Total Maximum Daily Loads for the Middle Columbia-Hood (Miles Creeks) Subbasin

Technical Support Document

Temperature

Draft

Date (*EQC adoption meeting month and year)*

State of Oregon
DEQ Department of Environmental Quality

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Acronyms

Listed acronyms apply to this document and its appendices.

7DADM	7-Day Average Daily Maximum
7Q10	7-Day, 10-Year Low Flow
ADWDF	Average Dry Weather Design Flow
AU	Assessment Unit
AWQMS	Ambient Water Quality Monitoring System
BG	Background Source
BLM	U.S. Bureau of Land Management
CFR	Code of Federal Regulations
cfs	Cubic Feet per Second
DEM	Digital Elevation Model
DEQ	Oregon Department of Environmental Quality
DMA	Designated Management Agency
DMR	Discharge Monitoring Report
DOGAMI	Oregon Department of Geology and Mineral Industries
DOQ	Digital Orthophoto Quad
DQL	Data Quality Level
DSM	Digital Surface Model
EPA	Environmental Protection Agency
EQC	Oregon Environmental Quality Commission
ETL	Excess Thermal Load
EWEB	Eugene Water and Electric Board
GIS	Geographic Information System
GLO	General Land Office
GNIS	USGS Geographic Names Information System
HTML	Hyper Text Markup Language
HUA	Human Use Allowance
HUC	Hydrologic Unit Code
IMD	Internal Management Directive
LA	Load Allocation
LAC	Local Advisory Committee
LC	Loading Capacity
LiDAR	Light Detection and Ranging
LT50	Lethal Time 50
MF	Middle Fork
MGD	Millions of Gallons per Day
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer System
MWMT	Maximum Weekly Maximum Temperature
NA	Not Applicable
NHD	National Hydrography Dataset

NID	National Inventory of Dams
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
NWI	National Wetland Inventory
OAR	Oregon Administrative Rules
ODA	Oregon Department of Agriculture
ODC	Oregon Department of Corrections
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish & Wildlife
ORS	Oregon Revised Statutes
OWRD	Oregon Water Resources Department
PCW	Protecting Cold Water
PGE	Portland General Electric
POD	Points of Diversion
POMI	Point of Maximum Impact
PRISM	Parameter-elevation Regressions on Independent Slopes Model
RC	Reserve Capacity
SCS	Soil Conservation Service
SF	South Fork
SIA	Strategic Implementation Area
SIC	Standard Industrial Classification
STP	Sewage Treatment Plant
SWCD	Soil and Water Conservation District
TIR	Thermal Infrared Radiometry
TMDL	Total Maximum Daily Load
TSD	Technical Support Document
USACE	U.S. Army Corps of Engineers
USFS	U.S. Department of Agriculture Forest Service
USGS	United States Geological Survey
WDOE	Washington Department of Ecology
WLA	Wasteload Allocation
WQMP	Water Quality Management Plan
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

1 Introduction

1.1 Document purpose and organization

This document provides comprehensive supporting information on technical analyses completed for the Total Maximum Daily Load (TMDL) and Water Quality Management Plan (WQMP) for addressing temperature impairments in the waters of the Middle Columbia-Hood (Miles Creeks) Subbasin. This document provides explanations of TMDL concepts and analysis and support for conclusions and requirements included in the TMDL and WQMP, which are proposed for adoption by Oregon's Environmental Quality Commission (EQC), by reference, in Oregon Administrative Rules (OAR) 340-42-0090.

This document is organized into sections with titles reflective of the TMDL elements required by Oregon Administrative Rule OAR 340-042-0040(4). This organization is intended to assist readers in finding and accessing the information relevant to that TMDL rule element. To keep the main sections in this document consistent with all the main sections in the TMDL but not duplicate content unnecessarily, some sections simply refer back to the TMDL.

1.2 Overview of TMDL elements

OAR 340-042-0030(15) defines a Total Maximum Daily Load as a written quantitative plan and analysis for attaining and maintaining water quality standards and must include a number of elements described in OAR 340-042-0040.

In plain language, a TMDL is a pollutant budget plan to ensure that the receiving waterbody can attain water quality standards that protect beneficial uses of the water. This budget calculates and assigns pollutant loads for discharges of point (end of pipe) and nonpoint (landscape) sources, in consideration of natural background levels, along with determination of a margin of safety and portion of the pollutant load held in reserve for new sources or expanded growth.

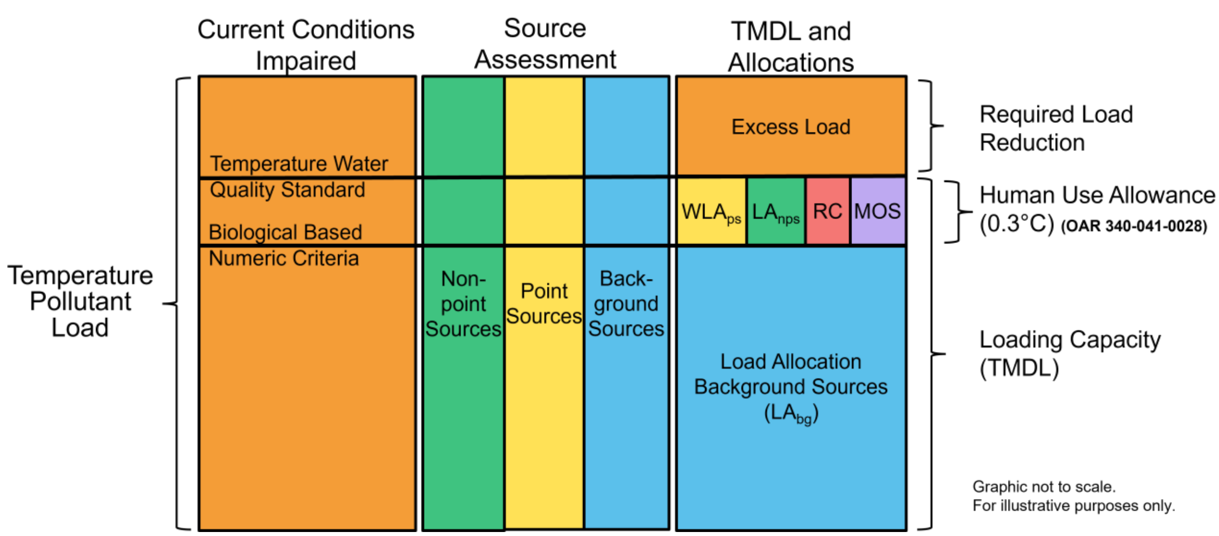

Figure 1-1: Conceptual representation of a TMDL and breakdown of total pollutant loading to a temperature-impaired waterbody into each TMDL element.

Figure 1-1 provides three separate conceptual representations of the TMDL and the pollutant budget. From left to right, the boxes represent steps in the TMDL development process, and the colors of the boxes show which terms are related. The first box on the left shows a temperature impaired water that exceeds the numeric temperature criteria. The current condition water temperature (the top of the box) is higher than the biologically based numeric criteria (which is visualized by the horizontal black line). The federal Clean Water Act requires that a TMDL be developed for waters that do not attain water quality standards.

The second box in the middle of the figure illustrates the TMDL source assessment step. This is where analysis is completed to identify the major sources of pollutant loading to the stream and categorize them into source categories or sectors. Nonpoint source related warming is in green, point source warming is in grey, and background source warming is in blue.

The third box on the right is the last step in the TMDL process. At this step the numeric TMDL pollutant budget is calculated. A key element of a TMDL analysis is the amount of pollutant that a waterbody can receive and still meet the applicable water quality standard. The biologically based numeric criteria plus the human use allowance is the temperature water quality standard for temperature. This is represented by the upper horizontal black line in Figure 1-1. The amount of pollutant loading up to the water quality standard is referred to as the "loading capacity" (LC) of a waterbody. Because the loading capacity must not be exceeded by pollutant loads from all existing sources, plus a margin of safety and any reserve capacity, it can be considered the maximum load. Hence, the loading capacity is often referred to as the Total Maximum Daily Load, or TMDL. A loading capacity, or TMDL, is calculated on each assessment unit (AU) for each applicable temperature criteria in the TMDL project area. An AU is a partition (segment) of the state's waterbodies (streams, river, lakes, estuaries, etc.) into manageable units. The Integrated Report makes assessment conclusions for each AU.

This general TMDL concept is represented by the following equation:

TMDL = ∑Wasteload Allocations + ∑Load Allocations + Reserve Capacity + Margin of Safety

Together, these elements establish the maximum allowable pollutant loads necessary to meet applicable water quality standards for impaired streams and protect beneficial uses.

The Excess Load is the amount of thermal load reduction required to meet the loading capacity and achieve temperature standards.

Wasteload allocations (WLAs) are portions of the TMDL loading capacity allocated to point sources. Load allocations (shown as LAnps and LAbg) are the portion attributed to nonpoint sources, including background sources.

A margin of safety (MOS) accounts for the uncertainty in predicting how well pollutant reductions will result in meeting water quality standards and can be expressed either explicitly, as a portion of the allocations, or implicitly, by incorporating conservative assumptions into the analyses. Reserve capacity (RC) sets aside some portion of the loading capacity for pollutant discharges that may result from future growth and new or expanded sources.

The human use allowance or HUA is part of the Oregon temperature standard rule (Oregon Administrative Rule 340-041-0028). This is the condition under which insignificant additions of heat are authorized in waters that exceed the applicable temperature criteria. The rule states that TMDL wasteload allocations and load allocations will restrict all point sources and nonpoint sources to a cumulative water temperature increase of no greater than 0.3 degrees Celsius above the biologically based numeric criteria. As Figure 1-1 shows, the HUA defines the maximum pollutant loading for point source waste load allocations, nonpoint source load allocations, reserve capacity, and margin of safety.

1.3 TMDL administrative process and public participation

DEQ convened a rule advisory committee to provide input on drafts of the TMDL, WQMP, and TMDL Technical Support Document (TSD), fiscal and economic impacts, and environmental justice and racial equity statements. The committee met on May 27, 2026, and September 10, 2026. The agency also held an informational webinar about this TMDL on March 12, 2026. A public comment period was held from [date TBA] through [date TBA]. DEQ held a public hearing on [date TBA]. DEQ considered all input received during these public participation opportunities and used input to guide the analyses and preparation of documents. DEQ developed a written response to comments document that is available online. EQC adopted the Middle Columbia-Hood (Miles Creeks) Subbasin Temperature TMDL and WQMP rule on [date TBA]. The TMDL was issued to EPA for action on [date TBA].

2 TMDL name and location

The Middle Columbia-Hood (Miles Creeks) Subbasin includes the Eightmile Creek Watershed (1707010502), the Fifteenmile Creek Watershed (1707010503), the Mill Creek-Columbia River Watershed (1707010504), the Upper Mosier Creek Subwatershed (170701051102), the Lower Mosier Creek Subwatershed (170701051103), the Rock Creek Subwatershed (170701051104), and the Rowena Creek-Columbia River Subwatershed (170701051105). Waters excluded from the Middle Columbia-Hood (Miles Creeks) Subbasin TMDL include the Columbia River and portions of the listed watersheds in the State of Washington.

Refer to the [final date] Middle Columbia-Hood (Miles Creeks) Subbasin TMDL (OAR ….) for the location of the impaired waters addressed by this TMDL.

2.1 Climate

The climate in the Miles Creeks portion of the Middle Columbia-Hood Subbasin is influenced both by marine air that flows through the Columbia Gorge from the west and by continental weather patterns that spread from the Great Basin to the East. Both summer and winter air temperatures can be somewhat extreme in the eastern portion of the Subbasin. The Cascade Mountains produce a rain-shadow effect, drastically reducing the total precipitation in the eastern end of the Subbasin. According to the Natural Resource Conservation Service (NRCS) Water and Climate Center, average annual precipitation varies from 65-80 inches in the higher elevation headwaters in the west to 11 inches on the eastern border of the Subbasin (NRCS, 1998). The majority of the precipitation is generally brought by winter storms blowing east from the Pacific Ocean. The Hood River Range, which forms the western boundary of the Subbasin, features the highest elevations and therefore receives the highest precipitation and the highest percentage of precipitation as snow. Winter snowpack is mostly confined to elevations above approximately 4,000 feet. Only 5-10% of the precipitation falls from June through August. At lower elevations, the tributaries are usually ephemeral because of both the seasonality of moisture and the low total precipitation.

Insert map
Figure 2-1: PRISM 1991-2020 Normal Annual Precipitation in the Middle Columbia-Hood (Miles Creeks) Subbasin temperature TMDL project area (Data Source: PRISM Climate Group, 2024).

Insert map
Figure 2-2: PRISM 1991-2020 Normal Annual Maximum Air Temperature in the Middle Columbia-Hood (Miles Creeks) Subbasin temperature TMDL project area (Data Source: PRISM Climate Group, 2024).

2.2 Hydrology

[add details]

2.3 Land use

[add details]

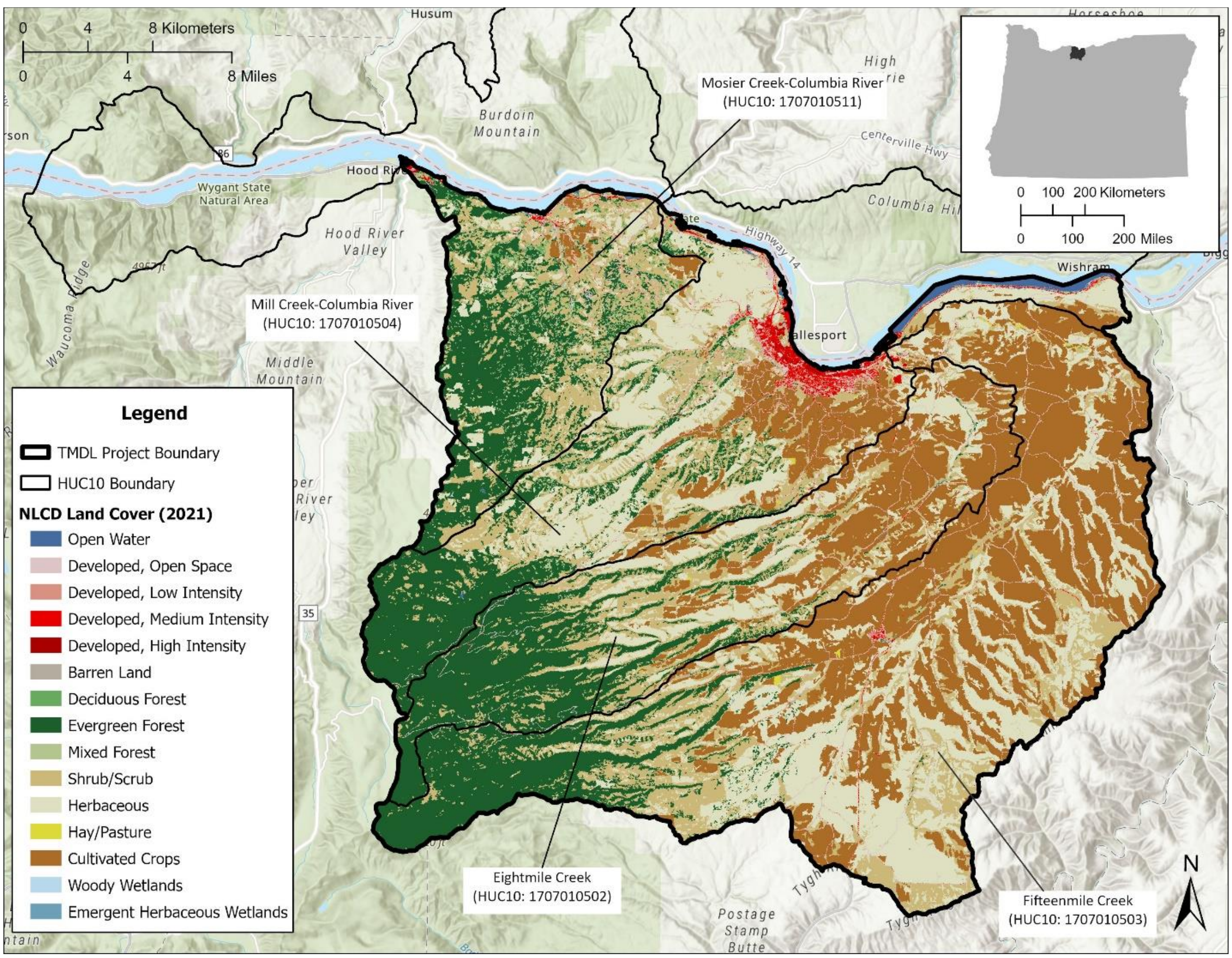

Figure 2-3: Land uses in the Middle Columbia-Hood (Miles Creeks) Subbasin Temperature TMDL project area based on the 2024 National Land Cover Database.

2.4 Land ownership and jurisdiction

[add details]

3 Pollutant identification

Temperature is the water quality parameter of concern, but heat or thermal loading is the pollutant of concern that causes impairment. Heat caused by human activities is of particular concern. Refer to the [final date] Middle Columbia-Hood (Miles Creeks) Subbasin TMDL (OAR ….) for a complete discussion.

4 Temperature water quality standards and beneficial uses

Refer to the [final date] Middle Columbia-Hood (Miles Creeks) Subbasin TMDL (OAR ….) for the applicable beneficial uses, temperature water quality standards, and temperature criteria in the basin.

5 Seasonal variation and critical period for temperature

Per OAR 340-042-0040(4)(j) and 40 CFR 130.7(c)(1), TMDLs must identify any seasonal variation and the critical condition or period of each pollutant, if applicable.

DEQ reviewed available temperature data to determine seasonal temperature variation and the critical conditions and periods for various subbasins in the project area. For a given waterbody, the critical period is based on the frequency and period when instream 7DADM temperatures exceed applicable temperature criteria or contribute to exceedances in a downstream waterbody.

The water temperature monitoring locations and periods used to determine seasonal variation and critical periods for the Middle Columbia-Hood (Miles Creeks) Subbasin TMDL are listed in **Error! Reference source not found.** and mapped in **Error! Reference source not found.**.

The critical periods for waterbodies in the Middle Columbia-Hood (Miles Creeks) Subbasin are presented in Table 5-2. A seasonal pattern could not be evaluated for the Mosier Creek-Columbia River watershed (HUC 1707010511) due to limited data, so the critical period from the Mill Creek-Columbia River watershed (HUC 1707010504) was applied.

Table 5-1: Water temperature monitoring locations and periods used to determine seasonal temperature variation and critical periods for the Middle Columbia-Hood (Miles Creeks) Subbasin.

Insert table

Insert figure

Figure 5-1: Water temperature monitoring locations used to determine seasonal variation and critical periods for the Middle Columbia-Hood (Miles Creeks) Subbasin TMDL.

Table 5-2: Designated critical periods for waterbodies in the Middle Columbia-Hood (Miles Creeks) Subbasin.

Watershed/Subwatershed	Waterbody Name	Critical Period
Fifteenmile Creek Watershed 1707010503	All waters	March 15 – October 31
Eightmile Creek Watershed 1707010502	All waters	March 15 – October 31
Mill Creek-Columbia River Watershed 1707010504	All waters	May 1 – October 31
Upper Mosier Creek Subwatershed 170701051102	All waters	May 1 – October 31
Lower Mosier Creek Subwatershed 170701051103	All waters	May 1 – October 31
Rock Creek Subwatershed 170701051104	All waters	May 1 – October 31
Rowena Creek-Columbia River Subwatershed 170701051105	All waters	May 1 – October 31

Figure 5-2 through Figure 5-5 show boxplots of the seasonal variation of 7DADM temperatures and the period of exceedance at temperature monitoring locations in the Middle Columbia-Hood (Miles Creeks) Subbasin.

Temperature data were grouped by the first and second half of each month. The month was split on the 15th with the first group including all results measured on the 1st through the 14th day and the second group including all results measured on the 15th through the end of the month. The boxplots are Tukey style boxplots with the middle line representing the median and ends of the box representing the temperature range between the first and third quartiles (25th – 75th percentile). The whiskers extend to values no further than 1.5 times the interquartile 7DADM temperature range (i.e., 1.5 times the difference between 25th and 75th percentiles). The points represent individual 7DADM temperature values beyond 1.5 times the interquartile range. The dashed line corresponds to the applicable temperature criteria.

The magnitudes and periods of exceedance vary based on monitoring location and applicable criteria. The plots show that maximum stream temperatures typically occur in July or August. This period coincides with the lowest annual streamflows, maximum solar radiation flux, and warmest air temperatures. Conversely, the coolest stream temperatures typically occur in December and January, which coincides with the lowest solar radiation fluxes and coolest air temperatures. [Add additional details]

In setting critical periods, DEQ relied upon monitoring sites with the longest periods of exceedance along with modeling analysis results that provided temperature estimates at locations without monitoring data. When downstream locations had longer exceedance periods relative to upstream waters, the longer period was used as the critical period for upstream waterbodies. This ensures warming of upstream waters does not contribute to downstream exceedances. [Add QAQC details for OWRD gages]

DEQ also considered the frequency of exceedance. If a given bimonthly period had any 7DADM temperature values that exceeded the criterion and were within 1.5 times the interquartile range (i.e., at or below the upper whisker in the plot, which may indicate that the value is not an outlier), DEQ included that period in the critical period. The critical periods and relevant locations are presented in Section 5-1 of the TMDL.

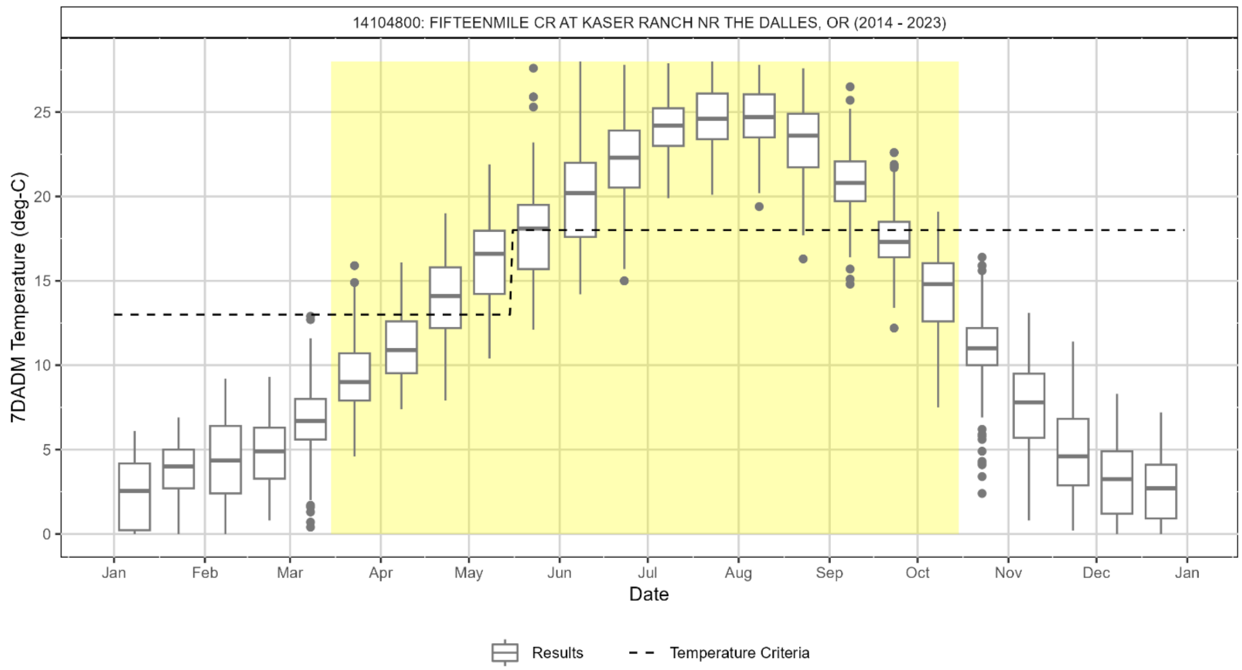

Figure 5-2: Seasonal variation in 7DADM temperature at Fifteenmile Creek at Kaser Ranch near The Dalles monitoring site.

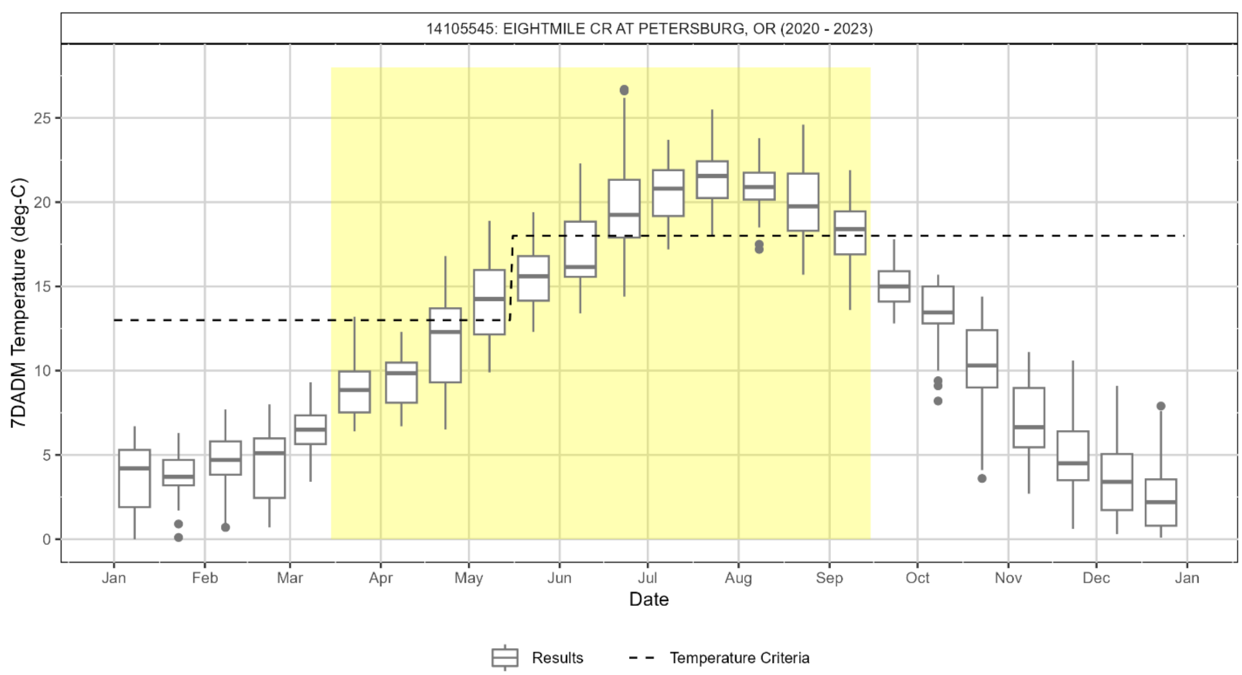

Figure 5-3: Seasonal variation in 7DADM temperature at Eightmile Creek at Petersburg, OR monitoring site.

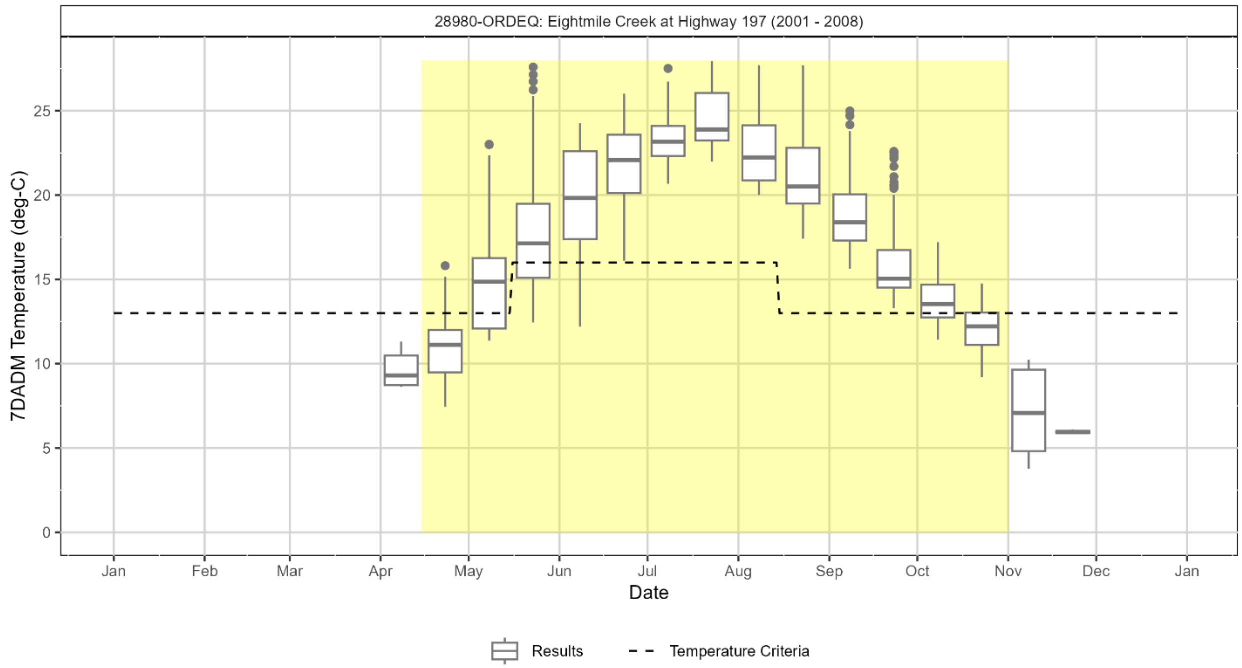

Figure 5-4: Seasonal variation in 7DADM temperature at Eightmile Creek at Highway 197 monitoring site.

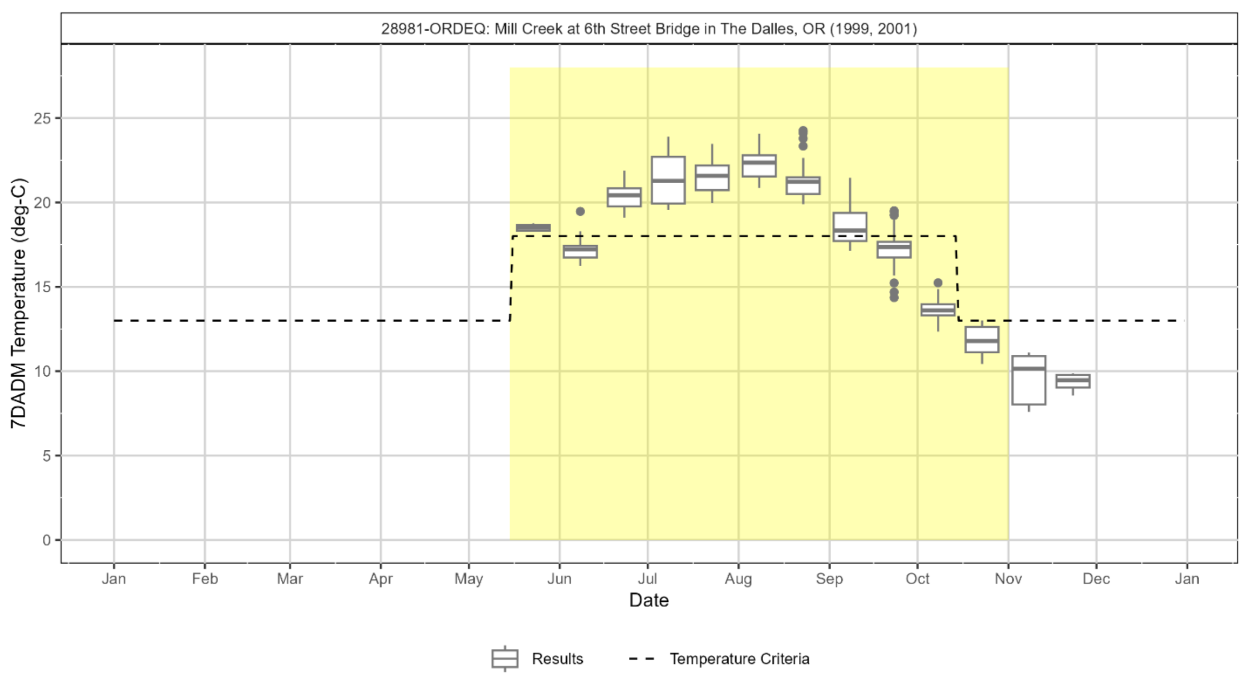

Figure 5-5: Seasonal variation in 7DADM temperature at Mill Creek at 6th Street Bridge in The Dalles, OR monitoring site.

6 Temperature water quality data evaluation and analyses

A critical component to TMDL development is water quality data evaluation and analysis. To the extent that existing data allow, the data and analysis are used to understand and characterize the temperature water quality impairment, assess potential pollutant sources, calculate necessary pollutant reductions, and evaluate various management scenarios and thermal loading levels for sufficiency of attaining the applicable temperature water quality standards. DEQ uses both field measured data and models to complete the TMDL analysis.

6.1 The 7Q10 low-flow statistic

The “7Q10” is a summary low-flow statistic equal to the lowest seven-day average flow that occurs once every ten years (on average). For the Middle Columbia-Hood (Miles Creeks) Subbasin temperature TMDL, estimated 7Q10s were used to calculate numeric loading capacities and allocations. DEQ calculated annual 7Q10s for temperature-impaired AUs in the Middle Columbia-Hood (Miles Creeks) Subbasin. The 7Q10s are listed for temperature-impaired Stream/River AUs in Table 6-1, and in Table 6-2 for temperature-impaired streams in Watershed AUs. Table 6-3 lists the 7Q10s for the receiving waterbodies that have NPDES permitted discharges with a WLA.

The 7Q10 estimates were based on the following approaches:

1) If sufficient daily mean flow data from USGS or OWRD gaging stations were available for a given waterbody, 7Q10 estimates were calculated using these data. Available flow data were retrieved for up to a 30-year period (October 1, 1993 to September 30, 2023). DEQ relied on quality control protocols implemented by USGS and OWRD. Only data with a result status of “Approved” (USGS) or “Published” (OWRD) were included in 7Q10 calculations. 7Q10s were calculated by the method of EPA’s DFLOW program (Rossman, 1990), which computes extreme design flows using the log-Pearson Type III probability distribution. A minimum of 10 years of flow data were used with some exceptions. For ungaged locations, if sufficient gage data were available from confluent streams, 7Q10s were estimated by either (a) summing the daily mean flows from upstream gages, or (b) calculating the difference of daily mean flows from downstream gages, prior to application of the DFLOW procedure. The specific gages used and the method (sum or subtraction) applied for calculating 7Q10s for each ungaged location are detailed as the flow estimation method in the tables. The 7Q10s calculated based on gage data are reported to the nearest tenth of a cubic foot per second (cfs) for values less than 10 cfs and to whole numbers for values greater than or equal to 10 cfs.

2) If insufficient daily mean flow data from USGS and OWRD stream flow gaging stations were available, the web-based tool StreamStats (USGS, 2019) was used to estimate 7Q10s. The 7Q10s are reported with the same level of significant figures as the values calculated using the gage method, except for values equal to or greater than 1000 cfs, which are reported to three significant figures. Details of StreamStats are described below.

3) StreamStats is not recommended for estimating 7Q10s in regulated streams (e.g., those with major dams, constructed reservoirs, catchment development, or significant

diversions/withdrawals). Instead, the drainage area ratio method is used. This method estimates 7Q10s by using the ratio of watershed drainage areas between the ungaged location and a nearby gaged tributary (Risley, 2009; Gianfagna, 2015; Ries et al., 2017). For example, if the watershed area upstream of a gaged tributary is 10 km^2 and the ungaged tributary's watershed area is 5 km^2, the 7Q10 in the ungaged tributary is estimated to be half of that in the gaged tributary. A weighting factor is recommended when the drainage area ratio between the two sites is between 0.5 and 1.5. These weighting factors can be evaluated if instantaneous observed flows are available at the ungaged location.

4) 7Q10s calculated and reported elsewhere (e.g., consultant studies, water quality permits, TMDLs) may have been used. In such cases, DEQ relied on the source's data quality and reported the values as they were provided.

5) For tidally influenced streams, DEQ reviewed each situation and made 7Q10 estimates based on the best available data from the relevant gaging stations. Methods are described for each case.

StreamStats version 4 is a web-based GIS application developed by the USGS (https://streamstats.usgs.gov/ss/). StreamStats has a map-based interface that allows the user to determine drainage area delineations, basin characteristics, and estimates of stream flow statistics for user-selected locations along available streams. The program also provides users with access to stream monitoring data by selecting USGS data collection stations in the map application and providing access to flow statistics and other information for the stations. StreamStats provides estimates of various stream flow statistics for user-selected sites by solving site-specific regression equations. The regression equations were developed through a process, known as regionalization, which involves use of regression analysis to relate stream flow statistics computed for a group of selected stream gages (usually within a state) to basin characteristics measured for the stream gages. Basin characteristics are used to obtain estimates of the stream flow statistics for ungaged sites.

StreamStats regression equations for Oregon were developed by Cooper (2005) and Risley et al. (2008). These equations were based on basin characteristics and flow statistics (e.g., historical percentile flow-exceedance values and annual and monthly 7Q10). Flow statistics were computed at 466 gaging stations across Oregon and proximal out-of-state areas. This study area was divided into 10 regions based on ecological, topographic, geologic, hydrologic, and climatic criteria. StreamStats includes 910 annual and monthly regression equations to estimate 7Q10s for ungaged stream sites in the 10 aforementioned regions. These equations were developed for unregulated streams (without major dams, constructed reservoirs, catchment development, or significant diversions/withdrawals). If the equations are applied to ungaged streams subject to such influences, the resultant estimates may require adjustment to approximate actual flows.

The StreamStats user selects a stream location of interest and the program estimates the associated drainage area and summary flow statistics. For this TMDL, DEQ's procedure specified that selected stream locations should be the most downstream location on each stream for which DEQ required flow estimates; the exception was if DEQ required 7Q10 estimates for NPDES permitted point source receiving waters, in which case the selected stream location was immediately upstream of the point source outfall. StreamStats also estimates basin characteristics for the selected catchment, including drainage area, mean annual precipitation, mean slope, and climactic characteristics (Cooper, 2005; Risley et al., 2008). If estimates are outside suggested parameter ranges, the warning message "extrapolated with uncertainty" appears in the StreamStats report.

Table 6-1: The 7Q10 low-flow estimates for temperature-impaired stream/river assessment units in the Middle Columbia-Hood (Miles Creeks) Subbasin.

AU Name	AU ID	Estimated 7Q10 (cfs)	Flow Estimation Method	Flow Estimation Latitude/Longitude	Gage Period
Eightmile Creek	OR_SR_1707010502 _02_101504	0.11	USGS: 14105545	45.605, -121.080	2013-09-01 ~ 2023-09-30
Dry Creek	OR_SR_1707010503 _02_101505	0	StreamStats	45.505, -121.047	
Fifteenmile Creek	OR_SR_1707010503 _02_101506	1.98	StreamStats	45.611, -121.122	
Fifteenmile Creek	OR_SR_1707010503 _02_101507	1.2	OWRD: 14104190	45.459, -121.109	2013-07-09 ~ 2023-09-30
Mosier Creek	OR_SR_1707010511 _02_101513	0.5	USGS: 14113200	45.649, -121.377	2005-06-08 ~ 2023-09-30
Ramsey Creek	OR_WS_1707010503 01_02_101984	1.48	StreamStats	45.434, -121.219	

Table 6-2: The 7Q10 low-flow estimates for temperature-impaired watershed assessment units in the Middle Columbia-Hood (Miles Creeks) Subbasin.

Watershed AU GNIS Name	AU ID	Estimated 7Q10 (cfs)	Flow Estimation Method	Flow Estimation Latitude/Longitude	Gage Period
Eightmile Creek	OR_WS_1707010502 01_02_101980	8.09	StreamStats	45.461, -121.237	
Eightmile Creek	OR_WS_1707010502 02_02_101981	2.94	StreamStats	45.516, -121.113	
Eightmile Creek	OR_WS_1707010502 04_02_101983	1.7	StreamStats	45.592, -121.079	
Fifteenmile Creek	OR_WS_1707010503 01_02_101984	12.6	StreamStats	45.433, -121.218	
Ramsey Creek	OR_WS_1707010503 01_02_101984	1.48	StreamStats	45.434, -121.219	
Fifteenmile Creek	OR_WS_1707010503 02_02_101985	5.8	StreamStats	45.450, -121.119	
Dry Creek	OR_WS_1707010503 03_02_101986	0	StreamStats	45.434, -121.105	
Threemile Creek	OR_WS_1707010504 02_02_101991	0	StreamStats	45.602, -121.144	
South Fork Mill Creek	OR_WS_1707010504 03_02_101992	0.34	Drainage area ratio method: 14113200	45.549, -121.309	2005-06-08 ~ 2023-09-30
Mill Creek	OR_WS_1707010504 04_02_101993	12.5	StreamStats	45.604, -121.187	
Chenoweth Creek	OR_WS_1707010504 05_02_101994	0.74	StreamStats	45.634, -121.204	
Mosier Creek	OR_WS_1707010511 03_02_102009	0.35	Drainage area ratio method: 14113200	45.648, -121.378	2005-06-08 ~ 2023-09-30

Watershed AU GNIS Name	AU ID	Estimated 7Q10 (cfs)	Flow Estimation Method	Flow Estimation Latitude/Longitude	Gage Period
West Fork Mosier Creek	OR_WS_1707010511 03_02_102009	0.15	Drainage area ratio method: 14113200	45.648, -121.379	2005-06-08 ~ 2023-09-30
Rock Creek	OR_WS_1707010511 04_02_102010	2.44	StreamStats	45.686, -121.405	

Table 6-3: The 7Q10 low-flow estimates for NPDES permitted discharges receiving a numeric wasteload allocation in the Middle Columbia-Hood (Miles Creeks) Subbasin TMDL.

Facility Name (Facility Number)	Stream	Estimated 7Q10 (cfs)	Flow Estimation Method	Flow Estimation Latitude/Longitude	Gage Period
City of The Dalles WTP (87831)	South Fork Mill Creek	0.34	Drainage area ratio method: 14113200	45.549, -121.309	2005-06-08 ~ 2023-09-30

7 Sources or source categories

A key element of TMDL development is a complete, comprehensive source assessment for the relevant water quality pollutant(s). This includes identification of all relevant point and nonpoint sources to the impaired waterbody, characterization/quantification of their pollutant load contributions, determination of seasonal variation, and delineation of periods when applicable temperature criteria are exceeded at various locations, to the extent that existing data allow. This section, along with the TMDL report and its appendices, describes the significant thermal pollutant sources identified within the Middle Columbia-Hood (Miles Creeks) Subbasin temperature TMDL area and the data sources that DEQ utilized for TMDL modeling.

7.1 Point sources

Point sources in the basin are generally required to obtain coverage under either an individual or a general National Pollutant Discharge Elimination System (NPDES) permit. One individual permittee was identified as a source of thermal loading to waters in the Middle Columbia-Hood (Miles Creeks) Subbasin, but is in the process of terminating their NPDES permit. One general NPDES permittee was identified and assigned thermal wasteload allocations. DEQ's individual facility-specific thermal load assessments are documented in Section 9.1.6.

For stormwater discharges authorized under general permits, DEQ determined that such discharges are unlikely to contribute to exceedances of the temperature standard. The same is true for landfill leachate discharges. Therefore, no additional TMDL requirements are needed for stormwater and landfill leachate sources to control temperature, other than those included in the existing NPDES permits. The determination for stormwater discharges is based on a DEQ review of published literature and other studies related to stormwater runoff and stream temperature in Oregon. The substantive findings of the literature review are summarized below.

A review of available studies from the midwestern and eastern United States indicated that, under certain conditions, runoff from impervious pavement or runoff retained in uncovered open ponds can produce short-duration warm discharges (Herb et. al., 2008; Jones and Hunt, 2009; UNH Stormwater Center, 2011; Winston et al., 2011; Hester and Bauman, 2013). Yet, runoff temperature changes are highly dependent on many factors including air temperature, dewpoint, seasonal precipitation patterns, pavement type, percent imperviousness, and the amount of impervious surface shielded from solar radiation (Nelson and Palmer, 2007; Herb et al., 2008; Thompson et al., 2008; Winston et al., 2011; Jones et al., 2012; Sabouri et al., 2013; Zeiger and Hubbert, 2015). When they occur, such warmed runoff discharges can create “surges” associated with typically short-duration stream temperature increases (Hester and Bauman, 2013; Wardynski et al., 2014; Zeiger and Hubbert, 2015). However, studies that evaluated stormwater discharges over longer (e.g., 7-day) averaging periods such as those used in assessing TMDL attainment (i.e., 7DADM) did not indicate exceedances above biologically-based benchmarks (Wardynski et al., 2014; WDOE, 2011a and 2011b).

Additionally, DEQ evaluated rainfall, cloud cover, air temperature, and stream temperature data from warm seasons for three years in the Miles Creeks area of the Middle Columbia-Hood Subbasin (DEQ, 2008b). DEQ concluded that stormwater discharges likely do not contribute to temperature standard exceedances in the study area. This is because (1) the standard is based on 7DADM temperatures such that a majority of days within each 7-day period would need have precipitation-runoff influences to affect the 7DADM, (2) exceedances are assessed for the critical summer period, and (3) 95% of summer time 7-day periods had fewer than 3 days of rain, while 80% had less than one day of rain. Thus, there are generally not enough runoff events to significantly influence 7DADMs for temperature in the critical period of this TMDL.

7.1.1 Individual NPDES permitted point sources

Dufur STP is the only industrial individual NPDES permitted point source within the Middle Columbia-Hood (Miles Creeks) Subbasin. However, the facility is currently in the process of terminating their permit and has decommissioned the piping to the Fifteenmile Creek outfall. (Table 7-1).

Table 7-1: Individual NPDES permit holder Dufur STP (permit termination in progress).

Permittee	Permit type	DEQ WQ File Number	EPA Number	Receiving water name (AU ID)	River mile
Dufur STP	NPDES-DOM-Db	25491	OR0029050	Fifteenmile Creek (OR_WS_170701050302_02_101985)	30.3

7.1.2 General NPDES permitted point sources

There are several categories of general NPDES permits with registrants in the Middle Columbia-Hood (Miles Creeks) Subbasin, including:

- 200-J Industrial Wastewater; NPDES filter backwash
- 1200-C Stormwater: NPDES construction
- 1200-Z Stormwater: NPDES specific Standard Industrial Classification codes

DEQ determined that the following general permit category has the potential to discharge thermal loads that contribute to exceedances of the applicable temperature criteria and impact beneficial uses (Table X).

- 200-J Industrial Wastewater; NPDES filter backwash

Table 7-2: General NPDES permit registrants that have the potential to contribute thermal loads to Middle Columbia-Hood (Miles Creeks) Subbasin streams at a frequency or magnitude that contributes to exceedances of the temperature standard.

Registrant	General Permit	DEQ WQ File Number	EPA Number	Receiving water name (AU ID)	River mile
City of The Dalles WTP	200-J	87831	ORG387001	South Fork Mill Creek (OR_WS_170701050403_02_101992)	0.87

Discharges covered by other general permits will not contribute to exceedances of applicable temperature criteria and impact beneficial uses based on the permit requirements, available dilution, or frequency and magnitude of discharge. Therefore, no additional TMDL requirements are needed for these sources to control temperature, other than those included in the NPDES permits. More specific wasteload allocations can be considered if subsequent data and evaluation demonstrate a need and if reserve capacity is available.

The 200-J general permit covers discharge or land application of filter backwash, settling basin, and reservoir cleaning water which have been adequately treated prior to discharge. Flushing of raw water intakes after storm events and spring runoff are also allowed. The sole 200-J general permittee within the project area is the City of The Dalles Water Treatment Plant (WTP).

To determine if the City of The Dalles WTP has the potential to increase stream temperature, DEQ reviewed discharge data using available discharge monitoring reports (DMRs). Maximum effluent flow during the TMDL critical period is listed in Table 7-3.

Effluent temperatures are not reported on 200-J DMRs, so an estimate was developed from effluent temperatures reported on 200-J NPDES permit applications for discharges in the Willamette Basin. On these applications, the maximum summer temperatures ranged up to 23°C. The sampling frequency (grab or continuous) for these reported temperatures is unknown so, as a conservative estimate, a maximum effluent temperature of 24°C was used when year-round criteria apply and 17°C was used during spawning periods. The current 200-J permit requirement includes a 30:1 minimum dilution ratio between river and effluent flow. This dilution ratio was used to estimate the maximum effluent flow under critical condition 7Q10 river flows. During periods of no flow, the 200-J permit does not authorize discharge. An estimated change in temperature was calculated using the 7Q10 river flow, maximum reported or dilution-based effluent flow, the estimated effluent temperature, and applicable temperature criteria. Based on the results, the City of The Dalles WTP has the potential to increase stream temperatures up to an estimated maximum of 0.19°C above the year-round temperature criterion and 0.13°C above the spawning criterion (Table 7-3). Because this facility has reasonable potential to increase stream temperature, it is provided a numeric WLA.

It should be noted that the actual temperature increase from 200-J registrants may be less than estimated here, particularly during the spawning period when river flows may be greater than the annual 7Q10.

Table 7-3: Summary of estimated temperature impacts from 200-J registrants located in the Middle Columbia-Hood (Miles Creeks) Subbasin.

NPDES Permittee WQ File# : EPA Number	Annual 7Q10* River flow (cfs)	Temp Criteria (°C)	Maximum DMR Effluent Flow (cfs)	Dilution Based or Reported Effluent Flow (cfs)	Estimated Maximum Effluent Temp (°C)	Change in Temp Year Round (°C)	Change in Temp Spawning Period (°C)
City of The Dalles WTP 87831 : ORG387001	0.34	18.0	1.38	0.01	24.0	0.19	0.13

7.2 Nonpoint and background sources

Nonpoint source categories or activities identified as sources of thermal loading that increase 7DADM stream temperatures above the applicable criteria include:

- Increases in solar radiation loading from the disturbance or removal of near-stream vegetation;
- Elevated temperatures from inflowing tributaries to Fifteenmile Creek;
- Dam and reservoir operation;
- Activities that modify flow rate or volume; and
- Background sources, including natural sources and anthropogenic sources defined as background sources.

7.2.1 Dam and reservoir operations

Reservoirs attenuate flood flows and retain spring runoff. Stored water is released when reservoir capacity is met or to augment stream flows during summer and early fall dry periods. As currently constructed and operated, water released from many reservoirs modifies natural downstream temperature patterns in late summer and early fall, but also in spring and early summer. The seasonal temperature shifts occur because water stored in reservoirs stratifies, and existing reservoirs were typically constructed with regulating outlets near the bottom of each structure.

Seasonal pattern shifts are of concern because water temperature regulates aquatic life activities such as spawning, incubation period, and fry emergence. Moreover, salmonid food supplies (i.e., macroinvertebrates) are affected by seasonal temperature shifts. Reservoirs are drawn down in late summer and early autumn to provide flood storage capacity for upcoming winter precipitation. During this time, reservoirs destratify but their water temperatures remain warmer than upstream tributary inflows. This is also when fall-spawning fish move into reaches below reservoirs to await spawning. Salmon and trout remain in the coldest water they find to await stream temperatures cool enough to trigger their spawning migration.

Alternately, colder winter waters are released in spring and early summer when upstream tributary inflow temperatures are warmer than stored reservoir waters. This is when fall-spawned fry should emerge, but the colder water shifts their emergence timing. Spring spawning is also delayed until water temperatures are warm enough to trigger spawning. Late spring spawning may result in summertime fry emergence when waters are too warm for them.

DEQ evaluated the thermal effects of Crow Creek Dam on South Fork Mill Creek using data collected in 2000 and 2004. Temperature data from monitoring stations upstream and downstream of the dam were compared to assess its influence on instream temperatures. Temperatures below the reservoir generally approximated upstream temperatures until mid- to late August, although with much less diel variation. After this period, dam releases were warmer than upstream temperatures, although instream temperatures remained well below the 18°C temperature criterion (add reference to figure).

These results indicate that while the dam may result in modifications to the temperature profile, the released waters do not exceed the applicable criterion. However, the warming observed below the dam may contribute to temperature exceedances in downstream reaches of the assessment unit.

As described in Section 4.6 of the TMDL document, the Protecting Cold Water (PCW) criterion applies to waters of the state that have summer ambient 7DADM temperatures that are colder than the biologically based criteria. With some exceptions, these waters may not be warmed cumulatively by anthropogenic point and nonpoint sources by more than 0.3°C above the colder ambient water temperature. Based on the evaluation process outlined in Figure 4-3 in the TMDL, it was determined that South Fork Mill Creek at Crow Creek dam meets the criteria for the PCW.

In the Lower Willamette and Lower Columbia-Sandy Subbasins, multiple studies examined the thermal impacts of in-channel ponds on water temperature and found that human-built in-channel ponds showed trends of increasing downstream temperature (Holzer, 2020; Fairbairn, 2022). For example, Holzer (2020) demonstrated that most in-channel ponds increased the total time period that a stream segment exceeded the temperature standard by several weeks. Fairbairn (2022) found that human-constructed ponds in the Johnson Creek (n=14), Columbia Slough (n=1) and Sandy River (n=2) Watersheds increased median 7DADM stream temperatures by -1.0 to 6.0 (°C). Nine (53%) of the 17 human-constructed in-channel ponds raised the median 7DADM stream temperature by more than 1°C.

[add figure]

7.2.2 Disturbance or removal of near stream vegetation

[add details]

7.2.3 Tributary warming

[add details]

7.2.4 Water management activities and water withdrawals

Water management activities and water withdrawals is a source category that accounts for nonpoint source temperature impacts associated with the withdrawal of water that is intended for consumptive uses (such as irrigation or domestic use) and the warming that might occur as that water moves through a canal or ditch before being returned to the natural river.

Water withdrawals decrease the capacity of streams to assimilate thermal loads and result in warmer stream temperatures. In waterbodies where temperatures are already known to exceed standards, further withdrawals from the stream will reduce the stream's assimilative capacity and cause greater fluctuation in daytime and nighttime stream temperatures. [add details]

7.2.5 Background sources

Background sources as defined in OAR 340-042-0030(1) 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. Stream temperature warming from climate change is a background source, as the majority of the climate change-causing pollutants emanate from outside of Oregon.

DEQ completed a literature review to assess climate change-driven stream temperature impacts. Based on that review (DEQ, 2025), since the late 1970s, stream temperature impacts from climate change ranged from +0.05°C to +0.27°C per decade on unregulated streams and -0.48°C to +0.52°C per decade on regulated streams. Stream temperature trends in regulated systems are more variable, as upstream flow and temperature management can confound natural long-term warming trends in the data (Isaak et al., 2012). The temperature impact in the summer months (June, July, and August) is greater relative to the annual average impact.

Non-human caused background thermal loading is influenced by a number of landscape and meteorological characteristics, such as: substrate and channel morphology conditions; streambank and channel elevations; near-stream vegetation; groundwater, tributary inflows; precipitation; cloudiness; air temperature; relative humidity and other factors. Many of these factors can be influenced by anthropogenic impacts.

It was not possible to develop a model in which all human or background influences were controlled or accounted for. As a best estimate, background thermal sources were quantified for the modeled stream segments by removing the thermal loading from point sources, removing the dam and reservoirs, and restoring streamside vegetation to the estimated site potential conditions. The setup and configuration details of this model, called the background scenario, is further described in Appendix C.

In Fifteenmile Creek, thermal loading from background sources contributed to exceedances of the applicable temperature criteria and therefore were identified as significant sources of thermal loading. Reductions from background sources will be required to attain the applicable temperature criteria. [add table]

8 Loading capacity and excess loads

Refer to the [final date] Middle Columbia-Hood (Miles Creeks) Subbasin Temperature TMDL rule (OAR ….) for the loading capacity and excess loads.

9 Allocations, reserve capacity, and margin of safety

OAR 340-042-0040(6) identifies the factors that DEQ or EQC may consider when distributing wasteload and load allocations. The factors include:

a) Contributions from sources;
b) Costs of implementing measures;
c) Ease of implementation;
d) Timelines for attainment of water quality standards;
e) Environmental impacts of allocations;
f) Unintended consequences;
g) Reasonable assurances of implementation;
h) Any other relevant factor.

Oregon's temperature standard provides a framework for how the loading capacity is distributed between human sources of warming and background sources. The HUA at OAR 340-041-0028(12)(b)(B) identifies the portion of the loading capacity reserved for human uses. The rule requires that wasteload and load allocations restrict all NPDES point sources and nonpoint sources to a cumulative increase of no greater than 0.30°C (0.5°F) above the applicable criteria after complete mixing in the waterbody, and at the point of maximum impact. DEQ allocated a thermal load equivalent to a 0.30°C increase to current and future loading from human sources and the remainder of the loading capacity to background sources. Distribution of the human use allowance is discussed in section 9.1, **Error! Reference source not found.** (point sources), and 0 (nonpoint sources). Factors used when assigning allocations included the relative contribution from existing sources, the environmental impact of the allocations and the regulatory requirement to attain water quality standards, and the policy goal to retain some of the loading capacity for future use as reserve capacity.

9.1 Human use allowance assignments

Refer to the [final date] Middle Columbia-Hood (Miles Creeks) Subbasin Temperature TMDL rule (OAR ….) Section 9 for tables of the human use allowance assignments to each source category on each assessment unit within the basin. The discussions below describe the processes DEQ used to make these assignments.

When distributing the thermal loads associated with a 0.30°C increase, DEQ considered the magnitude of the thermal load contributed from known sources, the allocation assigned in the older TMDLs being replaced, ease of implementing the allocations, the environmental impact of those contributions including where the impact occurs, and how the source contribution impacts cumulative warming.

A portion of the HUA was assigned to each relevant anthropogenic source category in each AU in the TMDL project area. These source categories, which are further discussed in the sections below, are:

- Nonpoint source (NPS) dam and reservoir operations,
- Anthropogenic warming from tributaries,
- Consumptive use water management and withdrawals,

- Solar loading from existing transportation corridors, buildings, and utility infrastructure,
- Solar loading from other nonpoint sectors, and
- NPDES point sources

A portion of the HUA is also assigned to reserve capacity. Temperature impacts associated with climate change sources are assigned a zero HUA.

Some source categories were assigned a zero human use allowance or no increase in temperature. A zero human use allowance should not be interpreted as zero total thermal loading or zero discharge. Thermal loads from source categories assigned a zero human use allowance may still have a discharge but cannot contribute to temperature increases above the applicable criteria when 7DADM temperature exceed the criteria.

9.1.1 Nonpoint source (NPS) dam and reservoir operations

DEQ assigned a load allocation and HUA of 0.00°C (no warming above the BBNC) to all dam and reservoir operations. This nonpoint source category accounts for warming from dam impoundment and other activity associated with reservoir operations and the release of impounded water back to the natural channel. In addition, a surrogate measure temperature target was developed to implement the dam and reservoir HUA and corresponding load allocation (TMDL Section 9.1.4.1).

9.1.2 Anthropogenic warming from tributaries

For AUs with tributary streams having point sources with HUAs assigned, an HUA was determined for the cumulative anthropogenic warming from the tributaries. These HUA assignments were based on a heat load balance approach. This approach used the critical flow from each tributary along with any point source HUAs assigned within each tributary. These values were then used to calculate the temperature increase above the BBNC within the receiving stream due to the combined effects of the tributaries. Anthropogenic warming from tributaries that do not have point sources with HUAs assigned is accounted for through the HUAs in the other source categories within the tributary AU.

9.1.3 Solar loading from existing transportation corridors, building, and utility infrastructure, and from other nonpoint sources

As summarized in Section 7.2.2, lack of streamside vegetation is one of the largest sources of stream warming contributing warming where it was assessed. Except streamside vegetation reduction caused by existing infrastructure (roads, railroads, buildings, and utility infrastructure), all other nonpoint sources of solar loading were assigned a zero human use allowance, meaning a reduction in streamside vegetation may not cause an increase in temperature above the applicable criterion.

DEQ chose to assign a portion of the human use allowance to existing infrastructure (roads, railroads, buildings, and utility infrastructure) over other land uses because moving, rebuilding, or modifying this infrastructure in addition to restoring streamside vegetation is a much more complex and potentially costly endeavor compared to restoring or protecting existing streamside vegetation in areas without infrastructure constraints. In the past, DEQ heard from municipalities commenting on TMDLs that these land uses are difficult constraints to restore. In addition, other land uses without infrastructure constraints represent a much higher percentage of streamside area raising issues related to the appropriate amount of vegetation reduction that could occur spatially and over time while still attaining a small HUA increase such as < 0.05°C, that does not contribute to cumulative temperature impacts downstream.

The solar loading allocation is implemented through an effective shade target. Effective shade can be easily measured in the field and is simpler to monitor relative to a thermal load. Based on an extensive literature review, DEQ determined that a vegetation buffer width based on a slope distance of 120 ft would be sufficient in most cases to have no warming and attain the shade targets.[1] Effective shade surrogate measure targets represent a surrogate for the amount of solar loading that will attain the HUA and load allocations for nonpoint sources managing streamside vegetation.

9.1.4 Consumptive use water management and withdrawals

DEQ assigned a load allocation and HUA of up to 0.10°C for temperature impacts associated with surface water withdrawals. This nonpoint source category accounts for warming from the withdrawal of water that is intended for consumptive uses (such as irrigation), and the warming that might occur as that water moves through a canal or ditch before being returned to the natural river.

9.1.5 Reserve capacity

DEQ set aside remaining human use allowance for reserve capacity to accommodate future growth, new sources, or to make allocation corrections to any existing source(s) that were assigned an erroneous allocation or may not have been identified during the development of this TMDL. DEQ allocated 0.05°C for reserve capacity on all AUs in the project area.

9.1.6 Human use allowances and wasteload allocations for point sources

This section summarizes the assigned portion of the HUA for each point source, the rationale, the findings from the assessment of current thermal loading, and the source of effluent discharge used in the wasteload allocation (WLA) equation. Unless noted, 7Q10 was assumed as the river flow for the loading assessments. 7Q10 details for each point source are summarized in Section 6.1 and Table 6-3. [add additional details]

9.1.6.1 Dufur STP

Dufur STP (WQ File#: 25491, EPA Number: OR0029050) is an individual NPDES permittee assigned an HUA of 0.00°C. The facility is in the process of terminating their NPDES permit, and has decommissioned the piping to the Fifteenmile Creek outfall. As a result, the facility no longer has a discharge connection to the creek.

[1] See the 2025 Willamette River Mainstem and Major Tributaries TMDL TSD for supporting documentation.

9.1.6.2 The City of the Dalles WTP

The City of the Dalles WTP (WQ File#: 87831, EPA Number: ORG387001) is a general NPDES permittee assigned an HUA of 0.20°C based on the assessment of loading and allocation in the 2008 TMDL. The effluent flow used in the wasteload allocation calculation is the maximum average monthly discharge reported in DMRs for 2022 and 2023, which is 0.89 MGD (1.38 cfs). Temperature is not reported on 200-J DMRs so a maximum temperature could not be determined. A maximum effluent temperature of 24°C was used when year-round criterion apply and 17°C was used during the spawning period for estimation purposes. See Section 7.1.2 for additional details.

9.1.7 Wasteload allocation equations

The following sections include the equations related to wasteload allocations.

[add additional details where needed]

9.1.7.1 Wasteload allocation equation

Equation 9-1 and Equation 9-2 were used to calculate the thermal wasteload allocations in the Middle Columbia-Hood (Miles Creeks) Subbasin TMDL rule.

$$WLA = \Delta T \cdot (Q_E + Q_R) \cdot C_F$$ ***Equation 9-1***

$$WLA = \Delta T \cdot Q_E \cdot D_F \cdot C_F$$ ***Equation 9-2***

where,

$WLA =$ Wasteload allocation (kilocalories/day), expressed as a rolling seven-day average.

$\Delta T =$ The assigned portion of the HUA at the point of discharge. Represents the maximum temperature increase (°C) above the applicable temperature criterion using 100% of river flow not to be exceeded by each individual source from all outfalls combined.

$Q_E =$ The daily mean effluent flow (cfs).
When effluent flow is in million gallons per day (MGD) convert to cfs:

$$\frac{1{,}000{,}000\ gallons}{1\ day} \cdot \frac{0.13368 ft^3}{1\ \text{gallon}} \cdot \frac{1\ day}{86{,}400\ sec} = 1.5472\ ft^3/sec$$

$Q_R =$ The daily mean river flow rate, upstream (cfs).
When flow is <= 7Q10, Q_R = 7Q10. When flow is > 7Q10, Q_R equals the daily mean river flow, upstream.

$D_F =$ Dilution factor $(Q_E + Q_R)/Q_E$ For lakes, the dilution factor is 1 unless determined using another method.

$C_F =$ Conversion factor using flow in cfs: 2,446,665

$$\left(\frac{1\ m}{3.2808\ ft}\right)^3 \cdot \frac{1000\ kg}{1\ m^3} \cdot \frac{86400\ sec}{1\ day} \cdot \frac{1\ kcal}{1\ kg\ \cdot 1°C} = 2{,}446{,}665$$

9.1.7.2 Wasteload allocation attainment equation

DEQ evaluated attainment of a wasteload allocation (WLA) at the point of discharge using Equation 9-3, which calculates the excess thermal loading (ETL). The ETL was compared against the WLA to assess attainment.

$$ETL = (T_E - T_C) \cdot Q_E \cdot C_F$$ ***Equation 9-3***

where,

$ETL =$ The daily excess thermal load (kilocalories/day), expressed as a rolling seven-day average.

$T_C =$ The point of discharge applicable river temperature criterion (°C).

$T_E =$ The daily maximum effluent temperature (°C)

$Q_E =$ The daily mean effluent flow (cfs or MGD)

$C_F =$ Conversion factor for flow in cfs: 2,446,665

$$\left(\frac{1\text{ m}}{3.2808\text{ ft}}\right)^3 \cdot \frac{1000\ kg}{1\ m^3} \cdot \frac{86400\ sec}{1\ day} \cdot \frac{1\ kcal}{1\ kg\ \cdot 1℃} = 2{,}446{,}665$$

Conversion factor for flow in millions of gallons per day (MGD): 3,785,411

$$\frac{1\ m^3}{264.17\ gal} \cdot \frac{1000\ kg}{1\ m^3} \cdot \frac{1000000\ gal}{1\ million\ gal} \cdot \frac{1\ kcal}{1\ kg\ \cdot 1℃} = 3{,}785{,}441$$

9.1.8 Calculating current change in temperature

9.1.9 Calculating acceptable effluent temperatures

9.1.10 Calculating acceptable effluent flows

9.1.11 Determination of when minimum duties provision applies

9.2 Load allocations for nonpoint sources

Refer to the [final date] Middle Columbia-Hood (Miles Creeks) Subbasin Temperature TMDL rule (OAR ….) for the load allocations assigned to nonpoint sources.

Load allocations are assigned to background sources and anthropogenic nonpoint sources on all waters in the Middle Columbia-Hood (Miles Creeks) Subbasin. Load allocations for background sources are calculated using Equation 9-4.

$$LA_{BG} = (T_C) \cdot (Q_R) \cdot C_F$$ **Equation 9-4**

where,

$LA_{BG} =$ Load allocation to background sources (kilocalories/day).

$T_C =$ The applicable temperature criteria, not including the HUA. When there are two year-round applicable temperature criteria that apply to the same AU, the more stringent criteria shall be used.

$Q_R =$ The daily average river flow rate (cfs). For a lake, a dilution factor of 1 may be used for Q_R unless determined using another method.

$C_F =$ Conversion factor using flow in cfs: 2,446,665

$$\left(\frac{1\text{ m}}{3.2808\text{ ft}}\right)^3 \cdot \frac{1\ m^3}{35.31\ ft^3} \cdot \frac{1000\ kg}{1\ m^3} \cdot \frac{86400\ sec}{1\ day} \cdot \frac{1\ kcal}{1\ kg\ \cdot 1℃} = 2{,}446{,}665$$

This equation will be used to calculate the load allocation to background sources for any AU or stream location in the Middle Columbia-Hood (Miles Creeks) Subbasin not identified in [TMDL section] or when river flows are greater than 7Q10. This equation may also be used to calculate the load allocations for background nonpoint sources if in the future the applicable temperature criteria are updated and approved by EPA.

Load allocations assigned to anthropogenic nonpoint sources on any AU or stream location in the Middle Columbia-Hood (Miles Creeks) Subbasin are calculated using X. The portions of the HUA (ΔT) assigned to nonpoint sources or source categories are presented in [TMDL section].

$$LA_{NPS} = (\Delta T) \cdot (Q_R) \cdot C_F$$ **Equation 9-5**

where,

$LA_{NPS} =$ Load allocation to anthropogenic nonpoint sources (kilocalories/day).

$\Delta T =$ The portion of the HUA assigned to each nonpoint source or source category representing the maximum cumulative temperature increase (°C) from the nonpoint source or source category. When the minimum duties provision at OAR 340-041-0028(12)(a) applies, ΔT = 0.0.

$Q_R =$ The daily average river flow rate (cfs). For a lake, a dilution factor of 1 may be used for Q_R unless determined using another method.

$C_F =$ Conversion factor using flow in cfs: 2,446,665

$$\left(\frac{1\text{ m}}{3.2808\text{ ft}}\right)^3 \cdot \frac{1\,m^3}{35.31\,ft^3} \cdot \frac{1000\,kg}{1\,m^3} \cdot \frac{86400\,sec}{1\,day} \cdot \frac{1\,kcal}{1\,kg\ \cdot 1^{\circ}\mathrm{C}} = 2{,}446{,}665$$

9.3 Surrogate measures

EPA regulations (40 CFR 130.2(i)) and OAR 340-042-0040(O)(5)(b) allow for TMDLs to utilize other appropriate measures (or surrogate measures). See Section 9.4 of the TMDL for a discussion of the surrogate measures that implement the TMDL load allocations.

10 Water quality standards attainment

TMDLs are a science-based approach to restoring water quality and eventually attaining and maintaining water quality standards in impaired waters. The Clean Water Act instructs that a TMDL "be established at a level necessary to implement applicable water quality standards." This TMDL assigns background sources load allocations consistent with applicable biologically based numeric temperature criteria, and wasteload allocations and nonpoint source load allocations consistent with the attainment of the 0.3°C human use allowance. As summarized in the allocations summary tables in TMDL Section 9.3, the sum of the wasteload allocations, load allocations, and reserve capacity on each assessment unit do not exceed that AU's thermal TMDL loading capacity. As discussed in TMDL Section 6.1, DEQ used the Heat Source model to evaluate attainment of the assigned allocations. For point and nonpoint sources, attainment is defined based on the human use allowance rule where the cumulative warming from all wasteload and load allocations must not be greater than 0.3°C (0.5°F) above the applicable biological criterion after complete mixing in the waterbody, and at the point of maximum impact (POMI).

[add additional details]

10.1 Point sources

[add details]

10.2 Nonpoint sources

[add details]

11 References

DEQ (Oregon Department of Environmental Quality), 2008. “Middle Columbia-Hood (Miles Creeks) Subbasin TMDL”. Portland, OR.

Fairbairn, D. 2022. *Water Temperature Impacts From In-Channel Ponds in Portland Metro and Northwest Region*. Oregon Department of Environmental Quality (DEQ) Report. https://www.oregon.gov/deq/wq/Documents/tmdlIn-ChannelPonds.pdf.

Herb, W.R., Janke B., Mohseni, O., Stefan, H., 2008. Thermal pollution of streams by runoff from paved surfaces. Hydrological Processes. 22: 987-999.

Hester, E.T., Bauman, K.S., 2013. Stream and retention pond thermal response to heated summer runoff from urban impervious surfaces. Journal of the American Water Resources Association. 49(2): 328-342.

Holzer, K. 2020, *Effects of Inline Ponds on Stream Temperatures in the Johnson Creek Watershed.* https://www.jcwc.org/wp-content/uploads/2020/08/Effects-of-Inline-Ponds-on-Stream-Temperatures-in-the-Johnson-Creek-Watershed.pdf.

Jones, M.P., Hunt, W.F., 2009. Bioretention impact on runoff temperature in trout sensitive waters. Journal of Environmental. Engineering. 135(8):577-585.

Jones, M.P., Hunt, W.F., Winston, R.J., 2012. Effect of Urban Catchment Composition on Runoff Temperature. Journal of Environmental. Engineering. 138(12):1231-1236.

Nelson, K.C., Palmer, M.A., 2007. Stream temperature surges under urbanization and climate change: data, models, and responses. Journal of the American Water Resources Association. 43(2): 440-452.

OAR (Oregon Administrative Rule) 340-041. Water Quality Standards: Beneficial Uses, Policies, and Criteria for Oregon.

OAR (Oregon Administrative Rule) 340-042. Total Maximum Daily Loads (TMDLs).

Sabouri, F., Gharabaghi, B., Mahboubi, A.A., McBean, E.A., 2013. Impervious surfaces and sewer pipe effects on stormwater runoff temperature. Journal of Hydrology. 502:10-17.

Thompson, A., Wilson T., Norman, J., Gemechu, A.L., Roa-Espinosa, A., 2008. Modeling the effect of summertime heating on urban runoff temperature. Journal of the American Water Resources Association. 44:1548-1563.

University of New Hampshire (UNH) Stormwater Center, 2011. Examination of thermal impacts from stormwater best management practices. The University of New Hampshire, Durham, NH.

Wardynski, B.J., Winston, R.J., Line, D.E., Hunt, W.F., 2014. Metrics for assessing thermal performance of stormwater control measures. Ecological Engineering. 71:551-562.

WDOE (Washington Department of Ecology), 2011a. Snoqualmie River Basin Temperature Total Maximum Daily Load: Water Quality Improvement Report and Implementation Plan.

WDOE (Washington Department of Ecology), 2011b. Salmon Creek Temperature Total Maximum Daily Load: Water Quality Improvement Report and Implementation Plan.

Winston, R. J., Hunt, W. F., Lord, W. G., 2011. Thermal mitigation of urban stormwater by level spreader-vegetative filter strips. Journal of Environmental. Engineering. 137(8): 707–716.

Zeiger, S.J., Hubbert J.A., 2015. Urban stormwater temperature surges: A central US watershed Study. Hydrology. 2:193-209.

12 Appendices

This report includes the following appendices. [update]

Appendix A: Model Report

Appendix B: Assessment Units Addressed by the TMDL