

# Draft Total Maximum Daily Loads for the Willamette Subbasins Temperature

**DRAFT**  
**Submitted Date**

*Updated Feb. 13, 2023:*

- *Table 9.5 (old table replaced with new one). Old table was from Lower Columbia-Sandy Subbasin TMDL*
- *Table 9.7 (old table replaced with new one). Old table was from Lower Columbia-Sandy Subbasin TMDL*
- *Text after Table 9.3 was updated. Old language was from Lower Columbia-Sandy Subbasin TMDL*
- *Updated Table of Contents and List of Figures and Tables as the page numbers changed.*



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# 1. Introduction

report adopted by reference into rule explanation

## 1.1. Previous TMDLs

In 2006 and 2008 DEQ issued, and EPA approved, two TMDL actions addressing temperature impairments (Table 1.1) within the project area for the Willamette Subbasins temperature TMDLs. Once approved by EPA, the Willamette Subbasins TMDLs for temperature will replace the temperature TMDLs developed for the applicable assessment units addressed by the TMDLs listed in Table 1.1. TMDLs for other parameters listed in Table 1.1 are still effective.

**Table 1.1. Summary of previous temperature TMDLs developed for the Willamette Subbasins.**

TMDL action ID	TMDL Name	EPA Approval Date	Water Quality Impairments Addressed
30674	Willamette Basin TMDL	9/29/2006	Bacteria (water contact recreation), DDT, dieldrin, Dissolved Oxygen, Mercury, Temperature, Turbidity
35888	Molalla-Pudding Subbasin TMDL and WQMP	12/31/2008	Bacteria (water contact recreation), DDT, dieldrin, chlordane, Iron, Nitrate, Temperature

## 1.2. TMDL prioritization

OAR 340-42-0040(3) requires DEQ or the EQC to prioritize and schedule TMDLs for completion considering various factors outlined in the rule. Temperature TMDLs for the Willamette Subbasins were identified as a high priority on Oregon's TMDL priority ranking submitted with Oregon's 2022 Integrated Report. These TMDLs were identified as a high priority due to court order to Oregon and EPA to establish new temperature TMDLs to replace the temperature TMDLs developed as part of the 2006 Willamette Basin TMDL (action ID 30674) and the 2008 Molalla-Pudding Subbasin TMDL and WQMP (action ID 35888) (Table 1.1).

# 2. TMDL name and location

Per Oregon Administrative Rule 340-042-0040(a), this element describes the geographic area for which the TMDL is developed.

Temperature TMDLs for the Willamette Subbasins are developed for all waters determined to be waters of the state as defined under ORS 468B.005(10), including all perennial and intermittent streams, located in the Middle Fork Willamette Subbasin (HUC 17090001), Coast Fork Willamette Subbasin (HUC 17090002), Upper Willamette Subbasin (HUC 17090003), McKenzie Subbasin (HUC 17090004), North Santiam Subbasin (HUC 17090005), the South Santiam Subbasin (HUC 17090006), Middle Willamette Subbasin (HUC 17090007), Molalla-Pudding Subbasin (HUC 17090009), Clackamas Subbasin (HUC 17090011), and Lower Willamette Subbasin (HUC 17090012). Waters excluded from the Willamette Subbasins TMDLs (Table 2.2) include the Willamette River, Multnomah Channel, and tributaries to the Willamette River downstream of the following dams: River Mill Dam, Detroit Dam, Foster Dam, Fern Ridge Dam, Cougar Dam, Blue River Dam, Dexter Dam, Fall Creek Dam, Cottage Grove Dam. The temperature TMDLs also do not include the section of the Columbia River that flows through the Lower Willamette Subbasin (HUC 17090012).

The map in Figure 1 provides an overview of where the temperature TMDLs are applicable. Appendix E of the Willamette Subbasin Technical support document, provides a list of all assessment units addressed by the TMDL.

The Willamette Subbasins is comprised of ten 10-digit subbasins as listed in Table 2.1.

**Table 2.1 The Willamette Subbasins.**

<b>HU10 code</b>	<b>Subbasin Name</b>
17090001	Middle Fork Willamette
17090002	Coast Fork Willamette
17090003	Upper Willamette
17090004	McKenzie
17090005	North Santiam
17090006	South Santiam
17090007	Middle Willamette
17090009	Molalla-Pudding
17090011	Clackamas
17090012	Lower Willamette

**Table 2.2 Waters not included in the Willamette Subbasins Temperature TMDLs.**

Waterbody	Extent
Willamette River	From the confluence of the Columbia River upstream to the confluence of Coast Fork of the Willamette and Middle Fork of the Willamette Rivers.
Multnomah Channel	From the confluence of the Columbia River upstream to The Willamette River.
Clackamas River	From the confluence with the Willamette River upstream to River Mill Dam.
Clackamas River	From the confluence with the Willamette River upstream to River Mill Dam.
Santiam River	From the confluence with the Willamette River upstream to the confluence of the North and South Santiam Rivers.
North Santiam River	From the confluence with the Santiam River upstream to Detroit Dam.
South Santiam River	From the confluence with the Santiam River upstream to Foster Dam.
Long Tom River	From the confluence with the Willamette River upstream to Fern Ridge Dam.
McKenzie River	From the confluence with the Willamette River upstream to the confluence with the South Fork McKenzie River.
South Fork McKenzie River	From the confluence with the McKenzie River upstream to Cougar Dam.
Blue River	From the confluence with the McKenzie River upstream to Blue River Dam.
Middle Fork Willamette River	From the confluence with the Willamette River upstream to Dexter Dam.
Fall Creek	From the confluence with the Middle Fork Willamette River upstream to Fall Creek Dam.
Coast Fork Willamette River	From the confluence with the Willamette River upstream to Cottage Grove Dam.
Row River	From the confluence with the Coast Fork Willamette River upstream to Dorena Dam.



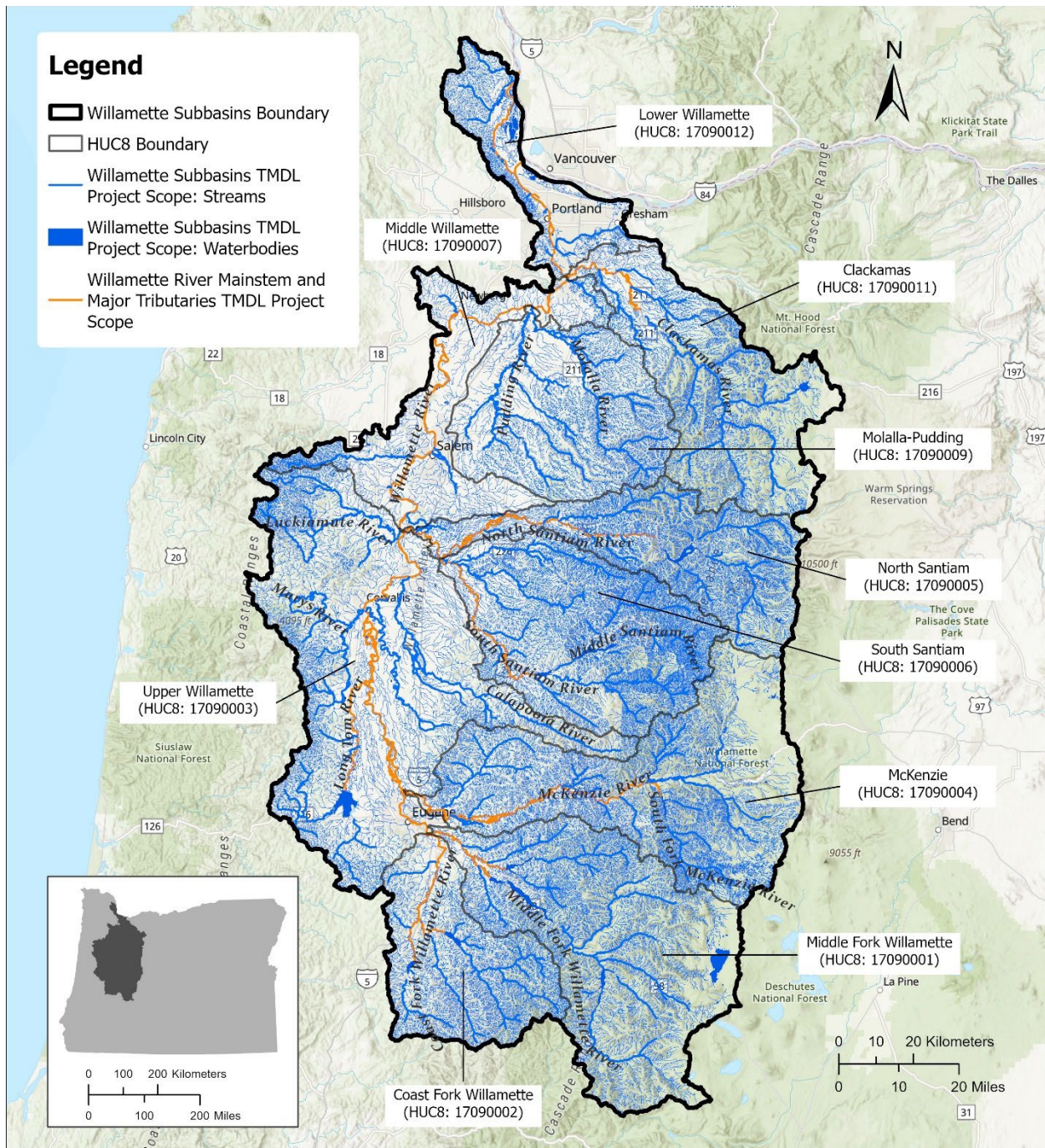


Figure 2.1 Willamette Subbasins temperature TMDLS project area overview.

### 3. Pollutant identification

As stated in OAR 340-042-0040(4)(b), this element identifies the pollutants causing impairment of water quality that are addressed by these TMDLs. The associated water quality standards and beneficial uses are identified in Chapter 4.

The pollutants addressed by this temperature TMDL are heat or thermal loads, with a surrogate measure for effective shade, percent consumptive use, and channel morphology.

Table 3.1 through Table 3.10 present stream assessment units within the Willamette Subbasins that were listed as impaired for temperature on DEQ’s 2022 Clean Water Act Section 303(d) List (as part of Oregon’s Integrated Report), which was approved by the Environmental Protection Agency on September 1, 2022. Status category designations are prescribed by Sections 305(b) and 303(d) of the Clean Water Act. Assessment units listed in Category 5 (designated use is not supported or a water quality standard is not attained) require development of a TMDL. Locations of these listed segments are depicted in Figure 2.

DEQ developed this TMDL to address Category 5 listed assessment units and to protect all other assessment units and assessment categories, including “unassessed”. The allocations, including surrogate measures, and implementation framework apply to all waters of the state, including all perennial and intermittent streams in the Willamette Subbasins, as described in Sections 2, 5, 8 and 9 of this document.

Surrogate measures are defined in OAR 340-042-0030(14) as “substitute methods or parameters used in a TMDL to represent pollutants.” In accordance with OAR 340-042-0040(5)(b), DEQ used effective shade as a surrogate measure for thermal loading caused by solar radiation. Effective shade is the percent of the daily solar radiation flux blocked by vegetation and topography. Implementation of the surrogate measures ensures achievement of necessary pollutant reductions and the nonpoint load allocations for this temperature TMDL.

**Table 3.1 Middle Fork Willamette Subbasin (17090001) Category 5 temperature impairments on the 2022 Integrated Report.**

Assessment Unit Name	Assessment Unit	Use Period
OR LK 1709000105 02 100684	Packard Creek	Year Round
OR LK 1709000109 02 100701	Fall Creek Lake	Year Round
OR SR 1709000101 02 103713	Middle Fork Willamette River	Year Round
OR SR 1709000102 02 103715	Hills Creek	Year Round
OR SR 1709000102 02 103715	Hills Creek	Spawning
OR SR 1709000103 02 103716	Salt Creek	Year Round
OR SR 1709000103 02 103716	Salt Creek	Spawning
OR SR 1709000104 02 103719	Salmon Creek	Year Round
OR SR 1709000104 02 103719	Salmon Creek	Spawning
OR SR 1709000105 02 104578	Packard Creek	Year Round
OR SR 1709000105 02 104579	Middle Fork Willamette River	Year Round
OR SR 1709000105 02 104580	Middle Fork Willamette River	Year Round
OR SR 1709000105 02 104580	Middle Fork Willamette River	Spawning
OR SR 1709000106 02 103721	North Fork Middle Fork Willamette River	Year Round
OR SR 1709000106 02 103721	North Fork Middle Fork Willamette River	Spawning
OR SR 1709000106 02 103722	Christy Creek	Spawning
OR SR 1709000106 02 103723	North Fork Middle Fork Willamette River	Year Round
OR SR 1709000107 02 103725	Middle Fork Willamette River	Year Round
OR SR 1709000107 02 103725	Middle Fork Willamette River	Spawning
OR SR 1709000107 02 103727	Lost Creek	Year Round
OR SR 1709000107 02 103727	Lost Creek	Spawning
OR SR 1709000107 02 103728	Lost Creek	Year Round
OR SR 1709000107 02 103728	Lost Creek	Spawning
OR SR 1709000108 02 103730	Little Fall Creek	Year Round
OR SR 1709000108 02 103730	Little Fall Creek	Spawning
OR SR 1709000109 02 103734	Hehe Creek	Year Round
OR SR 1709000109 02 103736	Fall Creek	Year Round



Assessment Unit Name	Assessment Unit	Use Period
OR_SR_1709000109_02_103736	Fall Creek	Spawning
OR_SR_1709000109_02_103737	Fall Creek	Year Round
OR_SR_1709000109_02_103737	Fall Creek	Spawning
OR_SR_1709000109_02_103738	North Fork Winberry Creek	Year Round
OR_SR_1709000109_02_103741	Portland Creek	Year Round
OR_SR_1709000109_02_103742	Logan Creek	Year Round
OR_SR_1709000109_02_103743	Fall Creek	Year Round
OR_SR_1709000109_02_103743	Fall Creek	Spawning
OR_SR_1709000109_02_103744	Portland Creek	Year Round
OR_SR_1709000109_02_103745	South Fork Winberry Creek	Year Round
OR_SR_1709000109_02_103747	Winberry Creek	Year Round
OR_SR_1709000109_02_103747	Winberry Creek	Spawning
OR_SR_1709000110_02_103749	Hills Creek	Year Round
OR_WS_170900010102_02_104186	HUC12 Name: Tumblebug Creek	Year Round
OR_WS_170900010105_02_104189	HUC12 Name: Staley Creek	Year Round
OR_WS_170900010106_02_104190	HUC12 Name: Echo Creek-Middle Fork Willamette River	Year Round
OR_WS_170900010202_02_104192	HUC12 Name: Lower Hills Creek	Year Round
OR_WS_170900010302_02_104194	HUC12 Name: Middle Salt Creek	Year Round
OR_WS_170900010303_02_104195	HUC12 Name: Lower Salt Creek	Spawning
OR_WS_170900010303_02_104195	HUC12 Name: Lower Salt Creek	Year Round
OR_WS_170900010402_02_104197	HUC12 Name: Upper Salmon Creek	Year Round
OR_WS_170900010403_02_104198	HUC12 Name: Lower Salmon Creek	Year Round
OR_WS_170900010501_02_104199	HUC12 Name: Coal Creek	Year Round
OR_WS_170900010502_02_104200	HUC12 Name: Buck Creek-Middle Fork Willamette River	Year Round
OR_WS_170900010503_02_104201	HUC12 Name: Packard Creek-Middle Fork Willamette	Year Round
OR_WS_170900010505_02_104202	HUC12 Name: Gray Creek-Middle Fork Willamette River	Year Round
OR_WS_170900010607_02_104209	HUC12 Name: Eighth Creek-North Fork Middle Fork Willamette River	Year Round
OR_WS_170900010608_02_104210	HUC12 Name: Dartmouth Creek-North Fork Middle Fork Willamette River	Year Round
OR_WS_170900010701_02_104211	HUC12 Name: Deception Creek-Middle Fork Willamette River	Year Round
OR_WS_170900010702_02_104212	HUC12 Name: Lost Creek	Year Round
OR_WS_170900010703_02_104213	HUC12 Name: Dexter Reservoir-Middle Fork Willamette River	Year Round
OR_WS_170900010901_02_104216	HUC12 Name: Delp Creek-Fall Creek	Year Round
OR_WS_170900010904_02_104219	HUC12 Name: Andy Creek-Fall Creek	Year Round
OR_WS_170900010905_02_104220	HUC12 Name: Winberry Creek	Year Round

**Table 3.2 Coast Fork Willamette Subbasin (17090002) Category 5 temperature impairments on the 2022 Integrated Report.**

Assessment Unit Name	Assessment Unit	Use Period
OR_LK_1709000202_02_100705	Dorena Lake	Year Round
OR_SR_1709000201_02_103752	Mosby Creek	Year Round
OR_SR_1709000201_02_103752	Mosby Creek	Spawning
OR_SR_1709000202_02_103755	Sharps Creek	Year Round
OR_SR_1709000202_02_103756	Martin Creek	Year Round
OR_SR_1709000202_02_103761	Row River	Year Round
OR_SR_1709000202_02_103765	Layng Creek	Year Round
OR_SR_1709000202_02_103766	Row River	Year Round
OR_SR_1709000202_02_103771	Brice Creek	Year Round
OR_SR_1709000202_02_103775	Sharps Creek	Year Round
OR_SR_1709000202_02_103776	Sharps Creek	Year Round
OR_SR_1709000203_02_104586	Coast Fork Willamette River	Year Round

Assessment Unit Name	Assessment Unit	Use Period
OR WS 170900020203 02 104229	HUC12 Name: Sharps Creek	Year Round
OR WS 170900020204 02 104230	HUC12 Name: King Creek-Row River	Year Round
OR WS 170900020401 02 104238	HUC12 Name: Hill Creek-Coast Fork Willamette River	Year Round

**Table 3.3 Upper Willamette Subbasin (17090003) Category 5 temperature impairments on the 2022 Integrated Report.**

Assessment Unit Name	Assessment Unit	Use Period
OR SR 1709000301 02 103790	Ferguson Creek	Year Round
OR SR 1709000301 02 103796	Coyote Creek	Year Round
OR SR 1709000302 02 103804	Marys River	Year Round
OR SR 1709000302 02 103806	Muddy Creek	Year Round
OR SR 1709000302 02 103812	Marys River	Year Round
OR SR 1709000302 02 103813	Marys River	Year Round
OR SR 1709000303 02 103815	Calapooia River	Year Round
OR SR 1709000303 02 103815	Calapooia River	Spawning
OR SR 1709000303 02 103816	Calapooia River	Year Round
OR SR 1709000303 02 103816	Calapooia River	Spawning
OR SR 1709000303 02 103819	Courtney Creek	Year Round
OR SR 1709000304 02 103821	Calapooia River	Year Round
OR SR 1709000305 02 103822	Little Luckiamute River	Year Round
OR SR 1709000305 02 103824	Teal Creek	Year Round
OR SR 1709000305 02 103825	Miller Creek	Year Round
OR SR 1709000305 02 103828	North Fork Pedee Creek	Year Round
OR SR 1709000305 02 103829	Luckiamute River	Year Round
OR SR 1709000305 02 103832	Soap Creek	Year Round
OR SR 1709000305 02 103833	Ritner Creek	Year Round
OR SR 1709000306 02 103838	Muddy Creek	Year Round
OR WS 170900030109 02 104251	HUC12 Name: Bear Creek-Long Tom River	Year Round
OR WS 170900030204 02 104256	HUC12 Name: Greasy Creek	Year Round
OR WS 170900030301 02 104264	HUC12 Name: Hands Creek-Calapooia River	Spawning
OR WS 170900030301 02 104264	HUC12 Name: Hands Creek-Calapooia River	Year Round
OR WS 170900030302 02 104265	HUC12 Name: Bigs Creek-Calapooia River	Year Round
OR WS 170900030402 02 104273	HUC12 Name: Lower Oak Creek	Year Round
OR WS 170900030503 02 104277	HUC12 Name: Maxfield Creek-Luckiamute River	Year Round
OR WS 170900030504 02 104278	HUC12 Name: Pedee Creek-Luckiamute River	Year Round
OR WS 170900030505 02 104279	HUC12 Name: Jont Creek-Luckiamute River	Year Round
OR WS 170900030510 02 104284	HUC12 Name: Berry Creek	Year Round
OR WS 170900030603 02 104290	HUC12 Name: Flat Creek	Year Round

**Table 3.4 McKenzie Subbasin (17090004) Category 5 temperature impairments on the 2022 Integrated Report.**

Assessment Unit Name	Assessment Unit	Use Period
OR SR 1709000401 02 103855	Horse Creek	Year Round
OR SR 1709000401 02 103856	Horse Creek	Year Round
OR SR 1709000403 02 103862	French Pete Creek	Year Round
OR SR 1709000403 02 103865	Augusta Creek	Year Round
OR SR 1709000404 02 104571	Lookout Creek	Year Round
OR SR 1709000404 02 104574	Upper Blue River	Year Round
OR SR 1709000404 02 104576	Quentin Creek	Year Round
OR SR 1709000404 02 104577	Upper Blue River	Year Round
OR SR 1709000405 02 103867	Quartz Creek	Year Round
OR SR 1709000406 02 103870	Mohawk River	Year Round
OR SR 1709000406 02 103870	Mohawk River	Spawning
OR SR 1709000406 02 103871	Mohawk River	Year Round
OR SR 1709000406 02 103871	Mohawk River	Spawning
OR SR 1709000406 02 103872	Shotgun Creek	Year Round
OR SR 1709000406 02 103873	Mill Creek	Year Round

Assessment Unit Name	Assessment Unit	Use Period
OR SR 1709000406 02 103874	Mill Creek	Year Round
OR SR 1709000406 02 103875	Cartwright Creek	Year Round
OR SR 1709000406 02 103875	Cartwright Creek	Spawning
OR SR 1709000406 02 103877	Mohawk River	Year Round
OR SR 1709000406 02 103877	Mohawk River	Spawning
OR SR 1709000406 02 103879	McGowan Creek	Year Round
OR SR 1709000406 02 103879	McGowan Creek	Spawning
OR SR 1709000407 02 103882	Deer Creek	Year Round
OR SR 1709000407 02 103882	Deer Creek	Spawning
OR SR 1709000407 02 103889	Camp Creek	Year Round
OR SR 1709000407 02 103889	Camp Creek	Spawning
OR SR 1709000407 02 103891	Cedar Creek	Year Round
OR SR 1709000407 02 103891	Cedar Creek	Spawning
OR WS 170900040104 02 104303	HUC12 Name: Middle Horse Creek	Year Round
OR WS 170900040105 02 104304	HUC12 Name: Lower Horse Creek	Year Round
OR WS 170900040202 02 104306	HUC12 Name: Hackleman Creek-McKenzie River	Year Round
OR WS 170900040203 02 104307	HUC12 Name: Smith River	Year Round
OR WS 170900040204 02 104308	HUC12 Name: Kink Creek-McKenzie River	Year Round
OR WS 170900040205 02 104309	HUC12 Name: Deer Creek	Year Round
OR WS 170900040206 02 104310	HUC12 Name: Boulder Creek-McKenzie River	Year Round
OR WS 170900040209 02 104313	HUC12 Name: Florence Creek-McKenzie River	Year Round
OR_WS_170900040304_02_104317	HUC12 Name: Rebel Creek-South Fork McKenzie River	Year Round
OR WS 170900040402 02 104323	HUC12 Name: Upper Blue River	Year Round
OR WS 170900040403 02 104324	HUC12 Name: Lower Blue River	Year Round
OR WS 170900040502 02 104326	HUC12 Name: Elk Creek-McKenzie River	Spawning
OR WS 170900040502 02 104326	HUC12 Name: Elk Creek-McKenzie River	Year Round
OR WS 170900040601 02 104327	HUC12 Name: Headwaters Mohawk River	Year Round
OR WS 170900040602 02 104328	HUC12 Name: Shotgun Creek-Mohawk River	Year Round
OR WS 170900040702 02 104333	HUC12 Name: East Fork Deer Creek-McKenzie River	Spawning
OR WS 170900040702 02 104333	HUC12 Name: East Fork Deer Creek-McKenzie River	Year Round
OR WS 170900040705 02 104336	HUC12 Name: Camp Creek	Year Round

**Table 3.5 North Santiam Subbasin (17090005) Category 5 temperature impairments on the 2022 Integrated Report.**

Assessment Unit Name	Assessment Unit	Use Period
OR SR 1709000502 02 103902	Boulder Creek	Year Round
OR SR 1709000503 02 103907	Blowout Creek	Year Round
OR SR 1709000503 02 103909	Blowout Creek	Year Round
OR SR 1709000505 02 103923	Elkhorn Creek	Year Round
OR SR 1709000505 02 104564	Little North Santiam River	Year Round
OR SR 1709000505 02 104564	Little North Santiam River	Spawning
OR SR 1709000506 02 103926	Chehulpum Creek	Year Round
OR SR 1709000506 02 103928	Bear Branch	Year Round
OR SR 1709000506 02 103929	Stout Creek	Year Round
OR WS 170900050203 02 104345	HUC12 Name: Marion Creek	Year Round
OR WS 170900050301 02 104351	HUC12 Name: Upper Blowout Creek	Year Round
OR WS 170900050503 02 104567	HUC12 Name: Upper Little North Santiam River	Year Round
OR WS 170900050504 02 104563	HUC12 Name: Middle Little North Santiam River	Year Round
OR WS 170900050602 02 104360	HUC12 Name: Bear Branch-North Santiam River	Year Round
OR WS 170900050603 02 104361	HUC12 Name: Marion Creek-North Santiam River	Spawning
OR WS 170900050603 02 104361	HUC12 Name: Marion Creek-North Santiam River	Year Round

**Table 3.6 South Santiam Subbasin (17090006) Category 5 temperature impairments on the 2022 Integrated Report.**

Assessment Unit Name	Assessment Unit	Use Period
OR LK 1709000603 02 100771	Green Peter Lake	Year Round

Assessment Unit Name	Assessment Unit	Use Period
OR LK 1709000604 02 100772	Foster Lake	Year Round
OR SR 1709000601 02 103934	Middle Santiam River	Year Round
OR SR 1709000601 02 103935	Pyramid Creek	Year Round
OR SR 1709000601 02 103936	Middle Santiam River	Year Round
OR SR 1709000601 02 103938	Middle Santiam River	Year Round
OR SR 1709000602 02 103941	Owl Creek	Year Round
OR SR 1709000602 02 103942	Trout Creek	Year Round
OR SR 1709000602 02 103947	Soda Fork	Year Round
OR SR 1709000602 02 103948	Two Girls Creek	Year Round
OR SR 1709000602 02 103949	Canyon Creek	Year Round
OR SR 1709000602 02 103950	South Santiam River	Year Round
OR SR 1709000602 02 103950	South Santiam River	Spawning
OR SR 1709000602 02 103953	Sheep Creek	Year Round
OR SR 1709000602 02 103954	Moose Creek	Year Round
OR SR 1709000602 02 103954	Moose Creek	Spawning
OR SR 1709000602 02 103955	Latiwi Creek	Year Round
OR SR 1709000603 02 103957	Quartzville Creek	Year Round
OR SR 1709000603 02 103960	Quartzville Creek	Year Round
OR SR 1709000603 02 103965	Middle Santiam River	Year Round
OR SR 1709000604 02 103968	South Santiam River	Year Round
OR SR 1709000604 02 103968	South Santiam River	Spawning
OR SR 1709000604 02 103969	Middle Santiam River	Spawning
OR SR 1709000605 02 103971	Wiley Creek	Year Round
OR SR 1709000605 02 103971	Wiley Creek	Spawning
OR SR 1709000605 02 103972	Wiley Creek	Year Round
OR SR 1709000605 02 103972	Wiley Creek	Spawning
OR SR 1709000606 02 103973	Beaver Creek	Year Round
OR SR 1709000606 02 103978	Crabtree Creek	Year Round
OR SR 1709000606 02 103978	Crabtree Creek	Spawning
OR SR 1709000607 02 103985	South Fork Neal Creek	Year Round
OR SR 1709000607 02 103986	Bilyeu Creek	Year Round
OR SR 1709000607 02 103988	Thomas Creek	Year Round
OR SR 1709000607 02 103989	Bilyeu Creek	Year Round
OR SR 1709000607 02 103991	Thomas Creek	Year Round
OR SR 1709000607 02 103991	Thomas Creek	Spawning
OR SR 1709000608 02 103993	Hamilton Creek	Year Round
OR SR 1709000608 02 103993	Hamilton Creek	Spawning
OR SR 1709000608 02 103994	McDowell Creek	Year Round
OR SR 1709000608 02 103996	Hamilton Creek	Year Round
OR SR 1709000608 02 103996	Hamilton Creek	Spawning
OR SR 1709000608 02 103997	Scott Creek	Year Round
OR WS 170900060501 02 104384	HUC12 Name: Little Wiley Creek	Year Round
OR WS 170900060705 02 104394	HUC12 Name: Lower Thomas Creek	Year Round
OR WS 170900060804 02 104398	HUC12 Name: Hamilton Creek	Year Round

**Table 3.7 Middle Willamette Subbasin (17090007) Category 5 temperature impairments on the 2022 Integrated Report.**

Assessment Unit Name	Assessment Unit	Use Period
OR SR 1709000701 02 104591	Rickreall Creek	Year Round
OR SR 1709000703 02 104007	Mill Creek	Year Round
OR SR 1709000703 02 104007	Mill Creek	Spawning
OR SR 1709000703 02 104008	Shelton Ditch	Year Round
OR SR 1709000703 02 104008	Shelton Ditch	Spawning
OR SR 1709000703 02 104012	Pringle Creek	Year Round
OR SR 1709000704 02 104017	Abernethy Creek	Year Round
OR SR 1709000704 02 104594	Abernethy Creek	Year Round
OR WS 170900070203 02 104411	HUC12 Name: McKinney Creek	Year Round

Assessment Unit Name	Assessment Unit	Use Period
OR_WS_170900070204_02_104412	HUC12 Name: Lower Mill Creek	Year Round
OR_WS_170900070301_02_104413	HUC12 Name: Croisan Creek-Willamette River	Spawning
OR_WS_170900070301_02_104413	HUC12 Name: Croisan Creek-Willamette River	Year Round
OR_WS_170900070303_02_104415	HUC12 Name: Glenn Creek-Willamette River	Year Round
OR_WS_170900070304_02_104599	HUC12 Name: Lambert Slough-Willamette River	Year Round
OR_WS_170900070306_02_104417	HUC12 Name: Chehalem Creek	Year Round

**Table 3.8 Molalla-Pudding Subbasin (17090009) Category 5 temperature impairments on the 2022 Integrated Report.**

Assessment Unit Name	Assessment Unit	Use Period
OR_LK_1709000902_02_100830	Zollner Creek	Year Round
OR_SR_1709000901_02_104062	Abiqua Creek	Year Round
OR_SR_1709000901_02_104066	South Fork Silver Creek	Year Round
OR_SR_1709000901_02_104067	Pudding River	Year Round
OR_SR_1709000901_02_104069	Drift Creek	Year Round
OR_SR_1709000901_02_104069	Drift Creek	Spawning
OR_SR_1709000901_02_104595	Silver Creek	Year Round
OR_SR_1709000902_02_104070	Butte Creek	Year Round
OR_SR_1709000902_02_104072	Butte Creek	Year Round
OR_SR_1709000904_02_104086	Molalla River	Year Round
OR_SR_1709000904_02_104086	Molalla River	Spawning
OR_SR_1709000904_02_104087	Table Rock Fork	Year Round
OR_SR_1709000904_02_104087	Table Rock Fork	Spawning
OR_SR_1709000905_02_104088	Pudding River	Year Round
OR_WS_170900090101_02_104454	HUC12 Name: Headwaters Pudding River	Year Round
OR_WS_170900090202_02_104465	HUC12 Name: Middle Butte Creek	Year Round
OR_WS_170900090204_02_104467	HUC12 Name: Brandy Creek-Pudding River	Year Round
OR_WS_170900090303_02_104470	HUC12 Name: Bear Creek	Year Round
OR_WS_170900090403_02_104474	HUC12 Name: Pine Creek-Molalla River	Year Round

**Table 3.9 Clackamas Subbasin (17090011) Category 5 temperature impairments on the 2022 Integrated Report.**

Assessment Unit Name	Assessment Unit	Use Period
OR_SR_1709001101_02_104142	Collawash River	Year Round
OR_SR_1709001101_02_104142	Collawash River	Spawning
OR_SR_1709001101_02_104144	Collawash River	Year Round
OR_SR_1709001101_02_104145	Nohorn Creek	Year Round
OR_SR_1709001101_02_104145	Nohorn Creek	Spawning
OR_SR_1709001104_02_104152	North Fork Clackamas River	Year Round
OR_SR_1709001104_02_104154	Clackamas River	Year Round
OR_SR_1709001104_02_104154	Clackamas River	Spawning
OR_SR_1709001104_02_104155	Clackamas River	Year Round
OR_SR_1709001104_02_104155	Clackamas River	Spawning
OR_SR_1709001104_02_104156	Fish Creek	Year Round
OR_SR_1709001104_02_104157	Trout Creek	Year Round
OR_SR_1709001104_02_104160	Roaring River	Spawning
OR_SR_1709001104_02_104161	Fish Creek	Year Round
OR_SR_1709001104_02_104161	Fish Creek	Spawning
OR_SR_1709001105_02_104163	Eagle Creek	Year Round
OR_SR_1709001105_02_104163	Eagle Creek	Spawning
OR_SR_1709001105_02_104165	North Fork Eagle Creek	Year Round
OR_WS_170900110402_02_104535	HUC12 Name: Roaring River	Year Round
OR_WS_170900110405_02_104538	HUC12 Name: North Fork Clackamas River	Year Round
OR_WS_170900110406_02_104539	HUC12 Name: Helion Creek-Clackamas River	Year Round
OR_WS_170900110501_02_104540	HUC12 Name: Upper Eagle Creek	Year Round
OR_WS_170900110607_02_104549	HUC12 Name: Rock Creek-Clackamas River	Year Round



**Table 3.10 Lower Willamette Subbasin (17090012) Category 5 temperature impairments on the 2022 Integrated Report.**

Assessment Unit Name	Assessment Unit	Use Period
OR SR 1709001201_02_104170	Johnson Creek	Year Round
OR SR 1709001201_02_104170	Johnson Creek	Spawning
OR SR 1709001203_02_104176	Milton Creek	Year Round
OR SR 1709001203_02_104176	Milton Creek	Spawning
OR SR 1709001203_02_104179	North Scappoose Creek	Year Round
OR SR 1709001203_02_104179	North Scappoose Creek	Spawning
OR SR 1709001203_02_104180	South Scappoose Creek	Year Round
OR SR 1709001203_02_104180	South Scappoose Creek	Spawning
OR WS 170900120101_02_104550	HUC12 Name: Upper Johnson Creek	Spawning
OR WS 170900120101_02_104550	HUC12 Name: Upper Johnson Creek	Year Round
OR WS 170900120103_02_104552	HUC12 Name: Lower Johnson Creek	Spawning
OR WS 170900120103_02_104552	HUC12 Name: Lower Johnson Creek	Year Round
OR WS 170900120104_02_104553	HUC12 Name: Oswego Creek-Willamette River	Spawning
OR WS 170900120104_02_104553	HUC12 Name: Oswego Creek-Willamette River	Year Round
OR WS 170900120201_02_104554.1	HUC12 Name: Columbia Slough (Lower)	Year Round
OR WS 170900120201_02_104554.2	HUC12 Name: Columbia Slough (Upper)	Year Round
OR WS 170900120202_02_104555	HUC12 Name: Balch Creek-Willamette River	Year Round
OR WS 170900120301_02_104557	HUC12 Name: South Scappoose Creek	Spawning
OR WS 170900120305_02_104561	HUC12 Name: Multnomah Channel	Year Round



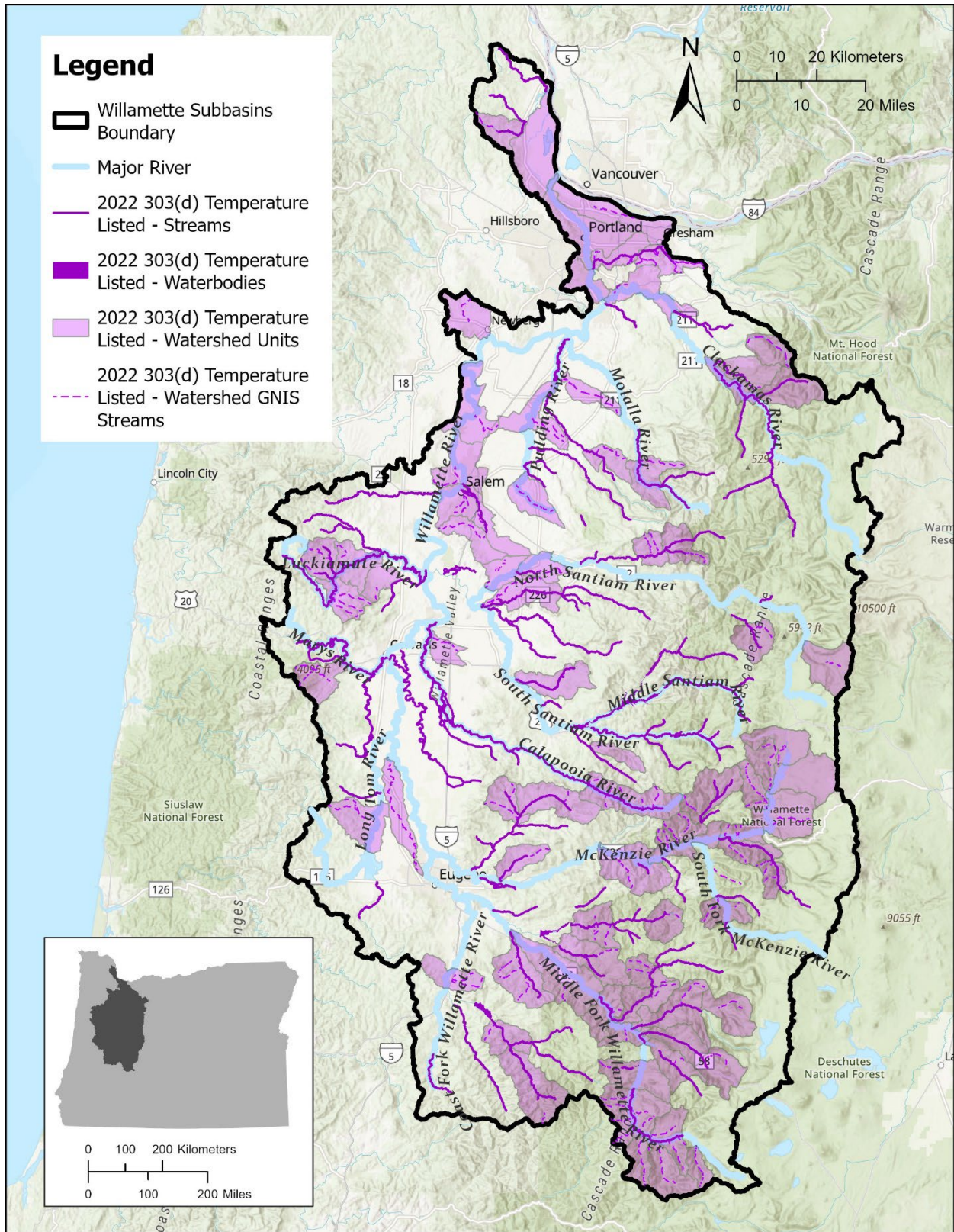


Figure 3.1. Willamette Subbasins category 5 temperature impairments on the 2022 Integrated Report.

# 4. Water quality standards and beneficial uses

As stated in OAR 340-042-0040(4)(c), this element identifies the beneficial uses in the basin, specifying the most sensitive beneficial use, and the relevant water quality standards established in OAR 340-041-0202 through 340-041-0975.

Table 4.1 and Table 4.2 specify the designated beneficial uses in the Willamette Subbasins surface water and the applicable numeric and narrative water quality standards addressed by these TMDLs, as well as indicated the most sensitive beneficial uses related to each standard. These TMDLs are designed such that meeting water quality standards for the most sensitive beneficial uses will be protective of all other uses.

**Table 4.1 Designated beneficial uses in the Willamette Subbasins as identified in OAR 340-041-0340 Table 340A.**

Beneficial Uses	All waterbodies
Public Domestic Water Supply	X
Private Domestic Water Supply	X
Industrial Water Supply	X
Irrigation	X
Livestock Watering	X
Fish and Aquatic Life	X
Wildlife and Hunting	X
Fishing	X
Boating	X
Water Contact Recreation	X
Aesthetic Quality	X
Hydro Power	X
Commercial Navigation & Transportation	

**Table 4.2 Applicable water quality standards and most sensitive beneficial uses**

Parameter	Rule Citation	Summary of applicable standards	Waters where standards are applicable	Most sensitive beneficial use
Statewide Narrative Criteria	OAR 340-041-0007(1)	The highest and best practicable treatment and/or control of wastes, activities, and flows must in every case be provided so as to maintain dissolved oxygen and overall water quality at the highest possible levels and <u>water temperatures</u> , coliform bacteria concentrations, dissolved chemical substances, toxic materials, radioactivity, turbidities, color, odor	All waters of the state	Fish and aquatic life

Parameter	Rule Citation	Summary of applicable standards	Waters where standards are applicable	Most sensitive beneficial use
		and other deleterious factors at the lowest possible levels.		
Temperature	OAR 340-041-0028(4)  OAR 340-041-0340 Figures 340A and 340B	(a) The 7-day average maximum temperature may not exceed 13.0°C (55°F) at the times indicated on maps and tables (b) The 7-day average maximum temperature may not exceed 16.0°C (60.8°F) (c) The 7-day average maximum temperature may not exceed 18.0°C (64.4°F) (f) The 7-day average maximum temperature may not exceed 12.0°C (53.6 °F). From August 15 through May 15 there may be no more than a 0.3 degrees Celsius (0.5 Fahrenheit) increase between the water temperature immediately upstream of Carmen reservoir on the Upper McKenzie River and the water temperature immediately downstream of the spillway when the ambient seven-day-average maximum stream temperature is 9.0 degrees Celsius (48 degrees Fahrenheit) or greater, and no more than a 1.0 degree Celsius (1.8 degrees Fahrenheit) increase when the seven-day-average stream temperature is less than 9 degrees Celsius.	See OAR Figures 340A and 340B	Salmonid and steelhead Spawning  Bull Trout spawning and juvenile rearing use
	OAR 340-041-0028(6)	Natural lakes may not be warmed by more than 0.3 degrees Celsius (0.5 degrees Fahrenheit) above the natural condition unless a greater increase would not reasonably be expected to adversely affect fish or other aquatic life.		
	OAR 340-041-0028(11)	(a) Not warmed by more than 0.3°C (0.5°F) above the colder water ambient temperature, by all sources taken together at the point of maximum impact	Cold water	Salmon, steelhead or bulltrout presence
	OAR 340-041-0028(12)(b)	(B) Human Use Allowance. Following a temperature TMDL or other cumulative effects analysis, wasteload and load allocations will restrict all NPDES point sources and nonpoint sources to a cumulative increase of no	All waters of the state	Salmonid and steelhead Spawning

Parameter	Rule Citation	Summary of applicable standards	Waters where standards are applicable	Most sensitive beneficial use
		greater than 0.3°C (0.5°F) above the applicable criteria after complete mixing in the water body, and at the point of maximum impact.		

## 5. Seasonal variation and critical period for Temperature

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

[summarize seasonality and critical periods and refer to xx Basin TMDL Technical and Policy Support Document]

## 6. Temperature water quality data evaluation overview

Summarize general evaluation approach – names of models and linkage analyses, refer to a schematic

[insert figure]

Figure 6: Schematic of temperature evaluation approach

## 7. Pollutant sources or source categories

As noted in OAR 340-042-0040(4)(f) and OAR 340-042-030(12), a source is any process, practice, activity or resulting condition that causes or may cause pollution or the introduction of pollutants to a waterbody. This section identifies the various pollutant sources and estimates, to the extent existing data allow, the significance of pollutant loading from existing sources.



Both point and non-point sources are sources of thermal pollution to surface waters in the Willamette Subbasins. Within the nonpoint source category, both background and anthropogenic nonpoint sources contribute thermal pollution. Each source's thermal loading varies in frequency and magnitude based on the flow rate and temperature of discharge, prevalence of the activities, size of the land area on which the activities occur, locations of activities in relation to surface water, and transport mechanisms.

## 7.1. Thermal point sources

OAR 340-045-001(17) defines point source as “any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged.”

There are 60 domestic or industrial individual NPDES permitted point source dischargers within the Willamette Subbasins identified as potential sources of thermal load (Table 7.1). There also are 10 individual Municipal Separate Storm Sewer System (MS4) NPDES permits identified as potential sources of thermal load.

Quantify contributions, as possible, and discuss significance relative to NPS and background.

**Table 7.1 Individual NPDES permitted point source discharges that contribute thermal loads to Willamette Subbasins streams at a frequency and magnitude to cause exceedances to the temperature standard.**

Permittee	Permit type	DEQ WQ File Number	EPA Number	Receiving water name	River mile
Alpine Community	NPDES-DOM-Db	100101	OR0032387	Muddy Creek	25.6
Arclin	NPDES-IW-B16	16037	OR0021857	Patterson Slough	1.8
Arclin	NPDES-IW-B10	81714	OR0000892	Columbia Slough	6
ATI Albany Operations	NPDES-IW-B08	64300	OR0001716	Oak Creek	1.6
Aumsville STP	NPDES-DOM-Db	4475	OR0022721	Beaver Creek	2.5
Aurora STP	NPDES-DOM-Db	110020	OR0043991	Pudding River	8.8
Blount Oregon Cutting Systems Division	NPDES-IW-B16	63545	OR0032298	Mount Scott Creek	0.9
Boeing Of Portland - Fabrication Division	NPDES-IW-B16	9269	OR0031828	Osburn Creek	1.6
Brownsville STP	NPDES-DOM-Db	11770	OR0020079	Calapooia River	31.6
Coburg Wastewater Treatment Plant	NPDES-DOM-Da	115851	OR0044628	Muddy Creek	50.7
Coffin Butte Landfill	NPDES-IW-B15	104176	OR0043630	Roadside ditch to Soap Creek tributary	4.5
Columbia Helicopters	NPDES-IW-B16	100541	OR0033391	Unnamed Stream (tributary to Pudding River)	2
Creswell STP	NPDES-DOM-Db	20927	OR0027545	Camas Swale Creek	4
Dallas STP	NPDES-DOM-C1a	22546	OR0020737	Rickreall Creek	10.5
Duraflake	NPDES-IW-B20	97047	OR0000426	Murder Creek	0.57
Estacada STP	NPDES-DOM-Da	27866	OR0020575	Clackamas River	23.3

EWEB Carmen-Smith	NPDES-IW-B16	28393	OR0000680	McKenzie River	82
Falls City STP	NPDES-DOM-Da	28830	OR0032701	Little Luckiamute River	12
Foster Farms	NPDES-IW-B04	97246	OR0026450	Camas Swale Creek	3.3
Fujimi Corporation - SW Commerce Circle	NPDES-IW-B15	107178	OR0040339	Coffee Lake Creek	1.8
Georgia-Pacific Chemicals LLC	NPDES-IW-B16	32864	OR0002101	Amazon Creek	2.7
Gervais STP	NPDES-DOM-Db	33060	OR0027391	Pudding River	28.2
GP Millersburg Resin Plant	NPDES-IW-B16	32650	OR0032107	Murder Creek	0.6
Halsey STP	NPDES-DOM-Db	36320	OR0022390	Muddy Creek	23
Hubbard STP	NPDES-DOM-Da	40494	OR0020591	Mill Creek	5.3
Hull-Oakes Lumber Co.	NPDES-IW-B19	107228	OR0038032	Oliver Creek	4.8
J.H. Baxter & Co., Inc.	NPDES-IW-B21	6553	OR0021911	Amazon Diversion Canal	1.5
JLR, LLC	NPDES-IW-B05	32536	OR0001015	Pudding River	27
Junction City STP	NPDES-DOM-Db	44509	OR0026565	Flat Creek	9.2
Kingsford Manufacturing Company - Springfield Plant	NPDES-IW-B20	46000	OR0031330	Patterson Slough	3.7
Knoll Terrace MHC	NPDES-DOM-Db	46990	OR0026956	Mountain View Creek	0.4
Lakewood Utilities, Ltd	NPDES-DOM-Da	96110	OR0027570	Mill Creek	3.9
Lane Community College	NPDES-DOM-Db	48854	OR0026875	Russel Creek	0.7
Mcfarland Cascade Pole & Lumber Co	NPDES-IW-B21	54370	OR0031003	Storm Ditch to Amazon Creek	1.8
Molalla STP	NPDES-DOM-Db	57613	OR0022381	Molalla River	8.2
Mt. Angel STP	NPDES-DOM-Da	58707	OR0028762	Pudding River	37.5
Murphy Veneer, Foster Division	NPDES-IW-B20	97070	OR0021741	Wiley Creek	0.9
Norpac Foods - Brooks Plant No. 5	NPDES-IW-B04	84791	OR0021261	Fitzpatrick Creek	1
Norpac Foods- Plant #1, Stayton	NPDES-IW-B04	84820	OR0001228	Mill Creek	18.5
Oakridge STP	NPDES-DOM-Da	62886	OR0022314	Middle Fork Willamette River	39.8
ODC - Oregon State Penitentiary	NPDES-IW-B15	109727	OR0043770	Mill Creek	2.5
ODFW - Marion Forks Hatchery	NPDES-IW-B17	64495	OR0027847	Horn Creek	72.1
Philomath WWTP	NPDES-DOM-Db	103468	OR0032441	Marys River	10.2
Portland International Airport	NPDES-IW-B15	107220	OR0040291	Columbia Slough	2.7
RSG Forest Products - Liberal	NPDES-IW-B19	72596	OR0021300	Unnamed ditch to Molalla River	9.8
Sandy WWTP	NPDES-DOM-Da	78615	OR0026573	Tickle Creek	3.1
Scio STP	NPDES-DOM-Db	79633	OR0029301	Thomas Creek	7.2
Seneca Sawmill Company	NPDES-IW-B19	80207	OR0022985	Ditch to A-1 Amazon Channel	7.0
SFPP, L.P.	NPDES-IW-B15	103159	OR0044661	Amazon Creek	7.9
Sherman Bros. Trucking	NPDES-DOM-Db	36646	OR0021954	Little Muddy Creek	8

Silverton STP	NPDES-DOM-C1a	81395	OR0020656	Silver Creek	2.4
Sunstone Circuits	NPDES-IW-B15	26788	OR0031127	Milk Creek	5.3298
Tangent STP	NPDES-DOM-Db	87425	OR0031917	Calapooia River	10.8
Timberlake STP	NPDES-DOM-Da	90948	OR0023167	Clackamas River	51.1
USFW - Eagle Creek National Fish Hatchery	NPDES-IW-B17	91035	OR0000710	Eagle Creek	12.3
Veneta STP	NPDES-DOM-Db	92762	OR0020532	Long Tom River	34.9
WES (Boring STP)	NPDES-DOM-Db	16592	OR0031399	North Fork Deep Creek	3
Westfir STP	NPDES-DOM-Da	94805	OR0028282	Nork Fork Middle Fork Willamette River	1
Willamette Leadership Academy	NPDES-DOM-Db	34040	OR0027235	Wild Hog Creek	2
Woodburn WWTP	NPDES-DOM-C1a	98815	OR0020001	Pudding River	21.4

**Table 7.2 Individual NPDES Municipal Separate Storm Sewer System permittees in the Willamette Subbasins.**

Permittee	Permit type	DEQ WQ File Number	EPA Number
Corvallis Municipal Stormwater	NPDES-DOM-MS4-2	113605	ORS113605
Springfield Municipal Stormwater	NPDES-DOM-MS4-2	84048	ORS084048
Turner Municipal Stormwater	NPDES-DOM-MS4-2	113607	ORS113607
Eugene, City Of	NPDES-DOM-MS4-1	107989	ORS107989
Gresham, City Of	NPDES-DOM-MS4-1	108013	ORS108013
Portland, City Of	NPDES-DOM-MS4-1	108015	ORS108015
Salem, City Of	NPDES-DOM-MS4-1	108919	ORS108919
WES (Clackamas Co. Service District #1)	NPDES-DOM-MS4-1	108016	ORS108016
ODOT	NPDES-DOM-MS4-1	110870	ORS110870
Multnomah County	NPDES-DOM-MS4-1	120542	ORS120542

There are multiple categories of general NPDES permit types with registrants in the Willamette Subbasins including:

- 100-J Industrial Wastewater; NPDES cooling water;
- 200-J Industrial Wastewater; NPDES filter backwash;
- 300-J Industrial Wastewater, NPDES fish hatcheries;
- 400-J Industrial Wastewater; NPDES log ponds;
- 1200-A Stormwater, NPDES sand & gravel mining;
- 1200-C Stormwater, NPDES construction more than 1 acre disturbed ground;
- 1200-Z Stormwater, NPDES specific SIC codes;
- 1500-A Industrial Wastewater; NPDES petroleum hydrocarbon cleanup;
- 1700-A Industrial Wastewater; NPDES wash water;

- MS4 – Phase 2 - Stormwater, NPDES Municipal Separate Storm Sewer System

DEQ determined the following general permit categories have potential to discharge thermal loads that contribute to exceedances of the applicable temperature criteria:

- 100-J when river flow is < 44 cfs, or any flow range for hydropower facilities
- 200-J
- 300-J

There are six registrants to the 100-J, six registrants to the 200-J, and two registrants of the 300-J general permits (Table 7.3) found to be potential significant sources of thermal load with a temperature impact. Other registrants to the industrial wastewater general permits were found to have a de minimus temperature increase based on the permit requirements, available dilution, or frequency and magnitude of discharge based on review of available discharge data.

Based on a review of published literature and other studies related to stormwater runoff and stream temperature in Oregon, DEQ found there is not sufficient evidence to demonstrate that stormwater discharges authorized under the current municipal (MS4s) permits or the construction (1200-C) and industrial (1200-A and 1200-Z) general stormwater permits contribute to exceedances of the temperature standard.

**Table 7.3 General NPDES permit registrants that contribute thermal loads to Willamette Subbasins 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	River mile
Americold Logistics, LLC	100-J	87663	ORG253544	Claggett Creek	4.9
Forrest Paint Co.	100-J	100684	ORG253508	Amazon Creek	17.0
Holiday Plaza	100-J	108298	ORG253504	Unknown	0.2
Malarkey Roofing	100-J	52638	ORG250024	Columbia Slough	5.9
Miller Paint Company	100-J	103774	ORG250040	Unknown	
Owens-Brockway Glass Container Plant	100-J	65610	ORG250029	Unknown	
PCC Structurals, Inc.	100-J	71920	ORG250015	Mount Scott Creek	2.3
First Premier Properties - Spinnaker II Office Building	100-J	110603	ORG253511	Unknown	0.8
Sundance Lumber Company, Inc.	100-J	107401	ORG253618	Stream without a name	14.0
Ventura Foods, LLC	100-J	103832	ORG250005	Unknown	
Albany Water Treatment Plant	200-J	66584	ORG383501	Calapooia River	0.1
Corvallis Rock Creek Water Treatment Plant	200-J	20160	ORG383513	Marys River	13.5
Dallas Water Treatment Plant	200-J	22550	ORG383529	Rickreall Creek	17.0
Molalla Municipal Water Treatment Plant	200-J	109846	ORG380014	Molalla River	21.6
Philomath Water Treatment Plant	200-J	100048	ORG383536	Marys River	12.2
Row River Valley Water District	200-J	100075	ORG383534	Laying Creek	1.4
Silverton Water Treatment Plant	200-J	81398	ORG383527	Silver Creek	3.9
ODFW - Roaring River Hatchery	300-J	64525	ORG133506	Roaring River	1.1
ODFW - Willamette Fish Hatchery	300-J	64585	ORG133507	Salmon Creek	0.4



## 7.2. Thermal nonpoint sources

OAR 340-41-0002 (42) defines nonpoint sources as “diffuse or unconfined sources of pollution where wastes can either enter, or be conveyed by the movement of water, into waters of the state.” Nonpoint sources of heat in the Willamette Subbasins streams include activities associated with agriculture, forestry, dam and reservoir management, and development.

Nonpoint sources or activities that contribute thermal load and may increase stream temperature include:

- Human caused increases in solar radiation loading to the stream network from the disturbance or removal of near-stream vegetation;
- Channel modification and widening;
- Dam and reservoir operation;
- Activities that modify flow rate or volume; and,
- Background sources, including natural sources and anthropogenic sources of warming through climate change and other factors.

Anthropogenically influenced thermal loads are targeted for reduction to attain the temperature water quality criteria. The following actions are needed to attain the TMDL allocations:

- Restoration of stream-side vegetation to reduce thermal loading from exposure to solar radiation,
- Restoration of complex channel morphology and hyporheic or groundwater connection
- Management and operation of dams reservoirs to minimize temperature warming.
- Maintenance of minimum instream flows

## 7.3. Thermal background sources

By definition (OAR 340-042-0030(1)), 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 the 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.

The amount of background thermal loading a stream receives 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; hyporheic flow; tributary inflows; precipitation; cloudiness; air temperature; relative humidity and others. Many of these factors, however, are influenced by anthropogenic impacts related to the surrogate measures. **Background sources of warming were explicitly quantified for xx Basin and subtracted from anthropogenic loads.**

# 8. Loading capacity and excess loads

Summarizing OAR 340-042-0040(4)(d) and 40 CFR 130.2(f), loading capacity is the amount of a pollutant or pollutants that a waterbody can receive and still meet water quality standards.

For temperature, thermal loading capacity is calculated using **Equation 1**.

$$LC = (T_C + HUA) \cdot Q_R \cdot C_F \quad \text{Equation 1}$$

where,

$LC$  = Loading Capacity (kilocalories/day).

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

$HUA$  = The 0.3°C human use allowance allocated to point sources, nonpoint sources, margin of safety, or reserve capacity.

$Q_R$  = The daily mean river flow rate, upstream (cfs).  
When river flow is  $\leq 7Q_{10}$ ,  $Q_R = 7Q_{10}$ . When river flow  $> 7Q_{10}$ ,  $Q_R$  is equal to the daily mean river flow, upstream.

$C_F$  = Conversion factor using flow in cubic feet per second (cfs): 2,446,665

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

**Equation 1** shall be used to calculate the thermal loading capacity for any surface water location in the Willamette Subbasins. Table 8.1 presents the minimum loading capacity for select temperature impaired category 5 assessment units modeled for the TMDL analysis. The loading capacities in Table 8.1 were calculated based on the 7Q10 low flow. **Equation 1** may be used to calculate the loading capacity when river flows are greater than 7Q10. **Equation 1** may also be used to calculate the loading capacity if in the future the applicable temperature criteria are updated and approved by EPA.

**Table 8.1 Minimum thermal loading capacity for select assessment units by applicable fish use period.**

AU Name and AU ID	Annual 7Q10 (cfs)	Non-Spawning Criterion + HUA (deg-C)	Spawning Criterion + HUA (deg-C)	Minimum Loading Capacity Non-Spawning (kilocalories/day)	Minimum Loading Capacity Spawning (kilocalories/day)
Mosby Creek OR_SR_1709000201_02_103752	10.7	16.3	13.3	426,722,843	348,184,896
Coyote Creek OR_SR_1709000301_02_103796	5.9	18.3	NA	264,166,420	NA
Luckiamute River OR_SR_1709000305_02_103829	15.9	18.3	13.3	711,373,841	517,009,404
Mohawk River OR_SR_1709000406_02_103871	15.7	16.3	13.3	624,217,004	509,330,439
Little North Santiam River OR_SR_1709000505_02_104564	19.5	16.3	13.3	776,380,456	633,488,348
Crabtree Creek OR_SR_1709000606_02_103978	25.4	16.3	13.3	1,012,968,243	826,532,370
Thomas Creek OR_SR_1709000607_02_103988	6.9	18.3	NA	307,215,372	NA
Molalla River OR_SR_1709000904_02_104086	38.1	16.3	13.3	1,519,452,365	1,239,798,555
Pudding River OR_SR_1709000905_02_104088	10.4	18.3	NA	467,027,454	NA
Johnson Creek OR_SR_1709001201_02_104170	11.1	18.3	13.3	497,335,067	361,451,169

In accordance with OAR 340-042-0040(4)(e), the excess load calculation evaluates, to the extent existing data allow, the difference between the actual pollutant load in a waterbody and the loading capacity of that waterbody.

Because flow monitoring data were not available at most temperature monitoring locations, it was not possible to calculate the excess load. Instead, the excess temperatures and percent load reduction were calculated for each assessment unit where temperature data were available (Table 8.2). The excess temperatures are the maximum difference between the monitored 7dadm river temperatures and applicable numeric criteria plus the human use allowance. The percent load reduction represents the portion of the actual thermal loading that must be reduced to attain the TMDL loading capacity. The percent load reduction can be calculated from the excess temperature and is mathematically equal to the percent load reduction calculated from the excess load. This is because the river flow rate used to calculate a thermal load is the same number in the numerator and denominator and is cancelled out when calculating the percent reduction. The percent load reductions were calculated from temperatures measured in degrees Celsius with reduction to thermal loading that is should also be measured and calculated from temperatures measured in degrees Celsius (rather than Fahrenheit or Kelvin).

**Table 8.2 Excess temperature and percent load reduction for various assessment units in the Willamette Subbasins.**

Assessment Unit Name	Assessment Unit ID	Maximum 7DADM River Temperature (°C)	Applicable Criterion + HUA (°C)	Excess Temperature (°C)	Percent Load Reduction
Middle Fork Willamette River	OR_SR_1709000101_02_103713	13.4	12.3	1.1	8.1
Hills Creek	OR_SR_1709000102_02_103715	16.5	13.3	3.2	19.4
Hills Creek	OR_SR_1709000102_02_103715	18.7	16.3	2.4	12.8
Salt Creek	OR_SR_1709000103_02_103716	16.1	13.3	2.8	17.1
Salt Creek	OR_SR_1709000103_02_103716	17.9	16.3	1.6	8.7
Salmon Creek	OR_SR_1709000104_02_103719	13.5	12.3	1.2	9.1
Salmon Creek	OR_SR_1709000104_02_103719	18.4	13.3	5.1	27.6
Salmon Creek	OR_SR_1709000104_02_103719	19.3	16.3	3.0	15.7
Middle Fork Willamette River	OR_SR_1709000105_02_104579	21.0	12.3	8.7	41.4
North Fork Middle Fork Willamette River	OR_SR_1709000106_02_103721	20.7	13.3	7.4	35.7
North Fork Middle Fork Willamette River	OR_SR_1709000106_02_103721	22.9	16.3	6.6	28.8
Christy Creek	OR_SR_1709000106_02_103722	15.5	16.3	0.0	0.0
Middle Fork Willamette River	OR_SR_1709000107_02_103725	17.8	13.3	4.5	25.3
Middle Fork Willamette River	OR_SR_1709000107_02_103725	19.2	16.3	2.9	15.1
Little Fall Creek	OR_SR_1709000108_02_103730	16.1	13.3	2.8	17.2
Little Fall Creek	OR_SR_1709000108_02_103730	18.1	16.3	1.8	10.1
Hehe Creek	OR_SR_1709000109_02_103734	21.0	16.3	4.7	22.5

Fall Creek	OR_SR_1709000109_02_103737	21.6	13.3	8.3	38.3
Fall Creek	OR_SR_1709000109_02_103737	24.5	16.3	8.2	33.3
Portland Creek	OR_SR_1709000109_02_103741	22.5	16.3	6.2	27.4
Fall Creek	OR_SR_1709000109_02_103743	18.6	13.3	5.3	28.5
Fall Creek	OR_SR_1709000109_02_103743	22.4	16.3	6.1	27.3
Winberry Creek	OR_SR_1709000109_02_103747	20.2	13.3	6.9	34.2
Winberry Creek	OR_SR_1709000109_02_103747	22.5	16.3	6.2	27.6
Sharps Creek	OR_SR_1709000202_02_103755	24.0	18.3	5.7	23.8
Martin Creek	OR_SR_1709000202_02_103756	19.9	18.3	1.6	8.0
Row River	OR_SR_1709000202_02_103761	25.1	18.3	6.8	27.1
Alex Creek	OR_SR_1709000202_02_103762	16.7	18.3	0.0	0.0
Junetta Creek	OR_SR_1709000202_02_103763	16.6	18.3	0.0	0.0
Layng Creek	OR_SR_1709000202_02_103765	24.3	18.3	6.0	24.8
Row River	OR_SR_1709000202_02_103766	25.1	18.3	6.8	27.1
Layng Creek	OR_SR_1709000202_02_103770	16.6	18.3	0.0	0.0
Brice Creek	OR_SR_1709000202_02_103771	23.1	18.3	4.8	20.6
Sharps Creek	OR_SR_1709000202_02_103775	19.2	18.3	0.9	4.6
Grass Creek	OR_SR_1709000202_02_103780	15.6	16.3	0.0	0.0
Calapooia River	OR_SR_1709000303_02_103815	16.0	16.3	0.0	0.0
Teal Creek	OR_SR_1709000305_02_103824	20.3	18.3	2.0	9.9
North Fork Pedee Creek	OR_SR_1709000305_02_103828	20.2	18.3	1.9	9.5
Ritner Creek	OR_SR_1709000305_02_103833	21.8	18.3	3.5	16.0
Horse Creek	OR_SR_1709000401_02_103856	13.8	12.3	1.5	10.9
Separation Creek	OR_SR_1709000401_02_103857	10.0	12.3	0.0	0.0
McKenzie River	OR_SR_1709000402_02_104587	8.4	12.3	0.0	0.0
McKenzie River	OR_SR_1709000402_02_104588	11.8	12.3	0.0	0.0
Rebel Creek	OR_SR_1709000403_02_103861	13.3	16.3	0.0	0.0
French Pete Creek	OR_SR_1709000403_02_103862	15.7	16.3	0.0	0.0
Roaring River	OR_SR_1709000403_02_103864	7.2	12.3	0.0	0.0
South Fork McKenzie River	OR_SR_1709000403_02_104589	8.7	12.3	0.0	0.0
South Fork McKenzie River	OR_SR_1709000403_02_104589	13.1	13.3	0.0	0.0
South Fork McKenzie River	OR_SR_1709000403_02_104589	14.9	16.3	0.0	0.0
Lookout Creek	OR_SR_1709000404_02_104571	20.9	16.3	4.6	22.0
Upper Blue River	OR_SR_1709000404_02_104574	20.6	16.3	4.3	20.9
Quartz Creek	OR_SR_1709000405_02_103867	12.1	13.3	0.0	0.0
Quartz Creek	OR_SR_1709000405_02_103867	16.3	16.3	0.0	0.2
Camp Creek	OR_SR_1709000407_02_103889	19.3	13.3	6.0	31.1
Camp Creek	OR_SR_1709000407_02_103889	22.4	16.3	6.1	27.2
Cedar Creek	OR_SR_1709000407_02_103891	20.9	13.3	7.6	36.4
Cedar Creek	OR_SR_1709000407_02_103891	24.3	16.3	8.0	32.9

Breitenbush River	OR_SR_1709000501_02_103892	17.5	18.3	0.0	0.0
Marion Creek	OR_SR_1709000502_02_103897	17.4	18.3	0.0	0.0
Whitewater Creek	OR_SR_1709000502_02_103898	12.4	18.3	0.0	0.0
North Santiam River	OR_SR_1709000502_02_103899	17.9	18.3	0.0	0.0
Boulder Creek	OR_SR_1709000502_02_103902	19.3	18.3	1.0	5.3
North Santiam River	OR_SR_1709000503_02_103906	16.7	13.3	3.4	20.4
North Santiam River	OR_SR_1709000503_02_103906	16.7	16.3	0.4	2.4
Blowout Creek	OR_SR_1709000503_02_103907	21.0	18.3	2.7	12.9
Little North Santiam River	OR_SR_1709000505_02_104564	23.0	13.3	9.7	42.2
Little North Santiam River	OR_SR_1709000505_02_104564	28.1	16.3	11.8	42.0
South Santiam River	OR_SR_1709000506_02_103925	15.0	13.3	1.7	11.3
South Santiam River	OR_SR_1709000506_02_103925	14.1	16.3	0.0	0.0
Pyramid Creek	OR_SR_1709000601_02_103935	20.3	18.3	2.0	9.8
Middle Santiam River	OR_SR_1709000601_02_103936	19.7	18.3	1.4	7.3
Owl Creek	OR_SR_1709000602_02_103941	19.2	16.3	2.9	15.2
Trout Creek	OR_SR_1709000602_02_103942	17.2	16.3	0.9	5.5
Soda Fork	OR_SR_1709000602_02_103947	16.1	16.3	0.0	0.0
Canyon Creek	OR_SR_1709000602_02_103949	20.7	16.3	4.4	21.4
South Santiam River	OR_SR_1709000602_02_103950	18.1	13.3	4.8	26.4
South Santiam River	OR_SR_1709000602_02_103950	21.4	16.3	5.1	23.7
Sheep Creek	OR_SR_1709000602_02_103953	20.9	16.3	4.6	21.9
Moose Creek	OR_SR_1709000602_02_103954	19.3	16.3	3.0	15.4
Quartzville Creek	OR_SR_1709000603_02_103957	19.3	18.3	1.0	5.2
Quartzville Creek	OR_SR_1709000603_02_103960	22.0	18.3	3.7	16.7
Middle Santiam River	OR_SR_1709000603_02_103965	24.0	18.3	5.7	23.8
South Santiam River	OR_SR_1709000604_02_103968	21.8	13.3	8.5	39.0
South Santiam River	OR_SR_1709000604_02_103968	24.4	16.3	8.1	33.2
Middle Santiam River	OR_SR_1709000604_02_103969	16.0	13.3	2.7	16.9
Middle Santiam River	OR_SR_1709000604_02_103969	14.4	18.3	0.0	0.0
McDowell Creek	OR_SR_1709000608_02_103994	21.7	18.3	3.4	15.6
Hamilton Creek	OR_SR_1709000608_02_103996	27.3	16.3	11.0	40.3
Mill Creek	OR_SR_1709000702_02_104007	18.6	13.3	5.3	28.6
Mill Creek	OR_SR_1709000702_02_104007	25.3	18.3	7.0	27.8
Shelton Ditch	OR_SR_1709000703_02_104008	18.5	13.3	5.2	28.2
Shelton Ditch	OR_SR_1709000703_02_104008	23.8	18.3	5.5	23.1
Pringle Creek	OR_SR_1709000703_02_104012	25.1	18.3	6.8	27.1
Clackamas River	OR_SR_1709000704_02_104597	17.7	13.3	4.4	24.9
Clackamas River	OR_SR_1709000704_02_104597	20.5	16.3	4.2	20.5
Clackamas River	OR_SR_1709000704_02_104597	24.5	18.3	6.2	25.3
Collawash River	OR_SR_1709001101_02_104142	17.4	13.3	4.1	23.5

Collawash River	OR_SR_1709001101_02_104142	19.8	16.3	3.5	17.8
Collawash River	OR_SR_1709001101_02_104144	16.3	13.3	3.0	18.6
Collawash River	OR_SR_1709001101_02_104144	20.5	16.3	4.2	20.4
Nohorn Creek	OR_SR_1709001101_02_104145	17.1	16.3	0.8	4.7
Oak Grove Fork Clackamas River	OR_SR_1709001103_02_104149	12.2	16.3	0.0	0.0
Oak Grove Fork Clackamas River	OR_SR_1709001103_02_104150	12.6	13.3	0.0	0.0
Oak Grove Fork Clackamas River	OR_SR_1709001103_02_104150	13.8	16.3	0.0	0.0
North Fork Clackamas River	OR_SR_1709001104_02_104152	19.2	16.3	2.9	15.1
Big Creek	OR_SR_1709001104_02_104153	13.7	16.3	0.0	0.0
Clackamas River	OR_SR_1709001104_02_104154	16.6	13.3	3.3	19.8
Clackamas River	OR_SR_1709001104_02_104154	18.5	16.3	2.2	11.9
Clackamas River	OR_SR_1709001104_02_104155	16.2	13.3	2.9	17.9
Clackamas River	OR_SR_1709001104_02_104155	19.5	16.3	3.2	16.5
Trout Creek	OR_SR_1709001104_02_104157	16.3	16.3	0.0	0.0
Roaring River	OR_SR_1709001104_02_104160	14.2	13.3	0.9	6.3
Roaring River	OR_SR_1709001104_02_104160	15.4	16.3	0.0	0.0
Fish Creek	OR_SR_1709001104_02_104161	19.1	13.3	5.8	30.4
Fish Creek	OR_SR_1709001104_02_104161	21.2	16.3	4.9	23.0
Johnson Creek	OR_SR_1709001201_02_104170	21.3	13.3	8.0	37.6
Johnson Creek	OR_SR_1709001201_02_104170	28.9	18.3	10.6	36.6
HUC12 Name: Paddys Valley-Middle Fork Willamette *	OR_WS_170900010101_02_104185	10.0	12.3	0.0	0.0
HUC12 Name: Tumblebug Creek	OR_WS_170900010102_02_104186	15.4	12.3	3.1	20.2
HUC12 Name: Staley Creek	OR_WS_170900010105_02_104189	16.4	12.3	4.1	25.0
HUC12 Name: Echo Creek-Middle Fork Willamette Riv*	OR_WS_170900010106_02_104190	15.6	12.3	3.3	21.1
HUC12 Name: Buck Creek-Middle Fork Willamette Riv*	OR_WS_170900010502_02_104200	18.9	12.3	6.6	34.9
HUC12 Name: Gray Creek-Middle Fork Willamette Riv*	OR_WS_170900010505_02_104202	17.7	13.3	4.4	24.9
HUC12 Name: Gray Creek-Middle Fork Willamette Riv*	OR_WS_170900010505_02_104202	18.1	16.3	1.8	9.9
HUC12 Name: Eighth Creek-North Fork Middle Fork W*	OR_WS_170900010607_02_104209	16.2	16.3	0.0	0.0
HUC12 Name: Dartmouth Creek-North Fork Middle For*	OR_WS_170900010608_02_104210	16.5	16.3	0.2	1.2
HUC12 Name: Andy Creek-Fall Creek	OR_WS_170900010904_02_104219	18.3	16.3	2.0	10.7
HUC12 Name: Winberry Creek	OR_WS_170900010905_02_104220	19.5	16.3	3.2	16.4

HUC12 Name: Layng Creek	OR_WS_170900020201_02_104227	17.6	18.3	0.0	0.0
HUC12 Name: Sharps Creek	OR_WS_170900020203_02_104229	16.3	16.3	0.0	0.0
HUC12 Name: Hill Creek-Coast Fork Willamette River	OR_WS_170900020401_02_104238	25.9	18.3	7.6	29.3
HUC12 Name: Greasy Creek	OR_WS_170900030204_02_104256	25.0	16.3	8.7	34.8
HUC12 Name: Greasy Creek	OR_WS_170900030204_02_104256	19.1	18.3	0.8	4.1
HUC12 Name: Maxfield Creek-Luckiamute River	OR_WS_170900030503_02_104277	21.1	18.3	2.8	13.3
HUC12 Name: Pedee Creek-Luckiamute River	OR_WS_170900030504_02_104278	19.5	18.3	1.2	6.3
HUC12 Name: Middle Little Luckiamute River	OR_WS_170900030507_02_104281	17.5	18.3	0.0	0.0
HUC12 Name: Flat Creek	OR_WS_170900030603_02_104290	25.7	18.3	7.4	28.8
HUC12 Name: Hackleman Creek-McKenzie River	OR_WS_170900040202_02_104306	12.3			
HUC12 Name: Smith River	OR_WS_170900040203_02_104307	23.4	12.3	11.1	47.4
HUC12 Name: Smith River	OR_WS_170900040203_02_104307	18.7			
HUC12 Name: Kink Creek-McKenzie River	OR_WS_170900040204_02_104308	12.7	12.3	0.4	3.1
HUC12 Name: Deer Creek	OR_WS_170900040205_02_104309	20.0	12.3	7.7	38.4
HUC12 Name: Boulder Creek-McKenzie River	OR_WS_170900040206_02_104310	14.4	12.3	2.1	14.8
HUC12 Name: Elk Creek-South Fork McKenzie River	OR_WS_170900040301_02_104314	8.4	12.3	0.0	0.0
HUC12 Name: Cougar Reservoir-South Fork McKenzie *	OR_WS_170900040307_02_104320	14.6	16.3	0.0	0.0
HUC12 Name: Cougar Creek-South Fork McKenzie River	OR_WS_170900040308_02_104321	15.0	16.3	0.0	0.0
HUC12 Name: Quartz Creek	OR_WS_170900040501_02_104325	11.7	13.3	0.0	0.0
HUC12 Name: Quartz Creek	OR_WS_170900040501_02_104325	16.3	16.3	0.0	0.2
HUC12 Name: Elk Creek-McKenzie River	OR_WS_170900040502_02_104326	15.3	13.3	2.0	12.9
HUC12 Name: Elk Creek-McKenzie River	OR_WS_170900040502_02_104326	17.9	16.3	1.6	8.8
HUC12 Name: Straight Creek-North Santiam River	OR_WS_170900050202_02_104344	14.2	18.3	0.0	0.0
HUC12 Name: Minto Creek-North Santiam River	OR_WS_170900050205_02_104347	11.4	18.3	0.0	0.0
HUC12 Name: Whitewater Creek	OR_WS_170900050206_02_104348	14.1	18.3	0.0	0.0

HUC12 Name: Sauers Creek-North Santiam River	OR_WS_170900050208_02_104350	15.8	18.3	0.0	0.0
HUC12 Name: Morgan Creek-North Santiam River	OR_WS_170900050604_02_104362	23.0	16.3	6.7	29.1
HUC12 Name: Upper Canyon Creek	OR_WS_170900060204_02_104370	17.6	16.3	1.3	7.6
HUC12 Name: Owl Creek	OR_WS_170900060205_02_104371	15.5	16.3	0.0	0.0
HUC12 Name: Lower Quartzville Creek	OR_WS_170900060305_02_104379	23.7	18.3	5.4	22.8
HUC12 Name: McKinney Creek	OR_WS_170900070203_02_104411	26.9	18.3	8.6	32.0
HUC12 Name: Lower Mill Creek	OR_WS_170900070204_02_104412	25.9	18.3	7.6	29.3
HUC12 Name: Croisan Creek-Willamette River	OR_WS_170900070301_02_104413	19.6	13.3	6.3	32.0
HUC12 Name: Croisan Creek-Willamette River	OR_WS_170900070301_02_104413	24.8	18.3	6.5	26.2
HUC12 Name: Glenn Creek-Willamette River	OR_WS_170900070303_02_104415	27.2	18.3	8.9	32.7
HUC12 Name: Canyon Creek	OR_WS_170900090601_02_104482	8.2	18.3	0.0	0.0
HUC12 Name: Lowe Creek-Clackamas River	OR_WS_170900110203_02_104525	15.6	16.3	0.0	0.0
HUC12 Name: Last Creek-Pinhead Creek	OR_WS_170900110204_02_104526	10.4	16.3	0.0	0.0
HUC12 Name: Pot Creek-Clackamas River	OR_WS_170900110205_02_104527	10.1	16.3	0.0	0.0
HUC12 Name: Roaring River	OR_WS_170900110402_02_104535	24.0	16.3	7.7	32.1
HUC12 Name: Fish Creek	OR_WS_170900110403_02_104536	16.0	16.3	0.0	0.0
HUC12 Name: South Fork Clackamas River	OR_WS_170900110404_02_104537	12.8	16.3	0.0	0.0
HUC12 Name: North Fork Clackamas River	OR_WS_170900110405_02_104538	17.0	16.3	0.7	4.2
HUC12 Name: Helion Creek-Clackamas River	OR_WS_170900110406_02_104539	16.5	16.3	0.2	1.2
HUC12 Name: Upper Eagle Creek	OR_WS_170900110501_02_104540	17.7	16.3	1.4	8.0
HUC12 Name: North Fork Eagle Creek	OR_WS_170900110502_02_104541	12.8	16.3	0.0	0.0
HUC12 Name: Upper Clear Creek	OR_WS_170900110601_02_104543	13.1	16.3	0.0	0.0
HUC12 Name: Upper Johnson Creek	OR_WS_170900120101_02_104550	19.4	13.3	6.1	31.4
HUC12 Name: Upper Johnson Creek	OR_WS_170900120101_02_104550	29.3	18.3	11.0	37.5
HUC12 Name: Lower Johnson Creek	OR_WS_170900120103_02_104552	19.9	13.3	6.6	33.1
HUC12 Name: Lower Johnson Creek	OR_WS_170900120103_02_104552	23.1	18.3	4.8	20.8



HUC12 Name: Oswego Creek- Willamette River	OR_WS_170900120104_02_104553	14.1	13.3	0.8	5.7
HUC12 Name: Oswego Creek- Willamette River	OR_WS_170900120104_02_104553	20.7	18.3	2.4	11.7
HUC12 Name: Columbia Slough (Lower)	OR_WS_170900120201_02_104554. 1	26.8	18.3	8.5	31.8
HUC12 Name: Columbia Slough (Upper)	OR_WS_170900120201_02_104554. 2	29.5	18.3	11.2	38.0
HUC12 Name: Balch Creek-Willamette River	OR_WS_170900120202_02_104555	21.8	18.3	3.5	15.9
HUC12 Name: Multnomah Channel	OR_WS_170900120305_02_104561	18.5	18.3	0.2	1.2

## 9. Allocations, reserve capacity, and margin of safety

OAR 340-042-0040(4)(g),(h),(i) and (k) [and 40 CFR 130.2(h) and (g) and 130.7(c)(2)] respectively define the required TMDL elements of apportionment of the allowable pollutant load: point source wasteload allocations; nonpoint source load allocations (including background); margin of safety; and, reserve capacity. Collectively, these elements add up to the maximum load a pollutant that still allows a waterbody to meet water quality standards. OAR 304-042-0040(5) and (6) describe the potential factors of consideration for determining and distributing these allocations of the allowable pollutant loading capacities. Water quality data analysis must be conducted to determine allocations, potentially including statistical analysis and mathematical modeling. Factors to consider in allocation distribution may include: source contributions; costs of implementing management measures; ease of implementation; timelines for attaining water quality standards; environmental impacts of allocations; unintended consequences; reasonable assurance of implementation; and, any other relevant factor.

### 9.1. Thermal Allocations

[Add discussion of allocation scenarios, with reference to TPSD, relevant factors considered in distribution and surrogate measures... Include assumptions and requirements, as needed]

[Add a section on seasonal variation and critical conditions if this is not a section earlier in the document because it influenced modeling decisions]

[Include discussion of HUA and how applied in the allocation tables.]

**Table 9.1 Molalla-Pudding Subbasin: Molalla River, Pudding River, Silver Creek, Abiqua Creek, and Mill Creek human use allowance allocations.**

Portion of Human Use Allowance (°C)	Source or source category
0.20*	NPDES point sources
0.00	Dam and reservoir operations
0.05	Water management activities and water withdrawals
0.02	Solar loading from existing transportation corridors and utility infrastructure
0.00	Solar loading from other NPS sectors
0.03	Reserve capacity
<b>0.30</b>	<b>Total</b>
<p>Note: * NPDES permitted point sources discharging to the Molalla River, Pudding River, Silver Creek, Abiqua Creek, and Mill Creek are allowed up to 0.20°C °cumulatively at the point of maximum impact. The portion of the human use allowance at the point of discharge is described in Table 9.3.</p>	

**Table 9.2 Human Use Allowance allocations for all other waters in the Willamette Subbasins**

Portion of Human Use Allowance (°C)	Source or source category
0.10	NPDES point sources
0.00	Dam and reservoirs operations
0.05	Water management activities and water withdrawals
0.02	Solar loading from existing transportation corridors and utility infrastructure
0.00	Solar loading from other nonpoint sectors
0.13	Reserve capacity
<b>0.30</b>	<b>Total</b>
<p>Note: * NPDES permitted point sources are allowed up to 0.10°C cumulatively at the point of maximum impact. The portion of the human use allowance at the point of discharge is described in Table 9.3.</p>	

### 9.1.1. Thermal wasteload allocations for point sources

Waste load allocations for the NPDES permitted point sources listed in Table 9.3 were calculated using **Equation 2**.

The wasteload allocation for registrants under the general stormwater permits (MS4, 1200-A, 1200-C and 1200-Z) and general permit registrants not identified in Table 9.3 is equal to any existing thermal load authorized under the current permit. More specific wasteload allocations can be considered, if subsequent data and evaluation demonstrates a need and if capacity is available.

$$WLA = (\Delta T) \cdot (Q_E + Q_R) \cdot C_F$$

where,

**Equation 2**

$WLA =$  Waste load allocation (kilocalories/day).  
 $\Delta T =$  The maximum temperature increase ( $^{\circ}C$ ) above the applicable river temperature criterion using 100% of river flow not to be exceeded by each individual source from all outfalls combined. When the minimum duties provision at OAR 340-041-0028(12)(a) applies,  $\Delta T = 0.0$ .  
 $Q_E =$  The daily mean effluent flow (cfs).  
 When effluent flow is in million gallons per day (MGD) convert to cfs:  

$$\frac{1 \text{ million gallons}}{1 \text{ day}} \cdot \frac{1.5472 \text{ ft}^3}{1 \text{ million gallons}} = 1.5472$$
  
 $Q_R =$  The daily mean river flow rate, upstream (cfs).  
 When river flow is  $\leq 7Q_{10}$ ,  $Q_R = 7Q_{10}$ . When river flow  $> 7Q_{10}$ ,  $Q_R$  is equal to the daily mean river flow, upstream.  
 $C_F =$  Conversion factor using flow in cubic feet per second (cfs): 2,446,665  

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

Wasteload allocations in Table 9.3 may be implemented in NPDES permits in any of the following ways: 1) incorporating the minimum wasteload allocation as a static numeric limit. Permit writers may recalculate the limit using using different values for 7Q10 ( $Q_R$ ), and effluent flow ( $Q_E$ ), if better estimates are available. 2) incorporating **Equation 2** directly into the permit with effluent flow ( $Q_E$ ), river flow ( $Q_R$ ), and the wasteload allocation ( $WLA$ ) being dynamic and calculated on a daily basis.

**Table 9.3 Thermal waste load allocations for point sources**

NPDES Permittee WQ File# : EPA Number	Allocated Human Use Allowance ( $^{\circ}C$ )	WLA period start	WLA period end	Annual 7Q10 River flow (cfs)	Effluent discharge (cfs)	Minimum WLA (kcal/day)
Arclin 16037 : OR0021857	0.10	5/1	10/31	0	1.55	378,555
Forrest Paint Co. 100684 : ORG253508	0.05	5/1	10/31	0	0.77	94,639
Georgia-Pacific Chemicals LLC 32864 : OR0002101	0.00	5/1	10/31	0	0.0	0
SFPP 103159 : OR0044661	0.05	5/1	10/31	0	0.02	2,839
J.H. Baxter & Co 6553 : OR0021911	0.10	5/1	10/31	0.6	0.12	175,909
Aumsville STP 4475 : OR0022721	0.00	5/1	10/31	0.7	0.52	0
Albany Water Treatment Plant 66584 : ORG383501	0.10	5/1	10/31	24	0.77	6,061,274
Brownsville STP 11770 : OR0020079	0.00	5/1	10/31	14.4	0.0	0

Tangent STP 87425 : OR0031917	0.00	5/1	10/31	20.3	0.17	0
Creswell STP 20927 : OR0027545	0.00	5/1	10/31	0	0.31	0
Foster Farms 97246 : OR0026450	0.00	5/1	10/31	0	0.0	0
Estacada STP 27866 : OR0020575	0.05	5/1	10/31	317	0.84	38,881,850
Timberlake STP 90948 : OR0023167	0.05	5/1	10/31	254	0.22	31,099,901
Americold Logistics, LLLC 87663 : ORG253544	0.10	5/1	10/31	0	0.77	189,278
Fujimi Corporation - SW Commerce Circle 107178 : OR0040339	0.10	5/1	10/31	0	0.2	47,221
Herbert Malarkey Roofing Company 52638 : ORG250024	0.10	5/1	10/31	0	0.77	189,278
Portland International Airport 107220 : OR0040291	0.00	5/1	10/31	0	0.0	0
Seneca Sawmill Company 80207 : OR0022985	0.00	5/1	10/31	0	1.19	0
USFW - Eagle Creek National Fish Hatchery 91035 : OR0000710	0.20*	5/1	10/31	21.3	52.6	36,161,709
Norpac Foods - Brooks Plant No. 5 84791 : OR0021261	0.00	5/1	10/31	0	0.0	0
Junction City STP 44509 : OR0026565	0.00	5/1	10/31	0	0.0	0
ODFW - Marion Forks Hatchery 64495 : OR0027847	0.10*	5/1	10/31	6.3	18.6	6,082,409
Row River Valley Water District 100075 : ORG383534	0.10	5/1	10/31		0.77	189,278
Falls City STP 28830 : OR0032701	0.00	5/1	10/31	5.34	0.0	0
Sherman Bros. Trucking 36646 : OR0021954	0.00	5/1	10/31	0.2	0.02	0
Veneta STP 92762 : OR0020532	0.10	5/1	10/31	6.3	0.81	1,739,762
Corvallis Rock Creek WTP 20160 : ORG383513	0.05	5/1	10/31		0.77	94,639
Philomath WTP 100048 : ORG383536	0.05	5/1	10/31	11	0.77	1,440,305

Philomath WWTP 103468 : OR0032441	0.00	5/1	10/31	6.6	0.0	0
EWEB Carmen-Smith 28393 : OR0000680	0.10	5/1	10/31	500.6	3.61	123,362,083
Oakridge STP 62886 : OR0022314	0.10	5/1	10/31	449.8	0.73	110,228,913
Sunstone Circuits 26788 : OR0031127	0.04	5/1	10/31	10.5	0.065	1,033,961
Hubbard STP 40494 : OR0020591	0.00	5/1	10/31	0	0.53	0
Lakewood Utilities, Ltd 96110 : OR0027570	0.00	5/1	10/31	0	0.0	0
Norpac Foods- Plant #1, Stayton 84820 : OR0001228	0.05	5/1	10/31	0	6.19	757,110
ODC - Oregon State Penitentiary 109727 : OR0043770	0.05	5/1	10/31	6.53	2.48	1,101,680
Molalla Municipal Drinking WTP 109846 : ORG380014	0.02	5/1	10/31		0.08	3,915
Molalla STP 57613 : OR0022381	0.10	5/1	10/31	55.8	3.46	14,498,083
Blount Oregon Cutting Systems Division 63545 : OR0032298	0.05	5/1	10/31	0	0.19	22,713
PCC Structural, Inc. 71920 : ORG250015	0.05	5/1	10/31	0	0.77	94,639
Knoll Terrace Mhc 46990 : OR0026956	0.00	5/1	10/31	0	0.09	0
Alpine Community 100101 : OR0032387	0.00	5/1	10/31	0.4	0.03	0
Coburg Wastewater Treatment Plant 115851 : OR0044628	0.10	5/1	10/31	0	0.68	166,564
Halsey STP 36320 : OR0022390	0.00	5/1	10/31	5.0	0.30	0
Duraflake 97047 : OR0000426	0.05	5/1	10/31	0	0.55	67,544
GP Millersburg Resin Plant 32650 : OR0032107	0.00	5/1	10/31	0	0.0	0
Westfir STP 94805 : OR0028282	0.10	5/1	10/31	174	0.05	42,583,328
WES - Boring STP 16592 : OR0031399	0.10	5/1	10/31	0.65	0.03	166,373

ATI Albany Operations 64300 : OR0001716	0.10	5/1	10/31	1.4	0.46	456,100
Hull-Oakes Lumber Co. 107228 : OR0038032	0.10	5/1	10/31	0	0.08	18,928
Boeing Of Portland - Fabrication Division 9269 : OR0031828	0.10	5/1	10/31	0	0.46	113,567
Kingsford Manufacturing Company - Springfield Plant 46000 : OR0031330	0.10	5/1	10/31	0	0.08	19,573
Aurora STP 110020 : OR0043991	0.00	5/1	10/31	10.1	0.1	0
Gervais STP 33060 : OR0027391	0.00	5/1	10/31	7.3	0.34	0
JLR 32536 : OR0001015	0.01	5/1	10/31	6.7	0.5	176,160
Mt. Angel STP 58707 : OR0028762	0.00	5/1	10/31	7.3	0.87	0
Woodburn WWTP 98815 : OR0020001	0.20	5/1	10/31	6.7	7.79	7,092,094
Dallas STP 22546 : OR0020737	0.10	5/1	10/31	4.2	3.09	1,784,709
Dallas WTP 22550 : ORG383529	0.10	5/1	10/31	3.3	0.77	996,677
Coffin Butte Landfill 104176 : OR0043630	0.10	5/1	10/31	0	0.0	0.0
ODFW - Roaring River Hatchery 64525 : ORG133506	0.10*	5/1	10/31	0.5	14.2	3,596,598
Lane Community College 48854 : OR0026875	0.00	5/1	10/31	0	0.22	0
ODFW - Willamette Fish Hatchery 64585 : ORG133507	0.10*	5/1	10/31	110	79.0	46,241,969
City of Silverton Drinking WTP 81398 : ORG383527	0.20	5/1	10/31	5	0.095	2,493,152
Silverton STP 81395 : OR0020656	0.20	5/1	10/31	14	3.87	8,743,437
Mcfarland Cascade Pole & Lumber Co 54370 : OR0031003	0.00	5/1	10/31	0	0.0	0
Sundance Lumber Company, Inc. 107401 : ORG253618	0.10	5/1	10/31	0	0.77	189,278
Scio STP 79633 : OR0029301	0.00	5/1	10/31	6.9	0.14	0

Sandy WWTP 78615 : OR0026573	0.00	5/1	10/31	0	0.00	0
Arclin 81714 : OR0000892	0.10	5/1	10/31	0.0	0.93	227,133
First Premier Properties 110603 : ORG253511	0.10	5/1	10/31	0	0.77	189,278
Holiday Retirement Corp 108298 : ORG253504	0.10	5/1	10/31	0	0.77	189,278
RSG Forest Products - Liberal 72596 : OR0021300	0.16	5/1	10/31	0	1.24	484,550
Columbia Helicopters 100541 : OR0033391	0.10	5/1	10/31	0	0.01	2,839
Willamette Leadership Academy 34040 : OR0027235	0.00	5/1	10/31	0	0.01	0
Murphy Veneer, Foster Division 97070 : OR0021741	0.10	5/1	10/31	4.2	1.11	1,299,023
Hydro Extrusion Portland, Inc. 3060 :	0.10	5/1	10/31	0	0.77	189,278
Miller Paint Co Inc 103774 : ORG250040	0.10	5/1	10/31	0	0.77	189,278
Owens-Brockway Glass Container Inc. 65610 : ORG250029	0.10	5/1	10/31	0	0.77	189,278
Ventura Foods, LLLC 103832 : ORG250005	0.10	5/1	10/31	0	0.77	189,278
Notes: WLA = waste load allocation; kcals/day = kilocalories/day						
* When the minimum duties provision at OAR 340-041-0028(12)(a) applies, $\Delta T = 0.0$ and the WLA = 0 kilocalories/day.						

The effluent discharge used to calculate the waste load allocations presented in Table 9.3 are typically based on the average dry weather facility design flow, the maximum effluent discharge characterized from discharge monitoring reports, or assumed maximum values. Average dry weather facility design flows were obtained from the current NPDES permit or permit evaluation reports. More information on the specific source of the effluent discharge flow is described in the technical support document.

### 9.1.2. Thermal load allocations for nonpoint sources

Load allocations for nonpoint sources were calculated using Equation 3.

$$LA = (\Delta T) \cdot (Q_R) \cdot C_F \quad \text{Equation 3}$$

where,

$LA =$  Load allocation (kilocalories/day).

$\Delta T =$  The maximum allowed temperature increase ( $^{\circ}\text{C}$ ). When the minimum duties provision at OAR 340-041-0028(12)(a) applies,  $\Delta T = 0.0$ . For background nonpoint sources,  $\Delta T =$  applicable temperature criteria.

$Q_R =$  The daily average river flow rate (cfs).  
 Conversion factor using flow in cubic feet per second (cfs): 2,446,665

$C_F = \frac{1 \text{ ft}^3}{1 \text{ sec}} \cdot \frac{1 \text{ m}^3}{35.31 \text{ ft}^3} \cdot \frac{1000 \text{ kg}}{1 \text{ m}^3} \cdot \frac{86400 \text{ sec}}{1 \text{ day}} \cdot \frac{1 \text{ kcal}}{1 \text{ kg} \cdot 1^{\circ}\text{C}} = 2,446,665$

Table 9.4 presents the minimum load allocation for background sources on temperature impaired category 5 assessment units that were modeled for the TMDL analysis.

The load allocations to background sources presented in Table 9.4 were calculated based on the 7Q10 low river flows and the minimum applicable criterion in the respective assessment units. Equation 3 may be used to calculate the load allocations when river flows are greater than 7Q10 or at other locations in the Willamette Subbasins.

The allocated portion of the human use allowance ( $\Delta T$ ) presented in Table 9.1 through Table 9.2 and Equation 3 shall be used to calculate the load allocation for other nonpoint source or source category for any assessment unit in the Willamette Subbasins.

Equation 3 may also be used to calculate the load allocations for anthropogenic and background nonpoint sources if in the future the applicable temperature criteria are updated and approved by EPA.

**Table 9.4 Thermal load allocations for background sources.**

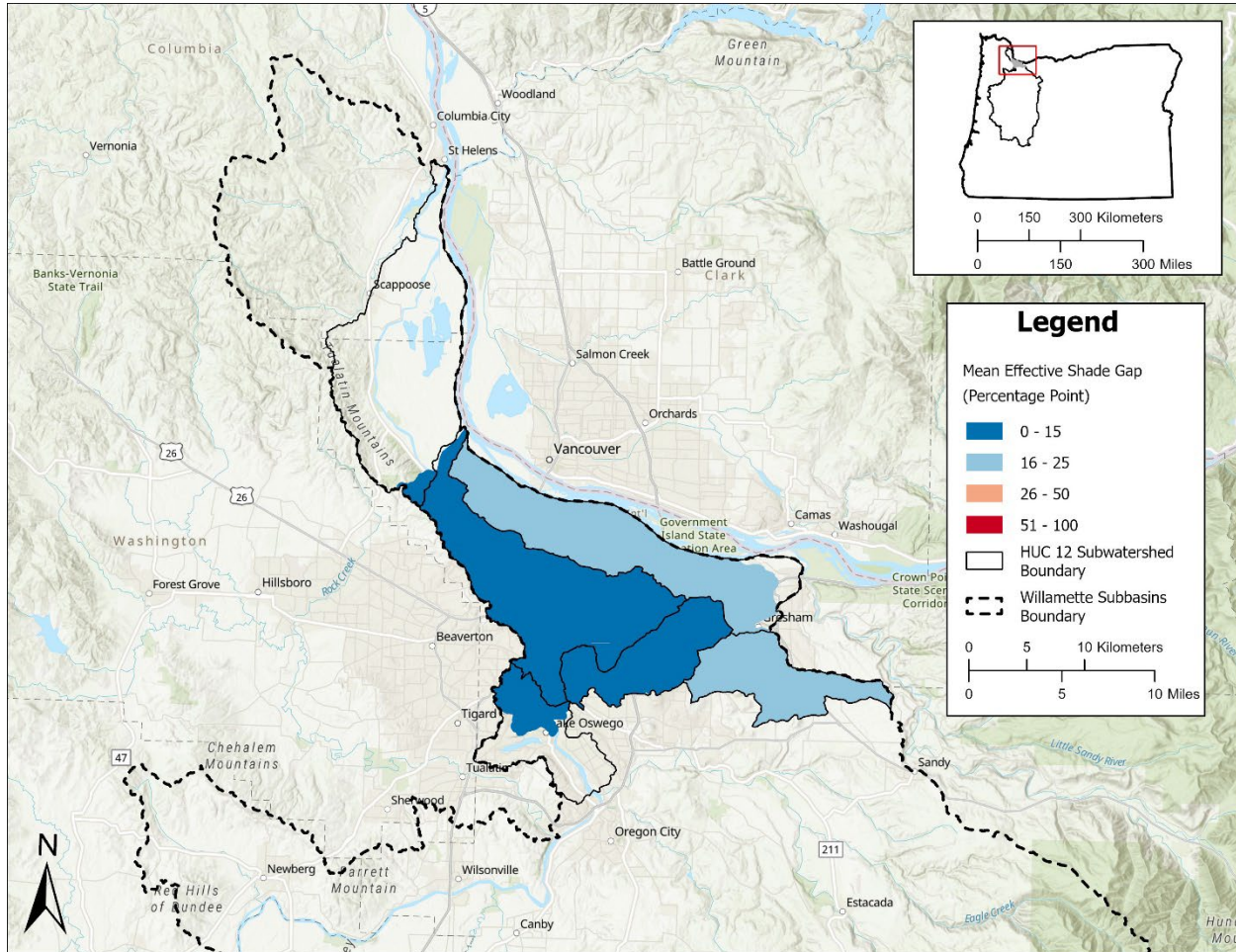
AU Name and AU ID	Annual 7Q10 (cfs)	Applicable criterion ( $^{\circ}\text{C}$ )	LA period start	LA period end	Minimum Loading Capacity Non-Spawning (kilocalories/day)	Minimum Loading Capacity Spawning (kilocalories/day)
Mosby Creek OR_SR_1709000201_02_103752	10.7	16.0 13.0	5/1	10/31	418,869,048	340,331,102
Coyote Creek OR_SR_1709000301_02_103796	5.9	18.0	5/1	10/31	259,835,823	NA
Luckiamute River OR_SR_1709000305_02_103829	15.9	18.0 13.0	5/1	10/31	699,711,975	505,347,537
Mohawk River OR_SR_1709000406_02_103871	15.7	16.0 13.0	5/1	10/31	612,728,347	497,841,782
Little North Santiam River OR_SR_1709000505_02_104564	19.5	16.0 13.0	5/1	10/31	762,091,245	619,199,137
Crabtree Creek OR_SR_1709000606_02_103978	25.4	16.0 13.0	5/1	10/31	994,324,656	807,888,783
Thomas Creek OR_SR_1709000607_02_103988	6.9	18.0	5/1	10/31	302,179,054	NA
Molalla River OR_SR_1709000904_02_104086	38.1	16.0 13.0	5/1	10/31	1,491,486,984	1,211,833,175
Pudding River OR_SR_1709000905_02_104088	10.4	18.0	5/1	10/31	459,371,266	NA
Johnson Creek OR_SR_1709001201_02_104170	11.1	18.0 13.0	5/1	10/31	489,182,033	353,298,135

### 9.1.2.1. 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).

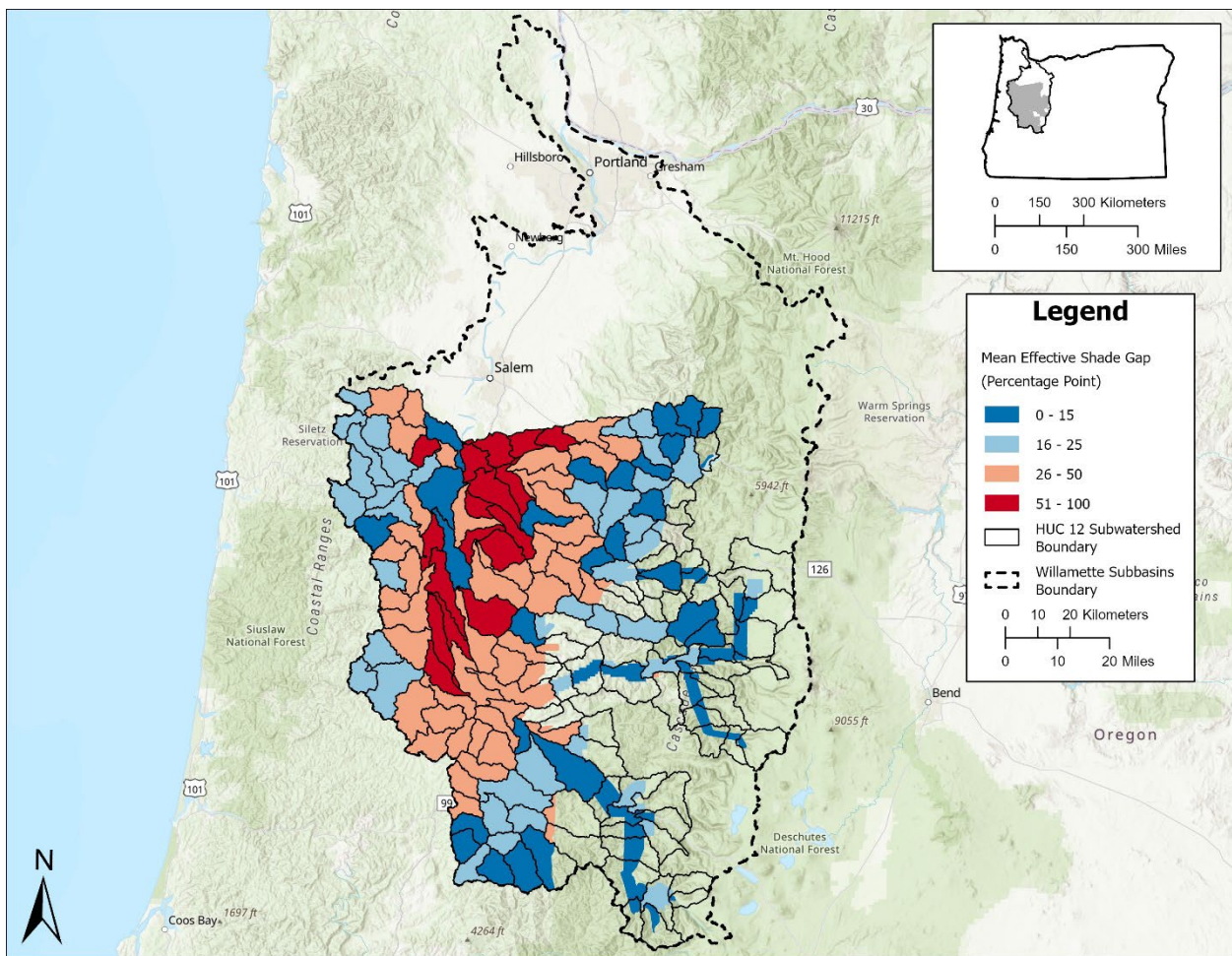
9.1.2.1.1. Site specific effective shade surrogate measure



**Table 9.5 Effective shade surrogate measure targets to meet nonpoint source load allocations for designated management agencies in the Lower Willamette Subbasin model area.**

Designated Management Agency	Total Kilometers Assessed	Assessed Effective Shade	TMDL Target Effective Shade	Shade Gap
BNSF	0.1	35	42	7
City of Fairview	0.1	21	54	33
City of Gresham	16	63	81	18
City of Happy Valley	0.8	79	90	11
City of Lake Oswego	5.8	83	90	7
City of Milwaukie	2.9	62	80	18
City of Portland	127.4	61	73	12
Clackamas County	13.3	66	86	20

Designated Management Agency	Total Kilometers Assessed	Assessed Effective Shade	TMDL Target Effective Shade	Shade Gap
Multnomah County	9.7	75	90	15
Oregon Department of Agriculture	13.5	65	85	20
Oregon Department of Forestry - Private	6.6	89	92	3
Oregon Parks and Recreation Department	0.1	91	91	0
Port of Portland	2.1	29	45	16
Portland & Western Railroad	<0.1	82	89	7
Roads	3.1	54	77	23
Union Pacific Railroad	0.1	34	62	28



**Table 9.6 Shade surrogate measure targets to meet nonpoint source load allocations for designated management agencies in the in the Southern Willamette model area.**

<b>Designated Management Agency</b>	<b>Total Kilometers Assessed</b>	<b>Assessed Effective Shade</b>	<b>TMDL Target Effective Shade</b>	<b>Shade Gap</b>
Albany & Eastern Railroad	0.1	96	97	1
Benton County	119.3	59	89	30
Bonneville Power Administration	2.3	35	94	59
Central Oregon & Pacific Railroad	0.2	8	86	78
City of Adair Village	2	29	93	64
City of Albany	47.7	37	76	39
City of Brownsville	4	29	67	38
City of Coburg	2.8	22	91	69
City of Corvallis	63.8	60	87	27
City of Cottage Grove	6.2	40	85	45
City of Creswell	4.6	19	91	72
City of Eugene	128.8	30	84	54
City of Falls City	9	57	97	40
City of Gates	4.7	37	85	48
City of Halsey	1.6	8	87	79
City of Harrisburg	0.8	3	88	85
City of Jefferson	3.2	23	82	59
City of Junction City	11.6	10	86	76
City of Lebanon	16.2	39	85	46
City of Lowell	2.7	34	90	56
City of Lyons	2.3	33	88	55
City of Mill City	2.9	18	76	58
City of Millersburg	17.2	27	78	51
City of Monmouth	0.5	82	89	7
City of Monroe	1.2	27	75	48
City of Oakridge	9.2	29	75	46
City of Philomath	7.6	38	88	50
City of Salem	0.8	25	45	20
City of Scio	1.7	53	59	6
City of Springfield	42.3	33	88	55
City of Stayton	3.9	43	86	43
City of Sweet Home	26.2	35	87	52
City of Tangent	10.9	50	82	32
City of Veneta	8.7	52	95	43
City of Waterloo	0.4	51	94	43
City of Westfir	3.1	30	80	50
Lane County	718.8	53	89	36
Lincoln County	0.2	9	96	87
Linn County	180.7	44	88	44
Marion County	49	44	78	34
Oregon Department of Agriculture	4790.6	33	86	53
Oregon Department of Aviation	0.2	1	92	91
Oregon Department of Fish and Wildlife	13.8	38	73	35
Oregon Department of Forestry - Private	8597.7	71	96	25
Oregon Department of Forestry - Public	526.6	87	97	10
Oregon Department of Geology and Mineral Industries	5	41	93	52
Oregon Department of State Lands	1.4	55	82	27
Oregon Department of Transportation	52.8	37	80	43
Oregon Military Department	0.2	0	86	86
Oregon Parks and Recreation Department	27.8	50	72	22



Designated Management Agency	Total Kilometers Assessed	Assessed Effective Shade	TMDL Target Effective Shade	Shade Gap
Polk County	64.9	52	93	41
Port of Coos Bay	1.9	58	94	36
Portland & Western Railroad	1.9	48	74	26
State of Oregon	2.5	64	68	4
U.S. Army Corps of Engineers	73.4	61	82	21
U.S. Bureau of Land Management	2569.5	90	97	7
U.S. Department of Agriculture	0.8	36	54	18
U.S. Department of Defense	1.5	49	85	36
U.S. Fish and Wildlife Service	39.7	49	77	28
U.S. Forest Service	2973.9	85	96	11
U.S. Government	10.1	62	84	22
Union Pacific Railroad	5.4	66	90	24

**Table 9.7 Effective shade surrogate measure targets to meet nonpoint source load allocations for specific model extents.**

Model Stream	Total Kilometers Assessed	Assessed Effective Shade	TMDL Target Effective Shade	Shade Gap
Pudding River	85.55	44	52	8
Molalla River	75.36	27	41	14

Designated Management Agency	Stream Name	Current Shade	TMDL Target	Shade Gap
Clackamas County	Salmon River	24	37	13
Oregon Department of Forestry - Private	Salmon River	26	40	14
Oregon Department of Transportation	Salmon River	10	48	38
U.S. Bureau of Land Management	Salmon River	26	35	9
U.S. Forest Service	Salmon River	49	59	10
<i>Water</i>	<i>Salmon River</i>	<i>26</i>	<i>40</i>	<i>14</i>
City of Portland	Sandy River	8	12	4
City of Sandy	Sandy River	23	25	2
City of Troutdale	Sandy River	13	18	5
Clackamas County	Sandy River	18	27	9
Multnomah County	Sandy River	16	19	3
Oregon Department of Agriculture	Sandy River	24	28	4
Oregon Department of Fish and Wildlife	Sandy River	22	26	4
Oregon Department of Forestry - Private	Sandy River	19	23	4
Oregon Parks and Recreation Department	Sandy River	6	7	1
Port of Portland	Sandy River	3	9	6

<b>State of Oregon</b>	<b>Sandy River</b>	<b>13</b>	<b>17</b>	<b>4</b>
<b>U.S. Bureau of Land Management</b>	<b>Sandy River</b>	<b>25</b>	<b>29</b>	<b>4</b>
<b>U.S. Forest Service</b>	<b>Sandy River</b>	<b>3</b>	<b>6</b>	<b>3</b>
<b>U.S. Government</b>	<b>Sandy River</b>	<b>16</b>	<b>18</b>	<b>2</b>

9.1.2.1.1. Effective shade curve surrogate measure

Effective shade curves are applicable to any stream that does not have site specific shade targets (Section 9.1.2.1.1). Effective shade curves represent the maximum possible effective shade for a given vegetation type. The values presented within the effective shade curves (Figure 9.1 to Figure 9.22) represent the mean effective shade target for different mapping units, stream aspects, and active channel widths. The vegetation height, density, overhang, and buffer widths used for each mapping unit vegetation type is summarized in Table 9.8. See the technical support document, for additional details on the methodologies used to determine vegetation characteristics. The technical support document provides tables of the plotted shade curve values.

Local geology, geography, soils, climate, legacy impacts, natural disturbance rates, and other factors may prevent effective shade from reaching the target effective shade. No enforcement action will be taken by DEQ for reductions in effective shade caused by natural disturbances.

**Table 9.8. Vegetation height, density, overhang, and horizontal distance buffer widths used to derive generalized effective shade curve targets for each mapping unit.**

Mapping Unit	Height (m)	Height (feet)	Density (%)	Overhang (m)	Buffer Width (m)
Qff1	40.7	134	70%	4.9	36.8
Qfc	37.7	124	64%	4.5	36.8
Qalc	26.9	88	71%	3.2	36.8
Qg1	21.6	71	64%	2.6	36.8
Qau	22.6	74	69%	2.7	36.8
Qalf	17.5	57	68%	2.1	36.8
Qff2	21.5	71	66%	2.6	36.8
Qbf	22.0	72	68%	2.6	36.8
Tvc	27.8	91	65%	3.3	36.8
Qtg	40.5	133	72%	4.9	36.8
Twv	35.1	115	65%	4.2	36.8
Tcr	36.9	121	68%	4.4	36.8
Tm	29.7	97	68%	3.6	36.8
QTt	25.2	83	66%	3.0	36.8
QTb	35.2	115	64%	4.2	36.8
Qls	44.0	144	65%	5.3	36.8
OW	1.9	6	74%	0.2	36.8
Upland Forest	40.9	134	75%	4.9	36.8
1d/1f - Coast Range - Volcanics and Willapa Hills	36.0	118.1	75%	3.9	36.8
3a -Willamette Valley - Portland/Vancouver Basin	26.0	85.3	75%	1.9	36.8
3c -Willamette Valley - Prairie Terraces	33.2	108.9	75%	1.9	36.8
3d - Willamette Valley – Valley Foothills	31.0	101.7	75%	1.9	36.8

Qff1

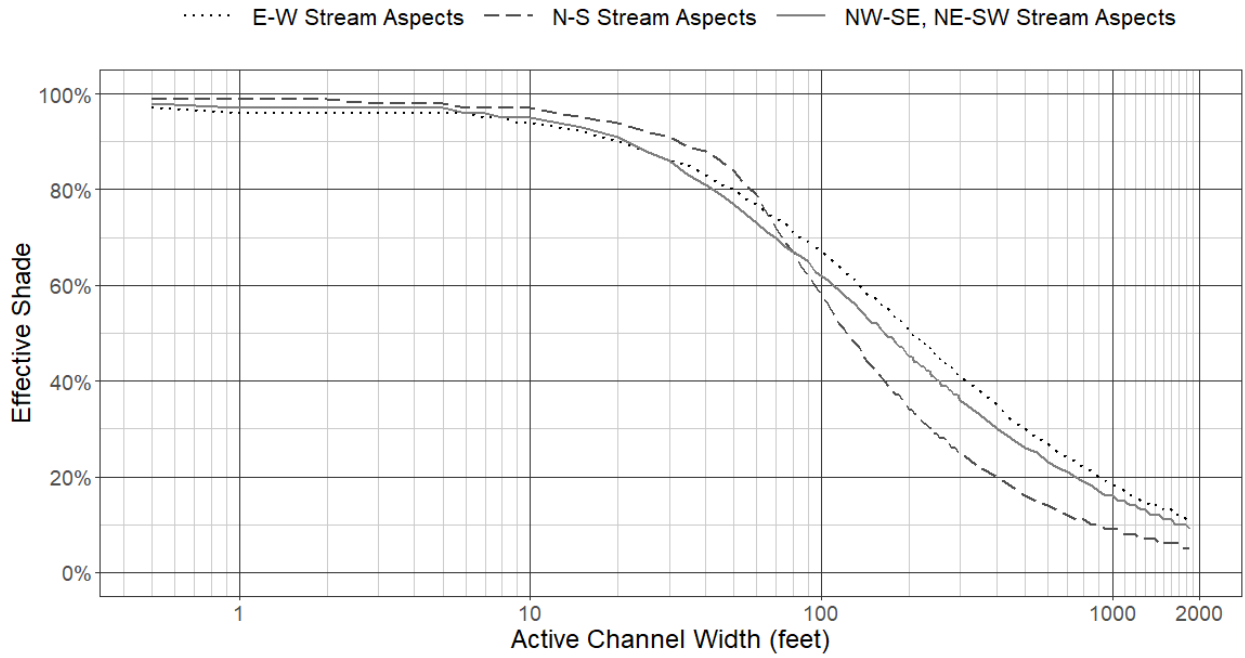


Figure 9.1 Effective shade targets for stream sites in the Qff1 mapping unit.

Qfc

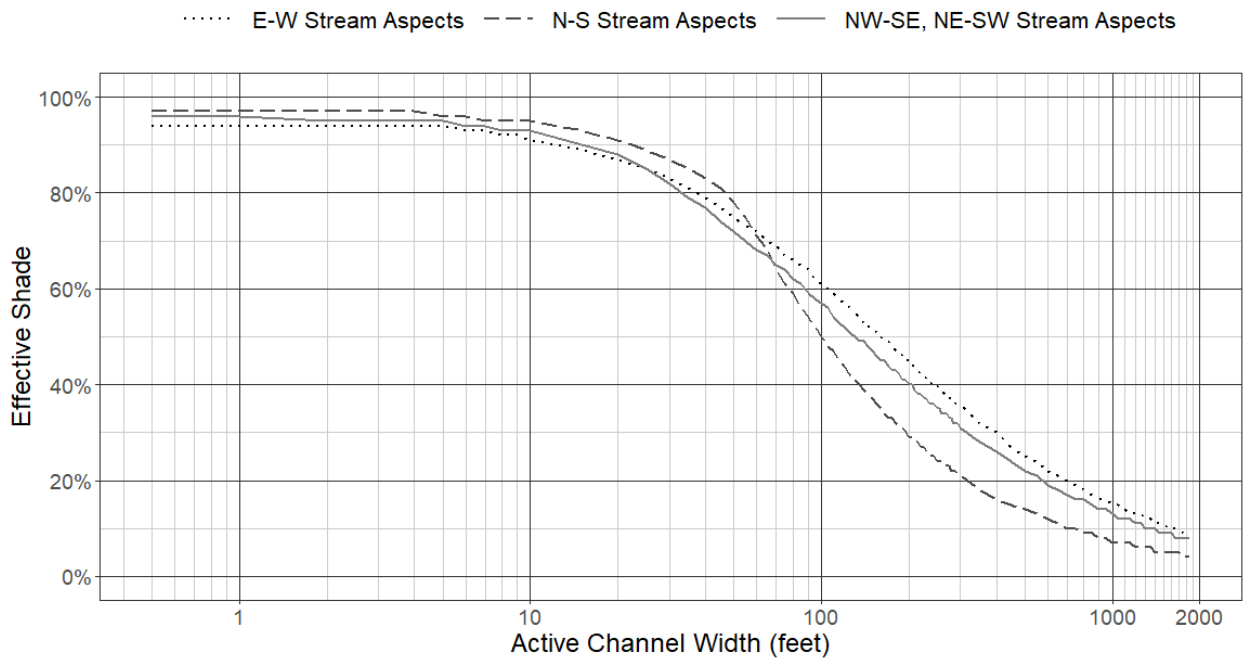


Figure 9.2 Effective shade targets for stream sites in the Qfc mapping unit.

### Qalc

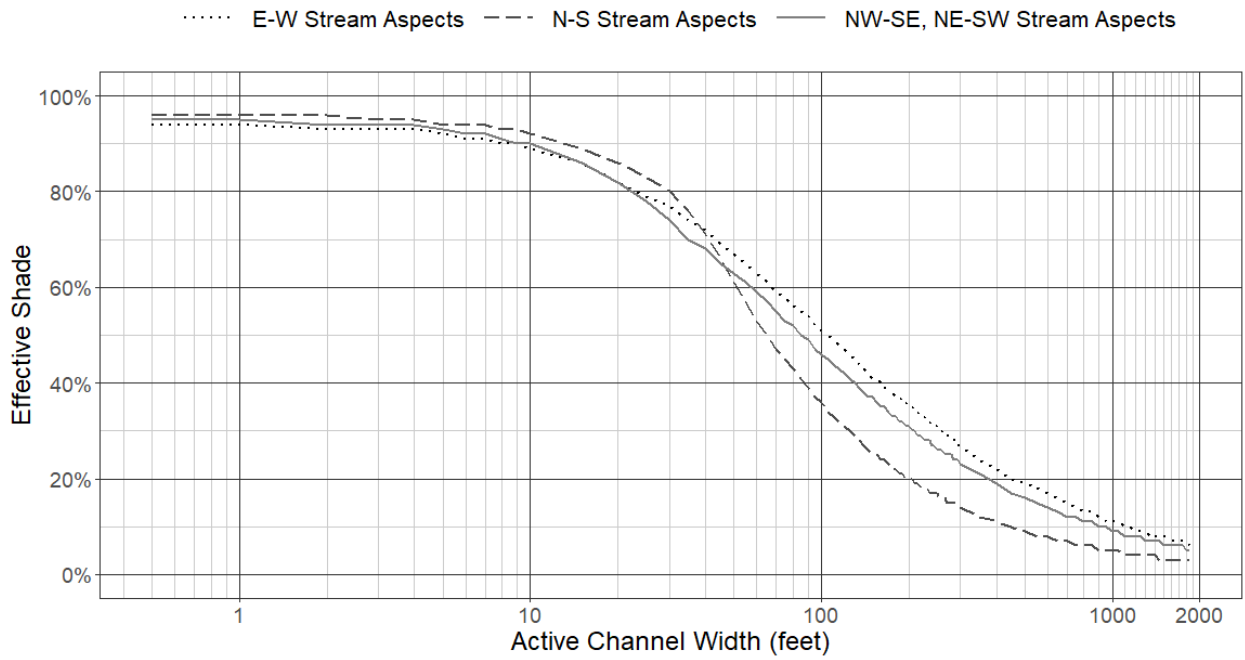


Figure 9.3 Effective shade targets for stream sites in the Qalc mapping unit.

### Qg1

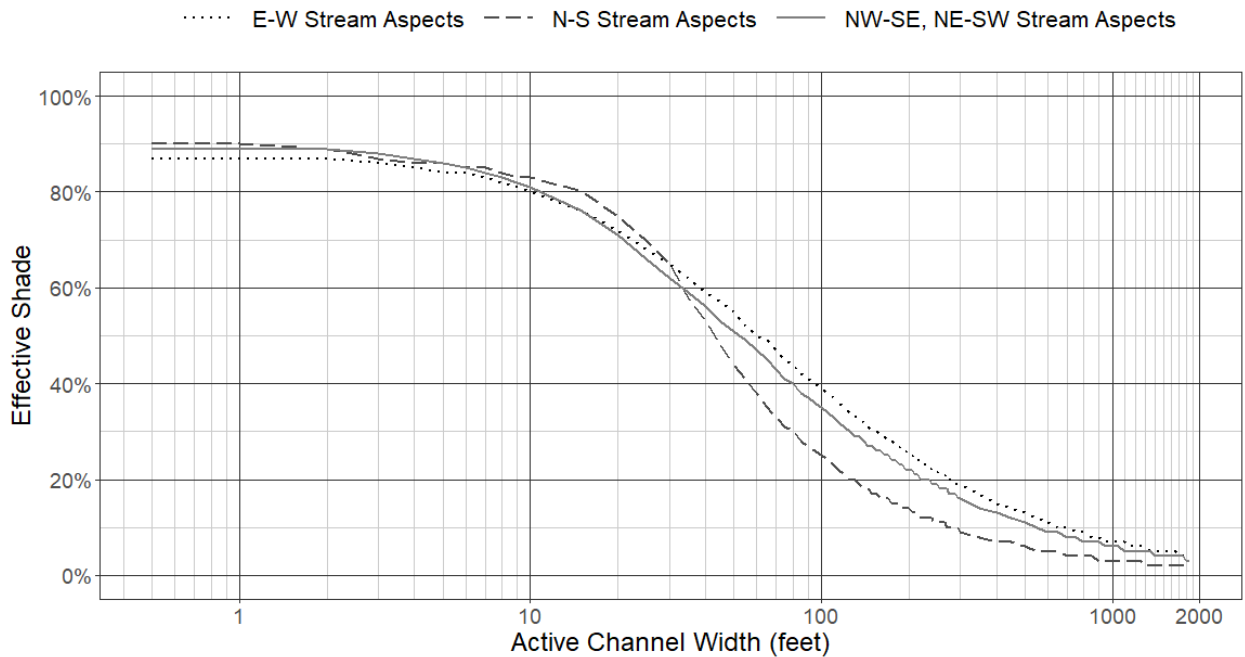


Figure 9.4 Effective shade targets for stream sites in the Qg1 mapping unit.



### Qau

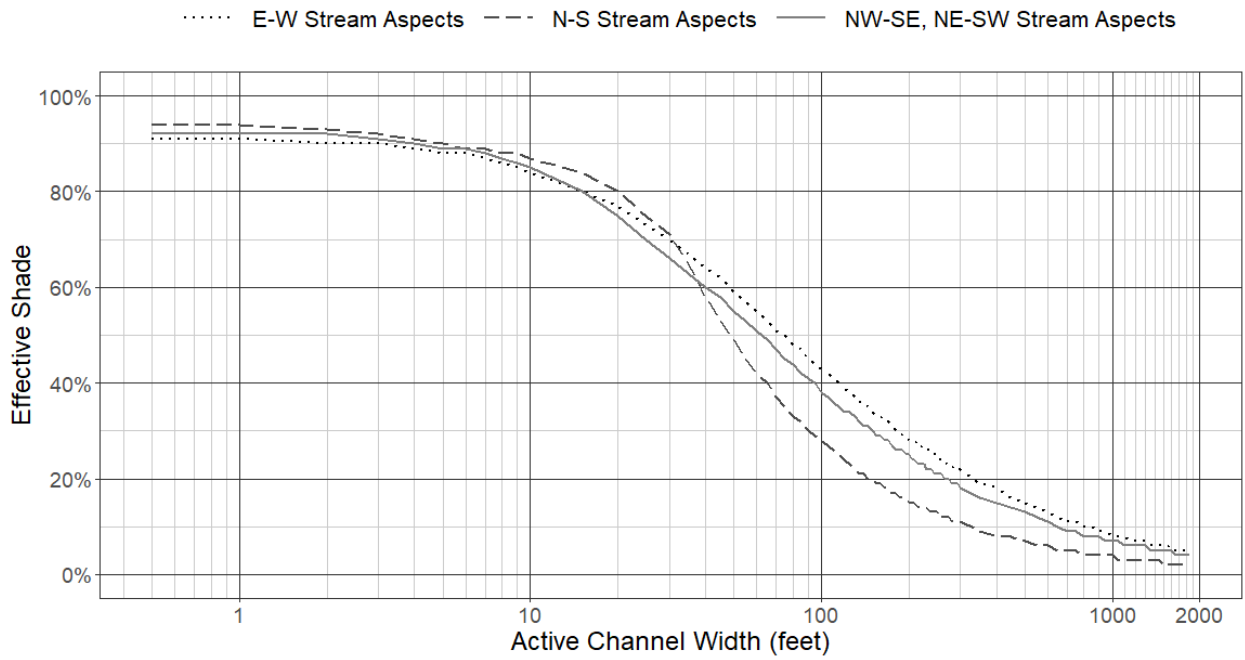


Figure 9.5 Effective shade targets for stream sites in the Qau mapping unit.

### Qalf

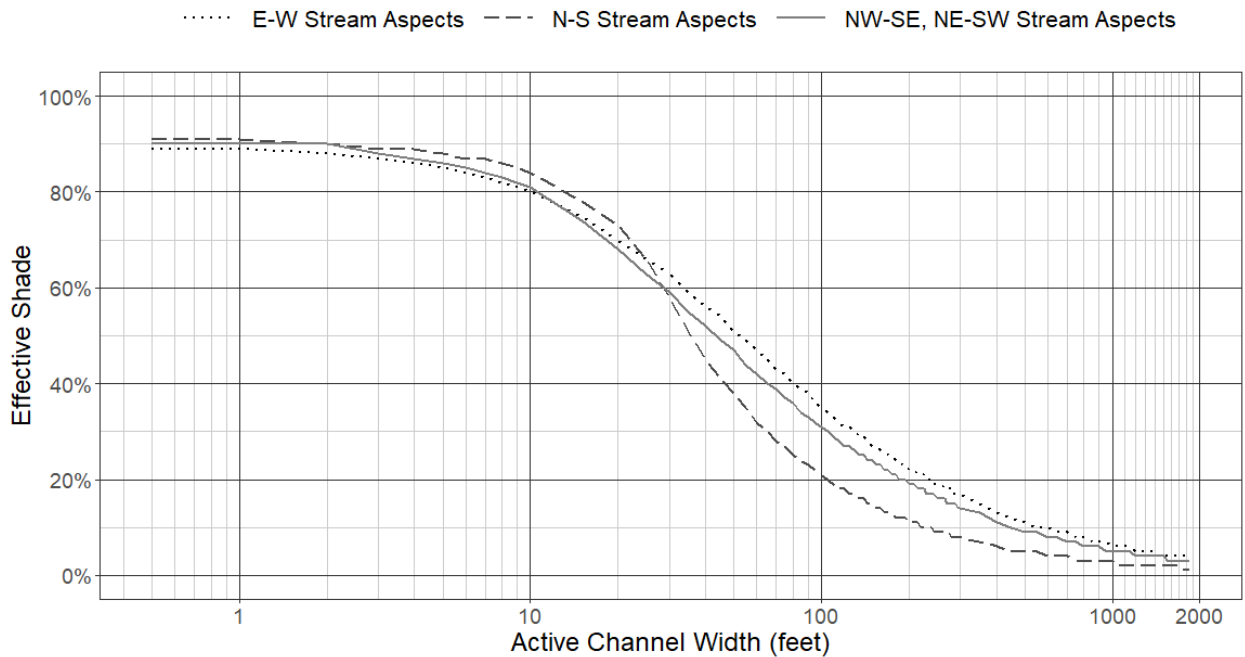


Figure 9.6 Effective shade targets for stream sites in the Qalf mapping unit.

Qff2

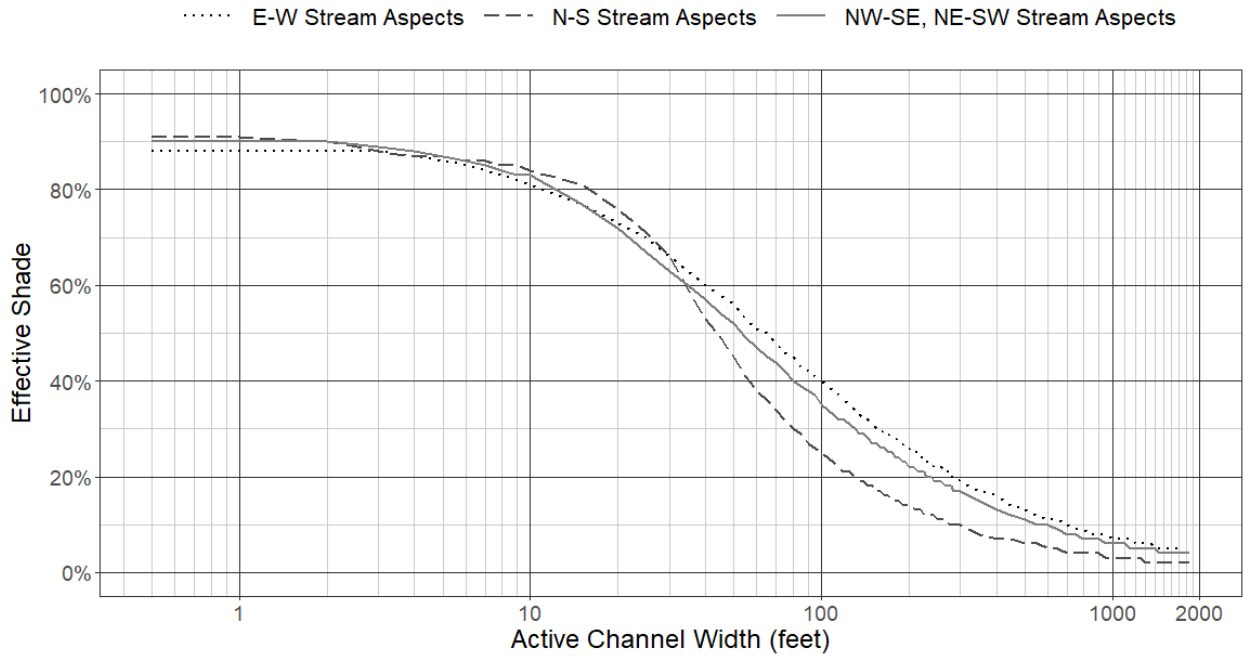


Figure 9.7 Effective shade targets for stream sites in the Qff2 mapping unit.

Qbf

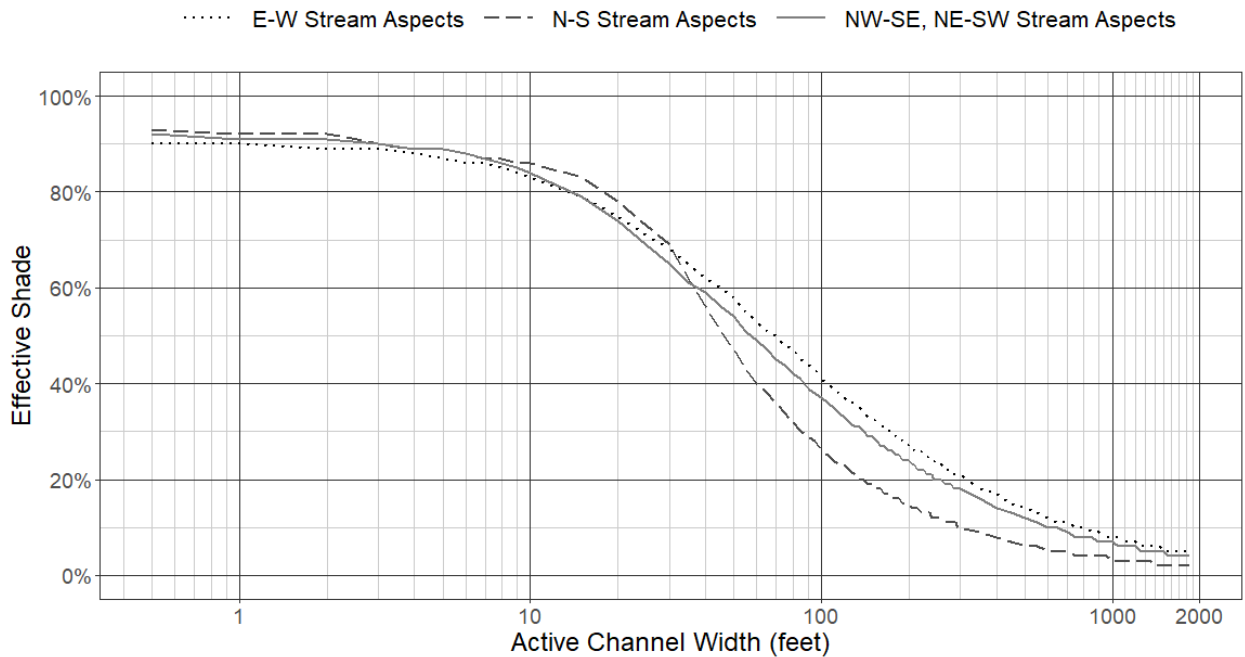


Figure 9.8 Effective shade targets for stream sites in the Qbf mapping unit.

Tvc

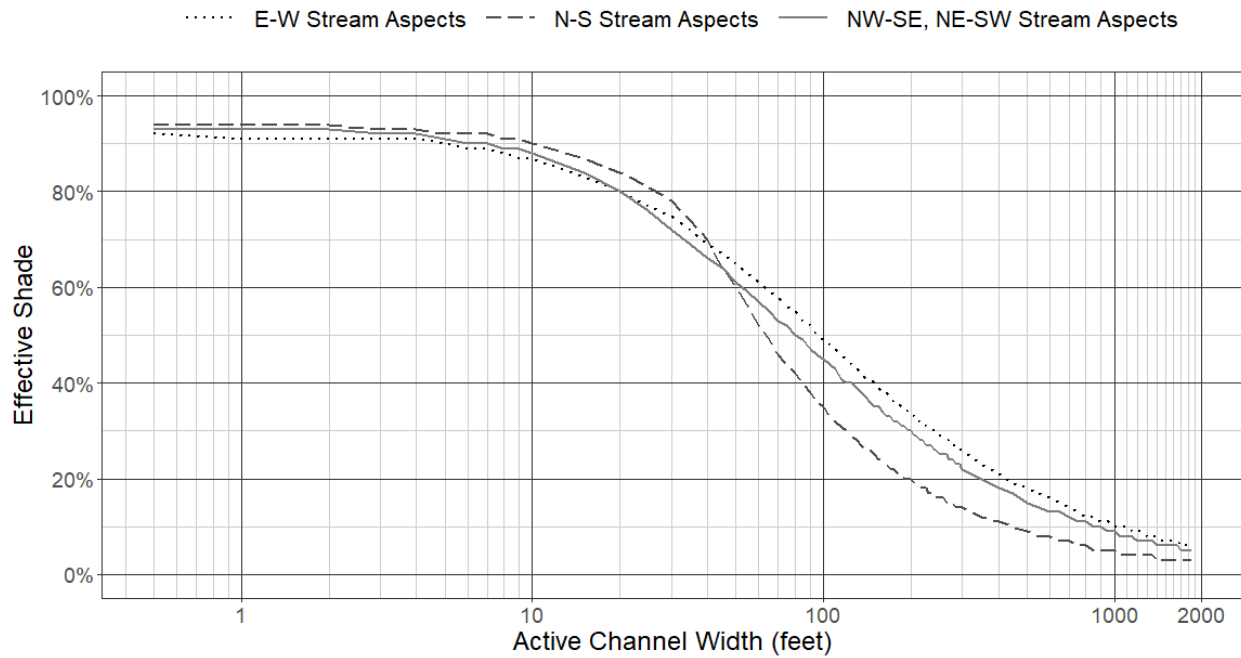


Figure 9.9 Effective shade targets for stream sites in the Tvc mapping unit.

Qtg

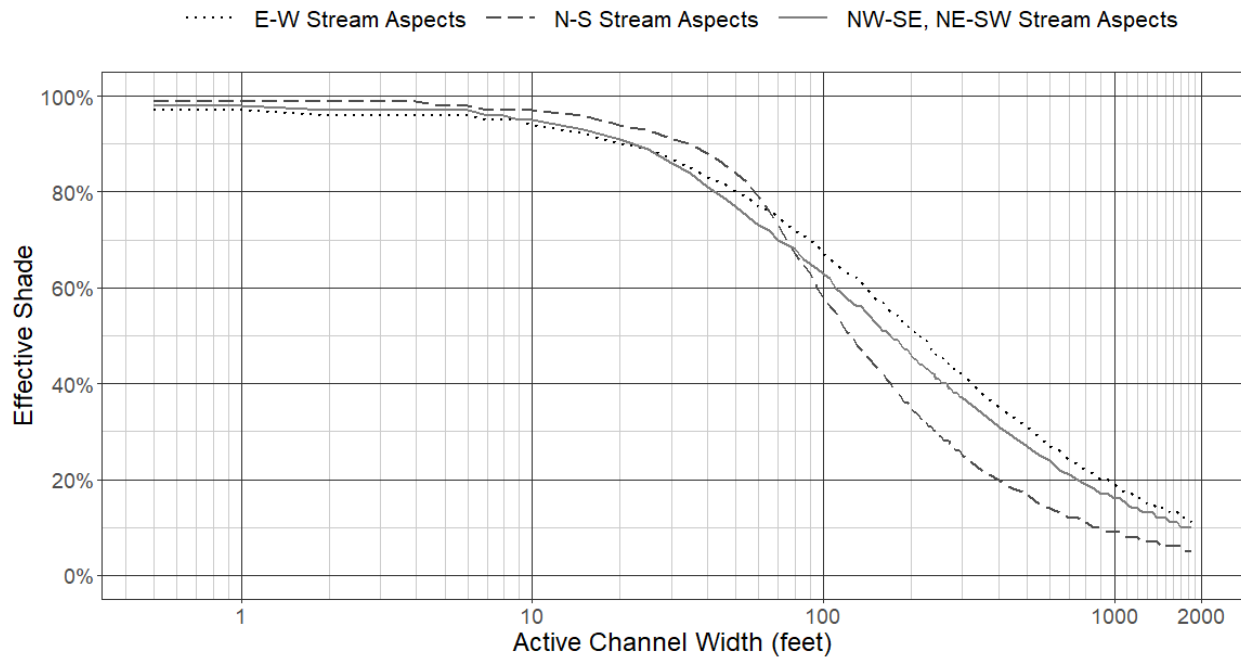


Figure 9.10 Effective shade targets for stream sites in the Qtg mapping unit.

T<sub>w</sub>

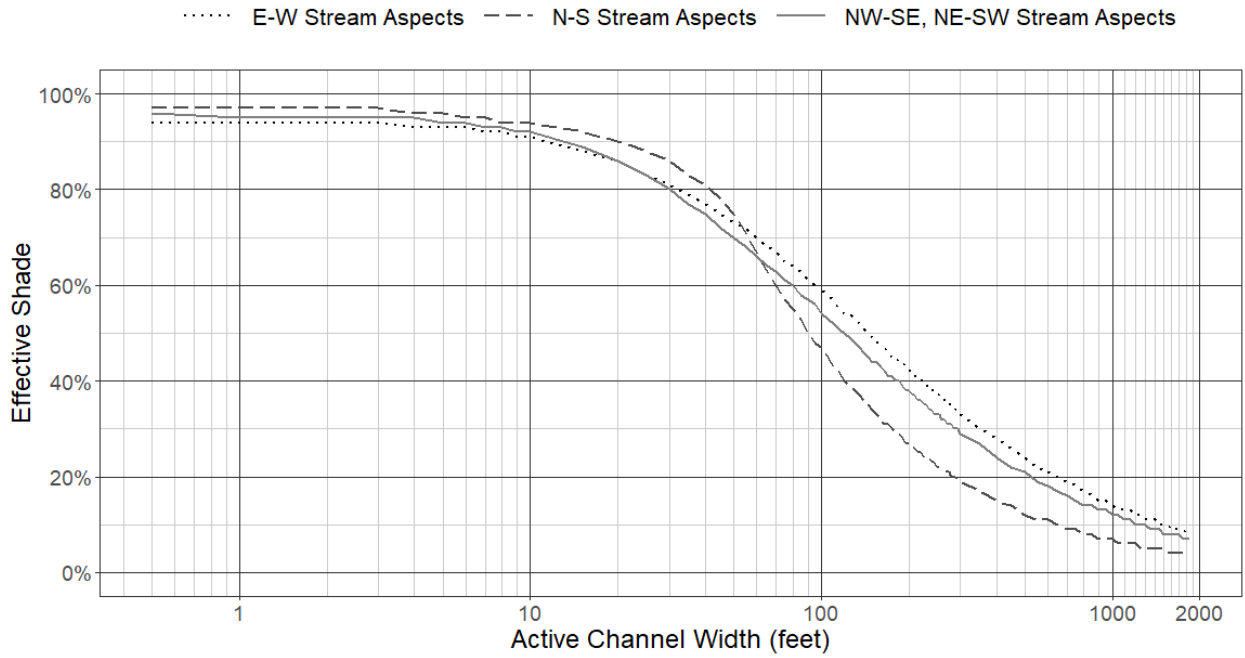


Figure 9.11 Effective shade targets for stream sites in the T<sub>w</sub> mapping unit.

T<sub>cr</sub>

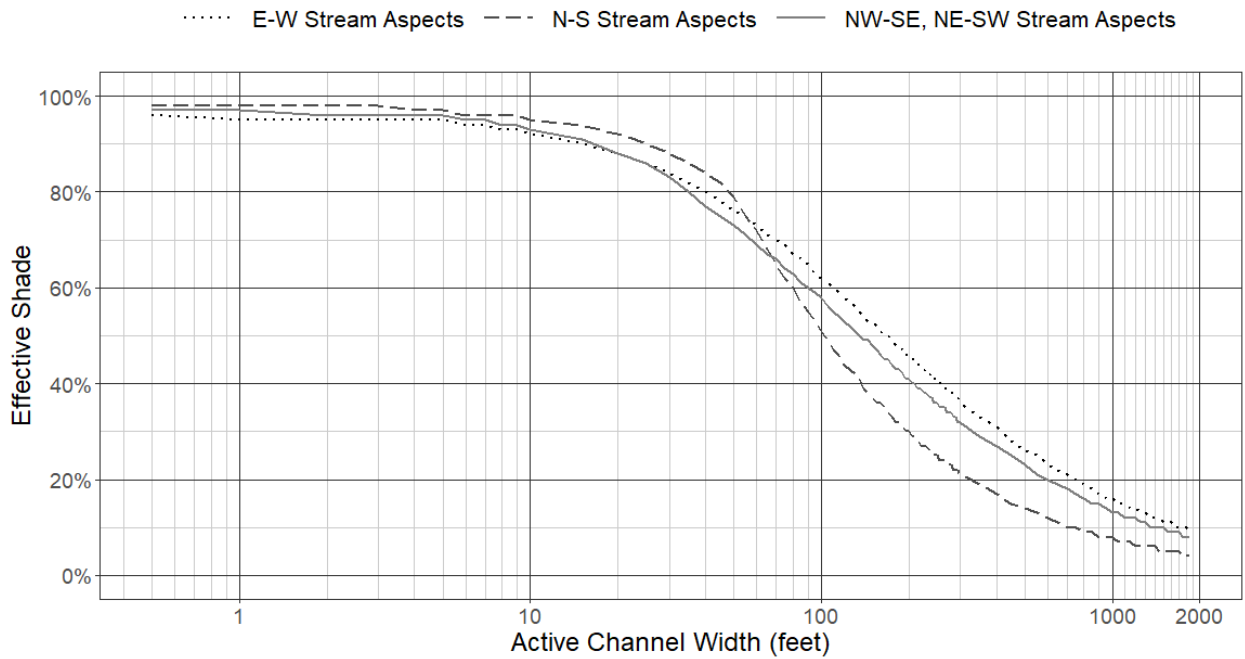


Figure 9.12 Effective shade targets for stream sites in the T<sub>cr</sub> mapping unit.

Tm

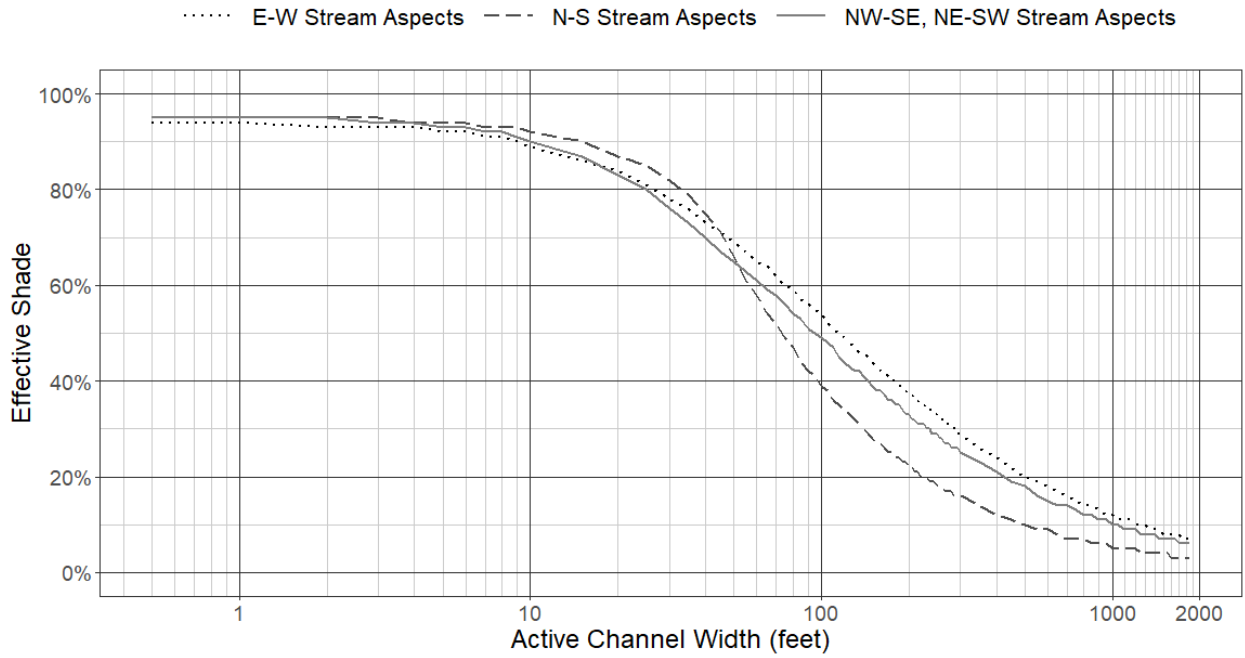


Figure 9.13 Effective shade targets for stream sites in the Tm mapping unit.

OW

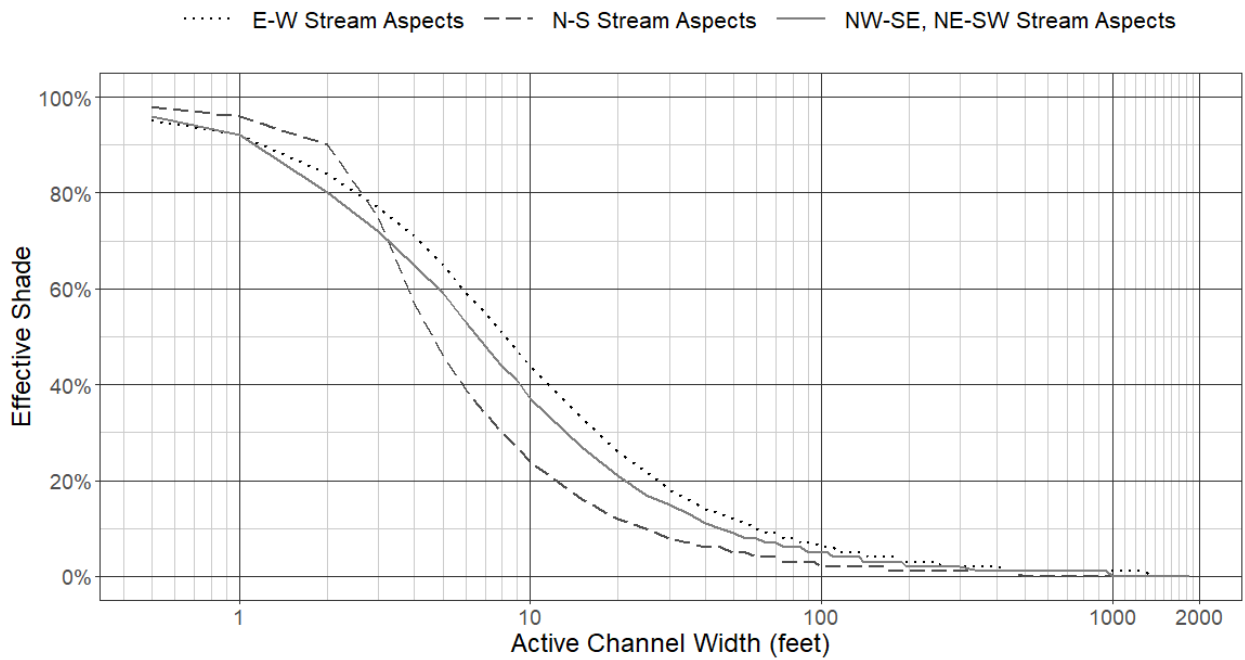
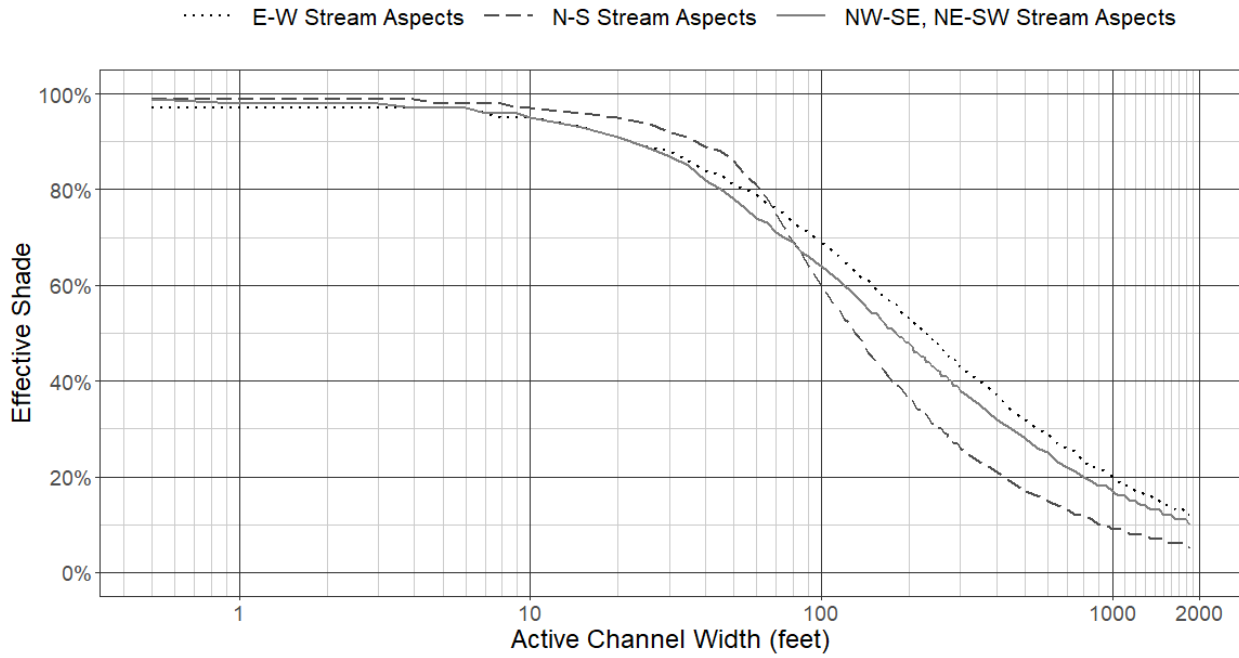


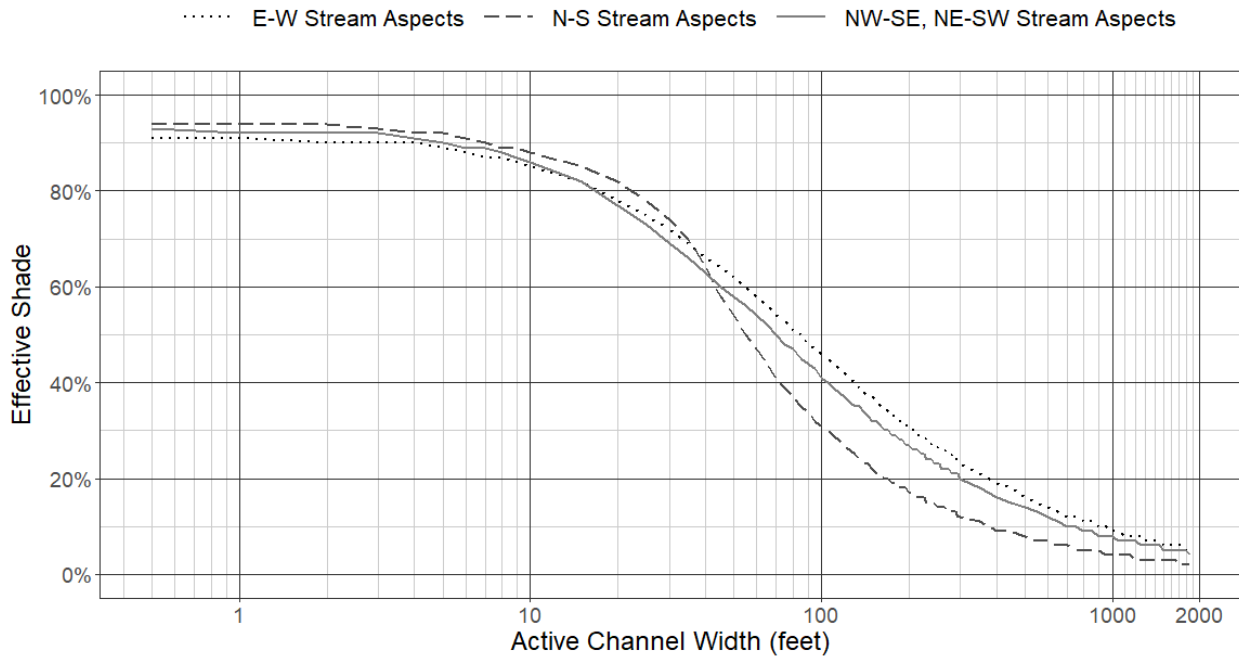
Figure 9.14 Effective shade targets for stream sites in the Open Water (OW) mapping unit.

### Upland Forest



**Figure 9.15 Effective shade targets for stream sites in the Upland Forest mapping unit.**

### QTt



**Figure 9.16 Effective shade targets for stream sites in the QTt mapping unit.**

QTb

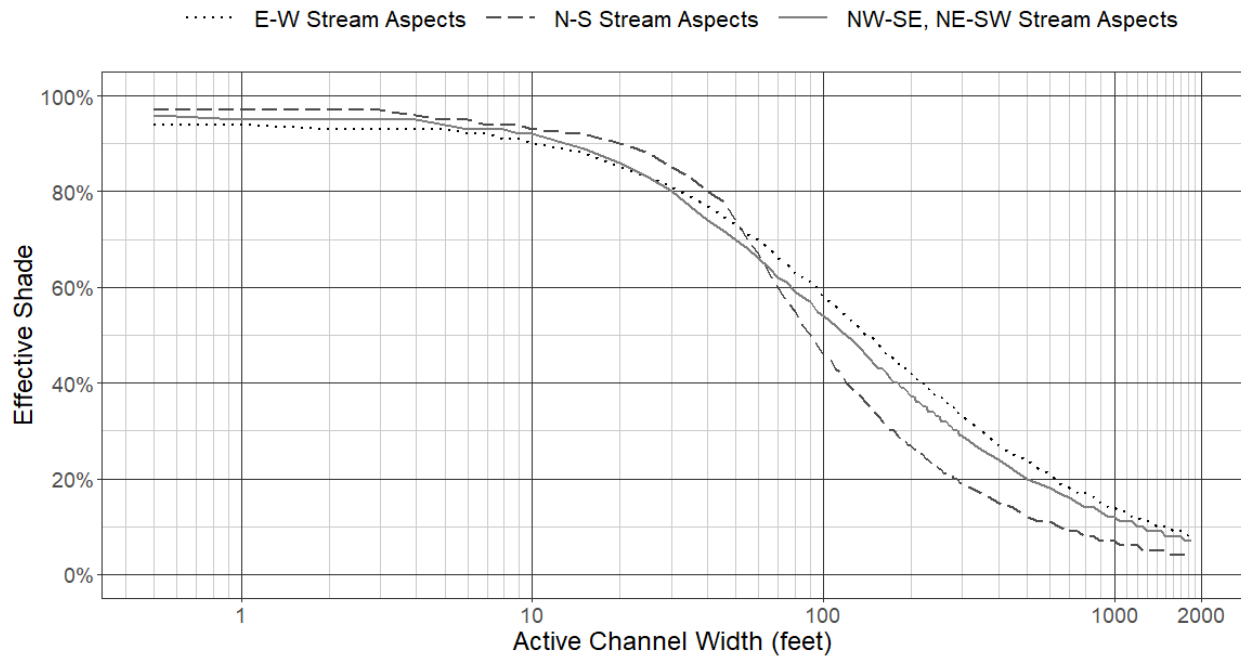


Figure 9.17 Effective shade targets for stream sites in the QTb mapping unit.

QIs

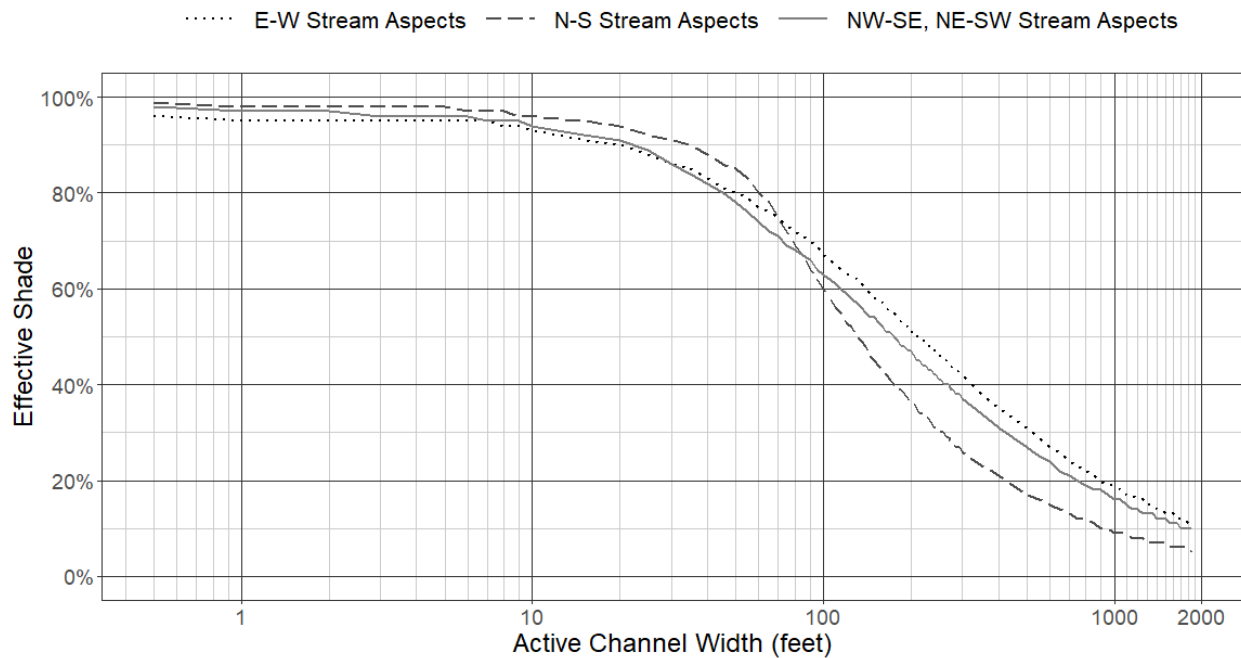


Figure 9.18 Effective shade targets for stream sites in the QIs mapping unit.



1d/1f - Volcanics and Willapa Hills

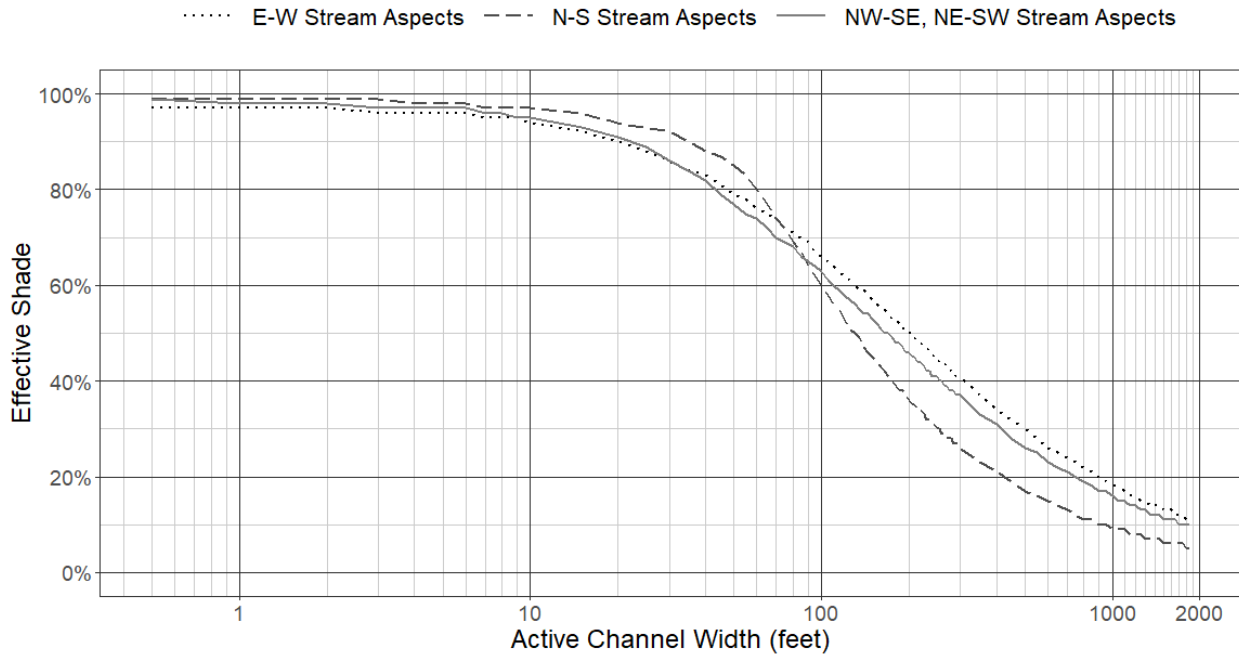


Figure 9.19 Effective shade targets for stream sites in Ecoregion 1d/1f - Volcanics and Willapa Hills.

3a - Portland/Vancouver Basin

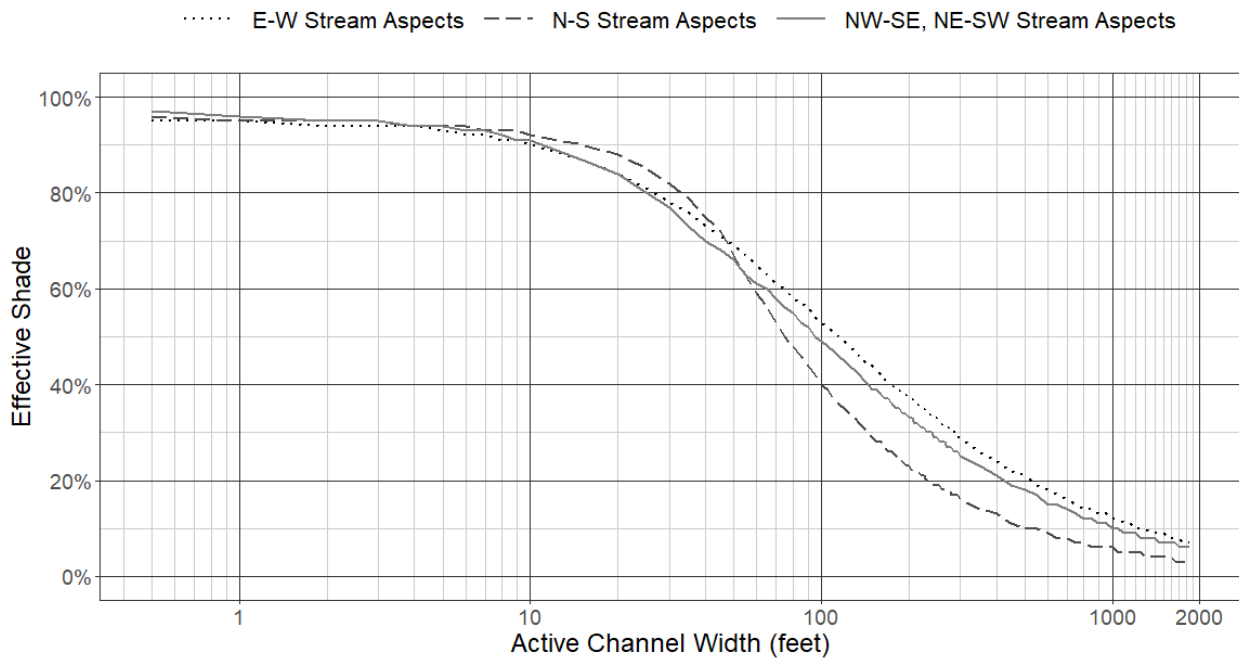


Figure 9.20 Effective shade targets for stream sites in Ecoregion 3a - Portland/Vancouver Basin.

### 3c - Prairie Terraces

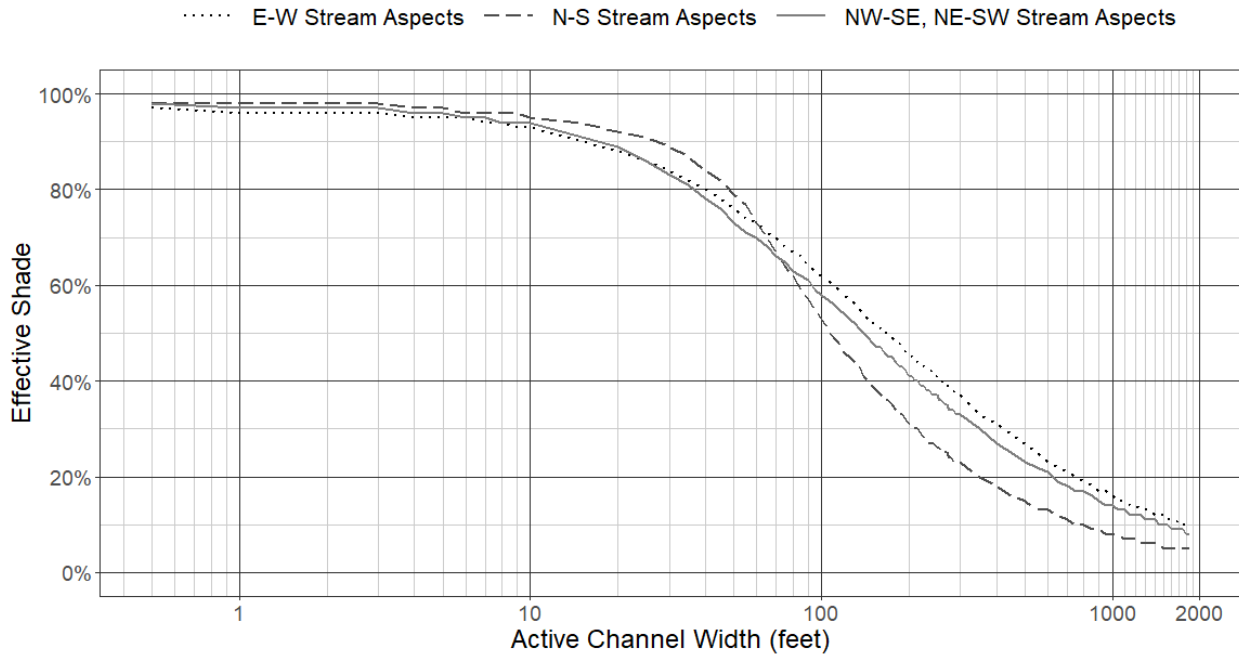


Figure 9.21 Effective shade targets for stream sites in Ecoregion 3c - Prairie Terraces.

### 3d - Valley Foothills

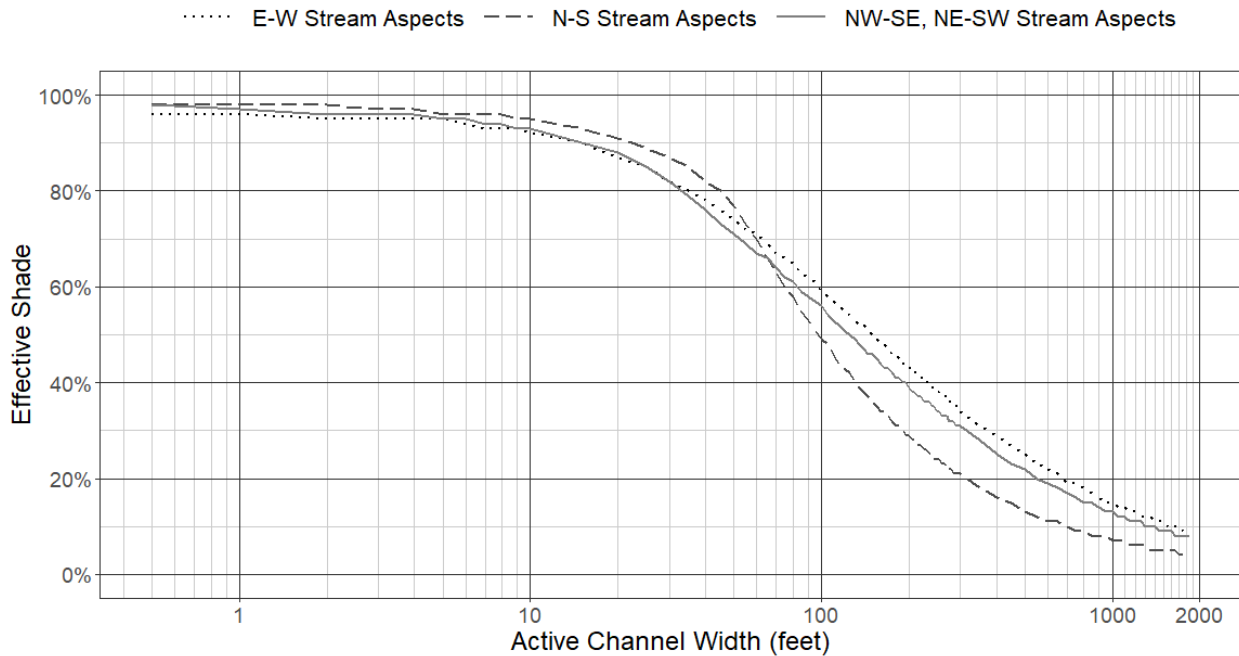


Figure 9.22 Effective shade targets for stream sites in Ecoregion 3d - Valley Foothills.

### 9.1.3. Reserve capacity

Explicit allocations for reserve capacity have been set aside for use by either point or nonpoint sources. Reserve capacity may be used for an allocation to new or increased thermal loads, or to any existing source that may not have been identified during the development of this TMDL. The portion of the human use allowance associated with the reserve capacity is described in Table 9.1 and Table 9.2.

## **9.2. Margin of safety**

This TMDL used an implicit margin of safety.

# **10. Water quality management plan**

As described in OAR 340-042-0040(4)(I)(A)-(O), an associated WQMP is an required element of a TMDL and must include the following components: (A) Condition assessment and problem description; (B) Goals and objectives; (C) Proposed management strategies design to meet the TMDL allocations; (D) Timeline for implementing management strategies; (E) Explanation of how TMDL implementation will attain water quality standards; (F) Timeline for attaining water quality standards; (G) Identification of persons, including Designated Management Agencies, responsible for TMDL implementation; (H) Identification of existing implementation plans; (I) Schedule for submittal of implementation plans and revision triggers; (J) Description of reasonable assurance of TMDL implementation; (K) Plan to monitor and evaluate progress toward achieving TMDL allocations and water quality standards; (L) Plan for public involvement in TMDL implementation; (M) Description of planned efforts to maintain management strategies over time; (N) General discussion of costs and funding for TMDL implementation; and, (O) citation of legal authorities relating to TMDL implementation.

DEQ sought and considered input from various persons, including DMAs, responsible for TMDL implementation and other interested public and prepared the Willamette Subbasins WQMP as a stand-alone document. DEQ intends to propose the draft WQMP as an element of Temperature TMDLs for the Willamette Subbasins for adoption as rule by the Oregon Environmental Quality Commission.

# **11. Reasonable assurance**

OAR 340-042-0030(9) defines Reasonable Assurance as “a demonstration that a TMDL will be implemented by federal, state or local governments or individuals through regulatory or voluntary actions including management strategies or other controls.” OAR 340-042-0040(4)(I)(J) requires a description of reasonable assurance that management strategies and sector-specific or source-specific implementation plans will be carried out through regulatory or voluntary actions. And as a factor in consideration of allocation distribution among sources, OAR 340-042-0040(6)(g) states that “to establish reasonable assurance that the TMDL’s load allocations will be achieved requires determination that practices capable of reducing the

specified pollutant load: (1) exist; (2) are technically feasible at a level required to meet allocations; and (3) have a high likelihood of implementation.” This three point test is consistent with EPA past practice and guidance on determining reasonable assurance and supports federal antidegradation rules and Oregon’s antidegradation policy (OAR 340-041-0004).

Temperature TMDLs for the Willamette Subbasins were developed for waters impaired by both point and nonpoint sources, with allocations distributed to sources of thermal loading. It is the state’s (and, with TMDL approval, EPA’s) best professional judgment as to a reasonable assurance determination that the TMDL’s load allocations will be achieved. DEQ employs a six-point accountability framework for reasonable assurance of implementation, as detailed in DEQ’s Water Quality Management Plan.

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

The rationale described in this TMDL Rule, TMDL Technical Support Document and Water Quality Management Plan stems from robust evaluations, implements an accountability framework and provides opportunities for adaptive management to maximize pollutant reductions. Together this approach provides reasonable assurance to meet state and federal requirements and attain the goals of the TMDL.