Snake River Temperature Total Maximum Daily Load Technical Support Document

Temperature

DRAFT RAC1
Date (EQC adoption month and year)

State of Oregon
DEQ Department of Environmental Quality

This document was prepared by:
Ryan Michie

Oregon Department of Environmental Quality
Water Quality Division
700 NE Multnomah Street, Suite 600
Portland Oregon, 97232
Contact: Steve Mrazik
Phone: 503-229-5983 x267
www.oregon.gov/deq

State of Oregon
DEQ Department of Environmental Quality

Translation or other formats

Español | 한국어 | 繁體中文 | Русский | Tiếng Việt | العربية
800-452-4011 | TTY: 711 | deqinfo@deq.oregon.gov

Non-discrimination statement

DEQ does not discriminate on the basis of race, color, national origin, disability, age or sex in administration of its programs or activities. Visit DEQ's Civil Rights and Environmental Justice page.

Table of contents

List of tables

List of figures

1 The 7Q10 low-flow statistic

The “7Q10” is a summary low-flow statistic equal to the lowest seven-day average flow that occurs once every ten years (on average). 7Q10s is considered the critical low flow and used to calculate numeric loading capacities and allocations. DEQ calculated annual 7Q10s for each assessment unit (Table 6-3) and upstream of each NPDES permitted point source (Table 6-4).

The 7Q10s were calculated from available daily mean flow rate data measured at USGS or IPC gaging stations between January 1, 1990 and December 31, 2024 (up to 35 years). DEQ relied on the quality control protocols implemented by USGS and IPC. Only data with a result status of “Approved” or “Published” were included in 7Q10 calculations. Annual 7Q10s were calculated by the method of EPA’s DFLOW program (Rossman, 1990), which computes extreme design flows using the log-Pearson Type III probability distribution. At least 10 years of flow data were used with some exceptions. The water year (Oct 1 – Sept 30) was used to define the annual period. For ungaged assessment units, it was possible to estimate the daily mean flow using gages located upstream, downstream, or on tributaries. The daily mean flows at the ungaged reach were estimated by summing or subtracting the daily mean flow from the gaged locations as appropriate. For example, the flow on the Snake River upstream of the Weiser River is not gaged but can be estimated by subtracting flow recorded on the Weiser River (USGS-13266000) from the flows recorded on the Snake River downstream of the Weiser River (IPC-13269000). Flow records needed to be available from all gages on the same day, otherwise the flow rate on that day was recorded as missing. Daily mean flows for the ungaged location were calculated first, prior to the 7Q10 calculation.

Table 6-1: The annual 7Q10 low flow for each assessment unit and the data sources used.

AU ID	Data Sources	Annual 7Q10 (cfs)	Data Period	Count of Daily Mean Flow Results
OR_SR_1705010311_02_102702	USGS 13213100 – USGS 13213000 – IPC 13184005	4256	10/1/2002 - 12/31/2024	7969
OR_SR_1705011501_02_103231	USGS 13213100	4755	01/1/1990 - 12/31/2024	12784
OR_SR_1705011502_02_103230	IPC 13269000 – USGS 13266000	5831	01/1/1990 - 12/31/2024	12784
OR_SR_1705020101_02_103229	IPC 13269000	6092	01/1/1990 - 12/31/2024	12784
OR_LK_1705020103_05_100578	IPC 13289720 (Brownlee Dam outflow)	7251	01/1/2014 - 12/31/2021	2922
OR_LK_1705020311_05_100605	IPC 13286700 + IPC 13288300	8	04/16/1999 - 12/31/2024	8205
OR_LK_1705020107_05_100583	IPC 13290030 (Oxbow Dam outflow)	6854	01/1/2014 - 12/31/2021	2922
OR_LK_1705020107_05_100582	IPC 13290450 (Hells Canyon Dam outflow)	6884	01/1/1990 - 12/31/2024	12748
OR_SR_1706010101_02_103274	IPC 13290450	6884	01/1/1990 - 12/31/2024	12748
OR_SR_1706010102_02_103280	IPC 13290460	7654	10/1/1992 - 12/31/2024	11508

AU ID	Data Sources	Annual 7Q10 (cfs)	Data Period	Count of Daily Mean Flow Results
OR_SR_1706010103_02_103282	IPC 13290460	7654	10/1/1992 - 12/31/2024	11508
OR_SR_1706010301_02_103306	USGS 13317660	11369	10/1/2003 - 12/31/2024	7763

Table 6-2: The annual 7Q10 low flow for each NPDES point source and data sources.

NPDES Permittee WQ File Number: EPA Number	Data Source	Annual 7Q10 (cfs)	Data Period	Count of Daily Mean Flow Results
Idaho Power – Hells Canyon Power Plant 41297 : OR0027278	IPC 13290450 (Hells Canyon Dam outflow)	6884	01/1/1990 - 12/31/2024	12748
Idaho Power - Oxbow Power Plant 41299 : OR0027286	IPC 13290030 (Oxbow Dam outflow)	6854	01/1/2014 - 12/31/2021	2922
Ontario STP 63631 : OR0020621	IPC 13290450	6884	01/1/1990 - 12/31/2024	12748
Simplot – Ontario 63810 : OR0002402	IPC 13290450	6884	01/1/1990 - 12/31/2024	12748

2 Wasteload allocations for point sources

The allocation approach for point sources in Oregon was to use the maximum thermal loads at critical 7Q10 low flow conditions as the starting point to calculate HUA assignments and waste load allocations. The model was then used to determine if this amount of warming provided capacity for other source categories and reserve capacity. For all point sources, it was determined that thermal WLAs could be set equal to or slightly greater than current maximum effluent discharge. Maximum effluent discharge is based on the paired average dry weather design flow (ADWDF) or a maximum flow allowed by the NPDES permit and maximum effluent temperature. These data were obtained from discharge monitoring reports and the NPDES permit. The HUA assigned to each facility at the point of discharge is therefore based on the temperature increase above the applicable criteria using the maximum effluent discharge at 7Q10 river flows, assuming 100% mix **Equation 9-3** was used to calculate the change in temperature. The temperature increase was rounded up to the nearest thousands place for the HUA. The following sections briefly summarize each point source and the data used to calculate the assigned HUA and wasteload allocations.

2.1 Idaho Power - Hells Canyon Power Plant

The Hells Canyon Power Plant operated by Idaho Power (WQ File #41297, EPA Number OR0027278), holds an individual NPDES permit for discharge of non-contact cooling water into the Snake River at approximately river mile 247. The Hells Canyon Power Plant consists of five outfalls. Outfalls 1-3 discharge non-contact cooling with a maximum permitted discharge of 9 MGD. Additionally, wastewater is collected in the powerhouse sump and discharged via outfall 4 into the Snake River, with a permitted maximum discharge of 1.5 MGD. Outfall 5 discharges sanitary wastewater into a holding tank, which is then pumped and transported off-site every two weeks. The current NPDES permit (# 101287) restricts discharge temperatures to be no more than background temperature (ambient temperature) plus 5.5 °C when background temperature is higher than 7.2°C (NPDES, 2004).

The maximum effluent discharge used for the WLA is based on the NPDES permitted maximum effluent discharge of 10.5 MGD. DMRs from 2014 to 2018 were reviewed to determine the maximum effluent temperature. Temperature observations in the DMRs were reported as a temperature change (ΔT), or the difference between the outfall temperature and ambient background water temperature. Ambient background temperature is not reported on the DMRs so the absolute effluent temperature was calculated by adding the reported ΔT to the calibrated model simulated temperature outflow from Hells Canyon Dam. The resulting maximum temperature (27.8 °C) was used as the maximum effluent temperature. The annual 7Q10 of 6884 cfs was calculated from discharge measured at the IPC/USGS gage 13290450 Snake River below Hells Canyon Dam. See Section 6.4 for additional 7Q10 details. The final calculated HUA assigned to the Hells Canyon Power Plant is 0.019°C and 0.035 °C during the 20°C salmon and steelhead migration corridor use period and 13°C salmon and steelhead spawning us period, respectively.

2.2 Idaho Power - Oxbow Power Plant

The Oxbow Power Plant operated by Idaho Power (WQ File #41299, EPA Number OR0027286), holds an individual NPDES permit for discharge of non-contact cooling water and sump wastewater into Hells Canyon Reservoir at approximately river mile 273. The Oxbow Power Plant has five outfalls. Outfalls 1-4 discharge non-contact cooling water with a maximum permitted discharge of 12 MGD. Outfall 5 discharges powerhouse sump wastewater, with a maximum permitted discharge of 0.15 MGD. The current NPDES permit (#101275) restricts discharge temperatures to be no more than background temperature (ambient temperature) plus 5.5 °C when background temperature is higher than 14.4°C (NPDES, 2004).

The maximum effluent discharge used for the WLA is based on the NPDES permitted maximum effluent discharge of 12.15 MGD. DMRs from 2014 to 2018 were reviewed to determine the maximum effluent temperature. Temperature observations in the DMRs were reported as a temperature change (ΔT), or the difference between the outfall temperature and ambient background water temperature. The ΔT was reported for most of the modeling period. The actual maximum temperatures were reported for winter and fall of 2014 and winter of 2015. Temperature for the power plant outfalls was calculated by adding the reported ΔT to the calibrated model simulated temperature outflow from Oxbow Dam. The resulting maximum temperature (27.6 °C) was used as the maximum effluent temperature. The annual 7Q10 of 6854 cfs was calculated from the derived discharge below Oxbow Dam. The data were provided by Idaho Power (IPC 13290030). See Section 6.4 for additional 7Q10 details. The final calculated HUA assigned to the Oxbow Power Plant is 0.021°C.

2.3 Ontario STP

The City of Ontario STP (WQ File #63631, EPA Number OR0020621) holds an individual NPDES permit for discharge of domestic treated wastewater to the Snake River at approximately river mile 369. The current NPDES permit (#101633) prohibits the facility from discharging water to the Snake River from May 1 to October 31. The maximum effluent discharge (3.06 MGD) is the Average Dry Weather Design Flow reported in the 2019 NPDES permit evaluation report. The maximum effluent temperature (20.3°C) is the maximum effluent temperature reported on DMRs from 2014-2018 during the discharge period from November 1 – April 30. Even though the facility is prohibited from discharge May 1 to October 31, the assigned WLA is applicable for the entire TMDL allocation period, including the summer period. The WLA will be incorporated into the NPDES permit should the discharge prohibition change in the future. The annual 7Q10 of 4755 cfs was calculated from discharge measured at USGS gage 13213100 Snake River at Nyssa. See Section 6.4 for additional 7Q10 details. The final HUA assigned to Ontario STP is 0.001°C (rounded up from the calculated value of 0.0004°C).

2.4 Simplot – Ontario

Simplot Ontario (WQ File #63810, EPA Number OR0002402) holds an individual NPDES permit for discharge of processed wastewater and stormwater to the Snake River at approximately river mile 370. The facility was formally operated by Kraft Heinz Foods Company. The maximum effluent discharge used for the WLA is based on the Average Dry Weather Design Flow (4.3 MGD) reported in the 2021 NPDES permit evaluation fact sheet. The maximum effluent temperature reported on DMRs reviewed from 2014-2018 was 35.6°C. However, for consistency with Oregon's thermal plume limitations in OAR 340-041-0053(2)(d)(B) a maximum temperature of 32°C was used for calculating the WLA. The annual 7Q10 of 4755 cfs was calculated from discharge measured at USGS gage 13213100 Snake River at Nyssa. See Section 6.4 for additional 7Q10 details. The final HUA assigned to Simplot Ontario is 0.017°C.

2.5 WLA equations

2.5.1 Wasteload allocation equation

Equation 9-1 was used to calculate the thermal wasteload allocations in the Snake River Temperature TMDL rule.

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

$$WLA = \Delta T \cdot Q_E \cdot D_F \cdot C_F$$ **Equation 9-1b**

where,

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

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

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

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

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

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

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

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

2.5.2 Wasteload allocation attainment equation

DEQ evaluated attainment of a wasteload allocation (WLA) at the point of discharge using **Equation 9-2**. **Equation 9-2** calculates the excess thermal loading (ETL). The ETL was compared against the wasteload allocation (WLA) to assess attainment.

$$ETL = (T_E - T_C) \cdot Q_E \cdot C_F \qquad \textbf{Equation 9-2}$$

where,

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

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

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

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

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

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

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

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

2.5.3 Calculating change in temperature

Equation 9-3 was used to assess the change in temperature based on point source effluent discharge, river flow, and the applicable temperature criteria.

$$\Delta T_{ps} = \left(\frac{Q_E}{Q_E + Q_R}\right) \cdot (T_E - T_C) \qquad \textbf{Equation 9-3a}$$

$$\Delta T_{ps} = \left(\frac{T_E - T_C}{D_F}\right) \qquad \textbf{Equation 9-3b}$$

where,

$\Delta T_{ps} =$ The river temperature increase (°C) above the applicable river temperature criterion using 100% of river flow.

$Q_E =$ The daily mean effluent flow (cfs).

When effluent flow is in million gallons per day (MGD) convert to cfs:

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

$Q_R =$ The daily mean river flow rate, upstream (cfs).

When river flow is <= 7Q10, Q_R = 7Q10. When river flow > 7Q10, Q_R is equal to the daily mean river flow, upstream.

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

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

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

2.5.4 Calculating acceptable effluent temperatures

Equation 9-4 was used to calculate the daily maximum effluent temperatures (°C) acceptable under the assigned portion of the HUA (ΔT) and the wasteload allocation (WLA).

$$T_{E\_WLA} = \frac{(Q_E + Q_R) \cdot (T_C + \Delta T) - (Q_R \cdot T_C)}{Q_E}$$ **Equation 9-4a** (using ΔT)

$$T_{E\_WLA} = \frac{(WLA)}{Q_E \cdot C_F} + T_C$$ **Equation 9-4b** (using WLA)

where,

$T_{E\_WLA} =$ Daily maximum effluent temperature (°C) allowed under the wasteload allocation. When T_{E_WLA} is > 32°C, T_{E_WLA} = 32°C as required by the thermal plume limitations in OAR 340-041-0053(2)(d)(B).

$WLA =$ Wasteload allocation (kilocalories/day) from **Equation 9-1**.

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

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

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

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

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

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

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

2.5.5 Calculating acceptable effluent flows

Equation 9-5 can be used to calculate the daily mean effluent flow (cfs) acceptable under the assigned portion of the HUA (ΔT) and the wasteload allocation (WLA).

$$Q_{E\_WLA} = \frac{(Q_R \cdot T_C) - ((T_C + \Delta T) * Q_R)}{T_C + \Delta T - T_E}$$ **Equation 9-5a** (using ΔT)

$$Q_{E\_WLA} = \frac{(WLA)}{(T_E - T_C) * C_F}$$ **Equation 9-5b** (using WLA)

where,

$Q_{E\_WLA} =$ Daily mean effluent flow (cfs) allowed under the wasteload allocation.

$WLA =$ Wasteload allocation (kilocalories/day) from **Equation 9-1**.

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

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

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

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

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

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