2000	27844-ORDEQ	East Fork Shively Creek						23	31	31	26			
2000	27845-ORDEQ	East Fork Stouts Creek				10	31	30	31	31	30	29		
2000	27847-ORDEQ	Fate Creek				10	31	30	31	31	30	3		
2000	27858-ORDEQ	Poole Creek						22	31	31	26			
2000	27859-ORDEQ	Rice Creek						24	31	31	20			
2000	27861-ORDEQ	South Fork Middle Creek				6	31	30	31	31	30	7		
2000	27862-ORDEQ	Shively Creek						23	31	31	26			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	27863-ORDEQ	Slide Creek						23	31	31	18			
2000	27864-ORDEQ	St. John Creek						22	31	31	11			
2000	27866-ORDEQ	Tributary to Tenmile Creek						24	31	31	20			
2000	27867-ORDEQ	Thompson Creek				4	31	30	31	31	30	8		
2000	27870-ORDEQ	Union Creek				4	31	30	31	31	30	8		
2000	27872-ORDEQ	Upper Days Creek						18	31	31	11			
2000	27873-ORDEQ	Upper South Myrtle Creek						29	31	31	18			
2000	27874-ORDEQ	Weaver Creek						29	31	31	18			
2000	27875-ORDEQ	West Fork Canyon Creek				4	31	30	31	31	30	8		
2000	27877-ORDEQ	Gossett Creek						2	19					
2000	27882-ORDEQ	Yellow Creek above Bear Creek						8	25					
2000	27883-ORDEQ	Yellow Creek-Smith						7	31	31	20			
2000	27898-ORDEQ	Martin Creek						8	25					
2000	27899-ORDEQ	Lower North Fork Tom Folley						8	31	31	30	12		
2000	27901-ORDEQ	Lower Big Tom Folley						8	31	31	30	12		
2000	27905-ORDEQ	Halfway Creek						4	31	31	18			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	27914-ORDEQ	Coffee Creek (new)						22	31	31	11			
2000	27916-ORDEQ	Dompier Creek						18	31	31	11			
2000	27917-ORDEQ	East Fork Poole Creek						22	31	31	26			
2000	27919-ORDEQ	Slide Creek (middle)						23	31	31	18			
2000	27921-ORDEQ	Thompson Creek (middle)				3	31	30	31	31	30	10		
2000	27922-ORDEQ	Thompson Creek (upper)				3	31	30	31	31	30	10		
2000	27923-ORDEQ	Upper Days Creek at gage					21	30	31	31	11			
2000	27924-ORDEQ	Upper Days Creek (sec 23)						18	31	31	11			
2000	27925-ORDEQ	Upper Martin Creek				6	31	30	31	31	30	7		
2000	27926-ORDEQ	Upper North Myrtle Creek (sec 13)						29	31	31	18			
2000	27927-ORDEQ	Upper North Myrtle Creek (sec 13)								30	18			
2000	27928-ORDEQ	Upper South Myrtle Creek (below Johnson)						29	31	31	18			
2000	27929-ORDEQ	Upper South Myrtle Creek (sec 11)						29	31	31	18			
2000	27930-ORDEQ	Tributary to West Fork Canyon Creek				4	31	30	31	31	30	8		
2000	27933-ORDEQ	Summit Creek mouth						7	31	31	27			
2000	27935-ORDEQ	North Fork Tom Folley NWNE						7	31					

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	28038-ORDEQ	Franklin Creek							26	31	30	10		
2000	28049-ORDEQ	Ceder Creek							21	31	30	4		
2000	28126-ORDEQ	West Branch, North Fork Smith River						1	31	31	30	4		
2000	28127-ORDEQ	West Branch, North Fork Smith River						1	31	31	30	4		
2000	28128-ORDEQ	West Branch, North Fork Smith River						1	31	31	30	4		
2000	28133-ORDEQ	West Branch, North Fork Smith River						1	31	31	30	4		
2000	28134-ORDEQ	West Branch, North Fork Smith River						1	31	31	30	4		
2000	28135-ORDEQ	West Branch, North Fork Smith River						1	31	31	30	4		
2000	28136-ORDEQ	West Branch, North Fork Smith River						1	31	31	30	4		
2000	30143-ORDEQ	Windy Creek at Glendale						11	31	31	15			
2000	30147-ORDEQ	Camp Creek at mouth						7	31	31	21			
2000	30154-ORDEQ	Calapooya Creek above Cabin Creek						1	31	31	14			
2000	30161-ORDEQ	Pass Creek at mouth						1	31	31	21			
2000	37477-ORDEQ	North Myrtle Creek at Evergreen Park						1	31	31	15			
2001	12134-ORDEQ	Harvey Creek at River Mile 0.5								29	4			
2001	25390-ORDEQ	Wind Creek						4	31	11	24			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2001	27831-ORDEQ	Wells Creek nr Mouth							7	31	1			
2001	27841-ORDEQ	West Fork Deadman Creek					2	30	31	31	13			
2001	27845-ORDEQ	East Fork Stouts Creek					21	30	31	31	13			
2001	27847-ORDEQ	Fate Creek					1	30	31	31	16			
2001	27849-ORDEQ	Iron Mountain Creek					20	30	31	31	12			
2001	27854-ORDEQ	Martin Creek					22	30	31	31	30	11		
2001	27855-ORDEQ	Middle Fork Deadman Creek					2	30	31	31	13			
2001	27866-ORDEQ	Tributary to Tenmile Creek						9	31	31	10			
2001	27867-ORDEQ	Thompson Creek							5	31	25			
2001	27870-ORDEQ	Union Creek					22	30	31	31	12			
2001	27874-ORDEQ	Weaver Creek					17	30	31	31	25			
2001	27875-ORDEQ	West Fork Canyon Creek					21	30	31	31	13			
2001	27887-ORDEQ	Upper Wolf Creek								21	17			
2001	27893-ORDEQ	Rader Creek								21	17			
2001	27895-ORDEQ	Miner Creek						22	31	31	17			
2001	27902-ORDEQ	Little Wolf Creek								21	17			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2001	27914-ORDEQ	Coffee Creek (new)					1	30	31	31	13			
2001	27918-ORDEQ	Olalla Creek									7			
2001	27922-ORDEQ	Thompson Creek (upper)						26	31	31	12			
2001	27923-ORDEQ	Upper Days Creek at gage					1	30	31	22				
2001	27927-ORDEQ	Upper North Myrtle Creek (sec 13)						30	31	31	11			
2001	27928-ORDEQ	Upper South Myrtle Creek (below Johnson)					17	30	31	31	25			
2001	27929-ORDEQ	Upper South Myrtle Creek (sec 11)					17	30	31	31	25			
2001	27933-ORDEQ	Summit Creek mouth							14	31	17			
2001	27938-ORDEQ	Berry Creek						26	31	31	10			
2001	27939-ORDEQ	Buck Fork Creek						30	31	31	11			
2001	27940-ORDEQ	Byron Creek						26	31	31	12			
2001	27941-ORDEQ	Canyon Creek (lower)					21	30	31	31	13			
2001	27942-ORDEQ	Cattle Creek near mouth					20	30	31	31	12			
2001	27944-ORDEQ	Deadman Creek (below junction)					2	30	31	31	13			
2001	27945-ORDEQ	Doe Creek near mouth					20	30	31	31	12			
2001	27946-ORDEQ	Letitia Creek					17	30	31	31	12			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2001	27947-ORDEQ	Louis Creek (lower)					17	30	31	31	12			
2001	27949-ORDEQ	Middle Creek (lower)					22	30	31	31	30	11		
2001	27950-ORDEQ	Middle Creek below South Fork Middle					22	30	31	31	30	11		
2001	27951-ORDEQ	North Myrtle Creek (lower)						30	31	31	11			
2001	27952-ORDEQ	Olalla Creek above Thompson Creek									12			
2001	27953-ORDEQ	Shively Creek (lower)					1	30	31	31	16			
2001	27954-ORDEQ	Slide Creek near mouth					14	30	31	31	16			
2001	27956-ORDEQ	South Umpqua River below Cow Creek							28	31	13			
2001	27957-ORDEQ	South Umpqua River above Cow Creek					16	30	31	31	13			
2001	27959-ORDEQ	Weaver Creek (lower)					17	30	31	31	25			
2001	27961-ORDEQ	Willingham Creek						30	31	31	12			
2001	27962-ORDEQ	South Fork Smith River at gage								10	17			
2001	27965-ORDEQ	Upper South Fork Smith River						29	31	31	17			
2001	27984-ORDEQ	Packard Creek at Ownership Body						21	31	31	30	22		
2001	28430-ORDEQ	Scholfield Creek downstream of Miller Creek							1	31	2			
2001	28432-ORDEQ	Otter Creek at River Mile 3 (Smith, Umpqua)								31	1			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2001	28435-ORDEQ	North Fork Smith River (mouth of Harlan Creek)							6	31	1			
2001	28436-ORDEQ	North Fork Smith River below Paxton Creek							6	31	1			
2001	28437-ORDEQ	Lake Creek downstream of Craig Creek								31	2			
2001	28438-ORDEQ	North Fork Lake Creek at mouth, upstream of Loon Lake (Umpqua)								31	3			
2001	28439-ORDEQ	Mehl Creek at River Mile 0.6 (Umpqua)							7	31	2			
2001	28440-ORDEQ	Haines Creek between Hwy 138 and Azalea Drive (Umpqua)							8	31				
2001	28441-ORDEQ	Haines Creek near Elkton							8	31	2			
2001	28442-ORDEQ	Elk Creek (River Mile 11.9)							7	31	3			
2001	30143-ORDEQ	Windy Creek at Glendale						7	11	12	11			
2001	30147-ORDEQ	Camp Creek at mouth						15	31	31	12			
2001	30154-ORDEQ	Calapooya Creek above Cabin Creek						12	31	31	9			
2001	30161-ORDEQ	Pass Creek at mouth						14	31	31	12			
2001	37477-ORDEQ	North Myrtle Creek at Evergreen Park						12	31	31	11			
2002	10442-ORDEQ	South Umpqua at Melrose Road								1				
2002	10444-ORDEQ	South Umpqua at Myrtle Creek							30	31	15			
2002	10996-ORDEQ	Calapooya Creek at Umpqua							60*	62*	30			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2002	10997-ORDEQ	Cow Creek at mouth							60*	63*	30			
2002	11304-ORDEQ	Elk Creek at Hayhurst Road (Drain)									2			
2002	11522-ORDEQ	South Umpqua at Stewart Park Road (Roseburg)								1				
2002	12248-ORDEQ	Lookingglass Creek at Hwy 42 at Winston OR							30	31	16			
2002	12574-ORDEQ	South Umpqua River at Stanton Park (upstream end)							30	31	15			
2002	12800-ORDEQ	Calapooya Creek at Oakland drinking water intake							2					
2002	12803-ORDEQ	Calapooya Creek at Sutherlin drinking water intake							2					
2002	12913-ORDEQ	Cow Creek 150 yards upstream of Riddle outfall								2				
2002	13050-ORDEQ	Cow Creek 100 feet upstream of Glendale STP outfall								2				
2002	13245-ORDEQ	Calapooya Creek at I-5 Bridge							2					
2002	17164-ORDEQ	Jackson Creek at Road Mile 1.3							30	31	15			
2002	17166-ORDEQ	Boulder Creek at mouth					3	30	31	31	25			
2002	21506-ORDEQ	Jackson Creek above Falcon Creek (tributary of South Umpqua)								2				
2002	21828-ORDEQ	Dumont Creek at River Mile 4.95						20	31	31	30	13		
2002	23837-ORDEQ	Wolf Creek at River Mile 3.5 (Umpqua)						17	31	31	30			
2002	25172-ORDEQ	Elk Creek at Harold Wooley Bridge									2			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2002	25173-ORDEQ	Elk Creek below Yoncalla Creek									2			
2002	26853-ORDEQ	Ash Creek						20	31	31	30	13		
2002	26973-ORDEQ	Jackson Creek above Twomile Creek								2				
2002	27839-ORDEQ	Coffee Creek					10	30	31	31	17			
2002	27841-ORDEQ	West Fork Deadman Creek					1	30	31	31	17			
2002	27845-ORDEQ	East Fork Stouts Creek					1	30	31	31	17			
2002	27847-ORDEQ	Fate Creek					1	30	31	31	17			
2002	27855-ORDEQ	Middle Fork Deadman Creek					1	30	31	31	17			
2002	27856-ORDEQ	Middle Creek					8	30	31	31	30	28		
2002	27857-ORDEQ	Mitchell Creek					8	30	31	31	24			
2002	27859-ORDEQ	Rice Creek						30	31	31	23			
2002	27861-ORDEQ	South Fork Middle Creek					8	30	31	31	30	28		
2002	27870-ORDEQ	Union Creek					8	30	31	31	19			
2002	27872-ORDEQ	Upper Days Creek					10	30	31	31	17			
2002	27873-ORDEQ	Upper South Myrtle Creek					3	30	31	31	22			
2002	27874-ORDEQ	Weaver Creek					3	30	31	31	22			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2002	27893-ORDEQ	Rader Creek						2	31	31	19			
2002	27900-ORDEQ	Lower Cleghorn Creek							28	31	19			
2002	27901-ORDEQ	Lower Big Tom Folley							28	31	19			
2002	27902-ORDEQ	Little Wolf Creek						2	31	31	19			
2002	27905-ORDEQ	Halfway Creek						3	31	31	19			
2002	27910-ORDEQ	Elk Creek						3	31	31	19			
2002	27914-ORDEQ	Coffee Creek (new)					1	30	31	31	17			
2002	27918-ORDEQ	Olalla Creek					9	30	31	31	19			
2002	27919-ORDEQ	Slide Creek (middle)					15	30	31	31	22			
2002	27921-ORDEQ	Thompson Creek (middle)						30	31	31	23			
2002	27922-ORDEQ	Thompson Creek (upper)						30	31	31	23			
2002	27924-ORDEQ	Upper Days Creek (sec 23)					10	30	31	31	17			
2002	27926-ORDEQ	Upper North Myrtle Creek (sec 13)					15	30	31	31	22			
2002	27928-ORDEQ	Upper South Myrtle Creek (below Johnson)					3	30	31	31	22			
2002	27942-ORDEQ	Cattle Creek near mouth					8	30	31	31	19			
2002	27949-ORDEQ	Middle Creek (lower)						4	31	31	19			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2002	27953-ORDEQ	Shively Creek (lower)					3	30	31	31	24			
2002	28998-ORDEQ	Elk Creek above Pass Creek (drain)									2			
2002	29000-ORDEQ	Calapooya Creek above White Creek						3						
2002	29220-ORDEQ	Jackson Creek downstream of Beaver Creek								2				
2002	29225-ORDEQ	Cow Creek downstream of Galesville Reservoir at Long Fiber Park near Whitehorse Creek								2				
2002	29227-ORDEQ	Cow Creek at Brandt Bridge (below Dads Creek; near road RR crossing)								2				
2002	29231-ORDEQ	Cow Creek below McCullough Creek								2				
2002	29271-ORDEQ	Jackson Creek downstream off Black Canyon Creek								2				
2002	29286-ORDEQ	Elk Creek 1.8 miles upstream of Elkton, OR									2			
2002	30143-ORDEQ	Windy Creek at Glendale						16	29		24	24		
2002	30144-ORDEQ	South Umpqua above smolt trap							30	31	15			
2002	30145-ORDEQ	South Umpqua above Lookingglass							30	31	15			
2002	30146-ORDEQ	Jackson Creek above Falcon Creek							30	31	15			
2002	30147-ORDEQ	Camp Creek at mouth						10						
2002	30148-ORDEQ	Cow Creek below Galesville							8	31	15			
2002	30149-ORDEQ	Pass Creek at Curtain Bridge							29	31	25			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2002	30151-ORDEQ	Elk Creek near Lanie Creek							29	31	25			
2002	30154-ORDEQ	Calapooya Creek above Cabin Creek						22	62*	62*	38*			
2002	30155-ORDEQ	North Myrtle Creek-air temperature						8	31	31	19			
2002	30157-ORDEQ	Umpqua River above Calapooya Creek							8	31	15			
2002	30159-ORDEQ	Main Stem Umpqua River abv Scottsburg							29	31	25			
2002	30160-ORDEQ	Elk Creek near Drew, OR							30	31	15			
2002	30161-ORDEQ	Pass Creek at mouth						20	62*	62*	40*			
2002	30163-ORDEQ	South Umpqua River above mouth							30	31	15			
2002	37477-ORDEQ	North Myrtle Creek at Evergreen Park						8	31	20	17			
2003	23836-ORDEQ	Wood Creek at River Mile 1.18 (Windy, Cow, South Umpqua, Umpqua)						27	31	31	7			
2003	30143-ORDEQ	Windy Creek at Glendale						4	31	31	15			
2003	30147-ORDEQ	Camp Creek at mouth						3	31	31	9			
2003	30154-ORDEQ	Calapooya Creek above Cabin Creek						4	31	31	12			
2003	30161-ORDEQ	Pass Creek at mouth						3	31	31	9			
2003	37477-ORDEQ	North Myrtle Creek at Evergreen Park						4	31	31	15			
2004	23836-ORDEQ	Wood Creek at River Mile 1.18 (Windy, Cow, South Umpqua, Umpqua)						8	31	31	14			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004	23837-ORDEQ	Wolf Creek at River Mile 3.5 (Umpqua)						7	31	31	14			
2004	30143-ORDEQ	Windy Creek at Glendale						7	31	31	16			
2004	30147-ORDEQ	Camp Creek at mouth						7	31	31	20			
2004	30154-ORDEQ	Calapooya Creek above Cabin Creek						7	31	31	16			
2004	30161-ORDEQ	Pass Creek at mouth						7	31	31	20			
2004	37477-ORDEQ	North Myrtle Creek at Evergreen Park						7	31	31	16			
2004	SNF-108	0257-Unamed Ck_LTWT					5	30	31	31	20			
2004	UmpNF-003	Beaver Creek on 3114_LTWT						20	31	31	27			
2004	UmpNF-006	Black Rock Fork at the Mouth_LTWT						21	31	31	21			
2004	UmpNF-007	Boulder Creek at the Mouth_LTWT						19	31	31	21			
2004	UmpNF-013	Buckeye Creek at the Mouth_LTWT							30	31	21			
2004	UmpNF-017	Castle Rock Fork at the Mouth_LTWT						21	31	31	21			
2004	UmpNF-025	Cow Creek above dismal Creek_LTWT							29	31	21			
2004	UmpNF-026	Coyote Creek Watershed #1_LTWT						1	31	31	21			
2004	UmpNF-027	Coyote Creek Watershed #2 LTWT						1	31	31	21			
2004	UmpNF-028	Coyote Creek Watershed #3 LTWT						1	31	31	21			
2004	UmpNF-029	Coyote Creek Watershed #4 LTWT						1	31	31	21			
2004	UmpNF-031	Deadman Creek at the mouth LTWT						20	31	31	28			
2004	UmpNF-036	Dumont Creek at the Mouth_LTWT						19	31	31	21			
2004	UmpNF-037	Elk Creek at Tiller_LTWT							31	31	17			
2004	UmpNF-050	Jackson Creek near the Mouth_LTWT							31	31	21			
2004	UmpNF-068	Quartz Creek at the Mouth_LTWT						21	31	31	21			
2004	UmpNF-076	South Umpqua at Tiller Ranger Station_LTWT							31	31	27			
2004	UmpNF-077	South Umpqua River above South Umpqua Falls_LTWT						19	30	2	21			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004	UmpNF-078	Squaw Creek at the Mouth_LTWT							31	31	21			
2005	23836-ORDEQ	Wood Creek at River Mile 1.18 (Windy, Cow, South Umpqua, Umpqua)						6	31	31	26			
2005	23837-ORDEQ	Wolf Creek at River Mile 3.5 (Umpqua)						7	31	31	26			
2005	30143-ORDEQ	Windy Creek at Glendale						3	31	31	19			
2005	30147-ORDEQ	Camp Creek at mouth						3	31	31	30	2		
2005	30154-ORDEQ	Calapooya Creek above Cabin Creek						3	31	31	30	1		
2005	37477-ORDEQ	North Myrtle Creek at Evergreen Park						3	31	31	19			
2005	SNF-107	4078						7	31	31	30	12		
2005	UmpNF-003	Beaver Creek on 3114_LTWT						19	31	31	30	15		
2005	UmpNF-006	Black Rock Fork at the Mouth_LTWT						20	31	31	30	1		
2005	UmpNF-007	Boulder Creek at the Mouth_LTWT						6	31	31	30	9		
2005	UmpNF-013	Buckeye Creek at the Mouth_LTWT						6	31	31	30	1		
2005	UmpNF-017	Castle Rock Fork at the Mouth_LTWT						20	31	31	30	1		
2005	UmpNF-025	Cow Creek above dismal Creek_LTWT							24	31	18			
2005	UmpNF-026	Coyote Creek Watershed #1_LTWT					5	30	31	31	26			
2005	UmpNF-027	Coyote Creek Watershed #2 LTWT					6	30	31	31	27			
2005	UmpNF-028	Coyote Creek Watershed #3 LTWT					6	30	31	31	26			
2005	UmpNF-029	Coyote Creek Watershed #4 LTWT					6	30	31	31	27			
2005	UmpNF-031	Deadman Creek at the mouth LTWT						20	31	31	30	10		
2005	UmpNF-034	Diamond Creek at the mouth WT							29	31	30	19		
2005	UmpNF-036	Dumont Creek at the Mouth_LTWT						21	31	31	30	10		
2005	UmpNF-037	Elk Creek at Tiller_LTWT						6	31	31	30	15		
2005	UmpNF-050	Jackson Creek near the Mouth_LTWT						19	31	31	30	15		
2005	UmpNF-051	Joe Hall Creek at the mouth WT						20	31	12				

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2005	UmpNF-068	Quartz Creek at the Mouth_LTWT						20	31	31	30	1		
2005	UmpNF-076	South Umpqua at Tiller Ranger Station_LTWT						6	31	31	26			
2005	UmpNF-077	South Umpqua River above South Umpqua Falls_LTWT						20	31	31	30	1		
2005	UmpNF-078	Squaw Creek at the Mouth_LTWT						6	31	31	30	15		
2006	23837-ORDEQ	Wolf Creek at River Mile 3.5 (Umpqua)					14	30	31	31	12			
2006	30143-ORDEQ	Windy Creek at Glendale						9	31	31	23			
2006	30147-ORDEQ	Camp Creek at mouth						7	31	31	4			
2006	30154-ORDEQ	Calapooya Creek above Cabin Creek						9	31	31	22			
2006	30161-ORDEQ	Pass Creek at mouth						7	31	31	22			
2006	33431-ORDEQ	Lutsinger Creek (ODFW)					23	30	31	6				
2006	33452-ORDEQ	Clear Creek (ODFW)					21	30	31	31	17			
2006	37477-ORDEQ	North Myrtle Creek at Evergreen Park						9	31	31	23			
2006	UmpNF-003	Beaver Creek on 3114_LTWT						10	31	31	20			
2006	UmpNF-006	Black Rock Fork at the Mouth_LTWT							31	31	18			
2006	UmpNF-007	Boulder Creek at the Mouth_LTWT							30	31	18			
2006	UmpNF-013	Buckeye Creek at the Mouth_LTWT						10	31	31	20			
2006	UmpNF-015	Callahan Creek at the mouth WT						6	31	31	19			
2006	UmpNF-017	Castle Rock Fork at the Mouth_LTWT							31	31	18			
2006	UmpNF-025	Cow Creek above dismal Creek_LTWT						7	31	31	20			
2006	UmpNF-026	Coyote Creek Watershed #1_LTWT						15	31	31	20			
2006	UmpNF-027	Coyote Creek Watershed #2 LTWT						15	31	31	20			
2006	UmpNF-028	Coyote Creek Watershed #3 LTWT						15	31	31	20			
2006	UmpNF-029	Coyote Creek Watershed #4 LTWT						15	31	31	20			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2006	UmpNF-031	Deadman Creek at the mouth LTWT							31	31	18			
2006	UmpNF-034	Diamond Creek at the mouth WT						7	31	31	18			
2006	UmpNF-035	Drew Creek at the mouth WT						6	31	31	19			
2006	UmpNF-036	Dumont Creek at the Mouth_LTWT							31	31	18			
2006	UmpNF-037	Elk Creek at Tiller_LTWT						9	31	31	19			
2006	UmpNF-050	Jackson Creek near the Mouth_LTWT						10	31	31	18			
2006	UmpNF-068	Quartz Creek at the Mouth_LTWT							31	31	18			
2006	UmpNF-076	South Umpqua at Tiller Ranger Station_LTWT						9	31	31	19			
2006	UmpNF-077	South Umpqua River above South Umpqua Falls_LTWT						10	31	31	18			
2006	UmpNF-078	Squaw Creek at the Mouth_LTWT						10	31	31	19			
2007	14320934	Little Wolf Creek Near Tyee, OR								1	30	26	26	31
2007	23837-ORDEQ	Wolf Creek at River Mile 3.5 (Umpqua)					7	30	31	31	3			
2007	30143-ORDEQ	Windy Creek at Glendale						7	31	31	30	6		
2007	30147-ORDEQ	Camp Creek at mouth							31	31	17			
2007	30154-ORDEQ	Calapooya Creek above Cabin Creek						3	31	31	30	7		
2007	30161-ORDEQ	Pass Creek at mouth							31	10	14			
2007	33431-ORDEQ	Lutsinger Creek (ODFW)					7	30	31	31	3			
2007	33452-ORDEQ	Clear Creek (ODFW)					7	30	31	20	9			
2007	37477-ORDEQ	North Myrtle Creek at Evergreen Park						7	31	31	27			
2007	UmpNF-003	Beaver Creek on 3114_LTWT						4	31	31	26			
2007	UmpNF-006	Black Rock Fork at the Mouth_LTWT						11	31	31	26			
2007	UmpNF-007	Boulder Creek at the Mouth_LTWT						10	31	31	26			
2007	UmpNF-013	Buckeye Creek at the Mouth_LTWT						15	31	31	26			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2007	UmpNF-015	Callahan Creek at the mouth WT						17	31	31	26			
2007	UmpNF-017	Castle Rock Fork at the Mouth_LTWT						11	31	31	26			
2007	UmpNF-025	Cow Creek above dismal Creek_LTWT						4	31	31	30			
2007	UmpNF-026	Coyote Creek Watershed #1_LTWT						15	31	31	30			
2007	UmpNF-027	Coyote Creek Watershed #2 LTWT						15	31	31	30			
2007	UmpNF-028	Coyote Creek Watershed #3 LTWT						15	31	31	30			
2007	UmpNF-029	Coyote Creek Watershed #4 LTWT						15	31	31	30			
2007	UmpNF-031	Deadman Creek at the mouth LTWT						10	31	31	26			
2007	UmpNF-034	Diamond Creek at the mouth WT						4	31	31	26			
2007	UmpNF-035	Drew Creek at the mouth WT						17	31	31	26			
2007	UmpNF-036	Dumont Creek at the Mouth_LTWT						10	31	31	26			
2007	UmpNF-037	Elk Creek at Tiller_LTWT						17	31	31	24			
2007	UmpNF-040	Flat Creek Near Mouth WT						1	31	31	27			
2007	UmpNF-050	Jackson Creek near the Mouth_LTWT						4	31	31	26			
2007	UmpNF-051	Joe Hall Creek at the mouth WT						19	31	7				
2007	UmpNF-068	Quartz Creek at the Mouth_LTWT						10	31	31	26			
2007	UmpNF-076	South Umpqua at Tiller Ranger Station_LTWT						17	31	31	26			
2007	UmpNF-077	South Umpqua River above South Umpqua Falls_LTWT						10	31	31	26			
2007	UmpNF-078	Squaw Creek at the Mouth_LTWT						4	31	31	26			
2008	14320934	Little Wolf Creek Near Tyee, OR	31	29	31	30	31	30	31	31	30	31	27	27
2008	30143-ORDEQ	Windy Creek at Glendale						29	31	31	23			
2008	30147-ORDEQ	Camp Creek at mouth						8	31	24				
2008	30154-ORDEQ	Calapooya Creek above Cabin Creek						24	31	31	24			
2008	30161-ORDEQ	Pass Creek at mouth						8	31	31	25			
2008	37477-ORDEQ	North Myrtle Creek at Evergreen Park						29	31	31	24			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	UmpNF-003	Beaver Creek on 3114_LTWT							31	31	17			
2008	UmpNF-006	Black Rock Fork at the Mouth_LTWT						21	31	31	17			
2008	UmpNF-007	Boulder Creek at the Mouth_LTWT						21	31	31	22			
2008	UmpNF-012	Brownie Creek at the mouth LTWT							30	31	17			
2008	UmpNF-013	Buckeye Creek at the Mouth_LTWT						21	31	31	17			
2008	UmpNF-015	Callahan Creek at the mouth WT						22	31	31	17			
2008	UmpNF-017	Castle Rock Fork at the Mouth_LTWT						21	31	31	17			
2008	UmpNF-025	Cow Creek above dismal Creek_LTWT						21	31	31	17			
2008	UmpNF-026	Coyote Creek Watershed #1_LTWT						22	31	31	30	14		
2008	UmpNF-027	Coyote Creek Watershed #2 LTWT						22	31	31	30	14		
2008	UmpNF-028	Coyote Creek Watershed #3 LTWT						22	31	31	30	14		
2008	UmpNF-029	Coyote Creek Watershed #4 LTWT						22	31	31	30	14		
2008	UmpNF-031	Deadman Creek at the mouth LTWT						21	31	31	17			
2008	UmpNF-032	Deep Cut Creek at the mouth WT							31	31	17			
2008	UmpNF-034	Diamond Creek at the mouth WT						22	31	31	24			
2008	UmpNF-035	Drew Creek at the mouth WT						22	31	31	17			
2008	UmpNF-036	Dumont Creek at the Mouth_LTWT						21	31	31	20			
2008	UmpNF-037	Elk Creek at Tiller_LTWT						20	31	31	22			
2008	UmpNF-040	Flat Creek Near Mouth WT						22	31	31	26			
2008	UmpNF-042	French Creek at the mouth WT							31	31	17			
2008	UmpNF-050	Jackson Creek near the Mouth_LTWT						21	31	31	22			
2008	UmpNF-051	Joe Hall Creek at the mouth WT						22	31	5				
2008	UmpNF-068	Quartz Creek at the Mouth_LTWT						21	31	31	17			
2008	UmpNF-075	South Umpqua at Three C Rock WT						21	31	31	22			
2008	UmpNF-076	South Umpqua at Tiller Ranger Station_LTWT						21	31	31	22			
2008	UmpNF-077	South Umpqua River above South Umpqua Falls_LTWT							31	31	17			
2008	UmpNF-078	Squaw Creek at the Mouth_LTWT							31	31	17			
2008	UmpNF-081	Trib to Joe Hall at Singing Falls WT						22	31	31	28			
2008	UmpNF-085	Zinc Creek at the mouth WT							31	31	23			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2009	14320934	Little Wolf Creek Near Tyee, OR	31	21	28	30	31	30	31	31	30	31	30	31
2009	23837-ORDEQ	Wolf Creek at River Mile 3.5 (Umpqua)							24	31	1			
2009	30143-ORDEQ	Windy Creek at Glendale						23	31	31	30	3		
2009	30147-ORDEQ	Camp Creek at mouth						12	31	29				
2009	30154-ORDEQ	Calapooya Creek above Cabin Creek						19	31	31	30	1		
2009	30161-ORDEQ	Pass Creek at mouth						12	31	31	30	2		
2009	33431-ORDEQ	Lutsinger Creek (ODFW)							22	31	5			
2009	33452-ORDEQ	Clear Creek (ODFW)							18	31				
2009	37477-ORDEQ	North Myrtle Creek at Evergreen Park						23	31	31	30	3		
2009	UmpNF-003	Beaver Creek on 3114_LTWT						14	31	31	30	8		
2009	UmpNF-006	Black Rock Fork at the Mouth_LTWT						15	31	31	30	9		
2009	UmpNF-012	Brownie Creek at the mouth LTWT						7	31	31	30	8		
2009	UmpNF-013	Buckeye Creek at the Mouth_LTWT						15	31	31	30			
2009	UmpNF-015	Callahan Creek at the mouth WT						7	31	31	30	8		
2009	UmpNF-017	Castle Rock Fork at the Mouth_LTWT						15	31	31	30	10		
2009	UmpNF-026	Coyote Creek Watershed #1_LTWT						8	31	31	8			
2009	UmpNF-027	Coyote Creek Watershed #2 LTWT						8	31	31	8			
2009	UmpNF-028	Coyote Creek Watershed #3 LTWT						8	31	31	8			
2009	UmpNF-029	Coyote Creek Watershed #4 LTWT						8	31	14				
2009	UmpNF-031	Deadman Creek at the mouth LTWT						14	31	31	30			
2009	UmpNF-032	Deep Cut Creek at the mouth WT						7	31	31	30	8		
2009	UmpNF-034	Diamond Creek at the mouth WT						7	31	31	30	8		
2009	UmpNF-035	Drew Creek at the mouth WT						7	31	31	30	8		

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2009	UmpNF-036	Dumont Creek at the Mouth_LTWT						7	31	31	30			
2009	UmpNF-037	Elk Creek at Tiller_LTWT						14	31	31	30			
2009	UmpNF-038	Falcon Creek at the mouth WT						7	31	31	30	8		
2009	UmpNF-040	Flat Creek Near Mouth WT						16	31	31	30	13		
2009	UmpNF-042	French Creek at the mouth WT						16	31	31	30	9		
2009	UmpNF-050	Jackson Creek near the Mouth_LTWT						14	31	31	30	8		
2009	UmpNF-051	Joe Hall Creek at the mouth WT						16	25					
2009	UmpNF-068	Quartz Creek at the Mouth_LTWT						15	31	31	29			
2009	UmpNF-075	South Umpqua at Three C Rock WT						14	31	31	30			
2009	UmpNF-076	South Umpqua at Tiller Ranger Station_LTWT						12	31	31	30			
2009	UmpNF-078	Squaw Creek at the Mouth_LTWT						7	31	31	30	8		
2009	UmpNF-081	Trib to Joe Hall at Singing Falls WT						16	31	31	30	31	11	
2009	UmpNF-085	Zinc Creek at the mouth WT						7	31	31	30			
2010	14320934	Little Wolf Creek Near Tyee, OR	31	28	31	30	31	30	31	31	30	31	30	31
2010	30143-ORDEQ	Windy Creek at Glendale						10	31	31	25			
2010	30147-ORDEQ	Camp Creek at mouth						11	31	31	30	1		
2010	30154-ORDEQ	Calapooya Creek above Cabin Creek						15	31	31	24			
2010	30161-ORDEQ	Pass Creek at mouth						11	31	31	30	1		
2010	37477-ORDEQ	North Myrtle Creek at Evergreen Park						10	31	31	25			
2010	UmpNF-003	Beaver Creek on 3114_LTWT						16	31	31	21			
2010	UmpNF-005	Black Canyon Creek at the mouth WT						15	31	31	23			
2010	UmpNF-006	Black Rock Fork at the Mouth_LTWT						16	31	31	26			
2010	UmpNF-012	Brownie Creek at the mouth LTWT						16	31	31	26			
2010	UmpNF-013	Buckeye Creek at the Mouth_LTWT						9	31	31	28			
2010	UmpNF-015	Callahan Creek at the mouth WT						16	31	31	26			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	UmpNF-017	Castle Rock Fork at the Mouth_LTWT						16	31	31	29			
2010	UmpNF-025	Cow Creek above dismal Creek_LTWT						16	31	31	24			
2010	UmpNF-026	Coyote Creek Watershed #1_LTWT						16	31	31	28			
2010	UmpNF-028	Coyote Creek Watershed #3 LTWT						16	31	31	28			
2010	UmpNF-029	Coyote Creek Watershed #4 LTWT						16	31	31	28			
2010	UmpNF-031	Deadman Creek at the mouth LTWT						16	31	31	27			
2010	UmpNF-032	Deep Cut Creek at the mouth WT						16	31	31	21			
2010	UmpNF-034	Diamond Creek at the mouth WT						16	31	31	26			
2010	UmpNF-035	Drew Creek at the mouth WT						16	31	31	26			
2010	UmpNF-036	Dumont Creek at the Mouth_LTWT						9	31	31	27			
2010	UmpNF-037	Elk Creek at Tiller_LTWT						8	31	31	23			
2010	UmpNF-038	Falcon Creek at the mouth WT						15	31	31	23			
2010	UmpNF-040	Flat Creek Near Mouth WT						13	31	31	30	23		
2010	UmpNF-042	French Creek at the mouth WT						16	31	31	27			
2010	UmpNF-047	Jackson Creek above Falcon Creek WT						15	31	31	23			
2010	UmpNF-050	Jackson Creek near the Mouth_LTWT						15	31	31	23			
2010	UmpNF-051	Joe Hall Creek at the mouth WT						13	31	31	30	23		
2010	UmpNF-068	Quartz Creek at the Mouth_LTWT						16	31	31	27			
2010	UmpNF-075	South Umpqua at Three C Rock WT						9	31	31	23			
2010	UmpNF-076	South Umpqua at Tiller Ranger Station_LTWT						16	31	31	30	5		
2010	UmpNF-077	South Umpqua River above South Umpqua Falls_LTWT						9	31	31	27			
2010	UmpNF-078	Squaw Creek at the Mouth_LTWT						8	31	31	21			
2010	UmpNF-081	Trib to Joe Hall at Singing Falls WT						7	31	31	30	23		
2010	UmpNF-085	Zinc Creek at the mouth WT						16	31	31	27			
2011	12899-ORDEQ	Myrtle Creek 200 feet upstream of Myrtle Creek STP outfall						3	31	31	30	3		
2011	14320934	Little Wolf Creek Near Tyee, OR	31	28	31	30	31	30	31	31	30	31	30	31
2011	30143-ORDEQ	Windy Creek at Glendale						10	31	31	25			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2011	30147-ORDEQ	Camp Creek at mouth						15	31	31	23			
2011	30154-ORDEQ	Calapooya Creek above Cabin Creek						14	31	31	25			
2011	30161-ORDEQ	Pass Creek at mouth						15	31	31	23			
2011	33247-ORDEQ	Myrtle Creek South Fork at Neal Lane Bridge below golf course (South Umpqua)						3	31	31	28			
2011	33248-ORDEQ	Myrtle Creek South Fork at Days Creek Cutoff Road above golf course (South Umpqua)						3	31	31	30	3		
2011	33249-ORDEQ	Myrtle Creek South Fork at River Mile 5.4 (South Umpqua)						3	31	31	30	23		
2011	33251-ORDEQ	Myrtle Creek South Fork at BLM 23 1 Road at River Mile 14 (South Umpqua)						3	31	31	30	23		
2011	33252-ORDEQ	Weaver Creek at Hidden Homestead Road near mouth (South Myrtle, South Umpqua)						3	31	31	30	23		
2011	33575-ORDEQ	Myrtle Creek at north end of North Myrtle Park (South Umpqua)						3	31	31	28			
2011	34124-ORDEQ	Louis Creek at South Myrtle Creek Road (S. Myrtle, Umpqua)						3	31	31	30	23		
2011	37477-ORDEQ	North Myrtle Creek at Evergreen Park						10	31	31	28			
2011	UmpNF-005	Black Canyon Creek at the mouth WT							30	31	22			
2011	UmpNF-006	Black Rock Fork at the Mouth_LTWT						6	31	31	25			
2011	UmpNF-007	Boulder Creek at the Mouth_LTWT							31	31	26			
2011	UmpNF-012	Brownie Creek at the mouth LTWT						7	31	31	22			
2011	UmpNF-015	Callahan Creek at the mouth WT						9	31	31	22			
2011	UmpNF-017	Castle Rock Fork at the Mouth_LTWT						8	31	31	21			
2011	UmpNF-025	Cow Creek above dismal Creek_LTWT						4	31	31	25			
2011	UmpNF-026	Coyote Creek Watershed #1_LTWT						8	31	31	27			
2011	UmpNF-027	Coyote Creek Watershed #2 LTWT						8	31	31	27			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2011	UmpNF-028	Coyote Creek Watershed #3 LTWT						8	31	31	27			
2011	UmpNF-029	Coyote Creek Watershed #4 LTWT						8	31	31	27			
2011	UmpNF-031	Deadman Creek at the mouth LTWT						9	31	31	21			
2011	UmpNF-032	Deep Cut Creek at the mouth WT						6	31	31	22			
2011	UmpNF-034	Diamond Creek at the mouth WT						7	31	31	25			
2011	UmpNF-035	Drew Creek at the mouth WT						9	31	31	22			
2011	UmpNF-036	Dumont Creek at the Mouth_LTWT						8	31	31	22			
2011	UmpNF-037	Elk Creek at Tiller_LTWT						8	31	31	26			
2011	UmpNF-038	Falcon Creek at the mouth WT							31	31	21			
2011	UmpNF-040	Flat Creek Near Mouth WT						1	31	31	30			
2011	UmpNF-042	French Creek at the mouth WT						5	31	31				
2011	UmpNF-045	Jackson Creek above Faclon above Structure WT							31	31	21			
2011	UmpNF-046	Jackson Creek above Falcon below Structure WT							31	31	21			
2011	UmpNF-050	Jackson Creek near the Mouth_LTWT							31	31	21			
2011	UmpNF-051	Joe Hall Creek at the mouth WT						4	31	31	30			
2011	UmpNF-068	Quartz Creek at the Mouth_LTWT						8	31	31	25			
2011	UmpNF-074	South Umpqua at Three C Rock SIde Channel WT							26	31	21			
2011	UmpNF-075	South Umpqua at Three C Rock WT							25	31	21			
2011	UmpNF-077	South Umpqua River above South Umpqua Falls_LTWT							31	31	21			
2011	UmpNF-078	Squaw Creek at the Mouth_LTWT							26	31	21			
2011	UmpNF-081	Trib to Joe Hall at Singing Falls WT						4	31	31	30			
2011	UmpNF-085	Zinc Creek at the mouth WT						8	31	31	25			
2012	12570-ORDEQ	Canyon Creek 60 feet upstream of mouth							27	31	24			
2012	14320934	Little Wolf Creek Near Tyee, OR	31	29	31	30	31	30	31	31	30	31	30	31
2012	30143-ORDEQ	Windy Creek at Glendale						14	31	31	30	12		
2012	30147-ORDEQ	Camp Creek at mouth						13	31	31	21			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2012	30154-ORDEQ	Calapooya Creek above Cabin Creek						15	31	31	30	12		
2012	30161-ORDEQ	Pass Creek at mouth						13	31	31	21			
2012	34129-ORDEQ	South Umpqua at Canyonville Park							27	31	24			
2012	37477-ORDEQ	North Myrtle Creek at Evergreen Park						14	31	24	3	5		
2012	40121-ORDEQ	South Umpqua River 0 M DS I5							14	31	24			
2012	40123-ORDEQ	South Umpqua River at RM 59							27	26				
2012	40124-ORDEQ	South Umpqua River 651 Meters US of Cor Cr							14	31	24			
2012	UmpNF-001	Anderson Creek at the mouth WT						4	31	31	30	1		
2012	UmpNF-003	Beaver Creek on 3114_LTWT						3	31	31	30			
2012	UmpNF-005	Black Canyon Creek at the mouth WT						3	31	31	30	2		
2012	UmpNF-006	Black Rock Fork at the Mouth_LTWT						5	31	31	30			
2012	UmpNF-007	Boulder Creek at the Mouth_LTWT						5	31	31	30	3		
2012	UmpNF-012	Brownie Creek at the mouth LTWT						4	31	31	30	1		
2012	UmpNF-013	Buckeye Creek at the Mouth_LTWT						5	31	31	30	3		
2012	UmpNF-015	Callahan Creek at the mouth WT						5	31	31	30	1		
2012	UmpNF-017	Castle Rock Fork at the Mouth_LTWT						5	31	31	30	3		
2012	UmpNF-025	Cow Creek above dismal Creek_LTWT						3	31	31	30	1		
2012	UmpNF-026	Coyote Creek Watershed #1_LTWT						5	31	31	30	8		
2012	UmpNF-027	Coyote Creek Watershed #2 LTWT						5	31	31	30	8		
2012	UmpNF-028	Coyote Creek Watershed #3 LTWT						5	31	31	30	8		
2012	UmpNF-029	Coyote Creek Watershed #4 LTWT						5	31	31	30	8		
2012	UmpNF-031	Deadman Creek at the mouth LTWT						8	31	31	30			
2012	UmpNF-032	Deep Cut Creek at the mouth WT						5	31	31	30			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2012	UmpNF-034	Diamond Creek at the mouth WT						3	31	31	30	3		
2012	UmpNF-035	Drew Creek at the mouth WT						11	31	31	30	1		
2012	UmpNF-036	Dumont Creek at the Mouth_LTWT						4	31	31	30			
2012	UmpNF-037	Elk Creek at Tiller_LTWT						2	31	31	30	1		
2012	UmpNF-038	Falcon Creek at the mouth WT						4	31	31	30	2		
2012	UmpNF-040	Flat Creek Near Mouth WT						3	31	31	30	11		
2012	UmpNF-042	French Creek at the mouth WT						5	31	31	30			
2012	UmpNF-045	Jackson Creek above Faclon above Structure WT						4	31	31	30	2		
2012	UmpNF-046	Jackson Creek above Falcon below Structure WT						4	31	31	30	2		
2012	UmpNF-050	Jackson Creek near the Mouth_LTWT						6	31	31	30	1		
2012	UmpNF-068	Quartz Creek at the Mouth_LTWT						5	31	31	30	3		
2012	UmpNF-074	South Umpqua at Three C Rock SIde Channel WT						5	31	31	30	2		
2012	UmpNF-075	South Umpqua at Three C Rock WT						5	31	14				
2012	UmpNF-076	South Umpqua at Tiller Ranger Station_LTWT										13	30	31
2012	UmpNF-077	South Umpqua River above South Umpqua Falls_LTWT						5	31	31	30	3		
2012	UmpNF-078	Squaw Creek at the Mouth_LTWT						3	31	31	30	2		
2012	UmpNF-081	Trib to Joe Hall at Singing Falls WT						3	31	31	26			
2012	UmpNF-085	Zinc Creek at the mouth WT						4	31	31	30			
2013	14320934	Little Wolf Creek Near Tyee, OR	31	28	31	24	31	30	31	31	30	31	30	17
2013	27924-ORDEQ	Upper Days Creek (sec 23)						3	31	31	30	1		
2013	30143-ORDEQ	Windy Creek at Glendale						21	31	29	21			
2013	30147-ORDEQ	Camp Creek at mouth						14	31	31	27			
2013	30154-ORDEQ	Calapooya Creek above Cabin Creek						16	31	31	21			
2013	30161-ORDEQ	Pass Creek at mouth						14	31	31	27			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013	34127-ORDEQ	Days Creek above Woods Creek (South Umpqua)						3	31	29	30	1		
2013	34129-ORDEQ	South Umpqua at Canyonville Park						3	31	31	24			
2013	36302-ORDEQ	S Umpqua upstream of ODOT Lawson Bar						10	31	31	24			
2013	37477-ORDEQ	North Myrtle Creek at Evergreen Park						17	31	31	21			
2013	37488-ORDEQ	Days Cr above Fate Cr						3	31	31	27			
2013	37490-ORDEQ	Days Cr above Perdue Cr						3	31	31	30	1		
2013	40110-ORDEQ	Days CK at first bridge						3	31	31	30	1		
2013	40111-ORDEQ	Woods CK at Mouth						3	31	31	30	1		
2013	40112-ORDEQ	Days CK 175 Meters DS Days Creek Road BR						3	22					
2013	40113-ORDEQ	Days CK at RM 8.84						3	31	31	30	1		
2013	40114-ORDEQ	Fate CK 205 Meters US of Days Creek RD						3	31	31	27			
2013	40115-ORDEQ	Days CR Trib RM 7.94						3	31	31	30	1		
2013	40116-ORDEQ	Days CR 95 Meters US of first May Creek Rd Bridge						3	31	31	27			
2013	40117-ORDEQ	Days CR at RM 5.01						3	26					
2013	40118-ORDEQ	Days CR at second bridge on Days Creek Rd						3	31	31	30	1		
2013	40119-ORDEQ	South Umpqua River at RM 60						3	31	31	24			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013	40120-ORDEQ	South Umpqua 100 m US of Myrtle CR						10	31	31	24			
2013	40121-ORDEQ	South Umpqua River 0 M DS I5						10	31	31	24			
2013	UmpNF-003	Beaver Creek on 3114_LTWT						20	31	31	26			
2013	UmpNF-005	Black Canyon Creek at the mouth WT						9	31	31	24			
2013	UmpNF-006	Black Rock Fork at the Mouth_LTWT						9	31	31	24			
2013	UmpNF-007	Boulder Creek at the Mouth_LTWT						18	31	31	22			
2013	UmpNF-012	Brownie Creek at the mouth LTWT						6	31	31	30	21		
2013	UmpNF-013	Buckeye Creek at the Mouth_LTWT						18	31	31	30	16		
2013	UmpNF-015	Callahan Creek at the mouth WT						6	31	31	30	21		
2013	UmpNF-017	Castle Rock Fork at the Mouth_LTWT						18	31	31	24			
2013	UmpNF-025	Cow Creek above dismal Creek_LTWT						18	31	31	22			
2013	UmpNF-026	Coyote Creek Watershed #1_LTWT						12	31	31	30	31	30	31
2013	UmpNF-027	Coyote Creek Watershed #2 LTWT						12	31	31	30	31	30	31
2013	UmpNF-028	Coyote Creek Watershed #3 LTWT						12	31	31	30	31	30	31
2013	UmpNF-031	Deadman Creek at the mouth LTWT						18	31	31	24			
2013	UmpNF-032	Deep Cut Creek at the mouth WT						9	31	31	18			
2013	UmpNF-034	Diamond Creek at the mouth WT							29	31	29			
2013	UmpNF-035	Drew Creek at the mouth WT							8	31	30	21		
2013	UmpNF-036	Dumont Creek at the Mouth_LTWT						18	31	31	24			
2013	UmpNF-037	Elk Creek at Tiller_LTWT						21	31	31	22			
2013	UmpNF-038	Falcon Creek at the mouth WT						6	31	31	26			
2013	UmpNF-040	Flat Creek Near Mouth WT							28	31	30	31	9	
2013	UmpNF-042	French Creek at the mouth WT						9	31	31	22			
2013	UmpNF-045	Jackson Creek above Faclon above Structure WT						6	31	31	30	20		
2013	UmpNF-046	Jackson Creek above Falcon below Structure WT						6	31	31	26			
2013	UmpNF-048	Jackson Creek above Luck Creek Fish Structure WT						6	31	31	23			
2013	UmpNF-049	Jackson Creek below Luck Creek Fish Structure WT						6	31	31	23			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013	UmpNF-050	Jackson Creek near the Mouth_LTWT						20	31	31	22			
2013	UmpNF-051	Joe Hall Creek at the mouth WT							6	31	30	31	6	
2013	UmpNF-068	Quartz Creek at the Mouth_LTWT						18	31	31	22			
2013	UmpNF-074	South Umpqua at Three C Rock SIde Channel WT						6	31	31	16			
2013	UmpNF-075	South Umpqua at Three C Rock WT						6	31	31	13			
2013	UmpNF-076	South Umpqua at Tiller Ranger Station_LTWT	31	28	31	30	31	30	31	31	24	31	30	31
2013	UmpNF-077	South Umpqua River above South Umpqua Falls_LTWT						18	31	31	22			
2013	UmpNF-078	Squaw Creek at the Mouth_LTWT						17	31	31	18			
2013	UmpNF-081	Trib to Joe Hall at Singing Falls WT							27	31	30	31	5	
2013	UmpNF-085	Zinc Creek at the mouth WT						9	31	31	22			
2014	14320934	Little Wolf Creek Near Tyee, OR	31	26	29	30	31	30	31	31	30	31	30	31
2014	27847-ORDEQ	Fate Creek						11	31	31	14			
2014	27924-ORDEQ	Upper Days Creek (sec 23)						11	31	31	14			
2014	30143-ORDEQ	Windy Creek at Glendale						14	31	31	30	2		
2014	30147-ORDEQ	Camp Creek at mouth						15	31	31	30	4		
2014	30154-ORDEQ	Calapooya Creek above Cabin Creek						10	31	31	26			
2014	30161-ORDEQ	Pass Creek at mouth						15	31	31	30	4		
2014	34127-ORDEQ	Days Creek above Woods Creek (South Umpqua)						11	31	31	14			
2014	37477-ORDEQ	North Myrtle Creek at Evergreen Park						14	31	31	30	2		
2014	37490-ORDEQ	Days Cr above Perdue Cr						11	31	16	10			
2014	40110-ORDEQ	Days CK at first bridge						11	31	31	14			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2014	40111-ORDEQ	Woods CK at Mouth						11	31	31	14			
2014	40112-ORDEQ	Days CK 175 Meters DS Days Creek Road BR						11	31	2				
2014	40113-ORDEQ	Days CK at RM 8.84						11	31	10				
2014	40114-ORDEQ	Fate CK 205 Meters US of Days Creek RD						11	31	31	16			
2014	40115-ORDEQ	Days CR Trib RM 7.94						11	31	23				
2014	40116-ORDEQ	Days CR 95 Meters US of first May Creek Rd Bridge						11	31	31	14			
2014	40117-ORDEQ	Days CR at RM 5.01						11	31	3				
2014	40118-ORDEQ	Days CR at second bridge on Days Creek Rd						11	31	31	14			
2014	UmpNF-003	Beaver Creek on 3114_LTWT						23	31	31	22			
2014	UmpNF-005	Black Canyon Creek at the mouth WT						19	31	31	22			
2014	UmpNF-006	Black Rock Fork at the Mouth_LTWT						22	31	31	21			
2014	UmpNF-007	Boulder Creek at the Mouth_LTWT						25	31	31	21			
2014	UmpNF-012	Brownie Creek at the mouth LTWT						15	31	31	22			
2014	UmpNF-013	Buckeye Creek at the Mouth_LTWT						25	31	31	21			
2014	UmpNF-015	Callahan Creek at the mouth WT						15	31	31	22			
2014	UmpNF-017	Castle Rock Fork at the Mouth_LTWT						25	31	31	21			
2014	UmpNF-025	Cow Creek above dismal Creek_LTWT						15	31	31	22			
2014	UmpNF-026	Coyote Creek Watershed #1_LTWT	31	28	31	30	31	30	31	31	30			
2014	UmpNF-027	Coyote Creek Watershed #2 LTWT	31	28	31	30	31	30	31	31	30			
2014	UmpNF-028	Coyote Creek Watershed #3 LTWT	31	28	31	30	31	30	31	31	30	31	30	31
2014	UmpNF-029	Coyote Creek Watershed #4 LTWT										31	30	31
2014	UmpNF-031	Deadman Creek at the mouth LTWT						21	31	31	22			
2014	UmpNF-037	Elk Creek at Tiller_LTWT						18	31	31	22			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2014	UmpNF-038	Falcon Creek at the mouth WT						25	31	31	22			
2014	UmpNF-045	Jackson Creek above Faclon above Structure WT						25	31	31	22			
2014	UmpNF-046	Jackson Creek above Falcon below Structure WT						25	31	31	22			
2014	UmpNF-048	Jackson Creek above Luck Creek Fish Structure WT						25	31	31	22			
2014	UmpNF-049	Jackson Creek below Luck Creek Fish Structure WT						25	31	31	22			
2014	UmpNF-050	Jackson Creek near the Mouth_LTWT						25	31	31	22			
2014	UmpNF-051	Joe Hall Creek at the mouth WT						28	31	9				
2014	UmpNF-068	Quartz Creek at the Mouth_LTWT						25	31	31	21			
2014	UmpNF-076	South Umpqua at Tiller Ranger Station_LTWT	31	28	31	30	31	30	31	31	22	31	30	31
2014	UmpNF-077	South Umpqua River above South Umpqua Falls_LTWT						25	31	31	21			
2015	12899-ORDEQ	Myrtle Creek 200 feet upstream of Myrtle Creek STP outfall						7	31	31	21			
2015	14320934	Little Wolf Creek Near Tyee, OR	31	28	31	30	31	30	31	31	30	31	30	31
2015	25950-ORDEQ	Deer Creek at Fowler Bridge, Roseburg (South Umpqua, Umpqua)						7	31	31	30	4		
2015	30143-ORDEQ	Windy Creek at Glendale						24	31	31	21			
2015	30147-ORDEQ	Camp Creek at mouth						23	31	31	26			
2015	30154-ORDEQ	Calapooya Creek above Cabin Creek						18	31	31	30	3		
2015	30161-ORDEQ	Pass Creek at mouth						23	31	31	26			
2015	34129-ORDEQ	South Umpqua at Canyonville Park						7	31	31	21			
2015	36310-ORDEQ	South Umpqua River at Lawson Bar just u/s of Cow Creek						7	31	31	21			
2015	37477-ORDEQ	North Myrtle Creek at Evergreen Park						24	31	31	21			
2015	40119-ORDEQ	South Umpqua River at RM 60						7	31	31	21			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2015	40120-ORDEQ	South Umpqua 100 m US of Myrtle CR						7	31	31	21			
2015	UmpNF-003	Beaver Creek on 3114_LTWT						30	31	31	30	5		
2015	UmpNF-006	Black Rock Fork at the Mouth_LTWT						21	31	31	29			
2015	UmpNF-007	Boulder Creek at the Mouth_LTWT						30	31	31	29			
2015	UmpNF-013	Buckeye Creek at the Mouth_LTWT						21	31	31	29			
2015	UmpNF-017	Castle Rock Fork at the Mouth_LTWT						21	31	31	29			
2015	UmpNF-026	Coyote Creek Watershed #1_LTWT						21	31	31	30			
2015	UmpNF-027	Coyote Creek Watershed #2 LTWT						21	31	31	30			
2015	UmpNF-028	Coyote Creek Watershed #3 LTWT	31	28	31	30	31	30	31	31	30			
2015	UmpNF-029	Coyote Creek Watershed #4 LTWT	31	28	31	30	31	30	31	31	30	31	30	31
2015	UmpNF-031	Deadman Creek at the mouth LTWT						30	31	31	29			
2015	UmpNF-037	Elk Creek at Tiller_LTWT						30	31	31	27			
2015	UmpNF-045	Jackson Creek above Faclon above Structure WT						29	31	31	30	5		
2015	UmpNF-046	Jackson Creek above Falcon below Structure WT						29	31	31	30	5		
2015	UmpNF-048	Jackson Creek above Luck Creek Fish Structure WT						29	31	31	30	5		
2015	UmpNF-049	Jackson Creek below Luck Creek Fish Structure WT						29	31	31	30	5		
2015	UmpNF-050	Jackson Creek near the Mouth_LTWT						29	31	31	30	5		
2015	UmpNF-068	Quartz Creek at the Mouth_LTWT						30	31	31	29			
2015	UmpNF-076	South Umpqua at Tiller Ranger Station_LTWT	31	28	31	30	31	30	31	31	27			
2015	UmpNF-077	South Umpqua River above South Umpqua Falls_LTWT						30	31	31	29			
2016	10997-ORDEQ	Cow Creek at mouth						8	31	31	20			
2016	11315-ORDEQ	Roberts Creek at Carnes Road in Green						29	31	31	30	5		
2016	11316-ORDEQ	Myrtle Creek at mouth						8	31	31	19			
2016	12247-ORDEQ	Rice Creek at junction of Willis Creek Road & Rice Creek Road					14	30	31	31	30	2		
2016	14320934	Little Wolf Creek Near Tyee, OR	31	29	31	30	31	30	31	31	30	31	30	31

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	24405-ORDEQ	Calapooya at Umpqua Landing						1	31	31	30	3		
2016	25187-ORDEQ	South Fork of Deer Creek near mouth, South Umpqua River						29	31	31	30	5		
2016	25188-ORDEQ	North Fork Deer Creek near mouth, South Umpqua						29	31	31	30	5		
2016	25950-ORDEQ	Deer Creek at Fowler Bridge, Roseburg (South Umpqua, Umpqua)						29	31	31	30	5		
2016	29820-ORDEQ	Hinkle Creek at Mouth (RM 0.14)						1	31	31	15			
2016	30143-ORDEQ	Windy Creek at Glendale						20	31	31	24			
2016	30147-ORDEQ	Camp Creek at mouth						19	31	31	30	8		
2016	30154-ORDEQ	Calapooya Creek above Cabin Creek						25	31	31	30			
2016	30161-ORDEQ	Pass Creek at mouth						19	31	31	30	7		
2016	30163-ORDEQ	South Umpqua River above mouth						1	31	31	30	5		
2016	30696-ORDEQ	South Umpqua River at Old Hwy 99 Bridge Crossing, River Mile 24.6						1	31	31	30	5		
2016	31694-ORDEQ	Newton Creek at mouth, NW Jefferson Street, Roseburg, OR						29	31	31	30	5		
2016	33227-ORDEQ	Calapooya Creek at Hinkle Creek Road						1	31	31	15			
2016	36302-ORDEQ	S Umpqua upstream of ODOT Lawson Bar						8	31	31	19			
2016	37477-ORDEQ	North Myrtle Creek at Evergreen Park						26	31	31	24			
2016	37493-ORDEQ	Yellow Cr near Mouth						2	31	31	30	3		

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	37508-ORDEQ	Umpqua River at James Wood Boat Ramp						2	31	31	30	3		
2016	38046-ORDEQ	Mehl Creek at Mehl Road						2	31	31	30	3		
2016	40120-ORDEQ	South Umpqua 100 m US of Myrtle CR						8	31	31	19			
2016	40210-ORDEQ	Rice Cr 290m DS of Porter Cr					14	30	31	31	30	2		
2016	40354-ORDEQ	South Umpqua at Oak Ave. Bridge						2	31	31	30	5		
2016	40518-ORDEQ	Calapooya Creek at Driver Valley Rd bridge						1	31	31	15			
2016	40519-ORDEQ	Hubbard Creek at Hubbard Creek Rd. Bridge						2	31	31	30	3		
2016	40520-ORDEQ	Umpqua River at RM 49.58						2	31	31	30	3		
2016	41074-ORDEQ	Rice Cr 410m US from mouth					14	30	31	31	6			
2016	41075-ORDEQ	Rice Cr at Rice Cr Rd					14	30	31	31	30	2		
2016	41078-ORDEQ	Rice Cr 250m US of lowest Rice Cr Rd Crossing					28	60*	62*	62*	60*	4		
2016	41080-ORDEQ	Rice Cr 400m US of lowest Rice Cr Rd Crossing					14	30	31	31	30	2		
2016	41082-ORDEQ	Rice Cr 610m US of lowest Rice Cr Rd Crossing					14	30	31	31	30	2		
2016	41084-ORDEQ	Rice Cr 540m DS of Porter Cr					14	30	31	31	30	2		
2016	UmpNF-003	Beaver Creek on 3114_LTWT						14	31	31	28			
2016	UmpNF-006	Black Rock Fork at the Mouth_LTWT						23	31	31	27			
2016	UmpNF-007	Boulder Creek at the Mouth_LTWT						23	31	31	27			
2016	UmpNF-012	Brownie Creek at the mouth LTWT						16	31	31	30	2		

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	UmpNF-013	Buckeye Creek at the Mouth_LTWT						23	31	31	27			
2016	UmpNF-015	Callahan Creek at the mouth WT						16	31	31	30	2		
2016	UmpNF-017	Castle Rock Fork at the Mouth_LTWT						23	31	31	27			
2016	UmpNF-025	Cow Creek above dismal Creek_LTWT						14	31	31	30	2		
2016	UmpNF-026	Coyote Creek Watershed #1_LTWT						10	31	31	30	31	6	
2016	UmpNF-027	Coyote Creek Watershed #2 LTWT						10	31	31	30	31	6	
2016	UmpNF-028	Coyote Creek Watershed #3 LTWT						10	31	31	30	31	6	
2016	UmpNF-029	Coyote Creek Watershed #4 LTWT	31	29	31	30	31	30	31	31	30			
2016	UmpNF-031	Deadman Creek at the mouth LTWT						23	31	31	27			
2016	UmpNF-037	Elk Creek at Tiller_LTWT						16	31	31	27			
2016	UmpNF-045	Jackson Creek above Faclon above Structure WT						21	31	31	28			
2016	UmpNF-046	Jackson Creek above Falcon below Structure WT						21	31	31	28			
2016	UmpNF-048	Jackson Creek above Luck Creek Fish Structure WT						21	31	31	28			
2016	UmpNF-049	Jackson Creek below Luck Creek Fish Structure WT						21	31	31	28			
2016	UmpNF-050	Jackson Creek near the Mouth_LTWT						14	31	31	27			
2016	UmpNF-068	Quartz Creek at the Mouth_LTWT						23	31	31	27			
2016	UmpNF-076	South Umpqua at Tiller Ranger Station_LTWT										31	30	31
2016	UmpNF-077	South Umpqua River above South Umpqua Falls_LTWT						23	31	31	27			
2016	UmpNF-081	Trib to Joe Hall at Singing Falls WT						13	31	31	30	12		
2017	10997-ORDEQ	Cow Creek at mouth						3	31	31	20			
2017	11315-ORDEQ	Roberts Creek at Carnes Road in Green						23	31	31	30	4		
2017	11316-ORDEQ	Myrtle Creek at mouth						3	31	31	20			
2017	12247-ORDEQ	Rice Creek at junction of Willis Creek Road & Rice Creek Road					21	30	31	31	30	3		
2017	12277-ORDEQ	Lookingglass Creek upstream of Applegate Creek						3	31	31	20			
2017	14320934	Little Wolf Creek Near Tyee, OR	30	28	30	30	31	30	31	31	30	31	30	31

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2017	24405-ORDEQ	Calapooya at Umpqua Landing						1	31	31	30	9		
2017	25187-ORDEQ	South Fork of Deer Creek near mouth, South Umpqua River						23	31	31	30	4		
2017	25188-ORDEQ	North Fork Deer Creek near mouth, South Umpqua						23	31	31	30	4		
2017	25950-ORDEQ	Deer Creek at Fowler Bridge, Roseburg (South Umpqua, Umpqua)						23	31	31	30	4		
2017	29820-ORDEQ	Hinkle Creek at Mouth (RM 0.14)						16	31	31	30	9		
2017	30143-ORDEQ	Windy Creek at Glendale						26	31	31	22			
2017	30147-ORDEQ	Camp Creek at mouth						27	31	31	8			
2017	30154-ORDEQ	Calapooya Creek above Cabin Creek						16	31	31	21			
2017	30161-ORDEQ	Pass Creek at mouth						17	31	31	23			
2017	30696-ORDEQ	South Umpqua River at Old Hwy 99 Bridge Crossing, River Mile 24.6						3	31	31	30	4		
2017	31694-ORDEQ	Newton Creek at mouth, NW Jefferson Street, Roseburg, OR						23	31	31	30	4		
2017	33227-ORDEQ	Calapooya Creek at Hinkle Creek Road						16	31	31	30	9		
2017	36302-ORDEQ	S Umpqua upstream of ODOT Lawson Bar						3	31	31	20			
2017	37477-ORDEQ	North Myrtle Creek at Evergreen Park						26	31	31	22			
2017	37493-ORDEQ	Yellow Cr near Mouth						1	31	31	30	2		
2017	37508-ORDEQ	Umpqua River at James Wood Boat Ramp						1	31	31	30	2		

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2017	38046-ORDEQ	Mehl Creek at Mehl Road						1	31	31	30	2		
2017	38048-ORDEQ	Umpqua River Below Osprey Boat Ramp							18	31	30	2		
2017	38319-ORDEQ	Wolf Cr above Little Wolf Cr near Umpqua OR						1	31	31	30	2		
2017	40119-ORDEQ	South Umpqua River at RM 60						3	31	31	30	9		
2017	40120-ORDEQ	South Umpqua 100 m US of Myrtle CR						3	31	31	20			
2017	40210-ORDEQ	Rice Cr 290m DS of Porter Cr					21	30	31	31	18			
2017	40354-ORDEQ	South Umpqua at Oak Ave. Bridge							20	31	30	4		
2017	40518-ORDEQ	Calapooya Creek at Driver Valley Rd bridge						16	31	31	30	9		
2017	40519-ORDEQ	Hubbard Creek at Hubbard Creek Rd. Bridge						1	31	31	30	2		
2017	40520-ORDEQ	Umpqua River at RM 49.58						1	31	31	30	2		
2017	41074-ORDEQ	Rice Cr 410m US from mouth					21	30	30	29	30	3		
2017	41075-ORDEQ	Rice Cr at Rice Cr Rd					21	30	31	31	18			
2017	41078-ORDEQ	Rice Cr 250m US of lowest Rice Cr Rd Crossing					35*	55*	62*	62*	30			
2017	41080-ORDEQ	Rice Cr 400m US of lowest Rice Cr Rd Crossing					21	30	31	31	18			
2017	41082-ORDEQ	Rice Cr 610m US of lowest Rice Cr Rd Crossing					21	30	31	31	18			
2017	41084-ORDEQ	Rice Cr 540m DS of Porter Cr					21	30	31	31	18			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2017	UmpNF-003	Beaver Creek on 3114_LTWT						16	31	31	24			
2017	UmpNF-006	Black Rock Fork at the Mouth_LTWT						23	31	31	24			
2017	UmpNF-007	Boulder Creek at the Mouth_LTWT						23	31	31	24			
2017	UmpNF-013	Buckeye Creek at the Mouth_LTWT						23	31	31	27			
2017	UmpNF-015	Callahan Creek at the mouth WT						22	31	31	27			
2017	UmpNF-017	Castle Rock Fork at the Mouth_LTWT						23	31	31	24			
2017	UmpNF-025	Cow Creek above dismal Creek_LTWT						22	31	31	26			
2017	UmpNF-026	Coyote Creek Watershed #1_LTWT							28	31	27			
2017	UmpNF-027	Coyote Creek Watershed #2 LTWT							28	31	27			
2017	UmpNF-028	Coyote Creek Watershed #3 LTWT							28	31	27			
2017	UmpNF-029	Coyote Creek Watershed #4 LTWT							28	31	27			
2017	UmpNF-031	Deadman Creek at the mouth LTWT						22	31	31	24			
2017	UmpNF-035	Drew Creek at the mouth WT						22	31	31	26			
2017	UmpNF-036	Dumont Creek at the Mouth_LTWT						16	31	31	24			
2017	UmpNF-037	Elk Creek at Tiller_LTWT						16	31	31	24			
2017	UmpNF-050	Jackson Creek near the Mouth_LTWT						16	31	31	24			
2017	UmpNF-051	Joe Hall Creek at the mouth WT						6	31	29				
2017	UmpNF-068	Quartz Creek at the Mouth_LTWT						23	31	31	24			
2017	UmpNF-076	South Umpqua at Tiller Ranger Station_LTWT	31	28	31	30	31	30	31	31	28	31	29	31
2017	UmpNF-077	South Umpqua River above South Umpqua Falls_LTWT						16	31	31	24			
2017	UmpNF-078	Squaw Creek at the Mouth_LTWT						9	31	31	24			
2017	UmpNF-081	Trib to Joe Hall at Singing Falls WT						6	31	29				
2018	10996-ORDEQ	Calapooya Creek at Umpqua					9	30	31	31	26			
2018	10997-ORDEQ	Cow Creek at mouth					14	30	31	31	30	24		
2018	12247-ORDEQ	Rice Creek at junction of Willis Creek Road & Rice Creek Road					29	30	31	31	30	1		
2018	12277-ORDEQ	Lookingglass Creek upstream of Applegate Creek					14	30	31	31	30	23		

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2018	12796-ORDEQ	Calapooya Creek at Driver Valley Road (Medley Bridge)					23	30	31	31	26			
2018	14320934	Little Wolf Creek Near Tyee, OR	31	28	31	30	31	30	31	31	30	31	30	31
2018	25180-ORDEQ	South Umpqua River at Roseburg Fairgrounds						9	31	31	30	31	6	
2018	25950-ORDEQ	Deer Creek at Fowler Bridge, Roseburg (South Umpqua, Umpqua)					14	30	31	31	30	24		
2018	28439-ORDEQ	Mehl Creek at River Mile 0.6 (Umpqua)					9	30	31	31	26			
2018	29820-ORDEQ	Hinkle Creek at Mouth (RM 0.14)					23	30	31	31	26			
2018	30143-ORDEQ	Windy Creek at Glendale						20	31	31	21			
2018	30147-ORDEQ	Camp Creek at mouth						21	31	31	22			
2018	30154-ORDEQ	Calapooya Creek above Cabin Creek						24	31	31	28			
2018	30161-ORDEQ	Pass Creek at mouth						21	31	31	22			
2018	33227-ORDEQ	Calapooya Creek at Hinkle Creek Road						10	31	31	26			
2018	36302-ORDEQ	S Umpqua upstream of ODOT Lawson Bar						9	31	31	30	24		
2018	37477-ORDEQ	North Myrtle Creek at Evergreen Park						22	31	31	21			
2018	37508-ORDEQ	Umpqua River at James Wood Boat Ramp					9	30	31	31	26			
2018	38319-ORDEQ	Wolf Cr above Little Wolf Cr near Umpqua OR					9	30	31	31	26			
2018	40119-ORDEQ	South Umpqua River at RM 60						9	31	31	30	23		

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2018	40120-ORDEQ	South Umpqua 100 m US of Myrtle CR						9	31	31	30	24		
2018	40210-ORDEQ	Rice Cr 290m DS of Porter Cr					17	30	31	31	30	1		
2018	40357-ORDEQ	Myrtle Creek Upstream of Railroad Trestle					14	30	31	31	30	23		
2018	40507-ORDEQ	Yellow Creek 790 m above Umpqua River					9	30	31	31	26			
2018	40519-ORDEQ	Hubbard Creek at Hubbard Creek Rd. Bridge					9	30	31	31	26			
2018	40520-ORDEQ	Umpqua River at RM 49.58					9	30	31	31	26			
2018	41074-ORDEQ	Rice Cr 410m US from mouth					30	30	31	7				
2018	41075-ORDEQ	Rice Cr at Rice Cr Rd					30	30	31	31	30	1		
2018	41076-ORDEQ	Rice Cr 55m US of lowest Rice Cr Rd crossing					30	30	31	31	30	1		
2018	41077-ORDEQ	Rice Cr 100m US of lowest Rice Cr Rd crossing					17	30	22		20	1		
2018	41078-ORDEQ	Rice Cr 250m US of lowest Rice Cr Rd Crossing					56*	60*	62*	62*	60*	2		
2018	41079-ORDEQ	Rice Cr 275m US of lowest Rice Cr Rd Crossing					30	30	24	12	30	1		
2018	41080-ORDEQ	Rice Cr 400m US of lowest Rice Cr Rd Crossing					13	30	5					
2018	41081-ORDEQ	Rice Cr 575m US of lowest Rice Cr Rd Crossing					17	30	31	31	30	1		
2018	41082-ORDEQ	Rice Cr 610m US of lowest Rice Cr Rd Crossing					17	30	31	31	30	1		
2018	41083-ORDEQ	Rice Cr 615m US of lowest Rice Cr Rd Crossing					17	30	31	6	29	1		

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2018	41084-ORDEQ	Rice Cr 540m DS of Porter Cr					17	30	23	31	30	1		
2018	41085-ORDEQ	Rice Cr 490m DS of Porter Cr					17	29	23	31	30	1		
2018	41086-ORDEQ	Rice Cr 435m DS of Porter Cr					17	30	31	31	30	1		
2018	UmpNF-003	Beaver Creek on 3114_LTWT						3	31	31	30	2		
2018	UmpNF-006	Black Rock Fork at the Mouth_LTWT						10	31	31	30	3		
2018	UmpNF-007	Boulder Creek at the Mouth_LTWT						10	31	31	30	3		
2018	UmpNF-013	Buckeye Creek at the Mouth_LTWT						2	31	31	30	3		
2018	UmpNF-015	Callahan Creek at the mouth WT						3	31	31	30	8		
2018	UmpNF-017	Castle Rock Fork at the Mouth_LTWT						10	31	31	30	3		
2018	UmpNF-025	Cow Creek above dismal Creek_LTWT						8	31	31	30	4		
2018	UmpNF-026	Coyote Creek Watershed #1_LTWT						2	31	31	30	29	29	31
2018	UmpNF-027	Coyote Creek Watershed #2 LTWT						2	31	31	30	29	29	31
2018	UmpNF-028	Coyote Creek Watershed #3 LTWT						2	31	31	30	29	29	31
2018	UmpNF-029	Coyote Creek Watershed #4 LTWT						2	31	31	30	29	29	31
2018	UmpNF-031	Deadman Creek at the mouth LTWT						10	31	31	30	3		
2018	UmpNF-032	Deep Cut Creek at the mouth WT						3	31	31	30	1		
2018	UmpNF-035	Drew Creek at the mouth WT							25	31	30	8		
2018	UmpNF-036	Dumont Creek at the Mouth_LTWT								5	30	29	29	31
2018	UmpNF-037	Elk Creek at Tiller_LTWT						3	31	31	30	8		
2018	UmpNF-050	Jackson Creek near the Mouth_LTWT						3	31	31	30	2		
2018	UmpNF-051	Joe Hall Creek at the mouth WT						9	31	31	30	31	17	
2018	UmpNF-068	Quartz Creek at the Mouth_LTWT						10	31	31	30	3		
2018	UmpNF-076	South Umpqua at Tiller Ranger Station_LTWT	31	28	30	30	31	30	31	31	30	29	29	31
2018	UmpNF-077	South Umpqua River above South Umpqua Falls_LTWT						10	31	31	30	3		
2018	UmpNF-078	Squaw Creek at the Mouth_LTWT						3	31	31	30	2		
2019	12247-ORDEQ	Rice Creek at junction of Willis Creek Road & Rice Creek Road					31	9	24	31	30			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2019	14320934	Little Wolf Creek Near Tyee, OR	31	28	31	30	17	30	31	31	30	23	17	31
2019	30143-ORDEQ	Windy Creek at Glendale						22	31	31	21			
2019	30147-ORDEQ	Camp Creek at mouth						29	31	31	30	5		
2019	30154-ORDEQ	Calapooya Creek above Cabin Creek						21	31	31	28			
2019	30161-ORDEQ	Pass Creek at mouth						21	31	31	21			
2019	37477-ORDEQ	North Myrtle Creek at Evergreen Park						22	31	31	21			
2019	40210-ORDEQ	Rice Cr 290m DS of Porter Cr					31	30	31	31	30			
2019	41074-ORDEQ	Rice Cr 410m US from mouth					29	30	31	31	30			
2019	41075-ORDEQ	Rice Cr at Rice Cr Rd					31	30	31	31	30			
2019	41076-ORDEQ	Rice Cr 55m US of lowest Rice Cr Rd crossing					31	30	31	31	30			
2019	41077-ORDEQ	Rice Cr 100m US of lowest Rice Cr Rd crossing					31	30	20	9	19			
2019	41078-ORDEQ	Rice Cr 250m US of lowest Rice Cr Rd Crossing					56*	59*	62*	62*	59*			
2019	41079-ORDEQ	Rice Cr 275m US of lowest Rice Cr Rd Crossing					31	30	31	31	30			
2019	41080-ORDEQ	Rice Cr 400m US of lowest Rice Cr Rd Crossing					31	30	31	31	30			
2019	41081-ORDEQ	Rice Cr 575m US of lowest Rice Cr Rd Crossing					31	30	31	31	30			
2019	41082-ORDEQ	Rice Cr 610m US of lowest Rice Cr Rd Crossing					31	30	31	31	30			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2019	41083-ORDEQ	Rice Cr 615m US of lowest Rice Cr Rd Crossing					31	30	31	31	30			
2019	41084-ORDEQ	Rice Cr 540m DS of Porter Cr					31	30	31	31	30			
2019	41085-ORDEQ	Rice Cr 490m DS of Porter Cr					31	30	31	31	30			
2019	41086-ORDEQ	Rice Cr 435m DS of Porter Cr					31	30	31	31	30			
2019	41087-ORDEQ	Rice Cr 430m DS of Porter Cr					31	30	31	31	30			
2019	UmpNF-003	Beaver Creek on 3114_LTWT						30	31	31	22			
2019	UmpNF-006	Black Rock Fork at the Mouth_LTWT						30	31	31	18			
2019	UmpNF-007	Boulder Creek at the Mouth_LTWT						30	31	31	22			
2019	UmpNF-013	Buckeye Creek at the Mouth_LTWT						29	31	31	18			
2019	UmpNF-015	Callahan Creek at the mouth WT						11	31	31	22			
2019	UmpNF-017	Castle Rock Fork at the Mouth_LTWT						30	31	31	18			
2019	UmpNF-025	Cow Creek above dismal Creek_LTWT					1	30	31	31	22			
2019	UmpNF-026	Coyote Creek Watershed #1_LTWT	31	28	30	30	31	30	31	31	30	21		
2019	UmpNF-027	Coyote Creek Watershed #2 LTWT	31	28	30	30	31	30	31	31	30	21		
2019	UmpNF-028	Coyote Creek Watershed #3 LTWT	31	28	30	30	31	30	31	31	30	21		
2019	UmpNF-029	Coyote Creek Watershed #4 LTWT	31	28	30	30	31	30	31	31	30	21		
2019	UmpNF-031	Deadman Creek at the mouth LTWT						23	31	31	18			
2019	UmpNF-035	Drew Creek at the mouth WT							29	31	22			
2019	UmpNF-036	Dumont Creek at the Mouth_LTWT	31	28	30	30	31	30	31	31	14			
2019	UmpNF-037	Elk Creek at Tiller_LTWT						23	31	31	22			
2019	UmpNF-050	Jackson Creek near the Mouth_LTWT						23	31	31	22			
2019	UmpNF-051	Joe Hall Creek at the mouth WT					6	30	31	31	22			
2019	UmpNF-068	Quartz Creek at the Mouth_LTWT						30	31	31	18			
2019	UmpNF-076	South Umpqua at Tiller Ranger Station_LTWT	31	28	30	30	31	30	31	31	22			
2019	UmpNF-077	South Umpqua River above South Umpqua Falls_LTWT						30	31	31	18			

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2019	UmpNF-078	Squaw Creek at the Mouth_LTWT						3	31	31	22			
2020	14320934	Little Wolf Creek Near Tyee, OR	31	29	31	30	31	30	31	31	30	31	30	28
2020	30143-ORDEQ	Windy Creek at Glendale						24	62*	62*	60*	6		
2020	30147-ORDEQ	Camp Creek at mouth						32*	62*	62*	46*			
2020	30154-ORDEQ	Calapooya Creek above Cabin Creek						22	62*	62*	42*			
2020	30161-ORDEQ	Pass Creek at mouth						32*	62*	62*	46*			
2020	37477-ORDEQ	North Myrtle Creek at Evergreen Park						34*	62*	62*	52*			

* Some stations have more daily maximum results than the number of days in the month due to multiple probes being deployed at the same location or due to duplicate entries in AWQMS. These data are not proposed to support the modeling so we did not investigate these specific situations further.

Appendix C Stream flow data summary

Table 65: Continuous flow measurements available from the USGS flow gaging stations in the South Umpqua and Umpqua Subbasins.

Station ID	Station	Latitude/Longitude
14308000	South Umpqua River At Tiller, OR	42.9304/-122.9484
14308500	Elk Creek Nr Drew, OR	42.89012/-122.9178
14308600	S. Umpqua River @ Days Creek, OR	42.96734/-123.1676
14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	42.82318/-123.1259
14309000	Cow Creek Near Azalea, OR	42.82484/-123.1789
14309500	West Fork Cow Creek Near Glendale, OR	42.804/-123.6109
14310000	Cow Creek Near Riddle, OR	42.92345/-123.429
14311500	Lookingglass Creek At Brockway, OR	43.13039/-123.4651
14312000	South Umpqua River Near Brockway, OR	43.13317/-123.3984
14312170	South Fork Deer Creek Near Dixonville, OR	43.17095/-123.2242
14319830	South Fork Hinkle Creek Near Nonpareil, OR	43.42206/-123.0395
14319835	North Fork Hinkle Creek Near Nonpareil, OR	43.42345/-123.0392
14319850	Gassy Creek Near Nonpareil, OR	43.41706/-123.1217
14320700	Calapooya Creek Near Oakland, OR	43.40262/-123.3637
14320934	Little Wolf Creek Near Tyee, OR	43.43123/-123.5868
14321000	Umpqua River Near Elkton, OR	43.58595/-123.5554
14321400	Elk Creek Near Elkhead, OR	43.59568/-123.1942

Table 66: Instantaneous flow measurements made by DEQ in the South Umpqua and Umpqua Subbasins.

Station ID	Station	Date	Flow (cfs)	Latitude/Longitude
407030	North Fork Smith River at approximately RM 5.2	1999-08-09	12.890	43.8083/-123.761
407029	North Fork Smith River downstream of Paxton Creek	1999-08-09	12.890	43.8731/-123.91
407026	North Fork Smith River downstream of the West Branch	1999-08-09	8.935	43.8804/-123.876
407027	North Fork Smith River upstream of the Middle Fork of the North Fork Smith	1999-08-09	3.740	43.876/-123.828
407025	Kentucky Creek at Falls Trailhead	1999-08-09	1.240	43.9287/-123.792

Station ID	Station	Date	Flow (cfs)	Latitude/Longitude
24116-ORDEQ	Smith River upstream of Johnson Creek	2000-07-16	33.480	43.8066/-123.802
24118-ORDEQ	Smith River upstream of West Fork Smith	2000-07-16	21.190	43.8081/-123.762
24148-ORDEQ	Smith River upstream of Carpenter Creek	2000-07-16	18.620	43.8026/-123.726
24126-ORDEQ	Smith River upstream of South Sister Creek	2000-07-16	18.390	43.8214/-123.671
24124-ORDEQ	Smith River upstream of Big Creek	2000-07-16	15.490	43.7693/-123.654
24123-ORDEQ	Smith River upstream of Halfway Creek	2000-07-16	11.000	43.7695/-123.592
24122-ORDEQ	Smith River upstream of Cleghorn Creek	2000-07-16	7.480	43.7625/-123.539
24121-ORDEQ	Smith River upstream of Yellow Creek	2000-07-16	8.650	43.7914/-123.548
24120-ORDEQ	Smith River downstream Salmonberry Creek	2000-07-16	4.990	43.8017/-123.482
24102-ORDEQ	Smith River upstream of South Fork Smith	2000-07-16	4.560	43.7825/-123.469
24101-ORDEQ	Smith River upstream of Peterson Creek	2000-07-16	1.380	43.7714/-123.367

Table 67: Summary of existing flow data in the South Umpqua and Umpqua Subbasins. Columns Jan – Dec indicate the number of daily mean flow results in each month.

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	14308000	South Umpqua River At Tiller, OR	31	28	31	30	31	30	31	31	30	31	30	31
1990	14308500	Elk Creek Nr Drew, OR	31	28	31	30	31	30	31	31	30	31	30	31
1990	14308600	S. Umpqua River @ Days Creek, OR	31	28	31	30	31	30	31	31	29			
1990	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	28	31	30	31	30	31	31	30	31	30	31
1990	14309000	Cow Creek Near Azalea, OR	31	28	31	30	31	30	31	31	30	31	30	31
1990	14309500	West Fork Cow Creek Near Glendale, OR	31	28	31	30	31	30	31	31	30	31	30	31
1990	14310000	Cow Creek Near Riddle, OR	31	28	31	30	31	30	31	31	30	31	30	31
1990	14311500	Lookingglass Creek At Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31
1990	14312000	South Umpqua River Near Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31
1990	14312170	South Fork Deer Creek Near Dixonville, OR	31	28	31	30	31	30	31	31	30	31	30	31
1990	14319850	Gassy Creek Near Nonpareil, OR	31	28	31	30	31	30	31	31	30	31	30	31
1990	14320700	Calapooya Creek Near Oakland, OR	31	28	31	30	31	30	31	31	30	31	30	31
1990	14321000	Umpqua River Near Elkton, OR	31	28	31	30	31	30	31	31	30	31	30	31
1990	14321400	Elk Creek Near Elkhead, OR	31	28	31	30	31	30	31	31	30	31	30	31
1991	14308000	South Umpqua River At Tiller, OR	31	28	31	30	31	30	31	31	30	31	30	31
1991	14308500	Elk Creek Nr Drew, OR	31	28	31	30	31	30	31	31	30	31	30	31
1991	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	28	31	30	31	30	31	31	30	31	30	31
1991	14309000	Cow Creek Near Azalea, OR	31	28	31	30	31	30	31	31	30	31	30	31
1991	14309500	West Fork Cow Creek Near Glendale, OR	31	28	31	30	31	30	31	31	30	31	30	31
1991	14310000	Cow Creek Near Riddle, OR	31	28	31	30	31	30	31	31	30	31	30	31
1991	14311500	Lookingglass Creek At Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31
1991	14312000	South Umpqua River Near Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31
1991	14312170	South Fork Deer Creek Near Dixonville, OR	31	28	31	30	31	30	31	31	30	31	30	31
1991	14319850	Gassy Creek Near Nonpareil, OR	31	28	31	30	31	30	31	31	30	31	30	31
1991	14320700	Calapooya Creek Near Oakland, OR	31	28	31	30	31	30	31	31	30	31	30	31
1991	14321000	Umpqua River Near Elkton, OR	31	28	31	30	31	30	31	31	30	31	30	31
1991	14321400	Elk Creek Near Elkhead, OR	31	28	31	30	31	30	31	31	30	31	30	31

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1992	14308000	South Umpqua River At Tiller, OR	31	29	31	30	31	30	31	31	30	31	30	31
1992	14308500	Elk Creek Nr Drew, OR	31	29	31	30	31	30	31	31	30	31	30	31
1992	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	29	31	30	31	30	31	31	30	31	30	31
1992	14309000	Cow Creek Near Azalea, OR	31	29	31	30	31	30	31	31	30	31	30	31
1992	14309500	West Fork Cow Creek Near Glendale, OR	31	29	31	30	31	30	31	31	30	31	30	31
1992	14310000	Cow Creek Near Riddle, OR	31	29	31	30	31	30	31	31	30	31	30	31
1992	14311500	Lookingglass Creek At Brockway, OR	31	29	31	30	31	30	31	31	30	31	30	31
1992	14312000	South Umpqua River Near Brockway, OR	31	29	31	30	31	30	31	31	30	31	30	31
1992	14312170	South Fork Deer Creek Near Dixonville, OR	31	29	31	30	31	30	31	31	30	31	30	31
1992	14319850	Gassy Creek Near Nonpareil, OR	31	29	31	30	31	30	31	31	30	31	30	31
1992	14320700	Calapooya Creek Near Oakland, OR	31	29	31	30	31	30	31	31	30	31	30	31
1992	14321000	Umpqua River Near Elkton, OR	31	29	31	30	31	30	31	31	30	31	30	31
1992	14321400	Elk Creek Near Elkhead, OR	31	29	31	30	31	30	31	31	30	31	30	31
1993	14308000	South Umpqua River At Tiller, OR	31	28	31	30	31	30	31	31	30	31	30	31
1993	14308500	Elk Creek Nr Drew, OR	31	28	31	30	31	30	31	31	30	31	30	31
1993	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	28	31	30	31	30	31	31	30	31	30	31
1993	14309000	Cow Creek Near Azalea, OR	31	28	31	30	31	30	31	31	30	31	30	31
1993	14309500	West Fork Cow Creek Near Glendale, OR	31	28	31	30	31	30	31	31	30	31	30	31
1993	14310000	Cow Creek Near Riddle, OR	31	28	31	30	31	30	31	31	30	31	30	31
1993	14311500	Lookingglass Creek At Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31
1993	14312000	South Umpqua River Near Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31
1993	14312170	South Fork Deer Creek Near Dixonville, OR	31	28	31	30	31	30	31	31	30	31	30	31
1993	14319850	Gassy Creek Near Nonpareil, OR	31	28	31	30	31	30	31	31	30	31	30	31
1993	14320700	Calapooya Creek Near Oakland, OR	31	28	31	30	31	30	31	31	30	31	30	31
1993	14321000	Umpqua River Near Elkton, OR	31	28	31	30	31	30	31	31	30	31	30	31
1993	14321400	Elk Creek Near Elkhead, OR	31	28	31	30	31	30	31	31	30	31	30	31
1994	14308000	South Umpqua River At Tiller, OR	31	28	31	30	31	30	31	31	30	31	30	31
1994	14308500	Elk Creek Nr Drew, OR	31	28	31	30	31	30	31	31	30	31	30	31
1994	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	28	31	30	31	30	31	31	30	31	30	31

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1994	14309000	Cow Creek Near Azalea, OR	31	28	31	30	31	30	31	31	30	31	30	31
1994	14309500	West Fork Cow Creek Near Glendale, OR	31	28	31	30	31	30	31	31	30	31	30	31
1994	14310000	Cow Creek Near Riddle, OR	31	28	31	30	31	30	31	31	30	31	30	31
1994	14311500	Lookingglass Creek At Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31
1994	14312000	South Umpqua River Near Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31
1994	14312170	South Fork Deer Creek Near Dixonville, OR	31	28	31	30	31	30	31	31	30	31	30	31
1994	14319850	Gassy Creek Near Nonpareil, OR	31	28	31	30	31	30	31	31	30	31	30	31
1994	14320700	Calapooya Creek Near Oakland, OR	31	28	31	30	31	30	31	31	30	31	30	31
1994	14321000	Umpqua River Near Elkton, OR	31	28	31	30	31	30	31	31	30	31	30	31
1994	14321400	Elk Creek Near Elkhead, OR	31	28	31	30	31	30	31	31	30	31	30	31
1995	14308000	South Umpqua River At Tiller, OR	31	28	31	30	31	30	31	31	30	31	30	31
1995	14308500	Elk Creek Nr Drew, OR	31	28	31	30	31	30	31	31	30	31	30	31
1995	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	28	31	30	31	30	31	31	30	31	30	31
1995	14309000	Cow Creek Near Azalea, OR	31	28	31	30	31	30	31	31	30	31	30	31
1995	14309500	West Fork Cow Creek Near Glendale, OR	31	28	31	30	31	30	31	31	30	31	30	31
1995	14310000	Cow Creek Near Riddle, OR	31	28	31	30	31	30	31	31	30	31	30	31
1995	14311500	Lookingglass Creek At Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31
1995	14312000	South Umpqua River Near Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31
1995	14312170	South Fork Deer Creek Near Dixonville, OR	31	28	31	30	31	30	31	31	30	31	30	31
1995	14319850	Gassy Creek Near Nonpareil, OR	31	28	31	30	31	30	31	31	30	31	30	31
1995	14320700	Calapooya Creek Near Oakland, OR	31	28	31	30	31	30	31	31	30	31	30	31
1995	14321000	Umpqua River Near Elkton, OR	31	28	31	30	31	30	31	31	30	31	30	31
1995	14321400	Elk Creek Near Elkhead, OR	31	28	31	30	31	30	31	31	30	31	30	31
1996	14308000	South Umpqua River At Tiller, OR	31	29	31	30	31	30	31	31	30	31	30	31
1996	14308500	Elk Creek Nr Drew, OR	31	29	31	30	31	30	31	31	30	31	30	31
1996	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	29	31	30	31	30	31	31	30	31	30	31
1996	14309000	Cow Creek Near Azalea, OR	31	29	31	30	31	30	31	31	30	31	30	31
1996	14309500	West Fork Cow Creek Near Glendale, OR	31	29	31	30	31	30	31	31	30	31	30	31
1996	14310000	Cow Creek Near Riddle, OR	31	29	31	30	31	30	31	31	30	31	30	31

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1996	14311500	Lookingglass Creek At Brockway, OR	31	29	31	30	31	30	31	31	30	31	30	31
1996	14312000	South Umpqua River Near Brockway, OR	31	29	31	30	31	30	31	31	30	31	30	31
1996	14312170	South Fork Deer Creek Near Dixonville, OR	31	29	31	30	31	30	31	31	30	31	30	31
1996	14319850	Gassy Creek Near Nonpareil, OR	31	29	31	30	31	30	31	31	30	31	30	31
1996	14320700	Calapooya Creek Near Oakland, OR	31	29	31	30	31	30	31	31	30	31	30	31
1996	14321000	Umpqua River Near Elkton, OR	31	29	31	30	31	30	31	31	30	31	30	31
1996	14321400	Elk Creek Near Elkhead, OR	31	29	31	30	31	30	31	31	30	31	30	31
1997	14308000	South Umpqua River At Tiller, OR	31	28	31	30	31	30	31	31	30	31	30	31
1997	14308500	Elk Creek Nr Drew, OR	31	28	31	30	31	30	31	31	30	31	30	31
1997	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	28	31	30	31	30	31	31	30	31	30	31
1997	14309000	Cow Creek Near Azalea, OR	31	28	31	30	31	30	31	31	30	31	30	31
1997	14309500	West Fork Cow Creek Near Glendale, OR	31	28	31	30	31	30	31	31	30	31	30	31
1997	14310000	Cow Creek Near Riddle, OR	31	28	31	30	31	30	31	31	30	31	30	31
1997	14311500	Lookingglass Creek At Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31
1997	14312000	South Umpqua River Near Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31
1997	14312170	South Fork Deer Creek Near Dixonville, OR	31	28	31	30	31	30	31	31	30	31	30	31
1997	14319850	Gassy Creek Near Nonpareil, OR	31	28	31	30	31	30	31	31	30	31	30	31
1997	14320700	Calapooya Creek Near Oakland, OR	31	28	31	30	31	30	31	31	30	31	30	31
1997	14321000	Umpqua River Near Elkton, OR	31	28	31	30	31	30	31	31	30	31	30	31
1997	14321400	Elk Creek Near Elkhead, OR	31	28	31	30	31	30	31	31	30	31	30	31
1998	14308000	South Umpqua River At Tiller, OR	31	28	31	30	31	30	31	31	30	31	30	31
1998	14308500	Elk Creek Nr Drew, OR	31	28	31	30	31	30	31	31	30	31	30	31
1998	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	28	31	30	31	30	31	31	30	31	30	31
1998	14309000	Cow Creek Near Azalea, OR	31	28	31	30	31	30	31	31	30	31	30	31
1998	14309500	West Fork Cow Creek Near Glendale, OR	31	28	31	30	31	30	31	31	30	31	30	31
1998	14310000	Cow Creek Near Riddle, OR	31	28	31	30	31	30	31	31	30	31	30	31
1998	14311500	Lookingglass Creek At Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31
1998	14312000	South Umpqua River Near Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31
1998	14312170	South Fork Deer Creek Near Dixonville, OR	31	28	31	30	31	30	31	31	30	31	30	31

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1998	14319850	Gassy Creek Near Nonpareil, OR	31	28	31	30	31	30	31	31	30	31	30	31
1998	14320700	Calapooya Creek Near Oakland, OR	31	28	31	30	31	30	31	31	30	31	30	31
1998	14321000	Umpqua River Near Elkton, OR	31	28	31	30	31	30	31	31	30	31	30	31
1998	14321400	Elk Creek Near Elkhead, OR	31	28	31	30	31	30	31	31	30	31	30	31
1999	14308000	South Umpqua River At Tiller, OR	31	28	31	30	31	30	31	31	30	31	30	31
1999	14308500	Elk Creek Nr Drew, OR	31	28	31	30	31	30	31	31	30	31	30	31
1999	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	28	31	30	31	30	31	31	30	31	30	31
1999	14309000	Cow Creek Near Azalea, OR	31	28	31	30	31	30	31	31	30	31	30	31
1999	14309500	West Fork Cow Creek Near Glendale, OR	31	28	31	30	31	30	31	31	30	31	30	31
1999	14310000	Cow Creek Near Riddle, OR	31	28	31	30	31	30	31	31	30	31	30	31
1999	14311500	Lookingglass Creek At Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31
1999	14312000	South Umpqua River Near Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31
1999	14312170	South Fork Deer Creek Near Dixonville, OR	31	28	31	30	31	30	31	31	30	31	30	31
1999	14319850	Gassy Creek Near Nonpareil, OR	31	28	31	30	31	30	31	31	30	31	30	31
1999	14320700	Calapooya Creek Near Oakland, OR	31	28	31	30	31	30	31	31	30	31	30	31
1999	14321000	Umpqua River Near Elkton, OR	31	28	31	30	31	30	31	31	30	31	30	31
1999	14321400	Elk Creek Near Elkhead, OR	31	28	31	30	31	30	31	31	30			
2000	14308000	South Umpqua River At Tiller, OR	31	29	31	30	31	30	31	31	30	31	30	31
2000	14308500	Elk Creek Nr Drew, OR	31	29	31	30	31	30	31	31	29			
2000	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	29	31	30	31	30	31	31	30	31	30	31
2000	14309000	Cow Creek Near Azalea, OR	31	29	31	30	31	30	31	31	30	31	30	31
2000	14309500	West Fork Cow Creek Near Glendale, OR	31	29	31	30	31	30	31	31	30	31	30	31
2000	14310000	Cow Creek Near Riddle, OR	31	29	31	30	31	30	31	31	30	31	30	31
2000	14311500	Lookingglass Creek At Brockway, OR	31	29	31	30	31	30	31	31	30			
2000	14312000	South Umpqua River Near Brockway, OR	31	29	31	30	31	30	31	31	30	31	30	31
2000	14312170	South Fork Deer Creek Near Dixonville, OR	31	29	31	30	31	30	31	31	29			
2000	14319850	Gassy Creek Near Nonpareil, OR	31	29	31	30	31	30	31	31	30			
2000	14320700	Calapooya Creek Near Oakland, OR	31	29	31	30	31	30	31	31	30	31	30	31
2000	14321000	Umpqua River Near Elkton, OR	31	29	31	30	31	30	31	31	30	31	30	31

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2001	14308000	South Umpqua River At Tiller, OR	31	28	31	30	31	30	31	31	30	31	30	31
2001	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	28	31	30	31	30	31	31	30	31	30	31
2001	14309000	Cow Creek Near Azalea, OR	31	28	31	30	31	30	31	31	30	31	30	31
2001	14309500	West Fork Cow Creek Near Glendale, OR	31	28	31	30	31	30	31	31	30	31	30	31
2001	14310000	Cow Creek Near Riddle, OR	31	28	31	30	31	30	31	31	30	31	30	31
2001	14312000	South Umpqua River Near Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31
2001	14320700	Calapooya Creek Near Oakland, OR	31	28	31	30	31	30	31	31	30			
2001	14321000	Umpqua River Near Elkton, OR	31	28	31	30	31	30	31	31	30	31	30	31
2002	14308000	South Umpqua River At Tiller, OR	31	28	31	30	31	30	31	31	30	31	30	31
2002	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	28	31	30	31	30	31	31	30	31	30	31
2002	14309000	Cow Creek Near Azalea, OR	31	28	31	30	31	30	31	31	30	31	30	31
2002	14309500	West Fork Cow Creek Near Glendale, OR	31	28	31	30	31	30	31	31	30	31	30	31
2002	14310000	Cow Creek Near Riddle, OR	31	28	31	30	31	30	31	31	30	31	30	31
2002	14312000	South Umpqua River Near Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31
2002	14321000	Umpqua River Near Elkton, OR	31	28	31	30	31	30	31	31	30	31	30	31
2003	14308000	South Umpqua River At Tiller, OR	31	28	31	30	31	30	31	31	30	31	30	31
2003	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	28	31	30	31	30	31	31	30	31	30	31
2003	14309000	Cow Creek Near Azalea, OR	31	28	31	30	31	30	31	31	30	31	30	31
2003	14309500	West Fork Cow Creek Near Glendale, OR	31	28	31	30	31	30	31	31	30	31	30	31
2003	14310000	Cow Creek Near Riddle, OR	31	28	31	30	31	30	31	31	30	31	30	31
2003	14312000	South Umpqua River Near Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31
2003	14319830	South Fork Hinkle Creek Near Nonpareil, OR						6	31	31	30	31	30	31
2003	14319835	North Fork Hinkle Creek Near Nonpareil, OR							31	31	30	31	30	31
2003	14321000	Umpqua River Near Elkton, OR	31	28	31	30	31	30	31	31	30	31	30	31
2004	14308000	South Umpqua River At Tiller, OR	31	29	31	30	31	30	31	31	30	31	30	31
2004	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	29	31	30	31	30	31	31	30	31	30	31
2004	14309000	Cow Creek Near Azalea, OR	31	29	31	30	31	30	31	31	30	31	30	31
2004	14309500	West Fork Cow Creek Near Glendale, OR	31	29	31	30	31	30	31	31	30	31	30	31
2004	14310000	Cow Creek Near Riddle, OR	31	29	31	30	31	30	31	31	30	31	30	31

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004	14312000	South Umpqua River Near Brockway, OR	31	29	31	30	31	30	31	31	30	31	30	31
2004	14319830	South Fork Hinkle Creek Near Nonpareil, OR	31	29	31	30	31	30	31	31	30	31	30	31
2004	14319835	North Fork Hinkle Creek Near Nonpareil, OR	31	29	31	30	31	30	31	31	30	31	30	31
2004	14321000	Umpqua River Near Elkton, OR	31	29	31	30	31	30	31	31	30	31	30	31
2005	14308000	South Umpqua River At Tiller, OR	31	28	31	30	31	30	31	31	30	31	30	31
2005	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	28	31	30	31	30	31	31	30	31	30	31
2005	14309000	Cow Creek Near Azalea, OR	31	28	31	30	31	30	31	31	30	31	30	31
2005	14309500	West Fork Cow Creek Near Glendale, OR	31	28	31	30	31	30	31	31	30	31	30	31
2005	14310000	Cow Creek Near Riddle, OR	31	28	31	30	31	30	31	31	30	31	30	31
2005	14312000	South Umpqua River Near Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31
2005	14319830	South Fork Hinkle Creek Near Nonpareil, OR	31	28	31	30	31	30	31	31	30	31	30	31
2005	14319835	North Fork Hinkle Creek Near Nonpareil, OR	31	28	31	30	31	30	31	31	30	31	30	31
2005	14321000	Umpqua River Near Elkton, OR	31	28	31	30	31	30	31	31	30	31	30	31
2006	14308000	South Umpqua River At Tiller, OR	31	28	31	30	31	30	31	31	30	31	30	31
2006	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	28	31	30	31	30	31	31	30	31	30	31
2006	14309000	Cow Creek Near Azalea, OR	31	28	31	30	31	30	31	31	30	31	30	31
2006	14309500	West Fork Cow Creek Near Glendale, OR	31	28	31	30	31	30	31	31	30	31	30	31
2006	14310000	Cow Creek Near Riddle, OR	31	28	31	30	31	30	31	31	30	31	30	31
2006	14312000	South Umpqua River Near Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31
2006	14319830	South Fork Hinkle Creek Near Nonpareil, OR	31	28	31	30	31	30	31	31	30	31	30	31
2006	14319835	North Fork Hinkle Creek Near Nonpareil, OR	31	28	31	30	31	30	31	31	30	31	30	31
2006	14321000	Umpqua River Near Elkton, OR	31	28	31	30	31	30	31	31	30	31	30	31
2007	14308000	South Umpqua River At Tiller, OR	31	28	31	30	31	30	31	31	30	31	30	31
2007	14308500	Elk Creek Nr Drew, OR										31	30	31
2007	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	28	31	30	31	30	31	31	30	31	30	31
2007	14309000	Cow Creek Near Azalea, OR	31	28	31	30	31	30	31	31	30	31	30	31
2007	14309500	West Fork Cow Creek Near Glendale, OR	31	28	31	30	31	30	31	31	30	31	30	31
2007	14310000	Cow Creek Near Riddle, OR	31	28	31	30	31	30	31	31	30	31	30	31
2007	14312000	South Umpqua River Near Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2007	14319830	South Fork Hinkle Creek Near Nonpareil, OR	31	28	31	30	31	30	31	31	30	31	30	31
2007	14319835	North Fork Hinkle Creek Near Nonpareil, OR	31	28	31	30	31	30	31	31	30	31	30	31
2007	14320934	Little Wolf Creek Near Tyee, OR								2	30	31	30	31
2007	14321000	Umpqua River Near Elkton, OR	31	28	31	30	31	30	31	31	30	31	30	31
2008	14308000	South Umpqua River At Tiller, OR	31	29	31	30	31	30	31	31	30	31	30	31
2008	14308500	Elk Creek Nr Drew, OR	31	29	31	30	31	30	31	31	30	31	30	31
2008	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	29	31	30	31	30	31	31	30	31	30	31
2008	14309000	Cow Creek Near Azalea, OR	31	29	31	30	31	30	31	31	30	31	30	31
2008	14309500	West Fork Cow Creek Near Glendale, OR	31	29	31	30	31	30	31	31	30	31	30	31
2008	14310000	Cow Creek Near Riddle, OR	31	29	31	30	31	30	31	31	30	31	30	31
2008	14312000	South Umpqua River Near Brockway, OR	31	29	31	30	31	30	31	31	30	31	30	31
2008	14319830	South Fork Hinkle Creek Near Nonpareil, OR	31	29	31	30	31	30	31	31	30	31	30	31
2008	14319835	North Fork Hinkle Creek Near Nonpareil, OR	31	29	31	30	31	30	31	31	30	31	30	31
2008	14320934	Little Wolf Creek Near Tyee, OR	31	29	31	30	31	30	31	31	30	31	30	31
2008	14321000	Umpqua River Near Elkton, OR	31	29	31	30	31	30	31	31	30	31	30	31
2009	14308000	South Umpqua River At Tiller, OR	31	28	31	30	31	30	31	31	30	31	30	31
2009	14308500	Elk Creek Nr Drew, OR	31	28	31	30	31	30	31	31	30	31	30	31
2009	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	28	31	30	31	30	31	31	30	31	30	31
2009	14309000	Cow Creek Near Azalea, OR	31	28	31	30	31	30	31	31	30	31	30	31
2009	14309500	West Fork Cow Creek Near Glendale, OR	31	28	31	30	31	30	31	31	30	31	30	31
2009	14310000	Cow Creek Near Riddle, OR	31	28	31	30	31	30	31	31	30	31	30	31
2009	14312000	South Umpqua River Near Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31
2009	14319830	South Fork Hinkle Creek Near Nonpareil, OR	31	28	31	30	31	30	31	31	30	31	30	31
2009	14319835	North Fork Hinkle Creek Near Nonpareil, OR	31	28	31	30	31	30	31	31	30	31	30	31
2009	14320934	Little Wolf Creek Near Tyee, OR	31	28	31	30	31	30	31	31	30	31	30	31
2009	14321000	Umpqua River Near Elkton, OR	31	28	31	30	31	30	31	31	30	31	30	31
2010	14308000	South Umpqua River At Tiller, OR	31	28	31	30	31	30	31	31	30	31	30	31
2010	14308500	Elk Creek Nr Drew, OR	31	28	31	30	31	30	31	31	30	31	30	31
2010	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	28	31	30	31	30	31	31	30	31	30	31

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	14309000	Cow Creek Near Azalea, OR	31	28	31	30	31	30	31	31	30	31	30	31
2010	14309500	West Fork Cow Creek Near Glendale, OR	31	28	31	30	31	30	31	31	30	31	30	31
2010	14310000	Cow Creek Near Riddle, OR	31	28	31	30	31	30	31	31	30	31	30	31
2010	14312000	South Umpqua River Near Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31
2010	14319830	South Fork Hinkle Creek Near Nonpareil, OR	31	28	31	30	31	30	31	31	30	31	30	31
2010	14319835	North Fork Hinkle Creek Near Nonpareil, OR	31	28	31	30	31	30	31	31	30	31	30	31
2010	14320934	Little Wolf Creek Near Tyee, OR	31	28	31	30	31	30	31	31	30	31	30	31
2010	14321000	Umpqua River Near Elkton, OR	31	28	31	30	31	30	31	31	30	31	30	31
2011	14308000	South Umpqua River At Tiller, OR	31	28	31	30	31	30	31	31	30	31	30	31
2011	14308500	Elk Creek Nr Drew, OR	31	28	31	30	31	30	31	31	30	31	30	31
2011	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	28	31	30	31	30	31	31	30	31	30	31
2011	14309000	Cow Creek Near Azalea, OR	31	28	31	30	31	30	31	31	30	31	30	31
2011	14309500	West Fork Cow Creek Near Glendale, OR	31	28	31	30	31	30	31	31	30	31	30	31
2011	14310000	Cow Creek Near Riddle, OR	31	28	31	30	31	30	31	31	30	31	30	31
2011	14312000	South Umpqua River Near Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31
2011	14319830	South Fork Hinkle Creek Near Nonpareil, OR	31	28	31	30	31	30	31	31	30	17		
2011	14319835	North Fork Hinkle Creek Near Nonpareil, OR	31	28	31	30	31	30	31	31	30	16		
2011	14320934	Little Wolf Creek Near Tyee, OR	31	28	31	30	31	30	31	31	30	31	30	31
2011	14321000	Umpqua River Near Elkton, OR	31	28	31	30	31	30	31	31	30	31	30	31
2012	14308000	South Umpqua River At Tiller, OR	31	29	31	30	31	30	31	31	30	31	30	31
2012	14308500	Elk Creek Nr Drew, OR	31	29	31	30	31	30	31	31	30	31	30	31
2012	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	29	31	30	31	30	31	31	30	31	30	31
2012	14309000	Cow Creek Near Azalea, OR	31	29	31	30	31	30	31	31	30	31	30	31
2012	14309500	West Fork Cow Creek Near Glendale, OR	31	29	31	30	31	30	31	31	30	31	30	31
2012	14310000	Cow Creek Near Riddle, OR	31	29	31	30	31	30	31	31	30	31	30	31
2012	14312000	South Umpqua River Near Brockway, OR	31	29	31	30	31	30	31	31	30	31	30	31
2012	14320934	Little Wolf Creek Near Tyee, OR	31	29	31	30	31	30	31	31	30	31	30	31
2012	14321000	Umpqua River Near Elkton, OR	31	29	31	30	31	30	31	31	30	31	30	31
2013	14308000	South Umpqua River At Tiller, OR	31	28	31	30	31	30	31	31	30	31	30	31

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013	14308500	Elk Creek Nr Drew, OR	31	28	31	30	31	30	31	31	30	31	30	31
2013	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	28	31	30	31	30	31	31	30	31	30	31
2013	14309000	Cow Creek Near Azalea, OR	31	28	31	30	31	30	31	31	30	31	30	31
2013	14309500	West Fork Cow Creek Near Glendale, OR	31	28	31	30	31	30	31	31	30	31	30	31
2013	14310000	Cow Creek Near Riddle, OR	31	28	31	30	31	30	31	31	30	31	30	31
2013	14312000	South Umpqua River Near Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31
2013	14320934	Little Wolf Creek Near Tyee, OR	31	28	31	30	31	30	31	31	30	31	30	31
2013	14321000	Umpqua River Near Elkton, OR	31	28	31	30	31	30	31	31	30	31	30	31
2014	14308000	South Umpqua River At Tiller, OR	31	28	31	30	31	30	31	31	30	31	30	31
2014	14308500	Elk Creek Nr Drew, OR	31	28	31	30	31	30	31	31	30	31	30	31
2014	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	28	31	30	31	30	31	31	30	31	30	31
2014	14309000	Cow Creek Near Azalea, OR	31	28	31	30	31	30	31	31	30	31	30	31
2014	14309500	West Fork Cow Creek Near Glendale, OR	31	28	31	30	31	30	31	31	30	31	30	31
2014	14310000	Cow Creek Near Riddle, OR	31	28	31	30	31	30	31	31	30	31	30	31
2014	14312000	South Umpqua River Near Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31
2014	14320934	Little Wolf Creek Near Tyee, OR	31	28	31	30	31	30	31	31	30	31	30	31
2014	14321000	Umpqua River Near Elkton, OR	31	28	31	30	31	30	31	31	30	31	30	31
2015	14308000	South Umpqua River At Tiller, OR	31	28	31	30	31	30	31	31	30	31	30	31
2015	14308500	Elk Creek Nr Drew, OR	31	28	31	30	31	30	31	31	30	31	30	31
2015	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	28	31	30	31	30	31	31	30	31	30	31
2015	14309000	Cow Creek Near Azalea, OR	31	28	31	30	31	30	31	31	30	31	30	31
2015	14309500	West Fork Cow Creek Near Glendale, OR	31	28	31	30	31	30	31	31	30	31	30	31
2015	14310000	Cow Creek Near Riddle, OR	31	28	31	30	31	30	31	31	30	31	30	31
2015	14312000	South Umpqua River Near Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31
2015	14320934	Little Wolf Creek Near Tyee, OR	31	28	31	30	31	30	31	31	30	31	30	31
2015	14321000	Umpqua River Near Elkton, OR	31	28	31	30	31	30	31	31	30	31	30	31
2016	14308000	South Umpqua River At Tiller, OR	31	29	31	30	31	30	31	31	30	31	30	31
2016	14308500	Elk Creek Nr Drew, OR	31	29	31	30	31	30	31	31	30	31	30	31
2016	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	29	31	30	31	30	31	31	30	31	30	31

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	14309000	Cow Creek Near Azalea, OR	31	29	31	30	31	30	31	31	30	31	30	31
2016	14309500	West Fork Cow Creek Near Glendale, OR	31	29	31	30	31	30	31	31	30	31	30	31
2016	14310000	Cow Creek Near Riddle, OR	31	29	31	30	31	30	31	31	30	31	30	31
2016	14312000	South Umpqua River Near Brockway, OR	31	29	31	30	31	30	31	31	30	31	30	31
2016	14320934	Little Wolf Creek Near Tyee, OR	31	29	31	30	31	30	31	31	30	31	30	31
2016	14321000	Umpqua River Near Elkton, OR	31	29	31	30	31	30	31	31	30	31	30	31
2017	14308000	South Umpqua River At Tiller, OR	31	28	31	30	31	30	31	31	30	31	30	31
2017	14308500	Elk Creek Nr Drew, OR	31	28	31	30	31	30	31	31	30	31	30	31
2017	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	28	31	30	31	30	31	31	30	31	30	31
2017	14309000	Cow Creek Near Azalea, OR	31	28	31	30	31	30	31	31	30	31	30	31
2017	14309500	West Fork Cow Creek Near Glendale, OR	31	28	31	30	31	30	31	31	30	31	30	31
2017	14310000	Cow Creek Near Riddle, OR	31	28	31	30	31	30	31	31	30	31	30	31
2017	14312000	South Umpqua River Near Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31
2017	14320934	Little Wolf Creek Near Tyee, OR	31	28	31	30	31	30	31	31	30	31	30	31
2017	14321000	Umpqua River Near Elkton, OR	31	28	31	30	31	30	31	31	30	31	30	31
2018	14308000	South Umpqua River At Tiller, OR	31	28	31	30	31	30	31	31	30	31	30	31
2018	14308500	Elk Creek Nr Drew, OR	31	28	31	30	31	30	31	31	30	31	30	31
2018	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	28	31	30	31	30	31	31	30	31	30	31
2018	14309000	Cow Creek Near Azalea, OR	31	28	31	30	31	30	31	31	30	31	30	31
2018	14309500	West Fork Cow Creek Near Glendale, OR	31	28	31	30	31	30	31	31	30	31	30	31
2018	14310000	Cow Creek Near Riddle, OR	31	28	31	30	31	30	31	31	30	31	30	31
2018	14312000	South Umpqua River Near Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31
2018	14320934	Little Wolf Creek Near Tyee, OR	31	28	31	30	31	30	31	31	30	31	30	31
2018	14321000	Umpqua River Near Elkton, OR	31	28	31	30	31	30	31	31	30	31	30	31
2019	14308000	South Umpqua River At Tiller, OR	31	28	31	30	31	30	31	31	30	31	30	31
2019	14308500	Elk Creek Nr Drew, OR	31	28	31	30	31	30	31	31	30	31	30	31
2019	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	28	31	30	31	30	31	31	30	31	30	31
2019	14309000	Cow Creek Near Azalea, OR	31	28	31	30	31	30	31	31	30	31	30	31
2019	14309500	West Fork Cow Creek Near Glendale, OR	31	28	31	30	31	30	31	31	30	31	30	31

Year	Station ID	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2019	14310000	Cow Creek Near Riddle, OR	31	28	31	30	31	30	31	31	30	31	30	31
2019	14312000	South Umpqua River Near Brockway, OR	31	28	31	30	31	30	31	31	30	31	30	31
2019	14320934	Little Wolf Creek Near Tyee, OR	31	28	31	30	31	30	31	31	30	31	30	31
2019	14321000	Umpqua River Near Elkton, OR	31	28	31	30	31	30	31	31	30	31	30	31
2020	14308000	South Umpqua River At Tiller, OR	31	29	31	30	31	30	31	31	30	31	30	31
2020	14308500	Elk Creek Nr Drew, OR	31	29	31	30	31	30	31	31	30	31	30	31
2020	14308990	Cow Creek Abv Galesville Res, Nr Azalea, OR.	31	29	31	30	31	30	31	31	30	31	30	31
2020	14309000	Cow Creek Near Azalea, OR	31	29	31	30	31	30	31	31	30	31	30	31
2020	14309500	West Fork Cow Creek Near Glendale, OR	31	29	31	30	31	30	31	31	30	31	30	31
2020	14310000	Cow Creek Near Riddle, OR	31	29	31	30	31	30	31	31	30	31	30	31
2020	14312000	South Umpqua River Near Brockway, OR	31	29	31	30	31	30	31	31	30	31	30	31
2020	14320934	Little Wolf Creek Near Tyee, OR	31	29	31	30	31	30	31	31	30	31	30	31
2020	14321000	Umpqua River Near Elkton, OR	31	29	31	30	31	30	31	31	30	31	30	31

Appendix D HTML map

DEQ prepared an interactive HTML map to display relevant information described in this QAPP. The map will be posted to DEQ's website alongside this QAPP and saved in same location as the QAPP in DEQ's files. The interactive map contains the following layers and location information:

1. OpenStreetMap base map.
2. USGS hydro cache base map that represents hydrologic information of the National Hydrography Dataset (NHD).
3. 2017 and 2018 one foot Oregon Statewide Imagery Program (OSIP) aerial imagery.
4. TMDL project area boundary.
5. Available continuous stream temperature monitoring locations, organizations that collected that data, and the count of days per month for each year when temperature data are available.
6. Available stream flow monitoring locations, organizations that collected that data, and the count of days per month for each year when flow data are available.
7. The location of meteorological monitoring locations and the source of the data.
8. The location of active individual NPDES permitted facilities, the permit type, and DEQ file number.
9. The locations of current registrants covered under the general NPDES GEN01, GEN03, GEN04, GEN05, GEN19, or GEN40 (MS4) permits.
10. The extent of existing calibrated models described in this QAPP.
11. The extent of newly proposed calibrated models described in this QAPP.
12. The location of temperature calibration sites.
13. The location of temperature monitoring used for model boundary conditions and tributary inputs.
14. The location of flow monitoring locations used for model boundary conditions and tributary inputs.
15. Eight-digit hydrologic unit boundaries (HUC8 Subbasins).
16. Ten-digit hydrologic unit boundaries (HUC10 Watersheds).
17. Twelve-digit hydrologic unit boundaries (HUC12 Subwatersheds).
18. 2018/2020 303(d) Integrated Report status that are classified as water quality limited Category 5 and/or Category 4A for temperature.
19. Fish use designations depicted in OAR 340-041-0320 Figure 320A.

20. Salmon and Steelhead spawning use extent and period depicted in OAR 340-041-0320 Figure 320B.