Internal Management Directive

Nonpoint Source Compliance With the Protecting Cold Water Criterion of the Temperature Standard

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State of Oregon
Department of
Environmental
Quality

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1. Introduction

Purpose of this IMD

The purpose of this document is to clarify how DEQ staff can evaluate nonpoint source compliance with the Protecting Cold Water (PCW) criterion for summer, part of Oregon's temperature standard. This IMD guides programmatic evaluation of whether current Best Management Practices (land use practices to prevent or reduce nonpoint source pollution) meet the PCW criterion for summer. This IMD does not address the PCW spawning criterion because the spawning criterion is only applicable to point sources (sources that require NPDES permits). This IMD supplements, but does not replace, the 2008 Temperature Standard Implementation IMD. Further details on this criterion can be found in Section 3.7 of the Temperature IMD (http://www.deq.state.or.us/wq/pubs/imds/Temperature.pdf).

Content of this document

This IMD describes how to evaluate whether or not nonpoint sources are attaining the criterion at the programmatic level. This document covers increases in stream temperature at the stream reach level (local effects) and at the watershed level (cumulative effects).

Purpose of the Criterion

The purpose of the PCW criterion is to prevent anthropogenic warming in stream reaches that consistently meet the numeric temperature criteria throughout the summer. Protecting a range of cold water habitats is important for temperature sensitive fish and other cold water biota. In addition, cold water holds more dissolved oxygen, better meeting the needs of those sensitive biota and their eggs and young. Since added heat is transported downstream, limiting warming in upper reaches can reduce the amount of downstream habitat that exceeds the applicable temperature criteria. The PCW criterion limits new sources and activities to a cumulative warming of no more than 0.3 °C above the current ambient summer maximum temperature in streams that: a) contain salmon, steelhead or bull trout, b) streams designated as critical habitat for salmonids, or c) streams that are necessary to provide cold water to a) and b) (see rule language below). This provision is intended to prevent or minimize degradation of these high quality and ecologically important streams by giving a quantitative limit to warming.

Rule Language

Subsections (a) and (c) of OAR 340-041-0028 (11) [Protecting Cold Water] are:

(a) Except as described in subsection (c) of this rule, waters of the State that have summer seven-day-average maximum **ambient** temperatures

that are colder than the biologically based criteria in section (4) of this rule, may not be warmed by more than 0.3 degrees Celsius (0.5 degrees Fahrenheit) above the colder water ambient temperature. This provision applies to all sources taken together at the point of maximum impact where salmon, steelhead or bull trout are present….
(c) The cold water protection narrative criteria in subsection (a) does not apply if:

(A) There are no threatened or endangered salmonids currently inhabiting the water body;
(B) The water body has not been designated as critical habitat; and
(C) The colder water is not necessary to ensure that downstream temperatures achieve and maintain compliance with the applicable temperature criteria.

Subsection (c) of OAR 340-041-0028 (12) [Implementation of the Temperature Criteria] is also relevant:

(c) Air Temperature Exclusion. A water body that only exceeds the criteria set out in this rule when the exceedance is attributed to daily maximum air temperatures that exceed the 90th percentile value of annual maximum seven-day average maximum air temperatures calculated using at least 10 years of air temperature data, will not be listed on the section 303(d) list of impaired waters and sources will not be considered in violation of this rule.

Policy

New sources and activities may not cumulatively increase the temperature of high quality cold water reaches (those that stay below the numeric criteria all summer) by more than 0.3 °C above the current ambient summer maximum temperature, with the exceptions shown in the rule language above and described below.

Definitions

For the purpose of implementing this criterion:
The "summer seven-day average maximum" temperature means the 7dAM temperature for the warmest 7-day period during the summer, or the maximum seven day average maximum for the water body or reach.

"Summer" means June 1 to September 30. [OAR 340-041-0002 (61)]

"Ambient stream temperature" means the instream temperature measured at a specified time and place prior to new human sources, activities, or alterations.

New sources, activities, and alterations means new or increased loads

after the adoption of this criterion (December, 2003).

Point of maximum impact means the location(s) on a water body, or on a downstream water body, at which the greatest increase in temperature caused by human sources/activities/alterations occurs.

Human sources, activities, or alterations may directly or indirectly affect stream temperature. Examples include streamside and upland vegetation removal, channel morphology alteration, streamflow alteration, stream impoundment and more.

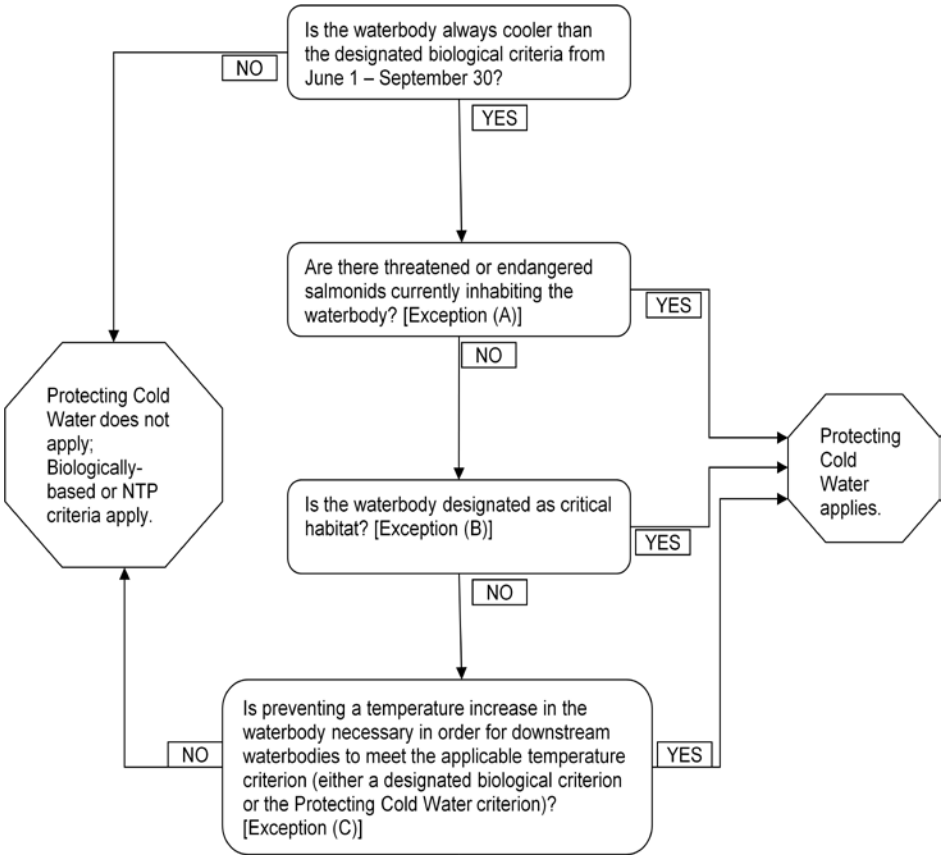
2. Application of Protecting Cold Water Criterion

Section 2.1 Evaluating if the Exceptions have been met

Applying the Exceptions

The Protecting Cold Water (PCW) criterion can apply to any water body that consistently meets the designated numeric criterion. The PCW is assumed to apply to any given stream reach that meets the numeric criteria unless it is demonstrated that all three exceptions in OAR 340-041-0028 (11) (c) are met (Figure 1). Determining whether or not PCW criterion applies to a stream reach is a critical step in application of OAR 340-041-0028 (11). Exceptions (A) and (B) of subsection (c) are readily assessed using information from NOAA's National Marine Fisheries Service (NMFS). See Map 1 or http://www.nmfs.noaa.gov/gis/data/critical.htm#nw for NMFS data and maps. Exception (C) (colder water is not necessary for downstream compliance with the standard) is more complicated to assess.

Figure 1: Application Flowchart



Location of the Point of Maximum Impact

The PCW criterion is applied at the point of maximum impact (POMI), defined as the "location(s)… at which the greatest increase in temperature caused by human sources/activities occurs." As stated in the rule above, the 7-day-average maximum at that point may not increase by more than 0.3 °C above the ambient temperature.

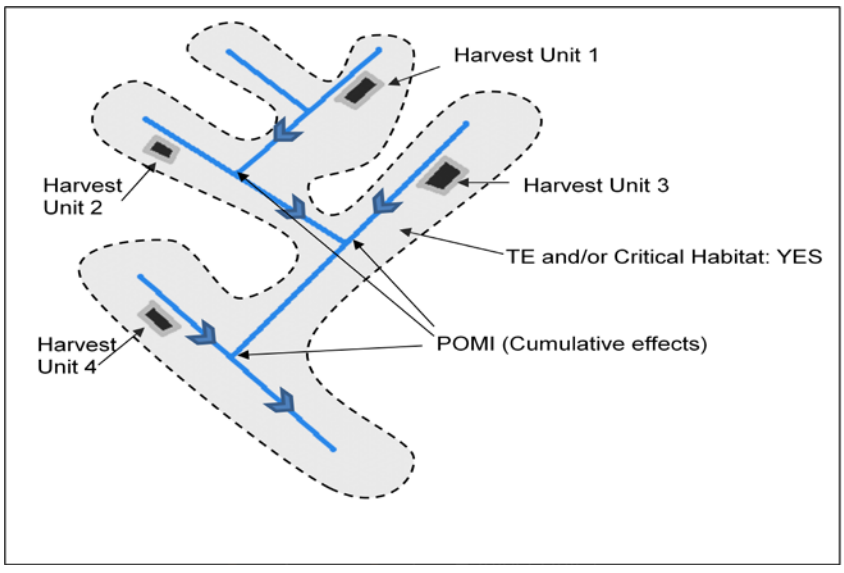
For simplicity's sake, forest harvest will be used as an example for determining the POMI. The PCW criterion can also apply in lower reaches of stream networks where agriculture and residential uses occur, although this is less common due to ongoing exceedances of the numeric criteria. Protecting Cold Water applies to *any* new source of heat or *any* other changes to the energy balance of the stream such as reducing summer flows. Altering stream hydrology or clearing vegetation for cropland or development, for example, could also trigger a need to evaluate PCW compliance.

For a single clearcut, the POMI is at the bottom of the harvested reach *if PCW applies to that reach*. If PCW does not apply to that reach, than the POMI is the nearest downstream location where the PCW criterion does apply. For multiple harvests throughout a watershed, the POMIs are at the bottoms of the harvested reaches (locally) and at the point where the most heat accumulates from all the harvests (watershed-wide) *if PCW applies to that location*.

Exceptions A and B not met

If Threatened and/or Endangered (TE) species and/or their critical habitat are present in the harvested reaches, the POMI is the downstream end of each harvest unit *and* the location(s) where cumulative effects may exist. Cumulative effects POMIs are shown in Figure 2. The PCW criterion applies to all these points.

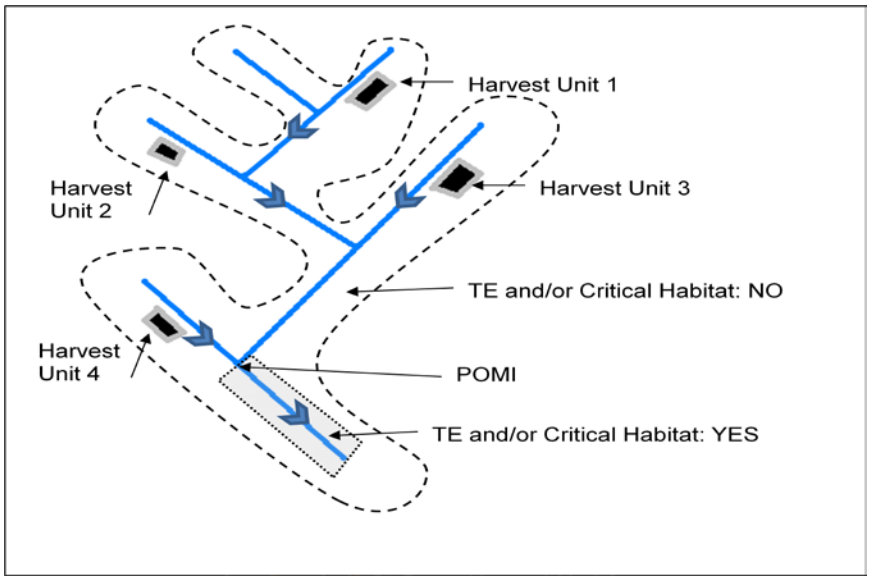
Figure 2: Protected fish or critical habitat are present



Exceptions A and B met, TE presence/ critical habitat is downstream

TE species or their critical habitat may not be present in the harvested reaches. If TE species presence or critical habitat begins downstream of the harvested reaches, then the POMI is at the beginning of TE species presence/critical habitat (Figure 3); the PCW criterion definitely applies starting at this point (Exceptions A and/or B are not met). If the harvests would raise the temperature at the POMI more than 0.3°C, then Exception C is not met for the harvested reaches (cold water is needed for downstream compliance with a criterion of the temperature standard), and the PCW criterion would also apply to the bottoms of those reaches.

Figure 3: Protected fish or critical habitat are downstream



Exceptions A and B met, cold water may be necessary to meet numeric criteria downstream

TE species or their critical habitat may not be present in the harvested reaches or in downstream reaches. The POMI for cumulative effects in this case is the point at which the most thermal impact could be expected *or* just upstream of the location where the biological criterion is exceeded pre-activity, whichever is closer to the activity (Figures 4&5). For example, accumulated heating caused by shade reductions due to timber harvests could cause the location where the biological criterion is exceeded pre-activity to move upstream, reducing the amount of available core cold water habitat and exceeding the numeric criterion. If the harvests would result in a post-activity exceedance of the numeric criteria at a downstream point, then Exception C is not met and the PCW criterion applies at the bottoms of the harvested reaches and the locations of the cumulative effects POMIs.

Figure 4: Cold water necessary for numeric compliance downstream, pre-harvest

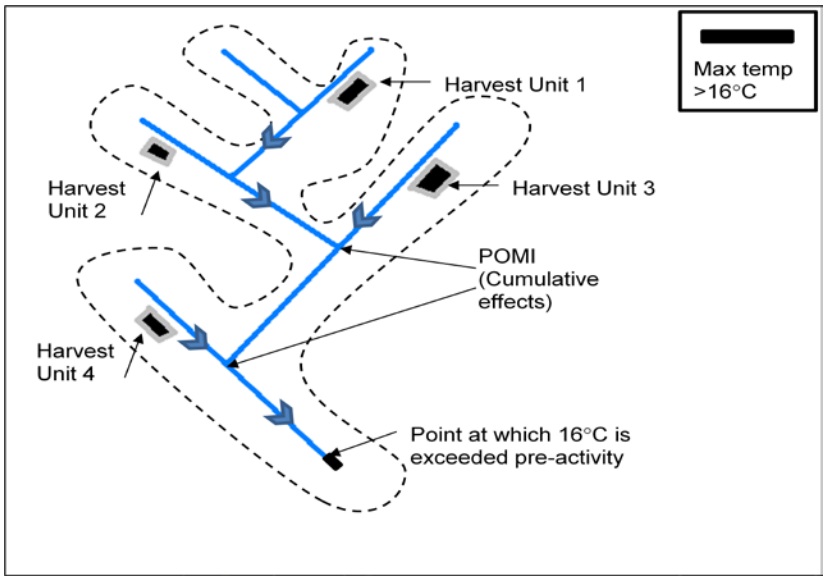
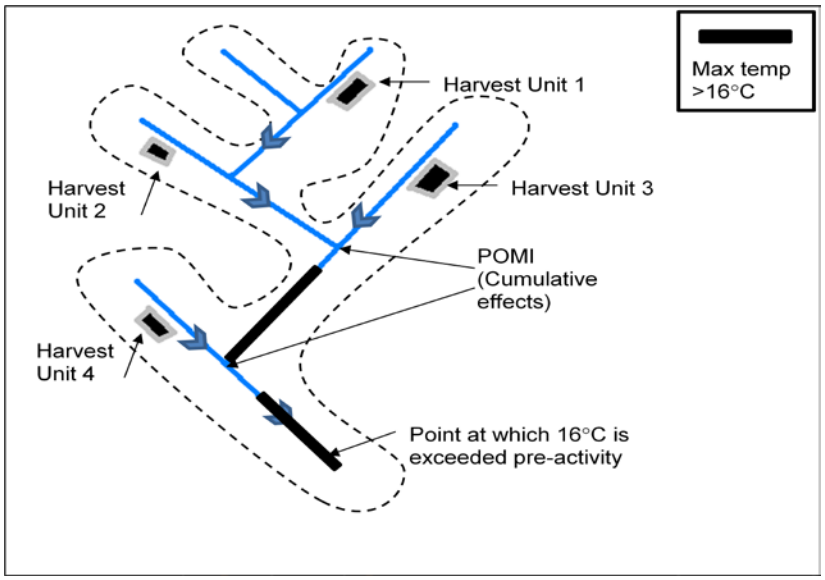
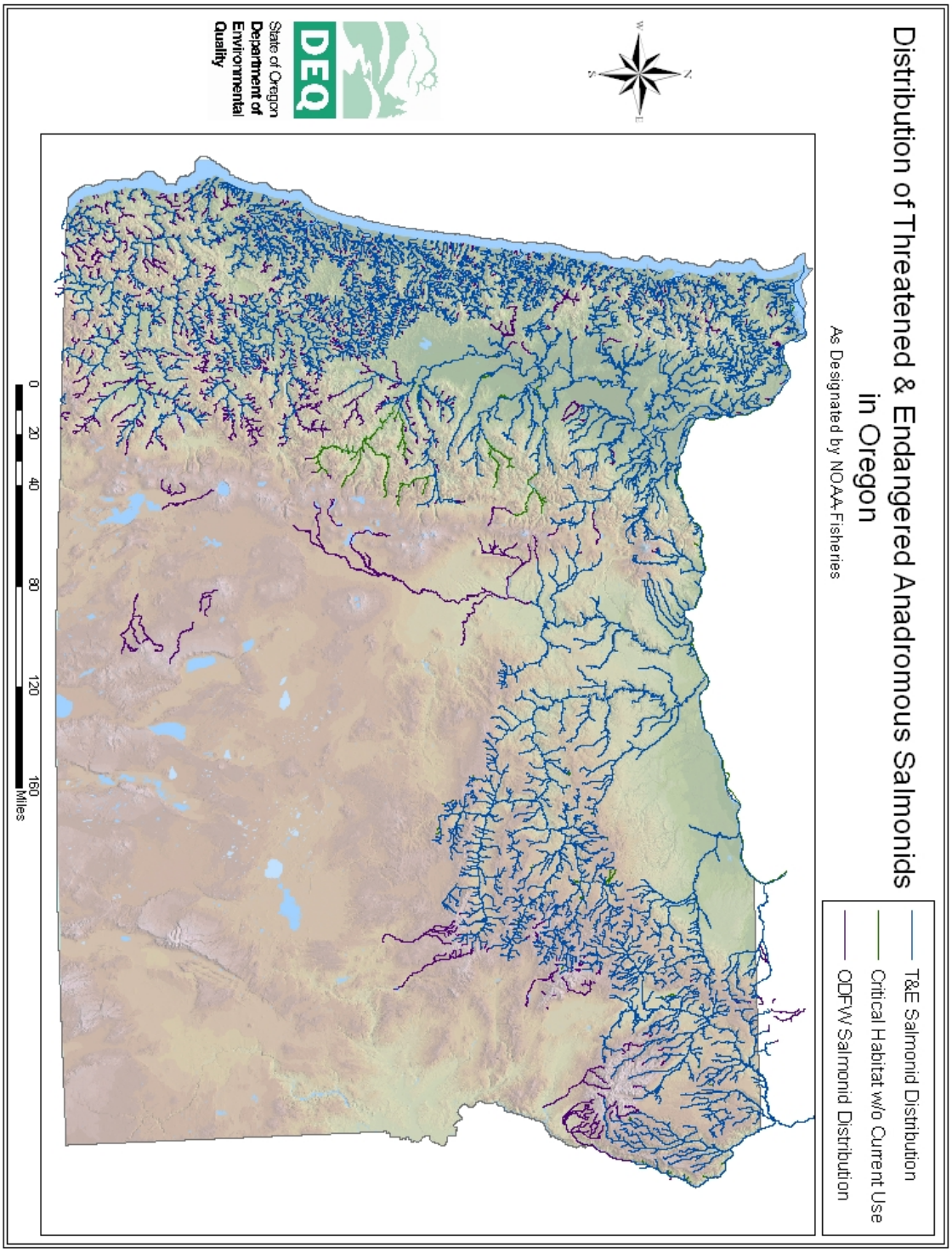


Figure 5: Cold water necessary for numeric compliance downstream, post-harvest





Map 1: Threatened & Endangered Salmonid Distribution and Habitat

Section 2.2 Determining Compliance with the Protecting Cold Water Criterion

Evaluating whether practices comply with the PCW criterion

Determination of whether or not a set of practices is meeting the PCW criterion is best evaluated by experimental studies and/or modeling. For nonpoint sources such as forestry and agriculture, the criterion is best used programmatically rather than administered on a case-by-case basis. Because of the location on the landscape, the PCW criterion is more likely to apply to forestlands and less likely to apply in agricultural areas. Nevertheless, the criterion applies anywhere that the relevant numeric standard is consistently met.

Evaluation of the ambient temperature at the reach level is one means of evaluating PCW compliance. Ambient temperature at the reach level is the natural temperature regime from where water enters an affected reach to the POMI at the end of that reach. The actual temperature cannot exceed the expected temperature (based on pre-activity data) by more than 0.3°C. A stream reach that naturally maintains the temperature of incoming water could not be warmed more than 0.3°C by human activity. A naturally warming stream reach could not increase the amount that it warms incoming water by more than 0.3°C. For example, a stream reach is expected to naturally warm incoming water by 1°C based on pre-activity data. After removal of riparian vegetation, if the reach actually warms water by 1.5°C, it would be noncompliant. If the reach warms water by 1.1°C, it would meet PCW requirements. If a reach is naturally a cooling reach, then it would need to retain the pre-activity amount of cooling after the activity occurs. For example, a stream reach is expected to cool the incoming water by 0.5°C based on pre-activity data. After removal of riparian vegetation, the stream reach actually cools water by only 0.1°C. The stream is warmer by 0.4°C and is noncompliant with the criterion. If the reach cooled water by 0.4°C, then PCW requirements would be met. **The goal is maintenance of the pre-activity temperature regime, whatever that may be.**

Whether evaluating PCW compliance at the reach scale or due to cumulative effects, any monitoring must have adequate spatial and temporal replication. It is essential to have reference sites which are similar to the treatment (or harvest) sites. At least two years of pre-activity and two years of post-activity data are also necessary to account for yearly climatic variation. Three or more years of both pre- and post-activity data are preferred. Evaluation also must account for confounding effects of variables other than temperature and management activity (e.g. inherent differences between reference and treatment watersheds), either through study design or analysis methods. A robust statistical analysis is necessary to show that the frequency of exceeding the criterion is significantly higher than the statistical background rate and that those exceedances are due to human activity,

such as timber harvest or riparian management practices. It is preferable that any analysis also identify what physical and/or management factors are responsible for the exceedances. If current forestry or agricultural riparian practices are demonstrated to be noncompliant, then DEQ will need to work with the relevant Department (Agriculture or Forestry) to change riparian practices to ensure compliance.

There are several potential statistical measures for showing exceedances of the PCW criterion. Any method must somehow exclude data which are subject to the Air Temperature Exclusion (ATE; see pg 2):

- If a post-activity summer seven-day average maximum (7dAM) temperature value is more than 0.3°C warmer than the expected 7dAM value based on pre-activity data, the 7dAM is not excluded based on the ATE, AND the change is statistically significant, then the criterion would be exceeded.
- If the overall post- activity 7dAM temperature profile warmed by more than 0.3°C compared to the pre-activity profile AND the change is statistically significant, then the criterion would be exceeded. Temperature profile could be a trend line of the 7dAM, such as a mean regression or a quantile regression for the 50^{th} (median), 90^{th}, or 95^{th} percentiles. Other statistics may also be appropriate. Any 7dAM data subject to the ATE need to be removed from the data set prior to analysis.
- If individual post-activity 7dAM temperatures are significantly different than the pre- activity trend, that 7dAM is not excluded based on ATE, AND the change is greater than 0.3°C, then the criterion would be exceeded.

Once a statistically significant change greater than 0.3°C is found, further analysis would need to show that the change was due to the human activity and not other factors. In analyzing a Before/After-Control/Impact temperature study, Oregon Department of Forestry used a mixed-model logistic regression of pre- and post-harvest year pairs to show whether variation was best explained by ownership, timber harvest, stream size, and whether a reach was harvested or a reference. Other methods may be appropriate, including use of parametric (e.g. t-test, ANOVA) or nonparametric (e.g. Mann-Whitney, Kruskal-Wallis) hypothesis tests to look for significant differences between control sites and sites with disturbance activities.

For individual stream reaches where PCW applies, modeling (such as Heat Source) or Before/After-Control/Impact stream temperature monitoring (such as Oregon Department of Forestry's Riparian Function and Stream Temperature study [RipStream]; see Groom *et al* 2011) can be used to show whether or not current practices meet the PCW criterion.

Cumulative effects analysis may be necessary to determine whether or not Exception (C) of the PCW criterion is met when accumulation of

heat has the potential to cause downstream exceedances of either the PCW or numeric criteria. Modeling or robust paired watershed studies could be appropriate ways to evaluate whether or not upstream harvests have cumulative temperature impacts downstream (e.g. downstream biological criterion being exceeded after upstream harvests or temperature increases of more than 0.3 °C in critical habitat).

Relationship to Total Maximum Daily Loads

Total Maximum Daily Loads (TMDLs) include a human use allowance. The human use allowance, according the Section 4.7 of the Temperature Standard Implementation IMD, "is the cumulative heat load that would cause a 0.3 °C increase in temperature above the NTP [natural thermal potential] from all anthropogenic sources (point and nonpoint) combined at the point of maximum impact after mixing with 100% of the streamflow." This heat load is allocated among all sources in the TMDL. An individual source or type of source (such as forestry) will typically get a load allocation that is a portion of the human use allowance (e.g. 0.1°C). If modeling or temperature monitoring shows that an activity or activities would fail to comply with the PCW criterion, then the activity would necessarily not comply with the TMDL human use allowance or load allocation. Appropriate action should be taken by DEQ and Designated Management Agencies to bring activities into compliance with the TMDL.

Upper watershed streams (headwaters streams), particularly small, non-fish-bearing, or intermittent streams, may or may not be subject to TMDL load allocations and surrogate measures. This can vary by TMDL. If TMDL load allocations apply to headwater streams and are more stringent than the PCW criterion, then the load allocations and their surrogate measures should be used. If the TMDL does not apply to all streams, then the PCW criterion applies to any streams not covered by the TMDL and an evaluation is necessary to determine if cold water from those streams is needed to meet the downstream TMDL load allocation (i.e. evaluate whether Exception C of the PCW criterion is met; see Section 2.1). In any case, the more stringent of PCW criterion or TMDL load allocations applies.

3. Publications and Contact Information

Publications

Groom, J. D., L. Dent, and L. J. Madsen (2011), Stream temperature change detection for state and private forests in the Oregon Coast Range, *Water Resour. Res.*, **47**, W01501, doi:10.1029/2009WR009061.

Oregon Water Quality Standards, Oregon Administrative Rules Chapter 340, Division 41. Available at: http://www.deq.state.or.us/regulations/rules.htm

EPA Region 10 Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards, April 2003. Available at: http://yosemite.epa.gov/r10/water.nsf/Water+Quality+Standards/WQS+R10+Docs

Additional documents such as the Temperature Water Quality Standard Implementation IMD are available at the DEQ temperature standard webpage http://www.deq.state.or.us/wq/standards/temperature.htm .

DEQ Contacts

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